Business Process Modeling:
An Example of Re-engineering the Enterprise

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Abstract. This paper explores the challenges of business process re-engineering, and describes how systems engineering practices were applied to re-engineer the Information Technology (IT) Infrastructure of the Enterprise. Our Customer, a Fortune 500 company, is establishing a complete "end-to-end" test environment to thoroughly validate new or upgraded software (S/W) applications or technologies. The objective of this exercise is to prevent any interruption in executing business transactions by ensuring that each "production load" (complete set of S/W applications) is thoroughly tested prior to fielding. The goal of modeling the Enterprise is to understand the impact of new or modified S/W applications or technologies targeted for fielding, and to establish a basis for testing the entire set of business processes. This paper will describe the Customer's challenge, will identify the approach taken to re-engineer the Enterprise, will identify the future directions of this exercise, and will draw some conclusions concerning the applicability of applying systems engineering techniques to business process re-engineering efforts.

Keywords. Re-engineering, BPR, Behavioral Modeling, System Validation, Tools.

Note. [The Customer has requested that they be referred to anonymously in this paper due to the sensitive nature of the work being performed.]

BUSINESS CHALLENGE

Welcome to the Twenty-first Century – the Age of Information Technology – where vast amounts of data is just a web-browser away, and anybody can purchase stocks over the web like they are a Wall-Street broker. The rapid changes in information technologies have taken a permanent foothold on how we live, and offer significant benefits to how businesses provide their products and services. However, harnessing this technology, making it an asset rather than an impediment to business success, profitability, and competitive strength, has become a central concern for every company on the planet. Businesses are more dependent on information technology as the basis for executing business transactions, tracking every facet of its business performance, and providing the day-to-day information upon which mission-critical business decisions are made. This dependency also exposes the business to unforeseen breakdowns when applications or new technologies are fielded prematurely, which can devastate an Enterprise's reputation, and bottom line.

The greatest challenge to business in this modern age of information technology is managing this asset in such a way as to improve its business operations by streamlining how business transactions are executed, tracked, and managed. Business process integration suggests that all of an Enterprise's business processes should be integrated so that every facet of the business, from production, sales, accounting, billing, and operations have access to each business transaction.

The approach of having standalone S/W applications supporting a single business function, such as accounting, can no longer be tolerated. The effectiveness of the Enterprise is dependent on "just-in-time information", where providing products and services to its customers is viewed within the Enterprise as a single, elongated thread through the array of integrated business processes via internal and external data networks.

Making the transition from standalone S/W applications to an integrated information technology infrastructure, supporting the full range of business processes, is the challenge which will be addressed by this paper. We will describe the overall approach to applying systems engineering practices to this problem, and establish the layered business process modeling paradigm which is being used to adequately model the "end-to-end" testing of the information technology infrastructure supporting the "business integration testing" concept. Finally, the paper will discuss how this Enterprise process-based model will be employed to support the "end-to-end" validation process and will become an integral element of the automated test environment.

APPLYING SE PRACTICES TO BUSINESS PROCESS RE-ENGINEERING

The basic principles of systems engineering establish that a "system" be viewed from three key perspectives:

1. Requirements baselines
2. Functional architectures, and
3. Physical architectures.

It is not difficult to recognize that a business process is essentially a "system" in that it should be viewed from these three perspectives. The subtle difference between a "process" and a "system" is in the perspective of the user. Most processes are viewed in terms of how a process is executed, the sequential steps, critical decision branches, and data flows, which represent how a service is provided. Underlying today's business processes is an information technology-based "system" composed of the following elements:

1. computational platforms and networks,
2. S/W applications, and
3. people (customers and enterprise personnel involved in the execution of a business process)

Figure 1 identifies the three key elements of the IT-based system that must be addressed by any business re-engineering effort. Therefore, business processes can be modeled by capturing the IT-based system, and from each of the three systems engineering perspectives.

By expanding the elements in Figure 1 to address the business and validation perspectives, we can produce Figure 2. This figure depicts elements, which must be managed to adequately re-engineer and model any business process.

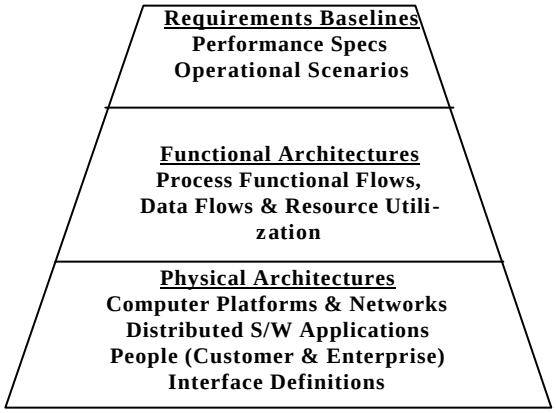

Figure 1: Elements of an IT-Based System

Ultimately, the aspects of business process re-engineering depicted in Figure 2 will be seen as central reasons for establishing a model-based representation of how the Enterprise functions. If a business wishes to improve how it provides a particular product or service, it must start by analyzing the existing "as-is" process, in terms of the three systems engineering views.

As approaches for process improvement are identified, the models may be changed to assess the impact of the proposed changes at the top level - in terms of how the proposed process specification would improve the products or services provided to its customers. If adopted, the new process specifications can be generated from the models, and the operational procedures can be generated for executing the refined process.

The functional architecture, representing the S/W architecture, can also be modeled to identify the new functionality required in the S/W applications, and the

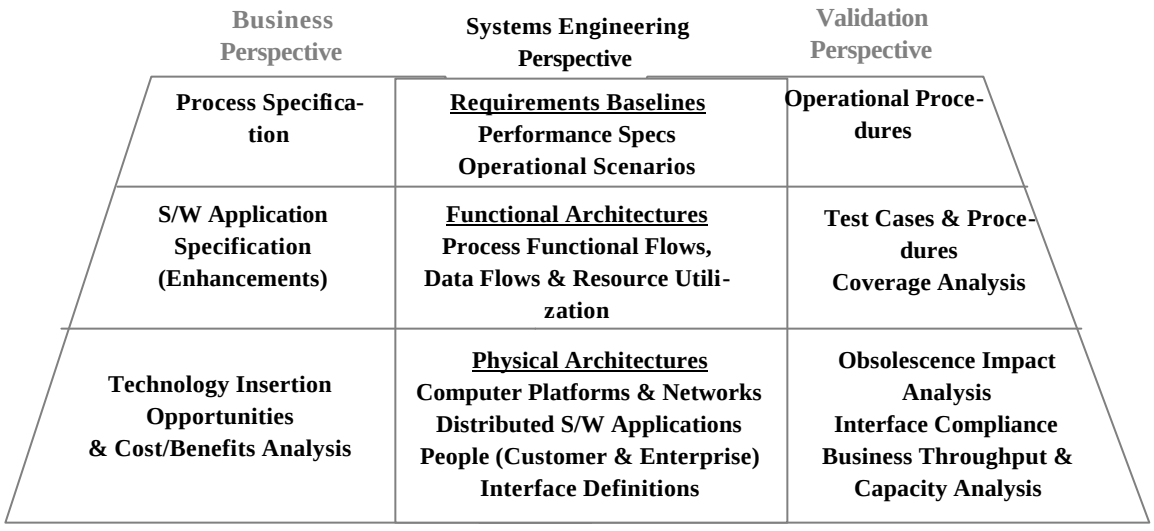

Figure 2: Elements of Business Process Re-engineering

new data required to support the data processing. From these models the S/W application specifications for enhanced functionality can be generated from the models. In addition, the specific conditions for executing test cases can be specified, and test cases and test procedures can be produced to support the validation testing of delivered applications.

Test coverage analysis can be supported via analysis of the test cases to determine which functions are being exercised to ensure that the proper set of test cases is being used to validate the business process once it is implemented.

The physical architecture represents the networks, computer platforms, and people involved in executing the business process. New technologies can be evaluated to determine the cost/benefit of technology insertion opportunities. Business throughput and capacity analysis can be assessed to ensure that investments in new technologies are justified given assumed return-on-investment (ROI) and the contribution of enhancements to achieving business objectives.

To date, we have developed a set of stand-alone models for the following elements of the customer's S/W applications, IT Infrastructure, and validation testing approach:

- **An integrated application model**, a functional model of the S/W applications including data flows,
- **An IT platform model**, a physical model of the networked computational platforms supporting the "Business Integrated Testing" validation process,
- **An allocated application model**, the allocated functional model of IT Applications to the physical model of IT platforms where the applications/functions are executed,
- **An end-to-end business transaction scenario**, a complete model of a single business transaction through the alternative paths by which a transaction can be processed,
- **A business integrated testing validation model,** a model of the "Production Validation" process depicting the testing process for each new "Production Load", and
- **An automated test tool functional model,** a model of the validation functions supported by automated test tools.

The intent of this exercise is to produce an executable model in CORE® that can be used to support future "production load" validation efforts. A complete, integrated model is desired which will provide the following capabilities:

- **Change impact analysis**, identification of which business processes and downstream applications/functions may be impacted by a proposed change,
- **Test case development,** automated test case identification and documentation,
- **Test procedures development,** automated test procedure identification and documentation, and
- **Test coverage analysis**, automated analysis of test coverage for a given set of test cases.

FUTURE DIRECTIONS

Once a single integrated model in CORE® is available, this integrated model of Enterprise business processes will provide the following benefits:

1. The ability to assess the impact of proposed changes to business processes, and providing a basis for making insightful decisions on which changes (functionality and technology) offer the best ROI for the Enterprise to invest in, in terms of:
   a. Procedural changes to business processes,
   b. S/W application releases (new functionality, enhancements, and bug-fixes), and
   c. New hardware technologies and equipment.
2. The ability to specify process enhancement, including procedural, S/W application functionality and performance, and hardware/equipment performance.
3. The ability to identify the necessary validation test cases and procedures required to ensure the "production load" is ready to field, including the following:
   a. Test case definition and documentation, to identify the minimum number of test cases necessary to adequately validate each production load, including regression testing,
   b. Test procedure definition and documentation, to identify the pre-test set-up (including automated test tool script definition), test initiation, data capture and analysis techniques, success criteria, and expected outcomes.
   c. Validation test resource utilization, to identify the computational platforms, applications, automated test tools, equipment, test operators, and databases required to support each test case.

CONCLUSIONS

This paper has identified an approach that applies systems engineering practices to business process re-engineering. It establishes a foundation for business process re-engineering where a process is modeled in terms of the key views of systems engineering: 1) requirements baselines, 2) functional architectures, and 3) physical architectures.

It suggests that processes that support Enterprise achievement of business objectives are accomplished by "systems" composed of operating procedures, people, hardware, and S/W components. Improving the effectiveness of business processes is best accomplished by re-engineering the "system" which supports the business process. Thus, many of the principals of systems engineering are directly applicable to business process re-engineering.

Finally, by suggesting that an integrated, executable model of the "system" which performs a business process can be invaluable in supporting process evolution. This model can be evaluated to:

1. Assess the impact of proposed changes and determine the contribution of proposed process changes in terms of return-on-investment,
2. Provide a basis for specifying a process change/enhancement,
3. Provide a basis for identifying the validation test cases/procedures for ensuring the "production" readiness of a modified "system" supporting a business process.

While systems engineering has accepted for some time that its "process" is a generic, problem solving process, this paper has demonstrated how a business process should be viewed as a "system", and how systems engineering practices can be applied to support the evolution of business processes.

Whether the community involved in business process re-engineering is ready to accept this fact is a matter of how well the systems engineering community can market and communicate how systems engineering can best satisfy business objectives when applied to process re-engineering.

The author has put this paper forth to initiate the discussion within the Systems engineering community. It is hoped that other members of the community can accept the conclusions derived, and are willing to explore the concept of applying systems engineering practices to business process re-engineering efforts.

BIOGRAPHY

Richard F. Schmidt, (rschmidt@vtcorp.com) has over 22 years of experience in systems and S/W engineering in the aerospace community. While serving the Air Force Systems Command, he chaired a Joint Service Working Group which produced Revision A of DoD-STD-2167, Defense Systems S/W Development, and DOD-STD-2168, Defense Systems S/W Quality Program.

Richard continued his involvement in standards by chairing the IEEE Working Group on Systems Engineering Management, responsible for the publication of *IEEE 1220, The Application and Management of the Systems Engineering Process.*

Richard is currently the Director of Marketing for Vitech Corporation, the providers of CORE. Richard has also worked for CASE Tool vendors including Rational S/W, and Ascent Logic Corporation.