Enterprise Application Integration at Comisión Federal de Electricidad (CFE)

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Abstract— **CFE is the largest power producer and supplier in Mexico with 65,000 active workers. CFE operates and maintains 150 production plants generating more than 37,000 Megawatt-hours of electricity a year. The utility also maintains more than 67,000 kms. of transmission lines serving 21 million customers in the whole country. This paper documents an analysis under the light of Enterprise Application Integration (EAI), over the information and process oriented systems in the CFE. It shows the current state of the systems, the need and possibilities of EAI in CFE, the methodology to attain a successful implementation, and the advantages to achieve it for all the company in terms of efficiency, productivity and integration.**

Index Terms—**About four key words or phrases in alphabetical order, separated by commas.**

I. INTRODUCTION

CFE is the largest power producer and supplier in Mexico with 65,000 active workers. CFE operates and maintains 150 production plants generating more than 37,000 Megawatt-hours of electricity a year. The utility also maintains more than 67,000 kms. of transmission lines serving 21 million customers in the whole country.

Its objective to be the very best electric utility in Mexico and Latin America, operate among international indicators and standards in productivity, competitiveness and technology and, manage agile, competitive and efficiently its resources; it is supported by the modernization and process improvement aligning such processes horizontally across its functional areas in the whole organization.

In 1998 CFE made an effort on moving its main administrative systems to an Enterprise Resource Planning systems (ERP), Financials, Procurement, Asset Management and other ERP modules replaced the old in-house developed systems, but not all of them could be replaced due to the planned scope defined for the initial project. Large systems like Human Resources with a support team of at least 50 members, SIAD (Distribution Administrative Information System) developed and used regionally and some

applications running on the web, and of course all the midsize process or technical systems remain the same with some kind of interfacing to the ERP.

Recently, in October 2006 an upgrade project was successfully completed, aggregating 4 new modules to the ERP, all of this effort has been done on a centralized approach, but the vision of the utility is moving forward, the next step to be taken must be an integrated one, strongly supported by the concepts and standards of EAI.

As the need to meet increasing customer and business partner expectations for real-time information continues to rise, CFE is being forced to link such disparate systems to provide information at higher levels of quality, efficiency and clarity.

II. ENTERPRISE APPLICATION INTEGRATION

EAI is the process of coordinating the operation of various applications across an enterprise [1]. Typically, an enterprise has existing legacy applications and databases and wants to continue to use them while adding or migrating to a new set of applications that makes use of the internet, e-commerce, extranet, Customer Relationship Management (CRM), Billing and other new technologies based on requirements. EAI may involve developing a new total view of an enterprise's business and its applications, seeing how existing applications fit into the new model, and then devising ways to efficiently reuse what already exists while adding new applications and data.

Major changes in the business and technology are forcing organizations to enhance their business efficiency. Business processes are seldom stand-alone and depend on information from other business processes to improve efficiency in performing a task. Improving business efficiency can be analyzed to be all about improving business processes and eliminating dependence issues between different business processes. The goal of all organizations striving to achieve business efficiency is to make business processes more cost effective through effective reduction in time, cost, and overhead of performing business.

Today Information Technology (IT) managers in many companies face serious threats in integrating the legacy and disparate systems as shown below in the Fig. 1 to acquire real time data's which forms the backbone of business excellence.

EAI addressed the need of integrating diverse applications

and creating an information backbone. Once in place, the EAI backbone becomes reusable and strategic asset, readily available to provide the next generation integration capability required to construct complex business processes [2].

Having an EAI backbone embedded into the IT architecture also catalyses change process. After plugging into the backbone, applications seldom need to know the actual data source. If a particular set of transactions, as dictated by the current application, is implemented in the newer system can be plugged in to the architecture without the information consumers ever knowing of the change.

In a pre-integrated phase, companies and customers suffer from numerous problems. Dealing with multiple stovepipe departments frustrates customers, where the right hand doesn't know what the left hand is doing. From the Return On Investment (ROI) perspective, companies typically make numerous stand-alone, non-strategic investments. Time-to-market may be fast, but non-integrated point solutions have a short life. Finally, pre-integrated enterprises are at risk due to the inability to share information, make intelligent decisions, or manage a customer portfolio to target low-risk customers with high payback. The contrast between pre-integrated and fully integrated enterprise is illuminating. In the latter, the company/customer relationship is symbiotic. Customers feel like an integral part of the enterprise. In regard to ROI, EAI can leverage value-chain relationships, increase market share, form new alliances, and create new customer channels. By investing in standards and strict controls, the EAI can shrink time-to-market from months or years to Internet time. The organization benefits from an intelligent focus of its IT assets so called a managed risk portfolio. These reasons compel to take an action that is more strategic and also more efficient; the following steps portray one of the best strategies for an EAI solution.

EAI as a new approach to interface implementation, has, among others, the two objectives of loosely coupling applications instead of tightly coupling them as well as providing near real-time data exchange. An increased data quality follows from these objectives as well as optimized business workflows, increased maintainability, and higher system availability [3]. Regarding the situation at hand, these objectives could only be reached by:

Replacing synchronous interfaces (tight coupling) by automated replication interfaces (loose coupling).

Replacing batch interfaces (delayed data transfers) by event driven messaging interfaces (instant data transfers). This reduces the amount of data per invocation considerably.

Replacing of bilateral interfaces by intelligent splitting and routing, if possible.

Among different perspectives on integration, anarchical integration approaches include methods for application integration. The standard literature on these methods is normally EAI, and concerns techniques and devices such as middleware, adapters, message brokers, etc. Application integration is typically performed using independent third-party software components. ETL (extract, transform, load) is the more restricted mechanism used to migrate data from one database to another [4].

Moving to the bustling world of the Electric Power Industry (EPI) it is found that the Business Alignment becomes the key foundation for IT-architecture and integration. To develop a feasible integration strategy several aspects have to be taken into account. All these factors can be sculptured into a Business Alignment Framework (BAF).

According to the BAF business processes and information requirements are defined in parallel with the technology enablers and models, which are linked throughout the alignment process. Objectives and measures are defined and reviewed in the light of the intended overall strategy, which leads to adjustments and refinements of existing results. The approach used to develop the business alignment framework may include the following modules:

Breakthrough objectives and process links
Key processes
Business models
Information models
Technology enablers and models
Solution mapping and selection
Functional mapping
Cost/Benefit analysis

In order to achieve best in class and cost effective business processes, most utilities followed the path:
Purchasing and implementing a standard ERP system, customer information system, supply chain management solutions and others, as in the case of CFE.
Implementing point to point integration, (current status in CFE).
Launching new initiatives that are now business process oriented rather than product oriented.
In ERP systems the business management components like financial management, cost controlling, balance calculation, asset management or human resources do not differ much from solutions in other industries. But there are industry specific solutions necessary for an optimal support of the business processes within an utility. The asset management solution derived from an out of the box product is one of these industry specific solutions.

All relevant figures regarding the business management situation of a utility must be accessible at every time. Flexibility, openness, internet capability and process orientation are the most important requirements for modern ERP solutions. Essential for a utility is the integration of the ERP systems with the other applications of the utility IT landscape.
This enables utilities e.g. to manage assets through their entire life cycle or to develop products and services that attract and retain customers in a highly competitive marketplace.

Only EAI-based solutions enable utilities to monitor, plan and develop their business on an entirely new level. Future IT solutions will have to provide up-to-the-minute facts and figures required to respond dynamically to the increasing management information demand. An ERP system, which is integrated with the other segments of the IT landscape, puts a utility firmly in control of the key business processes. The integration along the business processes of the applications in the area of Workforce, Asset, Outage Management and Geographic Information System (GIS), together with the customer information system, the ERP system and the Supervisory Control And Data Acquisition (SCADA), Document Management System (DMS) system will be the future solution.

Setting up and making optimal use of EAI support products requires specific skills, but EAI cannot and must not remain only in the hands of IT personnel. In order for EAI to be implemented successfully, each one of the company's departments must be fully involved and they must share the same piloting system with the IT team. The company must be organized in such a way as to allow this global data exchange to take place. It is up to each department to know just what data it can exchange with its counterparts. But of course if there is no place for dialogue, where that exchange can occur, departments do not necessarily think to share their information with others, or to re-use data that supposedly belongs to another department. Often this is because departments are not necessarily aware of what sort of information other parts of the business are producing or using or of what they could be providing themselves.

III. QUALITY ASSURANCE IN EAI

Even though the success of any project is a collective responsibility of all the members of the team, many times the responsibility of the delivery is in the hands of the Quality Assurance (QA) team [1]. QA team should be having the commanding capacity to accept or delay the delivery based on the quality of the deliverables; hence testing is a challenging task in terms of over all project success.

EAI QA is one of the most neglected parts even though EAI methodologies got main stream market acceptance. Most often EAI testing is delayed until the end of the project due to several reasons like less time, unavailability of standard testing strategy, insufficient tools and expertise to accomplish the task. However, delaying QA activities might impact severely due to the difficulties involved in testing a complex integration involving many end systems. Identifying bugs in a later stage is much more expensive than identifying the same in an early stage.

It is a known fact that stability of an integrated system lays on the stability and reliability of the middleware platform it is built up on. When the complexity increases, it is essential that all the loopholes have to be closed. Following a traditional QA lifecycle like unit tests, integration tests, systems tests, to acceptance tests will not work for EAI projects easily, since EAI QA involves system-to-system integration. Most of the IT testing tool do not work well for testing EAI projects since the EAI architecture is multi protocol message oriented and simulation of applications are required rather than virtual users.

In a complex software development scenario, traditional scenarios like sequential or iterative model face problems in accepting continuous changes. Agile methodologies are developed for accepting the changes quickly and smoothly. It is a collection of values, principles and practices that incorporate iterative approach for development, test and feedback for further changes. Here software is developed in incremental, rapid cycles, with each release building on previous functionality. Each release is thoroughly tested, which ensures that all issues are addressed in the next iteration. When we follow this approach for EAI project each components of EAI will be available for multiple round of testing in the early stages of the development cycle. Availability of each component for testing in the early stages will ensure the strength and stability of the application by eliminating the hidden issues in a later stage.

Performance testing is also very importance to ensure the system stability. The architecture of the EAI solution needs to provide the infrastructure for performance, as well as the selected enabling technology. A simple way of measuring the performance is, run some tests to see if the system performs well under a variety of conditions and measure the following, How well does it perform at 100 users, 500 users, 1000 users, and even 10,000 users? What about processing load? What happens to performance as you extend the EAI solution over time?

A well defined process for quality assurance always help to minimize major risks involved in the EAI testing area. Formulating a strategy based on the type of the project is also very important.

As already mentioned, when a proper quality assurance process is in place, testing related activities can be integrated into the project lifecycle starting from the beginning of the project. This will help to design the test cases based on the actual user requirement and not the design specification that may be defective. Test cases should be part of the requirements that drive system design that are understood by the users, analysts and developers, such as test cases derived from use cases and event flows. When the test cases are driven by requirements, test execution will be more complicated due to the distributed nature of EAI. This requires a dedicated test bed or a QA integration framework throughout the test execution phase.

Complexity of an EAI project is greater than other projects knowing the fact that EAI basically integrates different applications together, for the smooth business flow. Importance of specialized testing on integration projects can be a good solution for facing the challenges in EAI. This can be named as Quality Assurance integration (QAi).

Good software testing is a challenging intellectual process. In early days, first impacting area of any software budget cut , is the testing team, but the situation changed over a period due the underlining fact; Quality. It is impossible for any

product to exist in the highly competitive world with poor quality, so quality assurance is an integral part of anything.

An ordinary tester can assure the quality of a product by considering it as a black box. When he understands the internal complexity and the fundamental architecture of the product, we can name the tester as specialized. It is quit obvious that when multiple systems operates in different environments with different languages, interacts using a common middleware, the knowledge of the middleware architecture and the interacting sub-systems are essential, more over the communication between multiple systems are based on messages.

IV. PROPOSED INTEGRATION PLAN

Nowadays, CFE has a structural integration level (Fig. 1), the company uses more advanced middleware tools to standardize and control information exchange between applications. There are two major breakthroughs: (1) an architectural central hub or bus, which controls information exchange, that has replaced the confusing array of point-to-point application interfaces; and (2) diverse business rules governing data and transactions between applications are now aggregated and consolidated at the middleware level. At this stage, the organization is committed to an interface integration model encompassing a common data model with the future potential to manage all applications.
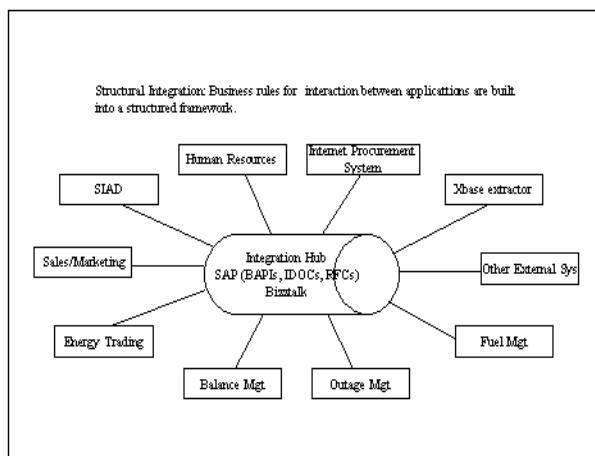

Figure 1: Structural Integration.

For the next 2 years, the goal is to achieve a complete external integration level (Fig. 2), where the company will be leveraging technology, business process transformation, and new structures to redefine the organization — from the standpoint of serving customers. At that time the organization will use EAI technologies to transform the business, often directly connecting both customers and suppliers to internal operations, achieving new capabilities to create innovative online offerings, new products and services, and can either improve an existing brand name or create a whole new Internet brand identity. An Integration at this level is so tight and smooth between the company and its partners that customer will need drive enterprise and partner

behavior, in real-time. Concurrently, advanced technologies will make it possible to manage and share information assets. By improving its knowledge base, the company will be fast, flexible, and responsive to market dynamics.
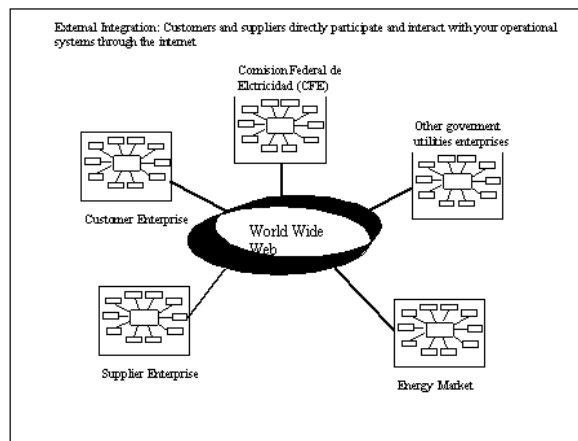

Figure 2: External integration.

V. CONCLUSION

Enterprise Application is an ad hoc, tactical, and temporary patch to a fundamental cognitive problem of the partial foresight of system evolution. Automated business processes and implementing IT enabled work flow processes will help corporation eliminate unnecessary personal costs, reduce error due to manual activity and continually refine the processes that are critical to maintaining a competitive edge. By implementing these approaches CFE will replace its synchronous interfaces (tight coupling) by automated replication interfaces (loose coupling), will replace batch interfaces (delayed data transfers) by event driven messages interfaces (instant data transfers) reducing the amount of data per invocation, and will replace bilateral interfaces by intelligent splitting and routing.

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