NICEG - A SDLC Model Specifically Designed to Address the Challenges of E-governance Projects

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ABSTRACT

Every E-governance projects starts with many fan fare but they fail to sustain their initial phenomenal success up to the end of the project. As e-Governance projects have certain challenges and unsolved issues, which are hardly addressed by any traditional or modern SDLC models. So a specific model need to be developed keeping in mind that, it should provide a common framework, guidelines and process flow to all categories of e-Governance projects and should meet their challenges at different stages. This paper focused on the crucial challenges faced during E-governance projects which lead to failure of many well designed smartly coded and strongly tested applications and suggests NICEG (National Informatics Centre e-Governance) model which addresses all these challenges effectively along with a case study of e-Municipality project in the state Orissa of India built upon this model.

Keywords: NICEG, SDLC, e-Governance, e-Municipality, Urban Governance

1. Introduction

Today, in the era of ICT, *e*-Governance has changed the citizen's perspective towards the government. Many *e*-Governance projects have been initiated to reduce the possibility of the corruption and have given a hope of transparent governance. But although all the *e*-Governance Projects are well funded, initiated very aggressively and supported by central or state government IT Departments but still it has been estimated by the World Bank, that as high as 85 percent of e-governance projects in developing countries are either total or partial failures. The funds are being wasted in the developing countries in *e*-Governance project due to lack of proper and effective monitoring, poor management, lack of co-ordination is very high and may be a great lose of the tax payer's money from share of the common citizen. All we need to follow up a certain framework, guidelines or process flow which can lead us to a productive *e*-Governance project rescuing the investment from being sinking and can overcome all the challenges which may lead to failure of the project.

There are mainly three type challenges in every *e*-Governance project which can drag the project towards failure; they are at Bureaucratic, Developmental and Implementation layers. During implementation time the lack of infrastructure, maintenance of the infrastructure if they are available and lack of willingness to adopt the new technology creates the real problem. This is the most crucial challenges faced in all the *e*-

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Governance projects which became the only reason for the failure of many well designed, smartly coded and strongly tested e-Government projects. At the time of developing *e*-Governance projects, there are very few SDLC models available which hardly addresses those challenges faced by the government and Implementing agencies. NICEG (*N*ational *I*nformatics *C*entre *e*-*G*overnance) model specifically designed to meet the challenges of *e*-Governance projects along with their smart implementation.

2. Challenges

Unlike any other Enterprise solution, the *e*-Governance projects meet certain specific challenges in the entire category like G2G (Government to Government), G2C (Government to Citizen), G2B (Government to Business) etc. These challenges can be categorized by three layers

- Bureaucratic Layers
- Developmental Layer
- Implementation Layer

2.1 Bureaucratic Layer:

Normally every kind of *e*-Governance project initiates from the Bureaucratic level. They are the real people who start the Herculean task to make the government smarter as well as the policy maker and responsible for arranging funds for the project. Normally

e-Governance projects leads to failure by some of the below mentioned reasons:

- Frantic effort to spend the fund at the end of the financial year without proper planning.
- Lack of technical knowledge and non-availability of expert panel at the Bureaucratic level.
- More focus on G2C services without having proper G2G services at the back end, which are the stepping stone of those G2C services.
- Loose monitoring, lack of support to the implementing agencies
- Non awareness of the ground reality, lack of vision towards the infrastructure management on a long term basis.
- Lack of vision toward Legacy system, future extensibility, integration to different government departments.

The above maintained challenges affect implementation level more than the developmental stage and may collapse the entire process of the project development. As this is the decision making layer so a dedicated team comprising of technical and domain experts must be formed from the beginning of the smart innovation.

2.2 Developmental Layer

Government changes in its policies on time to time basis so if they occur during the development of certain software system, it may become the headache for the developer team. For example during the development of Holding tax monitoring system, if it has been finalized that to collect property tax instead of holding tax and calculation is quite different then it is a problem for the developer team to absorb this amount of change in their project. Change management is out of scope of this paper.

Maintaining a well balance between the legacy system and future extensibility of the project creates a problem for the software architect where as the technology used to find a middle way also becomes antiquated before the implementation of the project. For inter government operability it need to integrate applications of related departments, but those application may be developed by some other venders using some other platform so integrating with them creates the real problem as they may not be developed keeping in eye for the multi platform integration.

2.3 Implementation Layer

Technology has never been a problem for implementation of e-governance projects, given the country's pre-eminence in IT. However, the problem lies in understanding the intricacies of implementation of meaningful e-governance projects. In our country, the government is probably one of the biggest employers, and the biggest sector, from the economic point of view. The main problem is managing process change and change management within the government. Processes are very much linked to government rules and regulations. These need to be simplified for the smooth implementation of G2C services. But the process reengineering is always very slow, with long gestation period.

The first and the most important point is that the objectives, the milestones and the framework should be clearly articulated before we embark on any ***e-***governance project. The evaluation of the project becomes very confusing due to the lack of measurable milestones, benchmarks or quantifying parameters. In this context, the emphasis should be on identifying quantifying parameters because, those things can't be measured can't be improved. Implementation is also affected due to lack of adequate funding towards awareness program, maintenance of infrastructure and lack of client coordination.

3. Limitation of existing SDLC model

Due to complex workflow and frequently policy change during life cycle phases, a strong *i*nteraction is required between bureaucratic expert panel, analysis team, developmental team, testing team and the domain expert but any of the existing SDLC models hardly addresses these issues. Prototype model is used at many places for small scale e-governance modules but in case of distributed solution and interoperability government services, it is very difficult to make a prototype. Every *e*-governance implementation needs extensive training on the modules to the departmental users. So, extreme programming may not be a suitable choice as minor modification or extra facility given in the software need to be communicated to the user in terms of hands on training, which is not always feasible. Resource management and fund utilization and optimization are also out of the focus by most of the commercial SDLC models.

4. NICEG Model

Any *e-*governance project can be compared to a super fast train. A super fast train initially waits for its passengers, for all the resources like fuel, security personals, and railway staffs etc and then starts slowly towards its destination. In an *e*-governance project, the users need to be aware about the project initiated at some bureaucratic level and collection of various resources like proper blueprint; fund, skilled man power, expert panel etc. are to be organized before starting. As a super fast train start its journey from one place and slowly move towards its destination covering many intermediate stations for giving services at those places and halts at some places to change the engine, supervise the machineries, and reenergizes the human resources, the ***e-***Governance projects also need to grow slowly from one place as pilot basis to a huge geographical location. After successful implementation of the pilot project also it need for time to time review of the implementation, customer and citizen's feed back, supervision of various vital resources of the project before extending it to other territory.

Normally the citizen faces two kinds of harassments when accessing the services from any of the government departments, that is because of inter department and intra department file processing to provide the services. So computerization of those departments and implementation of G2G services is the foundation stone for providing good G2C services effectively and to make them more robust and reliable.

4.1 Scope Identification

The terms ***e-***Governance and computerization although related to each other but not equivalent. Translating the manual file processing system to its exact equivalent but in an automated and digital environment is called computerization where as transforming the complex and lengthy departmental procedure to a citizen

centric and easily accessible service using ICT is called ***e-***Governance. Initially the departmental procedures should be identified, which is to be transferred to a simple and easily accessible. Detailed report on how to transfer is not the real goal behind the scope identification stage rather the goal is to identify what to be transferred for making the thing simpler and citizen centric.

4.2 Cost Estimation

Government fund is not the bag of Santa, because these resources are very limited, time bound and it is the peculiarity of the ***e-***Governance project to do cost estimation before the requirement analysis. Although this estimation is approximate but it is very necessary for fund management. The fund available for the current financial year to do the project is to be identified. After which, it is required to measure the performance within the specified amount of budget and mention the clear termination point of the project. This is a cyclic process through which we can achieve a stable system which meets all the constraints like time, performance and cost. If time is
optimized and as the performance is always constant then more manpower may lead to more cost. So the system should incorporate sufficient amount of time along with adequate fund towards the implementation of the project. NICEG advise that to optimize size of the project so that sufficient amount of fund and time can be allotted to the project and make it more stable and robust. As there are three vital parameters cost, time and performance for the project which normally the client deals with, so NICEG suggest the following.

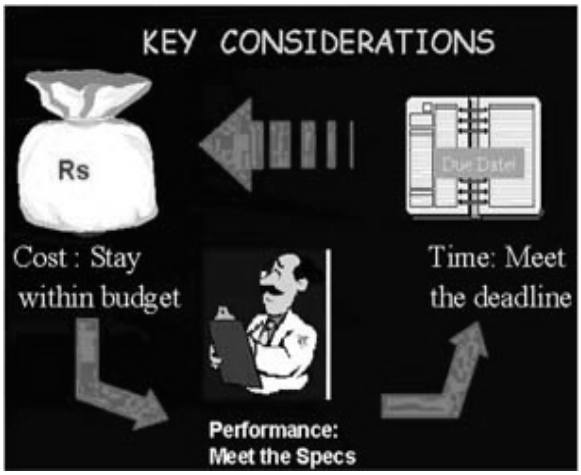

Figure 1: Key Considerations

	Time	**Performance**	**Cost**
Constrain		●	
Enhance	●		
Accept			●

Figure 2: Time Performance and Cost

Approximate investment to implement the modules is to be estimated, clearly mentioning the investment that is mandatory and those are optional. After getting the approval of the cost estimation report, requirement analysis should be started. Various vital methods required for approximate cost estimation are:

- Similar type of projects implemented earlier, if any.

- Availability of customizable or reusable software for the current project.
- Report of resources required and already available, if any etc

4.3 Requirements Analysis

During requirement analysis, departmental procedure along with rules and regulations followed by exceptional situations occurred in the past if any, are to be recorded. Study of related circulars, bylaws, gazettes etc is to be done so as to provide a periphery during the process reengineering. Study should be focused on three things i.e., Input, Output and the process which can be reduced with in the jurisdiction of the departmental and cyber law. Existing hardware resources should be identified for reuse of them. Process nodes should be identified where the real delay occurs for providing the services to citizen.

4.4 Resource Allocatio

Human Resource Utilization: To minimize the communication gap between the different teams, **NICEG** Model suggests merging of manpower among different teams in different stages of software development life cycle. So that at any stage of the software development life cycle, interaction will be available between the analysis, development and testing teams where as rest members of each team will work on other modules.

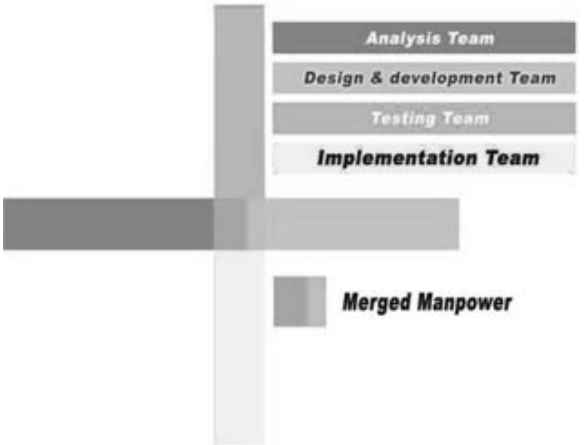

Figure 3: Human Resource Utilization

Fund Utilization and Optimization: NICEG Model suggests, Not to Invest on the hardware before the development of Software, as the hardware purchased may be obsolete at the time of actual implementation of the project. But also this procedure should not take last time approach, as the user of the project should get some time to be friendly with the new environment just before the real implementation. So, it is suggested to purchase the hardware if any, during the integration & testing phase so as to enable the user to be acquainted with the system and perform beta level testing. Fund should also be dedicated on a long-term basis towards the maintenance of the hardware & Software. As there are many G2C services available but still they are not in the strong focus of the citizens due to lack of awareness program. So, some fund may be allocated to make the services to reach at the citizen. As ICT (http://cert.org/archive/pdf/cross_site_scripting.pdf) differs from its counterpart IT by the way it communicates the technology (services) to the citizen. IT provides the services and makes the procedure simpler, organized and maintainable but these services should be communicated to the common citizen as they will not come voluntarily to use those services due to lack of awareness, infrastructure and computer literacy. So, funds also to be invested to reach at those places, by opening facilitation center and focus should be given on integrating with facilitation centers of other venders already available (like various

charitable donations, submitting electric bills through ATM), opening helpdesk etc.

4.5 Business Process Reengineering

Minimize the process by eliminating unnecessary formalities, which depends on how much transformation the government can tolerate. BPR should have two boundaries, one end that is limited by departmental law, rules, circulars etc and other that is the cyber law, which must not cross at any circumstances. After making a BPR plan it should be sent for approval by the authority. BPR report should be clearly mentioned the mandatory reengineering process required for implementing the project and those requirements, which are optional to increase the quality of service. A report should be generated clearly mentioning the services name along with various file process with delay in time like bellow.

Service	**Pro1**	**Pro2**	**Pro3**	**Total**
Birth Certificate	1Day	3Days	1Day	5Days
After BPR	1Day	X	X	1Day

Figure 4: Business Process Reengineering

The modified and approved version of the BPR report should be communicated to the respective department for their feedback along with information regarding infrastructure. Also data collection format may be redesigned accordingly. After which design phase can be started successfully.

4.6 Activity Report Release

As every project must have a definite start and definite end, so the release of the Gant Chart/Pert Chart is necessary and this always depends on the estimation of deadline of various modules. As the dead line of any module always tightly coupled with the starting time, so whenever calculating the deadline, special attention should be taken on the schedules of other projects. Avoid the situation where the dead lines of the currently undertaken project merge with the starting time of the upcoming projects.

4.7 Design and Development

Design should be done keeping in mind for future extensibility as well as legacy system. As IT revolution started in the ***e-***Governance area long before so there may be many places where e-Governance is available but in a dilapidated stage due to the lack of technology during their development, these services should be integrated keeping in mind to reuse some of the already available resources. Format of the input forms should be similar as much as possible to avoid vital training on the newly developed software. As the technology is changing rapidly so it is also necessary to provide an interface for future extensibility and for the integration of others services.

Today almost every e-governance projects lacks the integration with each other. Various e- governance projects are being developed on time-to-time basis by different vendors using different platforms so it is the problem to integrate all of them to give a strong G2G backbone. It suggested that SOA should be followed to make the project extensible and interoperable between G2G Services.

Vulnerability in the ***e-***Governance projects is becoming the media interest, so application security is another area, which needs the strong focus during the development stage. Normally **NICEG** model suggest some basic security policy to be taken care of so as to save the project from becoming the soft target of the hackers.

- **SQL Injection (Mahapatra and Sarangi, 2005)** is a technique that exploits security vulnerability occurring in the database layer of an application. Steps should be taken to avoid this.
- **Encryption**: Information should be encrypted before passing over the network and stored in the database.

- **Cross Site Scripting (Mahapatra and Sahoo, 2006)** is an attack technique that forces a web site to echo attacker-supplied executable code, which loads in a user's browser. Steps should be taken by the developers to recode dynamically generated pages in order to validate output.
- **CAPTCHA** is a program that can generate and grade tests that humans can pass but current computer programs cannot. It should be used in every online application form exposed to citizen.
- **Brute Force Password cracking:** software are available in the market which randomly chooses different words from dictionaries, important dates, name of the places, combining arbitrary characters and using those words to login into one's account. So, the system should be locked for that day after getting limited number of wrong password in the login module.
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- **SSL:** Secure socket layer must be used wherever it is required as it does the 128 bit encryption so unnecessary use may affect the performance tremendously. So whenever the application deals with the vital and secure data exchange then SSL should be used.

4.8 Testing:

System testing should be based on data collected by a well-organized sampling method. Some times thousands of random and unplanned sample data can not reveal the bugs which can be exposed by very few but smartly chosen samples. The sampling should contain the data from different domains of the real system. Special care should be taken for the testing of concurrency issue keeping in mind about the number future of user which may tremendously increase with the awareness program. The cyber security audit is not the cup of tea, by the regular testing team. So testing of the cyber security should be done by professional and ethical hackers. It is better to have a cyber security department but if not available then a good idea to outsource from government empanelled agencies. Next level of testing should be done by friendly user from the customer side, whose report should be taken by the testing team, and they translate that in to technical words to submit those to the development team.

4.9 Implementation

Implementation should always on pilot basis at few places. Special attention should be taken to get the review report from the implementing agency and from the departments and take necessary action if some changes are required. Expand the awareness program among the citizen after the successful pilot implementation and open dedicated grievance cell/help desk for the smooth implementation of the project. Pressurize the departmental staff to use the e-Governance software with parallel to the manual process for trial and cross checking purpose, which will be completely switch to the computerized process rather than the manual, once it is verified. All the above software development process and the investment will sink in to the ocean if adequate infrastructure is not available or maintenance of computer peripheral up to a level.

5. E-Municipality using NICEG Model

This is a state level project undertaken by the National Informatics Centre, Orissa State Unit using the NICEG Model and successfully completed the pilot implementation with integration to many other vendors on PPP mode within the estimated time frame. This success enables to get an award i.e "*Pragati Sathi*" (Partners of Progress) (Mahapatra and Sarangi, 2003) from one of its prestigious customer, Bhubaneswar Municipal Corporation (BMC), Orissa, India.

Initially the Scopes have been identified in the below mentioned primary area which can be innovated with the help of cutting edge technology. These are:
Kalyan Mandap Reservation Section, City Health Office, Establishment Section, Grievance Cell, Holding

Tax Section, License Section, Marriage Registration Section, Yatri Nivas Reservation Section, Old Age Pension Section, Vending Zone & Shop Section, etc.

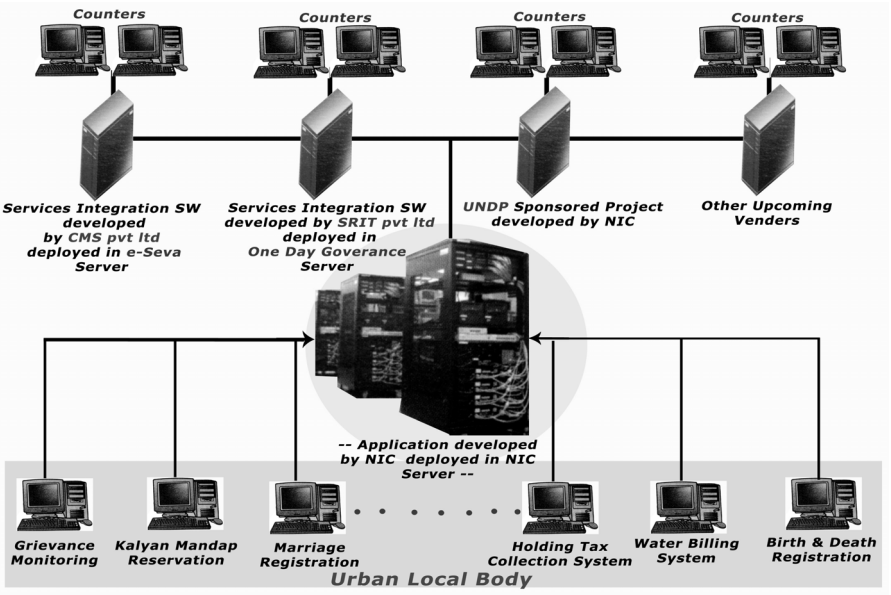

Figure 5: E-Municipality using NICEG Model

Approximation Cost has been estimated by comparing the project with other similar type of e-Governance project already implemented in different ULBs (Urban Local Bodies) along with some vital parameters affecting the cost and given the project proposal to the department with an approximate investment required. After getting the green signal from the government or the respective department Requirement Analysis started. In this phase the current manual procedure along with the ideal procedure according to the law are recorded. The input, output parameters and users are identified. To simplify the complex and unnecessary file movement procedures within the department and between the departments, Business Process Reengineering is applied taking care of the jurisdiction of departmental law and Cyber Law (IT Act). After getting the Approved Business Process Reengineering report from the government, it has been forwarded to the dealing person of corresponding departments for their feed back on this report along with asking for the detailed information about the hardware available with them and status of annual maintenance contract. During Design and Development phase special care has been taken to make well balance architecture for legacy system, future extensibility as well as integration by the use of SOA. Format of data structure should match the format previously entered data so that data conversion from old system to newer one will become easier. It enables the department to save money by converting the present data to the newer system rather reentering the same. As in the latter case many different venders came to picture on PPP mode to access these services through their facilitation centre and provide G2C services to the citizen, the SOA(http://msdn.microsoft.com/en-us/library/ms161953.aspx) provided the vender a framework to plug in to these services. Under the "One Day Governance" Service integration s/w developed by SRIT Ltd, under "e-Seva" project Service integration s/w developed by CMS Computers Ltd and UNDP sponsored projects developed through different platform successfully integrated with the central system developed by NIC through the Service Oriented Architecture. As the many private vender get accessibility to the business logic so the application security was also under the strong focus developer team to avoid being hacker's soft target. At the time of implementation the project being started on pilot basis, a computer literate person from the customer side became the project coordinator for smooth implementation of the

project in the departments. Currently Services are being delivered to citizen through various facilitation centers through PPP mode along with departmental counters

6. Concluding Remarks

The purpose of implementing *e*-governance is to provide good governance. As all *e*-Governance projects have certain common constraints, it was the need of software professionals from long time for the development of a specific SDLC Model for *e*-Governance, which will meet all the constraints & Challenges. NICEG Model addresses all those challenges. Using this Model rapid development lifecycle, fund optimization and utilization, interoperability in all *e*-Governance projects can be achieved successfully. This model provides a frame work to develop reliable, robust, extensible and pluggable e-Governance application. In addition, the developmental cost, and implementation costs can be lowered as well as services can be reached at the door step of the citizen providing more accessibility.

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