



AN EMPIRICAL STUDY ON ARCHITECTURE, CHALLENGES, TAXONOMY FOR ENTERPRISE APPLICATION MODERNIZATION

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ABSTRACT

In the era of digital space, the enterprise applications should be accessible from mobile and different channels like SMS, IVR, email and other smart devices. Modernizing traditional existing applications to meet the demand of the increasing enterprise growth requires major shift in the focus of adopting modern technologies. Enterprise are looking for most cost effective way of modernizing their existing portfolio of application and subsequently looking for reducing the enterprise costs. Cloud and big data adoption is the must for any enterprise to do business insight modeling and by keeping their enterprise innovation strategy at par with their competitors. In order to mitigate the risk involved and to improve on the Return on Investment (ROI) it needs a systematic approach and methodology to mitigate the key risks and challenges involved. The modernization strategy should not be big bang and it should be a phase wise approach and should bring out all the relevance aspects upfront so that the modernization can be planned systematically to avoid any risk at later point. We propose a unique generic approach in doing the enterprise modernization and discuss about the key challenges, risks involved and also proposing a consolidated taxonomy for reference. The proposed approach will act as a generic methodology to perform the enterprise modernization across industry verticals.

Keywords: *Enterprise Modernization, Business Insights, Big Data, Channels, Hybrid Clouds*

1. INTRODUCTION

Enterprise modernization of the applications became necessity, even though existing applications are serving the current needs very well. Due to enterprise business competition enterprise has to ensure their application meets future needs in cost effective way. This is very critical for business continuity and any investment to be made for modernization have to be properly justified by doing proper evaluation of whether the effort and cost put in to this will favor the client and brings in the expected ROI or not. Clients always have apprehension whether the modernized application will meet their needs or not. There is no unique methodology available to which client can rely upon. In this paper we are introducing a generic unique multi phased methodology to modernize the existing application by considering all the key characteristics. Each phase needs to be implemented in a holistic manner to meet the expectations of the client. This phase wise approach

is one of the major critical aspects as it involves well planned approach otherwise the risk in meeting the desired ROI will be at risk. There are varieties of challenge enterprise faces during the modernization journey because of the lag in the subject matter support (SME). The SME knowledge is very critical to understand the existing application and in this paper, we are discussing the challenges faced by the enterprise and proposing a key generic architecture in which all major enterprise customers are adapting to. We are also proposing the phase wise approach in addressing the migration strategy. The rest of the paper is organized as follows. Section 2 discuss about how the existing application getting modernized with all the key characteristics along with the proposed architecture. Sections 3 discuss about the major components and its key challenges involved in this modernization. Section 4 discuss about the proposed enterprise modernization approach along with key activities involved. Section 5 discuss about the taxonomy involved in the proposed enterprise

modernization approach. Finally we conclude with discussion and the future roadmap.

2. EXISTING PROPOSED APPLICATION ARCHITECTURE

Clients are facing difficulties in modernizing their existing application to meet the demands of the end user expectations. The application we took is generic and applicable to any verticals and the application is currently running on web application container (J2EE) with multiple logical layers as in figure 1. It is simple CRUD based application without any major current characteristics getting implemented [1], [2]. The application is one of the classic examples of the applications getting modernized these days. Not only the legacy applications or other language specific applications, even the current technology landscape applications, for example: J2EE, .NET applications are also getting modernized due to the business demands and also to meet the expectations of the enterprise customers. Enterprise modernization characteristics has been applied on to the traditional application and the transformed application [2], has to adhere to major complex transformation which needs to be tackled in a phased manner, by keeping the business ROI into consideration.

One of the significant challenges in architecting such an enterprise modernization application system is the amount and diversity of component integrations and implementation. For example, web applications today has to have real time chat integration, business insight modeling or even cloud and big data adoption and also it should have various external and interface related seamless integration techniques. Before the modernization exercise starts, the complete roadmap and strategy along with the validation model has to be pre-built to get succeeded. It is extremely vital for clients to have that confident upfront to proceed further on this enterprise modernization journey. Contextual and phase wise migration is very vital as the traditional OLTP based system might not withstand the huge demand and integration points of the target application. This brings the reduction in the movement of such applications and also decreases the relevance of the key IT related initiatives and recommendations to the end customer. In figure 2 it shows how the traditional application getting modernized to enterprise modernized application.

Multiple channels got introduced (web, mobile, IVR, chat, email, SMS), service oriented orchestration got added to enable the channels and other middleware and external interfaces

integration. The enterprise service bus characteristics introduction is the key for the success of this enterprise modernization. Other major components also got added into the overall application stack to meet the demands of the modernization requirements from the customers like real time chat introduction, business reporting and analytics [3], identity and access Management, document management system, rules engine and batch framework. This adds complexity to the overall modernization exercise. This needs a proactive phase wise approach and also each phases needs to be carried out effectively to yield the result business wants. The architecture proposed has to be scalable and SOA compliant by keeping all the non-functional requirements (NFR) into consideration. The requirements are mapped to key integration components without impacting the existing functionality.

3. MAJOR COMPONENTS INVOLVED IN ENTERPRISE MODERNIZATION

Modernization of traditional enterprise application involves multiple complex challenges, which indirectly affect the quality of service (QOS) provided by the existing traditional application. The challenge is to ensure the same QOS even with the modernized application. The enterprise modernization consists of five major components and these components are shown in figure 1.

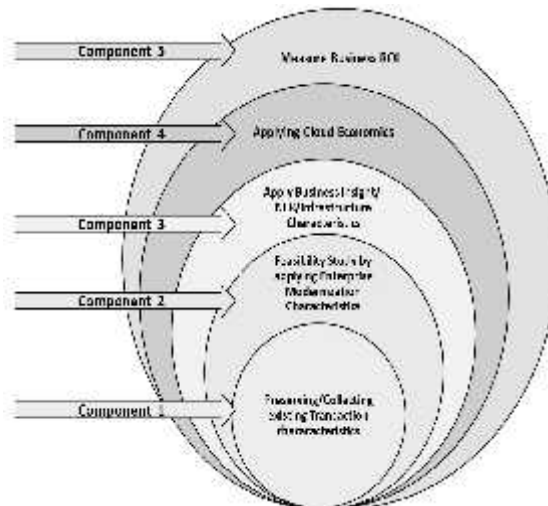


Figure 1: Major Components Involved In Modernization

The following section describes about the component wise major characteristics and the major challenges involved in enterprise modernization.



3.1 Collecting Existing Transaction Characteristics

Transaction characteristics need to be collected for the existing application and forecast the same for the modernized application. These characteristics play a vital part in visualizing how the transaction is going to behave even after the modernized application. These characteristics can be derived via autonomic and also from the existing business and technical SME. Autonomic derivation [4], will be done via mining the existing logs and the SME derivation will be done based on the interaction and by probing and capturing all the relevant details.

3.1.1 Challenges

Existing application logs is the major source of information in realizing the characteristics. If the application doesn't have any web logs [5], capturing the transaction level characteristics will be one of the major challenges. Most of the times SME knowledge will be limited towards functional scope, but how it's been implemented will be little complex to derive. Transaction information is not well defined and it's tightly coupled in majority of the existing applications, without any proper documentation, the business SME would be facing difficulty in collecting the existing transaction characteristics.

The applications are in existence for many years, and the key transaction attributes are mined inside the application without any proper documentation. Understanding the existing transaction characteristics are one of the major complex task. Predicting how the application SLA will look like after the modernization characteristics [6], applied is extremely hard. This becomes more important when the stakeholders use this as one of their key decision to proceed with the modernization phase. Preservation of existing business rules and its related characteristics is very difficult to achieve during enterprise modernization.

Mostly the difficulty lies in capturing enterprise modernization and application specific attributes with respect to application context as majority of the applications are built with heterogeneous platforms. Multiple level of interactive discussion with the key business stakeholders must happen in order to collect the characteristics. This involves various client departments by capturing their pain point and come up with a recommended visualization or representation towards an acceptable modernization view point.

3.2 Feasibility Study by Applying Enterprise Modernization Characteristics

This is one of the most important phases as this phase will be the pre-decision maker to proceed further with the modernization exercise or not. The decision needs to be consider all aspects and it should be backed up by relevant data points to ease out the decision making process for key stakeholders [7].

3.2.1 Challenges

This phase is one of the core and pivotal phase in the success of the enterprise big data modernization. Complexity is directly proportional to the number of transactions involved. Cloud and modernization architects needs an innovative model to predict this SLA numbers which closely analyze the existing business characteristics, as well as the number of complex transactions involved [8],[9]. This phase also acts as a decision making phase where the modernization is actually providing any major ROI for business needs [10].

3.3 Implementing Business Insight, Infrastructure, NFR Characteristics

This phase involves multiple complexities which are so interconnected. The transaction needs to be fine-tuned to adopt big data implementation there by batch/real time business insight characteristics will get intelligently captured [11]. The transaction also gets enhanced to meet the functional demands expected out of the application.

3.3.1 Challenges

Proactive NFR will be applied on to each and every transaction involved in this modernization brings a major complexity such as, stringent SLA, security level transaction migration on clouds, user interface level characteristics.

Identify critical business insight parameters and apply those parameters during the process is very critical. As the information is very limited, working with multiple SME team and get them on the same page in defining the parameters is a very difficult task. Existing application SLA parameters can't hold good for the modernized application because of the different characteristics like business, technology revamp.

A proactive approach is must for meeting the desired SLA. Templates are not matured enough for capturing non-functional requirements during movement of old generation languages or desktop applications to web application specific to hybrid clouds [12].

3.4 Applying Cloud Economics

This phase is very critical from the perspective of choosing the cost effective vendor. A



perfect cloud eco system integrator role needs to be played by the architect community to choose the cloud service providers. This needs dynamic decision making techniques [7], based on the cost and the requirements met. The critical part is, not only the cost, but also the services and the value addition provider brings along with them. The cost is not only the important factor, but the proper rationale and data point's needs to be analysed clearly.

3.4.1 Challenges

Contextual big data builder: Big data is one of the major areas of change in the process. As big data introduction to the existing context and its maintenance should be minified by keeping only the contextual big data. The storage and the variety of big data might go out of control and increases cost.

Big data cloud indicators: As cloud and big data is one of the pivotal requirements, but no proper representation of their characteristics with respect to the existing context is missing.

Insight modelling: Model the key business parameters to derive insights and it needs to be packed into the modernized application. This might disturb the behaviour of the transaction and its quality of services.

Hybrid cloud automation: Component demarcation by mapping the modernized transaction to be deployed in public or private cloud environment will be very difficult, as no matured framework available to map the transaction [13].

Deployment decision: Component demarcation on public vs. private cloud deployment is very complex to achieve as the components are not built with loosely coupled nature.

Consolidated modernization view: Enterprise modernization view composed of application, database and infrastructure and there is no holistic consolidated view available by keeping the existing contextual information.

Autonomic cloud economics: Cost effective cloud and projection towards futuristic load needs to be derived according to the transaction. Autonomic framework to derive cloud economics might be very complex.

3.5 Measure Business ROI

This phase is where the success of enterprise modernization relies, and the ROI model needs to evolve start from the initiation phase, and where each and every phase progresses, there should be a strategically view to change the way the other phases progresses. Feasibility and assessment

has to happen on the way these modernization characteristics are applied. Technical team have to take a decision on whether the existing application can be modernized without having any major impacts. The feasibility study is one of the key processes for key stakeholders in taking the important decision on this modernization journey. Realizing the true potential of the transaction after it got modernized is very critical for business. There is no methodology available to measure the business insights.

3.5.1 Challenges

Generic comparison study: Building a generic comparison study of existing legacy application space to predictive futuristic application space is not available. Enterprise customers have different ROI expectations, before and after modernization ROI should be mapped to meet the expectations of the client. The challenge is multi folded as the ROI parameters should be derived in each and every life cycle stages of modernization.

Sign off with client stakeholders: This is one of the critical phases, and making client understand about the potential risks involved and also align the client towards the risk. Normally this will be staged as one of the critical challenges SME will be facing due to huge investment made by the client for this modernization exercise.

4. PROPOSED MODERNIZATION ACTIVITY

In order to simplify the process to derive all the potential parameters, we are proposing phase wise approach to do the enterprise modernization. This will ensure the modernization exercise is successful and reduce the risk involved in after the decision has been taken on the actual migration. This proactive approach will enable modernization clients not to do any reactive activity as the decision is taken in well controlled phase wise manner. Phase wise approach will enable clients to reduce the impact and provide a holistic overall proactive influence and act in the key decision making process. As there are no proper ROI model for enterprise modernization with big data and hybrid cloud characteristics, clients are more interested to know about the ROI before getting into this modernization. Overall the quality of service has to be in acceptable format which satisfy all the important aspects of the key stakeholders. The important decision of making the application (existing) modernized is dependent highly on QOS. It can't be a reactive approach of fine tune and analyse after the application is modernized. It needs

to be proactive prediction closest to the expectations and the high risk area in which the architect and his team needs to focus on. This brings in clarity towards where to focus, how to modernize, what are all the key considerations to be taken care before the application getting modernized?. This prediction also act as decision making process for the enterprise whether to go for enterprise modernization.

4.1 Activities Involved

The activities involved in each phase have been broadly classified to modernize the existing application by following the four stage approach as in figure 10.

4.1.1 Analysis

In this phase, the business SME characteristics along with the technical SME knowledge will be leveraged to collect the existing application business characteristics, external interfaces and the number of business rules present in each and every transaction. The preservation of existing business knowledge is the key aspect. The target application characteristics have to be derived upfront to ensure the modernization exercise will yield desired ROI. The characteristics have to derive via autonomic way to bring out all the relevance. The benchmark data of the existing application will be mapped to the autonomic characteristics. The collected data will be analysed using the proactive models to bring out all the SLA and its relevant information. This analysis will also act as key inputs to the derivation phase.

4.1.2 Derivation

This activity is one of the major critical cores of enterprise modernization, as majority of the modernization attributes are getting applied in this phase. The analysis phase inputs will be leveraged to bring out all the scalability assessment requirements. Proactive performance engineering related steps will be applied to the target application characteristics. Contextual data builder will be built on to the pipeline data to ensure only the relevance data are getting captured by applying the transaction aware filtering to the generated data. The components will be identified on the basis of various factors which impact the components like security, SLA, and other business and technical characteristics, and based on the criticality the component gets deployed either to public or private clouds. This follows the key hybrid cloud adoption strategy to manage the enterprise expectation of cloud journey. Autonomic cloud economics will be derived based on the predictable load strategy to ensure the cost factors are considered in this

activity. The business insight modelling is one of the major features the enterprise wants to modernize their application to gain more insights and this business insight modelling activity will enable to produce the required results.

4.1.3 Validation

The data, model and the insights related information collected against the above two phases have to be validated and mapped to the desired ROI. This phase will bring in the confidence level of the enterprise to proceed further on the investment of this enterprise modernization. This also has some continuous discussion with key stakeholders to sign off on all the validation parameters and get the final sign-off on the NFR's and the ROI parameters.

4.1.4 Decision making

Based on the data collected, a detailed report will be present on all the key aspects, and with the weighted criteria for the stakeholders to take the decision. In broader aspect the result as shown in the table 1 will be derived to proceed with the next set of actions.

5. MODERNIZATION TAXANOMY

Analysis of the characteristics towards enterprise modernization in the context of technology adoption, infrastructure enhancements, access and channels and also on various non-functional requirement expectations requires a detailed study on different aspects towards modernization. Based on the above architecture and the components involved, in this section we present enterprise modernization taxonomy. The major category of the proposed taxonomy is depicted in figure 2.



Figure 2: Taxonomy Category

The below sections depicts the detailed categories involved in each taxonomy. These categories will be mapped to the key requirements as per the context of the application getting modernized. The technical and business SME will

decide on which attributes should be implemented from the defined taxonomy attributes. The figure 3 depicts the services taxonomy characteristics and the services are majorly consolidated with shared, integration and data. The services in most of the application are heterogeneous based integrations and majorly by leveraging SOA based integrations. The different components of the application have to be wired up during the transaction execution and it will lead to the complexities involved in services consolidation. The performance of the transaction needs to be monitored closely to ensure it meets the expectations. The data services on the other hand have the integrity and purge related requirements to be met. As the data getting generated is huge there should be clear planning on the backup and recovery strategy and the data services needs to be implemented to take care of such operations.

The other shared services will be operating mostly on the document and content management. These contents needs to be sent to multiple contents, so the services needs to be defined in fine grained manner, so that the consolidation and effective reuse of services are possible.

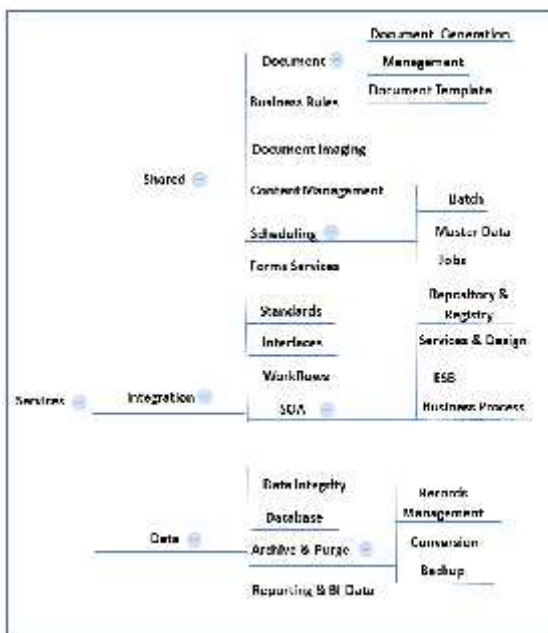


Figure 3: Services Taxonomy Characteristics

The figure 4 depicts the presentation taxonomy characteristics with major classification on the user interfaces, standards and access channels. The user interfaces has different compliance, other web application related requirements. The complexity gets multifold to the accessibility of the user interface from different sources.

The standards are very important in the presentation, as it deals with the majority of the standards, interfaces and controls the major workflows within the application. These workflows need major integration with different streams of data to perform the end to end operations. The most important part of the presentation characteristics is the access channels. The applications have to be accessed by different channel modes and most of the modes need services which needs to be exposed from within the application space to perform the expected operations.

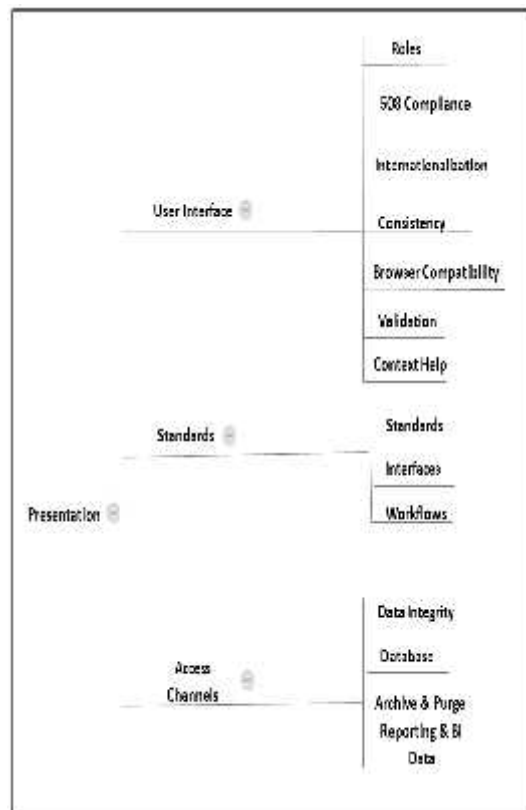


Figure 4: Presentation Taxonomy Characteristics

The figure 5 depicts the infrastructure taxonomy characteristics and the existing capacity needs to be reassessed and also most importantly the cloud hosting adoptions towards hybrid models. The transactions getting involved have to be properly demarcated and a clear deployment model on hybrid clouds have to be derived for cost, security and efficient management of resource utilizations. The other important aspects are platforms, network, storage and other disaster recovery also needs proactive planning during modernization.

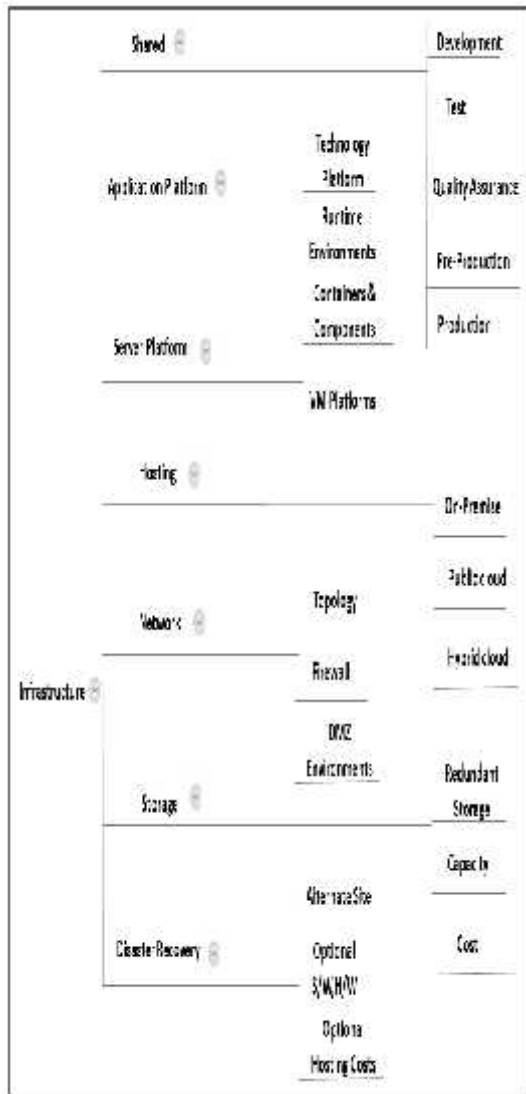


Figure 5: Infrastructure Taxonomy Characteristics

The figure 6 depicts the security taxonomy characteristics and which cut across application level and also standards and compliance levels. The component getting modernized should undergo major scrutiny on any security violations. Most of the enterprise contracts will have legal complications on each and every incident of not meeting the requirements [14]. Effective planning and monitoring towards the security aspects is very critical on enterprise modernization. The security aspects should be inbuilt and proactively the clients have to perform web application level security issues to ensure all aspects are covered.

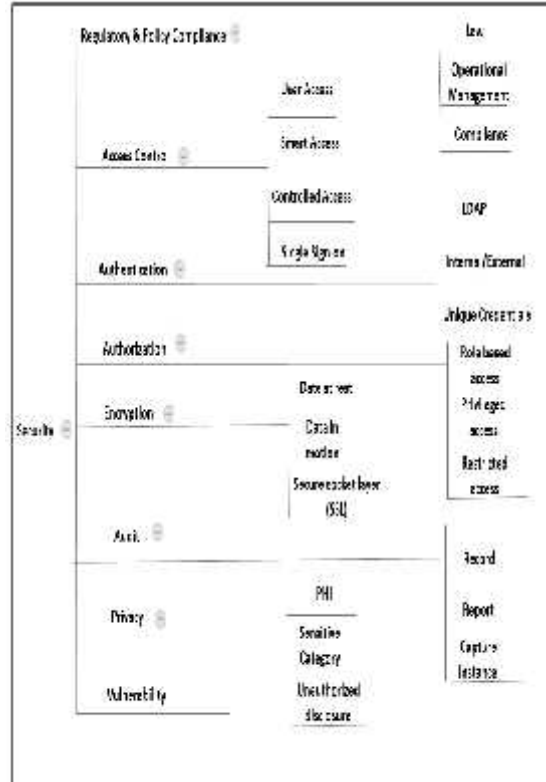


Figure 6: Security Taxonomy Characteristics

The consolidated percentage distribution in any of the enterprise modernization is depicted in the figure 7.

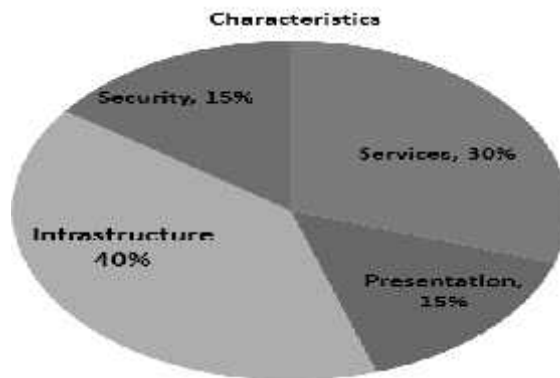


Figure 7: Consolidated Percentage Distribution

6. DISCUSSION

Considering the points, challenges and the modernization characteristics proposed in the previous section, the overall conclusion is that enterprise modernization included all the major issues such as channels, technology adoptions, cloud and big data related concerns, ROI related discussions. These needs a systematic approach



towards modernization and it has to be strategically addressed to reduce the risk involved. Another point observed is that, there is no unique methodology in addressing across technology and verticals, the proposed approach in this paper can act as the unique phase wise methodology for the same. All the major challenges are also discussed which can act as reference for those who involved in this modernization journey. The proposed approach will address some of the major issues in enterprise modernization journey as follows.

Transaction characteristics: This will ensure the new application will inherit all the properties of the existing transaction and also adds new capabilities and also provides.

Service Level Agreement (SLA): Transaction SLA will be predicted by the proactive performance engineering technique to ensure all desired QOS with respect to SLA [15], [16].

Hybrid cloud migration: This will ensure in identification sensitive components and ensure risk reduction by not moving the sensitive data outside of the data center.

Business insight modeling: This modeling will provide the rationale behind why enterprise modernization is done to meet the expectations set by the clients.

Cloud economics: Majority of the cloud adoption and migration will fail due to mislead information about the cost model for the cloud environment. This will provide insights about where the optimization parameters should be applied.

Return on investment: Clients will face challenge on decision making process of whether to go for enterprise modernization or not. This phase wised approach will provide go or no go decision at key important phases.

7. CONCLUSION AND FUTURE WORK

The proposed approach shows how to do enterprise modernization with reduced impact. This approach is generic in nature and can be applied for any industry verticals. Further we will be continuing our work towards phases by taking an experimental application by going through the real time implementation and analysis to refine the characteristics.

Detailed complexity analysis: The complexities discussed over here are from viewpoint, which need more data points by taking the real time experimental results into consideration

Adoption of Big Data: Involves Technical model to be put in place by considering the complexities involved [17].

Hybrid cloud adoption: After all the characteristics are applied, an autonomic model to depict which transactions are migrated towards public/private/hybrid to be represented.

Business ROI measurement: ROI calculation has to be done upfront to ensure the modernization journey becomes successful.

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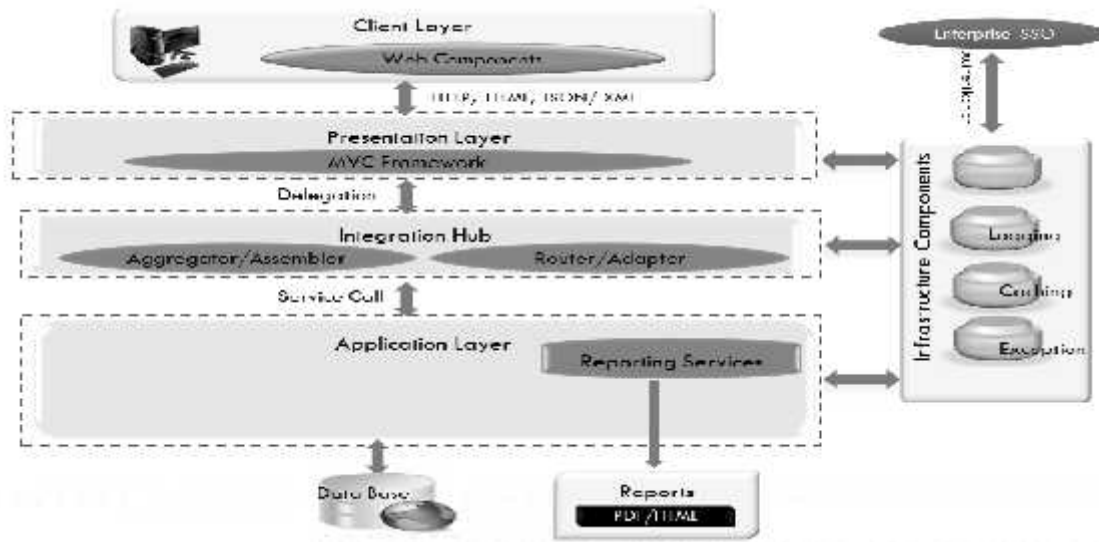


Figure 8: Existing Application Architecture

Table 1: Decision Making Criteria

Weighted Criteria result	Action steps
Greater than expected	Key stakeholders needs to fine tune or focus on getting the desired results
Equal to expected	No need to take any action but validation should happen during the modernization exercise
Greatly deviated from expected	These transactions need to be revisited from overall standpoint and see the relevance importance of getting modernized needs to be questioned. If the weighted criteria listed in this category are critical transactions, then the application team can decide on modernizing the same. If it has to be modernized then the feasibility of the NFR also have to be revisited

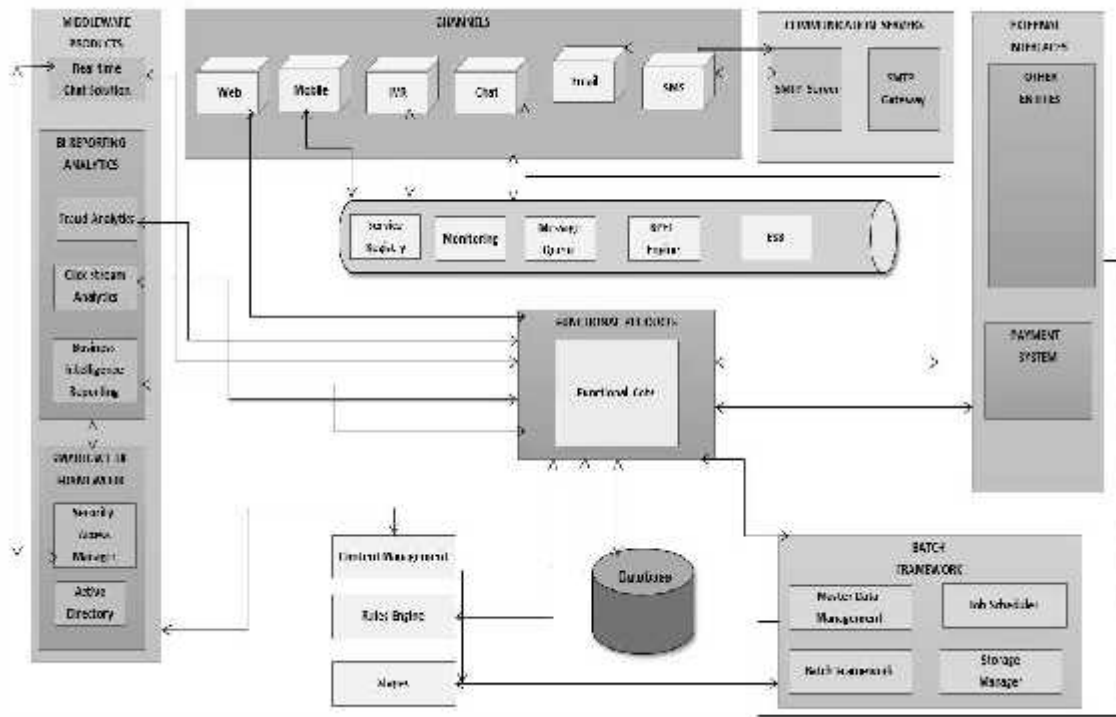


Figure 9: Proposed Enterprise Modernization Architecture, Transformation View

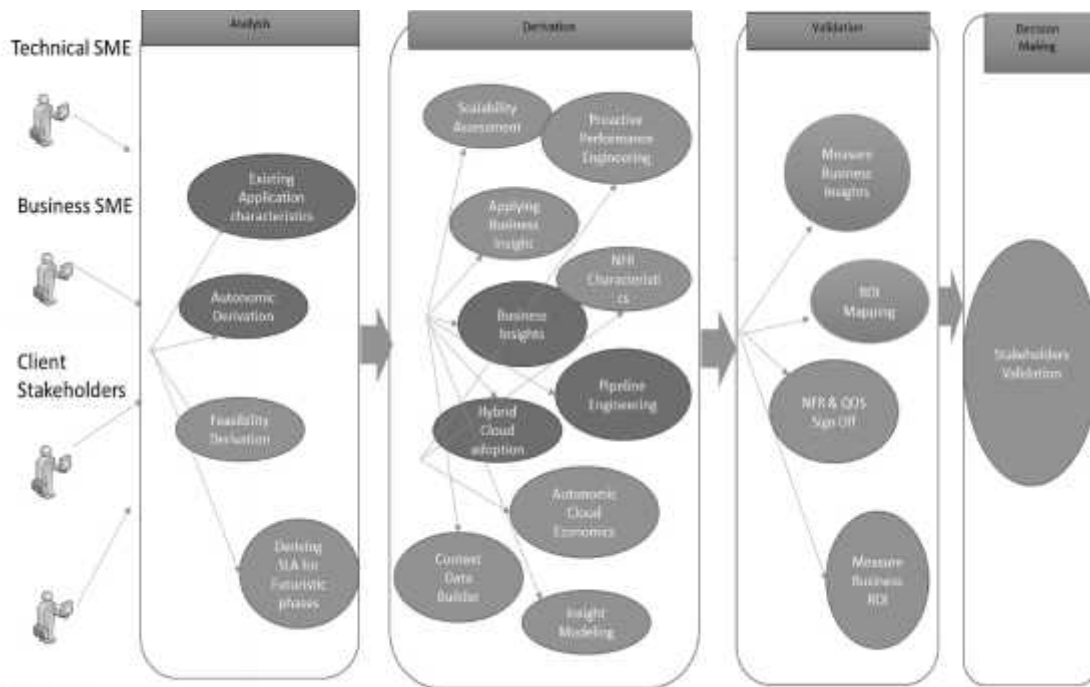


Figure 10: Major Activities Involved In Modernization