Robust, Effective And Flexible Software Architecture of E-Governance Based on Design Patterns For Indian Administrative Services

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Abstract— **The real need of e-governance structure in the area of Indian Administrative services is yet to be seen as there are various dynamics in the Indian scenario. Although previous studies have focused on evolution of various models, but majority of the model are based on small scale scenario of application. The current paper thereby exhibits a novel e-governance architecture which is purely designed considering the conventional structure of e-governance where the proposed solution of architecture is formulated with all the 4 layers of the e-governance structure considering both qualities of service as well as security aspects in the design patterns. The evolution of this novel idea is subjected to real time case studies considering the unique identification (UID) in Indian Administrative services, where the results are verified considering i) defect averting, ii) defect minimization, iii) maximized efficiency, iv) software reliability, v) architecture flexibility, and vi) risk management**

Keywords; Softwae Architecture, e-Governance, Indian Administrative Services.

I. INTRODUCTION

Electronic-Governance [1] is a subtle novel concept referred to the use of information and communication technology to furnish and enhance government services, transactions and interactions with citizens, businesses, and other arms of government. Architectural design model is a model, which assists software architects and software designers in designing software systems. The architectural design model we propose is useful, in architecting, designing and implementing e-Governance systems. It should be remembered that the model we propose is not a complete solution to the design of e-Governance systems. It can be used as a reference model. Aim of Standards formulation for e-Governance applications [2]

- To ensure smooth flow of information between citizen, business and Governments (State and Central) by having interoperable systems which are scalable for future transaction volumes and frequencies?
- To make requirements and specifications available in the public domain
- To promote reduction of effort (cost by variety reduction) and risk leading to economic solution.
- To protect consumer interests by facilitating adequate and consistent quality of Information and Services with human centric design of systems.
- To provide users a common terminology and a framework for communicating technologies across different domains.
- To avoid Vendor lock-in.

It is beyond doubt that e-Governance can smoothen the working procedure of Government machinery by providing transparency, effective working, instant response and availability of information of Government machinery to end users, time to time. The existing e- Governance is very much server centric, cost effective in nature and finds it unable to address all categories of users starting from rural urban to metropolitan citizens. The success of e-Governance lies on wiping out of this discrimination by providing accessibility of different web services of e-Governance irrespective of geographical and language barriers. There are a couple of other problems with developing countries, including absence of infrastructure, resistance to change, lack of education, natural disasters, power shortage, unavailable internet facility which hampers the implementation of electronic governance severely. For example, improper standardization of Bengali software, absence of effective legal framework, discontinuous human resource support affects the e-governance implementation greatly. It is quite rare in the developing countries that, the government is stable. In most cases the activities of ruling side are meaninglessly opposed by the counter parties which often makes potential concepts nipped in the bud. E-governance may also face the same fate in such developing countries like Bangladesh. More importantly, corruption is a great barrier to have any better and transparent step in developing countries.

II. RELATED WORK

As many countries have realized that there is a need to develop a one national system that would reach the urban and rural community, the effort to build e-Governance or e-

Government systems was envisaged. This section discusses about the prior research work in the same field.

Dwivedi and Bharti [3] have discussed the problems and acceptability of e-governance in India. According to the authors, 81% citizens report reduction in corruption, 95% find cost of e-governance affordable and 78% favors fast of delivery of services. E-Governance is a way to solve the social as well as economical problems exists in the developing countries like India.

Misra [4] has focused on a national agenda having all the dimensions of MMP and has the scope to include all the categories. Architectural challenges seem to be enormous. OA analysis indicates that guidelines are well formulated with transparent roles and responsibilities. Each layer of OA has adequate mechanism to carry out the task. ISA framework indicates that there is much scope to provide a well designed framework. On priority, a "systemic convergence" approach is needed. WPI guidelines have the provisions for convergence.

Paul et al. [5] have analyzed the need and possibility of Enterprise Architecture concept in the Indian context to achieve the e-Govt interoperability for integration of e-Governance services and they proposed a framework for this dilemma. This framework is helpful to arrive at the maturity level of e-Government in India that is expected in future by GOL.

Chakravarti et al. [6] has presented in this paper, result of the analysis of collected data and the proposed solution is based on the requirements identified in these states. Though it is presumed that the present scenarios of other states are similar, it would be necessary to perform a study of their requirements before implementing the proposed solution. As this enterprise architecture framework is platform independent and follows open standards, it can be implemented irrespective of technology or platform being used in the states.

Mujtava et al. [7] have proposed in this paper, they will attempt to provide an insight regarding: a definition of e-Governance to build a business case for its adoption. A brief discussion on evolution of e-governance technologies. Present Scenario of e-governance efforts in India. Strategies/action plan for designing e-government projects for addressing immediate objectives with a vision for future in mind

Marjit et al. [8] have illustrated a way to facilitate the issue of discovering the university e-governance services for student clearance certificate that addresses a user need. In this paper, it is also shown how a generic university governance service model can be expressed by means of WSML -a fully fledged logic programming language for describing Semantic Web Services. A novel concept regarding the security of web services is introduce here to protect, authorize, authenticate the propose model in e-governance system.

Mishra [9] have explained, it is posited that citizen participation with developmental perspectives would lead to better citizen centric services and would also provide scope for demand driven growth of e-governance services. In order to assess the suitability of the e-governance projects nationally for scale up, architectures and technology adoption and acceptance model are considered relevant in this paper to present an evaluation model. Through this evaluation model, a case of national e-governance plan is discussed to appreciate the relevance of providing citizen-centered e-governance services.

Mampilli et al. [10] have illustrated, the use of Semantic Web Technologies for web implementations in E-Governance will benefit end users as well as the decision makers in the government. The end users would be able to get a transparent view of the system in work and provide their thoughts on the same. At the same time the various government agencies would be able to do proper data analysis and decide on the future course of actions in a more accurate manner.

Mbale [11] have demonstrated, the architecture was built with Multiples of interlocking function blocks that interleaving relationships with one another forming a sophisticated interaction that maneuvered with information sharing. In view of these, the eGToH architecture was designed as an integrative and interoperability framework which adapted the evolved ICT technologies including the past, present and future changing requirements.

Morison [12] have proposed in this way the provision of public services online may be thought to offer a new level of openness in the operation of government along with levels of convenience in public services that are at least as good as those in the private sector where the internet is available routinely as an additional route for collecting information and accessing various services. There may even be cost savings although this is by no means guaranteed. In addition, computer networks are good at storing, manipulating and quickly transmitting data.

Janssen et al. [13] have analyzing discontinuities in the architectures coordinating back and front office applications five stages are derived. The five-stage model consists of 1) no integration, 2) one-to-one messaging, 3) warehouse, 4) broker and 5) orchestrated broker architecture. Public decision-makers can use these stages as a guidance and direction in architecture development, to reduce the complexity of the progression of e-government initiatives, to communicate changes to the rest of the organization and to provide milestones to evaluate and control cost of architecture development.

Peristeras et al. [14] have proposed the Governance Enterprise Architecture (GEA) as a set of domain models that serve as a top-level enterprise architecture. To this point, the development includes five high-level generic process and objects models. Namely, they present the GEA mega-process model, the GEA interaction model, the GEA public policy formulation object model, the GEA service provision object model and the latest development of the GEA object model for the overall governance system.

Contenti et al. [15] have illustrated the approach followed and the results so far achieved within the Eu-Publi.com research project, are presented. The discussion on the conceptual and design architectures of the Eu-Publi.com distributed, peer-to-peer system is enriched with results about the experimentation conducted on one of its core components.

III. PROBLEM DESCRIPTION

Since 1996, the administrative employees were fortunate enough to work closely with a variety of govt. and commercial concerns, investigating the continuing trends in the field of e-governance area. It can be said that although lots of efforts have been made in the creation of infrastructure and internal information handling by govt. bodies as well as public services, the diffusion of technologies in moving towards e-governance have been rather slow. This may primarily be attributed to the following reasons:

- *Lack of IT accomplishment and awareness relating to advantages of e-governance*: there's general lack of awareness relating to advantages of e-governance further because the method concerned in implementing productive G-C, G-G and G-B projects. The administrative structure isn't intermeshed for maintaining, storing and retrieving the governance information electronically. The overall tendency is to get the information from the files (print) as and once needed instead of using Document Management and work flow technologies. Recently the utilization of DMS and work flow technologies has been ready to notice its use solely in those departments wherever there's perceptible lightening of work of the subordinate workers.
- *Underutilization of existing ICT infrastructure*: To a bigger extent, the computers within the department are used for the aim of data processing solely, leading to the underutilization of the computers in terms of their use in data processing for supporting management choices. The time gap between the acquisition of the hardware and development of the custom applications is thus massive that by the time application is prepared to be used, the hardware becomes obsolete.
- *Attitude of government Departments*: The scientific discipline of government servants is sort of totally different from that of private sectors. Historically the govt. servants have derived their sustenance from the very fact that they're vital repositories of govt. data. Therefore any effort to implement DMS and work flow technologies or transfer out the modification within the system is met with resistance from the government servants.
- *Lack of coordination between Govt. Department and resolution developers*: planning of any application needs an awfully close interaction between the govt. department and therefore the agency developing the solutions. At the present the users in govt. departments don't contribute enough to design the solution architecture. Consequently the solution developed and enforced doesn't address the wants of an e-governance project and therefore doesn't get enforced.
- *Resistance to re-engineering of division processes*: productive implementation of e-governance comes needs uncountable restructuring in body processes, redefining of administrative procedures and formats that finds the resistance in most the departments in the least the degree. In addition there's lack of experience of division MIS executives in exploiting data processing techniques, updation and assortment of real time content onto web site etc. thus the content as is collected or maintained by varied e-governance portals is unreliable or full of gaps. In such a state of affairs, it's troublesome for any e-governance resolution to realize its supposed results.
- *Lack of Infrastructure for sustaining e-governance comes on national level*: Infrastructure to support e-governance initiatives doesn't exist inside government departments. The agony is that the govt. departments don't seem to be equipped to be in a very position to project the clear necessities nor are there any tips for involving personal sector. No matter efforts are created by varied govt. organizations is also outlined as islands of automation. The infrastructure creation isn't guided by a consistent national policy, however depends on the wants of individual officers championing a number of comes. Therefore, the specified networking and communication equipment is either non-existent in govt. departments, or if it exists in the least, it doesn't serve any tangible purpose as so much because the demand of e-governance project worries. the utilization of property choices provided by govt. agencies like NICNET etc. are utilized in a awfully restricted manner for knowledge transmission purpose between varied locations viz. Distt., State , Center etc. and is especially utilized for e-mail and web purpose solely.

Most state govts. have shaped the IT task force and have their IT policies in situ. though policies could have lofty goals, a lot of appears to own happened solely in automation and automation the disadvantage is that these IT policy documents don't seem to be created primarily based upon the wants and inherent capabilities of the state however are supported the surveys and methods utilized by different nations or different states. Although its awfully informed take examples from the productive e-governance methods of different states and countries, it is equally essential that we tend to customize our state policies when a careful study of the parameters applicable to the actual state in question

IV. PROPOSED FRAMEWORK

The proposed empirical framework attempts to discover the prime attributes that is engulfed in the effective implementation of novel framework of software architecture in e-governance, especially considering the Indian Administrative complexities. The proposed work has referred the prominent work done in [16] and [17]. The prime highlight of the empirical framework will be to understand the impact of adopted framework with 6 critical factors (C_F) e.g. Defect Averting, Defect Minimization, Maximized Efficiency, Software Reliability, Architecture Flexibility, Risk Management. The framework considers the attributes to be named as e-Governance Structure Attribute (G_A= {Access Layer, e-Governance Layer, e-Business Layer, Infrastructure layer}) and Architecture Tier attributes (A_A) with Time of Development (T). The Architecture Tier attribute (A_A) in this empirical framework basically consists of two parameters e.g. parameter related to project management and Time Size (T). Therefore, the Cumulative performance of the framework of e-governance architecture can be produced as:

$$C_p = \sum_{d=0}^{n} \frac{\zeta + C_F(\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 + \alpha_5)}{A_A + \sum_{1<T<k} T}$$

TABLE I. ILLUSTRATION OF VARIABLES USED

Variable	Meaning
α_1	Total successful duration of executing the e-governance framework
α_2	Maximum Number of Tiers where critical factors has been executed
α_3	Complexity Level in business layer and infrastructure layer.
α_4	Number of Computing resources
α_5	Frequency of Defect Generation logs
d	total duration of cycle from 0-n days
k	Total time of successful implementation of e-governance

It should be noted that the proposed empirical framework for e-governance is attempting to highlight the business and process benefits after adopting critical factors with exclusive interest on financial parameters of the considered organization. Also, α_1 and α_2 are specifically an integer number as the prime assumption of the empirical framework is higher the value of $\alpha_1/\ \alpha_2$, maximum is the scope of success rate of proposed e-governance framework.

The proposed empirical framework illustrates the Critical factor for e-governance principle for enhancing the software architecture efficiency as well as process required for it that can furnish various potentials to the layer management for the execution of e-governance software projects for the purpose of enhancement of the currently practiced processes. This is one of the critical considerations of the proposed empirical framework as our intention is to show the benefit of adoption of our e-governance framework especially in the area of Indian Administrative Services to eliminate any feasibility of hesitation of its technical adoption. We strongly believe that adoption of this framework will entitle the use to visualize the e-governance projects along with establishing the correlation between the e-governance process flow and its associated layers. Fig.1 shows the architecture that has been extracted from the empirical meaning of the empirical framework proposed. The proposed architecture consists of 5 prime components as discussed below:

- *E-Governance Layer Deployment*: The proposed framework considers that layers must be properly sequenced and integrated in order to be effective. Fig.1 shows the usage of the layers integrated during the duration of e-governance software projects in Indian Administrative service. There is a rational progression with the input of one layer often being the output from previously used layers. It starts with Access layer that involves the channels that government users can access the various government services. Government users can be citizens, business, employees, other governments, and other community members. Access channels are critical components of e-government. It is followed by e-Governance layer which is about integrating digital data of various organizations into a web-portal of government services, in the form of a one-stop e-government portal. This may result in improved access to government resources, reduces service-processing costs, and enables organizations to provide a higher quality of service. Next comes is one of the most challenging layer design which is e-Business layer that is focused on using ICT applications and tools to harness a networks of trust, knowledge sharing and information processing that takes place both within and between organizations. It provides a seamless, automatic and real-time communication between their systems at both a data and process level. Another issue in this part of the deployment is the execution of infrastructure layer that focuses on technologies that should be in place before e-government services can be offered reliably and effectively to the public. The potential of these technologies is to support and integrate the operations of information systems and applications in e-business layer across organizations by offering the necessary standards and protocols through network and communication infrastructure approaches (e.g. intranet, extranet, and internet). The key design principle is typically the first concern of the layer to be in used. The key design principle configures the range for subsequent layers by carefully identifying the business components. The design pattern corresponding to need to Indian Administrative Service naturally follows the process maps. Once the team agrees on the major steps in the process, it is logical to determine which steps and process variables are most critical to achieve. The design pattern does just this, by noting how strongly each key design principles and variable impacts on the performance. The key design principles and design pattern also provide input to the tier control factor by identifying the methods steps and variables that need to be included. Once the design patterns identifies the priority steps, the development team will need to ensure that it can accurately measure the prime variables at these steps, utilizing a (DCA) design component analysis. In addition, it may begin a formal (AIA) Architecture Incompatibility Analysis to explore the potential failures in the prioritized steps and variables, and begin proactive solutions to prevent them. Once the layer has identified with the defect it can accurately measure the prime variables, it will likely evaluate architecture capability using pilot projects in Indian Administrative Services and perform black box testing. Assuming the competency in the architecture is inadequate, the layers can use probabilistic approach considering modules, components, and functions to identify the prime layer variables that are causing the bulk of the deflections in the architecture outputs. Formal quality attributes provides additional potential to resolve redundancies and measure the quality. Quality attributes, such as security, performance, and usability can be used to focus thinking on the critical problems that the considered design should solve. Depending on the client requirements, one might need to consider every quality attribute, or one might only need to consider a subset.

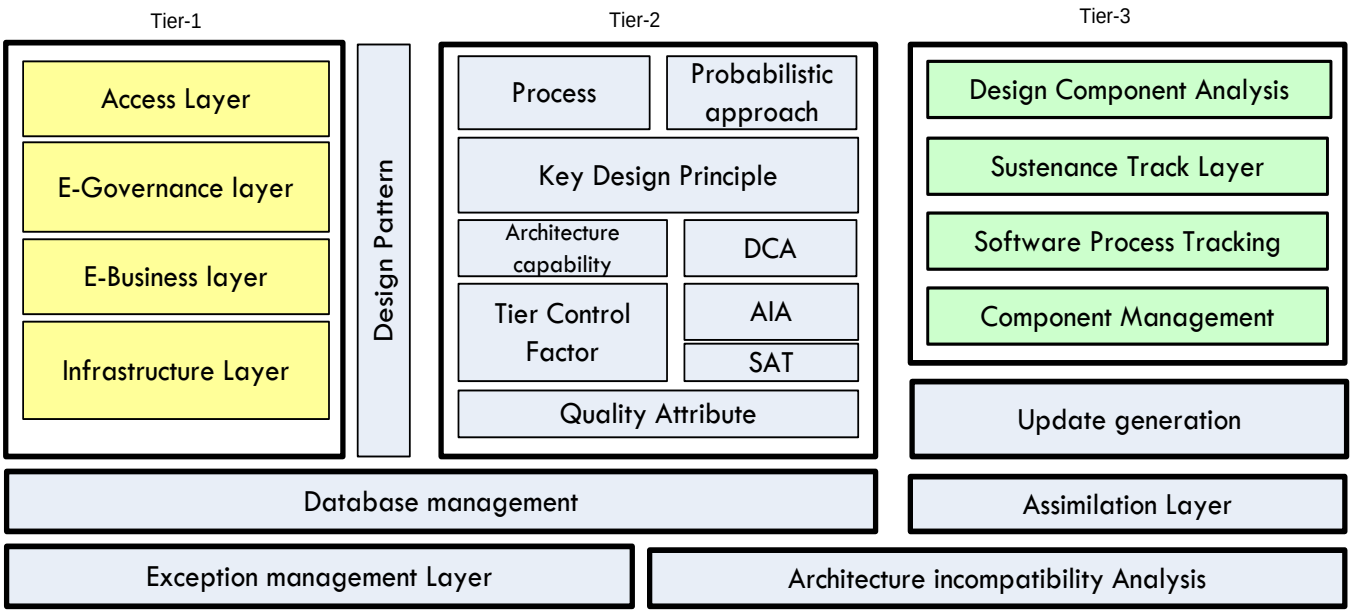

Figure 1 Proposed e-governance Architecture

For example, every application design must consider security and performance, but not every design needs to consider interoperability or scalability. Understanding the requirements and deployment scenarios is very important so that the user know which quality attributes are important for their design. It is to be noted that quality attributes may conflict; for example, security often requires a tradeoff against performance or usability. One of the key charecteristics of the proposed framework is that the output of each of these layers furnishes the input to the tier control factor, by determining the most important aspects of the process that need to be controlled to manage architecture enhancements. This technique drastically simplifies the development of the tier control factor as much of the hard work has already been done. Security of Active Threads (SAT) is another layer that is used to quickly identify vulnerable and suspicious behaviour in the process so that the root reason can be investigated by some cyber patrol. Security of Active Process will use various Intrusion Detection System and Prevention (IDS/IPS) System to investigate the range of normal behaviour in the threads for the running processes, allowing early detection of potential problems before they become major issues. This rational integration of the layers into an overall process enhancement is the major contribution of the proposed system in e-governance

- *Execution Layer*: Execution layer plays a prominent role in the proposed framework. The proposed layered based framework chooses design patterns in the execution layer prominently. The component furnishes all the e-governance layers.
- *Sustainance Track Layer*: The sustainance track layer mainly originates after the execution layer of the proposed e-governance framework that basically gives a benefit to software process tracking, components management, and finally updates generation. Sustainance tracking enables a monitoring of the current condition of the operational or active components in architecture for e-governance. Finally, update generation generates an updates that is connected to the evaluated results for the currently ongoing software projects.
- *Database Management*: Database Management also plays one of the critical models that govern the smoothness in accessibility of the sensitive data.
- *Assimilation Layer:* Assimilation layer groups the prior rule sets to other applications of supporting layer, management control layer, as well as network protocol analyzer (like WireShark).
- *Exception Management Layer*: For the purpose of further enhancement in the threads / process management, the proposed e-governance architecture deploys the rule-based system where the rule sets can be automatically trained and thereby updated without any supervision of any administrator. This layer primarily manages a prime catalog of all the prominent functions to be required in each process development. It gives the capacity to the framework by discarding all the time consuming effort towards forecasting task. Hence, these parameters address the defect averting, defect minimization, as well as risk management to a large extent. This layer therefore permits the user to outline a path on the far side the present or next sprint to feature some visualization of the future development requirements.

V. RESULTS ANALYSIS

After the evaluation of the results accomplished from the formulation of the empirical framework, it was also evaluated for its fitness in real time environment.

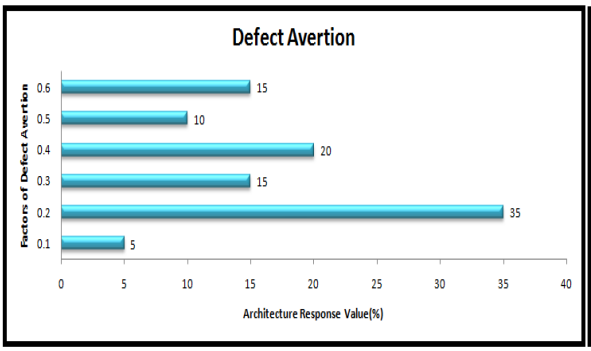

Figure 4 Post-Phase Results evaluation of Defect Averting

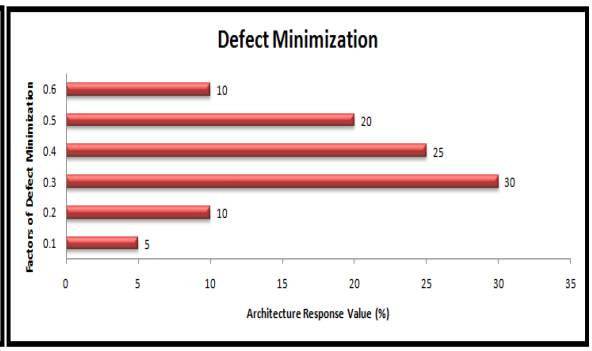

Figure 5 Post-Phase Results evaluation of Defect Minimization

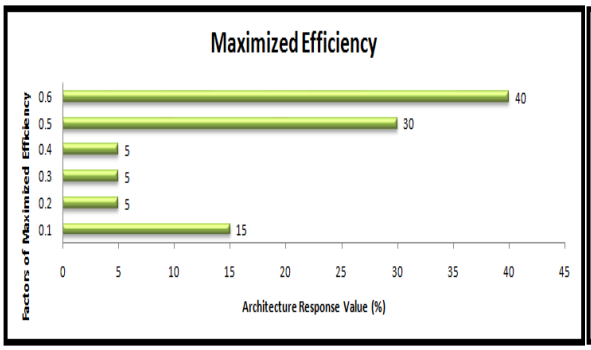

Figure 6 Post-Phase Results evaluation of Maximized efficiency

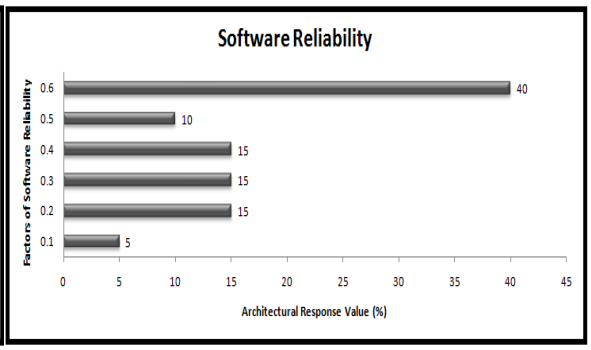

Figure 7 Post-Phase Results evaluation for Software reliability

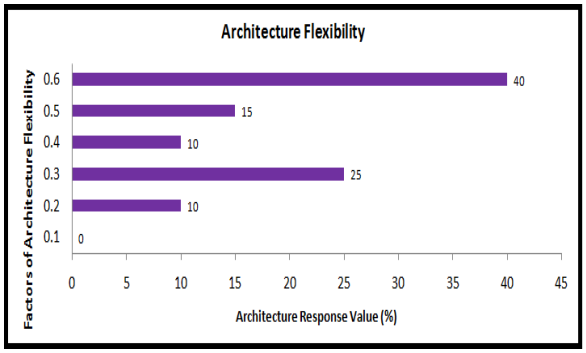

Figure 8 Post-Phase Results evaluation for Architecture flexibility

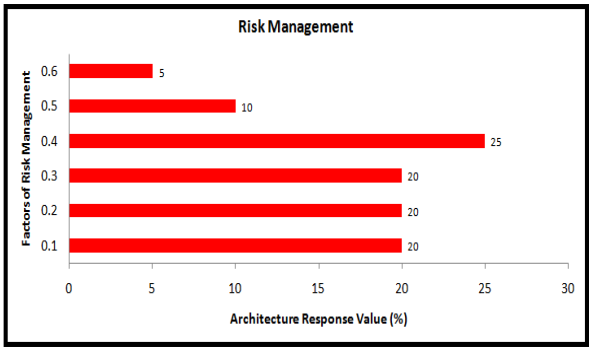

Figure 9 Post-Phase Results evaluation for Risk management

Hence, the framework was quantitatively judged from the same participants involved in the pre-investigation phase with respect to the research variables defect averting, defect minimization, maximized efficiency, software reliability, architecture flexibility, and risk management. Following are the quantitative results for real time evaluation,

The interpretation of the post-phase results evaluation are as follows:

- **Defect Averting**: From the results, it can be seen that proposed framework is successful in minimizing the obstruction of futuristic application (e.g. android based) integration which was the critical loopholes in majority of the existing work. The proposed system therefor supports a new version of electronic and mobile commerce system based application intended for e-governance in Indian Administrative services.
- **Defect Minimization**: The most significant effect of the proposed empirical framework is the better adoption of layers thereby ensuring less iteration in task. It also equally emphasizes higher flexibiity of open source applications and grading with well-organized maintainance of online event updates that hugely reduces the incompatibility

issues and thereby minizes the defects in e-governance architecture.

- **Maximized Efficiency**: The proposed framework has evaluated using design pattern principles where the evaluation exhibits potential compatibility of every modules, components, as well as the layer of the architecture. Just like in defect avertiion, the group of the results are also explored with improbability reduction and substantial scope of future enhancement.
- **Software Reliability**: The best part of the framework is in identification of the targeted defects in the software products. The framework also stresses on effective mangement and quality practices along with key design principles of architecture. It also effectively reduces any sorts of network overheads which usually occurs in the area of India Administrative services applications currently.
- **Architecture Flexibility**: The significant results accomplished in the evaluation is the minimized defect in proposed e-governance architecture which is very much ideal for Indian Administrative Services to adopt key design Principles in daily practices.
- **Risk Management:** One of the best parts of the implementation of the proposed empirical framework is the regular surveillance which allows the mitigation of denial of service attack as well as any types of downtime.

VI. CONCLUSION

Indian Administrative Services are shrouded by various challenges that posses a great threat to the innovation of new through of an effective architecture for e-governance. The existing system is highly ineffective as it fails to render the services either due to quality of service issue or due to security issues. The current paper has discussed a novel concept of e-governance architecture that considers all the effective layers in structure of e-governance. The system was tested as a pilot study in real –time environment qualitatively, where it was found the proposed system has better dimensionality in its throughout quality being evaluated with respect to Defect Averting, Defect Minimization, Maximized Efficiency, Software Reliability, Architecture Flexibility, Risk Management. The proposed architecture however is tested on Unique Identification Service based on Indian Administrative Services, hence our future work will be on the direction of extending the same architecture for various other services in Indian Administrative Service with more significant stress on flexibility and enhance cost effective computational capability.

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