Information Architecture and e-Government

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Summary

E-government has become pervasive in many parts of the world in various forms and can be defined in multiple ways. However it essentially looks at how ICT and the web in particular can be adopted to improve how government runs and especially how it interacts with citizens. It is possible to categorise e-government activities and what emerges is the central role information plays in enabling the delivery of effective services. This paper looks at existing and emerging e-government developments based on a specification of information architectures. It looks at how basic classifications can be used to ensure the flow of information across distributed services and enable accurate data management and goes on to present a case study of a government agency.

Key words: information architecture, e-government

1. E-government – Scene Setting

E-government can be defined in many different ways but essentially looks at how ICT and the web can be used to improve how government operates especially through its interactions with citizens. It is possible to categorise e-government activities and what emerges is the central role information has in enabling effective services. This is more true for certain aspects of government business such as tax collection which is essentially an administrative task whilst in other cases it provides a more supporting back office role.

One of the fundamental precepts of e-government is the shift from services which essentially serve the internal needs of government administration to those which are more proactive in meeting citizen needs, whatever their status or financial position, As Wimmer as it "IT has played a major part in incrementally changing and shifting traditional and bureaucratic government models into the current e-government model where services are delivered according to customer needs" (Wimmer 2004.)

The drivers according to Weearakkody (2007) include improving internal costs and management efficiencies, encouraging citizen participation, promoting economic development and improving overall governance. We can add to these the idea of service integration or 'joined up' government as the Blair government

described it whereby citizens are not shunted from department to department, often undertaking the same basic processes before achieving their desired outcome or, more critically, where the needs of vulnerable people are not neglected through different government agencies not taking a holistic view of an individuals situation.

E- government is now widespread across the globe especially in developed countries but also in the developing world. There are case studies aplenty on the status of projects in the UK, Europe generally, the US, Asia etc. These show remarkable similarities and face essentially the same challenges. Denmark for example has proved particularly adept at initiating- government activities with Enterprise Architecture and the establishment of an interoperability framework with specific integration standards (Weerakkody, 2005). Murphy (2005) quotes information sharing, ensuring inclusivity, and managing inter-agency initiatives as common key challenges. But he also notes the differences between countries: for one, the degree of government centralisation, where more federal structures present greater challenges to implementing cross agency solutions than those with a highly centralised structure; secondly is the issue of differing political agendas – with some countries focusing on broadband in order to deal with heavily distributed populations; finally he notes the local legal context where existing laws can facilitate or block e-government projects: thus if there is already a heavy administrative burden for business it is unlikely to be reduced significantly through new processes whatever they are and whilst the degree to which the state keeps information on its citizens will enable easier web based interaction. His report identifies projects in Australia, the US, Canada, Japan Europe.

Some definitions of e-government see it as essentially about improved service to citizens and predominantly using the web. It is seen as a way of enabling improved interaction with citizens so that they can transact their business in a slick and efficient way to suit them and not the producer. It borrows from e-commerce developments over the past decade and has similarities in the way services are offered, particularly those which are charged for. It also parallels a greater emphasis on customer service throughout the public sector. Other commentators rightly see it as about increased business efficiency between government agencies and government agencies, within agencies and between agencies and business. In essence e- government is about the transformation of internal and external processes.

Lastly the term transformational governance is also widespread and implies a fundamental rethink of the way in which services are offered focussing on savings, efficiency and customers service as the primary drivers for e-government and indeed many successful projects have managed to achieve these goals. However what is noticeable is that whilst there has been significant progress in enabling web access to government IT there has been less success in joining that access up to the (often disparate) array of back end functional services.

2. Challenges to E-Government

E-government will not come about organically and requires investment in programmes and people to bring it about. Nor is it necessarily straightforward, in that there are many barriers and challenges to overcome - these are discussed below.

2.1. Information sharing

Information sharing is at the root of e-government – it is required to bring systems together, to ensure a holistic approach to customer service and to ensure efficiency through reducing duplication of effort in collecting and storing information. In most organisations there is a high, continuing overhead in duplicate files which in turn leads to inaccuracy and poor decisions. But information sharing is not easily achieved; there are real barriers to its deployment which are both technical and cultural.

2.2. People Issues

Managing the people aspects of e-government is an often underestimated challenge, one example is delivering a national electronic health record system, which in itself is a large scale challenge, but ensuring that health professionals are willing and able to use it is a people challenge on similar scale. This kind of change is often only brought about by fostering public confidence through the delivery of projects which are seen to work and secure user acceptance.

2.3. Power structures

> "Power conflicts over departmental boundaries and control of
> services will become more apparent as integration progresses"
> (Signore, O et al 2005)

All commentators suggest that one of the most common barriers to the effective update of e-government is the pre-existing power structures which tend to inhibit cross agency working, information sharing and a focus on citizen as customer.

Effective e-government requires a change in mindset of agency directors; many perceive their department as the most important and tend to disregard other agencies. And though this silo structure may well work well in business where the ultimate focus is always on profitability it could be deemed anathema to public service.

2.4. The Legal Context

A further issue in information sharing is the problem of sharing personal data between different agencies as well as within agencies. The idea is that from a citizen perspective there is only one point of access and information has only to be conveyed once for relevant distributed systems to be actioned, thus both

saving the user time in interaction with a range of target systems and ensuring maximum efficiency in data collection and updating across those systems. However the legal framework can often block such exchange.

Data protection and other privacy laws are an inhibition to the extensive re-use of information in a pan government context. All European countries have something equivalent to a Data Protection Act or at least legislation relevant to the re use of information in a context other than which it was arguably provided. Thus taking information which might have been gathered from, say, a parking violation and re-using it to investigate tax evasion could be seen by citizens to be invidious and counter to their interests. But in other circumstances where information could be re-used to a citizen's advantage it would be pointless not to share it. Whichever way it is looked at, there should be a process in place which reflects citizens needs in an efficient and connected way and this will require an information sharing policy which must be supported by all, applied across all agencies and above all be legally sound.

2.5. Information Security

And whilst Data Protection laws are there to ensure that citizens rights over their personal information are protected, information security polices are a means of ensuring that personal data is not abused and is kept securely where it is deemed necessary. Information security has both technical and policy challenges, but is not the topic of this paper. Suffice to say that governments for whatever reason, do keep information confidential from their citizens and this requires systems which ensure maximum security where data can only be viewed by the relevant authority.

3. Information Architectures

So the argument is that e-government is underpinned by information and its effective management is a necessary prerequisite for service delivery. Information management is concerned with information quality, security, business processes and metadata and all of these need to be addressed to deliver good e-government. Good information management implies understanding what information assets are in place and what part they play in a particular business process and the first step in that regard is usually the compilation of an information audit which details the size and scope of the information available and its lifecycle. It comprises the total knowledge base of the organisation. This activity can be complex and is the subject of extensive literature.

Information architecture is a subset of information management and is not new but was previously more commonly used to describe Enterprise Architecture or Enterprise Information Architecture and was more concerned with infrastructure and applications than information per se. IA also leans towards describing what might be rather than dealing with the 'as is', so that it is more of a framework onto which future services and applications can be mapped.

So to understand government information, as well audit of the extent of it, we need to be able to model it and then to analyse, categorise and classify it and this is what we will turn to next.

3.1. Models for e-government

The seminal paper analysing models for e-government is that of Layne and Lee (Layne, K & Lee, J. Developing fully functional E-Government: a four stage model) Writing in 2001, they proposed a model which as a first stage, includes the cataloguing and presenting over the web of services and processes to inform citizens. This leads to a second phase which emphasises transactional government that is it supports forms processing, online transactions, e-payments etc.

It could be argued that many developed government agencies are now at, or very near this stage, though it requires users to be authenticated at some point so that the system knows who they are. These two models in turn lead to further phases of vertical and horizontal integration. Vertical integration envisages links to line of business systems whereby citizens can interact directly with back office systems so as to allow questions to be directly answered or a service secured. Business may be within an agency or straddle multiple agencies. Horizontal integration proposes that back office systems are themselves integrated to provide a one step approach to meeting users needs. Horizontal integration may not simply follow on from vertical integration but could well be run in parallel. Layne and Lee's model has stood the test of time albeit that other researchers have proposed enhancements to it such as Weerakody (2007)

Janssen and Veenstra (2005) propose a five-stage model for the development of architectures for local government agencies. Their model consists of 1) no integration 2) one to one messaging 3) warehouse base systems 4) brokering systems and 5) advanced broker architecture. The model moves from simple to an advanced process based architecture able to manage links and cross-organisational processes and supporting service oriented architectures.

Each of these models presumes organisational and technical challenges – and here we will look at those occurring at the level of horizontal integration as it is here where the most significant barriers are found and which need to be dealt with if we are to achieve a joined up approach to government.

3.2. Integration

What do we mean by integration? It could be argued that there are four different levels or types of integration which are current in information systems. Most integration at the moment is at Levels 3 and 4 but the ambition ought to be or is to move to 1 and 2.

- **Level 1 Functional Integration**
  Whereby a secondary application is accessed and used through a primary application to the extent that the secondary application is transparent to the user;

- **Level 2 Data Integration**
  Where data from one system is used to populate another either in near or real time usually using standard protocols /programmes such as SOAP/BizTalk
- **Level 3 Linked integration**
  Where a secondary application or dataset can be accessed/triggered via a primary application but which essentially appears as is to the user. Links might be hyperlinks or file paths
- **Level 4 Data exchange**
  Where data is moved from one application to another as the result of an operator initiated action. Data is usually structured as XML or CSV or XLS.

Integration at all levels is inhibited if underlying data structures are not using essentially the same data structures and the same descriptive metadata. (It is possible and indeed frequent to find that the same numbering system is used to mean entirely different things and only through standardisation).

4. Information Architectures

So there are a number of problems associated with system integration which need to be addressed for effective information sharing. These can be summarised as:

- In large organisations there are likely to be many application systems with high overhead on maintenance and complexity
- Data will probably be held many times in many places leading to confusion as data accuracy, currency and what to believe;
- There will be increasing complexity in understanding how data moves across and around the organisation;

How can these issues be overcome? Alternative architectures have been proposed which seek to answer these cases though none is perfect and each has problems. In this section I have documented four possible approaches.

4.1. SOAP/Web Services

In the web services approach, information assets essentially remain where they are within a functional business model but assets are then joined up using integration tools such as web services. Web Services is defined as 'reusable components as services and which enable linking of these services between and across different systems using XML. It deploys three XML standards SOAP, UDDI (Universal Description, Discovery and Integration**)** and WSDL (the web services description language) to provide a platform for developing available web services (Weerakkody,V, 2007)

The benefits of the web services approach are modularity, accessibility and a well described implementation independent of any given system and are thus

highly interoperable (Fremantle 2002). Web services can cross not only internal boundaries but external components can be brought into play. But there are complexities in that web services can accommodate not just information flows but also business logic requiring a separate repository for ease of maintenance and re-use. (Zhao, JL 2008)

4.2. The Single Repository or Data Warehouse

A second solution is that of the single information repository or data warehouse where all crucial data relating to customer interaction is copied to a single place. It leads to the concept of 'one version of the truth' where all information is confined within a single unified place and master data sets which support all systems. There are multiple benefits to this approach, sometimes known as a data warehouse, whereby data is brought together to support customer front office negotiations whilst the back office retains operational control. Front office or certain related staff are able to see the whole picture around a certain transaction.

The main problems associated with a data warehouse are 1) the potential vulnerability from having a sole source to support both back end and front end systems with the potential for failure and 2) that data often has to be copied across regularly into the repository from back end systems with the potential for the data set to be out of date at any given time;

4.3. Information Flows

Thirdly but not mutually exclusive is an architecture which looks at the flow of information flows into an organisation and seeks to track and audit it at that point. Much information will be in one of write, email or electronic document formats and unified systems can ensure that all such systems are converted to the same e-format and then logged to an audit file before being steered to the relevant back end system for processing. This is more a matter of workflow than architecture in that in some ways it simply reinforces the warehouse model above but it does have a major benefit in improving efficiency in that documents get to where they need to be processed quickly and in a processable format. The downsize is that metadata must be added at the front-end and is likely to be limited unless there is a system in place which is capable of some intelligent semantic derivation, so that documents can be routed to where they belong and finding that data at a later date is rendered easier..

5. Information Categories

Any of these approaches to information management will not succeed unless there is a well described set of information assets so as to allow them to be used in different contexts in different parts of the business. To achieve this we need some way of defining those assets so that they can easily be re-used. As a starting point we can generally define government services as essentially the deliv-

ery of a service to a citizen (people) or organisation based on a certain place or property. This leads to the four key categories of:

- People,
- Organisations,
- Property & Place,
- Transactions.

5.1. Property & Place

Property & Place in some ways is easily defined in that we can define any location through its geographic coordinates and hence uniquely identify the building, property or even street article concerned. In government contact is more often through often property or buildings and these are thus more critical. The UK at least has defined a national system of property management known as the Loan and Property Gazetteer which documents every building and address in the UK and allocates to each a unique identity known as the UPRN or Uniform property Resource Name. The 12-digit Unique Property Reference Number (UPRN) covers every building and plot of land in the country and is defined by a standard BS 7666 which thus allows for the interchange of such information between agencies and between systems.

5.2. People or citizens

People or citizens are more difficult to define. The status or position of an individual is usually a good starting point; citizen or voter or tax payer are all roles that we might occupy. Each of these roles will have a functional system or process attached to it and possibly therefore some identifier associated with that person and role. The availability of a unique identity is enormously helpful in that it can be used as proxy for people, with consequent benefits in processing their data and joining up systems. This is sometimes referred to as 'tell us once' where information submitted or collated for one purpose is reused for another. If there is no unique identifier then a combination of name, date of birth or other identifier could be used as a substitute. The management of people data is a particular challenge where there are itinerant populations, constantly shifting and with citizens living outside of formal structures.

5.3. Organisations

Organisations are less easily defined than other entities, given that they are subject to hierarchies, subsets and also constant change. The value of an accurate record to government is possibly largely in tax and revenue collection where tax raising from business is often highly critical that financial standing becomes key piece of information. But organisations do have other roles vis a vis government such as the voluntary or charity sector who can complement and work with government. Which ever way an organisational directory is often a key component.

5.4. Transactions

By transactions is implied a record of say a transaction between a person and a service which might also relate to a property, such as land purchase, and which might be undertaken within the business unit or agency or even corporately. Transactions also encompass financial records which are basically transactional records of specific actions between a person and an organisation e.g. payment or receipt of money

5.5. Key metadata

Finally, key metadata e.g. property/people can be exemplified as:

- Property
  - UPRN available in all property records;
  - GIS coordinates
  - Fileplans standardised around street name number
- People
  - Citizens;
  - Tax payers;
  - Students;
  - Government workers;
  - Visitors
- Organisations
  - Businesses
  - Schools;
  - Community Centres
  - Churches
  - Support agencies;
  - Public agencies
- Transactions
  - Case file Numbers
  - Invoice reference
  - Purchase orders
  - Transaction reference

Good descriptive i.e. semantic metadata will come from adding controlled vocabularies to documents either at source or later. To that end in the UK there have been attempts to standardise vocabulary across systems via a pre determined set of taxonomies defining services, activities, transactions etc with some (though not overwhelming) success. The best example of this is the IPSV (illustrated in Figure 1), a combination of sets of vocabularies designed to describe all government operations. Such taxonomies do have the wherewithal to address one of the key areas of integration, that of semantic interoperability.

. Nutrition
. . Diet
. . . Vegetarian diets
. . . . Vegan diets
. . Breast feeding
. Health care
. . Secondary health care
. . . Hospital waiting lists
. . Preventive medicine
. . . Immunisation
. . . . MMR vaccination
. . . Cervical smear tests
. . . Medical assessments
. . Primary health care
. . Private health care
. . . Private hospitals
. . . Private health insurance
. . . Private health clinics
. . . Private health centres
. . Complementary medicine
. . . Aromatherapy
. . . Acupuncture
. . . Alexander technique
. . . Chiropractic
. . . Herbal medicine
. . . Homeopathy
. . . Naturopathy
. . . Osteopathy
. . . Flower remedies
. . . Bowen technique
. . . Hypnotherapy
. . . Indian head massage
. . . Kinesiology
. . . Massage
. . . . Massage and special treatment licences
. . . Polarity therapy
. . . Pilates method
. . . Reflexology
. . Reiki

. . . Holistic medicine
. . . Iridology
. . . Macrobiotics
. . . Meditation
. . . Metamorphic technique
. . . Life coaching
. . . Postural integration
. . . Healing therapies
. . . . Spiritual healing
. . Medical and psychiatric treatment
. . . Abortion
. . Physiotherapy
. . . Massage
. . . . Massage and special treatment licences
. . . Hydrotherapy
. . . Psychotherapy
. . . . Art therapy
. . . . Dance therapy
. . . . Drama therapy
. . . . Music therapy
. . . . Sex therapy
. . . . Gestalt therapy
. . . . Pets for therapy
. . . Amputation
. . . Chemotherapy
. . . Circumcision
. . . Cochlear implants
. . . Colostomy
. . . Dilatation and curettage
. . . Fertility treatment
. . . . in vitro fertilisation
. . . Growth hormone treatment
. . . Dialysis
. . . Hysterectomy
. . . Immunisation
. . . . MMR vaccination
. . . Laser therapy
. . . Mastectomy
. . . Occupational therapy
. . . Radiotherapy
Speech therapy

Figure 1. The Integrated Public Sector Vocabulary (IPSV)

6. Unstructured versus Structured Information

A further possible categorisation is that between structured and unstructured data whereby it can be argued that a percentage of organisation assets are held in an unstructured format such as documents or reports and wherein is a lot of key information needed for effective service delivery. Structured information by contrast is that contained within a database be it a spreadsheet or sql or other. Structured content is by its very definition well managed and can be easily manipulated in a digital sense. However it tends to be small scale in volume. By contrast unstructured information needs very good metadata to make it retrievable and whilst OCR technologies are enabling more information to be derived, good findability through web engines and other enterprise search engines will only come through enhanced indexing.
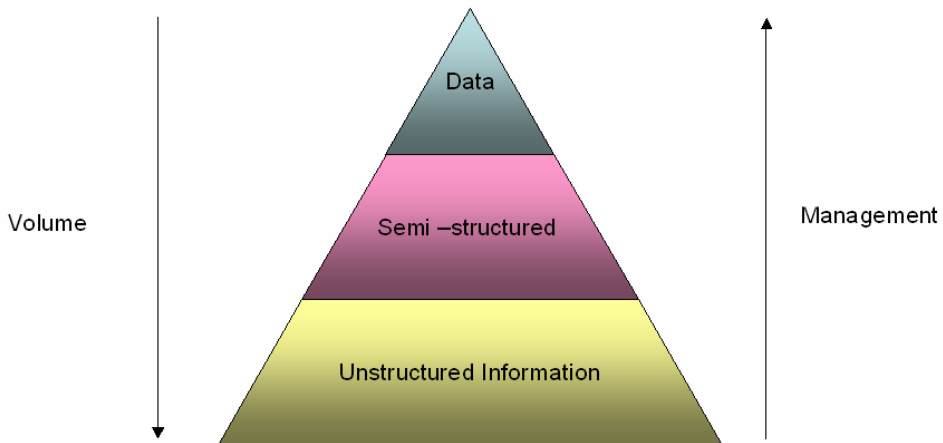

Figure 2. Structured and Unstructured Information

7. Case Study

In this section we look at a case study of a government agency in London providing a wide range of services including tax and revenue raising, environmental services, planning and building, road sand highways and social care. This mix is typical of such agencies. To provide context the agency supports over 100 system applications in over 50 key business units each of which supports a separate line of business. The challenge is to understand information architecture and set a strategy which will ensure that the agency is able to provide a coherent 'joined up' service to its community at the most economic cost. This strategy has to be underpinned by the guiding principle that information should

697

be held no more than once and should be re-used or repurposed for delivery to different channels rather than being recreated. That implies ensuring that all information assets are known and recorded and master data kept to ensure accuracy and integrity. To this end the strategy replicates the points made above – the first step is to ensure that all information assets are audited through an information audit and their availability and metadata recorded. This information asset base can then be categorised using the broad headings described in Figure 2 and built as below.

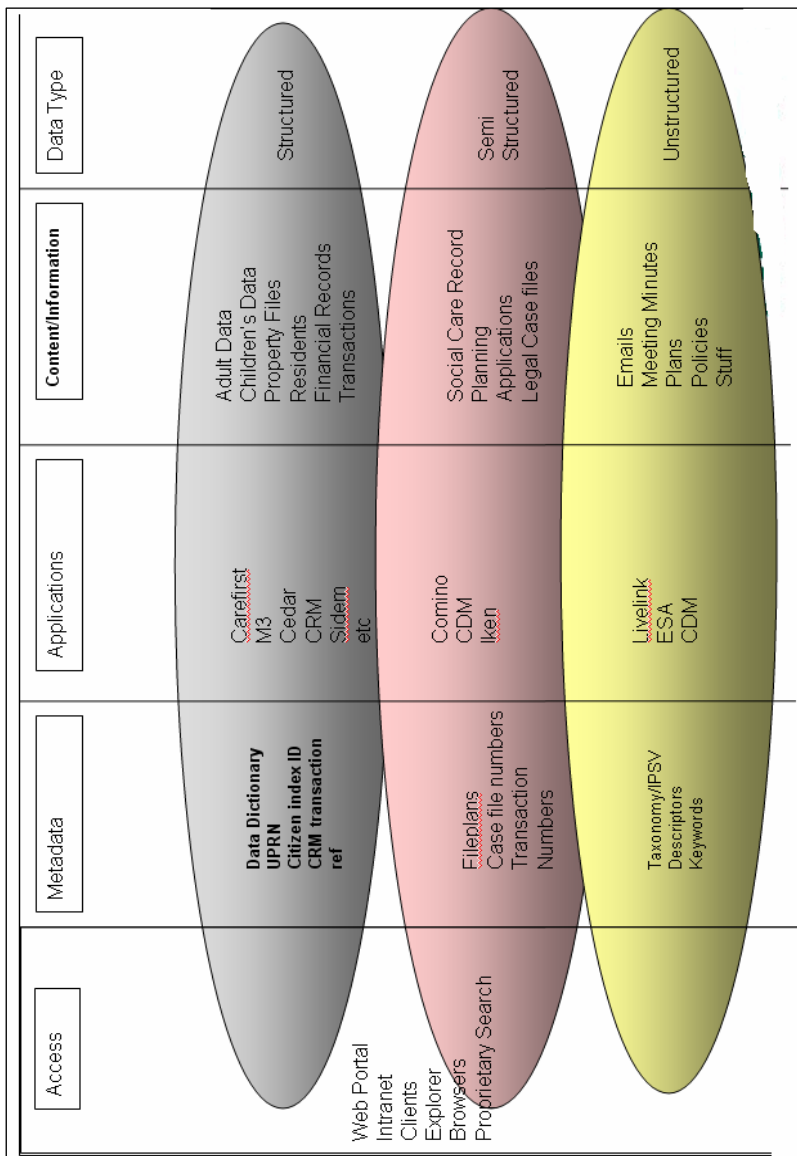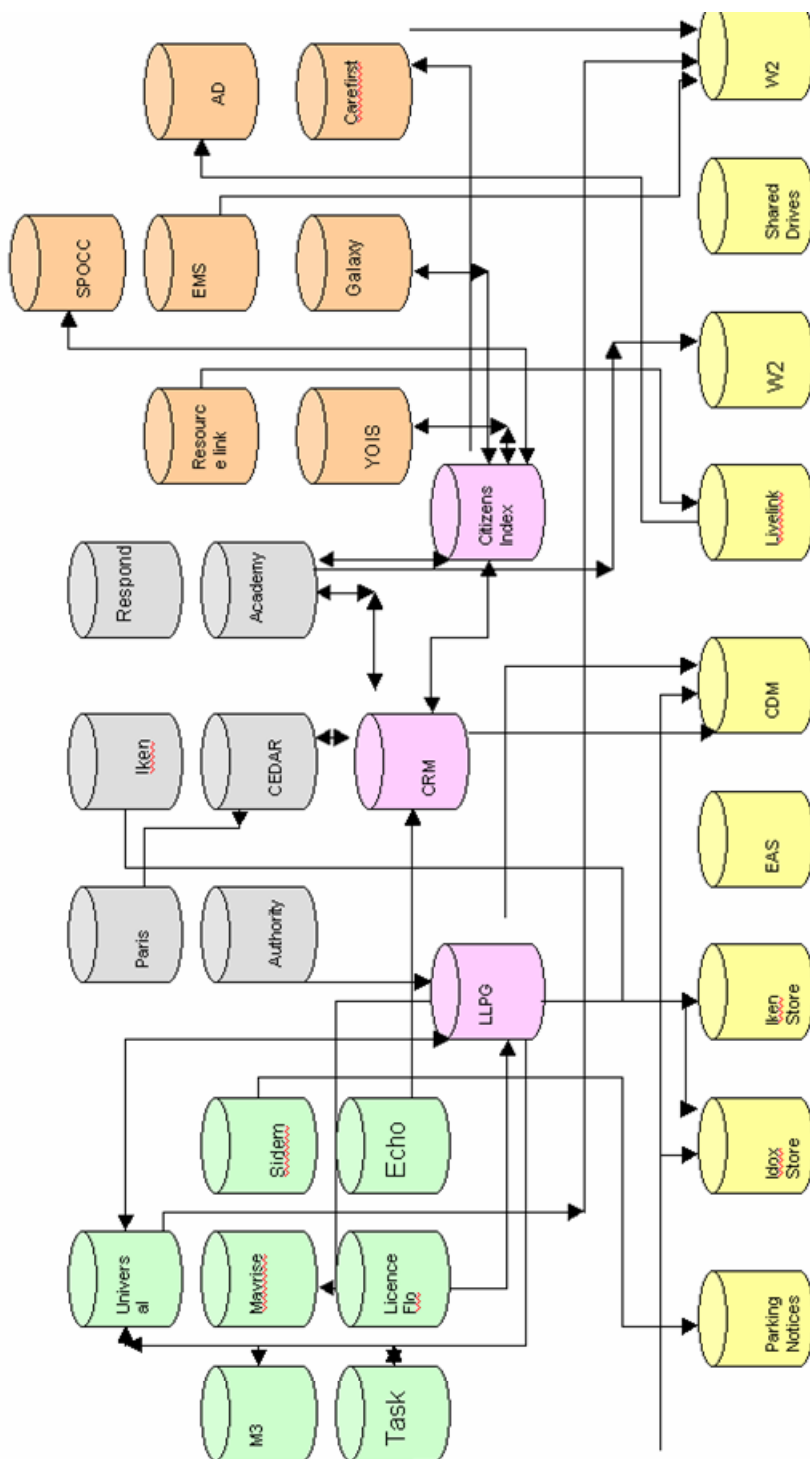Figure 3. Categorising information and applications both horizontally and vertically

Figure 4. Applications categorised on the basis of people, property and transactions also showing integrations between each

699

This in turn leads to an asset analysis described above where key information and the applications, which drive that information, are placed in context depending on the type of information they support.

This can be made even more specific by looking at each independent application and categorising on the basis of the people, property, and transaction analysis described in Section. This is shown in figure 4. In the top left are property related data assets and systems and the link between show the possible integration between those systems so as to ensure that data is not replicated and is sued to best effect. On the right are people related systems whether they are citizens or employees or others. And in the centre transactions bring all these systems together through a customer related system.

This kind of architectural analysis can serve to direct the information strategy and ensure a programme of integrations (the integration plan) so as to maximise the re-use of information across all systems and services. Information should flow swiftly to where it is needed when it is needed with little effort on behalf of staff.

Finally Figure 5 illustrates possibilities for bring all systems together in a coherent structure where independent systems are replaced by overarching corporate systems and the whole can be addressed through an enterprise search engine capable of bring disparate information resources together.
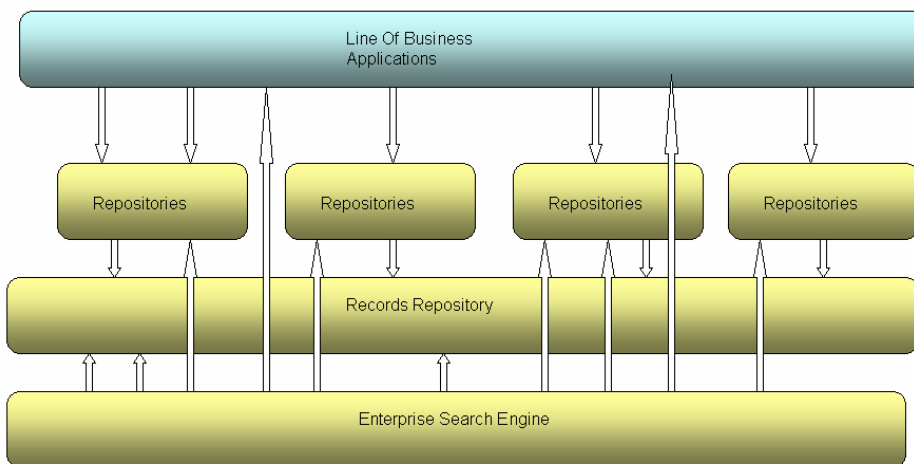

Figure 5. Possible future structure for a local government agency

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