

Reengineering with ERP: The Aramco Case

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This paper examined the strategic and operational impacts of the implementation of Enterprise Resource Planning (ERP) system at Aramco. The impacts of ERP implementation on organization structure, decision making, systems integration, streamlining and automation of operations, control, and accountability were also examined. The paper considered the following aspects of Aramco: 1) History and background, 2) Organization structure, 3) Business and competitive environment, 4) Information technology, 5) ERP project, and 6) Conclusion and lessons learned.

INTRODUCTION

The Business Impact Analysis provides an early indication of the likely changes the implementation of ERP has on the organization. It also provides key input for the following:

- Communication to Managers and End User Organizations
- Training Requirements for Managers and End Users
- Managing Change

The purpose of the Business Impact Analysis is:

To identify the current business procedures that are going to be affected by the implementation of the BSIP Business Model

To identify the individuals or groups of individuals within the organization that will be affected due to the implementation of the BSIP Business Model

To develop a change action plan that provides a framework for tracking changes to business procedures and organization

To aid in preparing organization for implementation

The BSIP Business Model is the conceptual redesign of the Aramco business processes that were developed during the modeling phase of the project. Certain processes have to be aligned with the ERP functionality; each process had to be carefully analyzed and changed only where value is added.

An impact is a difference between Aramco's current business processes and the BSIP Business Model that necessitates a change in either a business procedure and / or organization.

The Business Impact Analysis (BIA) is a combination of two tasks: Process Impact Analysis and Organizational Impact Analysis (impact on organization). The combining of these activities ensured that the BSIP design teams are focused on the entire impact of the business change regardless of whether it was organizational or process-oriented in nature.

The approach was to review the processes identified in the BSIP Business Model, identify the current procedures that need change because of the ERP implementation, and to highlight processes for which there are no current Aramco procedures available. The Business Impact Analysis classifies and catalogs the impacts between high, medium and low and defines a Change Management Action plan to resolve them. Each of these changes was reviewed with representatives from the end user community who are familiar with these processes. These reviews took place through discussions during prototyping.

HISTORY

In the early 1930s, geological surveys of the Kingdom found indications of possible petroleum deposits. The discovery of oil on the nearby island of Bahrain also provided an impetus for exploration. In 1933, the Kingdom signed a concession agreement with a major oil company, allowing for exploration in the country's Eastern Province. Other oil companies later joined the enterprise, which became the Arabian American Oil Company, or Aramco—predecessor of today's Saudi Aramco. Headquartered in Dhahran on the eastern shores of the Arabian Peninsula, Aramco manages all of Saudi Arabia's huge hydrocarbon operations. From the gigantic Safaniya and Chuwar oil fields, the world's largest fields, to the leading-edge technology at the Exploration and Petroleum Engineering Center, and from one of the largest and most modern fleets of supertankers to refining and marketing joint ventures around the world, Aramco is strongly positioned to continue to play a leading role in meeting the world's demand for energy (SaudiAramco.com)

CENTRALIZED PRODUCTION PLANNING

Currently the planning activities required to manage the hydrocarbon supply chain are carried out in two separate Business Lines by two different departments with manual exchanges of paper and reports in various formats and a significant number of telephone conversations. Both Refining & Distribution and International Operations coordinate aspects of the planning process with Exploration and Producing, Corporate Planning, Finance and other interested parties. ERP planning methodology and processes will promote change to the ways these organizations interact.

Due to the integrated nature of ERP, it is appropriate that planning functions be controlled and coordinated by one organization. In ERP, there are many levels of planning within well-defined planning cycles. Each planning level has integrated tasks that are scattered between Sales and Marketing Logistics Department (S&MLD), Oil Supply Planning and Scheduling (OSPAS), Distribution Operations & Refineries. Because of ERP integration, many functions that are now performed by these departments will have to be centralized and performed by a single central organization. This will require reorganization and reassignment of responsibilities and roles of current staff that will affect the number of staff involved in the planning cycle.

PROMOTES CENTRALIZED DATA MANAGEMENT

Data Management was considered on four separate control levels:

Physical Control – the technical data management environment controlled by the SCCC which includes the controls surrounding the relational database, associated disk space, the CPU's, memory, backup and archiving

Logical Business Control – a semantic layer that ensures data is properly organized into logical business groupings so that it is uniquely and consistently applied across the enterprise. A Data Manager or Data Architect who has broad knowledge about the business should control this function within the Information Technology organization.

Data Ownership – the owner of the data should be the business entity that is primarily responsible for the “content” of the data. The owner is responsible for data integrity and data reconciliation. It is planned that the ownership of data will remain within the various Business Lines.

Access Control – access control rules should be controlled centrally according to business rules defined by either the data or process owner. It is anticipated that a centralized control group will recommend policy, establish control procedure and administer the access control rules and environment. As the number of end users will be extremely high, it will be necessary to implement access control rules through a de-centralized group of sophisticated end users similar to the Computer System Liaisons within existing business lines.

Centralized Control of Master Data

Today, master data is owned and administered by one or more proponents, often within redundant databases. For example, the company now maintains several vendor masters and suppliers within the Supplier Information System, contractors within the Contractor Information Systems, vendors within the Accounts Payable system and employees within the Employee Information System. Within ERP, it will be necessary that the information and structure of these and other disparate systems be brought together into one centrally managed environment. Likewise, it is important that one entity be assigned responsibility to ensure data integrity and data content so that it can be uniquely and consistently applied across the enterprise. In the above instance, responsibility for control over vendor master data will need to be assigned to one group. A decision will need to be made among the respective “owners” as to the best or most logical corporate entity to control the content of master data. It will be necessary that organizational responsibility be clearly designated for each type of master data. In many cases, responsibilities may change from today’s practice.

Data & Application Ownership

Data and computer applications are corporate resources that need to be managed effectively. ERP provides a structure for clarifying the responsibilities of various organizations that create, update, maintain or delete data. Additionally, ERP encourages that ownership be established for all business functions within a process chain or process scenario. The concept of “process ownership” is new to Saudi Aramco and will be to be developed through BSIP working with the Business Lines to establish a clear framework for assigning responsibilities and clarifying data and application ownership issues.

As legacy systems have evolved, organizations have become the system proponent responsible for managing the data within various systems that have been specifically developed to meet the business requirements within their functional area. Most proponents view this arrangement as ownership. Most organizations are proponents of one or more legacy systems.

Within ERP, business processes integrate functions performed by several organizations together within a centralized environment. The ownership of data and the computer applications that support a process are less clear in an integrated environment than in the existing legacy environment. It will be necessary to define the process owner and all process stakeholders as well as the organization responsible for the integrity and content of each group of master, controlling or transactional data.

PROMOTES CHANGE IN HUMAN RESOURCES

Expanded Knowledge Base of Workforce

A major change is that most employees will need to develop a clear understanding of end-to-end processes as opposed to the current isolated task approach. ERP's horizontal integration across processes breaks down old departmental barriers that have caused bottlenecks in the past. Transactional data will move seamlessly from maintenance and projects to materials, services and finance. In most cases, the results of a transaction will be available to all users within a process instantaneously. The recorder of the initial transaction as well as his management will need to fully understand the downstream ramifications of his actions and take steps to ensure high quality data content. Generally, staff will need to acquire a broader level of competency with regard to the business process and the desktop-computing environment. This will require a major training effort, but it will result in a more competent work force and a more efficient processing environment.

Organizational Management Issues

The ERP Organizational Management function is somewhat different from the legacy environment in Saudi Aramco and offers an opportunity to rethink key design issues that can help manage our Human Resources more efficiently. ERP takes advantage of a holistic approach to systems' design so that Organizational Management is fully integrated with other Human Resource functions such as Recruitment, Personnel Administration, Employee Development & Training, and Personnel Cost Planning. Additionally, ERP presents us with many new business elements and structures that can help us manage our Human Resource business functions and the systems that support them more effectively. These include organizational units, jobs, positions, qualifications catalogue, workflow and authorizations.

To maximize the benefit of ERP implementation and ultimately meet the company-wide human resource management business needs, we need to take some steps that set us up for long-term success:

The existing jobs structure needs to be rationalized (better defined with some jobs added, some deleted and some consolidated) to provide more manageable and meaningful data. In ERP, a 'job' is a generic grouping of similar activities that define a set of tasks, e.g. Manager, Systems Analyst, etc. Many people at one company may be assigned the same job.

A 'positions' concept needs to be introduced to specify the manpower slots available within an organization, the jobs and individuals assigned to those slots, as well as any additional qualifications that are required to perform a 'job' within a specific organization. A job in ERP is linked to a position or many positions. ERP views a position as an extended definition of a job and may include additional tasks or requirements assigned by the organization; e.g. Human Resources Manager, Exploration Systems Analyst, etc. Clear lines of control and responsibility need to be established to manage positions. Furthermore, ERP requires that 'position' be defined as a key field within the Human Resources system architecture. Planning and budgeting procedures will need to be revised significantly to accommodate the 'position' concept.

A company-wide qualifications catalogue needs to be established to systematically include education, skills, competencies, etc. required to meet 'job' and 'position' requirements. This catalogue will help maintain and control the requirements that are to be associated with jobs and positions in a logical and efficient manner. ERP provides qualification catalogue functionality that allows the user to list, in a predefined order, all the qualifications that may be used in the company. This functionality supports prerequisites, equivalencies, proficiency levels and validity periods. The common catalogue will be used by all organizations. A single corporate authority must be designated to review, approve and maintain the qualification catalogue.

ERP has powerful features that allow individuals to inherit system privileges and approval authorities automatically as they move into jobs or specific positions within organizations. For example, individuals in acting assignments for a manager of a specific department can automatically be granted all authorizations for that position. Once the acting assignment has been completed, the individual would automatically lose those authorities.

The impact of the implementation of HR will be significant for some areas because the way of working and according responsibilities will change. For most, just the simple fact that all systems will be integrated with data widely available throughout the company will result in a different way of working. Furthermore, many departments will start sharing functionality, resulting in a more standardized way of working.

If designed efficiently and utilized properly, these ERP structures and business elements offer opportunities to:

- Streamline the business systems that monitor employee development, training and career planning
- Improve recruiting and job placement
- Automate approval authorities and access control
- Implement work flow
- Eliminate duplications of data entry
- Improve the accuracy of management reporting from a centralized data source

Job Changes

It is expected that standard job roles will be defined within ERP, which in some cases will be major changes from the current job role. In others, the change will be minimal. For example, the current Materials Investment Control Analyst (MICA) job family will be replaced by a new role, the Materials Requirement Planning (MRP) Controller. While in both cases, the prime function is to manage Inventory Investment, the scope and method of control is much greater in the MRP Controller role than in the current MICA role. Conversely, the role of the Buyer job family will be very similar in ERP to the current Buyer role but the strategies and processes used by the Buyers will change.

Personnel Redeployment and Retraining

With the anticipated centralized management and control of many databases, it is anticipated that some employees will need to be relocated to other organizations. For example, consideration is currently being given to centralizing the invoice verification process within one group. Likewise, the control of the vendor master will be consolidated. Some staff will be redundant and will need to be re-deployed.

Productivity Improvements

Generally, productivity will improve across the enterprise with the implementation of ERP. Less staff will be required to process transactions within a given processing chain. Individual managers will need to assess the impact of business change on their work force requirements. In most cases, the amount of reduction in staff will not be apparent until approximately six months after the process has been implemented. Upon implementation, a large amount of the time of existing labor resources will be engaged in making the changes work within their respective organizations. After a shakeout period, redundant staff will need to be identified for redeployment or redundancy programs.

Change to ID Number Assignment & Control

In the ERP system, the personnel number is an eight-digit field. The Business Systems Integration Program team will implement change with the agreement of the concerned organizations as follows:

Adopt ERP standard eight-digit personnel number for all new personnel (employees and contractors). During implementation, a procedure will be developed to ensure all numbers are unique and can be converted from or interfaced to legacy systems, which utilize the existing six or seven-digit key. Subsequent to the rollout of Human Resource business processes within the scope of this project, all-new personnel numbers for employees shall be generated internally (ERP-generated number).

Discontinue the allocation of personnel numbers by employee type and/or payroll except as stated above.

Discontinue the use of the check digit. ERP includes internal control features that mitigate the need for continuation of this practice. Legacy systems that required check digit validation should continue to utilize this feature.

IMPROVES ACCOUNTABILITY, BUDGETING & COSTING

Position Control within Human Resources

ERP has strong functionality with regard to how it manages work force slots that will allow the Operating Organizations as well as the various staff groups that support them – O&IE (Organization & Industrial Engineering), Personnel, Training & Career Development and Management Development and Finance – to manage key activities including:

- Manpower Planning
- Manpower Development
- Training
- Job Placement
- Recruitment
- Approval Authorities
- Access Control

ERP's Position concept resembles an automated update of the manual system that was discontinued in the 1980's. Manufacturing Operations and Training & Career Development have developed specific systems to add similar functionality to their legacy systems.

Within ERP, it will be necessary that each organizational unit plan for 'manpower by position'. In ERP terms, this is like a specific budget slot for each individual by job. For example, a department will need to budget positions for one Manager, 'x' division levels, 'y' Business Systems Analysts, etc. ERP's approach is far more detailed than our current approach. ERP's copy function makes the exercise more 'user friendly than the old system; however budgeting for manpower will require far more discipline than the current system.

The ability to attach 'authorization profiles' to rationalized jobs and positions as well as to organizations and tasks will simplify the automation of approval authorities. It will also greatly facilitate ongoing maintenance of 'ERP authorization profiles' which will allow access for individuals based on the work that they are performing. This simplification is the foundation within ERP to enhance and simplify our control environment.

Budgeting for Maintenance

ERP offers two options for budgeting and recording actual cost for maintenance. Both are different from existing practice within the company. One option treats maintenance similar to the way we currently treat capital projects. Costs are budgeted for, and collected against, work orders and settled to operations' cost centers as "second spent money." Under this option, the maintenance cost incurred for materials and services (invoices) would not be reflected against the corporate NDE budget. Companies that manage cost

at the Total Controllable level rather than NDE level utilize this option. In order to adopt this method within Saudi Aramco, it will be necessary to change budgeting and accountability focus from NDE to Total Controllable. This is a major change in budgeting procedures and would affect how budget and actual cost is reported to the Board of Directors. If this option were adopted for maintenance, it should also be considered for operating cost centers and projects (Operating Plan and Capital Program and Budget).

The second option allows maintenance cost to be recorded as an NDE at a corporate level within the Operating Plan, but it requires a change in budgeting procedures. Currently maintenance organizations budget and incur the NDE cost for labor, materials and invoices. As work orders are executed, these costs are charged to the work order and settled to benefiting organizations as “second spent money”. Under this option, ERP requires that the benefiting organization plans for and absorbs the materials and services (invoices) portion of work order cost as NDE. In this scenario, maintenance costs are planned for and charged against work orders as follows:

Maintenance labor is planned and charged to a work order as a secondary cost (second spent money) at a pre-established rate. The responsibility for the NDE portion of maintenance labor remains with the maintenance organization responsible for executing the work.

Materials and services (invoices) are charged directly to the work order as a primary cost element (first spent money).

Asset Life Cycles

ERP will introduce the concept of Asset Life Cycles within current processes for planning, recording, operating, maintaining, replacing and disposing of assets. Processes for recording events within the asset life cycle will leverage the strengths of ERP’s integrated approach to simplify control and improve the flow of information to end users for decision support. Assets will be recorded and tracked assets at a much higher level. An enhanced Plant Unit Concept “PUC” will be adopted to bring current procedure online with world-class practices. PUC integrates functionality within the Asset Management, Project Systems, Controlling and Plant Maintenance modules to achieve a holistic view of the events an asset moves through during its life cycle. Asset Master Records will be linked to underlying components identified within the Plant Maintenance Module as either Functional Location Records or Equipment Master Records.

AUTOMATES AND STREAMLINES PROCESSES

Simplified Approval Levels

To the extent possible consistent with meeting essential controls, both Approval and Signature authorities are currently being reviewed for simplification, elimination of redundancies and development of consistency. Once this review is completed, proposed changes to delegation of authority will be presented for endorsement to the Management Committee. A simplification is needed to improve processing efficiency and provide a more consistent framework for implementing on-line approval.

Online Approvals

Online approvals will be introduced within key approval cycles facilitated by ERP release strategy, workflow and centralized document management. It is currently anticipated that online approvals will be utilized within several major processes including the routing and approval of:

- Personnel actions
- Invoice processing
- Operating and capital program planning and funds release

- Job and organizational changes
- Purchase orders, contracts, change orders and amendments

Internally Generated Numbers

ERP is capable of internally assigning sequential numbers for controlling work objects such as personnel numbers, contracts, purchase orders, materials numbers. These internally generated numbers are not intelligent. No predetermined meaning has been built into the number; it is merely the next number in a sequence. In many cases, semi-intelligent numbers are used in legacy systems today to facilitate manual review. This change is expected to require a significant re-education of end users to assure a smooth implementation.

Invoice Processing

The invoice receipt and approval processes will change under the ERP implementation. ERP provides a three-way match among the purchase document, the goods receipt or service entry sheet, and the invoice.

It is expected that some staff will need to be reassigned to match skill requirements with the work requirements. In addition, vendors will need to be apprised about revised procedures and will need to improve their internal capability to provide pricing and other relevant data in electronic format. These proposed processing changes rely heavily on imaged documents, a sound document management system and workflow.

Vendor Master

A Consolidated Vendor Master will be implemented within ERP. Vendor master data from Purchasing Department's Supplier Information System (SIS), Contracting Department's Contractor Information System (CIS), and Finance's Accounts Payable System (APS) will be merged and cleansed prior to the implementation of ERP. This significant exercise will require close cooperation and staff from the respective departments who are proponents for the legacy systems.

Access and Control Environment

An effective implementation of ERP will require that Management rethink aspects of the existing corporate culture and become more open to change. It is anticipated that streamlined processes will rely more heavily upon detective controls rather than the costly preventive controls that have been developed within legacy systems. The following highlights areas where change is recommended:

Information Sharing

ERP's relatively seamless, integrated design promotes sharing of information. In legacy systems, ownership of data is assigned to proponents who tightly control access to information; most often on a strict 'need to know' basis, restricting the range of data that a user may see within tightly defined parameters normally controls access to specific data elements.

ERP's design promotes a more open approach to accessibility of information and empowerment of users. In ERP, a user who has been granted access privileges to create, change, view or delete data in a field generally has the same access for all values in that field. For example, a user who has access to view cost center information may view data about all cost centers. Furthermore, the user can drill-down through all transactions within all cost centers. Arguably, the increased visibility of cost information improves internal control. However, it is recognized that access privileges need to be restricted on an exception basis to limit accessibility to sensitive data such as amounts charged to the cost centers of Executive Management. ERP has effective tools for exception basis handling.

Management needs to accept controlling access to information on an exception basis. If not, developing and maintaining authorization profiles within ERP will be complex, labor intensive and costly.

Simplification of Approval Process

The company has an opportunity to improve the review and approval process using workflow. For workflow to be effective and for maintenance of authorization rules to be manageable, it will be necessary to simplify the existing approval authority matrix and rationalize positions, jobs and tasks across the company. For example, it will be necessary for all individuals in manager level jobs to acquire a set of authorities that are common to all manager positions. Any unique authorizations required to perform a specific manager's job would be additive.

Empowerment and a Knowledge-Based Workforce

Most existing systems have been designed so that clerical staff have narrow job scopes and can process data relatively quickly and accurately. Very few of current employees have a strong knowledge of the processing steps that precede or follow their job function. In an ERP environment, it will be necessary to broaden the knowledge base of the staff so that transactions can be processed efficiently. In most cases, the scope of an employee's job will broaden. Employees will be relied upon to exercise sound judgment. Further, employees will be empowered to execute transactions that ripple through the system instantaneously and affect other processes.

Empowerment carries a high degree of risk that needs to be mitigated through extensive training, segregation of duties, automated workflow, and improved accountability.

CONCLUSIONS

As Aramco stepped into the information age at the turn of the millennium, paradigms are shifting in a fundamental way in the area of operational structures.

One cannot always assume that an organization can be planned, analyzed, and controlled entirely rationally in a given situation. Instead, when looking at the overall picture, there are soft factors that must be taken into account, such as social competence, cybernetics, employee motivation, etc., in addition to the hard economic factors, in order to better meet changing market requirement.

It is also becoming increasingly clear in many businesses that market-driven requirements cannot adequately be met with the thought processes traditionally applied in planning and control or with the separation of decision making from performance.

With the growing complexity of the environment and the heightened dynamics of change, the gap is widening considerably between required reaction times and time needed by organizations, which are growing ever more complex. Successful systems must strive for harmonious cooperation between business strategy, organizational strategy, and technological strategy, to ensure that these concepts do not work against each other within the enterprise.

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