SmartCities

ICT architecture – supporting daily life in three smart cities

An introduction to ICT architecture for city managers and policymakers

Contents

SmartCities

1. Introduction

Would you build a house without first drawing up proper layouts, designs and plans? Would it be possible to build this house in a community without having detailed plans for land use or transportation links? You cannot start laying foundations and throwing around bricks and mortar without considering local laws, regulations and guidelines, in addition to questions about the functioning and appearance of the building and its place in the local environment.

National and local governments are finding this is also true for e-government initiatives. There is no point in throwing together a website and stuffing it with information – creating e-services that are difficult to find, complicated to use or unwanted by citizens is a big waste of time and money.

1.1 Why I-architecture?

You need a strategy, you need plans, you need some kind of blueprint that steers and supports the development of e-services. This framework, which we call an I-architecture, is not just about the ICT infrastructure you need to build online municipal services, but sets out all the structures – business processes as well as technology – that an organisation needs to roll out effective e-services.

In September 2010 the Smart Cities project held a meeting on I-architecture in Karlstad, Sweden. This meeting highlighted the role of ICT architectures as essential mechanisms for realising Smart Cities' goal of developing and delivering better customer services.

The participants in the Smart Cities project appreciate the importance of architecture; architectures are helping them to design e-services, focus on process oriented working, and select the most appropriate ICT to deliver these e-services to their citizens.

1.2 Why this publication?

Smart Cities has produced two publications about I-architecture and its role in the development and support of e-services. This first publication is written for municipal business managers, and managers and employees of ICT departments in local government. It complements the second, more technical and theoretical architecture publication which discusses various ICT architecture concepts and the value that an ICT architecture brings to an organisation.

This publication has been written by three Smart Cities partners: Kristiansand, Karlstad and Groningen. It shares the knowledge and experience of these three municipalities: what their architectures look like, how to introduce an ICT architecture approach, and how ICT architectures work in practice.

1.3 Our stories

The city of Groningen in the Netherlands is probably the most advanced among the Smart Cities partners in its introduction of architecture, so this publication leads with Groningen's story. Comments and observations from the other municipalities help to put Groningen's experiences in perspective.

While the pace of architectural initiatives and their maturity may differ across cities, the one thing that unites these three municipalities is their shared belief in the importance of ICT architectures. They all believe in a process-driven, client-oriented way of working, and this is the basis of the architectures in all three locations. One day this common approach may be demonstrated in practice as an e-service developed for example in Karlstad is used in both Kristiansand and Groningen. All three partners strongly believe that day is near.

This publication begins with a brief introduction into architecture work in our three cities in Chapter 2. We then share the lessons we have learned during the decision-making process and development of the architecture framework in Chapter 3, and what it is like to work under an ITC architecture framework in Chapter 4. We give a brief summary of the key lessons we've learned and our 'top tips' for architecture implementation in Chapter 5.

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2. The ICT architecture approach: tales from three cities

2.1 Groningen

In 2005 the Dutch national government launched *'The Other Government'* – an initiative to encourage municipalities to improve their customer services. This was the first of a number of national programmes in the Netherlands that set out to enhance the development of e-services.

Groningen's municipal ICT-department soon realised that it need some kind of framework – an ITC architecture – which could support a whole range of e-services and workflows. Work on the development of an ICT architecture was approved at the end of 2005.

An external consultancy, Atos Origin, was commissioned to assist the project and to collate all the information which was required to draw up the architecture. In the first phase of the project Groningen established its five architectural principles, and agreed the overall structure of its IT-architecture. It also published a roadmap setting out how the architecture would be implemented during 2007-2009. And just as building plans show the order in which parts of building must be constructed and prioritised, the I-architecture also included zoning plans to flesh out the details of particular aspects of the architecture and their priorities.

IT architectures are complicated, so the architecture team also produced a visualisation of the architecture in order to:

• provide a framework and easy reference tool for the project team and all others involved, and

• to make it easier to communicate and explain the architecture to everyone involved and help them to see how it all fitted together.

The visual illustration of the architecture worked extremely well, and help to make the abstract concepts of the architecture 'come alive' and have real meaning for people. The Groningen I-architecture is described in more detail in Figure 2.

The project's various plans showed how the ICT architecture framework would be implemented for different municipal activities and services. Three of the plans – for customer services, digital document management and basic registrations – focused on content. The fourth plan summarised the underlying 'zoning' plans and described the architectural principles (framework) and guidelines for the municipality.

It is a common mistake to think that ICT architecture is just about IT and the technological infrastructure on which e-services run. But an architecture framework is something much, much bigger: it deals with fundamental organisational issues – including how do you structure your organisation, and what techniques and strategies do you use to embed new structures.

Starting from this high level organisational perspective, Groningen defined five principles of information architecture within their enterprise architecture framework. These principles help to shape the important characteristics of the organisation's information landscape (their 'I-landscape'). The principles help to steer decisions about which guidelines, standards and models should be followed during an architecture initiative, placing emphasis not just on efficient IT infrastructure and e-service solutions, but also other aspects such as joined up IT management (to avoid duplicate purchasing, spaghetti integration, etc.).

The five principles

1. Customer-driven

Customer services should respond to clients' demands. Traditionally, municipalities have been supply-oriented: they offer certain products and expect clients to know which product they need and what they must do to get it. Today, however, local authorities are trying to become more demand-oriented organisation.

Groningen included this principle because they strongly believe that customers – not the organisation – should be able to choose how they interact with the municipality (e.g. by using counter services, the telephone, internet/e-mail or regular mail). Many citizens like the convenience and flexibility of online services, so allowing your customers to take the lead will inevitably push the development of e-services.

2. Store once, multiple use

Groningen aims to save data in a single location in their information systems: this data may then be accessed across the organisation by different departments and for different uses. In the Netherlands it is a statutory requirement for local authorities to hold a single copy of basic registration information on people, addresses/buildings, land, companies/institutions, etc.). But Groningen also wants to apply this principle to its own internal administration of personnel and real estate.

Dutch citizens get considerable benefits from this system, because they no longer have to provide all their personal details every time they deal with government. Once a citizen's identity has been confirmed (authenticated), the government or local authority has the duty to provide access to the data which is held for that individual ('reversed burden of proof' is the phrase that is used in the context of the national programme).

For example, a citizen may log in to the municipal website via DigiD, the Dutch national online authentication system. At that point all the accessible data that is held by the municipality must be displayed. The citizen could then update their address for example - and they would only need to do this once, because any institution dealing with this individual will then access the updated data source if they need the person's address.

This principle of single, authoritative records was emphasised during 'The other Government' programme. Although the name given to this principle frequently changes, the principle that you only store information once remains a key objective for the Dutch national government.

3. Compliance

Organisations should seek to 'follow the crowd' and not to try to stand out. Instead of trying to reinvent the wheel and develop bespoke solutions, municipalities are encouraged to follow national, European and global developments in architecture. The Groningen architecture, for example, is primarily based on the Dutch national NORA architecture. This national architecture has been developed to make it easier for organisations to exchange data with each other by deploying standard procedures and protocols.

Some municipalities in the Netherlands are also collaboratively developing e-services, for example the 'Dimpact' and 'GovUnited' initiatives. Groningen chose not to participate in these efforts as:

- they would require Groningen to replace some of its existing ICT infrastructure – for example its existing document management system and content management system – which was a big disinvestment;

- the services that were under development were mostly versions of services that Groningen already had; and

- neither Dimpact nor GovUnited offer any solution for the main challenge, which is connecting front-office interfaces and back-office systems.

4. Efficient organisation

Like most municipalities, Groningen had built a number of independent information system silos, which were designed to serve one department or process – like health care provision or social services. It was difficult to make connections and exchange data between systems. Today integration occurs at the application level: one application connects to another to access data (for example to check that an individual really lives at the address they have provided). This simple pairing happens between many applications (for example, the same address data is required by the planning permission department and the welfare office) and leads to what is known as 'spaghetti-automation (see Figure 1).
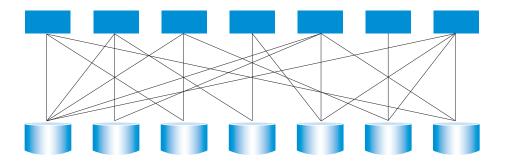
Figure 1: Spaghetti automation

The principle of 'efficient organisation' aims to reduce the costs, complexity and management burden of municipal information exchange.

How is this principle delivered in practice?

Application portfolio management

Groningen catalogued all the applications being used across the municipality and looked at what they all did. They found a high degree of duplication, for example most of the eight municipal departments had their own solutions for visitor registration.

OSOSS

Groningen has a policy to use open standards and open source software (OSOSS). Groningen expects departments to either comply with OSOSS or justify why they need a proprietary solution. Where products are similar, Groningen will favour the open source version. By insisting that ICT complies with open standards, all applications must meet national and international standards - for example the Dublin Core international open standard for document management and the Dutch national standards on website accessibility for users with disabilities (Web guidelines). Groningen has a list of ICT standards that cover all relevant open standards, and tenders for ICT contracts must meet these criteria.

No customisation

Groningen is working to ban bespoke products wherever possible to prevent high maintenance, management and upgrade costs.

5. Integrate with the outside world

Governments are increasingly trying to connect the different steps involved in executing electronic services. It is important that systems have the ability to connect with one another. Any new ICT system should have the potential for connectivity, using open standards, and simple integration with external systems.

In the Netherlands, there are two good examples of how separate organisations need to connect their systems and processes. Cases for social care and initially registered and assessed by the national agency UWV. Following a review of the case, social services may be delivered directly by UWV or the client may be referred to the municipality which then takes over the case. For welfare support, however, the municipality makes the initial assessment, and then refers the client to a care company.

External or cross-organisational integration is not just required by the national government; it also suits the ambitions of a municipality of the size of Groningen which tends to take a leading role within the region. By specifying the requirements for integration at the outset it will be easier in the future for Groningen to cooperate or even merge with neighbouring municipalities.

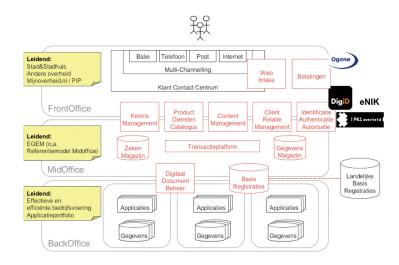## Visualisation of Groningen's I-architecture

Figure 2: Target architecture for the municipality of Groningen (2007)

Figure 2 shows a visualisation of Groningen's overall I-architecture. It may look relatively straightforward and logical, but it distils almost two years of hard work, consultation and negotiation.

So how were the different elements in the diagram chosen? Groningen's I-architecture project team considered all the current national developments and guidelines in the field (not just from the national government, but also from suppliers), then compiled these many schemes into a Groningen variant. The team analysed decided which components they would need to deliver Groningen's short- and longer-term requirements (as stipulated by legislation and their municipal vision for customer services). This process produced the target architecture in Figure 2: 12 components that are necessary to deliver e-services to citizens and employees.

Groningen's I-architecture distinguishes between the front office (where customers interact with the municipality) and the back office which processes and provides information. The mid-office takes care of interactions between the front and back offices. In the I-architecture diagram, you can also see the main developments required for each of these layers.

Once the team had settled on the components they then carried out some final checks: is this component already available within the organisation? If so, does it match our demands from an architectural point of view? If not, should we buy it?

It is essential to know all the steps involved to implement an architecture, hence the development of the roadmap in Figure 3.
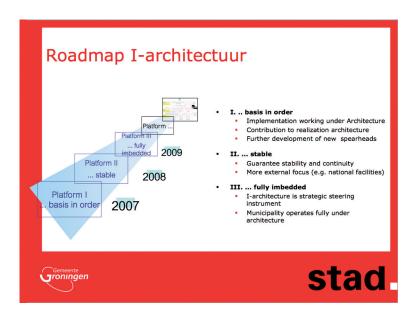

Figure 3: Groningen's I-architecture roadmap (2007)

Groningen completed its I-architecture development project in October 2006. But this was just the start; once the architecture is published it must then be accepted and adopted by the organisation. This second phase of activity is covered in the following chapter.

2.2 Karlstad

The context

At present (2011) there are no published guidelines or a coherent government strategy in Sweden which can be used by national, regional or local administrations for developing an ICT architecture. However, the Swedish Ministry of Health and Social Affairs, in partnership with the National Board of Health and Welfare, has worked on an initiative to develop coordinated, safer, more effective health and social care.

This work began in 2006 and most of the effort has focused on e-health systems, in cooperation with the Centre for eHealth and the Swedish Association of Local Authorities and Regions (SALAR). SALAR is a nationwide body; it participates in many initiatives developing e-government solutions. SALAR is responsible for coordinating national activities in cooperation with representatives from Swedish regions and municipalities.

Even though health and social care applications represent a substantial share of e-government, Sweden is working to 'bridge the gap' and deploy more e-government solutions in other areas of public administration. An eGovernment Delegation was appointed in March 2009, with the announcement that "Agencies have called for more coherent management, financing and coordination of eGovernment projects and greater scope for automated collaboration and collaboration with third parties. The Government accordingly announced in the 2007 budget bill its intention to strengthen management and speedup development. An eGovernment action plan was adopted in January 2008 and the eGovernment Delegation was appointed in March 2009. In the Delegation's view, the action plan's stated aim – *as simple as possible for as many as possible* – should be broadened to include an objective, which refers to *society's overall development capacity* and innovative potential. By focusing on the needs of society, objectives such as reducing the administrative burden on enterprises and simplifying the everyday lives of ordinary people can be achieved. In other words, eGovernment should no longer be regarded as an internal agency concern but as a tool capable of having a major potential impact on society as a whole. Moreover, the creation of a clearly defined, standardised environment for e-services will allow actors in society to take an active part in a collaborative effort with government agencies to develop e-services that generate further benefits for society at large.[1]"

The eGovernment Delegation's strategy document identifies five key areas for action:

- Flexible e-government based on user needs.

- Management and financing of demand-driven e-government services.

- The technological preconditions for a new, flexible infrastructure.

- More efficient support processes.

- E-identification.

The Delegation also encourages the use of open source and open standards.

The eGovernment Delegation focuses on Sweden's state public administrations and organisations. The idea is for Sweden's 290 municipalities to share their solutions with neighbouring municipalities and with others in their regions. However, the development of e-government in Sweden has until recently been slow and uncoordinated, with the exception of large state administrations, a few large regional bodies and a handful of large communities (with Stockholm taking the lead).

Despite the guidelines of the eGovernment Delegation, common principles and an ICT reference architecture still have to be developed, implemented and communicated to all.

In April 2011 SALAR released a complementary strategy on how to establish e-government for regions and local authorities.

[1] *Extract from 'Strategy for the government agencies work on eGovernment, SOU 2009:86'*

Karlstad's e-government agenda

Following a study conducted by external consultants KPMG in 2004, Karlstad's IT department realised relatively early on that an IT service management framework would only work if it was built on the foundation of an enterprise architecture. The development of an enterprise architecture has been the focus of activity since 2007 as part of Karlstad's participation in the Smart Cities project. The work has been carried out by the city's IT department, but has not yet been adopted by the municipality's management board.

The proposed enterprise architecture has been developed to support Karlstad's strategy to transform itself into a service-oriented organisation that meets the demands of its citizens. The municipality's governing council has adopted policies which lay the foundations for service orientation and introduce a new business-level architecture across the organisation. These policies cover:

- the development of the business (i.e. the administration) using ICT; and
- the management and maintenance of information systems throughout the organisation.

At the same time the municipality is undertaking a full restructuring exercise so that its internal management structures and workflows are more suited to its service oriented approach.

2.3 Kristiansand

Like Sweden, Norway does not have a central government strategy for ICT architecture. Kristiansand began its work in this area in 2005, largely due to the vision and drive of the municipality's CEO at the time, who argued that "Kristiansand municipality has to modernise and be able to offer the same service and communication tools for the public as other large actors, like banks and insurance companies, do".
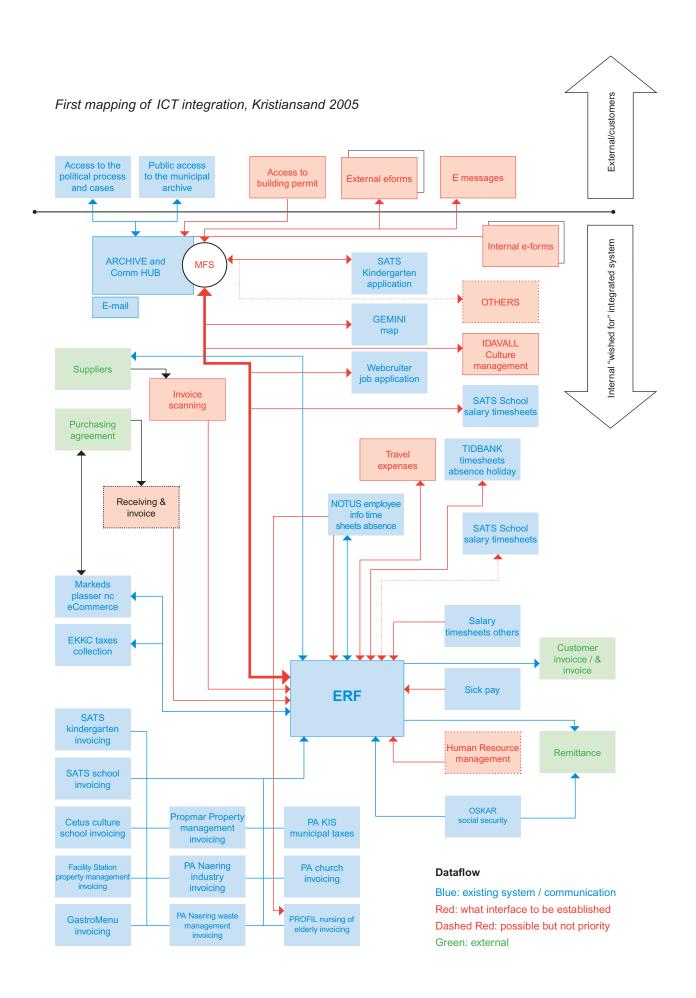
When the architecture initiative was launched, the project team consisted of a few ICT specialists, the municipality's web master, a member of the finance department and an HR officer. Together they tried to draw up a roadmap showing how the municipality could be modernized. With hundreds of processes and activities to investigate, it was a mammoth task, but some of the team members had previous experience of processes mapping and quality control.

The early work and draft process map was not a pretty sight, one team member recalls. It was clear that the organization had developed organically with no clear strategy (and certainly not a customer-focused one) in mind. The roadmap was presented to the CEO along with a plan on how his vision could be fulfilled and how the major barriers to service orientation could be overcome. One important suggestion was the introduction of "middleware" within the IT infrastructure. Middleware bridges the gap between software and hardware and helps to make data and information more accessible and easier to exchange and integrate into different IT systems. The municipality soon decided to implement an Oracle middleware solution.

From this phase of the project, the municipality appointed two project work groups: the most important group came from the IT department to develop the architecture model and design the IT platform to support the architecture. The architecture model has been adopted by a group of the 10 largest municipalities in Norway and is considered to be the leading service oriented architecture model in the country. The second work group focuses on applications and services, developing interfaces to automate service, provide electronic forms for service requests and integrate different components for electronic case handling and tracking.

Figure 4 shows how all the the architecture components link into the digital archive and the communication HUB. It also shows how the archive and the enterprise systems (e.g. finance) are linnked and interact (this diagram shows areas in red that need to be developed further).

Figure 4: The Kristiansand ICT architecture

First mapping of ICT integration, Kristiansand 2005

External/customers

Internal "wished for" integrated system

Access to the political process and cases

Public access to the municipal archive

Access to building permit

External eforms

E messages

Internal e-forms

ARCHIVE and Comm HUB

MFS

E-mail

SATS Kindergarten application

OTHERS

GEMINI map

IDAVALL Culture management

Suppliers

Invoice scanning

Webcruiter job application

SATS School salary timesheets

Purchasing agreement

Travel expenses

TIDBANK timesheets absence holiday

Receiving & invoice

NOTUS employee info time sheets absence

SATS School salary timesheets

Markeds plasser nc eCommerce

Salary timesheets others

Customer invoicce / & invoice

EKKC taxes collection

ERF

Sick pay

SATS kindergarten invoicing

Human Resource management

Remittance

SATS school invoicing

Cetus culture school invoicing

Propmar Property management invoicing

PA KIS municipal taxes

OSKAR social security

Facility Station property management invoicing

PA Naering industry invoicing

PA church invoicing

GastroMenu invoicing

PA Naering waste management invoicing

PROFIL nursing of elderly invoicing

Dataflow

Blue: existing system / communication
Red: what interface to be established
Dashed Red: possible but not priority
Green: external

3. Introducing architecture

Without a doubt one of the hardest aspects of any architecture work is convincing the municipality's decision-makers to adopt and invest in the new framework. In this chapter we discuss how this was tackled in Groningen, Karlstad and Kristiansand and explore the differences and similarities between these three Smart Cities partners.

3.1 Groningen

In Groningen the decision-making process lasted some six months, from October 2006 (when the management team first discussed it) to March 2007, when the decision to work 'under architecture' was finally made. This process was particularly long because the decision-makers struggled to understand the concept – let alone the details – of an architecture, and thought the proposals were too complex. They also felt that by agreeing to the I-architecture proposal without a comprehensive budget in place they would effectively give carte blanche to the project and saddle the municipality with a large and uncosted IT development (which are notorious for running over budget). A paradox emerged: the decision-makers initially only wanted a simplified, non-technical 'overview' of the project, but then found they could not make a final decision without more detail. Yet as they were provided with more and more detail they found the project became harder to understand and therefore they struggled even more to make a decision.

One of the biggest stumbling blocks was the lack of understanding that the architecture proposal was actually a set of organisational agreements that made up an entire business framework, and was not just limited to ICT. People could see the usefulness – even the necessity – of an ICT architecture, but mainly for its promise of cost savings rather than for its potential impact on service orientation and delivery.

This difficulty in understanding the broader view of the role of an ICT architecture was partly a reflection of Groningen municipality's organisational structure. Each of the municipality's eight departments worked semi-autonomously, so it was unusual to ask them to think at the organisational level. Each department protected its own interests and struggled to see the long-term, wider perspective. The successful implementation of an enterprise architecture is only possible when such conflicts of interest are overcome.[2]

The decision to adopt the proposed architecture ended in stalemate: Groningen's council was unable to make a decision either way. But the IT department decided that it could still convince the council that adopting the architecture was the best way forward for the city.

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[2] *Groningen recently witnessed an example of the tension between architecture and business needs. One department signed a software contract with an American internet payments provider; however, the Groningen architecture had already selected a Dutch company (Ogone) to handle online payments. In this instance the department had failed to check its plans against the architecture and made an independent IT purchase. This shows that the architecture framework is still not fully embedded within the organisation's working culture.*

It was clear that the story being told to the top decision makers was too technical and too focused on ICT. It was time to team up with non-technical supporters of the architecture. By teaming up with the programme manager for Public Services (who would be an important beneficiary of the architecture) the architecture working group tried another strategy. The proposal to the decision makers was reframed and rewritten by an expert communicator; an external advisor presented the proposal to the management team.

But first there was the question of cost; this had to be resolved before the management team could be approached again. So the external advisor led a workshop with people from the municipality's board of finance (including the finance directors of the eight municipal departments); this was where the breakthrough was finally made. At first the board found the presentation rather patronising, however, by the end of the discussions there was a mutual feeling that everyone understood that the architecture was just another way of organising just all the municipality's information services, but could deliver best value for the municipality. The board also agreed that there would be plenty of opportunity to decide on the costs of individual architectural components as the work progressed. The finance committee was reassured that the costs could be controlled. "Is this what all the fuss was about?" someone remarked.

The workshop led to a positive recommendation to the municipality's management team. In March 2007 the board agreed to adopt the architecture. The approval of the proposal agreed that:

- the whole municipality would work under architecture,

- the structure plan and zoning plans were ready for implementation, and

- an 'I-architect' should be appointed (this position was initially filled by the project manager for the architecture project and another member of the project team).

3.2 Karlstad

The ICT department in Karlstad introduced a reference architecture for ICT, which outlined how information systems were to integrate to form an ICT architecture framework that was based on service orientation within and outside the organisation.
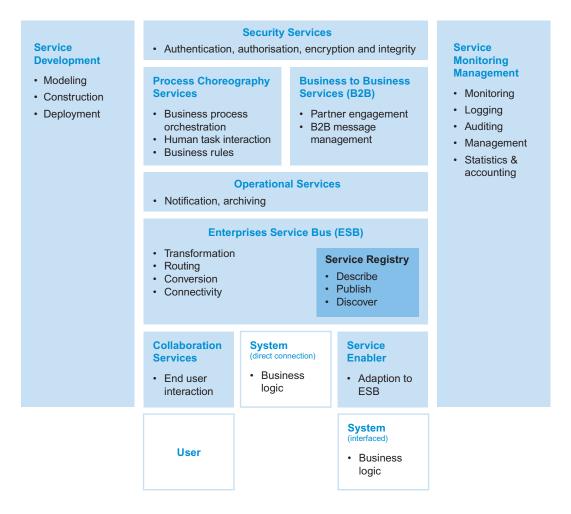
Service Development
- Modeling
- Construction
- Deployment

Security Services
- Authentication, authorisation, encryption and integrity

Process Choreography Services
- Business process orchestration
- Human task interaction
- Business rules

Business to Business Services (B2B)
- Partner engagement
- B2B message management

Service Monitoring Management
- Monitoring
- Logging
- Auditing
- Management
- Statistics & accounting

Operational Services
- Notification, archiving

Enterprises Service Bus (ESB)
- Transformation
- Routing
- Conversion
- Connectivity

Service Registry
- Describe
- Publish
- Discover

Collaboration Services
- End user interaction

System
(direct connection)
- Business logic

Service Enabler
- Adaption to ESB

User

System
(interfaced)
- Business logic

Figure 5: A high-level component based technology reference model

The work began in 2008, and the integrated platform (enterprise service bus) and its corresponding governance framework became available for the first time in 2010. An information security framework is currently under development which will enable and control access to the platform and data according to open security standards. The deployment of the information security architecture will enable the organisation to interact with citizens and other organisations with a satisfactory level of information security.

The different components of the reference architecture were brought together for the first time in an initial version in June 2011.

Karlstad's IT department is just beginning to work under architecture, currently focusing on information architectures (i.e. implementing application and data architectures). The insertion point for this is the configuration management database (CMDB) and directory services. Work on these components will soon make it possible for different municipal departments and other agencies to work together on joint projects (the potential for such joint ventures will be explored in more detail later in 2011).

The IT department is currently mapping its own internal processes so that it can assure they are compatible and optimised for the department's information system and compliant with the architecture. In this sense the department is taking a very pragmatic approach to implementing an enterprise architecture.

3.3 Kristiansand

The management board of Kristiansand also took a pragmatic view of architecture: "If this is needed to make electronic services possible and to realise our vision, than we have to do it!" The CEO of the municipality was kept up-to-date in the early stages of the architecture initiative; this constant 'drip feeding' meant that he built up a good understanding of the implications of "going digital" and could see that service improvement was synonymous with going online.
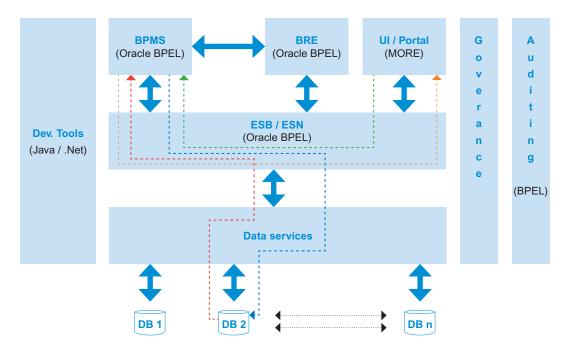

Figure 6: Kristiansand's current architecture model

Kristiansand's biggest concern was the involvement of central government in the development of e-services. Would the national government make recommendation or publish guidelines on standards, interfaces, usability and data integration? Or would central government only focus on national government departments and agencies?

Kristiansand decided to take a risk and move ahead with its own architecture design and implementation, slowly introducing architecture components and introducing electronic communication channels, digital forms and a list of municipal services on the city's website.

But they soon reached a stage of no return: the web had become the city's primary communication channel and it was clear that the use of e-forms and more online information was helping to reduce printing costs for forms and brochures.

While Kristiansand continued to work on its online services, the national government also added its support to local authorities, releasing an online service platform (Altinn) for companies, followed by a 'my pages' system called Min-side for citizens. The Altinn architecture provided a welcome contribution for Kristiansand and helped to confirm that the municipality was doing the right thing in the right way.

The architecture project was initially funded to design an architecture based on thinking about online services that was based on the approach taken in the banking and insurance sectors. This was supplemented with the Altinn concept of a central government hub for communication and reporting (e.g. tax information and details for private companies).

Kristiansand's first architecture design, published in 2005,copied Altinn to a large extent, adapting it for municipal services and placing more emphasis on electronic forms and their integration into the electronic archive and case management systems.

To realize this draft architecture the municipality licensed BPEL from Oracle to provide the central data hub and process/workflow tools. Kristiansand was the first municipality in Norway to adopt architecture principles; its architecture principals have now been adopted nationally and form the basis of the "principles of architecture for the municipalities in Norway", now known as FAKS.

It is interesting to remember, however, that despite its recognition today, the introduction of architecture in Kristiansand began for purely practical reasons and was little known beyond the team of IT specialists working to introduce digital forms into the organisation.

4. Working under an ICT-architecture

Once the decision to adopt an ICT architecture has been made, then the work really begins in earnest. But what is it like to work under an architecture framework? How does it change an organisation? What have the three Smart Cities partners learned from their experiences?

4.1 Groningen

The work of the ICT architecture team does not stop once the municipality adopts and implements the architecture. There is always work to do to tweak, adjust, refine and improve the architecture. In Groningen the I-architect was busy developing the model and giving advice during the organisational change process. The team was also responsible for controlling the architecture and reviewing operations and compliance within departments to the architecture and its principles. These tasks were all the responsibility of the I-architect, who was aided by the information managers of the eight departments ('department-architects').

The organisational context

In Groningen the greatest barrier to working under the ICT architecture framework was the resistance to change from the eight municipal departments. These decentralised, semi-autonomous departments were at odds with the idea of a central enterprise framework and principles. Moreover, the central steering of the architecture implementation was weak, so departmental resistance has made change and compliance very difficult. Work is underway to move to more centralised steering and management, but this change is relatively new and comes too late to influence the current state of architecture deployment in Groningen.

A second problem which the architecture team encountered is that Groningen's IT department is not subject to any management control or report to anyone on the city's management board. The voice of IT goes unheard and IT issues have little influence on strategic business decisions. IT is looked down on by board members who typically believe that ICT projects costs twice as budgeted and usually take twice as long as anticipated. However, attitudes in the boardroom are beginning to change; where most companies see ICT as their primary supporting process, Groningen is only just waking up to this truth.

The city's politicians and councillors also neglect the importance of ICT – it only makes it onto the political agenda if it has caused a scandal or if it can be used as an example in political debate. The adoption of open source/open standards software is a fine example. Politicians seized on this debate and saw open source as an excellent chance to break the effective monopoly of Microsoft and the two Dutch companies who dominate the public sector market. The issue of I-security was also politicised when Groningen's mayor asked how it was possible that a city resident could have received a letter commiserating on the death of his partner when she was sitting next to him, very much alive! The technical error became a political scandal.

Another major obstacle which Groningen has had to overcome is trying to get people to think in terms of processes – municipal employees are still very task oriented, rather than being process driven. The concept of architecture is an aide to process-oriented working, so it is difficult to understand, appreciate and follow when people are focused on their own individual tasks. It is extremely hard for governmental organisations (and Dutch municipalities in particular) to adapt to a changing world where multistep processes and cascading webs of interaction are rapidly formed, then changed.

Finally, Groningen discovered that is was simply not ready or able to cope with change. Municipalities are specialised organisations in the habit of doing their business year in, year out, the same way every time. Employees are not geared up to try new working practices or changing their daily routines. But customers are no longer satisfied with the old fashioned ways in which government delivers its services. Customer demands, backed up by national and European legislation, are forcing municipalities to change, but it is not something they are used to. As the famous Flemish poet Elsschot once wrote "Between dreams and deeds, there is legislation and practical objections".

Working under architecture in Groningen

Following Groningen's decision to work under architecture, the I-architect focused on three main tasks: developing the architecture, advising about change, and controlling and reviewing all ICT implementations to verify that they fit within the architectural framework.

1. Further development of architecture

Once the municipality's management board had agreed the proposal to work under architecture, they also authorised the I-architect to develop detailed 'zoning' plans – specific details on which architectural components would be prioritised and rolled out to 'fill in' the architectural plans. Almost all of the components were installed and live by mid 2011 (Figure 7).
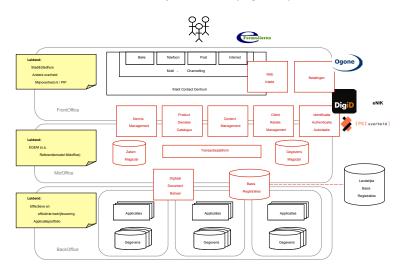

Figure 7: The state of architecture in Groningen, September 2010

In Figure 8 the colour green represents components already in use, blue is for components under construction and red represents the one remaining component that has yet to be decided upon.

The implementation of all these architecture components has been successful, but there has been a downside: the components together are merely a means for supporting e-services, but the business and its IT remain poorly aligned and some employees, typically middle managers, still resist changes to business processes and work routines.

Groningen has chosen a 'best of breed' architecture, assuming that when open standards are used information and systems integration is easy. But this is not quite the reality. Although the components of the mid-office are now integrated, the same old problems of integration resurface as soon as you go into the legacy systems of the back office.

Although the architecture is there, it is not always straightforward to exploit it to its full potential. Unfortunately there are numerous organisational barriers to full architecture deployment. Despite the presence of the mid-office, and the advantages it provides (i.e. lower costs by increasing online self-service), the eight departments have not instigated many e-service projects. Again, the fear of change – and discomfort with project-based working – is slowing innovation and e-service development. It seems like the architecture still needs much greater promotion among employees and within departments so that its benefits can be fully exploited.

There is one final disappointment for the I-architect: the architecture has not been expanded as originally planned. It was hoped that the architecture would be rolled out to support many secondary, internal processes, for example HRM, finance, facilities management, but so far the plans have not moved past a few conceptual diagrams.

Nevertheless, despite these difficulties and disappointments, there is no doubt that the introduction of an ICT architecture in Groningen has begun a process of change and planted the notion of service and process orientation among employees. There is still a long way to go before everyone can see beyond their immediate daily tasks, but the architecture project has been one of the catalysts for change.

2. Facilitating the transition to architecture

The existence and importance of the I-architecture is beginning to be recognised in Groningen and people are starting to think about how their work, ideas and plans fit with the architecture and its principles. Today all ICT procurement by the municipality must comply with the architecture, and tenderers are expected to meet all the architectural standards.

This position has sometimes caused problems of its own, however. In 2009 a tender for a new finance information system was published, but the purchase was delayed because none of the bidding companies could comply with Groningen's stringent requirements. Following this impasse, the list of requirements was adjusted so that some of the stated architectural standards were relegated to 'wishes'.

Nevertheless, the mere fact that the I-architecture was applied during this procurement process demonstrates how Groningen was beginning to embrace its new regime of working under architecture. Indeed, the city's alderman defended the problematic standards with great vigour in the council chambers – proof that architecture is slowly gaining acceptance right up to the boardroom.

Groningen's I-architect is also increasingly invited to participate in the early stages of departmental projects to ensure that the projects are launched 'under architecture' and fully understand the scope of what they can do within the limits of the architectural framework. Projects are finding that it is better for an architect to be involved in the creative process before ICT is even an issue in a project.

Although change is underway, the process remains slow. The architecture approach is still not embedded throughout the organisation, nor does it touch every work process. People still deviate from architectural standards and still focus on tasks rather than processes. The purchase of an internet payments tool by one department when another system had already been approved and incorporated into the I-architecture is sadly not an isolated incident (see Footnote 2). The municipal departments fiercely protect their autonomy; occasionally software purchases which deviate from the I-architecture still slip through the net.

But there is hope for change; in the past year the municipality has been forced to make serious cuts in its budgets; efficiency has become more of a business driver than ever before. It is clear that the principles of architecture can increase employee productivity and cut costs. Financial constraints may be the impetus that the municipality needs to really enforce work under architecture.

3. Control and review

The I-architect has been ideally placed to gather information from the different departments and review the ongoing architectural developments and their usefulness to the city. However, controlling IT projects and developments during the transition period and educating departments and employees about the implications of working under architecture proved to be difficult as the architecture still is not accepted throughout the organisation (some information managers do not actively take up their roles). Consequently the I-architect is often consulted about details, but frequently ignored by larger projects.

In conclusion, the success of the I-architecture can be determined by comparing the situation in Groningen today with that anticipated by the architecture roadmap. Over the past four year the municipality has accomplished many of its architecture objectives, but there is still some way to go before the I-architecture is fully embedded within the organisation. The lack of awareness among employees remains the biggest challenge to overcome – people need to understand that working under architecture has benefits and consequences and an impact on their daily work.
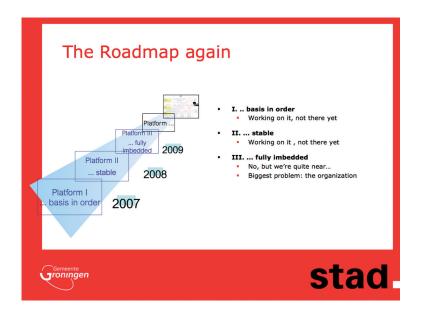

Figure 8: The achievements of the architectural roadmap

Figure 8 displays the original architecture roadmap extended through to 2009. Since then, architecture work has focused on maintaining the momentum and pushing architecture into every aspect of the organisation. For the I-architect and his team, 2010 focused on maintaining the architecture process; now, in 2011, there is a growing awareness within the organisation that the I-architecture need to be exploited and its potential released.

New developments like the rise of social media and the growing drive for flexible working among employees (e.g. working from home or in the evenings, known as "the new way of working" in the Netherlands) are making people refer back to the architecture. Moreover, the major financial cutbacks and other organisational changes such as the development of a centralised shared customer contact centre for all municipal departments means the architecture itself is up for reassessment. Are the components and tools in the existing architecture still suitable and adequate? What is the influence of cloud computing?

However, it is integration which remains the biggest challenge of all. Customers want joined up government, and seamless interoperability been national and local government and between internal and external data sources. Groningen will continue to lobby the national government to set national standards on interoperability; then perhaps one day the dream of 'plug and play' in a fully service oriented architecture will finally become reality.

4.2 Karlstad

Officers from Karlstad's e-office are just beginning to introduce a methodology and model for process mapping which has been developed as part of the Smart Cities project.[3] The model is now being followed by the municipality's administrative staff who have been tasked with mapping all the business processes within the organisation. This mapping initiative is being conducted to support the city's strategy to develop e-services; process mapping is an important step which will help to identify all the interacting components of a structured business architecture.

At present the city's IT department is working to pave the way for the new model of working under architecture, following the holistic approach laid out in 'Creating Municipal ICT Architectures – A reference guide from Smart Cities'. Karlstad want to adopt TOGAF[®][4] as its enterprise architecture framework and align this enterprise architecture with the IT service management framework ITIL[®][5] service design phase as a reinforcement of design capabilities.

Karlstad is just beginning to work under architecture. Awareness of architectures, the architecture process and the value of architecture is low outside the "inner circle" of people (primarily people in the IT department) who are closely involved in the architecture initiatives.

Karlstad is paying close attention to the place of its IT architecture within the wider enterprise (process oriented) architecture. It is investigating how the principles of the IT architecture can be adopted at the business level. The work of the architecture project so far means that the organisation is well placed to expand the presence of architecture across many areas of the organisation.

Architecture has benefits for business and ICT and the alignment of these two areas and their adoption of architecture can significantly improve the municipality's ability to meet its citizens' requirements while becoming more effective and efficient

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[3] See Improving business processes and delivering better e-services - A guide for municipalities from Smart Cities at http://www.smartcities.info/publications.

[4] TOGAF® is a registered trademark of The Open Group in the United States and other countries.

[5] ITIL® ® is a Registered Trade Mark of the Office of Government Commerce in the United Kingdom and other countries.

Karlstad has learned, however, that when an organisation chooses to adopt an enterprise (business) architecture, the control, management and ownership of the architecture framework should be transferred out of the IT department. Responsibility for the architecture should be held at the very top of an organisation.
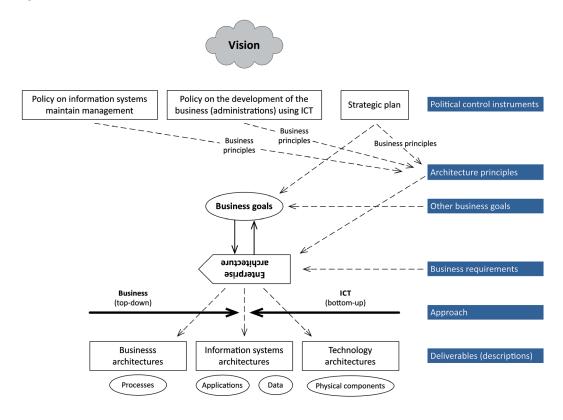

Figure 9: Preliminary enterprise architecture reference model for Karlstad

The main purpose of enterprise architecture should be:

- to make it easier to align ICT developments with business requirements and goals; and
- to produce descriptions which can be used during the change management process to control and review architecture implementations.

4.3 Kristiansand

Kristiansand suffers from being ahead of the game. The municipality has found remarkable support for working under architecture, but it has struggled to know which standards to follow because the national government has not published any recommendations or guidelines for the introduction of web services (as it has done for service systems). Norwegian municipalities are autonomous bodies, so it is challenging to get standards accepted and agreed among municipalities or imposed from central government.

This lack of any cooperation with other municipalities or central government has meant that Kristiansand has had to 'go it alone' and invest significant time and money into its architecture project. Even the introduction of relatively simple online forms which would integrate with the city's service systems was extremely resource intensive.

Over the last few years Kristiansand has seen its IT infrastructure gradually improve, piece by piece, one component at a time. More than 30 years of IT investments slowly being replaced, upgraded and integrated into the municipality's IT architecture. Some systems are being adapted to perform tasks they were never originally designed to do, which makes the roll out of the architecture slow and time consuming.

But has this gradual move to a strategically designed architecture made any real difference? Customer surveys suggest a good return on investment: higher customer satisfaction, more use of electronic services and an improvement in the structure of the organisation and the competence of employees.

Like most municipalities Kristiansand has been a sector/task-oriented organisation. Authority lies with departmental heads. But recently representatives of the IT department have been invited to participate directly in departmental projects to invest or change departmental systems. IT staff are able to advise these work groups on how their investments should fit within the organisation's architectural framework. Today departmental projects tend to be more successful: they choose the right systems and derive great financial returns from architecture-compliant investments.

As in Groningen, working under architecture is not something that Kristiansand's employees readily accept. However, some members of the municipality's management board and departmental heads have witnessed the improvements that architecture-compliant investments are beginning to achieve. Of course, like the other Smart Cities, there is a long way to go, but Kristiansand believes it is on the right track.

5. Lessons from three smart cities

5.1 Similarities between the three cities

All three cities seem to have the same sense of urgency and a great desire to be better prepared for the future. They all believe that developing an architecture is good preparation as it will help them to optimise their customer services and follow a carefully planned path of financial and organisational growth.

The three architecture frameworks developed by the cities are all based on a service oriented architecture approach. All three cities are well placed to adopt a global, widely accepted architecture, which, in theory at least, is open and therefore offers functionality and operability like never before. The dream is that architectures could enable municipalities to share services and exchange information and data; if a service is based on a service oriented architecture it should not matter whether the service in question was developed in Sweden or the Netherlands. However, service oriented architecture depends on the willingness of administrations to develop robust governance and adopt open standards. The adoption of open standards also makes municipalities supplier independent, helping to increase competition and ICT innovation and freeing municipalities from expensive deals with companies for proprietary technology and maintenance.

Finally, all three cities have got the 'architecture bug'. There is a strong desire among all three partners to pay more attention to process architecture and process work to make their business operations more efficient. Groningen's I-architecture helps to achieve these goals; there is no doubt that this will also happen in Karlstad and Kristiansand.

5.2.   Differences between the three cities

Both the Netherlands and Norway have some kind of national architecture model. The Norwegian model is not an official model or government standard architecture, but is recommended by the 10 largest municipalities. Suppliers are beginning to look to the Norwegian model to develop a better use interface and the result is that suppliers now look to this for developing standardised interfaces. In the Netherlands the national government issued the NORA (national government referential architecture): only Sweden does not have a model.

There is also a difference in pace between the cities: Karlstad is just beginning the architecture process, Kristiansand has six years of experience (since 2005) and Groningen has four years of experience (since 2007).

The three municipalities are also taking very different approaches to their work. The reference models for Kristiansand and Karlstad start from a technical point of view (in Karlstad an IT service management view), versus the more organisational/more top-down view taken by Groningen. Nevertheless, the ultimate aim is to collaborate to ensure they will reach the same goals.

The scope of the architecture implementations differ between the three cities. In Karlstad the architecture involves customer services – they are open to everything, but intend to have a bottom-up, customer focused approach. In Groningen however, the architecture is being developed with both internal processes and external processes in mind – this balance was not the result of a conscious process of talking to people and formulating a vision, but instead the consequence of the city manager's aversion to any hype (positive or negative) about public services. This is also a longer-term ambition of Karlstad, although their city's focus is currently on customer services.

The focus of ICT policy in Norway has for the last three years been on standardisation. In an ideal world standardisation would make true plug and play a reality: any system would be able to connect with any other system and communicate with it.

Sweden has also looked at standardisation. Smart Cities partners believe that municipalities across Europe could work more closely together as their needs and requirements are highly complementary. Closer collaboration could help to free funds to develop – and share – better e-service solutions. This would be impossible without architecture and process-based thinking. Architecture really is that simple.

5.3 What (not) to do

What Groningen learned

"One of the most important lessons we learned is that architecture is no 'silver bullet' – architecture cannot cure every problem. Sure, it helps to structure your ICT assets and gives you a strong basis for optimising public services and internal processes. But this doesn't provide all the answers to every municipality's problems.

Gjill Smit

"The root of most problems lies in the organisation itself. Once the importance of organisational change is understood in the context of the changing world, organisations then use I-architecture and a process architecture to cope with the new order.

"The process of developing an architecture is an excellent activity in itself because it helps to highlight an organisation's capabilities to develop e-government through the transformation of customer requirements into 'blueprints', and to back this up with a change management programme that covers the entire organisation.

"I cannot stress it enough: I-architecture is an instrument, not an end in itself. It does well when it is part of a much broader business process architecture. It is essential that you always keep in mind that I-architecture is just one layer of an enterprise's overall architectural structure."
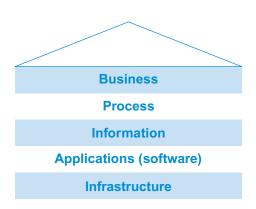
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    │    Process      │
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    │   Information   │
    ├─────────────────┤
    │ Applications (software) │
    ├─────────────────┤
    │  Infrastructure │
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Figure 10: The architecture stack

"You can imagine that this stack is like a house. Each of the floors supports the floor above, beginning with the technical infrastructure on the ground floor and working up to the abstract mission and vision of the organisation – the organisation's raison d'être – at the top. In terms of an I-architecture, information is gathered (mostly) out of the ICT systems, which in turn are supported by software and technical hardware and equipment like servers and networks. The information is put to use in processes which themselves support the organisation in achieving its goals. [6]

"It is really important not to neglect change management. Asking people to work according to a framework demands a change of mentality; employees must understand the bigger picture (not just how they can satisfy their own interests and complete their assigned tasks). From the very top of the organisation right down to the bottom, this change demands discipline and endurance. The first time someone gets away with deviating from the architecture without an argument or repercussions is the beginning of the end for architecture because it sets a precedent and a negative example to everyone else.

"Working under architecture is a shared responsibility between business and IT. ICT supports and enables the business' ambitions. Business-IT alignment is critical to success!

"When you tell the story about architecture and what it can do for the organisation is helps tremendously to have some picture, a visual aid that people from all target groups can immediately understand. In Groningen, almost everybody in management and in ICT knows our architecture diagram. It really helps our communication about architecture, although you always have to bear in mind the target group you are talking to. We've also created a website which shows the status of our architecture developments, explains the different components, and describes all the work going on to implement the architecture.

[6] *According to TOGAF® an enterprise architecture includes processes; this is how Sweden uses the 'stack'.*
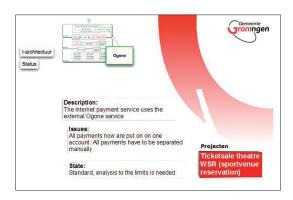
Figure 11: Screen shot from Groningen's I-architecture website

"If we could start our architecture work in Groningen from scratch again, we would pay more attention to the change management aspect of the whole process. That is what ultimately determines the success or failure of the project."

What Karlstad learned

"We would have liked much more commitment from the management board much earlier in the process. Top-down support really raises the profile and stresses the importance of a project. But managers are beginning to understand just what architecture can do for the organisation and what it promises to deliver. We're starting to get some enthusiastic buy-in."

Gunnar Kartman

What Kristiansand learned

The introduction of an efficient and effective architecture depends entirely on the establishment of standards. We hope this in itself will help to increase professionalism in the organisation, improve the quality of what we do, and simplify the processes and administration behind our work."

Bjørgulf Bergh Torjussen

5.4 Take home tips

DON'T

- Do not underestimate the importance of HRM (human resource management) and a change management strategy – guiding employees and reassuring them about the new way of working is much more important than buying IT products.
- Do not keep pushing if there is no interest or commitment.

DO

- Develop a strategy on how to convince decision makers to understand and embrace architecture and see how the adoption of architecture can provide the impetus for change.
- Create a sense of urgency.
- Form an alliance of leaders from within the organisation to champion the architecture.
- Keep everyone in the organisation continuously informed.
- Keep spreading the word

Smart Cities Guides

The Smart Cities project has produced a number of guides for municipalities and governments to help them design and deliver better e-services.

1. Customer Insight Profiling and Service Design Guide - http://www.smartcities.info/customer-profiling

2. Creating Customer Contact Centres - http://www.smartcities.info/customer-contact-centres

3. Creating Municipal ICT Architectures - http://www.smartcities.info/ict-architecture

4. Improving business processes and delivering better e-services - http://www.smartcities.info/business-processes

5. Using Co-design to design and deliver better e-services - http://www.smartcities.info/co-design

6. My City Online – making the case for municipal web portals - http://www.smartcities.info/web-portals

7. Using Geographic Information Systems to provide better e-services - http://www.smartcities.info/gis

8. An introduction to Municipal ICT Architectures for Managers - http://www.smartcities.info/ict-architectureSmart

Cities Research Reports

1. Comparing levels of internet access, internet use and e-government use in the Smart Cities countries

2. Customer profiling to target service delivery

3. Measuring levels of supply and demand for e-services and e-government: a toolkit for cities

4. An introduction to Process Modelling

5. Standards for classifying services and related information in the public sector

6. The Transformation of City portals

7. The Community of Practice as a virtual organisation

8. The Community of Practice as a virtual organisation: innovation seeking and knowledge creating

9. A Systems Perspective on Security Risk Identification: Methodology and Illustrations from City Councils

10. Making customer groups real – using personas

11. Using Customer Profiling and Activity Based Costing to inform channel shift and to increase service take-up – A practical guide

12. Customer Journey Mapping

13. What is a service list?

14. Ten reasons to use a service list

15. Evaluating e-services

16. Understanding web accessibility

17. Using email to deliver e-services

18. Edinburgh's Library App – a case study

19. BusTracker – bus information on the go

20. Using geolocation in e-services

These reports can be downloaded from http://www.smartcities.info/research

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