Enabling mGovernment: a framework and a case study

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Abstract: Organisations are increasingly turning to Content Management Systems (CMS) to handle the delivery of information to stakeholders. For companies hoping to supply to the mobile demand there are two options: either create duplicate information for mobile devices or leverage their existing CMS data. As the creation of duplicate information is often excessively time consuming and costly, leveraging existing content and repurposing it to a mobile friendly format is the optimal route. This paper explores the case of Oakland County's eGovernment in this endeavor, and proposes a three-stage approach involving a Process Transformation Framework (PTF), a Mobile Content Platform (MCP), and an Asset Leverage Strategy (ALS), that affords flexibility, scalability and reuse of existing digital content by organisations for the mobile channel. In addition, the requisite market research to identify the web content and services of greatest value proposition to a government's constituents (residents) is presented.

Keywords: government; eGovernment; mGovernment; mobile; content; framework; survey; implementation; CMS; content management system; e-finance; services; case study.

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1 Introduction

With more than 5 billion mobile subscribers around the world (Ericsson, 2010), and 700 million of them accessing the Internet via wireless devices (Huntington, 2011), mobile devices have become an integral part of daily life. These devices transform the way people communicate by incorporating unprecedented user mobility and speed in the transfer of information allowing people to access information on-the-go; this in turn creates a demand for the reformat and delivery of content offered through conventional wired technologies. Many well-invested businesses have established Content Management Systems (CMS) in house that handle the delivery of information. For companies hoping to meet such mobile information needs there are two options: create duplicate information for mobile devices or leverage existing CMS data. As the creation of duplicate information is time consuming and costly, most businesses are typically better off leveraging their existing content by converting it to a mobile friendly format.

Oakland County, Michigan is committed to serving its communities through empowered and progressive leadership that is entrusted to embrace innovation in every aspect of government. The Oakland County eGovernment leverages existing technologies to provide state-of-the-art programs and services to the community in order to bring citizens, businesses and education closer together with government. Oakland County has a large investment in its CMS and an ever growing citizen base that has quickly adopted the mobile market. Responding to this trend, the Mobile Content Services Initiative (MCSI) was formed in 2006. The MCSI was a joint venture between the Oakland County eGovernment and the Colleges of Business, Communication Arts and Sciences, and Computer Science and Engineering at Michigan State University (MSU). A private-public partnership between MSU students and Oakland County eGovernment personnel investigated the possibilities of leveraging information residing on existing Web-based CMS for further delivery to and access by small-format mobile wireless devices.

This paper explores the MCSI and the potential for replicating its results to other organisations. This paper will present details of the MCSI, which consists of three components that were developed in sequence:

- a Process Transformation Framework (PTF)
- a Mobile Content Platform (MCP)
- an Asset Leverage Strategy (ALS).

The modularity provided by these three components allows the MCSI's work to be customised and adopted by organisations looking to expand current wired-Web applications onto mobile formats.

2 Literature review

2.1 e-Government defined

Electronic Government refers to a government's use of technology, particularly web-based Internet applications to enhance the access to and delivery of government information and services to citizens, business partners, employees, agencies, and government entities. It has the potential to help build better relationships between the government and the public by making interactions for the former with citizens smoother, easier, and more efficient. Government agencies report using "electronic commerce (e-commerce) to improve core business operations and deliver information and services faster, cheaper, and to wider groups of customers" (McClure, 2000). Unlike traditional communication systems, eGovernment provides non-hierarchical, two-way interactions without time and space constraints and has improved public confidence in government (West, 2004).

eGovernment entails four major aspects:

- establishment of a secure system for government information
- web-based service delivery
- application of a government's e-commerce
- digital democracy (Moon, 2002).

The audiences being served by such e-Government services can be categorised into four segments:

- government to citizen (G2C)
- government to business (G2B)
- government to government (G2G)
- government's Internal Effectiveness and Efficiency (IEE) and overarching infrastructure (cross-cutting) (Lee et al., 2005).

The Digital States Survey, a study that examines best practices, policies and progress made by state governments in their use of digital technologies to better serve their citizens and streamline operations, reports that "four states received A grades, with Michigan and Utah receiving an A and Pennsylvania and Virginia receiving an A-" (Center for Digital Government, 2010). The survey evaluated state governments with respect to eight categories, including adaptive leadership and innovation; citizen engagement and open government; and administration and human resource management. State governments that earned a high grade had demonstrated results across all eight categories.

Arguably, the most visible of the four sets of e-Government services are those intended for citizens. G2C emphasises on using electronic communication systems to build a bridge between a government and its citizens. "One of the most popular benefits of G2C is the simple posting of forms and registrations that were previously only available to those who were willing to wait in long lines or wait for forms to be mailed to them" (Evans and Yen, 2005). Already, G2C has been applied in

- the US Department of Education for providing quantifiable information to parents
- political systems for monitoring prisons
- the administration of voting
- the court system
- the Social Security Administration
- the registration of motor vehicles.

The utilisation of eGovernment services is contingent on citizen trust, innovation and acceptance. A perception of online government services as easy to use is likely to increase the frequency of their utilisation. An important antecedent for such adoption is the compatibility of these services across the plethora of devices, form factors, and underlying technology. Unlike e-commerce, where businesses may target specific populations, e-government must be made available to the entire eligible population (Carter and Belanger, 2005).

2.2 m-Government defined

Over the past decade, advances in wireless and mobile technologies have changed the market landscape for mobile devices (Coursaris and Hassanein, 2002). A wide range of form factors and enabling technology has created an abundance of feature phones (i.e., traditional mobile phone form factor), Personal Digital Assistants (PDAs), wireless laptops, and hybrid

products that combine old features and introduce new ones, with most notable examples the newer touch-screen smartphones (i.e., mobile phones with embedded operating systems that support installed and web-based applications) and tablet devices (e.g., Apple's iPad). These new information and communication technologies have afforded government to extend their eGovernment services and reach citizens anytime, anywhere (Ghyasi and Kushchu, 2004) giving rise to a new mode of citizen servicing in mobile government or m-government.

"M-government has the possibility to extend the reach of e-government. Mobile devices, always with the user, enable government information to be reached from more places, extending the reach of the internet. In most countries, mobile penetration exceeds internet penetration, which enables government services to be reached by more people" (Mobi Solutions, 2010).

Forecasts of growth in this arena have constantly failed to meet targets, e.g., according to eMarketer, the number of wireless Internet users was set to surpass the number of wired users by the end of 2007, with 56.8% of all internet users connecting wirelessly (Trimi and Sheng, 2008), something that has not materialised to date. Instead, a more recent study by IDC suggests that this transition will occur in 2015, when "the number of people who access the internet wirelessly will surpass those who surf the web via wired connections" reaching 2.6 billion Internet users (Campbell, 2011). Regardless of when that occurs, the realisation that citizens are increasingly using their mobile devices to access web-based information has given impetus to increased m-government activity.

"M-government is defined as a strategy and its implementation involving the utilisation of all kinds of wireless and mobile technology, services, applications and devices for improving benefits to the parties involved in e-government including citizens, businesses and all government units" (Kushchu and Kuscu, 2003).

M-government is value-added e-government because it offers the following advantages:

- it improves the delivery of government information
- m-technology may be the best solution to overcome internet connectivity problems and digital divide issues faced by e-government applications
- compared with wired networks, wireless networks appear to be a more cost-effective choice for countries with dense populations and difficult terrain
- m-government applications can help avoid problems faced by some countries (Trimi and Sheng, 2008).

M-government services may be found in law enforcement, fire fighting, emergency medical services, education, health, and transportation (Kushchu and Kuscu, 2003). In the U.S., several states have applied m-Government in the public sector: The State of Virginia has applied m-Government to make its services more available to citizens through its 'My Mobile Virginia' project; The State of California also provides mobile-based services on energy warnings, traffic jams, state lottery results, and press releases through the "My California on the Go" project; The fire department in New York City has combined mobile equipment (e.g., IPAQs) with Global Positioning System (GPS) to identify directions and locations (Moon, 2004). Canada provides citizens with access to government information, which includes contact information, passport services, economic indicators, and government news releases on the go via its "Government of Canada Wireless Portal" project. Western Europe, exhibiting a 100% mobile phone penetration rate has a wide

acceptance of m-technology. Mobile services such as Short Messaging Systems (SMS), GPS, and MapMate are widely being used in the enablement of government services (Trimi and Sheng, 2008). m-Government is also being used in developing countries. In Turkey, for example, such services are mostly confined to G2G where mobile and wireless technologies are utilised within the government agencies to make them more effective and efficient. In the Czech Republic, m-Government applications are used for delivering important messages to citizens in time of crisis (G2C), while a few applications exist where there is interaction between the government and the citizens (both G2C and C2G) as in case of m-voting" (Ghyasi and Kushchu, 2004).

2.3 *m-Government challenges*

While the examples shared above paint may paint a rosy picture for mGovernment, a number of challenges stand in the way of similarly successful implementations that can generate optimal value for all stakeholders involved, and primarily for the end users, the citizens themselves. One such challenge may be the lack of compatibility between the mobile systems considered and the existing eGovernment systems. The challenge may be even greater in cases where government offices are using legacy systems that are difficult to integrate with. "The solution lies in implementing open systems using open, not proprietary standards". (Antovski and Lallana, 2004). Antovskij and Lallana also argued that m-Government should make effort on optimising its I.T. solutions by focusing on mobile communications and enabling technology. They further raised the concept of interoperability, which is the stipulation of common data models and common protocols for exchanging data that facilitate information exchanges among mobile systems. Europe launched the Mobile Services for Government (M-GOV) project, which is a research and innovation project at the Institute of Informatics, designed to encourage access to new mobile and wireless public electronic services. M-GOV is intended to contribute to the development of a new cost-effective, open public service platform for mobile citizens. The new platform will support usability, openness, interoperability, and scalability (Antovski and Lallana, 2004). Interoperability between agencies of heterogeneous technologies has also been enabled via message adapters provided in the Inter-Agency Messaging System (IAMS), which uses a flexible XML format called Mobile Government Extensible Language (MGML) in binary form (i.e., optimised for the mobile environment) (Antovski, 2007).

However, as m-Government is yet one more channel for the government to operate through, it creates additional costs. This will continue until m-Government can truly substitute for other delivery channels (Lallana, 2008). Until the, a high degree of data and service duplication is expected. Power (2009) claimed that high level of duplicate customer data can:

- annoy customers or undermine their confidence in organisations
- increase mailing costs
- cause hundreds of hours of manual reconciliation of data
- increase resistance to implementation of new systems
- result in multiple sales people, sales teams or collectors calling on the same customer.

According to Sharp (2010), the solution lies in duplication data consolidation, which can eliminate redundant and costly data. Sharp found nearly one million duplicate customers records on a marketing group he worked with and the estimated operations cost reduction was $450,000 in the first year alone. The American Health Information Management Association (AHIMA) also published that duplicate data led to an extra fee between $10 and $20 per pair with a total cost in the millions of dollars. Hence, "... there is evidence that the value proposition can be significant and can indeed add value to data-driven organisations" (Sharp, 2010).

The motivation behind this project is to produce a generalisable framework that can be used by government organisations in any setting as they invest in the migration to mobile service delivery. Hence, what follows in the remainder of this paper is the development of such a framework and an illustration as it applies in the case of the Oakland County, Michigan, eGovernment. The framework and the case study combined can support similar government initiatives elsewhere in the future.

3 Methodology: Oakland County eGovernment Case Study on Implementing m-Government

Oakland County eGovernment[1] is tasked with the integration of "web application services and tools through the (Oakland) County to create a seamless interface for conducting business online with the County". This government was faced with the same challenge of managing the migration of data and services to support mobile users as described in the previous sections. To overcome this challenge, the Mobile Content Service Initiative (MCSI) was founded by maintaining a current network architecture and content servicing while moving into mobile content deployment.

The MCSI was composed of Michigan State University students and Oakland County's eGovernment personnel. The MCSI was further supported by the faculty and staff of Michigan State University and Oakland Government. The entire MCSI lasted four months and fulfilled its purpose, i.e., Oakland County had become equipped with a working mobile content distribution system.

Specifically, the goal of the MCSI was to provide the Oakland County eGovernment with a MCP and an ALS, which included an analytical break down and identification of key mobile content pages to be supported on mobile devices, and recommendations and strategies for building upon the provided mobile platform. The MCP was intended to act as the bridge that would connect to Oakland County's pre-existing assets and link them to a mobile user. The analytical break down was to be done on Oakland County's current web traffic and validated by means of a survey of the population in an attempt to identify key areas of users' content/service interests. These areas were than analysed on the basis of their ease of portability to mobile displays. Recommendations and strategies were devised to give specific resolution to problems uniquely found in Oakland County.

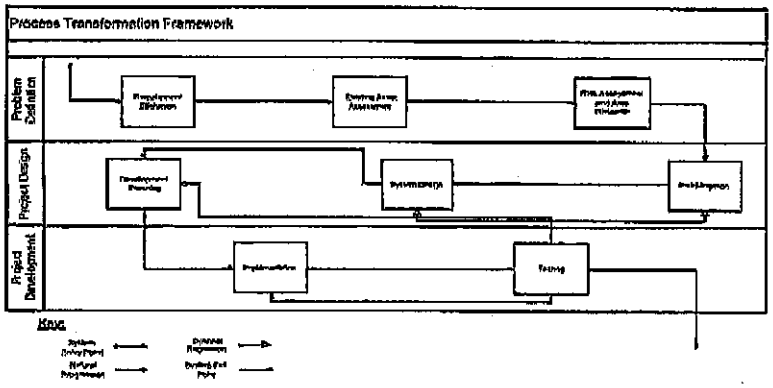
Upon its completion, the MCSI had also provided evidence that the concepts, methodologies, and techniques used to develop the MCP and ALS were successful in this regard. By reflecting on the entire set of goals, objectives, and actions undertaken within the context of the MCSI, a PTF was developed that is generalisable across organisations. The PTF is described next, followed by an overview of the MCP, and finally the ALS, all of which precede an illustration of the PTF in action through the "Oakland County Mobile Content Services Strategy and Prototype".

3.1 The Process Transformation Framework

The PTF is a proposed methodology to structure the preparation, design, and development of a project that specialises in building upon existing assets. What makes the PTF unique from conventional system development methodologies is its focus on the reuse and leveraging of existing assets. Asset re-use simply means that during the development phase of a project existing systems and hardware will be a major focus of re-use during the design and implementation of the new system. This allows for new value to be extracted from existing systems by re-purposing and extending the life of existing assets. A focused vision for the system to be developed and a detailed inventory of existing assets are critical in this transformation effort.

The PTF is a skeleton of linked goals and objectives that should be followed during the design and development phases of a project. Early in the conceptualisation of the PTF an issue was identified regarding the over-specification of the MCSI project. In resolution, the PTF was injected with flexibility through the abstraction of processes. These abstractions led to generalised goals in place of specific scenarios. This flexibility was inevitably followed by further modularisation of the goals into objectives. Each objective contains no specific instructions or structure. The PTF simply defines goals, objectives, tasks, deliverables, and relations between goals and objectives. It is the responsibility of the organisation to devise exact tasks and actions that can be followed to complete the tasks and generate the deliverables defined by the goals and objectives. The PTF's overarching purpose is to achieve three goals: facilitate a *problem's definition*, define a *system's design*, and facilitate the *development of an IT solution*. In its final form, the PTF consists of these three goals along with nine objectives all interconnected and eventually leading to the successful implementation of a new product/ service (see Figure 1):

Figure 1 Proposed Process Transformation Framework



1 *Problem Definition* is the first goal of the PTF and aims at improving the working team's understanding of the problem at hand. It has three objectives and respective deliverables that generate outputs related to the description of existing systems and the challenges that prevent a natural progression to the desired system; the three objectives are:

a *Requirement Elicitation* and it encompasses three tasks:

i discover system requirements

ii establish the high-level goals of the system

iii establish customer needs and expectations.

Once accomplished, the results are then written into the *System Requirements* document (i.e., the deliverable of this objective).

b *Existing Asset Assessment* and consists of the following tasks

i define systems in use within the organisation,

ii locate key assets and describe their involvement in the current systems' operations

iii locate systems and assets that can be incorporated into the developing architecture

iv locate potential areas of inputs and outputs that exist within the current systems and assets that can be used as entry and exit points to communicate with the developing system.

The results are then written into the *Existing Asset Summary*.

c *Risk Assessment* and *Area Research*, a two-fold objective, as identified risks must be properly researched before valid mitigation strategies can be formed. *Risk Assessment and Area Research* includes the following tasks

i define potential hazards and unknowns that if unchecked would compromise the integrity of the developing system and its usefulness

ii develop an understanding of these risks in preparation for mitigation strategies.

The results are then written into the *Risk Analysis Report*.

Upon completion of the *Problem Definition* goal, these three written deliverables should become available: *System Requirements*, *Existing Asset Summary*, and *Risk Analysis Report*.

2 *Project Design* is the second goal of the PTF and utilises the information created during the realisation of the earlier *Problem Definition* goal. As the name suggests, *Project Design* aims to create a system design that meets the customer needs while addressing the risks, all achieved while utilising existing systems and assets. Similar to *Problem Definition*, *Project Design* entails three objectives:

a *Risk Mitigation* is designed to subsume the *Risk Analysis Report* created during the *Risk Assessment and Area Research* objective and develop mitigation strategies to resolve and prevent potential system disturbances. *Risk Mitigation* involves the following two tasks:

i map possible risks to risk resolution strategies

ii classify risks into categories of unresolved, high priority, low priority, and system resolution (note: these categories are sets, meaning they have operations of intersection, union, and contain unique entries).

High priority risks are those that if unchecked would prevent the full functionality of the proposed system. Risks of low priority are those that would not significantly affect the productivity of the developing system and as such should only be addressed if time permits. System resolution risks are defined as risks that will be or are already mitigated through the system's design or implementation. During the first iteration of this objective there may be no risks in the category of system resolution although by the end of development all high priority risks should also be system resolution risks. The results are written into the *Risk Dictionary* document, which is left open to revisions as this objective is revisited during future iterations.

b *System Design*, which subsumes the *System Requirements*, *Existing Asset Summary* and *Risk Analysis Report* documentation produced during the *Problem Definition*. The tasks that fall within the scope of *System Design* are to:

i develop an understanding of desirable input and output from and into the new system

ii describe the inner workings of the system

iii describe connections between the new system and existing assets.

The results are then captured by the *Technical Specification* document, which is left open for future modifications.

c *Development Planning*, which subsumes the *Risk Analysis Report* and *Technical Specification*. The tasks within *Development Planning* are to:

i structure the system's implementation procedure

ii reduce risks associated with time constraints

iii optimise total implementation time.

The results are then recorded in the *Project Schedule* documentation.

In summary, upon completion of the *Project Design* goal three documents should be made available: *Project Schedule*, *Technical Specification*, and *Risk Dictionary*.

3 *Project Development*, and as the name alludes, the outcome is a usable solution to address the defined problem. *Project Development* takes advantage of the planning and design information generated during the completion of the *Project Design* goal and this information is used to begin system *Implementation* and *Testing*.

a *Implementation*, which subsumes the *Project Schedule*, *Technical Specification* and *Risk Dictionary*. Testing later produces a document known as *Application Feedback*, which becomes available for inclusion into this objective during future iterations. The deliverable of this objective is a testable piece of application code and comes in the form of an *Application Component*, which if successfully tested can be built onto and incorporated into the final product.

b *Testing*, which subsumes the *Application Component*. *Testing* tasks aims to locate bugs and feature flaws in the *Application Component* and are captured by the *Application Feedback* document. Bugs and flaws revealed during testing may produce the need for adjustment of the *Technical Specification* and the *Risk*

Analysis Report. In the cases where these documents are modified the objectives that subsume them will need to be re-evaluated and their corresponding outputs adjusted accordingly.

In the end, the deliverable of this objective is a usable application that solves the customers' problem.

Implementation may not always be a constant process from start to finish. Agile methods are becoming increasingly popular in software design. These methods encourage a more rapid approach to implementation. Through the approach proposed by the PTF, implementation is broken into small testable segments. These segments are then tested and improved before moving on to the next one, which usually adds more functionality. In this case, the *Project Development* goal would be non-linear and more of an iterative process that moves back and forth between the *Implementation* and *Testing* objectives.

In summary, the PTF (shown in full in Figure 2) may be best described as a set of operational guidelines classified into sections but linked by related processes. These guidelines contain sets of goals, objectives and deliverables that are used to direct the outcome of the process. It is important to note that the PTF is not a specific set of 'How-to' instructions that claims to work in all situations. The PTF is designed to be used as a framework that can be customised and expanded by an organisation to meet its unique project's needs.

3.2 The Mobile Content Platform

The MCP (see Figure 3) is the methodology that enables a mobile distribution of content within an existing, previously non-mobile supporting CMS. The MCP acts as a gateway for incoming HTTP page requests. When a client makes a Web page request to the server it passes through the MCP, which detects the device and routes it to the correct page. Microsoft Windows servers were the initial target environments for the MCP. Consequently, all gateway code was written in ASP.net. This does not limit the potential for the MCP to be ported to Linux Servers with code rewritten in PHP. Implementation of the MCP resulted in the existing CMS gaining additional functionality and value.

Oakland County's CMS is a repository of data used to produce the content that makes up the County's online web presence. More than 83.2 million mobile subscribers (or 31%) accessed the Internet via wireless devices in the USA (Nielsen, 2011). More locally, and without the MCP, this County's 1.2 million residents (Oakland county, 2010) Web-based access of Government-provided information and services would be restricted to traditional means of access via Web browsers found on desktops and laptops; this may not appear to be a challenge, but in an increasingly mobile society that is continuously growing in its consumption of mobile content, it is critical for government to offer services and information through the channels that citizens are using. In doing so, extending the CMS meant incorporating emerging mobile technologies found in feature phones and smartphones. With the completion of the MCP, Oakland County was able to bridge the gap that existed between their legacy CMS and the new access nodes found in mobile Internet browsers. To create this bridge the MCP was broken into three hierarchical layers. These layers worked together seamlessly to support the dissemination of Oakland County's digital information based on the software found on the accessing client's machine or node; the layers consisted of: *Analysis*, *Formatting*, and *Content*.

Figure 2 Full view of the Process Transformation Framework

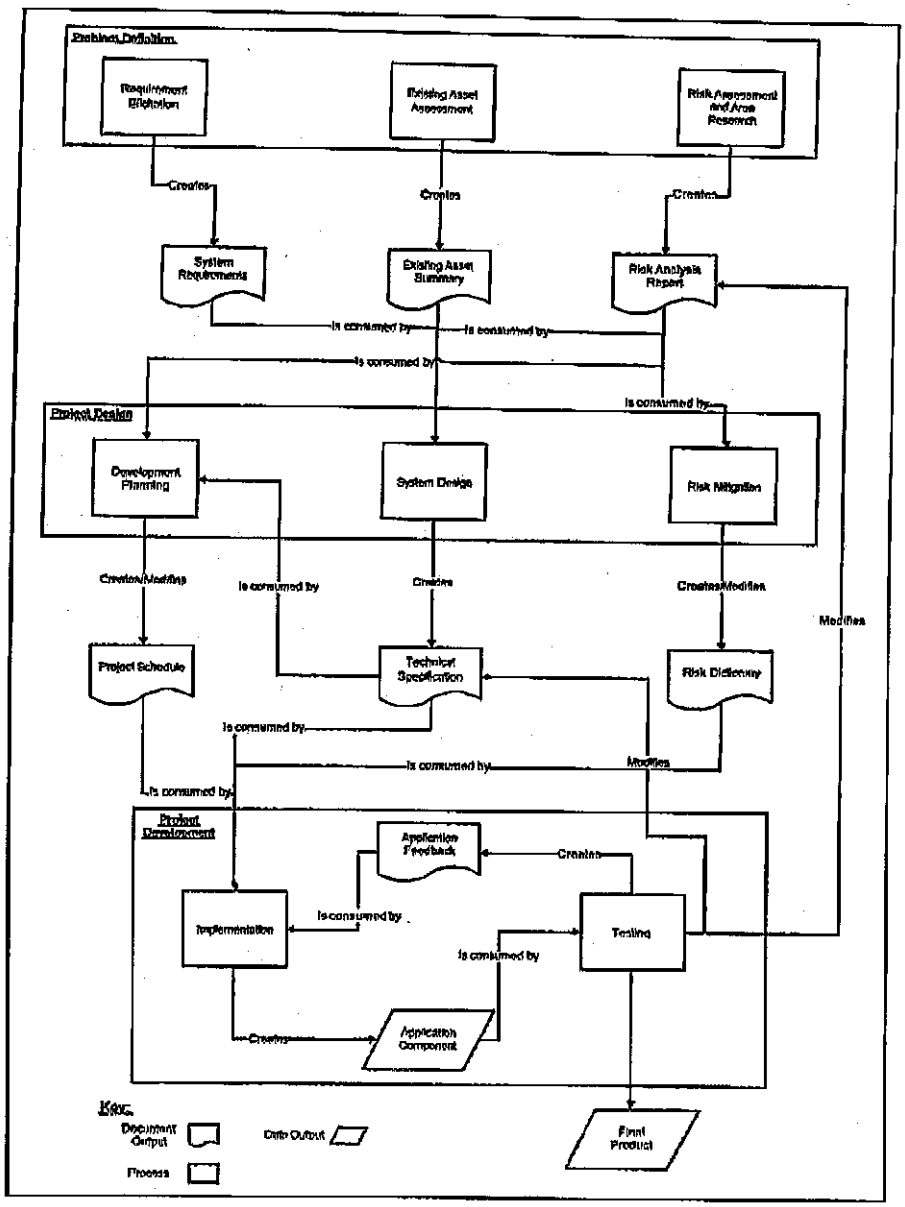
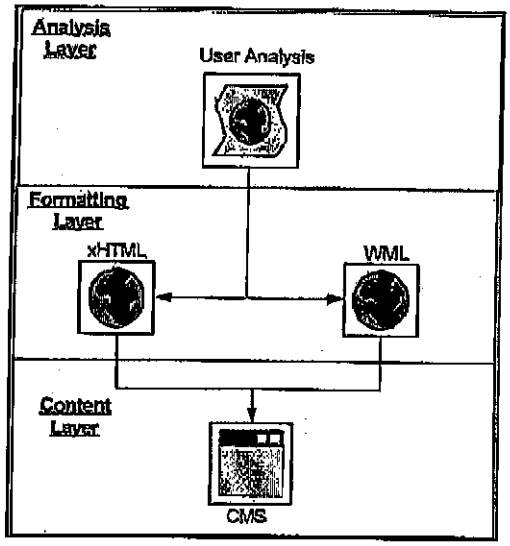


Figure 3 The implemented Mobile Content Platform (MCP) (see online version for colours)



1 *Analysis*, the top layer (see Figure 3), manages initial incoming requests from a client. When a user accesses the root of the Website the root points the user to the top layer of the MCP. Here the MCP requests information about the client's software. The MCP then analyses the information describing a user's browser capabilities. Once the analysis is complete, the MCP redirects the user to the appropriate web page within the *Formatting* layer.

2 *Formatting*, the middle layer, may normally consist of one standard, but in the case of Oakland County it actually consisted of two options

   i a Wireless Markup Language (WML) format

   ii an Extensible HyperText Markup Language (xHTML) format.[2]

Hence, to support Oakland County citizens who owned mobile phones utilising either of the formats, the MCP was designed to support both WML and xHTML Web pages. This was done by including hooks into the format of all pages, which then pulled content from the data layer.

3 *Data*, or the bottom layer, contained the CMS, which was queried by a formatted page in order to pull out all necessary information. This allowed for data in the CMS to be easily reused by different pages across multiple formats. The three layers of the MCP come together to produce pages with the correct content in the correct format for a specific view. Thus, the result of the MCSI and the development of the MCP was a three-layered system of client analysis, page formatting, and finally data retrieval and presentment. The MCP is a very important piece of the MCSI. It allows for easy extensions of new formats within the *Formatting Layer*. New devices and software can be recognised and accounted by simply adjusting the *Analysis Layer*. Finally, new content can be easily added into the CMS and utilised without changing retrieval procedures.

Arguably, the most meaningful outcome of the MCP is that it bridges Oakland County's pre-existing CMS with mobile device applications. In its implemented form the MCP was detecting the software and hardware of incoming mobile device requests. This functionality has the possibility of being expanded into a larger domain, which could include not only mobile requests, but also desktop and laptop requests.

3.3 *Asset Leveraging Strategy*

The *Asset Leveraging Strategy* (ALS) is a document that summarises how the MCP was customised to meet Oakland County's needs and includes strategies and recommendations for building upon the MCP. The ALS provides both a record of the development of and the information necessary to customise the MCP to fit into Oakland County's existing infrastructure. Due to the specific – and proprietary and confidential – nature of the ALS, its intended use was exclusively for Oakland County, although the steps taken in developing the ALS can be used by most organisations. The non-specific nature of the MCP meant that in order for Oakland County to extract optimal value it needed to specify instructions on how to incorporate their existing assets into the MCP. The ALS provides these instructions in the form of strategies and actionable recommendations. In order to generate contextually relevant strategies and recommendations, market research was conducted to infer the state of both Oakland County eGovernment and citizens' I.T. readiness on various levels. In the end, three major components were used in crafting the ALS

i a *Mobile Device Survey* of the residents

ii a current *Page Ranking Analysis*

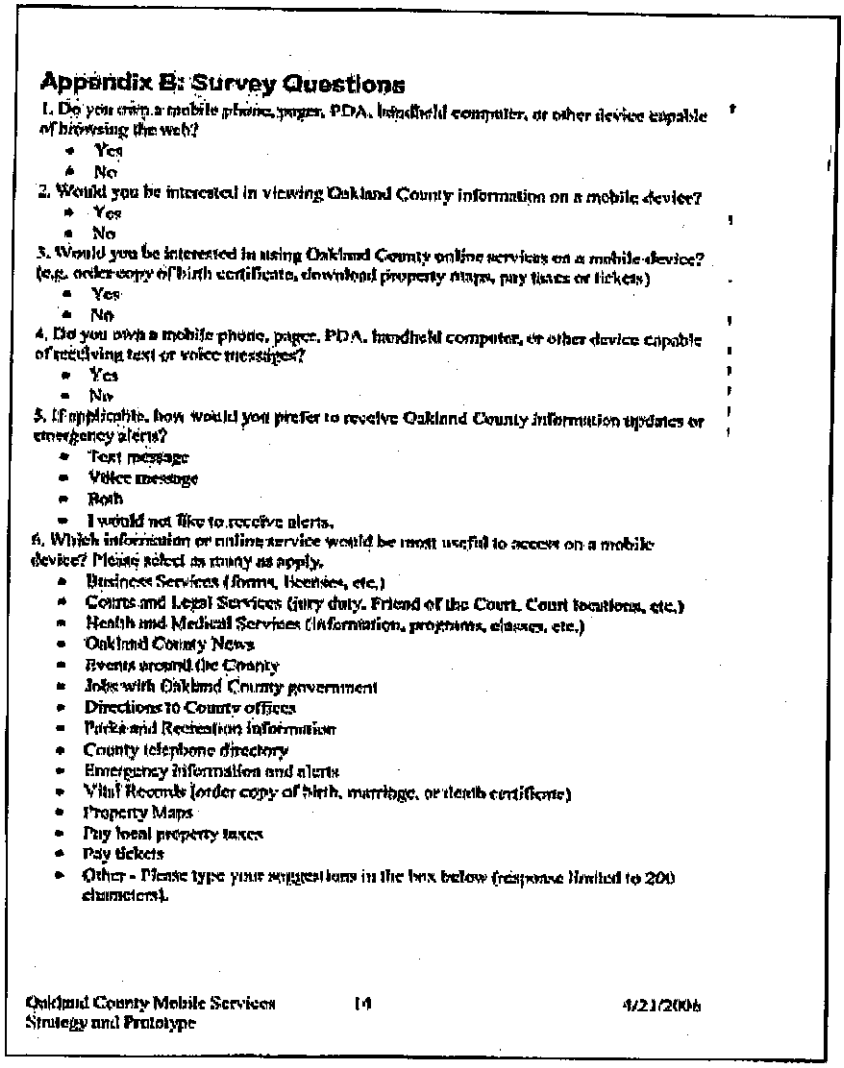
iii an *On-site Asset Evaluation.*

- The *Mobile Device Survey* (see Figure 4) was motivated by the realisation that a mobile web strategy is essential for any organisation with customer-facing systems or relationships (Jones, 2007). It consisted of six questions aimed at gaining insight into public interest in mobile devices and mobile content. These questions were used to gauge:
- 'mobile' acceptance in the community
- interest in mobile content
- interest in push vs. pull distribution of content
- interest in government services.

The survey results were first broken into two categories: those who were interested in mobile content distribution and those who were not. Those who expressed complete disinterest in or inability to access mobile content were discarded to generate a more robust set of results for the targeted audience (i.e., mobile users interested in m-Government services). Results included the ranking of services and pages according to interest in descending order (see Figures 5 and 6).

- A *Page Analysis* is a breakdown of Oakland County's wired-Web traffic into total page views, percentage of total traffic, and a popularity ranking relative to the other pages (see Figure 7). This Page Ranking report provided an additional dimension

Figure 4 Mobile Device Survey administered by Oakland County eGovernment



Appendix B: Survey Questions

1. Do you own a mobile phone, pager, PDA, handheld computer, or other device capable of browsing the web?
   - Yes
   - No
2. Would you be interested in viewing Oakland County information on a mobile device?
   - Yes
   - No
3. Would you be interested in using Oakland County online services on a mobile device? (e.g. order copy of birth certificate, download property maps, pay taxes or tickets)
   - Yes
   - No
4. Do you own a mobile phone, pager, PDA, handheld computer, or other device capable of receiving text or voice messages?
   - Yes
   - No
5. If applicable, how would you prefer to receive Oakland County information updates or emergency alerts?
   - Text message
   - Voice message
   - Both
   - I would not like to receive alerts.
6. Which information or online service would be most useful to access on a mobile device? Please select as many as apply.
   - Business Services (forms, licenses, etc.)
   - Courts and Legal Services (jury duty, Friend of the Court, Court locations, etc.)
   - Health and Medical Services (information, programs, classes, etc.)
   - Oakland County News
   - Events around the County
   - Jobs with Oakland County government
   - Directions to County offices
   - Parks and Recreation information
   - County telephone directory
   - Emergency information and alerts
   - Vital Records (order copy of birth, marriage, or death certificate)
   - Property Maps
   - Pay local property taxes
   - Pay tickets
   - Other - Please type your suggestions in the box below (response limited to 200 characters).

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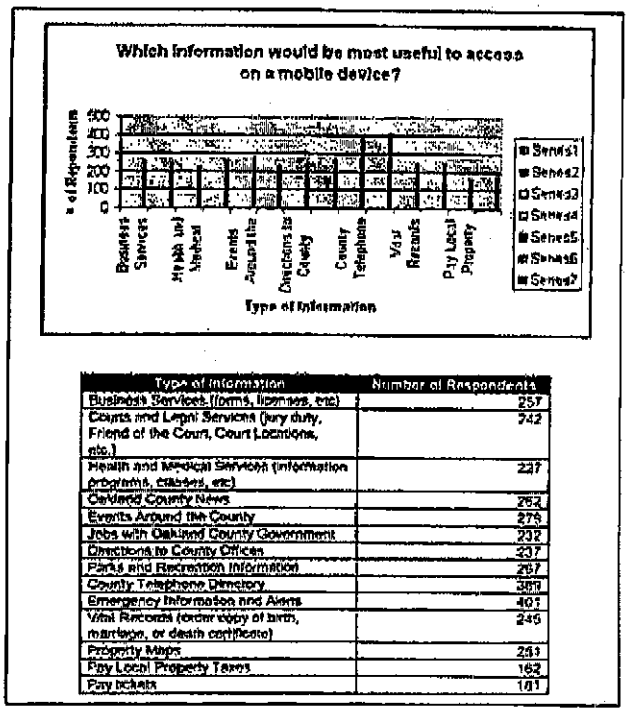
to gauge the public's interest in various information types provided by Oakland County.

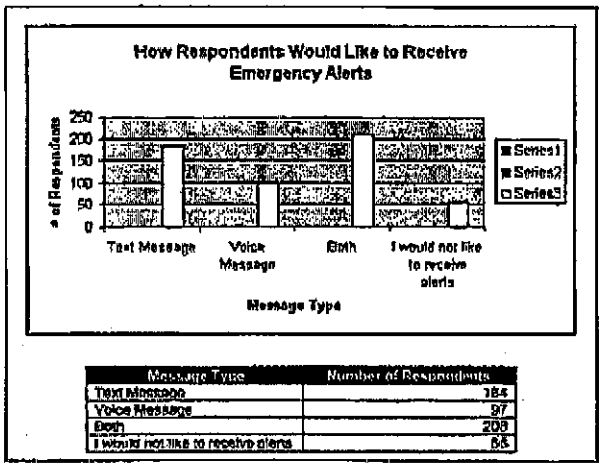
- An *On-site Asset Evaluation* was also conducted at Oakland County eGovernment to identify the assets already being utilised. Through direct observation of employees in the organisation's day-to-day operations, insight was gained on future assets being considered for development. This information was attained early during the *Area Research* phase to assess the project's feasibility.

Figure 5 Survey results regarding citizens' interest in mobile content offered by Oakland County eGovernment (see online version for colours)



Type of Information	Number of Respondents
Business Services (forms, licenses, etc)	257
Courts and Legal Services (jury duty, Friend of the Court, Court Locations, etc.)	242
Health and Medical Services (information programs, classes, etc)	237
Oakland County News	252
Events Around the County	279
Jobs with Oakland County Government	232
Directions to County Offices	237
Parks and Recreation Information	267
County Telephone Directory	389
Emergency Information and Alerts	401
Vital Records (order copy of birth, marriage, or death certificate)	245
Property Maps	251
Pay Local Property Taxes	162
Pay tickets	181

Figure 6 Survey results (continued) regarding citizens' interest in mobile content offered by Oakland County eGovernment (see online version for colours)



Message Type	Number of Respondents
Text Message	184
Voice Message	97
Both	208
I would not like to receive alerts	85

The above three components offered a holistic view of the value proposition for the government's transformation into mobile servicing of its constituents. The *Mobile Device Survey* results and the *Page Ranking Analysis* offered complementary information – one may argue they offered subjective and objective information respectively – and were used to identify the most valuable web pages and services to offer in a mobile format. Next, the results from the *On-site Asset Evaluation* were incorporated and project feasibility was reassessed. All of these elements worked in combination to support the generation of the strategies and recommendations used to customise the MCP to Oakland County eGovernment's unique situation. These strategies and recommendations were included in the final deliverable of the MCSI, i.e., the *"Oakland County Mobile Content Services Strategy and Prototype"* that is described next.

Figure 7 Page ranking analysis of Oakland County eGovernment web traffic (see online version for colours)

Appendix D: Top 100 Pageviews

The following table ranks the popularity of the pages (generally HTML files) visited on the Oakland County public Web site by number of pageviews and relative percentage. In general, images and other embedded content such as style sheets and javascript are not considered to be pageviews.

Report: Requested Pages – Oakland County site (external traffic)
Date Range: 02/01/2005 – 02/03/2006

Pages (1-100) / 15,177	Pageviews	Percent
1. http://www.oakgov.com/[illegible]	964,704	6.32%
2. http://www.oakgov.com/index.html	906,165	5.94%
3. http://www.oakgov.com/[illegible]	481,083	3.15%
4. http://www.oakgov.com/search/MainServlet	461,928	3.03%
5. http://www.oakgov.com/[illegible]/index.html	402,727	2.64%
6. http://www.oakgov.com/[illegible]	360,348	2.36%
7. http://www.oakgov.com/jobs/index.html	291,386	1.91%
8. http://www.oakgov.com/lms/parcelView/MapServices.htm	253,826	1.66%
9. http://www.oakgov.com/lms/parcelView/blank.htm	251,517	1.65%
10. http://www.oakgov.com/directory/index.html	230,185	1.51%
11. http://www.oakgov.com/online_services/index.html	228,377	1.50%
12. http://www.oakgov.com/sheriff/index.html	170,128	1.12%
13. http://www.oakgov.com/clerkrod/index.html	140,832	0.92%
14. http://www.oakgov.com/courts/index.html	110,876	0.73%
15. http://www.oakgov.com/sheriff/jail/index.html	109,282	0.72%
16. http://www.oakgov.com/[illegible]/MainServlet	108,801	0.71%
17. http://www.oakgov.com/committees/index.html	101,979	0.67%
18. http://www.oakgov.com/circuit/index.html	81,800	0.54%
19. http://www.oakgov.com/maps/index.html	81,027	0.53%
20. http://www.oakgov.com/parksrec/index.html	80,878	0.53%
21. http://www.oakgov.com/lms/parcelView/toolbar.htm	79,040	0.52%
22. http://www.oakgov.com/sheriff/jail/inmate%20Locator%20Page.html	77,078	0.51%
23. http://www.oakgov.com/health/index.html	76,572	0.50%
24. http://www.oakgov.com/directory/[illegible].pdf	72,132	0.47%
25. http://www.oakgov.com/sheriff/assets/docs/inmates.pdf	70,883	0.46%
26. http://www.oakgov.com/parksrec/info_pub/fees.html	69,327	0.45%
27. http://www.oakgov.com/[illegible]/Controller	68,534	0.45%
28. http://www.oakgov.com/clerkrod/election_committees	67,310	0.44%

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3.4 Oakland County mobile content services strategy and prototype

The final deliverable of the MCSI was titled "*Oakland County Mobile Content Services Strategy and Prototype*" and consisted of six major topics: *Strategy, Approaches and Findings, Recommendations, Barriers and Mitigation Strategies, Prototype Implementation*, and *Tactical Initiatives*.

Strategy contained eight strategic points that the MCSI followed and Oakland County continued to follow in customising the MCP. *Approach and Findings* provided a brief summary justifying the feasibility of the MCP and its customisation to Oakland County. This section also showcased important conclusions that shaped the MCSI decisions and the mobile device survey data that produced these conclusions. *Recommendations* included 15 actionable items for Oakland County to consider as it moves forward with its mobile content and services enablement; these items included suggestions on improving mobile traffic, valuable services, and improvements for ease of use. *Barriers and Mitigation Strategies* provided a list of potential obstacles that could impact the success of the mobile transformation. This list was balanced with a list of strategies that can be followed to mitigate these obstacles once they arose or even proactively prevent them from occurring. *Prototype Implementation* described the status of the MCP at the time of the document's authoring. Finally, *Tactical Initiatives* comprised a list of the primary goals that should be achieved as Oakland County adapts the MCP.

"*Oakland County Mobile Content Services Strategy and Prototype*" was able to bring Oakland County up to date with the progress that was made by the MCSI. It provided graphs and charts displaying survey results, sample code that was used to develop the MCP, and the raw data used by the MCSI when making its conclusions. The data provided in this documentation offered validation for the MCSI and support for the continued effort in the government's transition to offering mobile content and services. By following the results provided by this ALS, Oakland County was now equipped with the tools to successfully increase the value of its existing CMS whilst extending new services to its citizens.

Figure 8 Prototype of the implemented system as viewed on a mobile device (see online version for colours)

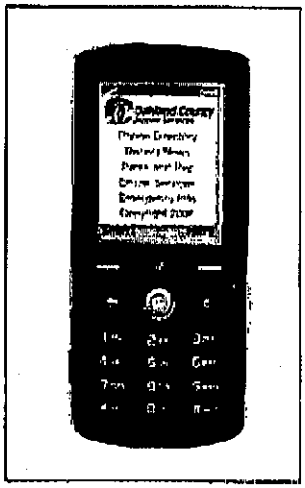
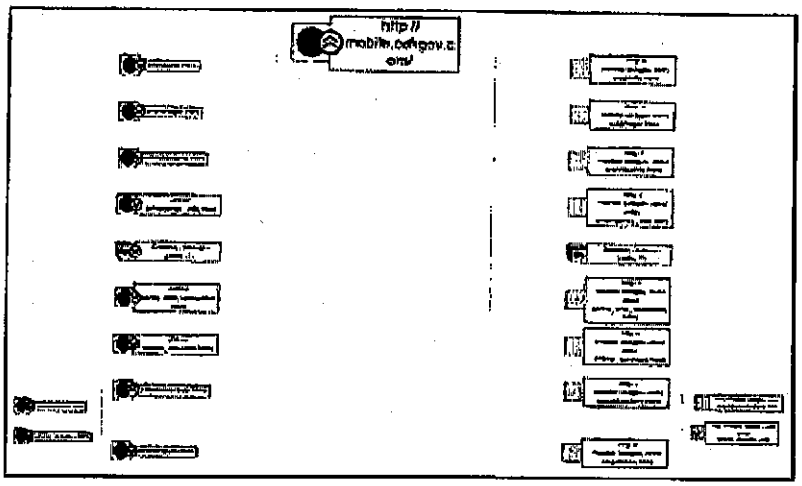


Figure 8 displays a screenshot from the implemented system prototype as it appeared on a feature phone. Figure 9 shows a view of the MCP and illustrates how content pages were related according to the *Analysis* and *Formatting* layers, i.e., once a request from a mobile device was received, it was analysed to detect the standard being used by it, and the content was then presented in the appropriate format, either WML or xHTML.

Figure 9 MCP view of the prototype (i.e., incoming request for a web page is *Analysed* for the device's technology standard, and the appropriate *Format* is returned, i.e., XML or xHTML) (see online version for colours)



4 Discussion

Flexibility is the ability to be easily swayed by the influence of, in this case, a changing environment. Government, as with any organisation, is constantly investing in infrastructure that affords an improved delivery of services to its stakeholders. When it comes to IT-related implementations, flexibility is a key success factor. Being equipped with the tools to adapt to a changing environment can not only achieve the said goal, but introduce more benefits, including more efficient and effective processes, increased satisfaction among residents and stakeholders, a greater level of their engagement, and ultimately a reduction of operational costs, which translate to a decreased demand for taxpayers contributions. In the context of mGovernment, the waters of service transformation to embrace mobile content and delivery are yet uncharted. This paper supports these entities through the provision of three tools of varying flexibility that can be used in their respective context:

- The PTF is designed to be an ordered set of guidelines broken into logical sections consisting of goals, objectives, and activities. It is the most flexible tool provided in this study, as the goals and objectives can be customised to the specific needs of an organisation or project, and by extension facilitate the transformation of any organisation's specific assets.

- The MCP, also a flexible structure, can be used by any organisation to build a similar architecture and extend a unique CMS. It was designed to incorporate the flexibility of an ever-growing organisation in both the top and middle layers. The top (*Analysis*) layer was implemented to focus specifically on mobile hardware and software. It is possible that an organisation would want to develop a similar system to the MCP, but to do so while incorporating the ability to also detect various desktop and laptop hardware and software beyond the two specified in the Oakland County case. This could easily be accomplished through the retooling of the *Analysis* layer to include system details, connection details, and system display layout recognition.
- The instantiated ALS is not very flexible, as it is designed to be specific to Oakland County's needs. Flexibility can be found in the lessons learned from the ALS, which could serve as a starting point for other organisations looking to leverage existing assets and produce comparable results specific to the processes involved. The survey data collection, recommendations, and strategies can – and should – all be performed by an organisation to obtain specific insight about their project.

Scalability is equally important as a success factor; scalability is the ability to easily expand or grow, and two scalable objects emerged from the MSCI in the form of the PTF the MCP.

- The PTF is designed to incorporate scalability by not limiting its use to any specific project size. It also provides guidelines that are designed to facilitate the reuse or repurposing of assets. In the case of Oakland County, the asset that the MCSI leveraged was the CMS. A larger asset or set of assets could be transformed into a new or additional functionality by following the same procedures found in the PTF.
- The MCP is scalable in the way that new features can easily be added into its layers. Scalability is incorporated in the MCP through the inclusion of new formats. An example of this would be to create a new format for XML documents. By attaching the proper hooks into the CMS and adjusting the *Analysis* layer to recognise the new format, the MCP could be expanded in its usefulness.

The flexibility and scalability found in each of these objects frees them from the bounds of this specific case study and opens them up for use by other organisations speaking to the practical contribution of this paper at a critical time of considering and/or harnessing mobile technologies in an organisation/business/government setting.

5 Implications and conclusions

Mobile device acceptance is growing continuously and it is estimated that there will be 140 devices for every 100 participants, even in the developing world, within 5–10 years (Bala, 2010), while mobile will surpass desktop Internet access by 2014 (Meeker, 2010). With analytical foresight, Oakland County collaborated with Michigan State University to form the MCSI. This initiative was tasked with the development of a method to distribute Oakland County's existing web content to mobile devices within the community. After extensive research, planning, and execution, the MCSI produced three valuable deliverables: a PTF, MCP, and an ALS.

These three components worked together to bring resolution to Oakland County's challenge of increasing the quality of service offered to its citizens in light of an increasing demand in mobile government content. For the benefit of other organisations, these components were analysed and decomposed to expose their adaptability in other settings and presented in this paper. Each component has its own part to play in the asset leveraging solution produced. User sophistication of mobile web browsing will only increase with time. Any organisation looking to make additional use of their available assets, especially when trying to capitalise on the growing mobile web market, should look to these components and their impact on Oakland County's eGovernment service delivery.

DeLone and McLean's (1992) seminal paper on the Information Systems (IS) Success Model demonstrated that the successful adoption of an information system is consequent of both information and system quality. Consistent with this theory, the MCP focuses on system quality, i.e., by ensuring that all possible technology standards selected by the organisation are supported through its Formatting Layer; also, information quality is supported by the ALS, as assets will be repurposed for the new context, thereby generating more value of the original investment in those IT artefacts. However, DeLone and McLean (1992) model assumes a system is already in place, and does not consider the organisation's transformation effort. Based on a series of statistics over IT projects failure rates (Anonymous, 2001), "an IT project is more likely to be unsuccessful than successful", and only "about 1 out of 5 IT projects is likely to bring full satisfaction". While the IS Success Model helps explain the reasons why an IS project may or may not success once it is in place, it does not offer guidance on how an organisation can maximise such quality, something that the PTF proposed here does. Furthermore, the IS Success Model had been tested in different contexts and received mixed support, e.g., in the context of internet banking (Andoh-Baidoo et al., 2010). It is plausible that the non-significance of suggested relationships was an outcome of omitting to control for project management variability in the cases analysed.

Moving forward, and beyond this paper's theoretical contribution of building on the IS Success Model by consider the implementation of a technology, practical contributions also emerge from the PTF, MCP, and ALS. For example, during the introduction of new value-added mobile services, such as a e-finance (Lingfen et al., 2010), e-banking (Andoh-Baidoo et al., 2010), mobile reservation and payment systems (Olaniyi et al., 2010), financial monitoring in the public sector (Kastanoulia et al., 2011), and more, these three tools could be used to optimise the I.T. project management's quality, thereby increasing the chances of the project's success.

In closing, justifying the move toward electronic and mobile servicing of an organisation's stakeholders can be capital intensive and comes with high risk. Through the above PTF, example MCP, and a carefully crafted ALS, support for such investments may be more easily obtained through the provision of a cost-benefit analysis. Still, the intangibles, brand equity, and consumer's loyalty that can be derived from the delivery of services anytime, anywhere need to be bore in mind, as they concurrently boost the lifetime value of a customer for companies, or residents for governments.

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References

Adesina, A.A., Daramola, J.O. and Ayo, C.K. (2010) 'A SOA-based framework for e-procurement in multi-organizations', *International Journal of Electronic Finance*, Vol. 4, No. 2, pp.156–170. AUTHOR PLEASE CITE THIS REFERENCE IN TEXT.

Andoh-Baidoo, F.K., Villarreal, M.A., Liu, L.C. and Wuddah-Martey, P. (2010) 'An exploratory study to examine the success of electronic banking systems implementation in a developing nation', *International Journal of Electronic Finance*, Vol. 4, No. 3, pp.221–235.

Anonymous (2001) *Failure Rate. IT Cortex*, Retrieved on December 21, 11, from http://www.it-cortex.com/Stat_Failure_Rate.htm

Antovski, L. (2007) 'Improving service matching in m-government with soft technologies', *18th Annual IEEE International Symposium on Personal, Indoor and Mobil Radio Communications (PIMRC'07)*, September, Athens, Greece.

Antovski, L. and Gusev, M. (2006) 'm-GOV: the evolution method', *Proceedings of the Second European Conference on Mobile Government*, 30 August – 1 September, Brighton, UK. AUTHOR PLEASE CITE THIS REFERENCE IN TEXT.

Antovski, Lj. and Lallana, E. (2004) 'm-Government framework', *Proceedings of the First European Conference on Mobile Government*, 10–12 July, Brighton, UK.

Bala, V. (2010) *Going Global Means Going Mobile in Emerging Markets. The Nielsen Company*, Retrieved on 1 September, 2011, from http://blog.nielsen.com/nielsenwire/global/going-global-means-going-mobile-in-emerging-markets

Campbell, P. (2011) *Study Predicts Mobile Internet Use will Surpass Wired Access by 2015. Lexology*, Retrieved on November 15, 2011, from http://www.lexology.com/library/detail.aspx?g=71490222-b0b6-46fc-95d7-3a5b363e6739

Carter, L. and Belanger, F. (2005) 'The utilization of e-government services: citizen trust, innovation and acceptance factors', *Information Systems Journal*, Vol. 15, pp.5–25.

Center for Digital Government (2010) *Digital States Survey – 2010 Results*, Retrieved on 10 October 2011, from: http://www.centerdigitalgov.com/survey/61

Coursaris, C.K. and Hassanein, K. (2002) 'Understanding m-commerce: a consumer-centric model', *Quarterly Journal of Electronic Commerce (QJEC)*, Vol. 3, No. 3, pp.247–272.

DeLone, W.H. and McLean, E.R. (1992) 'Information systems success: the quest for the dependent variable', *Information Systems Research*, Vol. 3, No. 1, pp.60–95.

Ericsson (2010) *Aircel's Largest 3G Partner in India*, Retrieved on September 3, 2011, from http://www.ericsson.com/news/1462531

Evans, D. and Yen, D.C. (2005) 'e-Government: an analysis for implementation – framework for understanding cultural and social impact', *Government Information Quarterly*, Vol. 22, pp.354–373.

Ghyasi, A.F. and Kushchu, I. (2004) *m-Government: Cases of Developing Countries, mGovLab, International University of Japan*, Retrieved 19 September, 2009 from www.mgovernment.org/resurces/mgovlab_afgik.pdf

Huntington, J. (2011) *Mob Rules*, Retrieved on 1 September, 2011, from http://www.wewanttraffic.com/news/category/Mobile.aspx

Jones, N. (2007) *Mobile Web Trends 2007–2011, Gartner*, Retrieved on 1 September, 2011, from http://www.gartner.com/DisplayDocument?id=507337

Kastanoulia, M., Petropoulos, F., Litsa, A., Nikitas, M., Pagourtzi, E. and Assimakopoulos, V. (2011) 'Project management and financial monitoring in public sector: an information support system', *International Journal of Electronic Finance*, Vol. 5, No. 2, pp.105–125.

Kushchu, I. and Kuscu, H. (2003) 'From e-Government to m-Government: facing the inevitable', *Proceedings of the European Conference on e-Government*, Trinity College, Dublin.

Lallana, E. (2008) *m-Government Benefits and Challenges. eGovernment for Development*, Retrieved on 1 December, 2011, from http://www.egov4dev.org/mgovernment/evaluation

Lee, S., Tan, X. and Trimi, S. (2005) 'Current practices of leading e-government countries', *Communications of the ACM*, October, Vol. 48, No. 10, pp.99–104.

Lingfen, C., Woods, D., Curran, K. and Doherty, J. (2010) 'Mobile development environments for electronic finance', *International Journal of Electronic Finance*, Vol. 4, No. 2, pp.99–119.

McClure, D.L. (2000) *Statement of David L. McClure, US General Accounting Office, Before the Subcommittee on Government Management, Information and Technology, Committee on Government Reform, House of Representatives*, Retrieved on 17 October 2011, from http://www.gao.gov

Meeker, M. (2010) *Internet Trends, Morgan Stanley*, Retrieved on 1 September, 2011, from http://www.gigaom.com/2010/04/12/mary-meeker-mobile-internet-will-soon-overtake-fixed-internet

Mobi Solutions (2010) *Mobile Government: 2010 and Beyond, White Paper*, Retrieved from: http://www.mobisolutions.com/services/m-government-m-city

Moon, J. (2004) *From e-Government to m-Government? Emerging Practices in the Use of m-Technology by State Governments*, IBM Center for the Business of Government, pp.424–433.

Moon, M. (2002) 'The evolution of e-government among municipalities: rhetoric or reality?', *Public Administration Review*, Vol. 62, No. 4, July–August. AUTHOR PLEASE SUPPLY PAGE RANGE.

Nielsen (2011) *State of the US Media*, Retrieved on September 3, 2011,from http://blog.nielsen.com/nielsenwire/wp-content/uploads/2011/01/nielsen-media-fact-sheet-jan-11.pdf

Oakland County (2010) *Fast Facts*, Retrieved on September 1, 2011, from http://www.oakgov.com/peds/assets/docs/databook/1_OaklandCountyFastFacts.pdf

Olaniyi, O.M., Ajose, S.O. and Adegoke, M.A. (2010) 'Development of a mobile airline reservation and payment system', *International Journal of Electronic Finance*, Vol. 4, No. 4, pp.372–389.

Power, D. (2009) *Hidden Cost of Duplicate Customer Data. Hub Solution Designs*, 13 December, Retrieved on December 14, 2011, from http://hubdesignsmagazine.com/2009/12/13/hidden-Costs-of-duplicate-customer-data/

Sharp, W. (2010) *Informatica Data Quality Matching Algorithms: Eliminate Duplicates and Reduce costs. EdgeWater Technology Blog Post, 23 January*, Retrieved on December 11, 2011, from http://edgewatertech.wordpress.com/2010/01/23/informatica-data-quality-matching-algorithms-eliminate-duplicates-and-reduce-costs-3/

Trimi, S. and Sheng, H. (2008) 'Emerging trends in m-government', *Communications of The ACM*, May, Vol. 51, No. 5, pp.53–58

West, D. (2004) 'e-Government and the transformation of service delivery and citizen attitudes', *Public Administration Review*, Vol. 64, No. 1, pp.15–27.

Notes

[1]http://www.oakgov.com/egov/

[2]The need for two formats stemmed from a transition in mobile phone generations and in versions of the supporting Wireless Application Protocol (WAP). WML 1.0 was a product of WAP 1.0 and was used as the programming language for wireless applications. WML incorporates the eXtensible Markup Language (XML) structure and is delivered to browsers in the form of 'decks'. Unlike traditional Web development languages, such as HTML, where pages are delivered on an individual basis, WML decks contain a set of pages. As mobile phones evolved into their second generation WAP 2.0 emerged. WAP 2.0 incorporated a new version of the WML and supported xHTML.