



**Tribhuvan University**

**Institute of Science and Technology**

# **Comparison on e-Government Maturity Models**

**Dissertation**

Submitted to

Central Department of Computer Science and Information Technology  
Kirtipur, Kathmandu, Nepal

In partial fulfillment of the requirements  
For the Master's Degree in Computer Science and Information Technology

By

**Bishwas Thapa**

December, 2011



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Supervisor

**Associate Prof. Dr. Subarna Shakya**

Department of Electronics and Computer Engineering  
Institute of Engineering, Pulchowk, Nepal



**Tribhuvan University**  
**Institute of Science and Technology**  
**Central Department of Computer Science and Information Technology**

**Student's Declaration**

I hereby declare that I am the only author of this work and that no sources other than the listed here have been used in this work.

.....

Bishwas Thapa  
Date: December, 2011



**Tribhuvan University**  
**Institute of Science and Technology**  
**Central Department of Computer Science and Information Technology**

Supervisor's Recommendation

I hereby recommend that the dissertation prepared under my supervision by **Mr. Bishwas Thapa** entitled "**Comparison on e-Government Maturity Models**" be accepted as fulfilling in partial requirements for the degree of M. Sc. in Computer Science and Information Technology.

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Institute of Science and Technology**

**Central Department of Computer Science and Information Technology**

**LETTER OF APPROVAL**

We certify that we have read this dissertation work and in our opinion it is satisfactory in the scope and quality as a dissertation in the partial fulfillment for the requirement of Master of Science in Computer Science and Information Technology.

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Bishwas Thapa  
December, 2011

**To my Parents, and my Wife Nirmala Sharma**



## Abstract

e-Governance is a way of delivering the government services using ICT tools. ICT tools are technical means for handling information and aiding communication including Computers, Network hardware, Communication middleware and Software. An **e-Government maturity model** provides us with guidance on how to gain control of our processes for developing and maintaining e-Government services and how to evolve toward a culture of excellence in providing and managing e-Government. A maturity model can guide us in selecting process improvement strategies by determining current process maturity and identifying the few issues that are most critical to e-Government quality and process improvement. By focusing on a limited set of activities and working aggressively to achieve them, we can steadily improve our organization-wide e-Government processes and enable continuous and lasting gains in our e-Government capabilities.[18]

There are many e-government maturity models in the literature. Maturity models are defined as: “A method for judging the maturity of the processes of an organization & for identifying the key practices those are required to increase the maturity of these processes”. [41]e-Governance stages are formulated by many Institutions (e.g. e.g. United Nations and American Society for Public Administration, 2001; Baum and Di Maio, 2000; Gartner Group Deloitte and Touche, 2001), or Individual researchers (e.g. Hiller and Bélanger, 2001; Layne and Lee, 2001; Moon, 2002). There are two main international trends in maturity models applied to the software engineering area: CMMI [36] of the USA, and ISO/IEC of Europe. ). In this research, different models will be compared based on various measurements Like Security, Technical implementation etc. and CMMI model will also be discussed to show the possibility of measuring the maturity within a stage of e-Government development process.

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### List of Abbreviations:

ICT	Information Communication Technology
E-Government	Electronic Government
SWOT	Strength, Weakness, Opportunity, Threat
PEST	Political Economic Social Technological
VAS	Value Added Service
DB	Database
IT	Information Technology
G2G	Government to Government
G2C	Government to Citizen
G2B	Government to Business
G2E	Government to Employee
WWW	World Wide Web
OOPL	Object Oriented Programming Language
HTML	HyperText Markup Language
LOC	Line of Code

# CHAPTER I

## INTRODUCTION

### 1.1 E-government:

e-Government is the delivery of Local/Central Government service using electronic means to its citizens, Businesses, external governments or its inter governmental agencies. There exist many definitions of e-Government. There are many Institutions (UN, Gartner Group, American Society for Public Administrations), IT-Firms, and Individual Researchers (Hiller, Lyane and Lee, Moon) etc. defining e-government on their own way. Below are some of the definitions:

World Bank ([www.worldbank.org](http://www.worldbank.org)) definition (AOEMA report): “E-Government refers to the use by government agencies of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions. [30]”

United Nations ([www.unpan.org](http://www.unpan.org)): “E-government is defined as utilizing the internet and the world-wide-web for delivering government information and services to the citizens. [30]”

Global Business Dialogue on Electronic Commerce (GBDE, [www.gdbe.org](http://www.gdbe.org)): “Electronic government (hereafter e-Government) refers to a situation in which administrative, legislative and judicial agencies (including both central and local governments) digitize their internal and external operations and utilize networked systems efficiently to realize better quality in the provision of public services. [30]”

Gartner Group’s definition: “the continuous optimization of service delivery, constituency participation, and governance by transforming internal and external relationships through technology, the Internet and new media. [30]”

Working Group on E-government in the Developing World ([www.pacificcouncil.org](http://www.pacificcouncil.org)): "E-government is the use of information and communication technologies (ICTs) to promote more efficient and effective government, facilitate more accessible government services, allow greater public access to information, and make government more accountable to citizens. E-government might involve delivering services via the Internet, telephone, community centers (self-service or facilitated by others), wireless devices or other communications systems. [30]”

UNESCO ([www.unesco.org](http://www.unesco.org)): “E-governance is the public sector’s use of information and communication technologies with the aim of improving information and service delivery, encouraging citizen participation in the decision-making process and making government more accountable, transparent and effective. E-governance involves new styles of leadership, new ways of debating and deciding policy and investment, new ways of accessing education, new ways of listening to citizens and new ways of organizing and delivering information and services. E-governance is generally considered as a wider concept than e-government, since it can bring about a change in the way citizens relate to governments and to each other. E-governance can bring forth new concepts of citizenship, both in terms of citizen needs and responsibilities. Its objective is to engage, enable and empower the citizen. [30]”

There has always been a common theme on every author’s definition of e-government. E-government makes use of ICT tools especially internet to deliver government services to its citizens, business agencies, and other external governments.



Citizens can interact to their government 24\*7 for their concerns, this is one of the major advantages of e-governance over traditional governing system.

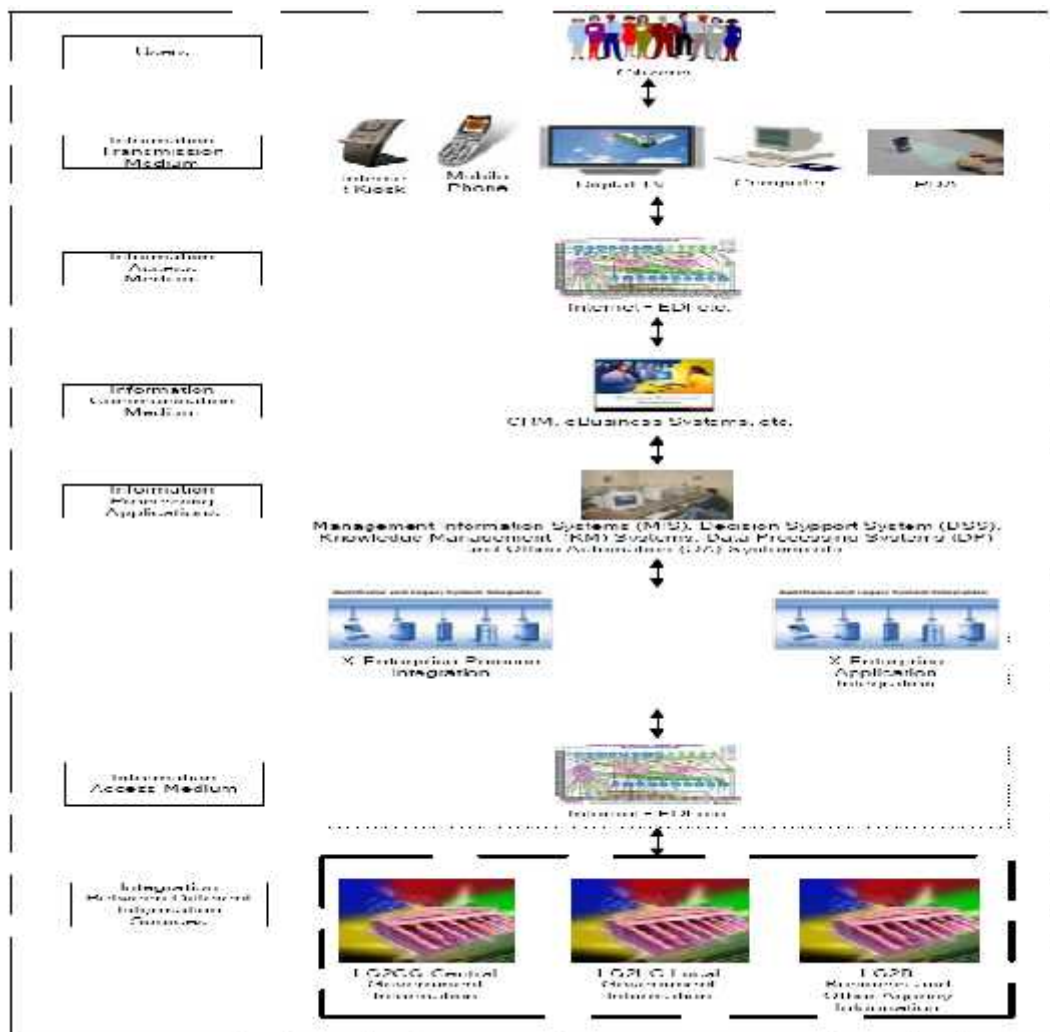


Figure 6.1: Information Communication and Processing Infrastructure in E-Government [32]

## **1.2 Technical Aspects of e-government:**

E-Government is a combination of both technical as well as Business Processes. When it comes to Technical aspects, this basically is about how the whole process is implemented to make it more "e". Starting from design/requirement collection to Optimization and validation, there is a complete cycle of technicality. Within technical part also, there are minute distribution on which part will handle which portion of the development process. There are interests about implementation complexity, collective or modular. If we further investigate on this, there are other aspects like, technical security, implementation optimality, Business easiness in terms of technical implementation etc.

### **1.3 Maturity Models:**

E-government maturity model outlines the various stages during the e-government development. An e-Government maturity model provides us with guidance on how to gain control of our processes for developing and maintaining e-Government services and how to evolve toward a culture of excellence in providing and managing e-Government. A maturity model can guide us in selecting process improvement strategies by determining current process maturity and identifying the few issues that are most critical to e-Government quality and process improvement [18]. Maturity Model is a sequence of maturity models with after accumulation in a certain period gains full maturity. Levels of e-government maturity has been a big topic since long and there are many scholars defining their own levels, however, they all agree in stating that the higher the level, more complex is the technology deployed, the larger the number of e-services provided and the more benefits that all stakeholders are entitled to. Below are the list of Maturity Models defined by many Institutions (UN, Gartner Group, American Society for Public Administrations), IT-Firms, Individual Researchers (Hiller, Lyane and Lee, Moon) etc. defining their own model of E-Government for its maturity.

#### **1.1.1 Layne And Lee's Four Stage Model:**

This model was proposed by Layne and Lee on 2001. This model describes the maturity of an e-government in four stages with basically focused on technical dimensions. Below are the steps on this model.

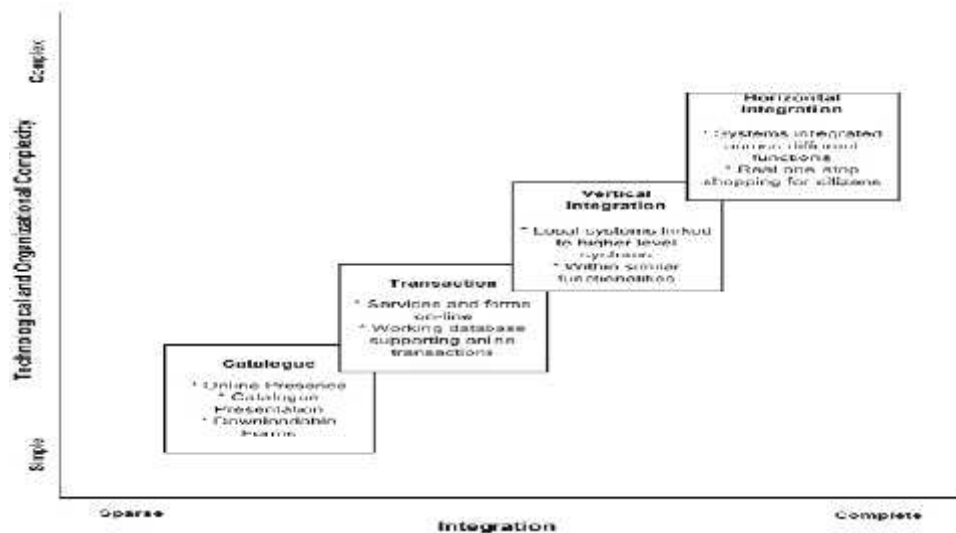


Figure 7: Layne & Lee, 2001 model

**a. Cataloging:**

This stage is the delivery of some basic government service over www static pages. In this stage there will be possibility to acquire the information from government sites, and download the required forms for fill up.

**b. Transactional:**

At this stage citizens are allowed to make a two way transaction with the government and not like only government listens to the citizens, but also citizens will listen from the government.

**c. Vertical Integration:**

At this stage Government starts integrating the government services provided on its different local/provincial/central levels.

**d. Horizontal Integration:**

This stage will unify all the services provided by various levels of the government to one place without having necessity to move from one site to another.

### 1.1.2 Gartner's Four Stage Model

In order to measure the level of progress with different levels and determine the it's roadmap to goal, Gartner research group defined a four stage model in 2000 entitled "Gartner's Four Phases of e-Government Model". This model is used to determine the reference position of an e-Government project in its overall evolution strategy.

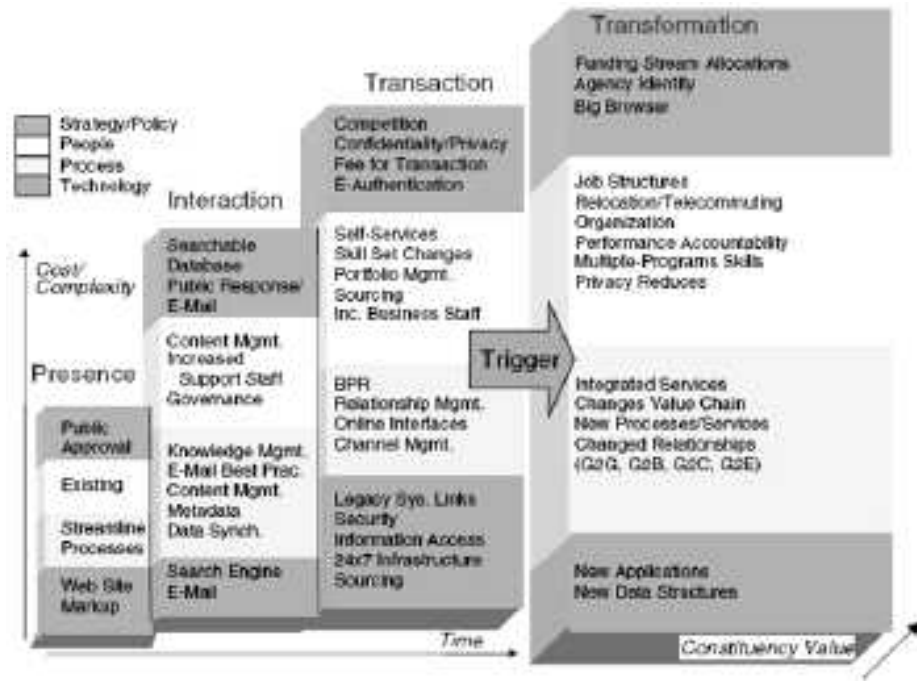


Figure 8: Gartner Research, 2000

#### a. Presence

This stage is classified by a simple information-providing Web site of a passive nature, sometimes described as "brochure ware," indicating the same level of functions as a paper brochure [32].

## **b. Interaction**

This level provides the simple interaction between various interacting groups in e-Government. Some of the interacting groups in this stage are:

- I. Government
- II. Citizen
- III. Business
- IV. Employees

This Kind of interaction is termed G2G, G2C, G2B and G2E.

## **c. Transaction**

Interacting groups in this group can have complete web transaction in this phase. Government transactions for e.g. Renewing driving license, applying for the

Passport, updating user information, paying taxes, submitting bidding forms etc are possible in this phase.

## **d. Transformation**

The highest stage, most closely aligned with the concept of governance, involves a reinvention of how government functions are conceived and organized [32].

### **1.1.3 United Nation's Five Stage Model**

United Nations in 2001 identified five stages to qualify the whole e-Government process. They have benchmarked e-Government process with global perspective. Below are the stages they have defined:

**i. Emerging Presence**

Stage I e-government presents information which is limited and basic. The e-government online presence comprises a web page and/or an official website; links to ministerial/departments of education, health, social welfare, labor, and finance may/may not exist; links to regional/local government may/may not exist; some archived information such as the head of states' message or a document such as a constitution may be available online; most of the information remains static with the fewest options for citizens [29].

**ii. Enhanced Presence**

Here it's about how often the content in sites are updated, and number of government sites start increasing here. Information in this Stage is more dynamic than the previous stage. Here in this stage government provides more information and even sometimes archived ones, like policies, past versions of agreements etc. Though more sophisticated, the interaction is still primarily unidirectional with information flowing essentially from government to citizen.

**iii. Interactive Presence**

By Stage III the online services of the government enter the interactive mode with services to enhance convenience of the consumer such as downloadable forms for tax payment, application for license renewal. Audio and video capability is provided for relevant public information. The government officials can be contacted via email, fax, telephone and post. The site is updated with greater regularity to keep the information current and up to date for the public [29].

**iv. Transactional Presence**

Stage IV allows two-way interactions between the citizen and his/her government. It includes options for paying taxes; applying for ID cards, birth certificates/passports, license renewals and other similar C2G [citizen-to-government] interactions by allowing him/her to submit these online 24/7. The citizens are able to pay for relevant public services, such as motor vehicle violation, taxes, fees for postal services through their credit, bank or debit card. Providers of goods and services are able to bid online for public contracts via secure links [29].

**v. Networked or Seamless Presence**

This is the most sophisticated level of e-government service delivery; all Services and functions across all government levels are integrated; citizens can access any kind of services from a central location at any given time [25].

**1.1.4 Moon's Five Stage Model**

Moon devised a model on 2002 for e-government maturity process. This model resembles with the previous model Hiller and Blanger (2002) except one distinct stage. Below are the stages defined by this model:

- i. One way communication
- ii. Two way Communication
- iii. Transformation
- iv. Vertical and Horizontal integration
- v. Political Participation

At this stage Government involves citizens into political participation activities including online voting and forums.

**1.1.5 Word Bank's Three Stage Model**



World Bank, Center for Democracy and Technology (2002) has divided the process of e-Government implementation into three phases. These phase are totally independent to each other and can be started any time, however, the all the three steps are for the ultimate goal of e-government process.

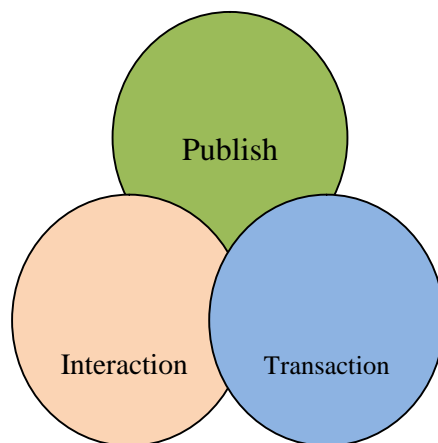


Figure 9: Center for Democracy and Technology, 2002

- **Publish:** Publish sites seek to disseminate information about government information compiled by government to as wide an audience as possible. In doing so, publish sites serve as the leading edge of e-Government.
- **Interact:** Interactive e-Government involves two-way communications, starting with basic functions like email contact information for government officials or feedback forms that allow users to submit comments on legislative or policy proposals.

- **Transact:** Allowing citizens to obtain government services or transact business with the government online. A transact website offers a direct link to government services, available at any time. Transact sites can enhance productivity in both the public and private sector by making processes that require government assistance or approval simpler, faster, and cheaper [32].

#### **1.4 Software Complexity Measurement:**

According to Basili, complexity of software is a measure of resource expended by a system while interacting with a piece of software to perform a given task. Hence, if this is about computing with computer then the complexity is defined with the execution time the storage required for completing the execution. Also complexity is about the effort required to design the computing environment, for e.g. effort required to code, debug, test, and modify it. There are two types of complexity metrics, Static and Dynamic. Static complexity is the measure without executing the actual program; it gives the measurement of the program execution effort without actually executing it. While dynamic analysis is the actual analysis with execution. There are various measures in practice, however, Halstead and his colleague's definitions of software complexity measurement are the widely used ones. McCabe metrics is also used often, and this is mostly useful when the software uses branching constructs. The McCabe metric determines code complexity based on the number of control paths created by the code. Halstead bases his approach on the mathematical relationships among the number of variables, the complexity of the code and the type of programming language statements [20].

### 1.4.1 HALSTEAD'S METRIC

Halstead has proposed metrics for length and volume of a program based on the number of operators and operands. In a program he defined the following measurable quantities:

1 the number of unique operators,  
2 the number of unique operands,  
N1, the total number of operators,  
N2 the total number of operands.  
Halstead defined the volume, V, of a program to be

$$V = (N1 + N2) \log_2(1 + 2)$$

And program difficulty, D, to be

$$D = 1 * N2 / 2^2$$

Halstead derived a number of other measures. The most extensively studied of these is an estimate of the effort, E, required to implement a program:

$$E = D * V [20]$$

Starting with the assumption that code complexity increases as vocabulary and length increase, Halstead observed the following:

- I. Code complexity increases as volume increases.
- II. Code complexity increases as program level decreases [38].

### 1.4.2 McCABE'S METRIC:

Thomas J. McCabe introduced the concept of Cyclomatic complexity. He mainly focused on the conditional and control statements in a program. Cyclomatic complexity is computed using the control flow graph of the program. This metric can be defined in below two ways:

- i. The Number of Decision statements in a Program + 1

- ii. For a Graph with  $n$  vertices,  $e$  edges, and  $p$  connected components [20]

$$v(E) = e - n + p \quad [29]$$

```

if (x < 0)
  do {
    if (y)
      b();
    m = c() * m;
  }
while (m < k);
else if (x == 0)
  do{
    if (y == 0)
      b();
    c();
  }
while (x == 0)
else
  do {
    if (j)
      b();
    m = c() * 2m;
  }
while (m <= k);

```

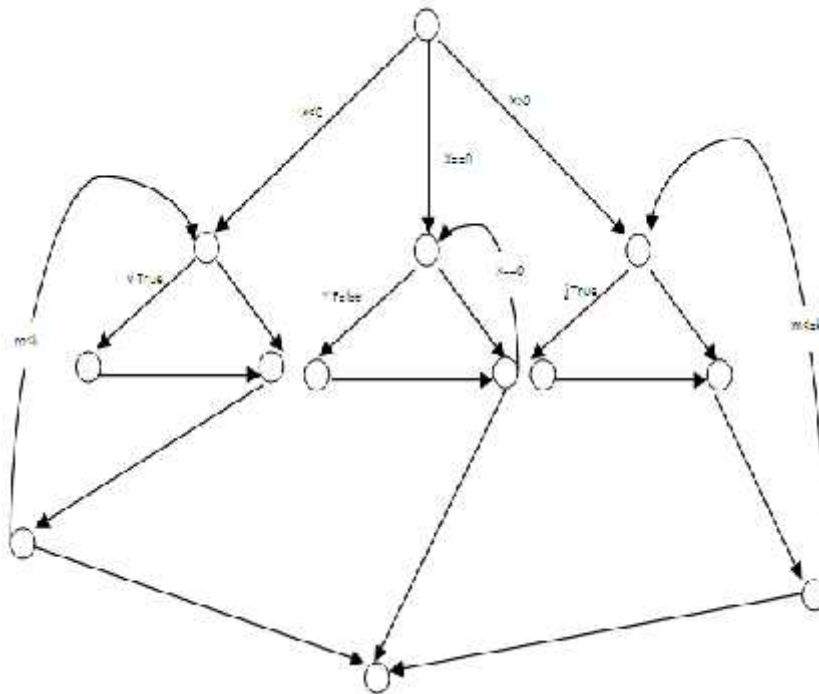


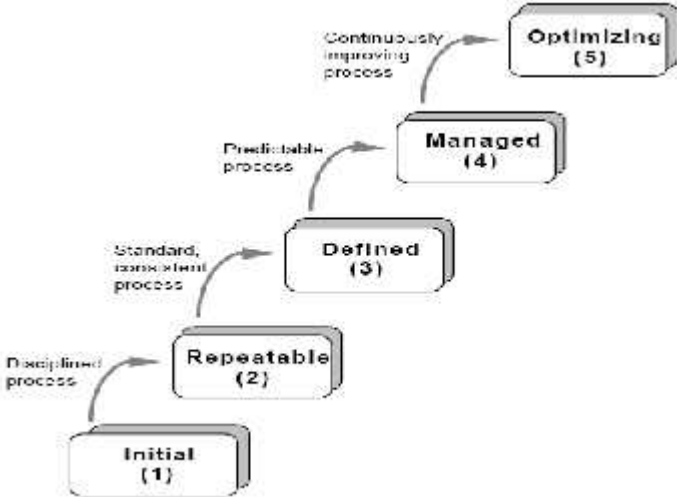
Figure 10: Flow Graph of the Example Program [20: Static and Dynamic Complexity Analysis of Software Metrics]

### 1.5 Maturity Measures:

Software process Maturity is the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective. Maturity implies a potential for growth in capability and indicates both the richness of the software process and the consistency with which it is applied in projects throughout the institution [25]. Software Engineering Institute (SEI) Derived several dimensions which Software process can focus on to improve the Performance.

#### 1.5.1 Capability Maturity Model (CMM):

CMM provides five maturity levels which are the foundations for



continuous process improvements. These levels provide the mechanism to measure the maturity of a software process and evaluate the software process capability [36].

**Figure 11: The Five Levels of Software Process Maturity [36]**

### **1.5.2 Capability Maturity Model Integration**

The CMMI is a collection of best practices that helps organizations improve their processes. Initially this concept was introduced by US Government together with Software Engineering Institute (SEI) to have a process improvement in product development covering product life starting from conceptualization through maintenance and disposal. CMMI currently addresses three areas of interest:

1. Product and service development — CMMI for Development (CMMI-DEV),
2. Service establishment, management, and delivery — CMMI for Services (CMMI-SVC), and
3. Product and service acquisition — CMMI for Acquisition (CMMI-ACQ).

CMMI is not as specific to Softwares as its predecessor, the software CMM. CMMI Key Proces Areas are:

Abbreviation	Name	Area	Maturity Level
CAR	Causal Analysis and Resolution	Support	5
CM	Configuration Management	Support	2
DAR	Decision Analysis and Resolution	Support	3
IPM	Integrated Project Management	Project Management	3
MA	Measurement and Analysis	Support	2
OPD	Organizational Process Definition	Process Management	3
OPF	Organizational Process Focus	Process Management	3
OPM	Organizational Performance Management	Process Management	5
OPP	Organizational Process Performance	Process Management	4
OT	Organizational Training	Process Management	3
PMC	Project Monitoring and Control	Project Management	2
PP	Project Planning	Project Management	2
PPQA	Process and Product Quality Assurance	Support	2
QPM	Quantitative Project Management	Project Management	4
REQM	Requirements Management	Project Management	2
RSKM	Risk Management	Project Management	3

**Table 5: CMMI Key Process Area**

## 1.6 SWOT/PEST Analysis

Strength, Weakness, Opportunities, Threats analysis addresses the problems of administering e-government within an well developed e-democracy system.

SWOT/PEST	Strength (S)	Weakness (W)	Opportunities(O)	Threats(T)
<b>Political(P)</b>	1. Public Policy (e.g Class Licence scheme). 2. Cooperation Between Public and Private Sector	1. Conservation in trying e-services	Political willingness	Cyber Terrorism and Cyber crimes
<b>Economical(E)</b>	1. Economic Policies. 2. Funds for e-service to Social and Physical Infrasructure	Unemployment	Better opportunities for IT literate for employment	Higher cost of living and broadband subscriptions.

<b>Social(S)</b>	Tech savvy Population.	Old generation and low life people are computer illiterate	Online Transaction opportunities.	Rapid development of mobile and SMS technology
<b>Technological(T)</b>	Innovation and Hi-tech based economy.	Heavy Traffic over government sites, and some sites might not be well managed.	Faster connection to broadbands.	Dependency on IT, i.e. small problem will disturb the entire network.

**Table 6: SWOT Analysis [15]**

## **CHAPTER II**

### **BACKGROUND AND PROBLEM DEFINITION**

#### **2.1 Background**

Identifying a better maturity model of e-government development process has always been an area of interest and been taken into study to identify the better one. Various metrics are used so far to have this compared and identified.



Basically there are various metrics to measure the maturity of an IT development process; however, there have been few efforts on defining and comparing e-government maturity process in technical basis. We find that many countries localize their own model of e-government maturity process. Most of the time it depends on local practices for about how to opt the maturity process. So, there are various approaches defined by different researchers one might be useful in the context of one country while another will fit for next country's practice. Implementing E-government is a continuing process, and most often the development is conceptualized in stages [34]. The maturity of citizens and their knowledge of information and ICT has been found important point in implementing E-government program [34]. These Models try to adopt the highest level of WWW capability [25]. Maturity models existed for a number of processes. One of the most well known is the Capability Maturity Model (CMM) for software development from the Software Engineering Institute at Carnegie Mellon University [18]. Regardless of the methodology used, there have always been common issues and challenges that always come with e-government implementations, for example, poor technical implementations, Organizational inflexibility, digital divides and choices, lack of trust etc [20].

If we check back, we see commonly there have been four stages for the development of e-government process in high level, static presence online, enhanced representation of government, interactive environment, and transactional occurrence.

## **2.2 Problem Definition**

The Key issue in comparing e-government maturity models is about how to compare them, what is the comparison basis for it. There have been very few efforts to compare these models on technical basis. Effort, volume, computation complexity, program vocabulary etc. are some of the basis we can take in indentifying the better maturity model among many available.

### **2.2.1 Software Metrics**

Software metrics is a measure of property of software or software development process. There have been many practices to quantify this analysis so as to plan about the quality, budget, debugging strategy, optimization, operation and maintenance (O&M) [30]. Some of the common software measurements are, Halstead Complexity, Cyclomatic Complexity (McCabe's Complexity), COCOMO, Cohesion, Coupling etc. Measuring complexity of software products was, and still is, a widely distributed research subject. The scope of studying it was to control the levels of the external attributes of software via internal attributes, like complexity. The most well-known internal attribute is software length. Another is complexity. While in the case of length is a quite well defined consensus about the ways the length should be measured, in the case of complexity is still a lot of confusion [28].

### **2.2.2 Halstead Complexity Measures:**

This complexity measurement technique was developed by Maurice Howard Halstead in 1977. This technique aimed to identify some measurable attributes of software. This technique tries to relate the various attributes of software just like devising an equation relating to mass, volume, density of an object. Halstead method is in use since when programs were procedural and , in general, monolithic. In other words out average computer program was just one

big file of code. Basically Halstead method is based on the number of Operators and operands. This is an issue with modern OOPs on how to define operators and operands for varieties of constructs they have. For eg. how to define Operators and Operands for Java provided methods, classes and packages. So, in general, an operand is something that may participate in an interaction with zero or more operators. The three most primitive Halstead metrics are Length, Vocabulary and Difficulty.

Let's assume a simple statement:

*int x = x + 1; .....eg.1*

Here "int", "+", and "=" are operators, while "x" and "1" are operands, i.e. 3 operators and 3 Operands.

First we need to compute the following numbers, given the program:

$\eta_1$  = the number of distinct operators (UOP)

$\eta_2$  = the number of distinct operands (UOD)

$N_1$  = the total number of operators

$N_2$  = the total number of operands

From these numbers, several measures can be calculated:

Program vocabulary:

$$\eta = \eta_1 + \eta_2$$

Program length:

$$N = N_1 + N_2$$

Calculated program length:

$$\hat{N} = \eta_1 \log_2 \eta_1 + \eta_2 \log_2 \eta_2$$

Volume: The Halstead Volume is based on the Length and the Vocabulary. We can view this as the ‘bulk’ of the code – how much information does the reader of the code have to absorb to understand its meaning. The biggest influence on the Volume metric is the Halstead length which causes a linear increase in the Volume i.e. doubling the length will double the Volume. In the case of the Vocabulary the increase is logarithmic [31].

$$V = N \times \log_2 \eta$$

Difficulty:

$$D = \frac{\eta_1}{2} \times \frac{N_2}{\eta_2}$$

Effort:

$$E = D \times V$$

BUG: Halstead Bug analysis estimates how much bugs are most likely to happen in a system. Volume divided by 3000 is the most considered bug analysis.

$$\text{VOL}/3000 \text{ or } \text{EFF}^{(2/3)}/3000$$

The difficulty measure is related to the difficulty of the program to write or understand, e.g. when doing code review. The effort measure translates into actual coding time using the following relation,



This complexity measure was developed by Thomas J. McCabe in 1976. This is used to measure the number of linearly independent path through a program's source code. Mathematically, the Cyclomatic complexity of a structured program is defined with reference to the control flow graph of the program, a directed graph containing the basic blocks of the program, with an edge between two basic blocks if control may pass from the first to the second. The complexity  $M$  is then defined as: [38]

$$M = E - N + 2P$$

If a graph is strongly typed, i.e. every node is connected to entry and exit point, Cyclomatic complexity of a program is equal to the Cyclomatic number of its graph, in this case the Cyclomatic complexity is defined as:

$$M = E - N + P$$

Where,

$E$  = the number of edges of the graph

$N$  = the number of nodes of the graph

$P$  = the number of connected components

### **2.2.3.1 Connected Components:**

Connected component of a graph is a sub graph where any two vertices has some path to connect to each other. If a graph is self connected will have one connected component i.e. the whole graph itself.

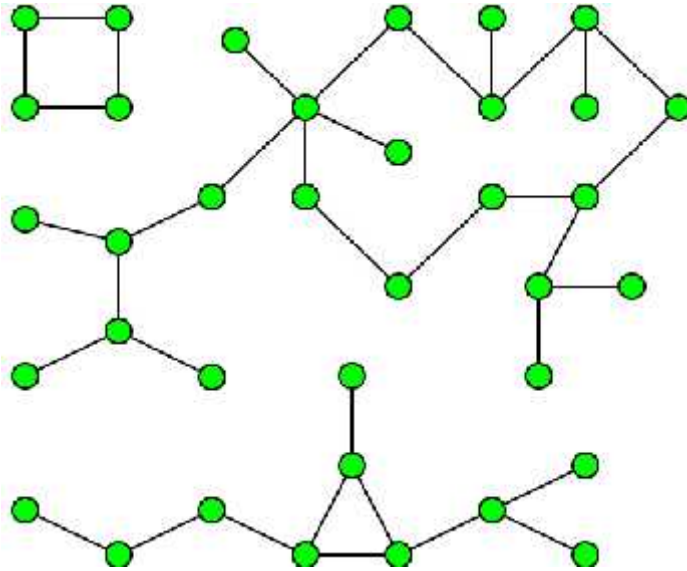


Fig 7: A Graph with Three Connected Components

McCabe has recommended that the designer/programmer should count the Cyclomatic complexity after developing every module, and split them into smaller modules whenever the module exceeds the Cyclomatic complexity. For every development process there will be an agreed Cyclomatic complexity limit between vendor and the customer, so up on exceeding the limit there should be suitable reason to justify the cause. Another implication of Cyclomatic complexity is in determining the number of test cases required to have a full testing of the module. Consider the below example with two sequential if-then-else statements:

```
if(c1())  
    f1();  
else  
    f2();
```

```
if(c2())
```

```
    f3();
```

```
else
```

```
    f4();
```

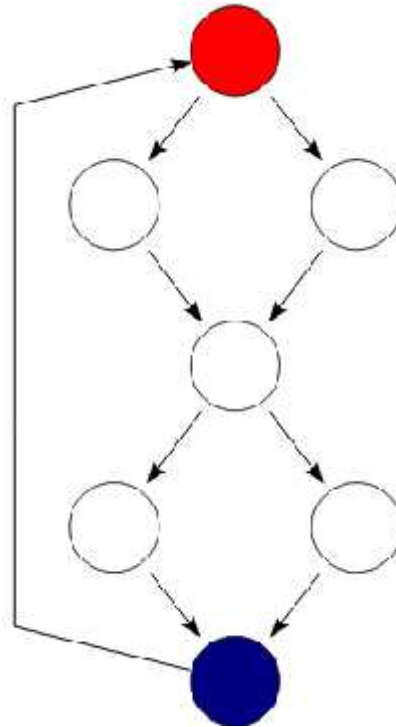


Figure 8: Control Flow Graph of Example control code.

This Strongly connected flow graph has 9 edges, 7 nodes, and 1 connected component.

So,

$$M = 9 - 7 + 1 \text{ (As strongly Typed)}$$

$$= 3$$



Modules with higher complexity level requires more tests to carry, because we will have to reach all possible paths, and also more difficult to understand the module.

### **2.2.3.2 Correlation between Cyclomatic Complexity and Defects:**

There have been numerous studies to relate the Cyclomatic complexity with the possible bug that module might contain. And most of the studies have proved that there is a strong positive correlation between Cyclomatic complexity and the number of defects that module is likely to contain. For example, in 2008 a software metric supplier company Enerjy analyzed Java modules and correlated between complexity and defects, classes with a combined complexity of 11 having a probability of being fault-prone of just 0.28, rising to 0.98 for classes with a complexity of 74.

### **2.2.4 Comparison Basis:**

There are various maturity models for e-governance development process, and to qualify one with suitable reason is a difficult task if we are considering technical factors to compare. Here, one interacting group (citizen for example)

will be taken as an example, and the implementation part for that will be shown and comparison for the whole process development will be made using Halsted and McCabe's complexity measurement technique. In this regard, also the human effort will be compared, as at highest maturity level, the software complexity level will be almost same for all the models.

## **CHAPTER III**

### **IMPLEMENTATION**

This chapter provides the implementation part for one of the e-government processes. Out of many interacting groups in e-government matured process, only one party will be taken into account. For this case, I am using "Individual" as an interacting group, and will create a scenario possible to compute the complexity level. Out of the Different levels in maturity, in this section, transaction stage will be implemented.

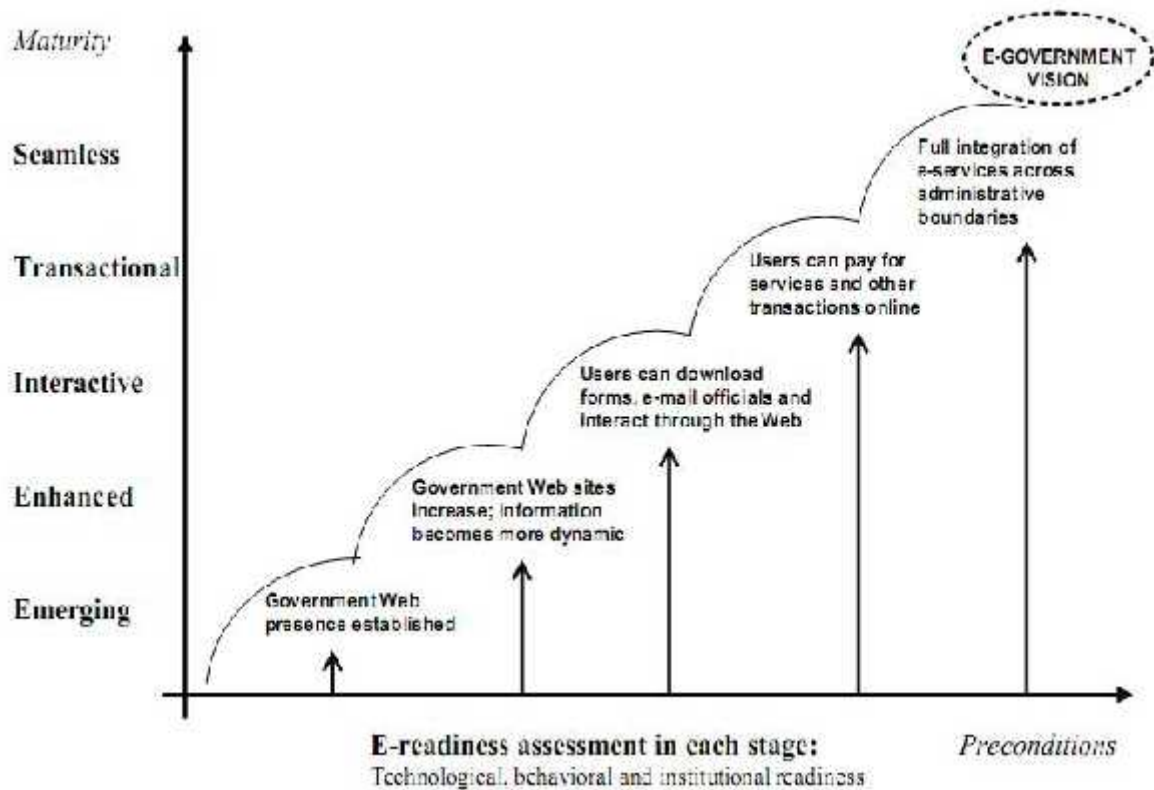


Figure 9: E-Government Development Stage Model

### 3.1 Implementation Models

There are number of stages e-government full development process goes through. Technically, this is a huge process, and requires a lot of implementation

procedures, debugging, testing & verification, optimization i.e. full process of a project development cycle.

### **3.1.1 Transaction Stage of E-Government:**

Out of various stages in e-government development process, Transaction is one of them. Not specific to any model, but this is included in all maturity models. This stage provides the end users with options like making changes to their own information stored over WWW, make online payments, make online purchase of government services, check online status of their own business operations etc. Users actually start to feel "e" from this stage, as they directly start getting responses from the government for their operations. Here I'll show a branch of functionality provided by e-government to one of its interacting groups, citizen. Citizen paying their usage bills online. Then, in later phase it'll be analyzed with its overall complexity if it was implemented with other interacting bodies, and integrated with other transaction events also.

### **3.1.2 Control flow Structures:**

Control structures in programming are block of structures which allows changing the ordering of how statements in our programs are executed [29]. Generally we see two types of control structures used,

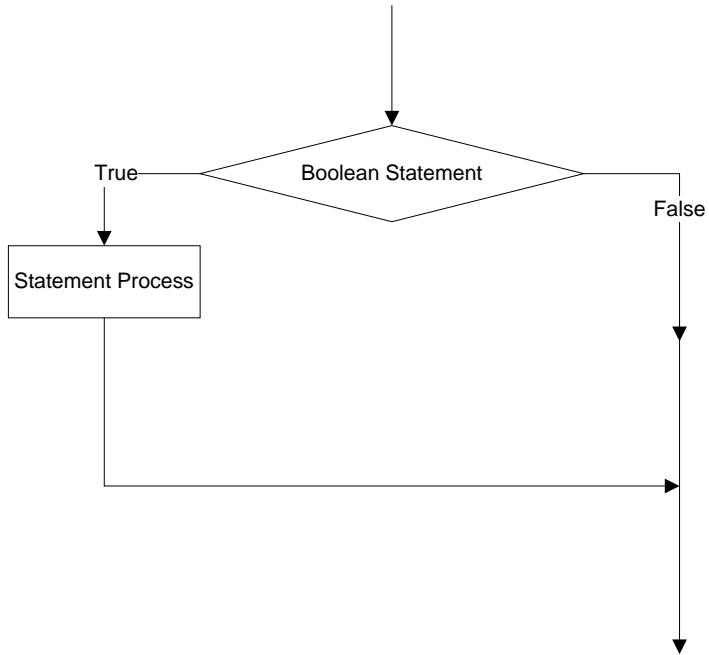
- Decision Control Structures
- Repetition Control Structures

Decision Control Structure	Repetitions Control Structures
IF Statement	WHILE Loop
IF ELSE Statement	DO WHILE Loop
IF ELSE IF Statement	FOR Loop
SWITCH Statement	

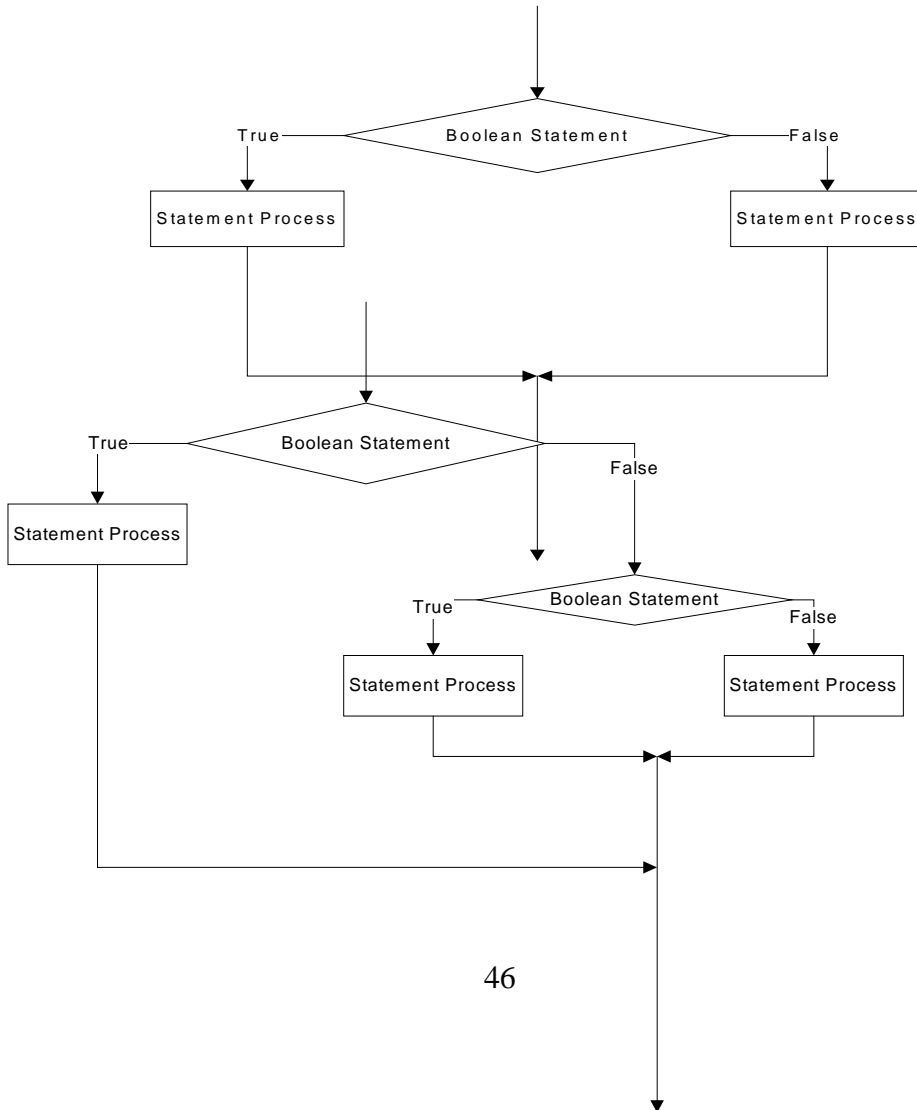
Table 7: Control Statements

### 3.1.3 Flow Charts of control Statements:

#### **IF Statement:**



**IF ELSE Statement:**



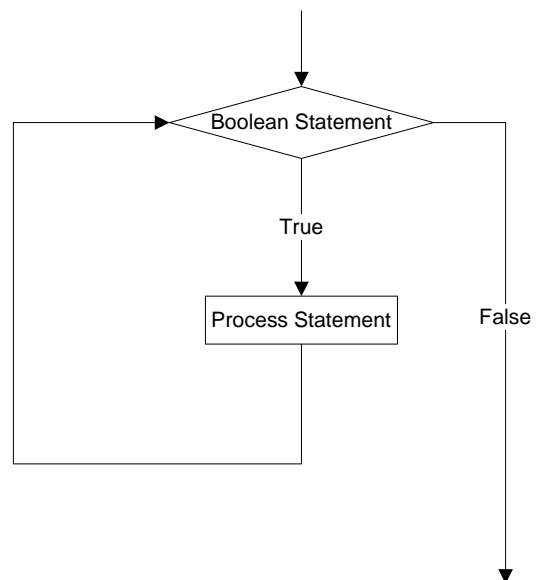
**ELSE**

**IF  
IF Statement:**

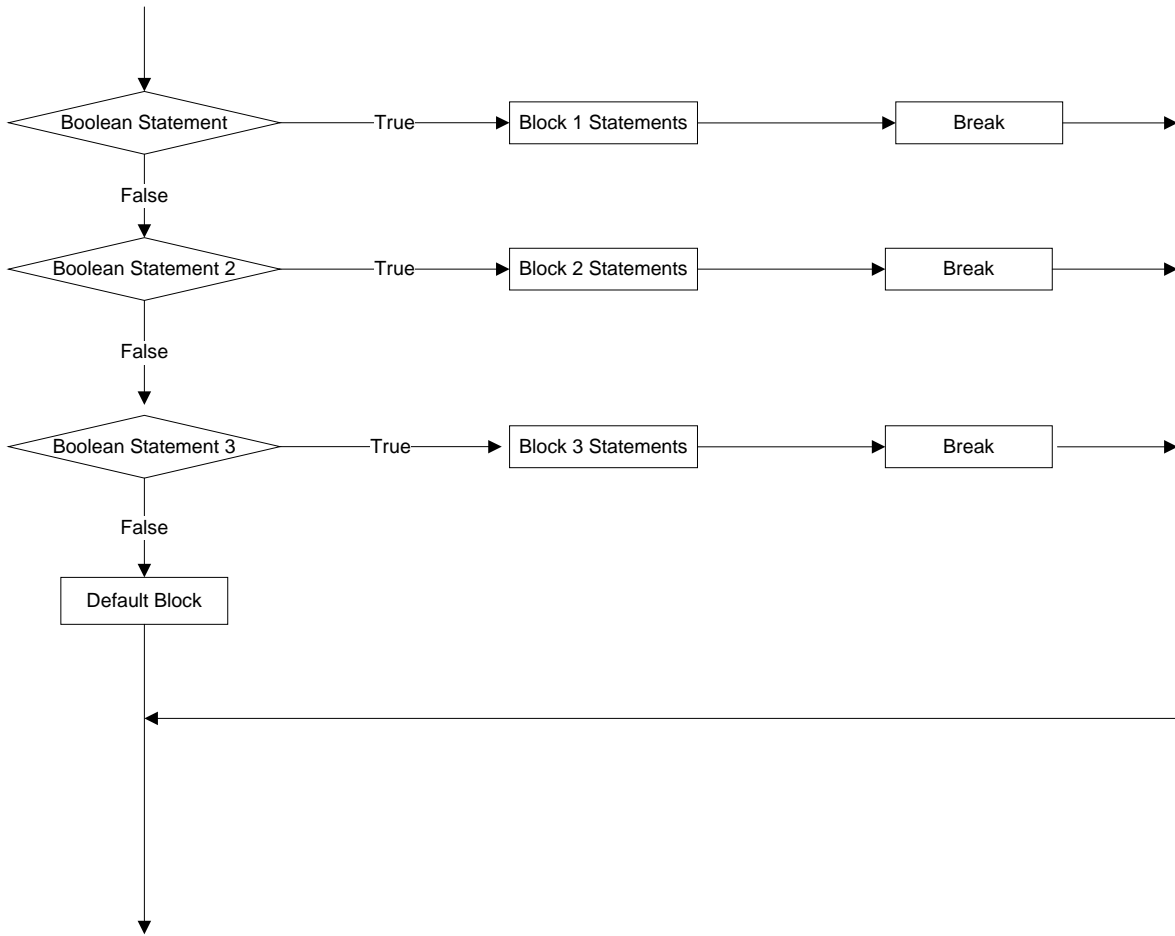
**SWITCH Statement:**

**WHILE Statement:**

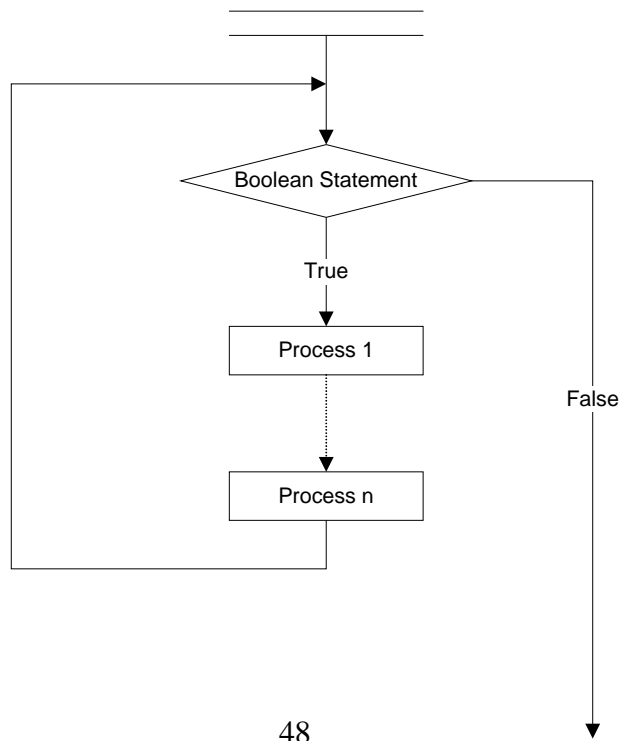
**While Statement**



**Switch Statement**

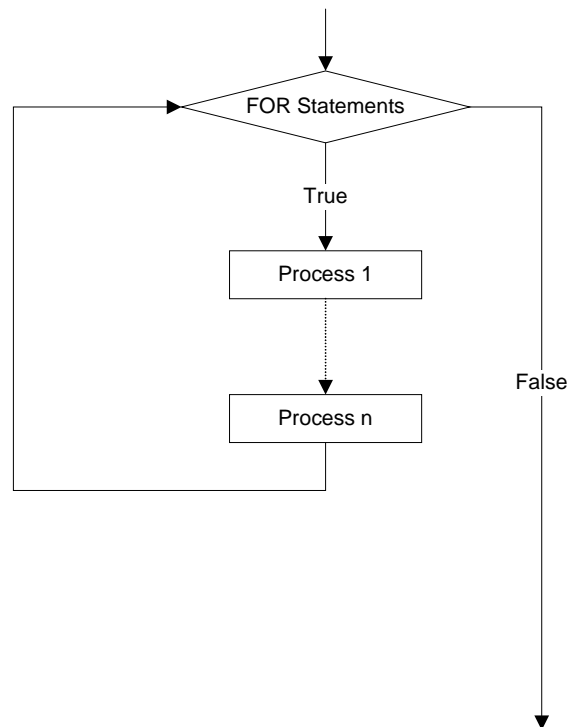


**DO WHILE**





## FOR Loop:



For Implementation, we'll consider a module which takes an input of different ID types of citizen, Analyzes it, and based on that entry validation for ID Numbers will be evaluated. If this Validation succeeds then, the corresponding matching between ID type, ID number, and Account Number will be carried, and meantime the amount for bill will be deducted. Our target here will be to calculate complexity of these operations.

There might be instances, the same module of the e-government process has different complexity level when developed by different programmers, this is because it depends on how much experienced the programmer is, and how much he can optimize the source code. There might be various programming constructs involved, HTML tags, DB select/update operations in background, arithmetic operations, variable initializations etc, and these all are accounted during

complexity computation. For this implementation part, major operations will be included,

1. HTML TAGs.
2. Arithmetic Operations.
3. Control Structures.
4. DB Operations.

### 3.1.4 HTML user Construct in Transaction

```
1: <html>
2:   <head>
3:     <title>Government Of Nepal - eGovernment
Portal</title>
4:   </head>
5:   <body>
6:     <div </div>
7:     <form id="FrmID1" method="post"
action="Submitted_Account_Compute.html">
46:    </form>
47:    <table>
48:      <tbody></tbody>
49:    </table>
50
69
119: </html>
```

### 3.1.5 Control Structure Construct in Transaction:

```
1:   if (ID_Typ == 'Citz')
2:     do {
3:       int k = 0
4:       if (ID_No like '5802%')
5:         {
6:           accept_input_citz();
7:         }
8:       else
9:         {
10:            exception_citz();
11:          }
12:          k++;
13:        }
14:      }
15:    while k<=3)

16:
17:   else if (ID_Typ == 'Psrt')
18:     do{
```

```

19:         if (ID_No Like '4802%')
20:             {
21:                 accept_input_pspert();
22:             }
23:         else
24:             {
25:                 exception_pspert();
26:             }
27:     }
28:
29: else
30:     do {
31:         suggest_input_type();
32:     }
33:
34:
35: accept_input_citz()
36: {
37:     compute_accounting_citz();
38: }
39:
40: accept_input_pspert()
41: {
42:     compute_accounting_pspert();
43: }
44: exception_citz()
45: {
46:     throw_msg_citz();
47: }
48: exception_pspert()
49: {
50:     throw_msg_pspert();
51: }
52: suggest_input_type()
53: {
54:
55: }

```

### 3.1.6 DB Operations:

```

1: <?php
2:
3:         //echo $_POST ["acctno"];
4:
5:
6:         $con =
mysql_connect("localhost:3306","root","");
7:         $dbname = 'egov_transac_implemenation';

```

```

8:             if ($con)
9:             {
10:                    echo 'Successful connection
to Database !';
11:             }
12:             else
13:             {
14:                    die('Could not connect: ' .
mysql_error());
15:             }
16:             $selectdb = mysql_select_db($dbname);
17:
18:
19:             if ($selectdb){echo '<BR>Database
Selected<BR>';}
20:             else{echo '<BR>No Database Selection
happened';}
21:
22:             $acctno = $_POST["acctno"];
23:             $result = mysql_query("SELECT due from
account_dues WHERE account_no = '$acctno'");
24:
25:
26:
27:
while($row=mysql_fetch_assoc($result)){
28:
29:                    // Update field
"name", matching with "id" value by while loop.
30:                    mysql_query("update
name_list set name='$name' where id='$row[id]'");
31:                    mysql_query("UPDATE
account_details SET balance = balance - $due where
account_no = '$_POST[acctid]'");
32:                    }
33:             echo "--- Update Complete ---";
34:
35:
36:
37:

38:             echo "<BR>Dear $acctno This is your due
$due";
39:
40:             $result = mysql_query("UPDATE
account_details SET balance = balance - $due where
account_no = '$_POST[acctid]'");

```

```
41:          if($result){echo '<BR>Your table has  
been populated';}  
42:          else {echo '<BR>No insertion';}  
43:  
44:          ?>
```

## **CHAPTER IV**

### **TESTING AND ANALYSIS**

This chapter we'll measure the complexity levels of different implementation modules of Transaction stage of e-governance maturity process. There are various measurement conditions that can be applied to say some maturity process is more complex than the other, however, we are considering the software metric provided by two measurement criterion provided by McCabe's Complexity Measure [38] [34], and Halstead Software Science [27]. If we go more in details there might be much to discuss about the computational complexity analysis, Product Metrics in terms of size (LOC), in terms of quality (Defects, Reliability, and Maintainability), Process metrics (Mostly process oriented), however, the scope here is to analyze the overall software metric for a module within a level and predict the complexity measures in levels up and down.

Finally the effort analysis will also be made in terms of continuous involvement for developing the functionality to mature the complete e-government process. First the test result will be taken out, and analysis will be made on that to recommend the better maturity model.

## 4.1 Test Input Data

Test here is carried out using the input from above program fragment. Program fragment consists of HTML operations, DB operations, and Control Structures. Based on these codes, Halstead and Cyclomatic complexity will be evaluated.

We'll see the Halstead and Cyclomatic complexity measure for control flow structure here. To define Halstead measure following information should be extracted first.

$\eta_1$  = the number of distinct operators (UOP)

$\eta_2$  = the number of distinct operands (UOD)

$N_1$  = the total number of operators

$N_2$  = the total number of operands

And yet another issue is with defining the operators and operands, and with Halstead measure below is the recommendation for even most modern OOP Languages:



### 4.1.1 Operands

Tokens of the following categories are all counted as operands:

IDENTIFIER	all identifiers that are not reserved words
TYPESPEC	(type specifiers) Reserved words that specify type: bool, char, double, float, int, long, short, signed, unsigned, void.
CONSTANT	Character, numeric or string constants.

Table 8: Operands Specification [27]

### 4.1.2 Operators

Following categories are all counted as Operators :

SCSPEC	(storage class specifiers) Reserved words that specify storage class: auto, extern, inline, register, static, typedef, virtual, mutable.
RESERVED	Other reserved words of C++: asm, break, case, class, continue, default, delete, do, else, enum, for, goto, if, new, operator, private, protected, public, return, sizeof, struct, switch, this, union, while, namespace, using, try, catch, throw, const_cast, static_cast, dynamic_cast, reinterpret_cast, typeid, template, explicit, true, false, typename. This class also includes some compiler specific nonstandard keywords.
OPERATOR	One of the following: ! != % %= & &&    &= ( ) * *= + ++ + = , - -- -= - > . ... / /= : :: < << <<= <= = == > >= >> >>= ? [ ] ^ ^= { }    = ~

Table 9: Operators Specification [27]

## COMMENTS

The comments delimited by /\* and \*/ or // and newline do not belong to the set of any categories.

With this definition, below are the values for control structure code in the above sample module.

Operators: if, ==, like, %, :, (, ), else, do, while, ', {, }, ++, <, =,

Operands: ID\_typ, citz, k, int, 52-8, 4208, 0, 3, psprt, IP\_No, accept\_input\_citz, exception\_citz, accept\_input\_pspert, exception\_pspert, suggest\_input\_type, compute\_accounting\_citz, compute\_accounting\_pspert, throw\_msg\_citz, throw\_msg\_pspert

Now,

$N_1 = 101$

$N_2 = 31$

$n_1 = 16$

$n_2 = 19$

Operators Count:

$if = 4, == = 2, like = 2, \% = 2, ; = 10, ( = 19, ) = 19, else = 4, do = 3, while = 1, ' = 8, \{ = 12, \} = 12, ++ = 1, < = 1, = = 1,$

Operators count:

$ID\_typ = 1, citz = 1, k = 3, int = 1, 5208 = 1, 4208 = 1, 0 = 1, 3 = 1,$   
 $psprt = 1, ID\_No = 2, accept\_input\_citz = 2, exception\_citz = 2,$   
 $accept\_input\_psprt = 2, exception\_psprt = 2, suggest\_input\_type = 2,$   
 $compute\_accounting\_citz = 2, compute\_accounting\_psprt = 2,$   
 $throw\_msg\_citz = 2, throw\_msg\_psprt = 2$

Now, we can compute the various measures of Halstead Science as below:

Halstead Length (LTH) =  $N_1 + N_2 = 101 + 31 = 132$

Halstead Vocabulary (VOC) =  $n_1 + n_2 = 16 + 19 = 35$

Halstead Difficulty (DIF) =  $1/2 * N_2 / n_2 = 16/2 + 31/19 = 9.6315789473684210$

Halstead Volume (VOL) =  $LTH * \text{Log}_2(\text{VOC}) = 132 * \text{LOG}_2(35)$

$= 132 * 5.1293 = 677.0676$

Halstead Effort (EFF) =  $\text{DIF} * \text{VOL}$

$= 19.6315789473684210 * 677.0676$

$= 13291.90604210$

Halstead BUG (BUG) =  $\text{EFF} / 3000 = 13291.90604210 / 3000 = 4.430635347366$

Now, we'll define a graph structure for this control structure in sample module, and compute the Cyclomatic complexity.

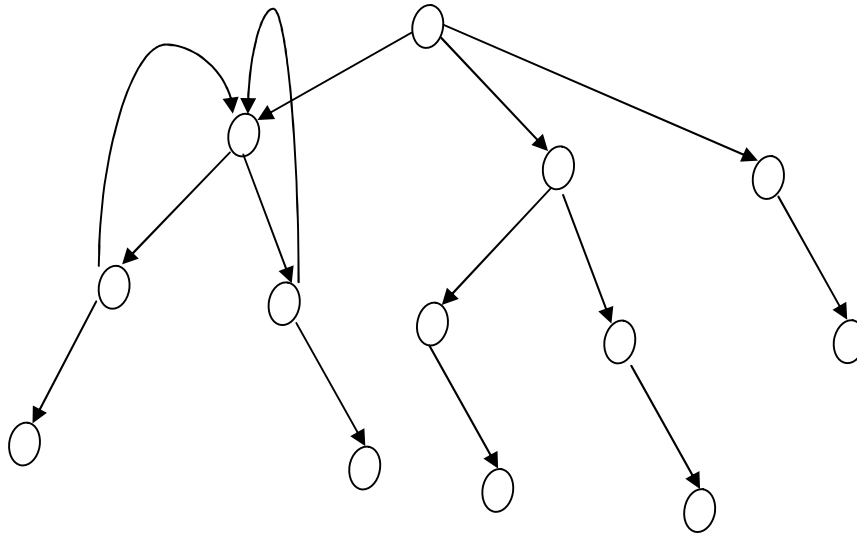


Figure 10: Flow Graph for Control construct

Now for evaluating Cyclomatic complexity, we can get below details:

$$M = E - N + 2P$$

Where

$E$  = the number of edges of the graph

$N$  = the number of nodes of the graph

$P$  = the number of connected components

Here,

$$M = 14$$

$$N = 13$$

$$P = 1$$

$$\text{Hence, } M = 14 - 13 + 2 * 1 = 1 + 2 = 3$$

## 4.2 Analysis:

We used two of the available software metric to check the complexity of implementation process of e-government. There will be many or some thousands such modules that need HTML Operations, DB Operations, Control Structure checks, and so on. As we saw maturity is the process consisting of different levels and modular components within each level.

There are many aspects we can judge e-government maturity models, however, when the process reaches to its highest level of maturity, i.e. when e-government process meets its goal fully, at that time the collective complexity from very bottom level to the top will be same whatever the model we use. Still there will be concerns about the effort requirement to make it.

Also, we see there are many implementation issue within one phase, for the case in my sample module for Transaction, we can be in a place to reduce the complexity of coding it making use of different choices of control structures, for instance use of SWITCH construct might help making it less complex compared to using nested IF-ELSE statements, or make use of FOR instead of using DO-WHILE, etc. Use of appropriate DB tool, good connectivity APIs can significantly reduce the complexity.

There are still open items that Halstead and McCabe's analysis can not answer:

In McCabe's Analysis, the complexity of an expression within a conditional statement is never acknowledged;

```
if((x = b * b + abs(SQRT(z) - 1)/ 3) > 1 * a)
```

This statement is counted the same as

```
if (x > y)
```

Both add 1 to the complexity measure. Also, any complicated expressions inside a non-conditional statement are not counted at all. A very long straight-line program will have a McCabe complexity of 1.

## CHAPTER V

### CONCLUSION AND FUTURE STUDIES

#### 5.3 Conclusion

With this Dissertation, we can say that at the highest level of E-Government maturity process the implementation complexity is same for all maturity models; however, if we compare with effort required, we can conclude that World Bank 3 Stage model is the better one among five models introduced. World Bank has clear three stages, and if we check about the non-technical process complexity metrics about business process, there are some issues about Effort Complexity, Understandability, Performance, and Maintenance [36]. There has been always a strong analogy between coding and the business process.

World Bank Model defines the whole E-Government development process in just three levels, Publish, Interact and Transact. If we compute the software complexity metric when this model reaches to its highest level of maturity, i.e. full flexed transaction, then the total complexity there will be same compared to other models as the ultimate goal of all maturity models is to have fully electronic government and provide means of transaction for almost all government works. So, At this point we consider about Understandability and Maintainability, i.e. if a software development process is modular too much, then its difficult for maintenance and will have low degree of understandability i.e. if a process goes through yet minute levels of Interaction phase, then there comes the versioning issue, i.e. when to integrate to previous version, and equally the effort for that will be high. World Bank clearly identifies about what end-users can do at a defined

level of maturity, and we can conclude that Integration/Maintenance/Upgrade will all require significantly low efforts.

## **5.4 Comparison in between the models:**

Based on the levels included in different models we can see that the Halstead effort required is having direct impact on how many levels a model uses to mature a whole e-government development process. So, comparing in between the models having 4, 5, 6 levels of maturity giving calculation of high degree of Halstead and McCabe's complexity, we can conclude that the World Bank's three Stage model will accomplish with minimum effort and complexity measure.

### **5.4.1 Further Studies:**

There have been much studies about eGovernment, and yet studies about mGovernment is not so wide. M-Government can be a complementary to eGovernment rather than a substitute. [28] There can be good control over national/local governance if we go for M-Governance, for instance Kaski mobile users can submit request to his local government only, here a level control can be assigned in provider like Telecom. Several VAS platforms can be introduced in Handheld devices to make it more interactive. This can be far more effective in urban areas where the telecom coverage is fine, and no wired connections are available [34]. Government can have a good control on service delivery, if they plan to give preferential tariffs to its segmented users based on URL they use.

So, studies about M-Governance and implementation architecture on this are yet another open topic for studies. This might require a good knowledge of telecom service flow structure. And integration of government services with providers is also an area to study. Basically telecom can offer different process flows and more interactive platforms to government, so yet another study area can be how a service process can be more and more interactive in collaboration with Mobile Service Providers



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# Appendix A

## Test Data used

### User Information:

Hari Thapaliya	K4356	psprt	58025221123	KSK-DEY
Chandra Maharjan	S9098	citiz	48025221123	DDR-JPN
Min Thapalayia	G4344	psprt	5802789656	JHP-TRY
Sambhu Thapa	X8978	psprt	58028098765	TEU-GIO

### Account Dues

4802000002 3311  
4802000003 4101  
4802000004 3095  
4802000005 4716  
4802000006 1498  
4802000007 3198  
4802000008 2220  
4802000009 2070  
4802000010 4905  
4802000011 3559  
4802000012 2434  
4802000013 4656  
4802000014 3218  
4802000015 1378  
4802000016 2426  
4802000017 1629  
4802000018 3147  
4802000019 2995  
4802000020 3912  
4802000021 2856  
4802000022 1656  
4802000023 2331

## Account Balances

4802000002	19890
4802000003	1836
4802000004	19306
4802000005	7242
4802000006	13085
4802000007	7987
4802000008	5012
4802000009	16822
4802000010	9566
4802000011	17281
4802000012	12748
4802000013	1506
4802000014	16807
4802000015	18149
4802000016	15999
4802000017	5246
4802000018	8386
4802000019	16680
4802000020	15378
4802000021	15912
4802000022	6082
4802000023	16217
4802000024	4830
4802000025	12658
4802000026	2574
4802000027	16786
4802000028	13791
4802000029	2654

## Appendix B

### Code for Implementation

```
-----HTML/PHP for Transaction -----

<html>
  <head>
    <title>Government Of Nepal - eGovernment Portal</title>
  </head>
  <body>
    <div style="PADDING-BOTTOM: 10px; PADDING-
LEFT: 10px; PADDING-RIGHT: 10px; PADDING-
TOP: 10px" class="portlet-text
<br/>&nbsp;<strong>ELECTRICITY AND WATER BILL PAYMENT PORTA
L <br/></strong><br/><font size="2">&nbsp;&nbsp;&nbsp; Department
of Electricity & Water suppliers welcomes you in onlin
e bill payment system.&nbsp;<br/>&nbsp;&nbsp;&nbsp; Now you can p
ay your bill from anywhere around the world. We hope this w
ill bring good experience on you. </font></div>
    <form id="acctinput" method="post" action="Submitted_Ac
count_Compute.php">
      <div style="PADDING-BOTTOM: 20px; PADDING-
LEFT: 20px; PADDING-RIGHT: 20px; PADDING-
TOP: 0px" class="portlet-text">
        <ol>
          <li>
            <font size="2">Choose the Type of ID </font> </li>
```

```

        <li>
            <font size="2">Enter Citizenship Number or the
Passport Nnmber </font>
        </li>
        <li>
            <font size="2">Enter your Account number </font
>
        </li>
    </ol>
</div>
<table class="cream-
bordered" border="0" cellspacing="12" cellpadding="3" width
="25%" bgcolor="#c0c0c0" align="left" height="250">
    <tbody>
        <tr>
            <td class="theadr form-
label" height="80" width="72">
                <font size="2">ID Type</font> </td><!--
find the IDType for logged in user --><td style="PADDING-
LEFT: 10px" id="idTypeBox" bordercolor="#808040" width="65%
">
                <select style="Z-
INDEX: 102; POSITION: absolute; WIDTH: 120px; TOP: 282px; L
EFT: 95px" id="SelectID1" class="txt-box-
long" size="1" name="IdType"> <option>-- Select ID Type --
</option> <option value="Citizenship_Number">Citizenship_Nu
mber</option> <option value="Passport_Number">Passport_Numb
er</option></select> <br/></td></tr>
        <tr>
            <td class="theadr form-label" width="72">
                <font size="2">ID No.</font> </td>
            <td style="PADDING-
LEFT: 10px" id="idBox" width="65%">
                <input style="Z-
INDEX: 103; POSITION: absolute; WIDTH: 120px; TOP: 364px; L

```

```

EFT: 98px" id="acctid" class="txt-box-
long" maxlength="9" name="acctid"> <br/></td>
</tr>
<tr>
<td class="theadr form-label" width="72">
<div align="center">
<font size="2">Account No </font>
</div>
</td><!--
Account number ,same as typed in text box --
><td style="PADDING-LEFT: 10px" width="65%">
<p></p>
<p>
<input style="Z-
INDEX: 104; POSITION: absolute; WIDTH: 120px; TOP: 439px; L
EFT: 102px" id="acctno" class="txt-box-
long" maxlength="10" name="acctno"/> </p>
<p>
<input style="Z-
INDEX: 105; POSITION: absolute; WIDTH: 60px; TOP: 505px; LE
FT: 49px" class="btn" value="Submit" type="submit" name="bt
m_Submit"/> <input style="Z-
INDEX: 106; POSITION: absolute; WIDTH: 60px; TOP: 504px; LE
FT: 129px" class="btn" value="Clear" type="reset" name="btm
_Clear"/> </p>
</td></tr>
</tbody>
</table>
</form>
<table>
<tbody></tbody>
</table>
<br/><!-- Portlets End --><table>
<tbody></tbody>
</table><div style="Z-

```



```

INDEX: 108; POSITION: absolute; WIDTH: 1024px; HEIGHT: 43px
; TOP: 549px; LEFT: 10px" id="quicklinks-container">
     <
font size="2">&nbsp;</font> <a class="links" href">
    <font size="2">
        <span class="gray-
bottom">Legal_Information </span>
    </font></a><font size="2">
        
    </font><a class="links" href="http://unpan1.un.org/intrado
c/groups/public/documents/un/unpan030561.pdf">
        <span class="gray-bottom">
            <font size="2">eGovernment-Nepal Policies </font>
        </span></a><font size="2">
            
        <!--
            --></font><a class="links" href="" target="_blank">
            <font size="2">
                <span class="gray-
bottom">Register Queries</span> </font></a><font size="2">
                
            </font><a class="links" onclick="showLegalStatement()" hre
f="javascript:void(0);">
                <font size="2">
                    <span class="gray-
bottom">Disclaimer</span> </font></a><font size="2">
                    
                </font><a class="links" href="">
                    <span class="gray-bottom">
                        <font size="2">Register Complain </font>
                    </span></a><font size="2">
                        
                    </font><a class="links" onclick="">
                        <span class="gray-bottom">

```

```

        <font size="2">Help </font>
    </span></a><font size="2">
        
</font><a class="links" href="">
    <span class="gray-bottom">
        <font size="2">Site Map </font>
    </span></a><font size="2">
        
</font><a class="links" href="">
    <span class="gray-bottom">
        <font size="2">Contact Us </font>
    </span></a></div><table border="0" cellspacing="0"
cellpadding="0" width="100%">
    <tbody>
        <tr>
            <td valign="bottom" align="left">
                <table border="0" cellspacing="0" cellpadding="
0">
                    <tbody>
                        <tr>
                            <td height="4"></td>
                        </tr>
                    </tbody>
                </table>
            </td>
        </tr>
    </tbody>
</table><table>
    <tbody></tbody>
</table></body>
</html>

```

## --Listening to the User Info request and Control Flow Check

```
<html lang="en">
  <head>
    <title></title>
    <meta content="text/html; charset=unicode" http-
equiv="Content-Type"/>
    <meta name="generator" content="CoffeeCup HTML Editor (www.co
ffeecup.com)"/>
  </head>
  <body><?php

$host      = "localhost"; // Host name
$username  = "root"; // Mysql username
$password  = ""; // Mysql password
$db_name   = "egov_transac_implemenation"; // Database name
$tbl_name  = "User_Information"; // Table name

// Connect to server and select database.
mysql_connect("$host", "$username", "$password") or die("Could no
t be connected to the Database : CDNCDB");
mysql_select_db("$db_name") or die("Database could not be selecte
d: DBCS");

// Get values from form
$user_name = $_POST['name'];
$accno     = $_POST['accno'];
$doctyp    = $_POST['doctyp'];
$docno     = $_POST['docno'];
$address   = $_POST['address'];
```

```

if ($doctyp == 'citz') {
    echo "<BR>Document Type Citizen";
    if (strpos($accno, "5802")) {
        echo "<BR>Account Code is correct";

        $sql = "INSERT INTO $tbl_name(User_Name, Account_No, Document_Type, Document_Number, Address)VALUES('$user_name', '$accno', '$doctyp', '$docno', '$address')";

        $result = mysql_query($sql);

        // if successfully insert data into database, displays message "Successful".
        if ($result) {
            echo "<BR>Congratulations, your record has been saved";

            echo "<a href='User_Information.php'>Back to main page</a>";
        } else {
            echo "<BR>Record not Saved";
            echo "<a href='User_Information.php'> <BR> Back to main page</a>";
        }
    } else {
        echo "<BR>Incorrect Account Code Format";
        echo "<BR><a href='User_Information.php'>Back to main page</a>";
    }
} else if ($doctyp == 'psprt') {
    echo "<BR>Document Type Passport";
    if (strpos($accno, "4802")) {
        echo "<BR>Account Code is correct";

        $sql = "INSERT INTO $tbl_name(User_Name, Account_No, Document_Type, Document_Number, Address)VALUES('$user_name', '$accno'

```

```

, '$doctype', '$docno', '$address');"

    $result = mysql_query($sql);

    // if successfully insert data into database, displays message "Successful".
    if ($result) {
        echo "<BR>Congratulations, your record has been saved";

        ;

        echo "<a href='User_Information.php'><BR>Back to main page</a>";
    }
    } else {
        echo "<BR>Incorrect Account Number";
        echo "<a href='User_Information.php'><BR>Back to main page</a>";
    }
}

else {
    echo "<BR>Incorrect Document Type";
    echo "<BR><a href='User_Information.php'>Back to main page</a>";
}

// close connection
mysql_close();
?></body>
</html>

```

-----Handling Dues-----

```
<!DOCTYPE html>
<html lang="en">
  <head>

    <title>Submitted_Account_Compute</title>

  </head>
  <body>
    <?php

//echo $_POST ["acctno"];

$con      = mysql_connect("localhost:3306", "root", "");
$dbname   = 'egov_transac_implementation';
if ($con) {
    echo 'Successful connection to Database !';
} else {
    die('Could not connect: ' . mysql_error());
}
$selectdb = mysql_select_db($dbname);

if ($selectdb) {
    echo '<BR>Database Selected<BR>';
} else {
    echo '<BR>No Database Selection happened';
}

$acctno = $_POST["acctno"];
$result = mysql_query("SELECT due from account_dues WHERE a
```

```

ccount_no = '$acctno');

while ($row = mysql_fetch_assoc($result)) {
    // Update field "name", matching with "id" value by while loop.
    mysql_query("update name_list set name='$name' where id = '$row[id]');
    mysql_query("UPDATE account_details SET balance = balance - $due where account_no = '$_POST[acctid]");
}
echo "--- Update Complete ---";

echo "<BR>Dear $acctno This is your due $due";

$result = mysql_query("UPDATE account_details SET balance = balance - $due where account_no = '$_POST[acctid]");
if ($result) {
    echo '<BR>Your table has been populated';
} else {
    echo '<BR>No insertion';
}

?>

</body>
</html>

```

-----MYSQL Dump Data for one of the Tables-----

```
-- phpMyAdmin SQL Dump
-- version 3.4.3.2
-- http://www.phpmyadmin.net
--
-- Host: 127.0.0.1
-- Generation Time: Dec 16, 2011 at 10:42 AM
-- Server version: 5.5.15
-- PHP Version: 5.3.8
```

```
SET SQL_MODE="NO_AUTO_VALUE_ON_ZERO";
SET time_zone = "+00:00";
```

```
/*!40101 SET @OLD_CHARACTER_SET_CLIENT=@@CHARACTER_SET_CLIENT */;
/*!40101 SET @OLD_CHARACTER_SET_RESULTS=@@CHARACTER_SET_RESULTS */;
/*!40101 SET @OLD_COLLATION_CONNECTION=@@COLLATION_CONNECTION */;
/*!40101 SET NAMES utf8 */;
```

```
--
-- Database: `egov_transac_implemenation`
--
```

-----

```
--
-- Table structure for table `user_information`
--
```

```
CREATE TABLE IF NOT EXISTS `user_information` (
  `User_Name` varchar(250) NOT NULL,
```



```

`Account_No` varchar(250) NOT NULL,
`Document_Type` varchar(250) NOT NULL,
`Document_Number` varchar(30) NOT NULL,
`Address` varchar(250) NOT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

--
-- Dumping data for table `user_information`
--

INSERT INTO `user_information` (`User_Name`, `Account_No`, `Docum
ent_Type`, `Document_Number`, `Address`) VALUES
('Hari Thapaliya', 'K4356', 'psprt', '58025221123', 'KSK-DEY'),
('Chandra Maharjan', 'S9098', 'citz', '48025221123', 'DDR-JPN'),
('Min Thapalayia', 'G4344', 'psprt', '5802789656', 'JHP-TRY'),
('Sambhu Thapa', 'X8978', 'psprt', '58028098765', 'TEU-GIO');

/*!40101 SET CHARACTER_SET_CLIENT=@OLD_CHARACTER_SET_CLIENT */;
/*!40101 SET CHARACTER_SET_RESULTS=@OLD_CHARACTER_SET_RESULTS */;
/*!40101 SET COLLATION_CONNECTION=@OLD_COLLATION_CONNECTION */;

```

## Appendix C Screen Shots

Local Host, APACHE HTTP server startup,



MySQL DB Administration Module:

