Ministry of Science
Technology and Innovation

White Paper on
Enterprise Architecture

Working Group on IT Architecture within the Coordinating Information Committee

2003

White Paper on Enterprise Architecture

This publication can be obtained at www.oio.dk/arkitektur

Published by the Ministry of Science, Technology and Innovation
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June 2003, circulation: 1,000 copies.

Foreword

E-government is largely a matter of getting public sector IT systems geared to interoperability. The authorities must have the capability to use each other's data so that citizens, companies and case officers do not have to provide and check the same information over and over again. This requires, for example, common data definitions and coherence in the handling of security and users. And it means dispensing with 'technological islands' if we are to create a platform for new work practices.

In this regard, a coherent enterprise architecture framework in the public sector is an important factor. Like a number of other countries, Denmark has now placed enterprise architecture high on its agenda because through enterprise architecture it is possible to govern the organisation and interoperability of IT systems. This is the background to this White Paper on the principles for a common public sector enterprise architecture.

The White Paper has been drawn up by the Coordinating Information Committee – a cross-public sector body within the area of IT − as a direct follow-up to the Ministry of Science's Green Paper, conference and electronic consultation on the subject in autumn 2002. The work on enterprise architecture is part of Project E-government, and the Coordinating Information Committee reports to the board of Project E-government in cross-public sector matters relating to enterprise architecture.

The White Paper makes proposals for broader, more qualified work on enterprise architecture in the public sector in Denmark. The aim is to achieve a general improvement in the quality of the process through which public sector IT systems are developed in collaboration with the IT sector.

You can read more about enterprise architecture at http://www.oio.dk

On behalf of the Coordinating Information Committee

Marianne Rønnebæk

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1. ABSTRACT

The objectives of the government's modernisation programme are to improve the service to citizens and business, and at the same time increase the efficiency of public administration. This is being achieved though a combined IT/organisational overhaul in which management, division of labour, work processes and competencies are all undergoing transformation.

The task of Project E-government is to promote e-government across the public sector, among other things by partially or fully removing technological barriers. A vital precondition for Denmark being able to offer coherent public services to citizens and companies is that the various systems that provide these services should be coherent. It is often stated that the organisational aspect of an overhaul makes up 80 per cent, while technology only makes up 20 per cent. But clearly this does not mean that the technological aspect is unimportant, since this is often the basis for being able to effect organisational change.

The survey of public sector IT use carried out by Statistics Denmark in 2002 shows that some of the main barriers for e-government are found in enterprise architecture. Across central, regional and local government, around seven out of ten authorities are thus lacking common public sector solutions and infrastructure, while roughly the same number are lacking common standards for data exchange. Just over half of the central government institutions surveyed also anticipate a rise from 2002 to 2003 in IT costs for integrating existing applications.

This White Paper has been drawn up jointly by central, regional and local government within the Coordinating Information Committee as part of Project E-government. The main recommendations of the White Paper are as follows:

- The public sector – individual authorities and joint projects − should take more active responsibility for its own enterprise architecture.
- A common enterprise architecture framework should be established for planning public sector IT systems, with special regard for ensuring interoperability.
- There should be a concerted effort to spread knowledge of and develop competencies in enterprise architecture, especially in relation to joint public sector initiatives.

The common enterprise architecture framework should include the following elements:

- Joint coordination, including the appointment of an Enterprise Architecture Committee reporting to the Coordinating Information Committee.

- Common methodology in the form of processes, concepts and specification standards for enterprise architecture.
- Common choice with regard to technical standards, infrastructure, etc., e.g. a reference profile and principles for enterprise architecture.
- Common tools such as databases and repositories of contract models, process specifications, data structure definitions, software components, and specifications for infrastructure solutions.

Increased focus on enterprise architecture and a degree of coordination across the public authorities – with due regard for both the private sector and international relations – are preconditions for realising the visions for e-government. There will be various benefits of increased focus on enterprise architecture:

- The value of investments will be optimised.
- The risk for individual projects will be minimised.
- The IT market will be more flexible and competition will be intensified.

In all IT projects, architecture decisions are taken − consciously or unconsciously − on various issues, perspectives and objectives. The purpose of this White Paper is to make these decisions more conscious. Common architecture principles will harmonise these decisions and thus generate added value in public sector IT use. The architecture work is an investment (by the public sector) which will reap benefits for the full lifetime of the system.

2. RECOMMENDATIONS

E-government cannot be realised unless public sector IT systems are geared to interoperability. Among other things, e-government concerns giving the authorities the capability of using each other's data so that citizens, companies and case officers do not have to provide and check the same information over and over again.

In May 2002, the government's modernisation programme *Citizens at the Wheel* expressed it as follows:

> New technology must contribute to the creation of increased collaboration across the boundaries of the public sector. With regard to the legal rights of citizens, it must be ensured that the exchange of information is possible between state IT systems, so that people come to experience the public sector as a well-functioning whole. This will eliminate double work, and will prevent people having to provide the same information several times.

New demands are imposed on IT systems when multiple systems have to be able to interoperate. For example, it requires common data definitions and coherence in the handling of security and users. And it means dispensing with 'technological islands' if we are to create the technological platform for new work practices. The establishment of a common framework for enterprise architecture is an important factor in this regard.

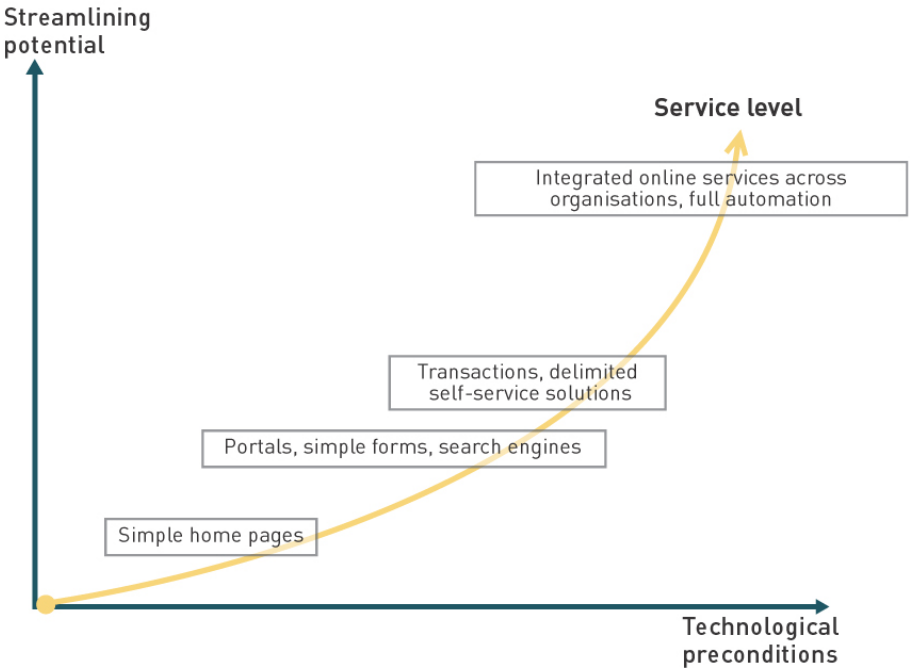
Enterprise architecture denotes the basic organisation of one or more IT systems, including principles for system design and development and for interoperability. The establishment of a common framework for enterprise architecture means that solutions are defined on the basis of a common conceptual framework and that individual IT solutions are organised so that they can interoperate with other solutions on a functional level.

In Denmark − as in a number of other countries − this realisation has put enterprise architecture high on the agenda, because through enterprise architecture we can organise the IT systems to achieve interoperability. The board of Project E-government, which is made up of senior administrative representatives of central, regional and local government, has thus indicated that, in connection with the development of the civil service's business processes and organisation, there should also be systematic work relating to the organisation of the IT solutions that will support the new work practices.

Figure 1 illustrates how a high maturity level in e-government has two basic preconditions: firstly there is a need for maturing business procedures and coordination of new and old administrative processes, and secondly the IT systems must be able to support the new optimised processes. For each maturity level there is both a business

vision and a technological platform – and the task of the architecture process is to bind these two elements together.

Figure 1: Maturing of e-government in services for citizens and business



The maturing process takes place on two fronts, i.e. by simultaneously developing business procedures and technology. The architecture programme seeks to establish the preconditions for a business-oriented strategy for IT development with the aim of boosting the value-creating processes. It is therefore necessary that the organisational processes are set out in accordance with the vision before the IT solutions are optimised in respect of the work processes. Without the organisational groundwork, the requirements for the IT system will be imprecise, and it will not be possible to meet many of the expectations for the IT support. Thus, it has often been shown that the flexibility of IT systems cannot compensate for non-existent or imprecise planning of the processes that the systems have to support.

The Ministry of Science, Technology and Innovation has already clearly announced that it will act as facilitator and support this development through a range of initiatives.

In September 2002, the Ministry of Science, Technology and Innovation published its Green Paper on enterprise architecture, the purpose of which was to put the **common needs for a public sector enterprise architecture** on the agenda and provide the material for a debate on common principles for a public sector enterprise architecture. The Green Paper laid the groundwork for public debate on the issues of whether we should have a common framework for enterprise architecture, what form it might take, and how we could

ensure that it is actually being used. The debate is in progress and the potential is obvious: for the public sector, it will mean enhanced quality of case-handling entailing constant or falling costs. For industry, there is clear potential for rational development of advanced e-government solutions.

The process has given rise to much constructive input from central, regional and local government, as well as from suppliers, consultancy firms and trade associations, etc., and has clearly demonstrated a need for a common framework.

This White Paper has been drawn up by the Coordinating Information Committee as a direct follow-up to the Green Paper and has taken account of the extensive input from the consultation process. It makes proposals for broader, more qualified work on enterprise architecture in the public sector in Denmark. The aim is – as a contribution to the work on e-government − to achieve a general improvement in the quality of the process through which public sector IT systems are developed in collaboration with the IT sector.

The Green Paper and the White Paper are the first stepping stones in a long process. The next phase should see the establishment of the concrete base for ensuring both development work and operational work connected with more coherent and effective IT use in the public sector.

The main recommendations of the White Paper are as follows:

- The public sector – individual authorities and joint projects − should take more active responsibility for its own enterprise architecture.
- A common enterprise architecture framework should be established for planning public sector IT systems, with special regard for ensuring interoperability.
- There should be a concerted effort to spread knowledge of and develop competencies in enterprise architecture, especially in relation to joint public sector initiatives.

These recommendations should be followed up as quickly as possible, since investments are constantly being made in IT projects which have significant consequences for the future. The sooner we get started, the better. An action plan should be pragmatic and build up activities gradually. Project E-government faces an enormous overall challenge, and everything cannot be done in a short time or all at once. We should therefore focus on starting to establish the joint framework and implement it in large-scale strategic projects.

2.1. Public sector responsibility for its own enterprise architecture

The key recommendation of the White Paper is that the public sector should take more active responsibility for its own enterprise architecture in order to be able to realise the objectives for e-government.

It could cause problems for the development of e-government if individual authorities construct IT systems in a way that ends up precluding them from being part of the collaboration in which authorities – and private bodies – are working together, sharing data and integrating each other's electronic services. It could also cause problems for individual authorities because over time there will be far too broad a portfolio of IT systems that cannot be integrated and that are relatively difficult to maintain.

Up to now, many public sector IT systems have been developed on the basis of certain relevant, but at the same time rather narrow considerations where the 'best and cheapest' principle has in many cases been synonymous with the buyer focusing on meeting his own functional needs at the lowest possible price, and the supplier optimising the architecture on the basis of their own product portfolio. We have therefore often seen solutions where the supplied functionality corresponds to what is needed, but where major, long-term considerations, including the possibility of integration with other systems, have been given lower priority.

New requirements for coherent solutions require the public authorities, through strategic system procurements, to tackle the issues that are crucial to the value of the systems throughout their lifetime and the systems' ability to operate together with other systems. This means, for example, that the requirements set out by individual authorities must focus on the organisation of the systems – and not just on their functionality. It is thus the responsibility of the authorities to ensure that the enterprise architecture does not just cover a single system, but rather covers a complex of systems so that they can function together.

System suppliers will continue to have the task of assembling infrastructure components for an overall solution and implementing the business logic in these components. However, when the public authorities make demands on the enterprise architecture, the choice of components and interfaces will be subject to a set of common principles, which will ensure coherence between public sector IT systems. The enterprise architecture must ensure that the solution's general structure corresponds to administrative requirements and common architecture principles. The architecture responsibility should therefore basically lie with the public authority, although the work could be taken care of by a consultant on their behalf.

A major consequence of making demands on the architecture is that competition is intensified. When a public authority makes demands on an IT system's organisation, this brings about high comparability between the solutions on offer, and the possibility of combining modules from different suppliers is increased. Architecture requirements can be included in public sector tendering in the same way as functional and operational requirements.

In order to be able to increase the responsibility for enterprise architecture and produce the desired results in terms of the vision for e-government, the public authorities' enterprise architecture must be based on a common reference framework so that local systems can be included in the overall e-government. Furthermore, there must be ongoing development of knowledge and competencies relating to enterprise architecture. This applies to decision-makers at both business and technology level.

2.2. A common enterprise architecture framework

The White Paper recommends that the common enterprise architecture framework should include the following elements:

- **Joint coordination**, including the appointment of an Enterprise Architecture Committee reporting to the Coordinating Information Committee.
- **Common methodology** in the form of processes, concepts and specification standards for enterprise architecture.
- **Common choices and principles** with regard to standards, infrastructure, etc., e.g. a reference profile and service-oriented enterprise architecture.
- **Common tools** such as databases and repositories of contract models, process specifications, data definitions, software components, and specifications for infrastructure solutions.

Joint coordination

Suitable formal frameworks for the work on enterprise architecture are a precondition for successful progress. The frameworks should involve key stakeholders in this area and make them accountable.

The architecture work should take as its starting point the principle of subsidiarity, and at the same time roles and objectives for the work should be set out jointly by the business level (the main decision-makers) and the technology level (IT managers, IT architects, consultants, suppliers, etc.).

We recommend appointing an **Enterprise Architecture Committee**, which will be given the responsibility of developing and maintaining the common enterprise architecture framework. A main task for this committee would be to balance the interests of individual authorities with those of the public sector as a whole in Denmark. This balancing

would form the basis for the recommendations and guidelines that the committee issues. Another important task would be to provide consultancy relating to strategic public sector development projects.

The committee should be rooted in the Coordinating Information Committee and report through this to the board of Project E-government. The committee should be made up of representatives covering a broad spectrum of in particular IT, but also administrative and business expertise.

The Coordinating Information Committee and the Enterprise Architecture Committee should be given the task of facilitating the work on enterprise architecture in central, regional and local government. In many cases, implementation of new cross-functional enterprise architecture presupposes that there are business models that can generate the necessary incentive.

For example, the board of Project E-government has set out a number of focus areas in which it assesses that there is a special need to create new cross-functional business models. As an extension to these business models, in many cases enterprise architectures will be agreed across administrative boundaries; the Enterprise Architecture Committee will have to help the steering groups in this.

The committee's specific tasks will include:

- choosing, developing and maintaining common concepts, methods and principles;
- choosing, developing, maintaining and communicating relevant standards;
- facilitating the sharing of knowledge, experience and tools;
- sparring and consultancy vis-à-vis individual authorities and joint projects; and
- contributing to further planning of specific initiatives.

Sparring and consultancy should focus on ongoing projects and activities in high-priority sectors. Sparring for projects may take the form of an active review of the architecture for public sector IT projects, and the general modus operandi should be more facilitative than controlling.

Practically speaking, the committee will need a secretariat to take on the role of fulcrum in a national competence pool for public sector enterprise architecture. The Ministry of Science has been proposed as the secretariat and has already begun to bolster competencies in this area.

Additionally, a *forum for enterprise architecture* should be set up in which specialists representing authorities, suppliers, consultants and

researchers, among others, can collaborate through dialogue and knowledge sharing. This forum will form part of the competence pool and will, among other things, be able to offer support to the committee.

Common methodology

The White Paper stresses the need for the architecture work to aim at greater uniformity in the conceptual approach, and in methodology and process specifications.

The architecture must take shape in a coherent process that ensures that the vision's direction markers are reflected in the technical solutions whereby the IT solutions are optimised in terms of the public administration's primary needs. Enterprise architecture is a continuous process that aims to ensure ongoing improvements in the value of IT application. Continuity in the architecture process is important, especially in a world where progress is characterised by agility, innovation and change.

Within the architecture process, conceptual architecture principles are formulated to govern the choice and organisation of the IT solutions. A key factor is to specify the desired – or enforced – business changes that the IT has to support. The architecture principles are taken as the starting point for the solution-oriented and practical implementation process, which includes procurement or development projects.

We need to develop a common methodology and a common conceptual approach for preparing enterprise architecture. It is vital that we establish a common language and common procedures if we are to achieve the objectives of collaboration, harmonisation and sharing in relation to enterprise architecture that the White Paper sets out.

The architecture's methodology and conceptual approach should be documented through the continuous issuing of guidelines and checklists. For example, a guidebook of good architecture practice and a checklist of architecture decisions for specific projects should be issued.

The common methodology should also include a specification standard for the decisions and principles of the architecture process and for common architecture components that can be reused. This common specification would facilitate comparison of different projects and cross-functional utilisation of experience and knowledge.

The choice between different IT implementations such as central or decentral servers will be based on analysis of a number of key factors such as data quantity, update frequency, communication patterns, etc., all of which are estimated on the basis of the specified task and

application scenario. It is *not* a precondition for optimising the overall public sector enterprise architecture that all solutions should use the same specific architecture. On the contrary, we recommend that individual projects be subject to local optimisation using the same methodology.

The basic concept of good enterprise architecture work is that it is principle-driven. The work must ensure coherence between requirements and principles so that business requirements will be met by a solution that complies with the principles, and that the relevant principles are always grounded in business requirements.

Common choices and principles

The architecture principles are placed in a three-level hierarchy. The highest level comprises common general principles, which among other things reflect the need for coherence across the public sector. The next level comprises principles that typically aim to optimise the IT solutions in a single sector or focus area. The lowest level comprises principles that are directed at a specific system or a portfolio of systems in a single institution.

As a general principle, the White Paper recommends a *service-oriented* architecture model in which IT solutions are designed in a modular fashion, are divided into services with well-defined mutual interfaces and, as far as possible, interfaces to existing public sector IT systems.

The general principle of the service-oriented architecture model is that the individual components are organised in layers that offer and use each other's services. The common concept therefore constitutes the service-oriented architecture model. In contrast to simple data access, services provide the possibility of exchanging information in a context and thus open up advanced interoperability between the public administration's IT systems. The layering makes it possible to categorise the individual services so that they can link different systems at the same functional level.

Part of the common principles is a standardisation that can ensure data exchange in the public sector without technical barriers. Standardisation must focus on supporting interoperability, security and openness, and should include both the technical standards that make interconnection possible and the information structure that defines the common conception of data. One example is the choice of the XML exchange format in Denmark. Technical standardisation should take its starting point in international, open standards or, where these do not exist, de facto standards. A key task for the committee will be to draw up a summary of standards with recommendations on their application. This summary – a reference profile − can be included, for example, in the public authorities'

tender documents. The reference profile will need to be continuously maintained.

Other principles define the use of common infrastructure solutions, including services associated with data exchange, security and identification. An example of this is the choice of the digital signature solution in Denmark. Here it is an architecture task to organise the security functions and to specify their features so that they satisfy the vision. Thus, there is also a need in the security area for requirements and solutions to be specified on the basis of a common concept and coordinated at the overall level.

Common tools

An important task is to facilitate the use and propagation of standard architecture components and solutions. We recommend making technical/administrative capacity available for running a cross-public sector information base in the form of an expansion of the cross-public sector website www.oio.dk and the infostructure base. Among other things, this should include a repository of design solutions, components, processes and services. Additionally, it might be beneficial to make management, analytical and technical tools available for e.g. benchmarking and analysis.

As well as the topics presented in the White Paper, the work of the Enterprise Architecture Committee requires access to information on the existing systems in the public sector and the concepts on which these are modelled. There is currently no adequate overview of the general public sector system portfolio. Systematic data collection in this area is therefore required. It is also necessary to monitor corresponding international developments. A side-effect of this will be to identify a number of future-oriented projects, some of which will undoubtedly be able to serve as *best practice* models for other solutions. This data collection can fulfil an important function in providing coordination between different public sector IT projects.

Collaboration and knowledge sharing between public authorities and private suppliers, consultants and researchers, etc., will be a crucial precondition for achieving the objectives of e-government.

2.3. Communication and competence development

In order to ensure propagation of common principles, methods and processes, there is a need for both communication and competence development. As one of their main tasks, the Enterprise Architecture Committee and its secretariat will have to ensure extensive promotion and marketing of the architectural concept.

There should be a highlighting of projects with good enterprise architecture and of IT solutions that have been designed in

accordance with the issued guidelines and standards (reference implementations).

Enterprise architecture is not a common subject at the higher educational establishments or in other educational contexts. An important task − headed by the proposed Enterprise architecture Committee − will be to set out and take part in implementing competence-generating training elements, typically based in existing educational and further educational establishments. Certification is considered to be an important incentive for increasing the competence level in enterprise architecture.

2.4. Consequences

Increased focus on enterprise architecture and a degree of coordination across the public authorities – with due regard for both the private sector and international relations – are preconditions for realising the visions for e-government. If we do not take initiatives that correspond to those recommended by this White Paper, there is a risk that many projects will not meet expectations and will be unnecessarily costly.

A common public framework for enterprise architecture is therefore considered to be a critical parameter for propagating e-government. The common framework must ensure that architecture decisions meet the need for general coherence between public sector IT systems, at the same time as the systems are optimised in terms of local needs.

Enterprise architecture is an appropriate tool for ensuring a common framework with a view to quality improvement, resource optimisation and cost reduction. Collaboration on enterprise architecture not only gives better coherence between IT systems, it also opens up the possibility of major benefits on two fronts, firstly with the value of investments being optimised, and secondly with costs being reduced through recycling of common components and services. Thus, the work on enterprise architecture is an important tool for supporting the government's other streamlining initiatives.

A common framework for enterprise architecture that, among other things, prioritises open standards will also help to create increased transparency and competition in the marketplace. This will mean both lower prices and reduced supplier dependency.

Individual authorities will naturally have a varied level of IT competence, and they can therefore assume different roles in the architecture work. For example, in certain situations an authority will be able to make use of a common public sector reference profile and reuse well-functioning solutions so that the architecture will be (almost) predefined in IT projects that are very similar to other authorities' projects. In other cases it will be important to use the

architecture principles as part of the specification of requirements for ensuring that a new system will meet the common need for interoperability. In the case of large-scale systems, new technology or the supporting of new work procedures, it will be expedient to carry out a local enterprise architecture process to ensure that the system is optimised for the process as well as complying with the common principles for interoperability.

The introduction of a common enterprise architecture framework will mean greater value realisation because systems will more easily be able to support the changes in organisation and working practice. It will also mean reduced risk in the development of IT solutions because there will be clear common frameworks and possibilities for recycling tried-and-tested solutions.

All IT projects require architecture decisions to be taken in one form or another − consciously or unconsciously − on various issues, perspectives and objectives. The White Paper's recommendations will change the distribution of roles among the public authorities, suppliers and advisors. In financial terms this will not mean increased costs, but possibly a marginal redistribution of items in public authority IT budgets. However, linked to this point is a management challenge: it is not always the party that gives thought to architectural considerations and makes investments that reaps the benefits.

It is also important to emphasise that it may take major investment to implement strategic architecture choice in terms of interoperability. This applies with regard to both new investments and changes in existing systems. Conversely, an architecture choice based on short-term, narrow considerations will prove to be a costly investment in the long term.

Architecture choice that supports interoperability may be a precondition for being able to actually realise an administrative project. Investments should therefore be judged in the light of specific business cases that can justify that a coherent enterprise architecture is profitable in the longer term. The enterprise architecture work will primarily find relevance in cross-sector projects, including digitalisation of service collaborations where there is a high potential for service improvement and data recycling. Bearing in mind that the structure of and task distribution in the public sector may change in the future, the benefits of a flexible architecture assume even greater importance.

3. PURPOSE OF AND BACKGROUND TO THE WHITE PAPER

The purpose of the work on public sector enterprise architecture is to ensure the technological platform for the development of e-government, which covers the entire public sector and is of considerable importance for society as a whole, including citizens and business.

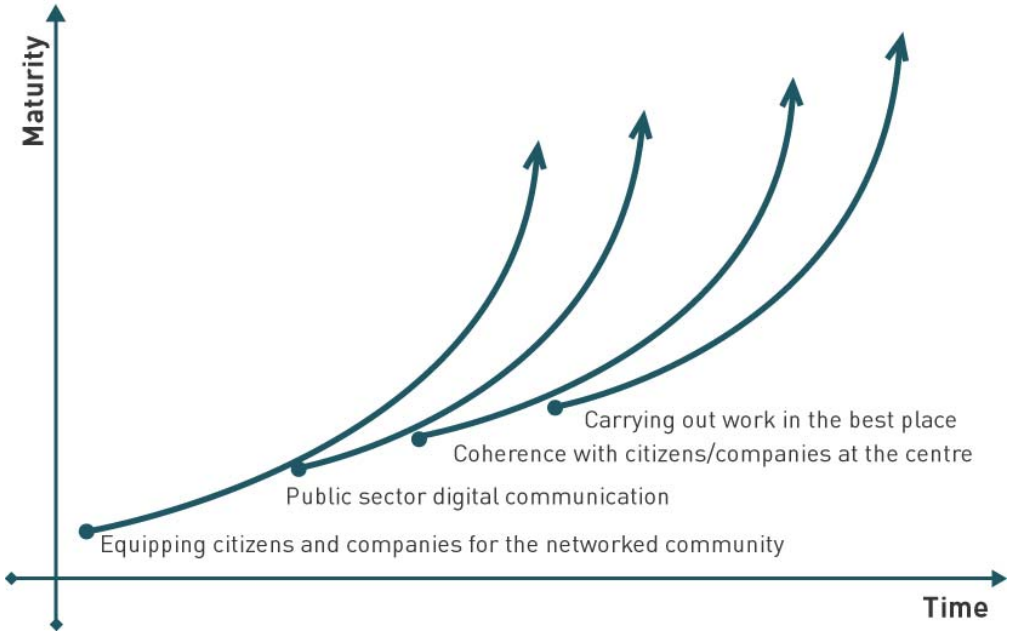
3.1. The vision for e-government

The White Paper takes its starting point in the four direction markers for e-government formulated by the board of Project E-government:

1) E-government should equip citizens and companies for the networked community.
2) The public sector should work and communicate digitally.
3) Public sector services should be delivered coherently with citizens and companies at the centre.
4) Public sector work should be carried out where it is handled best.

These direction markers can be translated into processes that will run over several years with differing content and development logic. The following chart attempts to illustrate the correlation between the direction markers and the maturing of e-government.

Figure 2: Direction markers and maturity



On the basis of the four direction markers (primarily 2-4), we have set out a number of objectives that enterprise architecture can help to meet:

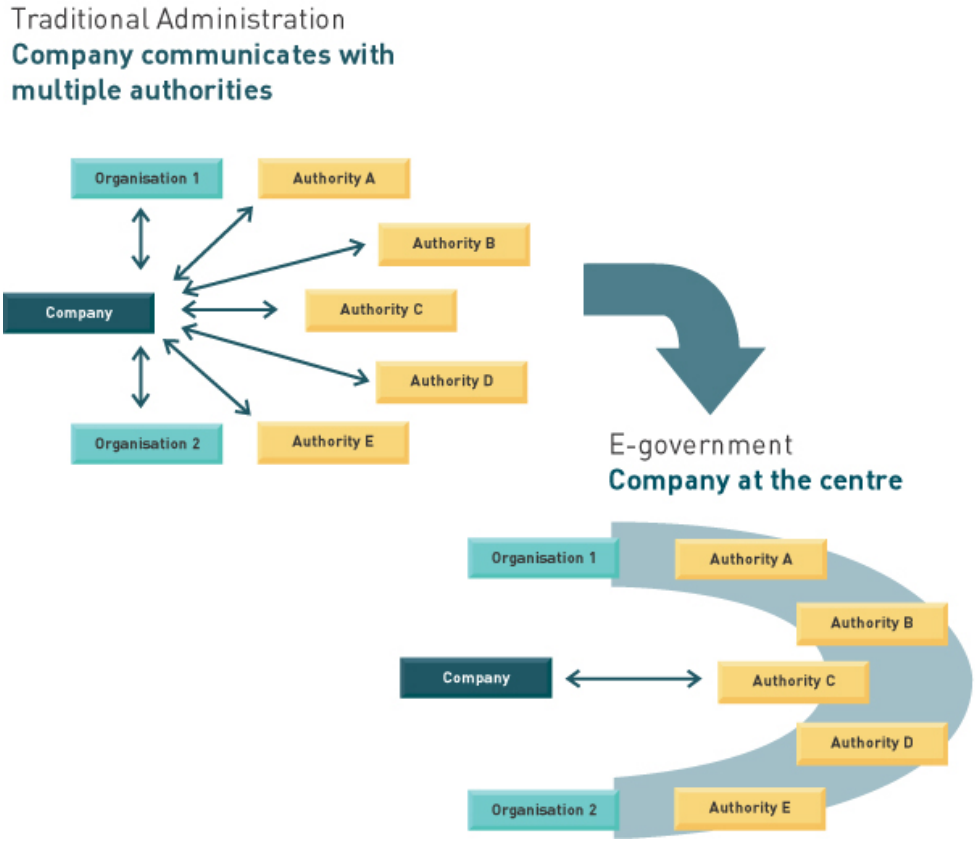
a. Ensure better public service through higher quality IT support.
b. Support the development of *innovative cross-functional administrative processes* through greater coherence in information.
c. Achieve *more efficient administration* through more efficient use of IT.
d. Provide the capability for *fast support of new or modified administrative processes* or organisational changes through access to tried-and-tested infrastructure solutions.
e. Provide *easier access to public information* through open interfaces between citizens, companies and authorities.
f. Provide *adequate protection of public information* through secure solutions for handling and exchanging data.
g. Create *more successful IT solutions* through greater predictability of the results of IT investments.
h. Provide a *solid platform for public administration* through stable IT systems with sufficient capacity.

The following figure illustrates one of the most radical aspects of the new paradigm reflected in e-government, showing a shift

- from the traditional scenario in which citizens and companies have to run from pillar to post and themselves coordinate their problem-solving – often without access to the bigger picture and without self-motivation

- to the new scenario in which citizens/companies are placed at the centre, as authorities and other players relevant to carrying out the overall task are coordinating both the user interface and the underlying systems and processes.

Figure 3: From traditional administration to e-government



Certain rules will need to be observed if the new scenario is to be achieved and if the above-mentioned visions and objectives for e-government are to be realised. The White Paper proposes some general architecture principles.

3.2. From Green Paper to White Paper to …

On 30 September 2002, the Ministry of Science, Technology and Innovation published its Green Paper on enterprise architecture, the purpose of which was to put public sector enterprise architecture on the agenda and to kick-start a debate centring on three main issues:

- Should we have a common enterprise architecture framework?
- What form should such a framework take?
- How can we ensure that the framework is actually being used?

To follow up on the Green Paper, the Coordinating Information Committee under Project E-government has appointed a working group with representatives from central, regional and local government, which has been commissioned to tackle these issues in the form of this White Paper. The working group's mandate and composition are given in Annex A.

The Green Paper and the preparation of the White Paper have occasioned broad dialogue with a large number of different players in the public sector − among others, the board of Project E-government, the Coordinating Information Committee, the Government IT Council and the Government IT Forum − as well as organisations such as Dansk IT, the Danish IT Industry Association and Skåne Sjælland Linux User Group (SSLUG). Other parties to the dialogue included a range of suppliers such as KMD, CSC, IBM, SAP and Microsoft, and advisors such as PLS-Rambøll Management, Devoteam Fischer & Lorenz, the Gartner Group and the META Group.

Generally speaking, the dialogue parties have supported the aims of the Green Paper and stressed the strategic importance of enterprise architecture and common, open standards. At the general strategic level, there is considerable agreement on the importance of the architecture programme.

However, the dialogue also shows that, if we look more closely at the issues, there may well be a need to balance different interests. For example, some authorities have special needs relating to security and interoperability due to the special confidentiality requirements of their work or extreme divergence in the technological maturity of the players with which they communicate. In the private sector, it is only natural to protect or promote one's own interests and business strategies. For example, application developers will focus on interoperability between their own applications, while system houses will focus on interoperability at an information and service level. Cases in point are the varying assessments of the importance of openness or whether it is profitable to build 'shells' around various legacy systems.

The White Paper does not attempt to take a clear standpoint on all the many issues, but to take account of the natural and legitimate divergence in needs and interests through general principles for managing and developing enterprise architecture. The purpose of the work on the White Paper has not been to resolve all the many, often highly specific problems that the consultation process brought to light, but rather to propose a framework that can handle these problems within the future process. Enterprise architecture involves making choices, but, as a framework, the White Paper also seeks to establish a solid base in the form of broad-based support and consensus.

The process has made important contributions to the work and has been of major importance both in terms of testing the water and providing inspiration for setting out principles and recommending specific initiatives.

The White Paper does not offer all the solutions, since these will come about through broad-based cooperation between the civil

service as a whole and the market. The White Paper will create a platform and framework for future work on developing an optimised, coherent enterprise architecture in the public sector.

Enterprise architecture encompasses both a *process* to be introduced and a *result* to be implemented. The White Paper is a contribution to the process and a part of the result in that it offers a series of recommendations that will contribute to a decision-making basis for the future process towards the development of a common public sector enterprise architecture.

The implementation, which is again a part of the process towards e-government, involves the development of common, specific architecture models and common standards that can be used in connection with the procurement and development of public sector IT solutions, etc.

The architecture work should be carried out at several levels: nationally, general decisions should be taken to ensure interoperability (that IT systems can 'converse') and other common considerations, while in individual projects the architecture should be optimised in terms of the given task and the given organisation. The common architecture work will result in e.g. the establishment of a framework, i.e. designing the actual architecture process.

The architecture work should also result in the establishment of cross-public sector services and tools implemented as common systems, e.g. resource management systems, user identification and access control.

3.3. Denmark in an international perspective

The *Realizing the Vision* survey carried out by Accenture in 2002 showed that the leading countries in terms of e-government are Canada, the USA and Singapore. The next group comprises ten countries, including Australia, the UK, Denmark, Finland, Norway and Germany. The leading countries are also the ones that have most systematically taken initiatives to work on public sector enterprise architecture.

Denmark can learn a lot from other countries, just as many other countries are taking an increasing interest in the work being done in Denmark. In many areas, however, Denmark is so far ahead that there is little experience to draw on. When it comes to data standardisation and enterprise architecture, few countries have carried out similar processes. They do not match the extent and complexity of the Danish ambition level, which covers not just the central government/ministries, but in principle the whole of the public sector.

Many countries have now begun major e-government initiatives, but the nature and scope of the initiatives are different and their focus varies significantly. In countries where the electronic infrastructure has not yet been widely developed, it is natural to focus on building up a platform for e-government in the form of citizen access to public sector systems and electronic networks between different civil service units.

In countries with a more developed infrastructure, the initiatives are typically directed at increasing the visibility of public information and offering electronic access to well-known public services such as libraries and national registers. However, these services often have limited functionality since the necessary security mechanisms or the necessary coherence between civil service units are non-existent.

The electronic solutions with the highest practical value are those that can replace an entire work process, e.g. the submission of tax returns. However, this requires not only a secure connection to the citizen, but also close integration of the underlying systems and adaptation of the work processes in public administration. The most prominent examples of e-government are characterised by the following common features:

- Combination of political leadership and clear objectives in the work on e-government.
- Design of interfaces and services based on the needs and wishes of citizens.
- Establishment of portals with cross-functional services instead of unit-specific websites.
- Offer of complex services (transactions) rather than just information.
- Genuine self-service for citizens in the sense that they carry out (parts of) the civil service's case-handling.

All these features are closely linked with an overall framework for enterprise architecture to ensure that the political and administrative visions are translated into solutions that find broad acceptance with citizens and provide administrative benefits for the civil service.

Countries such as the USA, Canada, Germany, the UK and Sweden have chosen different approaches to establishing e-government:

- **Canada** is probably the world's most advanced country in respect of implementing e-government – with broad-based solutions, high complexity and high user acceptance. The basis is a common architecture (technical architecture, information architecture and business architecture) and strong management rooted in the government via the Federated Architecture Program (2000-) and a central budget.

- The **USA** has achieved relatively extensive coverage and volume, but low complexity and integration. The work on *Federal Enterprise Architecture* (FEA) was initiated by law in 1996 and has been prioritised upwards in the last few years. The law stipulates that each authority must have a person responsible for architecture. A number of service areas are selected as special focus areas that are 'architected' under tight, central management.
- **Germany** has focused intently on e-government in the last few years. *SAGA* is an architecture framework including a common standards list for IT architects that clearly sets out technical and software-related choices taken centrally. The framework does not include actual architecture specifications, but is to be regarded as a set of rules for specific projects. Compliance with SAGA standards is a formal part of project approval.
- The **UK** has, under the management of the *Office of the e-Envoy*, set up an ambitious programme, *UK Online*, rooted in the highest level of government. *Government Gateway* is a centrally financed infrastructure solution that connects existing systems with different data structures. The e-GIF document (*e-Government Interoperability Framework*) lays down inter alia a range of standards for technical data exchange formats and protocols. By complying with the technical standards, the individual authority can enjoy the large-scale operational benefits that derive from the provision of central solutions and principles.
- **Sweden** has a highly decentralised decision-making process and was until recently an example that letting a thousand flowers bloom with the help of a central facilitator can lead to dynamic e-government with loosely connected IT systems. The *SHS* infrastructure solution provides a common transport service for exchanging data, developed to link civil service units. This year, the Swedish government is appointing a delegation to manage financing across official boundaries, as well as a cooperative body for common architecture decisions.

Denmark can and must learn from the following experiences of countries that have carried out corresponding processes to a major extent:

- Founding the initiative at government level is necessary.
- Cross-ministerial organisation/governance is necessary.
- Standardisation of data structures and functional interfaces should be incorporated.
- Choice of technical standards should be incorporated.
- Common infrastructure solutions support coherence.
- Initiatives of certification and communities of practice should be incorporated.

Denmark is involved in a range of international collaborations, partly through EU programmes, and will in future intensify collaboration in the above areas.

3.4. Guiding principles of architecture work

Based on the Green Paper consultation process and an assessment of foreign experiences, the White Paper has set out some guiding principles for the architecture work:

1) The service-oriented architecture should be a model for public sector IT investments that will contribute to coherent e-government.
2) The perspective is that all authorities and institutions should in time be able to participate actively in the service-oriented architecture.
3) The national enterprise architecture should be a lowest common denominator that leaves room for expansion (a common *minimal architecture* or *dogmas*).
4) A given enterprise architecture should reflect the business vision as well as certain necessary choices. There must be broad support for such choices – and preferably consensus.
5) The national enterprise architecture should be used where there are real administrative/business needs. It should also be based on business analyses that show that it can be beneficial.
6) The intention is not that all old systems should be scrapped or that everyone should now use the same platform. Conversely, no systems should be granted an advance preservation order.
7) Architecture work should proceed pragmatically and iteratively. Decisions should be taken that give short-term benefits as well as decisions in accordance with the long-term strategy.
8) Enterprise architecture should respect the principle of subsidiarity, which means that decisions should be taken at the lowest possible political/administrative level.
9) The architecture programme should be coordinated with similar work at international level and Denmark should be proactive in international standardisation work.
10) Enterprise architecture work includes i.a. a number of recommendations and requirements relating to standards that are published at www.oio.dk

4. ELECTRONIC TOWN PLANNING

This chapter introduces the White Paper's model for architecture work. It uses the metaphor of planning a town structure with houses, roads and supply lines to illustrate how the architect helps to systematise and organise. The cornerstones of the architecture model are two processes – cyclic and iterative – that influence and enrich one another. The elements of the two processes are explained and specified in relation to the given possibilities and circumstances in Denmark.

The White Paper does not promise easy solutions, but highlights the crucial mechanisms of an organisational, process-related and technological nature that must be implemented, managed and evaluated in order to realise the very real benefits of planned, managed enterprise architecture-conscious development programmes and investments.

The White Paper does not aim at unification, monopolisation or bureaucratisation of the decision-making processes. The public sector units are by and large self-governing, and have their own cultural and legislative contexts. Emphasis is therefore placed on how general architecture principles rooted in the desire for efficiency and cross-public sector collaboration can be implemented locally for the good of the community without losing local government.

4.1. Town planning and enterprise architecture

The development of public sector IT systems is like the town planning process in many respects. In our towns, there are numerous projects underway and it is difficult to keep tabs on every detail. There is therefore a need for a general planning framework to ensure orderly development and systems with a better capability of coherence.

Enterprise architecture work can be compared with town planning where common resources are planned and rules for their use set out, e.g. common safety solutions.

Like other town planning, ranging from general national/regional planning to local planning, enterprise architecture can be developed on several levels:

- National level;
- by sector/service community/focus area;
- by individual organisation/authority.

A town plan sets out the framework for the town's development – designation of industrial and residential areas, requirements for water, heat and electricity supplies, traffic load planning. A town plan is a

social agreement that facilitates reasonable development of the town through the local projects carried out by the town's inhabitants and companies.

Without a town plan, there is a real risk of chaos − the town is not cohesive and investments in traffic and supplies have no inner coherence. The town plan is an official instrument that sets boundaries for what may be done and objectives for how development will proceed – always in due consideration of all the interests that have to be reflected in the general decisions. It is inevitable that some citizens or companies feel restricted in their private town planning projects or that their projects become unnecessarily costly as a result of the town plan. Town planning therefore builds on a political process.

Towns have different preconditions in respect of, for example, geography, demographics, history, business/competence structure. Consequently, they have different plans that may appear essentially similar to the untrained eye, but which in actual fact involve very different 'realities' and have arisen in vastly different contexts. Town planners and architects also naturally have a common inheritance through training and professional associations, but what characterises a good planner and architect is first and foremost their practical knowledge and experience.

Town planning work involves firstly establishing rules for a given property's siting and layout, e.g.

- Standardisation – dimensioning of pipes, voltage, road width.
- Certification – authorisation of planners and electricians.
- Management – rules and notifications/approvals/permits.

Town planning also includes principles for the common services to which a property can or must be connected:

- Supply of water, electricity, heat, etc.
- Sewage and refuse systems.
- Telephone, cable TV, Internet, etc.

The establishment of services is a common investment, and the use of these services is regulated to achieve acceptable profitability. At the same time, the services can be offered at an attractive price for a given property.

In the same way, the IT world needs both regulation of the individual system's design and the establishment of common services in areas where it is expedient to work jointly. For both these initiatives, standardisation of connection points (in theform of well defined

interfaces) is a precondition for achieving coherence between the IT systems.

Historically, there has been a tendency in Denmark for investments in the infrastructure to be public and under public control. In recent years, however, we have increasingly allowed the market to make the investments, allowing the public sector to focus on the necessary regulation to ensure stable provision and reasonable market conditions.

Within this picture, we must include the fact that town planning is a process involving many stages that can last from several decades (e.g. Ørestad) to a few weeks (simple renovation, etc.) and has varying degrees of planning. Traditionally, there is a division of labour between the town planning architect, sectoral planning and the technical administration.

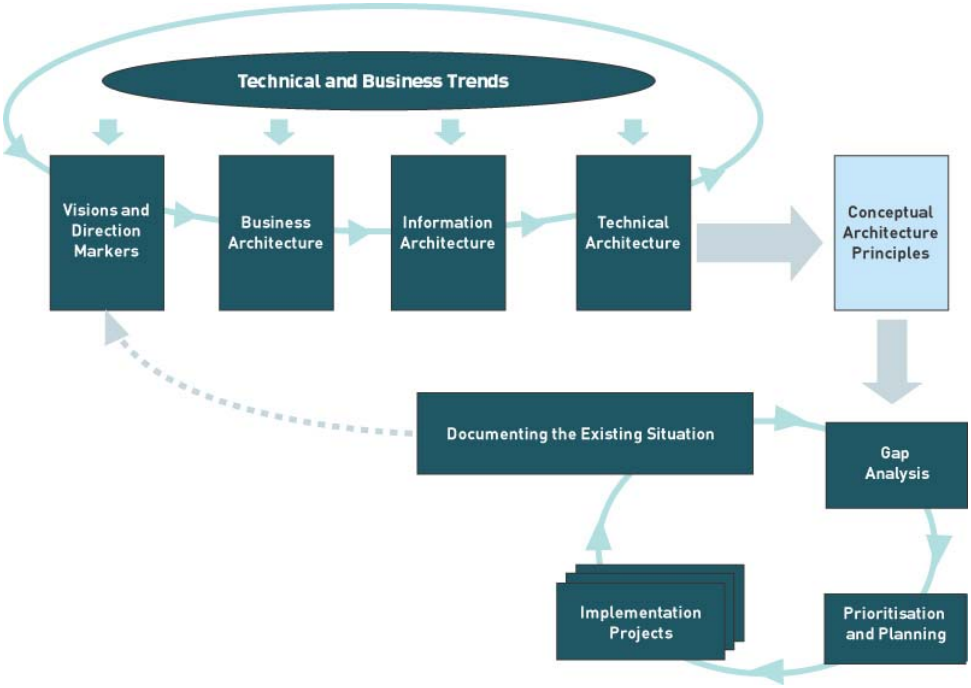
4.2. How should we work on enterprise architecture?

Like town planning, IT involves multi-stage processes and different levels in planning and architecture work. In the White Paper the term enterprise architecture is an all-embracing term for several different levels of this broad specialist area:

Both the strategy process and the implementation process are cyclic processes that systematically bring IT use into line with business objectives.

The architecture model builds on internationally recognised principles for *enterprise architecture*. The model expresses the processes that the public sector must pass through in the transformation to e-government.

Figure 4: Architecture processes



The architecture processes embrace more than just IT, since it is a precondition for establishing a suitable technical architecture that the business visions and objectives are clearly defined so that they can be used as a planning basis for IT development. The architecture process is thus based on fruitful dialogue between business and IT.

In Denmark, the public sector has prepared itself – at a general, national level – by letting the cross-public sector *Project E-government* set out visions and direction markers. This provides for development of new models for making public services more user-specific and more efficient than is the case today. *The Digital Taskforce*, which is the secretariat for the board of Project E-government, supports the various authorities in the business-oriented part of the work, while the Ministry of Science, Technology and Innovation is responsible for technical perspectives such as the setting up of information and technical architectures.

Development of the architecture is a complex process. At one single level, it moves from vision to implementation, operation and evaluation. The process is far from linear, so it is a mistake to see the process as one that moves from point A to point B. Enterprise architecture is a continuous process that aims to ensure continuous improvement of the value of IT use.

The architecture process is part of the interaction with an implementation process. The two processes are linked and must run in tandem, but at different speeds. The architecture process is the conceptual, strategic long-term process, while the implementation

process is solution-oriented, practical and shorter-term. The architecture process defines the objectives for the implementation process, while the reverse connection is also important: the systematically gathered experience from implementation should also be incorporated in the overall planning. The entire process can be described as follows:

The architecture process takes its starting point in the vision and external trends and culminates in conceptual architecture principles relating to IT. All phases of the architecture process build on an analysis of trends and requirements. Consideration is given to competitors, customers and suppliers, and strategic advisers are consulted. The process has the following phases:

- **Visions and direction markers.** Defines the strategic business objectives, direction markers and visions, especially those relating to IT. Dialogue with senior business management and the political level is required.
- **Business architecture.** Defines the work processes that the IT system has to support, both in terms of functionality and operational features. This definition is the result of analysis and subsequent optimisation of the existing work processes.
- **Information architecture.** Defines the business strategy's requirements for organisation of information, both at a general level and as specific data definitions based on a common conceptual approach.
- **Technical architecture**. The requirements for the technical solutions are defined using a common categorisation system. The technical architecture denotes both the system's general categorisation into modules, and the organisation of the functions of the individual modules. A key factor is to reflect the desired – or enforced – business changes that IT has to support.
- **Conceptual architecture principles.** A set of rules for the choice of IT solutions to ensure compliance with the identified requirements for the information structure and the technical architecture.

Alongside the strategic architecture process runs the solution-oriented and practical implementation process, which includes the following phases:

- **Documenting the existing situation**. The documentation serves as the starting point for forward-looking planning and is maintained continuously as part of the operational work. The documentation is also an important basis for laying down and revising the visions and direction markers.
- **Gap analysis.** Describes how the existing solutions, methods and organisation fit in with the conceptual architecture principles.
- **Prioritisation and planning**. This phase describes the technical migration that is needed to bring the existing solution the required

steps closer to the architecture principles and business objectives. This planning prioritises the changes that are of greatest business value and identifies their consequences.

- **Implementation projects**. Implementation is effected in the form of a number of projects that are coordinated and aim at the same general objectives. The projects are run as a portfolio with active risk management and performance optimisation.

Enterprise architecture determines guidelines for the general organisation of data and choice of functional components for one or more IT systems with a view to:

- optimising the systems' meeting of objectives in relation to business requirements;
- optimising the systems' interoperability with other relevant systems;
- optimising the systems' cost-efficiency throughout their life-cycle.

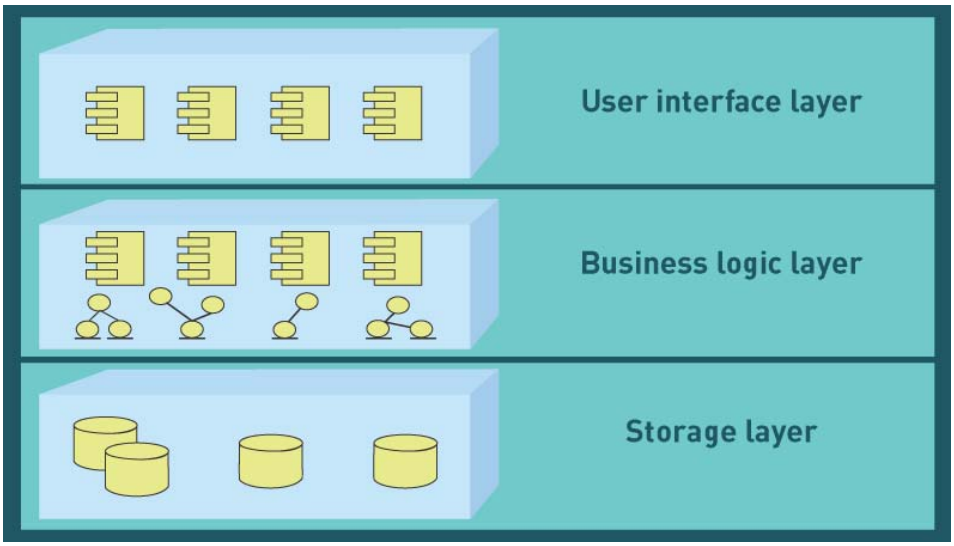
IT investments must obviously generate value. A well-designed enterprise architecture can increase the value of IT investments by creating a framework that harmonises the investments. Enterprise architecture is an investment in a process and a range of tools such as a set of general design principles, a checklist, or a standard annex for a specification of requirements. A public sector enterprise architecture framework should help to prevent IT projects being based on proprietary and closed solutions and promote the projects' observance of common standards and use of the recycling philosophy.

The background to the new focus for enterprise architecture is the increased requirements for coherence and efficiency in the civil service. These are the new capabilities that technology has brought about and the new objectives for e-government that have been determined at political level. If these capabilities and objectives are to be realised, the many different players must to some extent harmonise their IT systems so that they observe certain common standards and rules, including standards for interoperability (e.g. XML) and security (e.g. digital signatures). This can be supported by implementing certain services under common management, e.g. functions for exchanging data and solutions for handling digital signatures.

The core of this common public sector architecture work is the choice of the **service-oriented architecture model**, which defines the interoperability between IT systems as services offered by one system component and used by another. By choosing this concept, we ensure the best possibility of coherence between IT systems by using harmonised service definitions.

The service-oriented architecture model is an extension of the classic layered architecture model, which is illustrated by the following figure in the Green Paper:

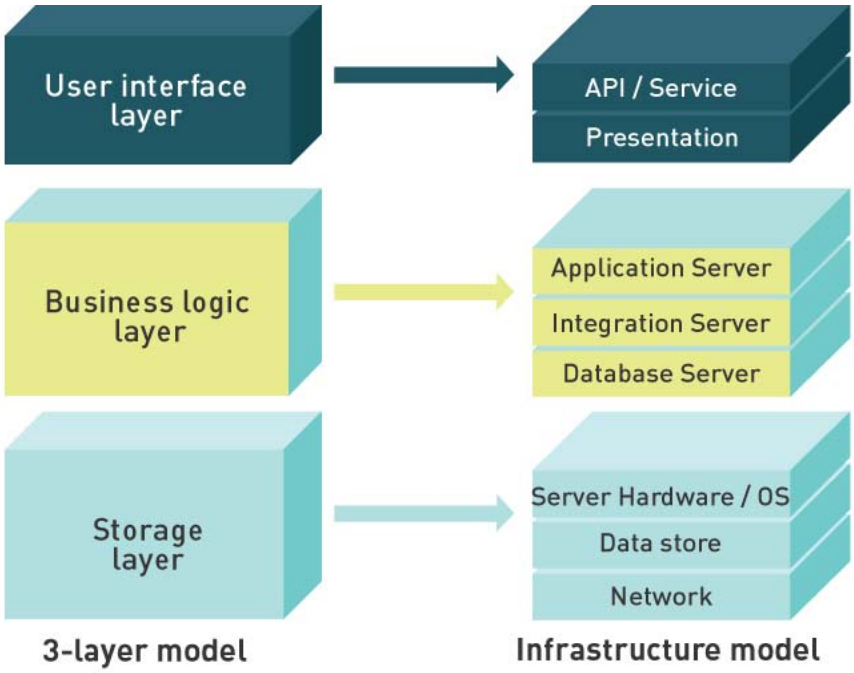
Figure 5: Three-layer model



Source: *Realising eGovernment,* CSC, 2002.

This classic three-layer architecture model is a logical (i.e. conceptual) model that represents a more complex scenario (with more layers). In order to describe the design requirements and implementation strategy for the system architecture, we need a more detailed model.

Figure 6: From three-layer model to infrastructure patterns



If interoperability between different systems is to be ensured, it is important to provide linkage where conceptually equivalent components are connected. It is consequently necessary to use a more detailed division of the three layers, and the figure illustrates how the three layers are subdivided. This gives a segmented (modularised) model that provides the possibility of describing the coherence in more normative terms.

This more normative model is often called a *service-oriented architecture*, which is different from earlier architecture models (such as mainframe and client/server). The following table gives examples of the features of the different architecture models:

	Mainframe Architecture	**Client/Server Architecture**	**Service Oriented Architecture**
Platforms	Monolithic and centralised	Homogeneous and controlled	Diverse and unpredictable
Networks	Restricted and closed	LANs widespread but isolated	Internet, omnipresent and linked
Data Formats	Non-transparent and inaccessible	Binary and proprietary	Semantic and divided
Technology Focus	Operating system	Database	Interface
Users	IT operators	Case officers	Suppliers, employees, customers/users
Business Value	Digitalisation of data-centric operations	Provides data to users	Promotes business agility, adaptability and interaction

Features of system architectures *(Source: The Stencil Group)*

The service-oriented architecture is a model for system elements that converse, e.g. via web services. Web services represent a specific implementation of a service-oriented architecture. However, the model can also be seen as a model for public sector e-services – i.e. services for citizens, companies and other authorities as well as internal services.

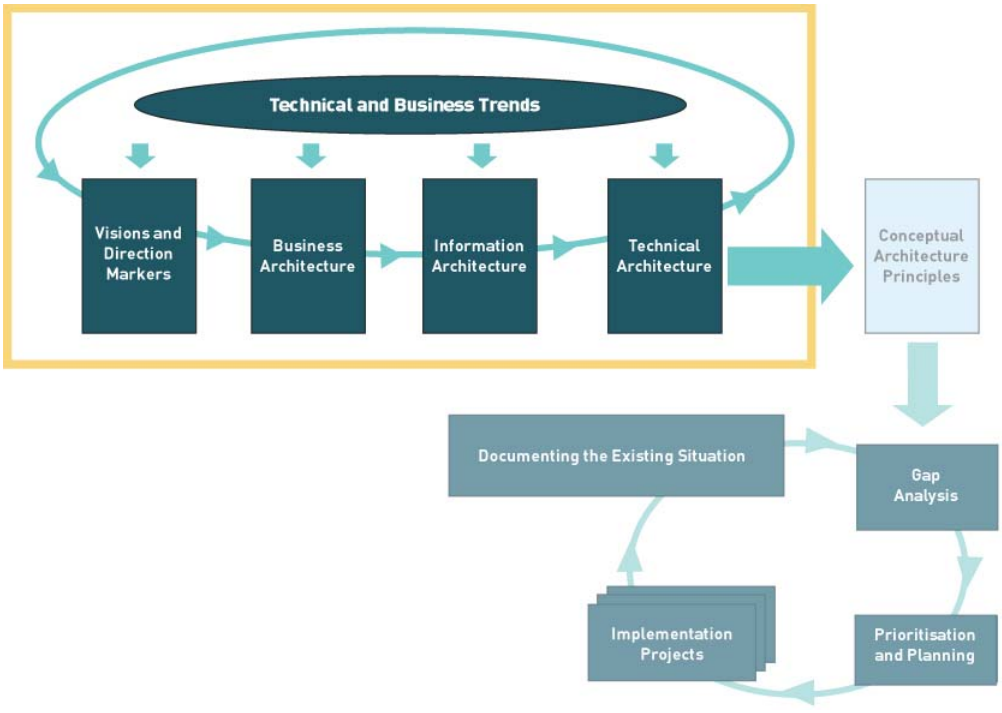
In this context, the term *services* can be understood on several levels:

- **Conceptually**, a service-oriented architecture represents a *model* in which loosely connected applications work together by making services available to one another.

- **Business-wise**, services are an expression of *data and function services* that a party can make available to others, where appropriate under business conditions.
- **Technically**, service-oriented architecture uses a *group of standards* under continuous development that defines protocols and creates a loosely connected framework for programmed communication between different systems.
- **Specifically**, web services denote *a method* that allows an application to be called up by other applications by receiving and responding to data in a standardised language (XML).

Service-oriented architecture does not in itself prescribe specific technology standards, although many suppliers offer a specific technological platform for this. The choice of standards is expressed in the conceptual architecture principles, which summarise the decisions taken during the architecture process. The standardisation of service interfaces is in full swing in many international standardisation bodies (W3C, OASIS, WS-I, etc.) and the process is expected to run over the next few years and bring consolidation around a common set of mature technological standards. The application of these standards in public sector enterprise architecture will be a central task of architecture work in the coming years.

Figure 7: Value-creating enterprise architecture



The *strategic cycle* of the architecture process is illustrated in the above figure within the uppermost framework.

The task of the enterprise architecture is to organise the general design of IT systems so as to maximise the value of IT investments

measured by the business definition of value. The starting point of the architecture process should therefore be the business needs of the civil service, which must then be translated into the identified needs for IT support so that IT use can be optimised. In this context, technological capabilities and the IT market's specific products play an important but secondary role as instruments for realising IT support in the most expedient manner.

In defining the civil service's provision of IT support, we do not advise starting with existing administrative processes. Simple IT support of existing work processes will not realise all the possible benefits because these processes have evolved in a world with limitations that IT cannot remove. IT support thus gives new possibilities for optimising work processes to increase efficiency and quality. On the other hand, in many cases it will be necessary to modify the processes to make the investments in IT support profitable.

It may therefore be relevant at the same time to consider the civil service's objectives and visions in the areas concerned. For example, there may be many opportunities to change and soften boundaries and working relations with other authorities and private bodies as a result of new technological capabilities and business progression.

Successful IT projects are based on a thorough understanding of the administrative processes − and of the possibilities that IT gives for optimising value throughout the chain. This calls for activities in the form of process analysis and process optimisation alongside the architecture work and with the same general rooting in the civil service management. A central part of the enterprise architecture - process is the dialogue in which administrative and technological understanding meet.

Value creation is a central element of this optimisation, and it is therefore important to identify where and how value is created. In many contexts, it will be possible to determine internal gains in the form of increased speed, productivity and quality of case-handling. But in other situations, especially when establishing cooperation with external parties and when introducing self-service for citizens, significant gains will come outside public administration, for example as saved time for citizens or saved costs for companies. In reckoning the value of IT support, it is therefore important to apply a comprehensive view that takes reasonable account of secondary and external benefits.

Enterprise architecture work requires ongoing, qualified dialogue with civil service management, which in this context has the role of building sponsor, and it is the architect's job to formulate IT-strategy decisions as business choices in which advantages and disadvantages are sufficiently described to form a reliable basis for the decisions.

Creating this basis requires thorough understanding of the IT solutions' components and their features in the application scenario so that a realistic reckoning of consequences can be made in terms of both cost and practical value assessment. Enterprise architecture work should therefore, as one of its tools, make use of systematic benchmarking models based on experience from comparable situations and IT solutions.

In all phases of the architecture work, it will be possible to formulate the decisions as part of an optimisation process. For example, the information architecture will need to be chosen according to all system users' required access to the information. If there is a need for synchronous access to common data from a number of geographically separate offices, it may be optimal to centralise data, whereas cases where the information is primarily used locally will call for a distributed information architecture. These considerations are naturally affected by the available communication options (quality and price) viewed against any large-scale benefits from handling data centrally.

When optimising enterprise architecture on the basis of value-oriented objectives, the consequences throughout the life-cycle of the IT solution should be taken into account. In architecture work, decisions are often taken that have far-reaching consequences, for example the choice of specific interfaces or data structures. This means that subsequent decisions on modernisation or integration of the solution with other systems can be affected − positively or negatively − by previous choices. Architecture work should therefore be based on a number of general principles which reflect the civil service guidelines for optimisation of enterprise architecture and which are maintained over a number of years. Both locally and for larger sections of the public sector, these principles must ensure that the need for integration can be met at the same time as the value of the specific IT solution is optimised.

Enterprise architecture is not just of major importance for establishing new IT solutions. In modernising and expanding existing solutions, it is just as important to choose technologies, interfaces and data formats that help facilitate functional integration of IT solutions in the public sector. Coordinated planning of both the development of existing solutions and the establishment of new systems is necessary for achieving coherence across systems with the maximum possible cost-efficiency throughout the combined life-cycle of the systems.

In this regard, it is important to aim at multi-string solutions that can meet the needs of different organisations without neglecting the need for cross-functional interoperability. It will be expedient to establish a set of general guidelines for assessing the civil service's needs for integration between the general IT structures and to determine the value of this integration. Such an assessment will be usable in

strategic choice scenarios where the future development of outdated IT solutions has to be defined.

4.3. Multi-speed architecture development

On the road towards e-government, we will often face a choice between tactical and strategic investment in IT solutions. For example, the tactical choice may be to create ad hoc links between existing systems, while the strategic solution will be to convert the systems to use a common service that provides for more extensive integration.

General IT planning must reflect that tactical and strategic initiatives are *not* mutually exclusive, but often represent additional means of achieving the general objectives. At each stage in the development, different initiatives will be appropriate, and the balancing act is best done by considering the solution alternatives as investments with separate cost and performance profiles. This makes it possible to judge when initiatives with a strategic perspective (e.g. functional interlinking of systems) should have higher priority than initiatives that bring short-term benefits (e.g. data exchange between existing systems). Each case should consider not just the local consequences, but also the effects on areas that are expected to be influenced in future by data sharing or functional integration.

The common enterprise architecture framework will help to coordinate all initiatives that contribute to the interoperability of public sector IT systems, regardless of whether they are tactical or strategic. By setting up a common reference framework for assessing the value of individual integration initiatives, we can ensure that the balancing of local and national considerations as well as of short-term and long-term investments is generally carried out optimally.

At both tactical and strategic level, there will be a need for joint initiatives to create coherence and price-optimal IT solutions. A central task will therefore be to identify functions that can be usefully carried out under common management and to design these solutions so that they give maximum value for the given project as well as minimising costs. This applies, for example, to common services where a central function is made available for a large number of public sector IT systems instead of local systems acting independently. Examples of this might be control of a user's identity or making a payment to a citizen.

In other areas, a common enterprise architecture framework will be able to bring major benefits through harmonisation of the functionality that the IT systems implement. Examples of this might be calculation of public sector payments or the carrying out of general functions in public sector case-handling. By recycling the IT implementation of such functions, expenditure on local systems can

be significantly reduced and the resulting uniformity of the implementations will help future integration.

The joint initiatives should not just involve a common set of rules for general IT decisions, but also a proposal for the design and implementation of selected services under common management that can ensure coherence between the systems and reduce the costs of the given project.

4.4. Economic perspectives

The experience of organisations that have introduced a common architecture process show that focus on enterprise architecture is a sound investment. Basically, it is a matter of decisions that have always been taken. When the public sector organisations impose requirements on the architecture, the architecture decisions move from the supplier to the system owner. The decisions are thus rooted in the user organisation and are taken with greater economic rationale. The result is a major net gain that is apparent in both the IT budget and in the business processes.

Savings must be seen in relation to costs in that not working systematically with the architecture means increased maintenance and adaptation costs. Gains can be can made as total savings through the lifetime of the system. In other words, the rationales of the terms ROI − *Return on Investment* and TCO −*Total Cost of Ownership*. Economic accounting covers all income and savings as well as all the costs of setting up and running the solution, including those for e.g. acquiring knowledge and training IT personnel and in the user organisation.

However, the benefits of an appropriate enterprise architecture run to more than savings on IT solutions. The architecture is vital for the practical value that the organisation acquires by using the IT solution in the form of e.g. higher productivity, quality and user satisfaction. It also becomes easier to adapt to new business and new business division. These benefits are hard to quantify without objective measuring methods, so architecture initiatives should be justified using a business case and followed up with disclosure of the results.

The general aim of optimising enterprise architecture is to reduce costs and increase the performance of IT solutions. Often the benefits occur elsewhere than where the investment is made and this can make it difficult to justify the investment. It should also be considered that a major part of the gains of a good architecture is only achieved in the operating phase and so will only make a positive contribution to economy in the years after the decisions have been taken and the investment made. A comprehensive view is needed when assessing profitability:

- Firstly, it may be necessary to consider IT investments as a common investment for a group of institutions or across several sectors. This means that economic mechanisms must be introduced to ensure that both investments and benefits are suitably distributed. An example of such a mechanism is the distribution keys for the investment.
- Secondly, it may be necessary to link the investments in the set-up phase with the ongoing benefits to be gained throughout the lifetime of the IT solution through reduced costs and increased practical value. This raises the need for a financing model for IT solutions that prepares the ground for architecture decisions to be optimised in terms of the solution's overall economy. An example of this might be a central investment that is paid for by ongoing usage fees.
- Thirdly, it may be necessary to balance the need for special solutions against the possibility of using ready-developed solutions, either in the form of concept recycling or in the form of connection to common solutions. Although a given IT need may call for a simple solution, there may be benefits in using a common solution even if it is more complicated or has a higher service level if it is more economically attractive because of large-scale operating benefits,.

In conclusion, suitable control mechanisms should be established to ensure that architecture decisions are taken with a view to optimising the overall economy of the solutions for all the parties concerned. This may, for example, involve management principles, incentives or agreements. The following economic models may be cited as inspiration for the choice of these control mechanisms:

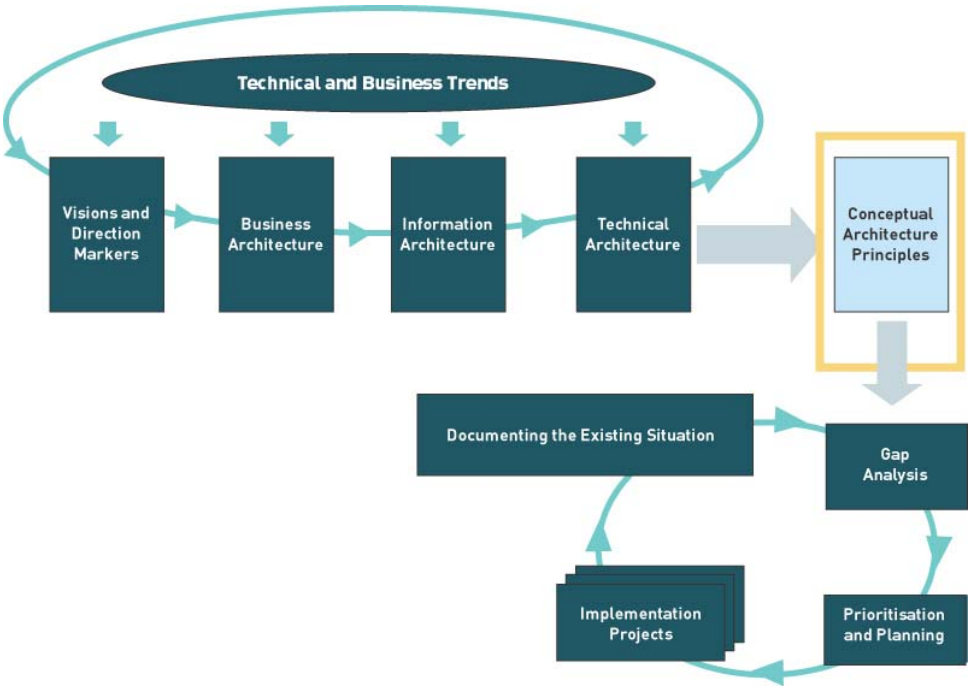
- Central investments in a common infrastructure with distribution of costs according to usage keys or ideal shares.
- Usage charging of services made available to other organisations, based on true-cost prices.
- Sale of licences to suppliers running common services or applications under commercial terms.
- Subsidies for IT projects connected with common services or using common specifications of functionality or data structures.

The economic models must promote optimisation of IT investments. They should also help to spread the knowledge, understanding and acceptance of enterprise architecture work and its results. The benefits will be saved investments in the local project, a shorter implementation time and profits in the use of common facilities because this will be cheaper than local operation. This increases the user organisations' option to choose and construct IT solutions with a higher achievement of objectives and greater efficiency.

5. PRINCIPLES

A good enterprise architecture is characterised by the architect achieving a good balance in terms of the many, complex requirements. In specific solution contexts, there is normally a wide range of solution requirements for given functionality and a range of operational requirements for e.g. performance and stability. The architecture (town plan) must ensure that the specific solution can meet local needs within the framework of common planning.

Figure 8: Principle-driven enterprise architecture



The basic concept for good enterprise architecture work is that it is principle-driven. This means that first the business requirements are analysed, then on the basis of this a set of conceptual architecture principles is established for use in organisation and technical selection. The architecture work must ensure coherence between the requirements and the principles so that the business requirements will be met by a solution that accords with the principles, and that the relevant principles are always grounded in business requirements.

The architecture principles are established in a multi-level hierarchy. The top level comprises common, general principles that, among other things, reflect the need for coherence across the public sector. The next level comprises principles that normally aim to optimise the IT solutions within a given sector or focus area. At the lowest level are principles directed towards a specific system or portfolio of systems in a given institution. This section puts forward the general principles for this hierarchy. Further architecture work will be

directed at developing these general principles into a common enterprise architecture framework.

The purpose of the general architecture principles is to ensure the honouring of the visions and objectives of the government's modernisation programme and Project E-government. These are described in chapter 2. A common public sector framework for enterprise architecture must first and foremost incorporate the following five principles:

- Interoperability.
- Security.
- Openness.
- Flexibility.
- Scalability.

The principles are important for achieving coherent digital communication within the public sector with consequent efficiency and quality improvement as well as optimisation in respect of the social value of the public sector services.

The following section describes these principles and, for each principle, justification is made for the part of the vision (the vision elements above) that they support. The end of this chapter describes how these guidelines can be tackled.

5.1. Interoperability

Interoperability is vital for creating a better, more coherent service that places the user at the centre. It is also a prerequisite for creating innovation, efficiency and fast support of new rules and frameworks in the civil service. This applies, for example, in connection with organisational changes where there is a need to change the interplay between existing IT systems or to add new ones. Interoperability is also important for security and protecting public information since it is a prerequisite for establishing cross-functional security solutions.

Interoperability, which means achieving the required coherence in the most effective way, can thus be seen as the most important key for e-government. In the architecture context, interoperability means especially that it is necessary to have common integration principles and standards for exchanging information.

The White Paper's recommendation of a service-oriented architecture model stresses that interoperability is not just based on reading data from other systems, but that there must be functional coherence between systems, e.g. one system providing a service to the other. Such coherence requires inter alia agreement on the meaning of the data content, and functional integration also requires a common

definition of the context in which the information is exchanged. The definition may include requirements on, for example, data consistency or access control, and will be crucial for the choice of linkage of the systems.

Interoperability can be based on bilateral agreements in which the rules for communication are defined for each new system that is connected. This model works well both in principle and in practice where there are only a few well-defined parties with well-defined, stable needs for exchanging data. However, if this is not the case, it can be a costly and inflexible method of creating interoperability. In situations where multiple systems have to communicate, a multi-layer architecture using common standards is much more preferable because there is no need to define and implement a large number of interfaces with the same purpose.

If information is to be easily exchanged between authorities, it is necessary for the IT systems to speak the same language. The core of interoperability is the stipulation of common data models and common protocols for exchanging data. The protocols must support the data models via so-called metadata (i.e. information about data), which describes and defines data. In other words, the organisations (authorities, institutions and companies) that have to exchange data must be agreed on data definitions.

The Ministry of Science, Technology and Innovation has established a national, central repository for metadata definitions. This so-called infostructure base is an important element in terms of a common national enterprise architecture because this is where information on the content of public sector registers, ESDH systems, content management systems and other IT systems will be stored.

5.2. Security

Security is vital for protecting public information and a precondition for all players taking part – from authorities to private companies to citizens. Without assurance that data is handled securely, there will not be the required confidence neither among providers nor among users of e-government. Security is thus also a vital precondition for e-government and a general requirement for enterprise architecture.

The architect's job is to organise the security functions in such a way that the business requirements for security (of both the civil service and citizens) can be met to an extent that is acceptable in the given application scenario. The solution also has to be adjustable for any new (more stringent) requirements, without a large part of the previous investment in security becoming worthless.

The security architecture takes its starting point in the business requirements for the work processes, the sensitivity of the

information, and an analysis of the given risks. The security architecture must satisfy legal requirements, the reasonable expectation of citizens for secure information handling, and official needs to offer effective case-handling and good service. In order to specify the overall requirements for security, we should proceed from a common definition of security concepts at the business level.

In many situations, the requirement for security will be seen as conflicting with, for example, interoperability and openness. Here the IT architect's job will be to structure the information according to sensitivity and to grade access according to the needs of the given parties. A basic decision may be whether especially sensitive data should be stored together with other data or whether it should be stored in separate IT systems. Such security considerations have major consequences for architectural choice, and it is therefore of prime importance that they are regarded as general principles for the architecture work. Later expansion of the security functions of existing systems will be costly or impossible.

The specific security solutions (access control systems, certificates, backup, etc.) should be chosen so that they meet the general requirements for interoperability, etc. This means that they are based on common standards (possibly as common solutions) and a common understanding (agreement) of reliability, legitimacy and administrative procedures. In this point they are no different from the other architecture principles.

The security aspects are seen by many as the main factor for expanding e-government and should therefore have high priority in future work. The Ministry of Science, Technology and Innovation has appointed a new council for IT security, a competence pool in matters of IT security, and taken concrete decisions relating to digital signatures.

5.3. Openness

Openness in relation to interfaces and models for the data that is to be exchanged is vital for establishing a well-functioning service architecture. Openness is not just important for interoperability – and hence the associated objectives. Having open standards can also be of major importance for the success and soundness of IT investments in both the short and long term. By having open standards, we can inter alia avoid supplier dependency. Access to source codes (possibly common or open access) can be important for the quality and price of custom built software.

We can discuss openness on several levels:

- open standards (e.g. W3C standards);
- open interfaces (e.g. XML-based);

- open specifications (e.g. documented using the form in the infostructure base);
- open source codes (e.g. when an authority procures specially developed software).

There are a number of formal standardisation bodies such as ISO, CEN, CEFACT and IEC. They prepare formal standards. There are also a number of organisations that prepare open specifications, which in many cases acquire the nature of de facto standards. Important examples are OASIS and W3C. For example, W3C (*World Wide Web Consortium*) prepares specifications – so-called recommendations for websites and Internet architecture. W3C has defined e.g. the HTML and XML standards, including a range of technologies that together form an essential part of the technology platform for a service-oriented architecture. Such industry-developed specifications generally acquire the nature of de facto standards and are often unchallenged by more formal standards due to the division of labour that has arisen over the years.

In principle, public authorities should use open, formal standards, but where this is not possible or attractive the advantages and disadvantages of using open de facto standards should be considered. Open de facto standards can give very good future security if they have broad, strong support from the market. A de facto standard can also be based on proprietary technology which does not belong to a standardisation body or an open organisation, but which has found broad use on the market. An example is Microsoft's Windows operating system and the .DOC document format. The disadvantage of proprietary de facto standards is that they can bind to a given supplier or circle of suppliers. Generally, such binding should be avoided wherever possible.

An open IT system must have well-defined interfaces (e.g. so-called APIs, *Application Programming Interfaces*) that observe open standards such as OIOXML or, if this is not possible, widely accepted de facto standards. In a service-oriented architecture, there may also be a need for openness in terms of e.g. data models (for data portability) or various operational data (for troubleshooting or optimisation).

5.4. Flexibility

Flexibility in the sense of designed for change and development is vital in a changing world. Flexibility is important both for innovation and the ability to adapt IT solutions to changes in needs, rules, work processes, organisation, etc. In a changing world, flexibility is also crucial for the success of IT projects and robustness in IT solutions.

The architecture should be conceived in a modular design where main functionalities are developed separately in modules that, when

combined correctly, carry out the whole desired process. The individual modules can continually be adapted to new requirements. These may, for example, take the form of legislative changes that affect calculation methods. Or they may take the form of desires/needs for new functionality, e.g. more output channels from a public sector specialist system that is to communicate with other systems/services. The individual modules can often be used in several contexts − by external services also − and so are integrated in new systems. This makes it possible to react relatively easily, cheaply and quickly to new needs and opportunities.

The individual modules should be recyclable in systems other than the one for which they have been developed/supplied and should be openly specified in terms of both functionality and interfaces. The modules can (and often will) include proprietary elements, but should be replaceable as a whole, possibly with a similar module from another supplier. A good principle is to define the modules as complete functions and to ensure that they can all be supplied by an alternative supplier.

5.5. Scalability

Scalability should be built into a system from the start. If systems cannot 'keep up with' the actual usage of them, neither service level nor efficiency will be satisfactory. No chain is stronger than its weakest link, and in complex IT solutions it is important that all elements support the necessary, adequate scaling to ensure robustness.

It is important to be able to maintain both the functionality and efficiency of an IT solution if the need changes, for example in respect of user numbers, transaction volume or data quantity. It is the architect's job to avoid unnecessary bottlenecks that could cause problems at peak load as well as overloading.

It should be stressed that scalability is not a requirement for a certain capacity, but a principle that the system must be expandable (or reducible) so that it always meets the given needs in an optimal fashion.

In practice, this means a modular architecture so that the capacity can be varied by adding or removing elements (of the same type) in all areas where there is a need for scalability. This variation must at no point be restricted by technical or logical barriers, e.g. in the form of the limited capacity of a single element that cannot be supplemented.

Modularity and scalability must also relate to the nature and scope of the work. It would be costly and unnecessary to take account of all conceivable expansions if the given system has to meet a static need. The need for scalability therefore depends largely on the size, role

and use of the system. For example, scalability will not be a major issue in small systems that do not interoperate where there may be high loads and large fluctuation in data traffic. Conversely, it is crucial in large systems that have to interact in a complex of several large systems with high traffic or with potential for development of high traffic over time.

5.6. Guidelines for enterprise architecture

It is necessary to begin a range of national initiatives to support the practical use of these five principles. One way is to draw up common guidelines for a specific approach to these principles. Chapter 7 examines the possibilities for supporting the principles via pcommunities of practice and common reference models, repositories, etc.

Architecture work in both individual authorities and cross-functional projects must ensure that the five basic principles are followed and that the project-specific solution requirements are met. The enterprise architecture work should therefore follow a set of common guidelines that specify how the strategic architecture choices should be made and define the common choice of interfaces and other architecture components.

It is recommended that the guidelines tackle at least the following conditions, which are linked to a process from identification of needs to specification of requirements to specification of solutions:

- The business architecture for each solution should take its starting point in an *analysis of the work processes that have to be supported by the IT solution*. Before the IT solution is designed, it should be investigated whether the work processes can be simplified or streamlined, and the consequences of the recommended changes should be determined. Once these choices have been made, the work processes and the required IT support are specified. The guidelines must give general methods for analysis and specification.
- A general *specification of the information architecture* should be drawn up justifying the choice of the given structure. For all data structures that have to be exchanged with other systems, it should be investigated whether an open definition of a similar data structure is available in the cross-public sector repositories and whether it can be used to advantage. If this is not the case, the reasons for this should be documented and the data formats used should be defined and provided to the common repository (infostructure base).
- A general *specification of the solution, including the functional components (application components)* should be drawn up, justifying the choices. For all components, it should be investigated whether a similar solution is available in cross-public sector repositories and whether it can be used to advantage. If this is not the case, the reasons

for this should be documented and the alternative choice provided to the common repository.

- *The planning of the IT infrastructure* must be based on a number of justified choices between *solutions that are specific to the given system* and *services that can be used by different applications*. Common infrastructure choices can either be implemented in a uniform way (but independently) in the individual systems, or they can be implemented under common management as infrastructure services that are used by a large number of public sector IT systems.

In relation to the final point, in both cases the purpose is to enhance the coherence between the public sector IT systems while also reducing the costs of developing equivalent solutions. The IT infrastructure services that are made available to IT systems in the various areas must be provided via a range of standardised, open interfaces. Thus, it is especially in determining the *infrastructure's* architecture that the use of open standards is relevant. The use of standards must be prioritised on the basis of a central assessment of the standard's relevance and maturity, and its position on the market, as well as a local assessment of the need for interoperability with other systems within the lifetime of the given solution.

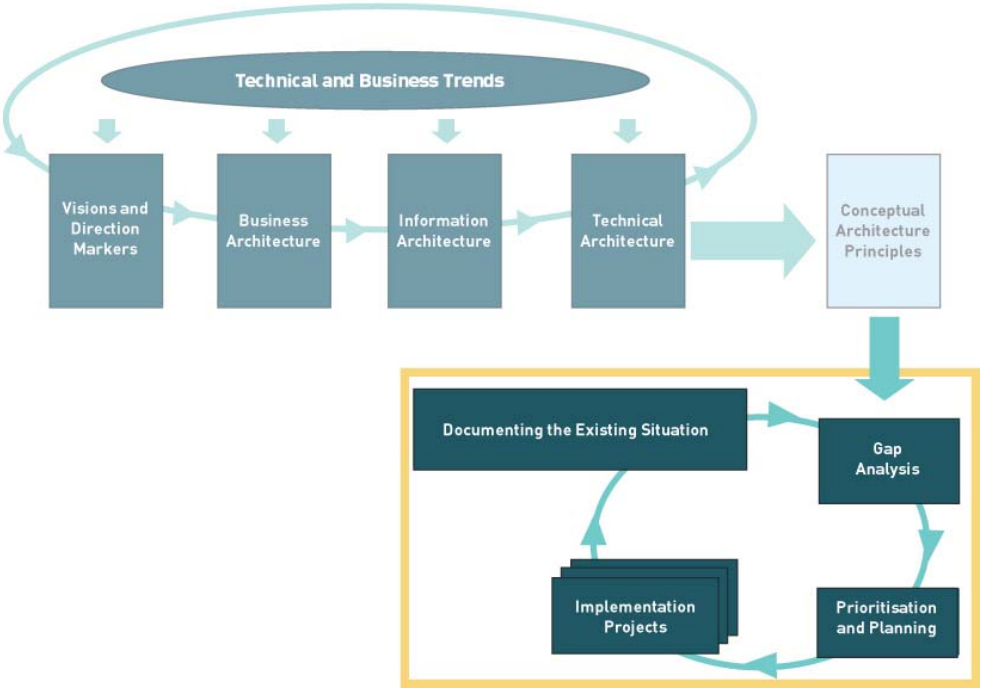
6. STANDARDS AND SOLUTIONS

In order to promote the development of a national enterprise architecture framework, we recommend introducing a range of initiatives, including:

- Development and concretisation of architecture principles.
- Organisation and definition of infrastructure solutions.
- Setting up and maintenance of a reference profile of standards and technologies used in e-government.
- Setting up and maintenance of security architectures.
- Setting up and maintenance of information architectures.

These initiatives are necessary to build a bridge between the framework and the specific implementation. The following figure illustrates the implementation work within the frame in the bottom right-hand corner.

Figure 9: Implementation of the enterprise architecture



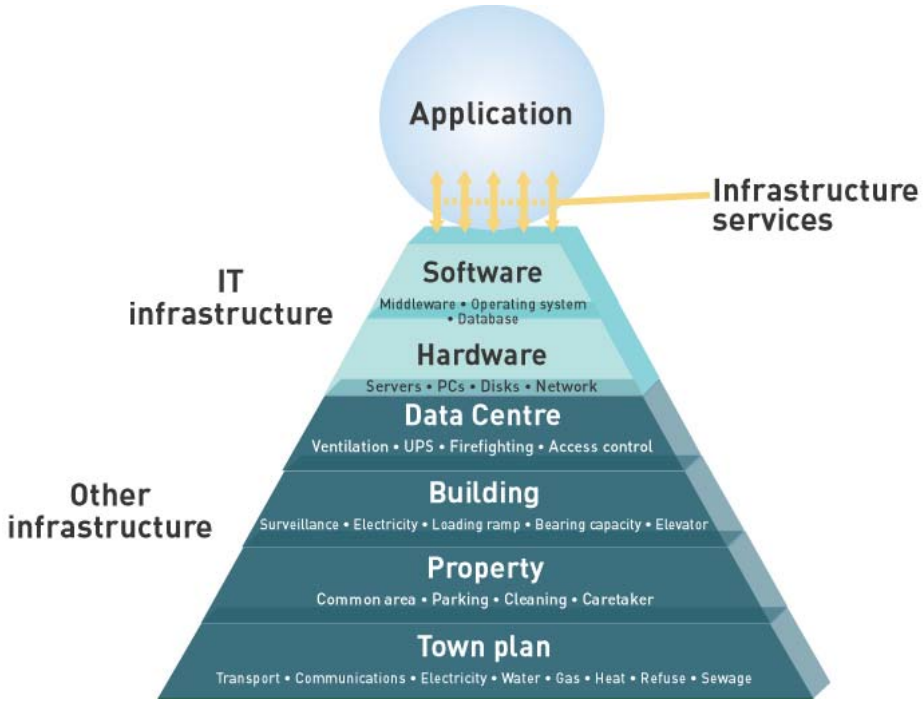
The work centres on establishing common references and tools for the architecture process, as well as implementing common solutions to demonstrate the value of a common enterprise architecture.

6.1. Infrastructure solutions

As in town planning, the term infrastructure is also used in connection with IT planning. The IT infrastructure provides a number of services that are generic for a group of IT systems, for example

general printing or storage functions. The following figure illustrates how the IT infrastructure forms the base for the application at the same time as being supported by the rest of the infrastructure such as the building's physical framework.

Figure 10: The IT infrastructure is the base for the application



Where we define IT infrastructure as *services without business logic*, we have at the same time defined it as a part of the systems that can be reused across the various civil service units. However, the IT infrastructure is not just important as a common platform for implementing different functionality. It also plays a central role as an integration platform. Within the IT infrastructure the standardised interfaces are established that make it possible to interconnect different administrative systems. It is also in connection with the development of the IT infrastructure that the choice of technical standards is vital for creating interoperability between the systems.

The IT infrastructure has two main purposes: firstly, it must form a common platform for the working out of the business logic to give quicker, cheaper and less risky IT projects, and secondly it must form a common framework for interoperability between the systems.

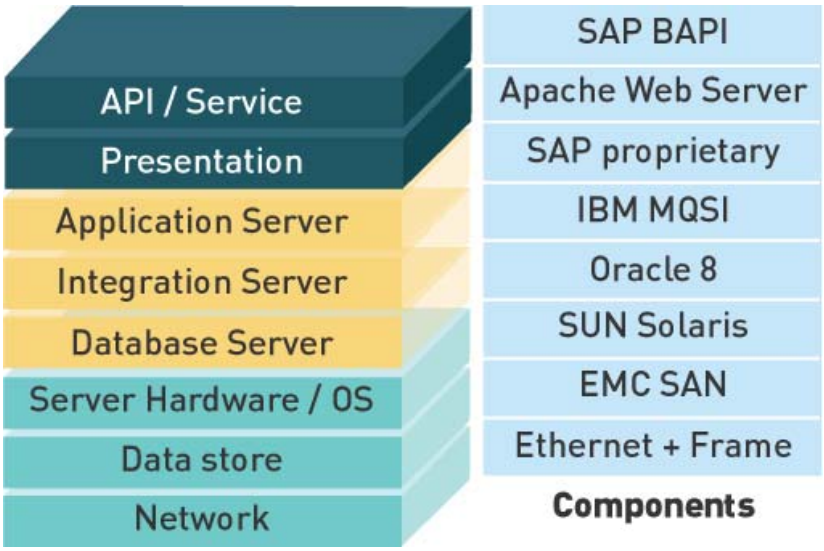
However, the tasks of the civil service are nowhere near sufficiently uniform to be supported by one common IT infrastructure. Differences in the application scenario or geographical distribution, or in the information structures used, require different services from the IT infrastructure. On the other hand, there will be situations where very different systems make the same basic requirements of the IT infrastructure. There is thus a need for a controlled diversity of infrastructure solutions. The specific infrastructure solution must be

linked to the others by well-defined integration mechanisms so that they are integrated in advance and together can support the need for coherence between the civil service's administrative applications. Organising and planning the IT infrastructure is a central task of the enterprise architecture and the following sections propose how the benefits of a harmonised IT infrastructure can be achieved.

Patterns

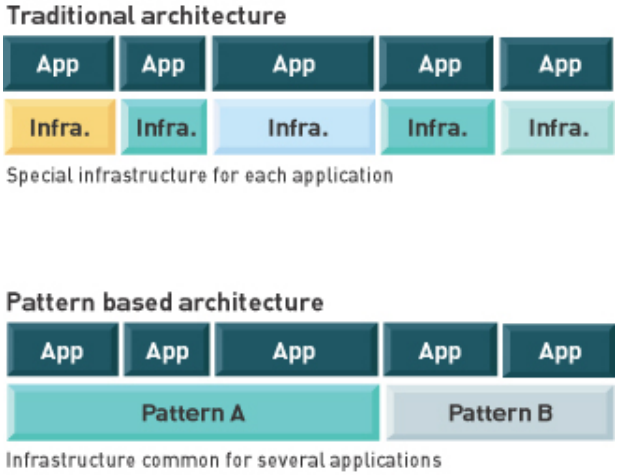
The infrastructure can be organised and defined as patterns, i.e. standardised definitions of requirements, components and services that together form the necessary, adequate infrastructure for a given application/business logic. The following figure illustrates the general definition of an infrastructure pattern in the form of a layered classification of the functions and a list of the technical components in each layer:

Figure 11: Example of an infrastructure pattern



By organising the infrastructure into patterns with uniformly defined components and features, this part of the IT system can be reused for a range of applications making the same requirements of the infrastructure. The following figure illustrates the principle of pattern-based infrastructure planning: instead of setting up a separate infrastructure for each application, the infrastructure is developed as a set of patterns, each supporting several applications:

Figure 12: From traditional architecture to pattern-based architecture



In order to be able to support a broad spectrum of applications, it will be necessary to set up a portfolio of infrastructure patterns. In compensation, each pattern in the portfolio will be able to support a whole class of applications and thus give major savings in the development of the infrastructure.

Patterns are defined not just by their technical components, but also by many other concrete parameters, for example their features and potential application areas.

Common infrastructure

In order to ensure interoperability between the civil service's IT systems, it will be expedient to implement parts of the IT infrastructure as cross-public sector solutions, while other parts can be set up as more limited common solutions servicing a sector or focus area. The breadth of such implementations will often be determined by the operational circumstances or the sector's specific functional needs.

The setting up of common IT infrastructure solutions can in principle be divided into two categories:

1) Services that do not have specific business logic (e.g. communication functions) should be implemented as part of the infrastructure and must observe a common specification of the functionality with well-defined, open interfaces to the applications and the outside environment.
2) Services that have business logic can be located in connection with the individual systems or as independent applications implemented under common management. This will be the case, for example, in specific gateway or broker services.

The difference between infrastructure services and common applications can be defined in brief as follows. If a common system offers a differing service to the parties it serves and thus has business logic, this is considered as a common *application*. By contrast, a system that offers the same service to all parties can be designated a *service*.

In a collaboration of services and applications, it is essential that control over the common functionality is maintained by a circle of stakeholders, both with regard to flexibility in terms of new administrative processes and to avoid dependency on external suppliers.

Services that are implemented in the infrastructure must satisfy the agreed requirements for function and operation. On the other hand, how such a service is realised is not crucial for the user organisation and it will therefore be possible to outsource it. If there is a need for adjustment to the service, the specification may be updated and the service renegotiated.

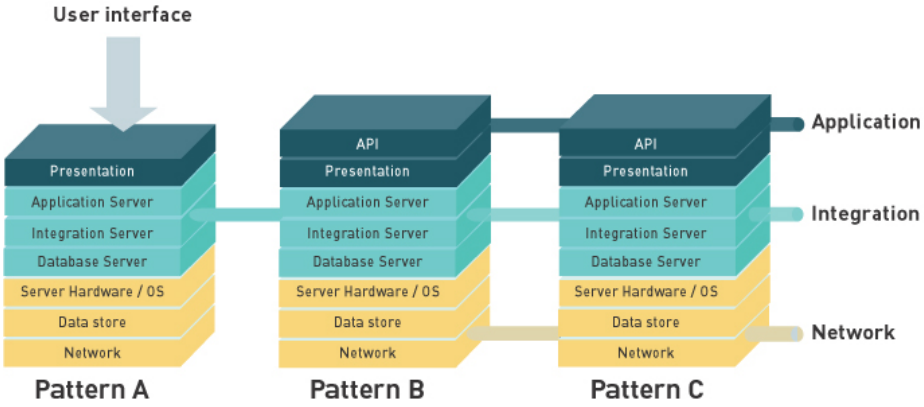
It is a different matter with a common application, e.g. in the form of a broker function, that is part of a public sector work process. Here it is of major importance that the function's architecture is known and managed by the relevant civil service units since this is the only way to ensure that the function will be adaptable to future administrative processes. If such a function is outsourced, the user organisation should itself acquire the rights to the business logic to avoid dependency on an external supplier. The business logic may, for example, comprise distribution lists, sets of rules or network addresses. If the administrative process has to be changed, there will be a need to change these logical components.

6.2. Technical standards

Effective e-government that offers citizens optimum service depends on information being able to flow freely within the civil service – freely in the sense of without technical barriers, but obviously in accordance with applicable legislation in the area.

A central architecture consideration relating to the setting up of an IT system should be how the system can interoperate – converse with – other IT systems. This aspect is related to the infrastructure work in the sense that in reality this is where the framework is established for how a pattern can be built up and designed. It is therefore of prime importance that a common platform is established in this area in the form of a reference profile in which it can be checked which technical standards a given pattern has to support.

Figure 13: Common choice of communication patterns



The reference profile recommends the technical standards that form the basis for the communication between the patterns and their environment. In the figure, this is illustrated using transverse pipes. Common choice of communication patterns ensures that different systems can communicate with each other.

The convention should be operationalised by making a central authority or committee responsible for setting up and maintaining the reference profile. The reference profile is by nature a strategic means of achieving interoperability and standardisation gains in the longer term, which is why the initiative must also be handled accordingly, i.e. as a long-term strategic effort managed and supported through processes that ensure continuity.

The reference profile

The reference profile will include definitions of and an opinion on selected standards, technologies and protocols that are required to be used and supported in setting up e-government in Denmark. By establishing a convention on which standards are to be supported in individual patterns, we will achieve the streamlining, service improvements and savings that are the target of e-government.

In introducing the reference profile, it is important to define whether it is to function as a positive or negative list, and whether it is to be recommendatory or prescriptive/proscriptive. In principle, the government could use the reference profile politically to control the market in detail – as in Germany, where their e-GIF (SAGA) prescribes the use of Java and Linux. The government has thus controlled the market with a visible hand.

We recommend that the reference profile should clearly define its function and the choices that are made. The reference profile should be prepared and updated on the basis of consultation and open dialogue with the market. It should also be coordinated with international work on the *e-GIF*, e-Government Interoperability Framework, including within the EU.

The purpose of the reference profile is to provide an overview of the status of current and upcoming standards, and to present general assessments of the situations in which a given standard should be supported. The reference profile should be divided into categories of standards, as set out in the following table for example.

User interface	Interface for presenting to and communicating with people; i.e. the interface a person will experience when interacting with systems (including e.g. accessibility for handicapped users).
Document and data exchange	Data formats and technologies for data exchange between people and/or systems and people.
Web-based services	Technologies for establishing services via networks – may be relevant in connection with establishing web-based services and other functional links between systems in real time.
Content management metadata definition	Concept system for setting out and defining data.
Data integration	Data formats and technologies for data exchange between systems.
Specifications for interconnectivity	Basic technologies for connecting and establishing services via a network (the Internet).
Network	Defines the physical connections' characteristics. This is the only layer that sends bits from one computer to another.

Each category will include a definition of relevant standards structured according to a general template, based for example on the following classification:

A **component** may be a technology area or a specific technology or protocol that is or can be used in e-government. An example of a component is 'security', which is a high-priority area in connection with the realisation of the vision for e-government in Denmark. A category may contain one or more components with associated subgroups.

Subgroups are normally specific technologies or protocols that are or can be used in e-government. An example of a subgroup of 'security' would be *IP security*.

The **definition** of a component or a subgroup is normally the technical designation. For *IP security*, the designation would be 'IP-SEC RFC2402/2404)', which gives the technical name and reference to the RFC specification of the component or subgroup.

Status is the statement of the component's or subgroup's usability following assessment by the relevant, competent body in relation to the implementation of e-government in Denmark. The assessment must reflect both the standard's maturity and the application scenarios in which it is relevant, recommended or required to observe the standard.

The **notes** are where the component's or subgroup's functionality is defined and where the considerations behind the status indication are discussed.

6.3. Information architecture

Danish central, regional and local government have agreed to use XML as the common exchange format. The methods and principles recommended by the XML Committee can also be used for internal data exchange and system integration.

The common XML work comprises two sub-projects:

- The aim of the **standardisation process** is to specify standards in XML for exchanging data between public authorities and between public and private institutions.
- The **infostructure base** is a database containing information on the content of public databases and information on how to access this data.

Part of the standardisation work involves the preparation of a number of 'cookbooks':

- **Implementation cookbook**: a guide for project managers covering all the other cookbooks.
- **Modelling cookbook**: Modelling principles in UML (*Unified Modeling Language*) presented through a specific case (sickness benefit payments) and mapping rules that govern mapping from the UML model to the *XML schema*.
- **Standardisation cookbook**: a guide to the principles that apply to the standardisation of interfaces using the infostructure base.
- **XML schema rulebook**: rulebook for developing XML schemas so that they can be incorporated in the cross-public sector data model.
- **Integration cookbook**: a technical guide covering topics such as protocol choice, security and versioning of services.

A permanent XML Committee has been appointed reporting to the *Coordinating Information Committee* and, through this, to the *board of Project E-government*, which is consulted on theoretical problems and recommendations. The XML Committee is responsible for ensuring coherence and initiative in XML standardisation across the public sector. The committee appoints working groups to undertake standardisation in different prioritised areas.

6.4. Security architecture

Structured handling of IT security is regarded as a crucial parameter for expanding e-government. However, security is not just a component or a product that can be added to the finished solution to meet business requirements. The security requirements must be

considered in the architecture process from the vision stage as basic design criteria for the security architecture.

A precondition for coherence in the security area is that requirements and solutions are defined using a common concept and coordinated at the general level. Security must be managed on the basis of principles (rooted in security policy, legislation and rules) with both technical and organisational elements. The security architecture defines the general organisation of the security functions and specifies the features of the solutions so that they satisfy the vision. This means, for example, that the architecture defines what functions and methods are used to identify a user or protect information against loss or corruption.

A common framework for the security architecture should cover several areas:

- A detailed risk analysis is vital for the choice of security architecture and security solutions. This describes the threats for which protection must be provided and assesses what efforts would be suitable for investing in protection. It is recommended that the public sector uses common principles for this analysis.
- Conceptually, security features can be organised as e.g. identity, isolation, access control, accessibility, and integrity. A common conceptual approach for this is a prerequisite for uniformly defining security needs for different systems. It is therefore recommended that a common framework should clearly define these concepts.
- In order to be able to choose security measures that match the given risks, it is necessary to organise security needs using a common concept. It is recommended that the public sector uses common concepts and classifications (e.g. user roles and data sensitivity) as a basis for allowing interoperability where sensitive information is involved.
- Specific security solutions cover both technology and procedures (rules) and only through a combination of hard and soft elements can the required security level be maintained. There is therefore a need for a common framework for how to assess the features of the security solutions.

A service-oriented architecture divides an application into a number of services that work on behalf of other services or on behalf of a user. This places special requirements on the security handling of the interplay between the different services. In future, far more data will be handled in heterogeneous systems with their own security solutions. The task is to create security from start to finish, regardless of what route the information takes.

Security is a part of information technology in which the integration between specific solutions is still at a very low level, and real interoperability therefore requires a major coordinating effort. A coherent enterprise architecture, which includes security, can save public sector organisations investing in stand-apart solutions that will

be a barrier to interoperability because their security concepts are non-compatible.

International standardisation work is attempting to define how to create a security terminology that can unite existing, non-compatible technologies. It will be an important part of the ongoing work with public sector enterprise architecture to follow and influence this work.

7. COMMUNITIES OF PRACTICE AND ARCHITECTURE COMPONENTS

Communities of practice working with common methods, tools and standards are important for supporting better coherence. With a common reference framework, communities of practice with representation from various public authorities can utilise the potential in reusing everything from agreements and business processes to data models, applications and infrastructure.

Communities of practice should be understood here as collaborations between parties that, having common tasks and interests, enter into collaboration. For example, this may take the form of a service collaboration in which the players wish to coordinate and harmonise their servicing of citizens or internal administrative tasks. A community of practice can support the development of common solutions and common standards, knowledge sharing and resource sharing. Communities of practice can thus be seen as another form of learning systems that cross administrative boundaries.

Individual authorities may take part in many different communities of practice. Project E-government entails so many challenges for both the communnity at large and individual authorities that there are major gains to be made not just in standardised interfaces, but also in collaboration on a range of the building blocks needed to construct solutions. This way of thinking has a long tradition, for example in the health area, where *Medcom* is a good example. The national XML project reflects a further development of this way of thinking and a broadening of perspective. The tools that are developed in connection with the national XML project, including the InfoStructure Base, which is a repository of common data definitions and represenations, have the job of supporting the cross-sector exchange of information throughout the public sector.

The idea of communities of practice is not limited to Danish authorities, but should also cover private organisations and companies, including suppliers, as well as foreign authorities. The term itself is based on the common denominators that can be defined in connection with executing practical work.

Architecture work should therefore have as broad an outlook as possible both locally and nationally. Collaboration with the private sector is often vital for success, and the same applies increasingly to international collaboration.

7.1. Portfolios of architecture components

The purpose of enterprise architecture is to organise the components of a given IT solution in such a way that the needs of the civil service units for IT support of work processes can be met optimally in terms

of efficiency and quality. This means that the IT functions must meet the relevant requirements, while the costs are being reduced as much as possible.

When assessing costs, the entire life-cycle of the IT system should be considered and all the planning and design costs should be included, through implementation and testing to operations throughout the system's lifetime. In such an assessment, it is extremely important whether the system builds on components with known features – or whether the system is designed solely on the basis of a theoretical proposal.

As support for architecture work, we recommend *organising a range of common components* so that they can be reused in various contexts. Basing architecture work on well known solution components reduces time and effort significantly in the design phase, and also reduces uncertainty in subsequent implementation. When the system is later put into operation, there are many major benefits to be derived because the running can be arranged on the basis of experience with other systems incorporating the known components.

At national level, in individual sectors and in individual projects, it is possible to reduce costs and increase practical value by reusing common architecture components.

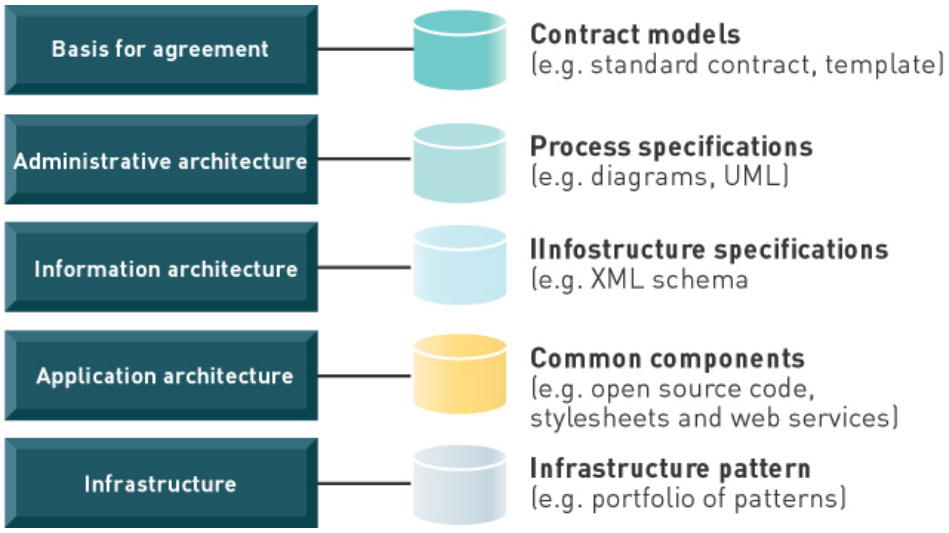
When a specific IT system is to be realised, it will often be necessary to balance the local need for custom built solutions with the benefits of using common specifications, data structures and functions. Even in cases where the application requires a new development that is not compatible with existing solutions, there will still be major benefits in allowing the newly developed components to be included in a common repository so that they can be candidates for reuse in a new area.

In relation to enterprise architecture work, we use the term *architecture component* to designate a number of different components involved in different stages of the architecture process. The common architecture components are divided into the following categories:

- Basis for agreement, e.g. agreement components and clauses.
- Administrative architecture, e.g. process specifications in the form of UML diagrams.
- Information architecture, e.g. data definitions defined in XML schemas.
- Application architecture, e.g. business logic components that can be reused.
- Infrastructure, e.g. definition of infrastructure in the form of patterns.

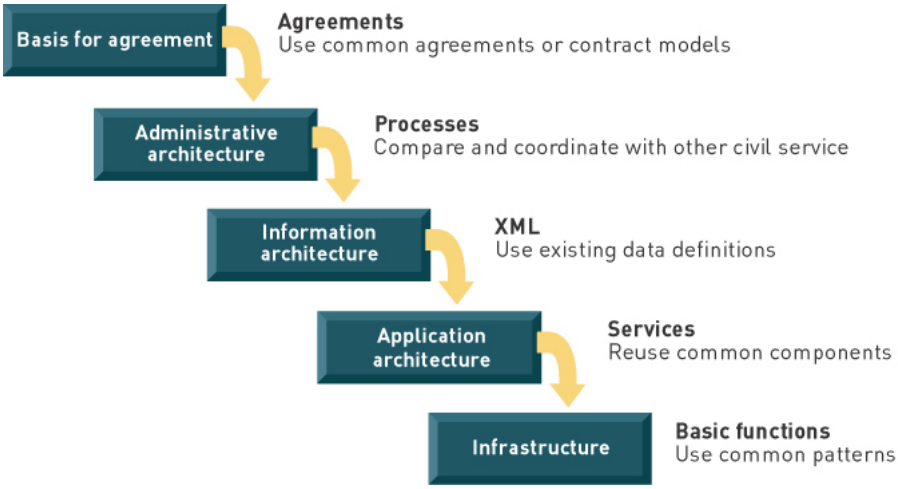
In the following model, the five categories of architecture component are arranged according to where they occur in the architecture process. Each category is assigned a database in which the common components are stored and defined so that they can be reused in other IT solutions.

Figure 14: Architecture components



The following model is used to show how communities of practice and standardisation support the individual authority and can contribute to quality assurance and savings for the individual authority and for the collaboration.

Figure 15: Communities of practice support the individual authority



A specific case can illustrate the importance of this, i.e. the administration of sickness benefit. A digital solution is envisaged that allows data to flow more easily between the players involved (employer, employee, authority, doctor, etc.). With this starting point, it is envisaged that at each stage of the architecture process a number of questions are answered and solutions documented, for example:

Agreement:
Who is responsible for what? (data arrival; forwarding the form; security; process completion; archiving)
Process:

What form does the process take? (what is the optimum process?; are there alternatives?)
Information:
What data has to be exchanged? (data definitions; where is the data?; data quality; classification systems)
Application:
What components should be used to handle and present data and functionality? (program module; service)
Infrastructure:
What technical infrastructure is needed to support the digital process? (server; technical handling of security, etc.)

The following sections describe the possibilities of reusing architecture components on all five levels.

7.2. Common contract models

An essential part of the challenge of integrating systems in the civil service is the setting up of a basis of agreement to regulate responsibilities and entitlements relating to the information and functions involved. Here there will be major benefits in setting up a collection of common contract models. This forms a common set of rules for access to information or use of services that are made available for/by another party. A common set of rules will be valuable both in respect of common public sector services and collaboration with suppliers and collaboration partners outside the public sector.

The following table gives an overview of the potential benefits of drawing up and sharing contract models:

Collaboration on…	Local perspective	Common perspective
Actual development process	Can be of strategic importance in terms of e.g. being able to work with systems and players, including currently unknown parties. Makes integration work easier.	If data definitions can be reused by others, this makes the general integration work in the public and private sectors cheaper and easier.
Standardisation work	There will often be great interest in coordinating and influencing other players to not end up in a blind alley.	A crucial precondition for realising the visions for e-government, including the user/citizen at the centre, service collaborations and data sharing.
Sharing data standards	Opportunity to use the data definitions and schemas of others and for them to use yours.	Facilitation of sharing of data standards to ensure quick and effective implementation.

7.3. Common function definitions

Some civil service units use comparable or even identical work processes because they perform the same function for citizens. This gives them the opportunity to reuse the general definitions of administrative processes, or just common parts of it, such as the issuing of a payment or the sending of a letter to a citizen's address. By collecting these process specifications in a common database in a structured form, the specification of requirements for system procurements will become much simpler and future systems will be far easier to integrate because they are functionally closer to one another. They will also be able to form the basis for developing relevant model specifications, e.g. in UML.

The following table gives an overview of the potential benefits of drawing up and sharing function definitions:

Collaboration on…	Local perspective	Common perspective
Actual development process	Many organisations miss out here. The opportunity to learn from your 'neighbour' can be very valuable, especially for small organisations of which there are many of the same.	Opportunity to reuse analyses and specifications. This requires a lot of work and so resources can be saved. Common development will also facilitate quality assurance.
Testing of the quality of the process and the specifications	Increased safety in being able to compare. Can be used more easily for benchmarking when following the same method and making results available to one another.	Necessary assurance of common understanding and, if necessary, common handling of specific processes and sub-processes.
Coordination of process elements	Increased confidence in respect of collaboration partners if you know how they handle processes.	Crucial parameter for establishing close collaboration business-wise, process-wise and technically.

7.4. Common data models

A precondition for ensuring interoperability between different civil service units is access to common models for the data to be exchanged. This can be achieved by setting up a common database of data definitions such as that already realised in the *infostructure base* (ISB). This provides for recycling in other implementations and will pave the way for continually improved integration between the systems.

The following table gives an overview of the potential benefits of drawing up and sharing standardised data models and definitions.

Collaboration on…	Local perspective	Common perspective
Actual development process	Can be of strategic importance in terms of e.g. being able to work with systems and players, including currently unknown parties. Makes integration work easier.	If data definitions can be reused by others, this makes the general integration work in the public and private sectors cheaper and easier.
Standardisation work	There will often be great interest in coordinating and influencing other players to not end up in a blind alley.	A crucial precondition for realising the visions for e-government, including the user/citizen at the centre, service collaborations and data sharing.
Sharing data standards	Opportunity to use the data definitions and schemas of others and for them to use yours.	Facilitation of sharing of data standards to ensure quick and effective implementation.

7.5. Common components and services

At application level, most projects will be based on a standard development environment with administration-specific functions implemented as special components or services. Many systems in the civil service perform functions that are essentially identical. There is therefore great potential for recycling custom built components, which can be realised if each project contributes by placing a copy of the new/adapted components in a common repository where other projects can obtain the source code or design.

The following table gives an overview of the potential benefits of drawing up and sharing components and services:

Collaboration on…	Local perspective	Common perspective
Actual development process	Can be of strategic importance in respect of i.a. using more suppliers and avoiding lock-in. Also makes integration work easier.	If the code can be reused by other authorities, development costs and time can be saved.
Testing of the quality of the component/service	There will often be major interest in a third party being able to test/carry out reviews.	A typical large-scale benefit can mean that collaboration is a relevant framework, but it is obvious to hand over as much as possible to the market.
Sharing the source code	Interest in being able to use the source code of others, for example in the form of expansions of your own applications.	Facilitation of sharing of open source code and collaboration.

7.6. Common infrastructure patterns

At the lowest level, there is potential for recycling infrastructure solutions made up of a large number of standard components that are already integrated. The infrastructure has no business logic, but offers the general services that the applications use when the business logic

is implemented. A typical infrastructure service may be identification of a user.

The infrastructure can be organised and defined as patterns, i.e. *standardised definitions of requirements, components and services*, which together make up the necessary and adequate infrastructure for a given application. By organising the infrastructure in patterns, this part of the IT system can be reused for a range of applications that require the same operational features of the infrastructure. To be able to support a broad spectrum of applications, it will be necessary to build up a portfolio of infrastructure patterns. In compensation, each pattern in the portfolio will be able to support a whole class of applications and thus give major savings in the development of infrastructure solutions.

The following table gives an overview of the potential benefits of collaboration relating to infrastructure patterns.

Collaboration on…	**Local perspective**	**Common perspective**
Actual IT investment	Expenses, risk and benefits are borne and reaped locally as far as possible. If the collaboration can offer competitive solutions, they will be preferred.	The collaboration should only be involved where it is strategically important. Alternatively, the collaboration can be supplier for the local unit.
Testing and quality assurance of solution elements and products	A resource-intensive task that should ideally be avoided, but may possibly be a requirement for a supplier in specific cases.	A typical large-scale benefit can mean that collaboration is a relevant framework, but it is obvious to hand over as much as possible to the market.
Drawing up of patterns	Motivation for developing patterns for own portfolio management, but only if the needs are known and it is deemed beneficial. Possible motivation to contribute to the collaboration.	Major benefit in getting patterns developed that can be used by many.
Sharing of patterns	Interest in using patterns with 'declared' features. Willingness to pay if there is practical value.	Major benefit in facilitating sharing of patterns and collaboration.

8. COORDINATION, COMPETENCIES AND COMMUNICATION

The most important aspect of the public sector enterprise architecture work is that it is tackled in a coordinated way. If the objectives for e-government are to be met, this will require a number of enterprise architecture decisions coordinated across authorities and sectors.

A common framework for enterprise architecture makes the architecture choice much easier because individual projects can take their starting point in the common choice of standards and draw on the experience of other public sector IT systems. The specific solution can also be based on components and structures that are tried-and-tested and have well-defined features.

A common enterprise architecture framework will ensure optimum usage of resources, so it is essential that all IT decision-makers utilise the benefits of choosing common architecture elements, both in the form of functional components and services and in the form of common infrastructure solutions, to optimise the individual administrative systems and create coherence between them.

The following suggests how the roles can be divided, how we can ensure the necessary development of knowledge and competencies in decision-makers, and how we can work with common management tools.

8.1. Coordination

Architecture and management on several levels

As is clear from the above, it will be expedient to define and optimise enterprise architecture on several levels in the same way as for physical buildings. The division will have three levels:

- General level: nationally or internationally.
- Collaboration level: by sector, service or focus area.
- Local level: individual authorities, institutions or projects.

Enterprise architecture represents the coherence between the business/political objectives and the general organisation of the IT systems. It should be managed according to the principle of subsidiarity, i.e. decisions should be taken at the lowest possible political/administrative level and should only be taken at a higher level if necessary for greater cooperation.

As a consequence of this principle, architecture decisions relating to cross-functional initiatives should be taken by the parties involved taking into consideration the higher levels.

This means, for example:

- that the government or a cross-public sector body with the necessary competence at national level can stipulate national architecture principles;
- that public authorities at central, regional or local level may, on their own initiative and possibly jointly (or with private players), lay down more detailed architecture principles in the given area.

The following table seeks to classify the architecture principles:

Architecture level	**Who takes architecture decisions**	**Coverage area**	**Focus**
General level	E.g. board of Project E-government, the Coordinating Information Committee or the Enterprise Architecture Committee, depending on how fundamental and far-reaching the decision is.	Covers the whole of the public sector. Can in principle also apply to collaboration with suppliers and partners.	Will typically be oriented towards general frameworks for interoperability and security and common services/infrastructure.
Collaboration level	E.g. a steering group for a service collaboration or a cross-regional collaboration.	Can be composed across central, regional and local government and possibly with private parties.	Will typically be oriented towards necessary observance of common standards to ensure operational solutions.
Local level	The individual authority or institution itself decides the competence distribution.	Can e.g. be a municipality, county or ministry. In the latter case, the department, agencies, etc., can be seen as separate or as a corporate unit.	Will typically be oriented towards economy, efficiency and general target management.

At national level, in individual service collaborations and in individual authorities, it is important that strategic decisions on IT use are taken on the basis of constructive collaboration between management and IT specialists.

This means that the IT organisation must take responsibility for the technical choices that are expressed in the enterprise architecture and their consequences in such a way that the balancing of benefits, economy and risk can be carried out by the civil service management to give a reliable decision.

Looking at individual projects, there will normally be three primary players that together have to quality-assure the enterprise architecture:

Civil service units and institutions:
The senior management has the role of sponsor for the IT system, owns the business processes, and defines the business requirements for functionality, capacity, etc.

IT organisation:
Optimises the general structure of the IT solutions taking into account central and local requirements.

Suppliers and partners:
Have many roles and forms of collaboration at both infrastructure and application level.

The Enterprise Architecture Committee and competence pool

To ensure implementation and management of the national architecture framework, it is necessary to establish a common public sector body for this purpose. The working group recommends the setting up of an Enterprise Architecture Committee.

As part of Project E-government, the committee should report to the Coordinating Information Committee and, through this, to the board of Project E-government.

The Enterprise Architecture Committee should comprise experts from the public sector. It should also be considered how representatives of the private sector can be involved in the architecture work in respect of:

- Securing the required expertise.
- The need to create coherence between public and private sector IT use.
- Public sector collaboration with IT suppliers.

It should be ensured that the committee covers a wide and relevant field of expertise. The committee should be composed so that there is a good balance between IT competencies and business. At its meetings, it should be possible to supplement the committee with expert assistance, specially invited guests, etc.

The committee will need the support of a secretariat. A competence pool should also be set up based on a small core in the form of the secretariat and a network of relevant experts in the public authorities, the research world and the private sector.

The committee and associated support functions must take care of the following primary tasks:

- Developing and maintaining common concepts, methods and principles.
- Giving recommendations on the use of relevant standards.
- Giving recommendations on the development of common infrastructure services.
- Advising on the implementation of general decisions on enterprise architecture taken jointly by central, regional and local government.
- Contributing to the further planning of specific initiatives.
- Facilitating the sharing of knowledge and experience.
- Administering any central funding.

The following may be cited as specific examples of activities connected with architecture work:

- Establishment of a general framework for training and certification.
- Knowledge sharing, collaboration and consultancy relating to specific projects.
- Planning of a common public sector IT infrastructure with common services.
- Definition/publication of common architecture elements, including portfolios of contract models, process specifications, infostructure specifications, business logic (application components) and infrastructure solutions.
- Assistance and advice to players in decentralised processes relating to enterprise architecture.
- Quality assurance of decentralised decisions relating to enterprise architecture.
- Making known results and benefits.

Any architecture work must take into account the current circumstances. We currently lack an adequate overview of the overall public sector system portfolio. We therefore recommend the setting up of a framework for a formalised gathering of knowledge in this area. A positive side effect of this will be the identification of a number of future-oriented projects, some of which will undoubtedly be able to serve as *best practice* models for other solutions, and some of which will in the long term be included as *common components* in the overall public sector enterprise architecture. This data gathering will also be able to serve an important function in the coordination of public sector IT projects.

Benchmarking

The main aim of the enterprise architecture process is to improve the efficiency and quality of public sector IT use.

In order to make known the results of a collaborative effort for a common enterprise architecture, it is necessary to establish a common model for benchmarking public sector IT use. Benchmarking means measuring and comparing a number of specific parameters that indicate the value of a common enterprise architecture. Work has been initiated on benchmarking within the government's IT policy.

The results of the benchmarking initiative will not just be used to assess established solutions and make known their development over time. Through systematic gathering of experience, a common benchmarking method will also be of great value as a model in budgeting the costs of planned initiatives, including comparing alternative scenarios for establishing new solutions and modernising existing ones.

A common method for benchmarking IT use in central, regional and local government − naturally with freedom to expand according to specific needs − can be a very useful tool for both individual authorities and for collaborations. The methodology should include a common framework for measuring the maturity of the architecture work, as well as mapping and analysing existing IT solutions.

8.2. Competencies and communication

In order to ensure propagation of the common principles, methods and processes, there is a need for both communication and competence development. One of the main tasks of the Enterprise Architecture Committee and its secretariat will be to ensure extensive promotion and marketing of the concept of enterprise architecture.

Existing projects and activities in high-priority sectors are a useful starting point. There should be sparring for running projects, perhaps in the form of an active review of the architecture for public sector IT projects. The general modus operandi should be facilitative, not regulating or controlling.

There should be a highlighting of projects with good enterprise architecture and of IT solutions that have been designed in accordance with the issued guidelines and standards (reference implementations), as well as an emphasising of the benefits that have been achieved and an open, serious analysis of problems and challenges.

Enterprise architecture should be promoted as a discipline, with focus on the overall process of *enterprise-level, government-wide architectural IT-decisions driven by business needs.*. Enterprise architecture is not a common subject at universities or in other educational contexts. An important task will be to set out and take part in implementing competence-generating training elements, typically under the auspices of existing educational and further

educational establishments. The common public sector principles and methods for enterprise architecture should also be disseminated in the education sector with a view to incorporation in relevant educational programmes. To this end, dialogue should be initiated with higher educational establishments and other relevant organisations with a view to establishing a certification scheme for IT architects so that they have a common knowledge base. Genuine certification is considered to be an important incentive if we are to quickly achieve visible growth in the number of IT architects in Denmark. We therefore recommend that this work be given high priority.

In order to promote the visibility of the public sector work to harmonise enterprise architecture, institutions and companies that have certified IT architects should be made known, and projects that are based on a good architecture should be brought to public awareness.

As well as more specific technical competencies, there is a need for a broad understanding of the relationship between administrative/business management and optimisation of IT investments. It is necessary to motivate the political, administrative and commercial players to support a common framework for managing enterprise architecture. This also applies to the private sector in the role of supplier, collaboration partner and consultant for the public sector.

It is therefore important that activities are carried out to ensure the spread of knowledge, understanding and acceptance of the work that has to be initiated and of the concepts and methods that have to be put into use. On this basis, we should set up a *forum for enterprise architecture*, i.e. a professional supplement to the Enterprise Architecture Committee and part of the competence pool. Such a forum will help to facilitate the sharing of knowledge, experience and tools across organisational boundaries. The target group for the forum is, in addition to IT architects in the public sector, experts in the private sector and in the research world. The communities of practice will naturally also be represented.

Annex A: Mandate for the Working Group on enterprise architecture

(Extract from the Coordinating Information Committee's mandate for the working group that has prepared the White Paper on Enterprise Architecture)

Commission
The working group will prepare a White Paper on Enterprise Architecture. The White Paper will define the framework for public sector strategies for developing an up-to-date enterprise architecture and give direction markers for implementation, including proposing specific architecture models, technical standards, etc.

The White Paper will, among other things, build upon the Green Paper on enterprise architecture that the Ministry of Science, Technology and Innovation, IT and Telecom Agency, is submitting for public consultation in September 2002 and on the answers that present themselves during the consultation.

The White Paper will be coordinated with the work on developing business processes and prioritisations under the management of the Digital Taskforce.

Composition of the working group
The group comprises 10-12 persons. The Ministry of Science, Technology and Innovation has, after consulting with the Coordinating Information Committee and the Government IT Forum, invited a relevant circle to take part in preparing the Green Paper as a reference group. It is recommended that the same group continues as the working group, but it may be supplemented with other members if the Coordinating Information Committee so wishes.
The IT and Telecom Agency will undertake the chairmanship and secretariat.

Members
Michael Bang Kjeldgaard, IT and Telecom Agency (chairman)
Jens Ole Back, Digital Taskforce
Winn Nielsen, Digital Taskforce
Michael Hald, Local Government Denmark
Jesper Nørgaard Andersen, County of North Jutland / Association of County Councils
Bo Møller, Ministry of Refugee, Immigration and Integration Affairs
Martin Pedersen, Ministry of Economic and Business Affairs
Lilian Sølbeck, Ministry of Culture
Mogens Andersen, Customs & Tax
Stig Katznelson, Ministry of Science, Technology and Innovation
Søren Bauer, Agency for Governmental Management
Søren Klostergaard Pedersen, National Railway Agency
Vagn Lauersen, Ministry of Education

Secretariat, IT and Telecom Agency:
John Gøtze
Søren Alain Mortensen
Torsten Møller Madsen
Allan Bo Rasmussen, consultant