CitiScape Architecture for eGovernment Effectiveness

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Abstract

We introduce CitiScapes, an architectural concept that enables implementers of eGovernment systems to organize capabilities and dynamically present the services to match the context of the citizen and other stakeholders in an effective and efficient manner. CitiScapes addresses the underlying challenges due to the complexities of change in organizational structures and business processes, presentation of thousands of objects and services, and the integration of information systems supporting these aspects. We present examples based on our design experiences working with a large US city and evaluate the CitiScapes concept with respect to existing award winning eGovernment websites. We show how a CitiScapes-based eGovernment web presence can lead to increased usability, navigability, and performance for users as well as enhanced maintainability for administrators.

1. Introduction

As cities and other government organizations evolve from the current generation of websites, they are faced with both complexity and opportunity. The complexity arises due to thousands of legacy objects and content reflecting information provided by silo departments, the number of different departments and the diversity in their capabilities, large amounts of information (like the one-stop call center records) that could be of potential value to other public and private organizations, and, finally, incomplete understanding of citizen needs. Here we present a widely-applicable citizen-oriented conceptual architecture, called CitiScapes, based on the ongoing development of a specific City website.

Government web sites, which up until a few years ago provided limited information to the citizens, are now attempting to progress to higher-and-higher levels and goals [11]:

1. Information: presentation of static material such as publications and information about the services provided by the government agency. This information is seen as “packaged” by the agency, with only limited possibilities to interact with the Web site.
2. Interaction: represented by services such as searching in databases, ordering printed publications, downloading and ordering forms relating services and subscribing to newsletters.
3. Transaction: includes picking up and leaving personal information related to the services provided by the agency as well as initiating and following up on the status of services.
4. Integration: of services between agencies and departments. This is the realization of a one-stop government that, regardless of organizational boundaries, provides services at one point of entry, even where several agencies are involved.
5. Life Events: brings a higher level of interaction and integration to citizens by addressing their needs, i.e. Live, Work, Raise a Family. This level includes personalization and customization of services and interfaces.
6. Transformational: Beyond transforming government services through technology, the goal is to create and retain the capacity to innovate and use technology effectively as technology itself develops, enabling yet more ambitious goals to be set and accomplished [1].

Due to the underlying complexity, however, the evolution of a site to higher levels is not easy. Citizen expectations are high but project costs are not predictable. User experience must also be considered. At the same time, newer trends are emerging that change the way sites have to be designed. For example, Internet savvy users are more likely to use searches than existing site navigation schemes. Many of the goals and aspirations of eGov portals are identified in [20, 21].

The opportunity enabled by the CitiScapes architecture presented here leverages the next
generation of eGov technologies and powerful content management systems (CMS) to 1) provide dynamic context-driven services for both citizens and stakeholders and 2) meet critical user experience goals and achieve the following benefits:

- Quick access to services and focus on what is needed rather than how the departments work
- Integrated services presented to match the life events and roles of users
- Push of information relevant to the user
- Intelligence mining to achieve transformations based on insight into performance
- Trust based on role-based controlled sharing of information
- Increased re-use and maintainability through localizing impact of change.

Our objective in this paper is to present a systematic methodology for constructing portals (tool sets for organized knowledge discovery) [19] that achieve both the organization’s goals and user experience.

2. Background in Research and Best Practices

In this section we will 1) examine the requirements met by award winning web-sites, 2) identify underlying requirements, and 3) show how we can build on existing best practices and research to achieve our objective.

2.1 Attributes of Award winning sites

A competitive analysis of award winning websites has helped us identify the existence of important requirements and objectives in providing the desired user experience. The eGov websites that are successful according to the Center for Digital Government [16] and popular among citizens are the ones which have organized their services around the citizens rather than their departments. They concentrate on helping citizens with varied interests find what they are looking for by connecting them with the appropriate services or information in the least amount of time. We know that these websites, because of the recognition process, are the ones perceived by citizens as the most helpful in meeting their needs; thus these sites are the best examples of those that meet higher levels of e-Government goals as discussed in the introduction. The recognition of these sites is based on goals such as [12]:

- Targeting different user groups: This involves identifying the different user groups who would interact with the portal and provide them with the appropriate view of information and services. The goal is to create satisfaction within every user group, that the agency is committed to addressing their problems and needs.
- Seamless integration between public and private sectors: The citizen who visits the portal for accessing a particular service should not be bogged down by the details of whether the service is public or private. For a citizen, the goal should be to achieve a one-stop portal which would address all the issues that the citizen may have in each context, regardless of service location.
- Simple and logical user interface: Providing good search capabilities is necessary to get the citizens to find the relevant information with minimal effort, thereby increasing satisfaction.
- Good search: Providing good search capabilities is necessary to get the citizens to find the relevant information with minimal effort, thereby increasing satisfaction.

2.2 Underlying Requirements

The types of requirements exhibited by these award winning sites [16] are:

- Identification of roles: The information and services provided must be organized in a structured manner depending on the role and circumstance of the user interacting with the system. For example, typical user groups – or roles - will include residents, visitors, businesses, government, police, city council etc. This ensures that the portal presents a view of the information that is most relevant, and also that the user is authorized to see [14]. Example characterizations of user groups appear in [2] and in existing e-Government websites such as [12, 13].
- Identification of context and life-events: The context of the user is captured in order to project services which are most applicable. For example, instead of viewing healthcare as a governmental department, the portal provides healthcare as a service which is relevant to the citizen with that need. Expanding on this notion further, we can identify the life event in the user’s context that caused the user to come to the website. Examples of life events include getting a job, having a child, losing a loved one, moving, retiring, getting
married, buying/selling property, health or crime events, and more.

- Using right levels of abstraction: A citizen interacting with the portal for accessing a particular service should not be bothered with having to find out whether the service is private or public and which department is offering that service. Thus, the right level of abstraction is needed which hides the unnecessary details. Again, this is achieved by providing a citizen-centric landscape of services as opposed to a government-centric departmental view of the information and services.

- Providing information in multiple ways: The relevant information must be accessible even though different paths might be taken. For example, in the City of Aurora portal [14], ‘Animal Care’ is accessible to the residents through navigation paths of ‘Information’ or ‘e-Services’, but it is also accessed through ‘Neighborhood Services’.

- Focus on giving more than what’s currently needed but not more than what’s necessary: This increases user satisfaction by going a step beyond what the citizen currently requests and giving them what they might need next. In the Aurora City portal [14] for example, the user accessing the portal as a ‘visitor’ to the city is also given information needed to move into the city (housing, utility services, etc.). However, the information is organized such that additional details are provided only if the user is interested in them. This avoids burdening the citizen with unnecessary details.

- Making the most needed information most easily accessible: The news and current events or FAQs on topics that would be of the most interest to the citizens should be accessible most easily. For example, the ‘Today in Tampa’, a section on daily events of interest like exhibitions, association meetings, news, etc. that the citizens could participate in. This has the potential to be extended in a crisis situation like an epidemic by providing information on vaccinations and preventive measures for handling the crisis effectively.

- Encouraging participation of citizens: The citizens are encouraged to voice their opinions on complaints or issues they face in their daily lives. For example, the Singapore website [17] encourages citizen feedback on issues and their solutions through REACH (Reaching Everyone for Active Citizenship at Home) by maintaining blogs and discussion boards where citizens share their experiences and opinions, and using that as feedback for the government.

The top rated sites meet requirements and share characteristics that form the basis of their web presence and most importantly relate the design of the portal to the goals of citizen satisfaction. They are also successful in managing a tremendous warehouse of information and services. The CitiScapes model formalizes this and helps create a more formal architecture that dynamically understands the needs of the citizens, the goals and capabilities of the government and uses the web portal as a means of aligning both of them.

2.3 Research in Information Architecture Methods

Many conceptualizations and specific abstractions exist to help address the requirements above. We discuss the specific concepts and tradeoffs below.

2.3.1 Collaboration and Performance Framework. The structure, process and dynamics of participation and performance of eGov systems can be shown as aspects which affect each other within the larger institutional, business, technical, political, social, economic and cultural environments as in Figure 1 [6]. While this is helpful in considering the issues which contribute to the success or failure of an eGov implementation, in actual development of such a system the problem of mapping this conceptual architecture to the actual implementation still remains.

Figure 1: Collaboration and performance framework

2.3.2 Taxonomies and related definitions. We next include definitions here that will be used throughout the rest of the paper to illustrate the mapping between
aspects of collaboration, performance, and system implementation.

**Taxonomy**: is a way of classifying things into categories. Taxonomies are most often hierarchical in structure, with “is-a” or “part-of” relationships defined between each category level. With a taxonomy, we can achieve classification of objects along one dimension, as well as an indication of how they are related to one another given the built-in relationships of the given taxonomy. An example taxonomy appears in the services dimension of Figure 2.

**Faceted classification**: is a way of classifying things into categories defined on multiple dimensions. For an object, we may be able to decide which taxonomic category it belongs to by looking at one of its attributes. However, in faceted classification, there can be multiple attribute types (facets) and values that determine which categories the object belongs to.

**Information Object**: is a collection of attributes that logically defines an entity. Attributes include those that are normally considered “data” along with “metadata”.

**Object**: is term is used to refer to information objects, aggregates of information objects, services, or process interfaces. An object also has associated triggers that can take parameters in order to enable the execution of queries to populate objects with data.

**View**: one or more views are defined on each object to dictate the appearance of the object in a given CitiScape.

**Item**: we differentiate items from objects simply by the fact that an object is view-independent, and an item is the object with a given view.

### 2.3.3 Representation methods and trade-offs.

Taxonomies such as the IPSV [7] exist for the purpose of organizing government information and services to present to the user. However, an inherent limitation exists in that a hierarchical taxonomy only allows classification along one dimension; in the case of the IPSV it is the “type” of service or information that makes up the category. Faceted classification improves on this by allowing us to use multiple additional facets to organize services and information as discussed in the next section.

The conceptual architecture must also be physically realizable in order to meet the needs of a government organization. An implementation vehicle such as a Content Management System (CMS) is one possible way of structuring and classifying the complexity of services and information that exists within it. Most CMS systems incorporate the use of a taxonomic structure to classify and organize the objects within them. Having a folder structure containing objects and folders that in turn contain other objects is one way to realize this hierarchy. Representing the domain in terms of objects made up of attributes facilitates easy modeling of intricate relationships that exist and also increases reusability and flexibility.

Some CMS even allow the content to be tagged to multiple taxonomies; however, this kind of tagging does not help to provide a user-centric view of services. For instance, a government organization typically has many departments to provide an array of services to the citizens. Classifying the services according to department may be helpful for the administrators designing the web presence, but provides no help to the users, as the differences between their government’s Public Service and Public Safety departments are probably not common citizen knowledge.

Use cases and user modeling techniques attempt to address this problem. These techniques encourage the use of taxonomies and other metadata schema in order to define entities and the relationships that exist between them. However, in the case of portals, the context-driven user needs are too dynamic to define use cases and build a web presence around those use cases. Also, the task of identifying what a given user wants from the system is a huge and difficult task that is often not within the capabilities of content developers and web administrators.

The increasing popularity of search engines and wikis has increased flexibility in terms of assimilating information that the user wants. A wiki’s flat structure for organizing information is effective especially along with search technologies that are continually improving in order to provide the most relevant information to the users in the least amount of time. But if citizens are eventually going to use searches that can give them better or equivalent performance results, why do we need a conceptual framework such as CitiScapes?

The answer is that in the case of the citizens interacting with the government, the knowledge of what they are looking for does not lie entirely with the citizens. The citizens have partial knowledge about what they want and the rest of the knowledge of what is needed is with the departments. By using a search or a wiki structure, the citizen will be able to access only those services that he or she is aware about individually. For example, a recent graduate who is newly employed might be aware of services such as getting an SSN, filing taxes, etc. The graduate would be less likely to remember about voter registration before it is too late. Thus, we illustrate that we need both search capabilities and the ability to ‘push’ relevant information to users, much in the same way as online advertising.
Marriage
Stakeholder
Sight seeing

3. CitiScapes and Dynamic Architecture

The context of the citizen, the use of services, the services capabilities and the underlying IT components can be organized in four dimensions, each with associated taxonomies organizing the related objects as illustrated in the architecture of Figure 2. Each dimension is described below starting from the top dimension. Subsequently we will discuss the dynamic relationships between these dimensions.

3.1 Portal Taxonomy Dimensions

Context taxonomies:
This consists of life events and roles taxonomies that together help identify what is known about the user. Roles and life-events are also distinct facets of a user. For example, a person’s role as a senior citizen may be impacted by various life events that include retirement, marriage, divorce and so on. The same events might also impact a person in the role of a parent.

CitiScapes taxonomies:
We use healthcare services for citizens to illustrate the CitiScapes conceptualization. Healthcare is an example of a governmental entity that would have a significant degree of direct interaction with citizens and other stakeholders. There are many different roles which would interact with the health department for accessing its services. The roles could include citizens, visitors, businesses, employees and other agencies. The services and information provided to each role would vary depending on the needs and context of the user. The services themselves could be categorized from the user’s perspective. For example different CitiScapes could offer services as follows:

- **Healthy living**: This could include exercise tips, nutrition or diet instructions and stress management techniques for promoting healthy living among citizens.
- **Getting and paying for healthcare**: This could include information on common diseases, nearby hospitals and the healthcare services provided in each of them, information on support groups such as those for cancer or addictions, rehabilitation information, and online services such as scheduling appointments. The information and services related to financial aspects of healthcare could include health insurance information or search, medical claim plans or even tips on saving with healthcare.

The services that the visitor roles would be interested in when moving to ‘Healthy living’ could include some of the above, like getting information on nearby hospitals and healthcare services, but it could also include international patient guides, emergency services, and other consumer-oriented services.
services, etc. The government or other agencies moving to the same CitiScape would be more interested in services metrics and statistics related to various diseases which could be useful during epidemic or other emergency events.

Thus, with the CitiScape conceptualization, a space can be dynamically populated for each role and interest group based on the event. This space will thus provide those services that are relevant to each role and interest. More generally, by entering a particular CitiScape, the user explicitly or implicitly provides information that allows the system to guess at the service transactions most likely to meet needs.

CitiScape definition:
We can now define a CitiScape as a logical collection of items. Each object should be unique in an information system (i.e. there should be no duplication), but an object can have multiple points of interaction by appearing in multiple CitiScapes. Each CitiScape is designed to have the following three characteristics (see illustration in Figure 3):

1. Characterization of items by at least six facets:
   - Role of the citizen
   - Life-event of the citizen that is causing the visit
   - Services that correspond to the life event, role and the CitiScape
   - Time of service delivery
   - Value of service from each stakeholder perspective, and
   - Location of service delivery

2. Facets as a basis for dynamic rules: The facet values provide a basis for applying rules that connect the citizen to the services. The facets characterize objects in each dimension. For example, they may have default values that determine how the CitiScape is presented to the user. If more specific information is known about the user – for example the role and events – then the selection of the CitiScape causes the local triggers to use these more specific parameters to dynamically populate the specific services from the underlying dimension.

3. Conceptual design of CitiScapes: The user’s perspective is the starting point for design. The rules dynamically connect the conceptual service (or services) to implementation-oriented services. At the same time it also allows us to organize CMS objects into larger display-independent abstractions for re-use. This allows us to share specific information and services leading to several additional advantages that will be discussed later.

Business Services taxonomies:
The typical range of services has been identified in taxonomies for eGov [7]. These taxonomies define the areas of concern for users interacting with governments. Additionally, many government web presences already make use of a taxonomy or definite folder structure as a way of organizing information. These taxonomies are hierarchies or acyclic graphs that describe the departments and their competencies. As illustrated in this dimension (see Figure 2), each department has many service capabilities that are organized. With the CitiScape architecture, each service in this dimension can contribute to many different CitiScapes in the dimension above.

Infrastructure taxonomies: Each IT component provides information services that are useful in the delivery of a service. For example, access to citizen records, 311 calls, single sign-on password, etc.

3.2 Dynamic ‘Pull’ Population of the CitiScapes

CitiScapes Rules:
Given the complexity of navigating the dimensions, even when they are organized into taxonomies, we need a way to make the right subset of services available to all of the different types of users. To accomplish this, the dimensions are related dynamically by rules that classify the context and based on the classification query the services that need to be displayed. The role and life event context of the user, including related keywords and clicks, are interpreted as input parameters to an information retrieval trigger that populates the particular CitiScape with services of interest. This minimizes navigation between the dimensions and allows the same service to be used whenever applicable by identifying the context...
of the user and allowing the user to pull services that match.

As an example, consider a parent who needs to find information on their children’s school vacation days. This user belongs to a very broad group of citizens with the context dimension. If we can detect that the user is a parent of children at a specific school, then the service need is specific and can be implemented as a specific request belonging to a general category of school-related or even education-related services provided by the services dimension. In addition, the location facet lends itself to hierarchy very well; the need focuses on a certain school, which may be a subset of a school district or located in a certain part of a city. (We leave the discussion of how this detection of user context is done to future work.)

Citizen-specific CitiScape:

Next we show how a CitiScape architecture accomplishes this by integrating both retrieval and filtering concepts [15] to provide the user with customized e-landscape. The details are accomplished by the organized portal dimensions, taxonomies, and faceted nodes that are connected dynamically to provide the user with a custom CitiScape as follows.

To dynamically populate a CitiScape, we use the ideas of faceted classification [8]. Whether a departmental service belongs to a particular CitiScape is determined by faceted classification. CitiScapes and Services are both organized based on a collection of categories, called facets. Each of which has a group of associated default values that describe the information.

A CitiScape has default facet values. However, if more specific role and event facet values are known, they are used to customize queries that ‘pull’ to populate more specific services, time, location and value/cost information into the “Getting health care” CitiScape. The long-term characteristics of a user (e.g. lives in a certain neighborhood, is a frequent user of the website, is a parent/senior citizen/college student, has certain interests or works in a certain profession) can also be combined with their short-term information need to provide a rich user experience. Additional facets may also apply to populate the CitiScapes – such as accessibility alternatives.

Thus, through our notion of CitiScapes, we support the interaction of the user with the system and help the system in making intelligent choices with regard to the services that it needs to push to the user based on how they enter the system, their behavior within the system, system metrics, and other metrics that will be used to define facet values. This conceptual model helps the government bundle services together to be provided to citizens in the appropriate order and relevance, thereby enhancing the user experience.

User experience with Dynamic CitiScapes:

The effective organization of services or information items is crucial for the government in order to provide citizens with the enhanced user experience and remain competitive itself. However, the organization of these items is as challenging as much as it is crucial. This is because each of these items can be of interest fully or partially to more than one user group while a single user group may be interested in a varied collection of items.

As shown in Table 1, various user groups such as citizens, visitors, families, seniors, safety and health workers would like to interact with the City to access the items of interest to them. This would be a subset of all the information items and services that the Government has to offer. The use of the facets as cues for user interest is illustrated next.

Services such as finding a hospital, doctor, or insurance will probably be most helpful to the user if they take into account the user’s location. Most of the services and information in the health example are applicable to citizens in general, although finding a

### Table 1: Sample items pertaining to health-related CitiScapes. - denotes the default value for the facet.

<table>
<thead>
<tr>
<th>CitiScape Item</th>
<th>Role facet</th>
<th>Event facet</th>
<th>Time facet</th>
<th>Location facet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paying for Healthcare</td>
<td>Citizens</td>
<td>Finding Healthcare</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Find Flu Shots</td>
<td>Citizens</td>
<td>Finding Healthcare</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Make Appointment at Clinic</td>
<td>Citizens</td>
<td>Finding Healthcare</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Find Doctor</td>
<td>Citizens</td>
<td>Finding Healthcare</td>
<td>., urgent</td>
<td>., proximity to user</td>
</tr>
<tr>
<td>Insurance Search</td>
<td>Citizens</td>
<td>Finding Healthcare</td>
<td>-</td>
<td>., proximity to user</td>
</tr>
<tr>
<td>Find Hospital</td>
<td>Citizens, Visitors</td>
<td>Finding Healthcare</td>
<td>., urgent</td>
<td>., proximity to user</td>
</tr>
<tr>
<td>Nutrition/Diet Info</td>
<td>Citizens, health care providers</td>
<td>Staying Healthy</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Exercise Tips</td>
<td>Citizens/Seniors/Families</td>
<td>Staying Healthy</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Staying Healthy in Winter</td>
<td>Citizens</td>
<td>Staying Healthy</td>
<td>., winter</td>
<td>-</td>
</tr>
<tr>
<td>Family Health Tips</td>
<td>Families</td>
<td>Staying Healthy</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Evacuation</td>
<td>Citizens, safety providers</td>
<td>Health</td>
<td>Urgent</td>
<td>-</td>
</tr>
<tr>
<td>Sign up for Email Update</td>
<td>Citizens</td>
<td>Health</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
hospital is an example of a service that might be of interest to visitors as well.

Exercise tips is an example of a dynamic information object that can take parameters from a CitiScape and return specific information depending on the context of the CitiScape. Here, different exercise information will be presented, depending on the role of the CitiScape, which in turn depends on the role of the user. The *time* facet may be used to determine in which situations or times information is available; for instance, in case of a health emergency, users visiting any of the health CitiScapes may be redirected to a CitiScape dealing specifically with emergency services and information. Thus, for example, the items from the table above could be dynamically assembled into the identified CitiScapes in Figure 4. These CitiScapes cater to the interests of different users based on their context of interaction.

![Figure 4: Example CitiScapes associated with Health.](image)

### 4. Application Benefits of CitiScapes Architecture

In this section we explore the more strategic benefits of the CitiScape architecture further.

**Business Intelligence Mining:**

CitiScape architecture realizes that the knowledge of the services that the user needs is available only partially with the user while the Government itself holds a lot of that knowledge. Hence, a symbiotic interaction is facilitated by CitiScapes between the user and the Government. With every step in the interaction, the user reveals more of his interest and context of interaction and the system narrows these services and pushes them to the user. The interaction sequence could be also monitored as follows:

1. A user enters the system through a general CitiScape providing value for location and time.
2. When a user is identified as a citizen, the system knows that the user could be interested in spaces like Citizen Finding Healthcare, Citizen Emergency, Citizen Staying Healthy, but they could also be interested in other spaces like job opportunities, community events, filing taxes etc. They could even be interested in more specific spaces like Senior Health or Family Health. This provides intelligence on populations and in certain areas.

3. If the user indicates interest in finding healthcare, the system narrows down the services that it will push to the user. So, the focus now will be on spaces related to healthcare as opposed to spaces related to employment or taxes, for example. The user may then access an item like general exercise tips or finding a doctor. Thus, the spaces of Citizen, Staying Healthy, Citizen Finding Healthcare and Citizen Emergency will be relevant for this level of interaction. Now we have a significant understanding of the users’ interests. The user may choose to stop at this level if their need has been met, or he may continue interacting with the system to get more services. This type of telescoping can provide significant understanding of trends within populations as well.

4. Next if this user is a senior citizen, they could enter the CitiScape for senior citizens and now access additional items or even view the same items from the perspective of a senior citizen. So, if they want to look at exercise tips, they could find those specific to senior citizens in this CitiScape. They would also be able to find other information such as nutrition, common ailments, and access services such as participation in community events for senior citizens. They could access a general service like finding the nearest doctor or hospital but could also access a specific service such as finding a doctor specializing arthritis, since they are now a part of the Senior Health CitiScape. Thus, they are now looking at not only those services that they initially thought they wanted, but also related services in which they would now be interested, even if they weren’t aware of them initially. Again, this provides insights into new needs.

In summary, this sequence illustrates several aspects 1) the user has an intuitive and progressive interaction with the system that provides needed services, 2) the sharing and reuse of items like ‘exercise tips’ across spaces and in contexts that are both general (as in the Citizen Staying Healthy CitiScape) or more specific (as in the Senior or Family Health CitiScapes), and finally, 3) the dynamic population of the spaces based on citizen interaction to provides significant intelligence.
**Dynamically enhanced navigation and user experience:**

In a traditionally organized website, the citizen might begin at the city homepage, and traverse links through a structure that is often organized by department. We can think of the CitiScapes architecture and navigation path as a continual narrowing down of the user’s intent until the user arrives at a place where they can complete their intended interaction. However, even this generalization is optimistic for many government web presences which have become cluttered and disorganized due to the rapid increase in demand for online services and the lack of time and/or experience necessary to keep all of the information contained in a web presence accurate, timely and organized. In addition, the internal organization structure (e.g. departments) is not an appropriate structure for navigability. For instance, given a certain service need, how would a citizen know whether his or her request should go to the Public Service or the Public Safety department? As shown in the previous section, CitiScapes addresses these issues by providing views of services relevant to users, their roles and interests, and the additional facets that account for their individual context for using the system.

**Improved reuse and searchability:**

The overall approach used at all levels is to dynamically populate the CitiScapes and the items within them with content. The content objects themselves are all maintained in a self-contained and local fashion and used whenever and wherever they meet the criteria. This occurs not only when populating the CitiScapes but also when developing content. To illustrate the point, suppose a content provider role needed to add a new news story to ‘Getting Health Care’. In the proposed layered CitiScapes architecture, the news story would be a specific independently maintained object with a collection of attributes, such as Title, Author, Date Created, Date of Expiration, Summary, Body, and Subject, along with additional attributes to define its position in an underlying taxonomy and its applicability to various CitiScapes. Instead of creating all of the attributes’ values uniquely, the content role will have the opportunity to select from existing objects as values for attributes of the news story object. Selecting an object and content that most likely already exists in the system enforces reuse of the existing information, avoids duplication, and specifies a dynamic relationship between the two objects – Getting health care and news story. Next a query can be easily constructed to find any news story releases related to a given subject.

Moving to such a dynamic approach also allows us to take advantage of semantic querying. For example, logic and ontology languages such as RDF and OWL can be used to express relationships between objects and facilitate flexible queries and searches, as well as inference.

**Improved services:**

The role facet allows great flexibility of user access to objects in a CitiScapes-based system. It supports the integration of various services using data from the enterprise directory and CMS-based user registration as well as profiles gathered from user behavior and online transaction activity. As the users in different roles narrow their intent by navigating and providing values for the different facets that the CitiScapes are built on, the system pulls appropriate service items based on accumulated knowledge about the particular user. For instance, if there exists some profile or cookie information indicating that the given user has used the website many times to find information on public parks, the system might direct them to a CitiScape having a focus on parks or outdoor activities. If we know that the user is a citizen of the city, the system will direct them to a citizen-centered CitiScape, as opposed to directing a visitor to a visitor-centered CitiScape. This two-way interaction will help us identify those services that are used often and in what context, those that are not used and even what CitiScapes are effective. Thus the information can help the government strategically to develop services that are more specific to the citizens.

**Service Use and IT Traceability:**

A CitiScapes implementation improves the ability to collect and mine relevant information about how, when, and where services and information are used. For example, we can now track for each object which CitiScapes are being used to access it, and thereby know which user groups and roles are associated with its use. Combining this information with traditional web presence metrics such as length of time spent viewing information or completing a service, navigation patterns, and frequency of access will allow more user-centric performance data to be gathered. Deriving patterns from these observations will allow the government organization to truly understand the needs and habits of the citizenry, and incrementally improve the services and information it provides. Additionally, we will be able to provide business-IT traceability, because we also know which back-end system each object is residing in, and therefore track the usage of these systems in order to provide better analysis of technology use.
5. Conclusions

Structuring an eGovernment system around the concept of CitiScapes will provide significant benefits to users of the system as well as administrators and stakeholders. The dynamic population of CitiScapes presents users with services chosen to match their roles and needs, thereby affording the opportunity to ‘push’ highly relevant services to a user in addition to retrieving information to satisfy a given need, while ensuring trustworthiness and security by only providing services that the user can access based on their role. The organization of services by relevant facets gives users easy access to needed services without having to understand how the government organization is structured. The support for underlying information objects and relationships provided by the CMS allows the connection to be made between the different dimensions of the portal environment; it is now possible to keep track of when, where, how and by whom services are being used, and gather this information to provide performance feedback to the system for future improvement. In addition, the reusability of information and service objects across multiple CitiScapes increases maintainability of the web presence by centralizing the change process away from pages toward services. Finally, we envision that eventually the support for CitiScape-type features will be incorporated into CMS systems to enable better socio-technical interactions.

6. References


