Editor
Bel G. Raggad, Ph.D.
Pace University, NY

Associate Editors
Abdur Choudhary, Ph.D.
Bell Labs, NJ

Kamal Jedidi, Ph.D.
Columbia University, NY

Charles Tappert, Ph.D.
Pace University, NY

David Sachs, Ed.D.
Pace University, NY

Journal of e-Business and Information Technology is published twice a year by both Pace University, New York, and the American Institute of Management and Information Technology, Delaware.

Subscription Fees (see form in announcements):
- Individual membership: $32.00 per year, U.S.A.
  $42.00 per year, International
- Library subscription: $120.00 per year, U.S.A.
  $140.00 per year, International

Please direct all subscription inquiries, address changes, and other business correspondences to:

Journal of e-Business and Information Technology
School of Computer Science and Information Systems
186 Bedford Road
Pleasantville, New York 10570

Claims for missing issues will be honored free of charge within three months after the publication of the issues.

© 2000 by The AIMIT Group

AIMIT shall obtain the copyright for all Journal of e-Business and Information Technology’ articles except for those of the public domain.
A Management Guide to Data Warehousing
Hassine Saidane, Ph.D., Lucent Technologies ........................................ 05

Business Value Creation: How Do Aligned Firms Organize IT for Value?
Thomas F. Brier, IBM Advanced Business Institute ................................. 31

SCR Control for Large DSS: Base vs. Delay Costs
Nazar Younes, Ouman University
M..S. Gouider, ISG de Tunis
M. Zaghdoud, ENSI de Tunis ................................................................. 44

Impact of Strategic HRM Practices on Corporate Financial Performance
Morsheda T. Hassan, Louisiana Tech University ..................................... 61

Announcements ......................................................................................... 75
From the Editor-in-Chief

The Journal of e-Business and Information Technology is a semiannual international journal which aims to publish articles of high quality dealing with how online business technologies relate to the information technology, addressing various e-business forms and their evolution, and covering all aspects of IT, particularly those touching the Internet.

Even though most online business technologies, attracted only large businesses and banks in the past, due to the high costs involved, the rapid development of the Internet made it feasible for individual consumers and small businesses to participate.

Today, every business in the global marketplace is certainly affected by the Internet, and business technologies on it. Popular information technologies used for online business include 1) the traditional EDI which employs private telecommunication lines and value-added networks, 2) the Internet EDI (I-EDI), and 3) electronic commerce (e-commerce). More e-business configurations are arriving every day …

Owners are however faced with the real challenge of creating business value in e-business and redefining the new requirements and directions for survival or success in this new online business environment. Owners do not hide the fact that information technology, EDI, and e-commerce have become not only necessary for success, but a fundamental requisite for survival.

It is e-business if you fail and e-business if you thrive…

With its exceptional preeminence, the Internet embraces almost the whole field of business and touches at some point or other, on almost every social issue of our time.

Let us have this forum where we all learn how to design, develop, and exploit IT to plan business value in e-business.

Belraggad

Bel Gacem Raggad, Ph.D.
Editor In-Chief
A Management Guide to Data Warehousing

Hassine Saidane*, Ph.D., Lucent Technologies, NJ

Abstract

The article provides a brief introduction to the Data Warehousing tools that several corporate Information Systems are adopting. This management guide for the Data Warehousing tools offers easy steps that can lead to significant gains in productivity and remarkable competitive advantages through this powerful business intelligence technology. The article also provides design support of an integrated Data Warehouse environment where significant improvements in business analysis and decision support may be achieved. The Lucent’s “Take Share” and “Staying Ahead of the Curve” strategies are used to demonstrate what similar corporations can accomplish through successful implementations of the Data Warehousing tools.

Introduction

The purpose of this article is to provide non-technical business and IT management and staff with a brief introduction to the Data Warehousing tools that several corporate Information Systems are fast migrating to. An integrated Data Warehouse is believed to bring significant improvements in business analysis and decision support often needed for Lucent’s “Take Share” and “Staying Ahead of the Curve” strategies. It is reported that 90% of large corporations are engaged in this massive migration. Successful implementations have resulted in significant gains in productivity and remarkable competitive advantages through this powerful business intelligence technology.

For example, Harris Corporation’s “Mission Critical” Data Warehouse provides an early warning system that automatically alerts its production engineers and planners around the world about potential problems which are then quickly resolved, resulting in large reductions in material and labor wastage. The French railroad company SNCF has realized significant revenue improvements through effective market and yield management using the new tools of the “Enterprise Information Factory” and associated powerful automatic decision support and business analysis tools.

Other companies reported to have implemented this business intelligence technology to their competitive advantage include American Express, British Telecom, Good Year, MCI, Kmart, and Siemens.

These success stories should motivate business and CIO managers to promptly start the planning and implementation of this productivity tool in order to sustain Lucent’s “Stay Ahead of the Curve” and “Take Share” strategies.

The content of this article is structured as follows: In the second section 2, the definition and need for Data Warehousing is discussed and contrasted with those of Operational Databases, along with their respective main attributes and benefits. Elements of a Data Warehouse data architecture and prototype data model are presented in the third
section. The fourth section presents extensive arguments in the form of a presentation that can be used by the champions of a Data Warehouse project as an internal sales tool to jump-start a migration to a DW environment. In the fifth section, a practical method for developing the Data Warehouse Vision is presented. A seven-step methodology for Data Warehouse Return on Investment (ROI) analysis is given in the final section.

**Data Warehouses and Operational Databases**

The Conspectus Data Warehousing Glossary reports that a Data Warehouse is a pragmatic response to a business management need. That need is stated simply, over and over by the often-asked question that begs effective answers to how a firm can use its computers to manage its business better. Specifically, managers are always seeking ways that enable a firm to reduce costs, and more especially increase revenues, by making sure its executives and middle managers can easily get access to the rapidly growing stores of information in their companies’ databases.

While it has greatly helped the development and implementation of large transactional and operational databases, the Relational Database revolution could not provide efficient solutions to meet these critical needs. This situation got worse under a number of diverse pressures increasingly exerted by the complex forces of today’s global market place. These included pressures to make business more proficient and more profitable than ever, coupled with pressures from new marketing and manufacturing techniques. These pressures required knowing what data is available and where the data is, and additionally what more can be done with it which meant that management need more and more information, and need it now! Such an urgent need helped create the new Data Warehousing Information Technology. In order to effectively meet these critical demands a Data Warehouse solution is designed to be (Kimbal, 1996):

- A place where people can access corporate or organizational data, immediately, on demand, with high performance, directly, not through another unreliable or slow intermediary.

- A Decision Support and Business Analysis Delivery Vehicle that integrates data across disparate legacy systems, and a tool used to bridge the vertical silos and integrate the information that each holds into more synergetic and meaningful ways.

- A “subject-oriented”, integrated, time-variant, non-volatile collection of data in support of management decision-making processes”, as defined by Bill Inmon, the father of data warehousing. Subject-orientation implies that the data is organized by subject or entity (e.g. customer) not by application (e.g. sales or stock control). Integration requires that the data be held in one place and in a consistent form. Time-variance demands that the data is not only current (as it is on an operational database) but is historic and time-stamped as such. Non-volatility requires that the data, once stored in the warehouse, does not change and is not updated as it would be if held on an operational database.
• Never complete in that it evolves over time driven by needs through its use, which dictates addition of data elements, integration of additional sources of functions, and/or inclusion of additional users.

The Different Worlds of Transactional Data Bases and Data Warehouses

Data processing involves the two basic operations of data input and data output. So far, these operations have required the need to think separately about putting the data in (transaction) and getting the data out (reporting and analysis) as each implies a different way to store data, i.e. a different data model that is most efficient for the operation.

Transactional/Operational Databases are concerned mainly with getting data in rather than getting data out. The best data model for On Line Transaction Processing purpose of these systems is the Relational Model which is based on complex data dependencies and multiple data relationships. The attraction of the relational databases stems from their ability to offer a much more flexible access through their data dependencies. It was hoped that relational data models would be able to unlock corporate information bottlenecks, but turned out to be useful mostly for dynamic rather than static environments. Moreover, data these dependency models in relational databases give a false sense of security when assuming that if it is detailed, it must be good.

An alternative data model is the dimensional data model, which represents data as multidimensional entities called matrices or cubes. Both relational and dimensional data models are capable of storing exactly the same data, and supporting the same final business analyses. Although the multidimensional model was found to be very inefficient for Operational and Online Transactional databases, it provides the ability to easily visualize data (as a cube) and access it much faster. The attraction of the dimensional model is its simplicity, which allows understanding of databases, while enabling software to navigate them efficiently. Such a coherent design serves well the needs of a Data Warehousing.

With Operational/OLTP databases users turn the wheels of the organization by dealing with one account at a time (Berry and Linoff, 1999; Groth, 1999). The primary function is data entry involving the same task, many times. Performance is critical, in that no slowing down of the system (through optional activities like reporting) is allowed. Reports involve mostly the preparation of listings of entire tables. Performance and reliability are critical since if the OLTP stops, the company stops!

In contrast, Data Warehouse users watch the wheels of the organization, never dealing with one account at a time. They ask for a page or two of summaries requiring hundreds or thousands of records to be researched and compressed into a small answer set, continuously changing the questions they ask. The template of requests may be the same from query to query, but the impact on the DW may be widely different, from fetching hundreds of records to fetching millions of records. Performance has a different character. Small single table queries called browses need to be instantaneous. Large multiple queries called join queries are expected to run in seconds or at most in minutes. Reporting is not only the primary activity; in some ways, it is the only activity. DW users consume information in human-size chunks of one or two pages. The ideal report is a
single page top line summary shown on the screen with a few of the numbers blinking in boldface. Users can touch any blinking number to ask why. A new page containing the numbers that make the blinking bold item is then instantly provided.

Significant and highly variable resource demands on the DW, the need for not slowing down the OLTP system, which Data Warehousing tends to do, and a different system configuration, make it necessary to implement a DW on a machine separate from OLTP systems (Adamson and Venerable, 1998; Berry and Linoff, 1999; Groth, 1999).

In an OLTP environment, the system is constantly being changed, and relationships between business entities are constantly being altered. This kind of database is called the “Twinkling Database”. This continuous change is not allowable for querying and reporting since it results in different answers for consecutive queries. Thus it is not possible to do reporting queries on a live twinkling database.

By contrast, a data warehouse is composed of a discrete time-dependent series of snapshots. Twinkling in the Data Warehouse is not allowed in order to represent all points in time correctly. Snapshots, which are called production data extracts, are migrated to the DW at the same time for every period (day, week, month, etc.).

Given these conflicting purposes, the OLTP and OLAP environments are profoundly different in data structures, users, hardware, software, administration, management, and daily rhythms. These differences still resist reconciliation. Table 1 depicts the main differences between these two worlds.

<table>
<thead>
<tr>
<th>Operational Attributes</th>
<th>Operational Data Base</th>
<th>Data Warehouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Organization</td>
<td>Entity Relation. Overly complex schemas</td>
<td>Multidimensional entity. Simplicity of data structure</td>
</tr>
<tr>
<td>Activities</td>
<td>Thousands of Transactions/day</td>
<td>One transaction/day, thousands of records</td>
</tr>
<tr>
<td>Dynamics</td>
<td>Constantly changing. No record of history Support</td>
<td>Historic, relatively static time series</td>
</tr>
<tr>
<td>Data Consistency</td>
<td>Record every transaction</td>
<td>Consistent: same data within a time period</td>
</tr>
<tr>
<td>Main Function</td>
<td>OLTP</td>
<td>OLAP</td>
</tr>
</tbody>
</table>
Main Requirements and Attributes of a Data Warehouse

A Data Warehouse is thus a relatively static or slowly changing database. Every Data Warehouse holds a time series of regular snapshots updated at discrete time intervals. The functions of a DW involve three main activities: Data Acquisition, Data Storage, and Data Access meeting the following main requirements (Kimbal, 1996; Kimbal, et al., 1998):

• The DW is a place to publish “used” (historical) data. Its main responsibility is to publish data, which is not accumulated at a central point and let loose. Data is carefully assembled from a variety of sources, cleaned up, quality-assured, and released only if it is fit to use.

• The data in the DW is consistent: same value, same meaning. The DW provides warning about incomplete data.

• The DW provides easy Access to Corporate or Organizational Data. Connection to data must be immediate, on demand, and with high performance.

• Data in a DW can be separated and combined (sliced and diced) by every possible business dimension.

• Tools are provided for managers’ and analysts’ easy use.

• Queries happen in less than a second.

• The quality (or lack of it) in the DW is a driver of business reengineering.

Good data plays a crucial role in Business Reengineering. For example, to fix poor quality service or product, one needs reliable quality data in the DW. Therefore a Data Quality Assurance Manager whose job is daily data quality assurance and data publishing is needed.

Main Benefits of a Data Warehouse

The main benefits reported to be gained from a Data Warehouse’s “data at your fingertips” are listed below (Kimbal, 1996; Kimbal, et al., 1998, Kimbal et al., 2000):

• Getting Decisions made quicker

• Providing business intelligence: Making business decisions on facts not intuition
• Improving customer service (inventory, competitors, customer satisfaction, fast delivery, etc.)

• Controlling corporate data and assuring better use of it for long term enterprise planning and modeling

• Allowing cross-organization communication and bringing different business organizations closer together

• Facilitating change in organizational and business processes.

**DW Architecture and Prototype Data Model**

**Elements of a DW Architecture**

A typical Data Warehouse architecture is composed of the following elements that should be identified and carefully planned for a successful and efficient data Warehouse implementation project:

1. DW vision or mission

2. End users and their organizations (list and numbers)

3. Business Subject Areas and Applications

4. Data Sources

5. Application Data Bases and their integration

6. Data Content:
   • Data Elements (dimension, facts, granularity, data summaries)
   • Updates, keeps and purges

7. Data schemas (multi-dimensional or relational)

8. Data Base Management Systems

9. Hardware platform and structure (centralized or distributed)

10. Staging platform

11. Network platform

12. Tools:
   • Extraction, cleansing/transformation, loading
• Reporting & analysis tools (basic query, reporting, analysis, data mining, EIS, data visualization)
• Meta Data (data about data: description of content of data) and repository
• Delivery systems

13. Server operating systems

14. Operating system implementations (Unix, Windows/NT, etc.)

15. Administration and management.

Data Warehouse Structural Components

Data Warehouse structural components define the typical resource needs at the different levels listed below:

A. Three major activity (vertical) components:

1. Acquisition: extraction of data from a variety of legacy systems; cleansing; validation; formatting and staging for loading in the DW

2. Storage Component: collection of data base tables

3. Access Component: Tools for analysis, query, visualization; mining

B. Four main infrastructural (horizontal) components:

1. Computer hardware to host acquisition, storage and access components

2. Network configuration to tie the system to legacy systems, acquisition end and end users

3. Operating System (OS) and Network Operating system (NOS)

4. System level utilities

C. Five operational (longitudinal) components:

1. Support staff that keep the DW running

2. Roles, responsibilities, and procedures to manage the DW
3. Management structure that keeps all the parts of the DW working and communicating with each other, and support the operation of the DW

4. Customized software for tracking inventory and progress of the data through the different components

5. Feedback mechanisms to send data back to the legacy systems

**A Prototype Multidimensional Data Base for Data Warehousing**

As discussed earlier, the multidimensional data model sometimes referred to as star-join schema is found to be most efficient for data warehousing since it provides the fastest response to queries, reports and analyses. This model consists of two types of tables. A single very large dominant table in the center, called “the Fact Table” is the only table with multiple joins. The other tables, called the Dimension Tables, have only a single join attaching them to the central table. Dimension tables describe the different business dimensions and associated attributes. Facts are generated from transactions involving the different business dimensions. The chart produced, in Figure 1, shows a prototype multidimensional data model generally used for data warehousing.

**Transaction Fact Tables and Business Dimensions**

**Fact Tables:**

These are tables where numerical measurements or records (units, dollars, etc.) of the business are stored. Each measurement is taken at the intersection of some business dimensions (e.g. for a product, market segment, and time period). The “best facts” are those measured in the market place. They are numeric, continuously valued and additive thus ideal for compression of millions of records into a few rows to construct answer sets to users’ queries. The continuity attribute of the value helps distinguish a fact from a dimensional numeric attribute (e.g. dollar facts vs. invoice number). Additionally, there are semi-additive (additive only along some dimensions) and non-additive facts. For non-additive facts, counts are used to summarize the records; otherwise, records can be printed out a few at a time since they can be too many to be of use. Most fact tables are extremely sparse as nothing is recorded so that cells are not filled with zeros when nothing happens (e.g. there is no sale) during a time period.

**Dimension Tables:**

Textual descriptions of the dimensions of the business are stored in “Dimension Tables”. Each description helps define a member of a given dimension. For example, each record in the product dimension represents a specific product.
A dimension table has many attributes. Dimension attributes play the role of describing one of the items in a dimension and are most useful in text form. The best attributes are textual, discrete, and are used as source of query constraints and/or row headers in users’ answer sets. Typical attributes for a product include brand name, category name, packaging type and size. Attributes are representation use both a short description and a long description. Numeric attributes such as size in a textual description behave more like textual descriptions rather than numeric measurements.

**Distinction between Fact and Attribute in a Numeric Data Field:**

Facts vary continuously at each sampling while attributes, which are discretely valued descriptions of entities, are more or less constant. When it is hard to classify a numeric value as either fact or attribute, an arbitrary call is made.

**Roles of Dimensions and Facts**

Dimensions and Facts play different but important roles in a Data warehouse operations as defined below. A dimension is an independent entity in the model of an organization that serves as an entry point, or as a mechanism for slicing the additive measurements of an organization. Dimension table attributes play a vital role in a DW as they are the source of virtually all interesting constraints, and the source of all row headers in users’ answer sets. Fact tables expresses a many-to-many relationship while other tables are dimension tables.

**Importance of dimension attributes:**

Dimension attributes are critical to building better Data Warehouses. The key to achieving this goal is to spend enough time:

- Providing textual descriptions of attributes.
- Filling out the values in an attribute field.
- Quality assuring the values in attribute fields.

**Facts and Dimensions Types**

The sources of all facts are business transactions and business events. These include events related to production, purchasing, sales, contracts, shipping, delivery, and receipt. Transactions are incurred for a variety of business
dimensions such as time, product, plant, warehouse, customer team, customer, and vendor. Facts are measurements or observations on dimension attributes. The following are examples of dimension attributes are:

- **Production Events**: Bills of Materials, Production Warehousing, Work in progress (semi-finished goods) and Finished goods.
- **Purchasing Events**: Orders, Receiving, Warehousing/Inventoring, and Distribution.
- **Sales Events**: Customer Orders, Invoicing/Billing, Ship from, Ship to.
- **Delivery Events**: Transportation, Installation, and Maintenance.

---

**Figure 1: Chart of a DW Data Model Prototype**

**Efficiency of Data Warehousing in Data Management**

The growth of independent efficient systems created the need for sharing information between systems. However, improved integration efficiency creates dependency between systems at the high cost of developing several links numbering \( n(n-1) \) when \( n \) independent systems are present. Updates of the interfaces are needed every time a change in the system occurs. The cost of such updates becomes significantly higher as the number of systems increases, so that eventually system changes become
highly unaffordable. The Data Warehouse solution offers relief by developing new systems that pull their information from the warehouse and by developing feedback mechanisms into those applications. In a DW environment the number of system interdependency is greatly reduced from \( n(n-1) \) to \( 2n \), for \( n \) independent systems. For example, the number of interfaces for a 100-system environment can be reduced from 9, 900 to 200! The reason is that the DW environment greatly simplifies the overall architecture of the total system at a fundamental level as depicted in Figure 2.

![Figure 2: Efficiency of Data Warehousing in Data Management](image)

Arguments in Support of Data Warehousing

Data vs. Information

- **Data Overload**

  Organizations are swamped with data that is hard to access or use. Traditional DP centers often provide several feet high reports from which management can’t decipher any information or intelligence to run the business.

- **Chaotic Growth of Legacy and Stand-alone Systems**
Corporate data resources are often scattered in many different places, and not many know what it is. Corporations are now desperate to get control of their data.

- **Growth and Complexity of Information Needs**

  In today’s globally competitive market place, management needs for sophisticated and timely business information and complex analyses are steadily growing and are nowhere to be met.

- **Long Turnaround of Management Information Requests**

  The usual high turnaround of data requests cannot be tolerated. Management needs the intelligence now, and cannot wait months, weeks or even days to get it.

- **Inability to Meet Complex Needs**

  The dispersed structure of DP legacy systems is unable to meet the needs of the fast changing business dynamics, which call for complex analyses in order to provide the business intelligence required by complex and critical decisions.

**Productivity Pressures**

- **Pressure to Know What Data and Where for Timely and Easy Access**

  Increasing pressures to know what data is available, where it is located, and how it can be accessed easily and on demand are emanating from today’s global competitive forces.

- **Pressure to Limit Costly Growth of Application Silos**

  Unconstrained and costly growth of independent business applications can no longer be tolerated under the cost busting pressures of fierce competitive forces. Example: the “Billing Interval” initiative should be a matter of just a system query, instead of a six-month-effort.

- **Pressure to Do More with Data**

  Tremendous pressures to do more with data are experienced daily. New approaches to marketing, JIT manufacturing techniques and sophisticated data mining methods are increasingly in demand in order to provide higher levels of business intelligence required by strategic decisions.
• Pressure to Be More Competitive

Today’s global competitive forces are exerting tremendous pressures on the survival of today’s globally interconnected and interdependent market places. The fast changing business environment demands instant intelligence now, not in months or years.

Data Warehousing to the Rescue

• Data Warehousing, the Only Viable Solution

Instead of continually reengineering existing systems at exorbitantly increasing costs, a Data Warehouse offers a more cost effective and more efficient solution to the information and business intelligence crisis.

• Huge Warehouse for “used” Data

One of the major roles for a DW is that of a huge warehouse for used or historical data, i.e. data that is not the current or latest transactional data on corporate business activities.

• Integrator of Legacy Systems and Data Repository for Easy OLAP

A DW is thus a large repository that integrates data from all legacy systems. Data is cleansed, checked for consistency and accuracy before being loaded into the DW. The DW provides easy access to quality data on diverse business aspects, thus making fast On Line Analytic Processing possible.

• Business Intelligence Delivery Vehicle

The DW is also equipped with powerful OLAP and data mining tools capable of delivering higher levels of business intelligence never experienced before the advent of the DW Technology.

Attributes of a Data Warehouse

• Snapshots of Business Activities at regular Time Intervals

The DW data consists of snapshots of business activities or business events taken at regular time intervals, e.g. each day, week or month, thus providing a time series of business states for discrete time periods. No changes in the data are recorded between time periods so that consistent information is published and used throughout the company.
• **Quality Data at Management’s Fingertips**

Data is checked for consistency and accuracy (scrubbed & transformed) before getting loaded in the DW. This combined with corporate-wide consistency of the data during processing and analysis provides instant access to high quality data.

• **Answers to Queries in Less than a Second**

Management ad-hoc queries on business issues are then possible to be produced instantly, instead of taking days and becoming useless (either too late or obsolete) in the process.

• **Data Slicing, Dicing and Drills**

The ever-growing management appetite for data slicing, dicing, and drilling down or across can now be quickly satisfied with the DW technology.

• **Powerful Tools for Complex Business Analyses and Decision Support**

The ultimate purpose of a DW is the timely provision of complex business analyses in support of critical business decisions dictated by the strong competitive forces of today’s global market place. Sophisticated business analysis and data mining tools constitute a major component of a DW designed to meet such critical needs.

**Data Warehousing Benefits**

Most of the benefits addressed below are discussed in more details in most of the data warehousing and data mining literature, in particular, Adamson and Venerable, 1998; Berry and Linoff, 1999; Groth, 1999; Kimbal, 1996; Kimbal, et al., 1998; and Kimbal et al., 2000.

• **Strategic Competitiveness**

Successful implementations of corporate-wide Data Warehouses were found to significantly increase the strategic competitiveness of most companies. Among the most significant benefits derived from the DW technology are the effective and timely production and use of critical business information. The accuracy and timeliness of the information is now providing powerful business intelligence that resulted in highly improved customer service relations and business opportunities.
• **Wholistic View of the Business**

Corporate Data warehouses are providing a comprehensive and accurate view of the entire business while enabling the management of the business at both the micro and macro levels.

• **Business Processes Re-engineering Opportunities**

In-depth information about a company’s performance in diverse aspects of the business have invariably uncovered opportunities for reengineering of business processes and operations in such areas as production, inventory management, billing, accounts receivable, and sales.

• **Incremental Revenue Growth Generation**

Other significant tangible benefits that resulted from the business intelligence and insights provided by the DW technology materialized in incremental revenue generation through market share increases, and through more effective and efficient marketing programs, and market segmentation.

• **IS Resource Productivity Improvements**

Among the most immediately noticeable and tangible benefits are the productivity gains made in Data Processing and Information Systems shops. As mentioned earlier, the DW technology enables instant access to a comprehensive data repository thus enabling extremely fast turnaround for management information requests and business analysis applications that used to take weeks or even months. This results in significant savings in DP personnel time and computer resources.

• **Management Productivity Improvement**

Fast production of reports, analyses, and business applications also impact beneficially business analysts and managers. Time savings from report generation, elimination of redundant work, and timely decisions are the major contributing factors to management productivity improvement.

• **Integration of Data Sources and Fast Application Development**

The integration of company-wide data in one place, the Data Warehouse, enables fast application development, thus greatly decreasing the turnaround times. Instant access to quality assured data offer DP personnel, business analysts
and managers great flexibility and efficient access and use of corporate data resources.

- **Hidden Benefits**

  Implementation of a corporate-wide integrated DW is also found to foster organizational empathy and increased cooperation and communication.

**Basic Business Intelligence Capabilities**

- **Basic Querying and Reporting**

  One of the most basic but useful business intelligence is to ask the DW to tell managers what happened in their business, and get instant answers.

- **Data Slicing, Dicing, Drilling Down and Across**

  Another mandatory feature is to address the DW to “tell more” details on what happened. This is provided by such DW functionalities that would “Slice and Dice” the data, “Drill Down and Across” the many business dimensions. Managers who waited for so long to own this capability can easily afford this dream tool now available in a DW environment.

- **Executive Information System Enabler**

  The ultimate executive tool is the realization of a fully functional and truly useful “Executive Information System”, which can now tell executives a lot more about the performance and state of their business without requiring hardly any computer operation or effort on their part.

**Advanced Business Intelligence Capabilities**

- **Know What May Happen**

  The ultimate objective of a corporate-wide DW is achieved through a data processing approach known as “Data Mining”. Data Mining tools provide robust answers to such management futuristic requests as “tell me what may happen” through powerful forecasting and trending tools.

- **Uncover Useful Insights and Hidden Trends**

  The large amounts of data in a corporate DW provide the opportunity for the use of new and powerful “Artificial Intelligence” tools that can “tell something interesting” that is happening in a manager’s business or industry
sector by uncovering hidden useful insights, and valuable hidden trends relationships.

- **Measure Effectiveness of Marketing Programs**

  Powerful analysis tools and the availability of large amounts of data now make it possible to readily analyze and evaluate the effectiveness and performance of current and alternative marketing programs.

- **Identify the Best Marketing Targets and Segments**

  The comprehensive business analysis environment offered by a corporate Data warehouse also makes it feasible to optimally select the best targets for marketing programs as well as the best way to segment the addressable markets in order to maximize revenues and increase or “take” market share.

- **Manage Customer retention and Life Cycle**

  The DW information technology can tackle the most evasive business issues of customer life cycle management and customer retention through new potential insights that are made easily and quickly available and accessible to decision makers.

- **Perform Complex “What-if” Scenario Analyses**

  The highly sought after “What-If” and “Scenario” analyses of complex business strategies are now made possible by the availability of large amounts of data and powerful new analysis tools provided by a corporate DW.

- **Provide Automatic early Warnings About Current or Potential Problems**

  Some of the successful implementations of DW technology provide automatic alerts to management in all corporate centers about actually occurring or potentially expected operations problems in production, inventory, or market position. These automatic alerts are highly valuable to management as control and problem prevention tools.

The Great Success Stories

- **Implementation in More than 90% of Large Corporations**

  DW technology watchers report that 90% of large corporation are implementing Data Warehousing projects. This is indicative of the wide acceptance of the technology, and a warning to the remaining companies about their eroding competitive edge.
• **Mission Critical: Strategic Tool for Competitive Advantage**

  Companies who made the DW technology implementation a “Mission Critical” are reaping great competitive advantages over their competitors, as they found data warehousing to be of significant strategic value.

• **Sample of Large Corporate Implementation**

  Among large corporation cited for having embraced and benefited from the DW technology include American Express, AT&T, BT, Good Year, Harris, Kmart, MCI, Siemens, and French SNCF.

**Now Is the Time for Good Start**

• **DW: Mission Critical**

  Given the urgency and the accumulated lag on the adoption of the strategic technology of Data warehousing, it is just about the time to get on the DW wagon to a good start. A corporate-wide DW implementation should be adopted now as “Mission Critical” for the “Take Share” and “Stay ahead of the Curve” strategies to be sustained.

• **Who, What and When**

  Now is the time to identify who will be the sponsor and champion of the effort, and which organizations and business areas will be included. Time is of the essence. There is an urgent need to start planning today. A plan outline should be produced ASAP.

• **Start Planning Now to Secure Resources**

  The required resources include funding (budget provisioning for ’99 and beyond), as well as the internal and external (outside consultants) that teams need to be identified quickly. Campaign team and effort are needed now in order to secure the necessary resources and launch the DW initiative as “Mission Critical”.

**The Data Warehouse Vision Development**

  An important aide to successful development of the “right” Data Warehouse is the mission for the Warehouse which should be elucidated through an agreed upon practical “Vision”. A Vision is an anticipation of what may or will come to be. It is therefore
critical that the developers, sponsors and users of a Data Warehouse have an accurate and shared vision of exactly what the warehouse is supposed to be, and what the system is going to look like at completion. Coupled with this shared vision is the need to get people to identify the focus, or central activities that the system should address since in the beginning of a DW project different organizations have different visions depending on their particular focus. In addition to focus, every vision has a scope involving either small applications or corporate-wide large applications. Furthermore, hard or soft visions result in hard or soft benefits, depending on an organization’s specificity or generality of the vision’s definition, and its development processes and culture.

**Different Types of Visions.**

Visions are stated in terms of varying degrees of scope, focus and hard or soft tangibility. It is important to clearly establish the kind of vision applicable to the Data Warehouse under consideration. For example, a strategic long-term corporate vision would involve a list of strategic initiatives such as:

- Improvement of operational efficiency
- Redesign of operational approaches
- Creation of new operational approaches

**Examples of Visions:**

**CEO corporate-level vision:**

I would like to see this warehouse make it possible for us to reduce our operating cost by x%. This is our number one priority. I am also looking for ways to increase our level of customer service while improving our current profit margin.

**Marketing manager- marketing-level vision:**

Our company is moving in the direction of one-to-one marketing. We want to have a personal relationship with each of our customer. To do that, we need to have access to all of the information that we can get our hands on about those customers. We have got the information. We have got the sales history, returns records, and credits ratings, but we can’t get at it. We need all of that information in the same place at the same time.

**MIS manager-IS vision:**

Our organization is currently suffering from a nine-month production backlog, and our users have had enough. I need a way to deliver these new types of data mining applications more quickly and at less cost than I am able to deliver anything today.
Production manager-production-level vision:

We need a system to help us track products as they move through our factory. Right now, we have dozens of systems, but none of them talk to each other. Somehow we need to integrate this information so that we can identify production problems faster and respond more quickly to changing market conditions.

Development of the appropriate vision

Steps of vision development:

Vision development typically requires the following activities:

- Collect visions from different advocates
- Analyze and understand the different visions
- Determine the real value and cost of the vision, whenever possible
- Decompose the collected visions into their least common denominator, i.e., break each vision into smaller, manageable pieces.

Vision decomposition Process

Vision decomposition is possible under any of the following dimension:

- **Organizational Decomposition:**

  Find the owner (department, roles, and responsibilities): Decompose the vision down into the pieces of the solution that belong to different organizational units or individuals. Figure out what each of these areas needs to do as their contribution to the ultimate solution. Continue breaking down along these organizational lines, all the way down to the individual person, if necessary.

- **Functional/process decomposition**: (steps in the process):

  Break down the big processes into smaller ones.

- **Financial decomposition**:

  Apply financial criteria to the analysis: How is money involved in the process, and how does it move from one part to the next.
• **Syntactic decomposition:**

Apply the verb and noun decomposition method. Write a description of the vision so that everything about it is clearly defined, then start to figure out where each of the verbs and nouns are in the sentences provided. Each verb and noun is fully decomposed or can be broken down into smaller verbs. When the verbs and nouns can no longer be broken down, the full population of discrete application candidates is isolated.

**Example: Noun decomposition for the definition of a DW vision**

**MIS Manager Vision:**

Our organization is suffering from a nine-month backlog, and our users have had enough. I need a way to deliver these new types of data mining applications much faster and for considerably less cost than I am able to deliver anything today.

<table>
<thead>
<tr>
<th>Noun</th>
<th>Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>Marketing, accounts payable, and management</td>
</tr>
<tr>
<td>Production Backlog</td>
<td>Marketing &amp; production control applications</td>
</tr>
<tr>
<td>Users</td>
<td>Marketing users</td>
</tr>
<tr>
<td>Data mining products</td>
<td>SAS, SPSS, Neural Nets</td>
</tr>
</tbody>
</table>

Note that the marketing department shows up three times. It might be beneficial to go back to the marketing department to determine what is really needed.

When the decomposition process is completed the end result is no longer a collection of unrelated visions, but is now a list of candidate warehouse applications.

**Verifying the decomposition**

After applying the decomposition that makes the most sense, verify that the decomposition still makes sense. For this, apply the following criteria:

- Does the application make sense as an autonomous project?
- Will it involve aspects of acquisition, storage and access?
- Do the candidate applications make sense from a business perspective?
If necessary, interviewed people are consulted again to validate the accuracy of understanding of the original problem and related breakdown.

**Rejection Criteria**

Develop a list of rejected candidates using the following reasons:

- The application is an independent project, not a DW application.
- The candidate application will cost more than the value it will bring

**A Seven-Step ROI Analysis for DW Projects**

The seven steps addressed below are discussed in more details in Informatica, 1999.

**Review of Main DW Uses and Benefits**

In order to perform an adequate “Return On Investment” (ROI) analysis of a Data Warehousing project, the following general DW uses and benefits need to be remembered:

**Data Warehouse uses:**

- Locating the right information
- Presentation of information
- Testing of hypotheses
- Discovery of information
- Sharing the analysis

**Main Benefits of a DW**

- Analyses and reports never before accessible
- Management information is more robust
- Better informed executive decisions
- Strategic competitive advantage through effective information analysis

**ROI Modeling**

ROI is the traditional measure of corporate resource value. It thus can be used to supply a fundamental evaluation and cost-justification framework for a DW project. Such an evaluation encourages and mandates advance planning among concerned parties by clarifying expected benefits and bringing about agreement on these benefits which to help set realistic expectations on the benefits.
Limitations

A major shortcoming of ROI analysis is that it only allows quantifiable elements and values to be taken into account. Far reaching strategic benefits (gaining better, faster access to customer information, making better informed business decisions) cannot be factored in ROI. Intangible benefits and potential risks should nevertheless be identified and qualitatively used in conjunction with quantitative ROI results in order to appropriately evaluate the merits of a DW project.

General Approach

The general approach used in ROI studies includes the following steps:

- Develop a multi-year (five-year) development map
- Maintain dialog between constituencies concerned through new information from development map, and ROI modeling effort
- Manage the interplay between costs, benefits and risks
- Determine which qualitative strategic benefits are important, and assign value to them whenever possible.

Benefit Analysis Process

The benefit analysis process entails the identification of tangible and intangible benefit elements. A sample list of these elements is given below:

Sample of Tangible Benefits:

- Administrative time and cost savings
- Improved reports response time
- Reduced number of paper reports
- Reduced inventories
- Reduced billing cycle
- Increased market share from cross selling
- Reduced overstock and stock-out
- Improved inventory turnover
- Flexible and quality market analysis that eliminates or enhances market programs
- Enhanced asset/liability management
- Reduced operating costs

Sample of Intangibles Benefits:

- Lighter data management burdens for non-DP personnel
- Reduced MIS production backlog
- Improved productivity (single data location, no data re-keying)
• Timely information for timely decisions
• Reduced redundant processing, support, software and overlapping decision support applications
• Faster access to customer records for cross selling
• Improved customer service
• Strategic value (this should be the primary driving force)
• Enabling more effective decisions
• Managing total customer relationship/opportunity
• Creating value adds for customers
• Building organizational empathy
• Reacting quickly to volatile controls and opportunities
• Managing both the macro and the micro perspective
• Improving managerial ability
• Enabling business process engineering

The Seven Steps of ROI Analysis

The following seven steps are recommended for conducting a “running” ROI analysis which should be updated periodically in order to assess the validity of the project through its life cycle. The steps are self-evident and need to be performed in the order they appear on the list.

1. **Conduct a base line analysis (a “before” snapshot)**

2. **Prioritize benefits according to impact on real business goals**

3. **Define Overall cost (actual cost or percentages to estimate)**

   • Hardware: target DB server, PC upgrades and related hardware
   • Networks
   • DBMS
   • Back-end tools
   • Query/reporting tools for different groups: programmers; business analysts, product & sales managers, executives
   • Meta Data Repository (dedicated data base hardware and software)
   • Internal Labor: DB managers, project managers, programmers & other employees associated with the project
   • External Labor: outside consultants, systems integrators, contract programmers, and other non-employee help
   • Ongoing support: help desk and other forms of support
   • Training for programmers and end users
4. Calculate Net Present Of:
   - All project costs
   - All cost savings and incremental revenues

5. Assess Risk, Adjust Costs and Benefits

   Identify and evaluate project threats such as:
   - Budget or time overrun
   - Scope creep
   - Integration Complexity
   - Inappropriate architectural strategy (distributed dependent, vs. centralized independent) Management or end users withheld support
   - Reluctant managers and political problems (up-front realistic expectations, process for keeping managers engaged, and users informed through honest effective communications and regular dialog
   - Potential negative effects of the “garbage in/garbage out syndrome” through careful data definition and data cleansing
   - Technologies that don’t function as promised: carefully assess the performance of prospective vendors’ products; apply best case/worst case metrics
   - Sponsor’s strength
   - Animosity/Rivalry: inter-operational units, operational vs. systems organizations

6. Identify actions needed to counter risks (see list above)

7. Determine Overall ROI

   - Compute NPV (incremental revenues and cost savings) / NPV (Cost streams). Some Applications of ROI Analysis include: Build vs. Buy; Standalone Proof of Concept; and Independent vs. dependent DW growth.

Conclusion

The article presented a brief introduction to the Data Warehousing tools that several corporate Information Systems are adopting. The management guide for the Data Warehousing tools provided easy steps that can lead to significant gains in productivity and remarkable competitive advantages through this powerful business intelligence technology. The article also provided design support of an integrated Data Warehouse environment where significant improvements in business analysis and decision support may be achieved. The Lucent’s “Take Share” and “Staying Ahead of the Curve”
strategies were used to demonstrate what similar corporations can accomplish through successful implementations of the Data Warehousing tools.

References


* Dr. H. Saidane is currently working for NCR, San Diego, CA
Business Value Creation: How Do Aligned Firms Organize IT for Value?

Thomas F. Brier, IBM Advanced Business Institute, NY

Abstract

Business value creation is the ultimate measure of organizational success. While successfully aligned organizations can better structure themselves to be positioned to provide true value to the business of which they are a part, the choice of their IT organization can either accelerate the value creation or decelerate it.

So, is staying aligned sufficient to assure the true business value of an organization and are there accepted models for organizing IT so that business value creation can be maximized?

The article addresses business value creation in terms of the organization structure and its IT organization in two steps: first, a discussion of how companies can organize their IT; and second, how can these companies maintain or accelerate business value creation by staying successfully aligned.

Introduction

How do successfully aligned organizations structure themselves to be positioned to provide true value to the business of which they are a part? Is a "federal" model suitable? Is staying aligned sufficient to assure the true business value of an organization? As described by Charles Handy, the organizing principle of a small, central core with outlying connected units, all having a central allegiance, may fit the modern IT structure.

The article addresses business value creation in terms of the organization structure and its IT organization.

This article first provides a synthesis of several ideas for organizing IT, most of which have been proposed to seminar attendees at the IBM Advanced Business Institute in 1997-98. Surveys of these attendees reveal that the "federal IT" approach is the most desirable design philosophy for many Chief Information Officers in building their departments.

The article, in a second step, discusses how successfully aligned companies examine all of their capabilities, including IT, as potential levers for success when defining their business strategy. They concentrate on finding opportunities for IT to help in creating value for their customers. When IT projects are commissioned, everyone with a stake in the project and its outcomes works with the proper sense of urgency to insure completion within specified requirements.
Organizing IT for Value

For many years the department responsible for Information Technology (IT) support within a number of organizations has considered the question: "Should we centralize or decentralize our operation?" The answer depended on a variety of factors, all of which had to be weighed in order to assess the value that IT could provide to the business. Part of the discussion centered on the main role that IT fills. Is it primarily to support all of the business functions, or is there a true strategic role, aligned to the business strategy, that is filled by IT?

The Federal Organization

As Chief Information Officers (CIOs) build their organizations today, they may gain insight from the concept of a "federal" structure, proposed by Charles Handy. In his view, federalism implies a variety of groups allied together under a "common flag" with some shared identity. This format combines autonomy with cooperation. Any power held at the center of the structure is given by the outlying groups. The center does not direct or control, but rather advises and coordinates. In this model, decentralization implies that the center delegates certain tasks to the outlying groups, while remaining in overall control, initiating and directing. (Handy, 1989).

Tom Davenport, Bob Eccles, and Larry Prusak made the case that "federalism" is an effective approach to information management. Federalism allows consensus and negotiation on critical information elements and reporting structures. The distinguishing feature of federalism is the use of negotiation to bring potentially competing and non-cooperating parties together. Strong central leadership is required, along with a culture that encourages cooperation and learning. (Davenport, Eccles and Prusak, 1992).

In 1997 and 1998 I surveyed 321 CIOs attending seminars at the IBM Advanced Business Institute (ABI) in Palisades, NY. I asked them to identify the structure of their IT organizations at two points in time: "Today" (the point in time at which they answered the question), and "In the Future" (a prediction based on their planning horizon). The results are in Table 1.
## Table 1: ABI’s Survey Results

<table>
<thead>
<tr>
<th></th>
<th>Today</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavily Centralized</td>
<td>25%</td>
<td>10%</td>
</tr>
<tr>
<td>Between Centralized and Federal</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Federal</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>Between Federal and Decentralized</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Heavily Decentralized</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

It's clear from this information that the trend is toward the federal structure for IT groups. More than half of those surveyed (55%) are currently "centralized" or leaning that way, whereas only 20% see themselves as "federal." When asked about the future, the latter number jumps to 60%!

### BPX - A Federal Case Study

The motivation to change the structure of any unit is often the perception of poor performance of that unit by its superiors. That was the situation at British Petroleum's Exploration Unit (BPX) in 1989. The IT function for BPX set out to transform itself, in line with its mission to "...become the best in class in its support of BPX's goal to be the best upstream company in the world."

They supported this mission by changing their direction, with the explicit purpose of moving from "system provider" to "infrastructure planner." In the view of John Browne, CEO of BPX at the time and now the CEO of British Petroleum, IT had inhibited corporate change because a coherent architecture was lacking, resulting in blockage of the free flow of information. To reduce complexity in the architecture, BPX identified regional centers of responsibility and global portfolios of application systems. IT costs were reduced by outsourcing, and distributed computing was adopted as the main platform model. Principles of information management were formulated. Open standards were adopted and decisions were made to create oil industry policies for information sharing with external partners. A unified desktop strategy was pursued worldwide.
By 1994 the IT function for BPX was truly an "infrastructure planner," overseeing technical integrity and value creation through information sharing. Although some IT resources remain in the local businesses, the top IT management team provides global vision for infrastructure planning, which they refer to as "centralized top sight." BPX has centralized the management of information, and decentralized its use. (Cross, Earl and Sampler, 1997).

The New IT Infrastructure

What should be the new infrastructure for IT? Peter Weill and Marianne Broadbent describe it as "...the foundation of the information technology portfolio's long-term infrastructure, which is linked to external industry infrastructures, such as bank payment systems and airline reservation systems, and public infrastructures, such as the Internet and telecommunications providers." These technologies provide the foundation for new organizational forms, as well as products, services and jobs. The IT portfolio, in their view, is designed to achieve four distinct management objectives:

- Infrastructure, which constitutes the reliable services shared throughout the organization, such as communication network services, management of large-scale computing and intranet capability.
- Transactional needs, which are the processing and automating of the basic repetitive transactions of the firm, such as order processing, inventory control and statement production.
- Informational requirements, which provide the information for managing and controlling the firm, and include systems that support decision making, planning and communication.
- Strategic technology, which constitutes investments made to gain competitive advantage or to position the firm in the marketplace. (Weill and Broadbent, 1998).

The IT function at BPX has been positioned in a manner consistent with these objectives. To aid them in determining where to focus their activities, CIO John Cross and his team created a model, called the "IT Value Chain", as shown in Figure 1. In this model, "Value Creation" refers to those activities which provide opportunities to create business value, in terms of additional revenue. "Value Realization" focuses on the world-class delivery of IT services, where the main contribution is cost saving. The model is used by BPX to outsource their industry-generic activities, allowing their re-skilled IT personnel to aid the business in creating value from information use and sharing. (Cross, Earl and Sampler, 1997).
Implicit in the "IT Value Chain" model is the decision on what to outsource and what to keep in-house. In his concept of the IT function as a "value center," N. Venkatraman discusses basic changes in the external market, for IT products and services. Leading IT organizations must be active buyers of standard market offerings "...in the wake of the exploding number and type of business arrangements. These include multiyear outsourcing relationships with one primary vendor, strategic sourcing involving multiple vendors to simulate competitive pressures and continuous benchmarking, joint development, cross-equity investments and joint ventures." (Venkatraman, 1997).

**Figure 1: IT Value Chain for XIT**

Applying the Federal Model to IT

In seminars at the ABI, I have asked CIOs to consider the model developed by S. L. Hodgkinson (referenced by Jack Rockart, Michael Earl and Jeanne Ross) as a way of thinking about the concept of a federal organization approach for their group, as shown in Figure 2. In conducting discussions concerning this philosophy of design for IT organizations, I have found that there is general agreement that the benefits of delegating responsibilities - some to the center and some to local units - are undeniable. The main challenge for CIOs is the implementation of the design. The left side of the diagram illustrates some general disadvantages of centralized IT organizations, such as tendencies to be unresponsive and to have difficulty in meeting every business unit's needs. The right side of the model shows some general disadvantages of decentralized IT, including tendencies toward excessive overall costs and the "reinvention of wheels." The ellipse in the center is drawn to focus on the benefits of both centralized and decentralized IT,
along with "what ties all this together.. a well-thought-out IT vision, effective leadership, and group wide IT strategy and architecture." (Rockart, Earl and Ross, 1996).

**Figure 2: Federal Organization Approach**

This federal IT model delegates some responsibilities to the center, but much is given to the local units. For many firms, it becomes an organizational design project, challenging individuals to surrender control of their domains in some cases. That is consistent with the leading body of thought on federalism.

The choice of organizational structure will affect the way in which several decisions are made. If the IT department is centralized, for example, the decision in most firms is that the business units will own no systems and that IT will control and set standards. In a decentralized structure, the decision is most often made that the business units will control the IT priorities and own the Systems. In the federal model, all of these decisions, and more, are weighed with the objective of achieving the best of both of the other two designs.

**The Entire Enterprise**

The application of a federal model to the IT organization is meaningful if it is consistent with the structure of the enterprise of which IT is a part. According to Randy, the direction of most enterprises is toward the federal structure. "Everywhere companies are restructuring, creating integrated organizations, global networks, and 'leaner, meaner' corporate centers. In so doing, whether they recognize it or not, they are on a path to
federalism as a way to govern their increasingly complex organizations." He mentions the existence of several paradoxes:

- Organizations have to be both "big" and "small" at the same time, to achieve economies of scale as well as flexibility and innovation.
- Free markets tend to guarantee efficiency, but managers lean toward centralized control for their unit.
- Wholly owned businesses are a thing of the past, but alliances are tough to manage; they must be built on trust and common goals.

It's the "pull of the professional" that is forcing the move toward federalism. The intangible intellectual assets residing in people are what truly provide value. (Handy, 1996). That realization was a critical factor in the transformation of BPX. A major element of their success was the identification of new core skill requirements for their IT staff. They changed the overall profile of their programmers from "craftsmen" to project managers. IT personnel no longer viewed their jobs as unique and independent. They became facilitators and integrators, working with partners to achieve coordinated results. The traditional systems analyst job was redefined at BPX. The new profile is that of a business consultant, who is expected to have an equal balance between business, technical and people skills. Several human resource initiatives are in place to help develop individual skill sets. (Cross, Earl and Sampler, 1997).

The Challenge for the CIO

The federal IT concept is not as clear a template for organizational design as is either centralized or decentralized IT. It does, however, suggest some principles that can drive implementation decisions:

- Business stakeholders have to accept ownership for setting priorities for information.
- The IT group has to set and control standards as part of the IT architecture.
- IT professionals have to become consultants to the business.
- There has to be a strong working relationship among all of the workers, both inside and outside of the IT organization.

There are other organization-related questions, to be sure. Several will surface as more IT functions adopt the federal model. The ultimate challenge for the CIO is to be a leader and facilitator, rather than a manager and controller. It is then that the IT organization can be positioned to truly deliver value to the business. The second part of this article shows how can business value be gained through staying aligned.

Staying Aligned

Aligning information technology (IT) strategy to the business strategy of the organization to which IT belongs has long been a concern of senior management.
Several firms have been able to achieve this objective. Their challenge is to maintain that level of achievement. This requires a continuation of the behaviors they have adopted along the road to alignment.

Successfully aligned companies examine all of their capabilities, including IT, as potential levers for success when defining their business strategy. They concentrate on finding opportunities for IT to help in creating value for their customers. When IT projects are commissioned, everyone with a stake in the project and its outcomes works with the proper sense of urgency to insure completion within specified requirements. IT professionals and their line management partners agree completely with the desired business outcomes required for a project before selecting a technology appropriate for the project. There is an open atmosphere of human communication throughout the business. Teams are formed and work toward a common cause; they are truly empowered to act. Skill development is a continuous process, not a one-time event.

The issue of "aligning" information technology (IT) strategy to the attainment of business goals has been one of increasing importance in recent years. IT represents a significant investment in resources, and senior management wants a commensurate return on that investment.

How do firms derive benefit from IT? I believe that an "alignment behavior" must be developed and cultivated. This type of behavior is observable in firms who use IT to strategic advantage. After four years of extensive client work on the subject of strategic alignment at IBM's Advanced Business Institute in Palisades, NY, I have concluded that there are several significant behavioral traits, as shown in Figure 3, that are characteristic of organizations who have linked IT directly to their business strategy. By adopting these behaviors, companies can increase their potential for complete alignment and improve their ability to gain business value from investments in IT.
Successfully Aligned Organizations Are Those Who Concentrate On:

- Allowing for all capabilities to be weighed equally
- Leading in the deployment of IT to create customer value
- Instilling a sense of urgency in managing IT-enabled projects
- Gaining agreement on outcomes required from the business processes
- Nurturing a culture of open human communication
- Empowering workers in a team-based environment
- Developing the skills necessary for success

Figure 3: Who are Successfully Aligned Organizations

Allowing For All Capabilities To Be Weighed Equally

As is true for all functions of a business, the strategy for IT should be a logical component of the business strategy. To executives at United Services Automobile Association (USAA), there is no separate IT strategy. There is a business strategy, into which all functions are wholly integrated. According to CEO Robert Herres: "Technology forces us to think about how and where our processes intersect. Alignment across businesses is critical for us because our goal is to exploit the efficiencies of centralized information management while we decentralize service delivery." (Garvin, 1995).

C.R. England & Sons Trucking Co. has a process in place which promotes the sharing of ideas across the firm. This program, called "Super Goals," is designed to "...allow employees to designate innovative projects, systems, applications, and processes as longer term goals. These typically revolve around maximizing customer satisfaction. The Corporate Information Systems Department is an integral partner in the establishing and meeting of these Super Goals."(Davidson, 1991). The project descriptions are presented by employees to the senior executive team at semi-annual meetings designated for the purpose of sharing new ideas.
Leading In The Deployment Of IT To Create Customer Value

An unrelenting focus on customer needs has never been more critical than it is today. IT can play an important role in attracting and keeping customers, and the results should flow to the bottom line. Paul Strassman, former director of defense information for the U.S. Department of Defense says: "I have concluded that the lack of correlation between computer investments and operating results is largely attributable to differences in the ways organizations govern themselves. The superior performers do not waste people and technology to conduct mostly intra-organizational transactions but instead deploy IT almost exclusively where it creates customer value." (1995).

Charles Schwab Corporation has an overall strategy of using technology to lower costs while offering superior service to its investors. In becoming the leading discount brokerage firm, Schwab introduced many IT initiatives to the industry, including electronic trading on the Internet. "In October of 1995, Schwab introduced e.Schwab, a service which provided investors with account and research information via the Internet's World Wide Web. Only five months later, Schwab announced an upgraded e.Schwab and became the first major brokerage firm to offer trading via the Internet." (Burgelman and Maggioncalda, 1996). All of Schwab's innovations in the use of IT are directly focused on their clients. According to their CEO: "The customer decides when he or she wants to contact us at any time of night or day, and whether it's by phone, mail, or PC. Customers decide how and when and what they want from Schwab and the terms on which they want it." (Armour, 1996).

Instilling A Sense Of Urgency In Managing IT-Enabled Projects

The history of application development is replete with stories of concern by CEOs that projects "take too long and cost too much." Modern tools (such as rapid application development techniques) are helpful, but there has to be a personal commitment as well. David Lord, president of Cokesbury Consulting Group and formerly a CIO for one of AT&T's business units, told a group of CIOs attending a seminar in 1998 at IBM's Advanced Business Institute: "IS must partner with the business areas in deploying IT to benefit the business, and must adopt the same sense of urgency as its customers, the business process owners."

The CEO can create an environment that is conducive to making it all work coherently. Jim Cortada of IBM Consulting Group says: "Make IT conform to the same core business practices as the rest of the company. Computing is no exception to other business activities. It lends itself to the same disciplines and best practices as marketing, accounting, and manufacturing." (1996).

Gaining Agreement On The Outcomes Required From Business Processes

Too often the latest technology instinctively becomes the solution. Successful firms resist this trend. Instead, they begin with the overall business strategy, deciding what results they must have from the business processes in place to carry out the strategy. It is then that technologies are weighed along with other resources as possible solutions.
At the McGraw-Hill Companies' PRIMIS\textsuperscript{1} Custom Publishing business unit, an electronic database lets college professors create customized textbooks tailored to their specific course needs. PRIMIS resulted from a change in business strategy. Bob Lynch, Director of PRIMIS until 1995, said that competition, in the form of copy centers and used book sellers, told him he "...must do something different to make my product more attractive to the market." (Venkatraman, 1998).

Careful focus on business processes requires the involvement of those responsible for business results. United Parcel Service went through a major transformation of its business in the 1980s.\textsuperscript{1}

An essential element in its success was the formation of steering committees for IT. Each committee included the first or second level manager in each functional business unit. Management today credits UPS's success in these efforts to its unwavering focus on business priorities. According to former CEO Kent Nelson: "Certainly the technology group is the enabler to get much of the technical work done, but decisions are user-driven, user-supported, and, for the most part, user-implemented." (Brier, Curtin, and Kosits, 1995).

Nurturing A Culture Of Open Human Communication

Alignment might succeed without any one of the other factors listed here, but a climate of clear communication is an absolute necessity. In their study of IT management practices in fifty firms, Rockart, Earl, and Ross concluded that the building of effective relationships with line managers is imperative for successful IT organizations in the late 1990s: "IT personnel at all levels must develop strong, on-going partnerships with line managers. Only through these relationships can the necessary communications occur to insure that both business and technology capabilities are integrated into effective solutions for each level of the business." (1996).

At Inland Steel Industries a major IT project for order fulfillment has resulted in significant savings to the firm. Inland's objective is to provide the most consistent customer service in the steel industry. Information available in the order fulfillment system allows for price quotes, delivery times and orders to be given to a customer in a single conversation. Order status information and billing have become very accurate, resulting in high degrees of customer satisfaction. The project would not have succeeded without clear communication at all levels, starting at the executive level. According to CEO Robert Darnall, "We have a real partnership between the technology experts in our organization and the management people running our various operating companies." "The secret to our success is the relationship IT has with the business," says CIO Bill Howard. "There's a lot of teamwork, and that helps tremendously." (Kleinschrod, 1996).

Empowering Workers In a Team-Based Environment

Corporate delayering in the 1990s has resulted in renewed challenges to the manner in which work is accomplished. Careful attention to the development of teamwork is essential. C.R. England & Sons Trucking Co. has "promoted a corporate

\textsuperscript{1} "PRIMIS" is a registered trademark of the McGraw-Hill Companies
culture that involves employees at the development level. Its 'team system' brings together members of one or more departments and assigns them the task of improving processes and systems. By allowing employees to participate in the quality process and see their ideas positively affect the company, a feeling of empowerment among the team members is created." (Davidson, 1991).

From December 1993 to April 1994, IBM Consulting Group conducted an in-depth study of 24 companies who successfully completed client/server implementations. An important finding of the study is that small, multi-disciplined, self-directed teams seemed to increase the odds of a successful implementation. In all cases, the implementation teams had a mixture of technical and general business expertise.

**Developing The Skills Necessary For Success**

My 1995 survey of 225 executives on the factors involved in implementing new technologies resulted in the clear finding that skills in project management are always important, but skills in people management are more critical than ever. The skills that organizations need to get IT projects completed have assumed new dimensions. My research reveals that such personality traits as persistence, creativity and enthusiasm are now valued as highly as traditional project management skills. (1996).

This is a major shift for most IT professionals. Technical skills have always been the preeminent requirement in staffing. But IT education in many organizations "... now includes interpersonal skills such as active listening, negotiation skills or team building." (Rockart, Earl and Ross, 1996).

**Alignment Must Become Part of the Culture**

In order to contribute to the business bottom line, IT must be integrated with the corporate direction. The correct technology for the business and the most current application development techniques are important, but the key to ongoing success is change in organizational behavior along the lines that I have described. It is only when true learning occurs and is cultivated that organizations can tip the balance toward continual IT investment success.

**Conclusion**

Business value creation is indeed the ultimate measure of organizational success. While successfully aligned organizations can better structure themselves to be positioned to provide true value to the business of which they are a part, the choice of their IT organization can either accelerate the value creation or decelerate it.

So, is staying aligned sufficient to assure the true business value of an organization and are there accepted models for organizing IT so that business value creation can be maximized?

The article addressed business value creation in terms of the organization structure and its IT organization in two steps: first, a discussion of how companies can
organize their IT; and second, how can these companies maintain or accelerate business value creation by staying successfully aligned.

References
SCR Control for Large DSS: Base vs. Delay Costs
Nazar Younes, Oumain University
M.S. Gouider, ISG de Tunis
M. Zaghdoud, ENSI de Tunis

Abstract

This article examines the conflict between end-users and developers of ongoing DSS projects which can grow when organizational change generates excessive system change requests (SCR) that jeopardize the successful completion of the DSS project. This article considers two SCR control methods: the maximum impact and the minimum impact. Four SCR processing rules; the base cost rule, the delay cost rule, the total cost rule, and the open-acceptance rule; and nine performance measures are used to study the superiority of a SCR control method.

Sigma simulation experiments are conducted to analyze the effects on performance of various design parameters for methods of controlling SCRs generated by organizational change. Further experiments are conducted to investigate the structural relationships between several design parameters used in the maximum impact and minimum impact SCR control methods and their performance measures. Regression analysis is used to characterize the relationships between the parameters and the response measures.

The article reports findings which show when a SCR control method and a SCR processing rule are recommended, for particular end-user desired performance measures, and provides linear models for partial support to end-users in situations where formal analytic and rigorous models fail to grant significant results.

Introduction

System change request (SCR) control methods play a critical role in the development process of a large DSS and its commercialization by providing the key link between end-user acceptance of the system and the delivery timing of the DSS product. Because of the accumulation of SCRs resulting from organizational change, more uncertainty will be associated with the DSS profitability to end-users. While original end-user requirements may be met according to the original DSS plan, excessive organizational change can produce new system requirements that will delay system delivery and considerably increase DSS development cost. The addition of an enhancement phase, as a remedial recourse to the original DSS development plan, provides one way to manage the difficult trade-off between the DSS delivery delay and DSS enhancement under various SCR control methods such as those involving process time and process cost restrictions.

This article is concerned with the analysis of the design parameters of two SCR control methods, the maximum impact and the minimum impact control methods, where different SCR processing rules may be applied. The first SCR control method is characterized with a DSS enhancement phase that is prolonged until the point of
maximum impact $T_m$. The second control method is characterized by a shorter enhancement phase which ends when the SCR arrival rate starts to significantly decline at the point of minimum impact. In a maximum impact SCR control method, end-users fix a time limit, called the point of maximum impact (Locket, 1994), after which they do not accept the DSS. In the minimum impact SCR control approach, end-users allow developers to end the enhancement phase at the point of minimum impact, characterized by a declining SCR arrival rate.

While the strategy of fixing the length of the enhancement period as a way to reduce developers' uncertainty about organizational change has been studied and proven effective (Locket, 1994), it is important to determine whether the conclusions of these studies hold when different SCR processing methods are considered. For example, recent work (Locket, 1994) in analyzing the effect of organizational change on DSS delivery timing for large and complex DSSs, showed that the tremendous cost of DSS project delay are as elevated as the high programming costs.

This article first reviews related work and discusses the problem of SCR management. Next is described the design of simulation experiments that analyze the impact of organizational change on DSS delivery using the framework developed in Locket et al. (Locket, 1994). Then an analysis of the experiment is presented, followed by a discussion of findings.

**Prior Work**

Little research on how to control SCRs have been reported in the literature. Traditional methodologies suggested structured approaches which inherently avoid uncertainty (Martin, 1984). A few other studies (Wiggander, 1984) attempted to manage SCRs by suggesting very detailed plans but which have been proven ineffective due to the inherited classic assumption that initial design phases are capable of sorting out all system problems. Those improved methodologies have been criticized for considering SCR management as a minor activity of system development (Locket, 1994).

Recently, Locket, Ahmed, and Turner (1994) presented a model for managing SCRs in the development of a large and complex DSS (Locket, 1994). They applied their cost model to the case of an international chemical company, and presented the details of the effect of SCRs on a large DSS project. Other related work has discussed several informal models which, despite the absence of empirical support, may be useful in SCR studies. For instance, Gustavsson (1989), and Clemm (1989) discussed several project-level change control tools (Clemm, 1989) (Gustavsson, 1989). Books by Pressman (1993), and Bersoff, Henderson, and Seigal (1980), and Babich (1987) provide good introduction to SCR management (Babich, 1987) (Bersoff, 1980) (Pressman, 1993).

Locket et al. added an enhanced stage to the DSS project process for the purpose of controlling the SCRs generated by organizational change. The task of this enhancement phase is to filter out the proliferation of SCRs and turn as few as possible into system changes, without killing the project. They showed that the use of a version approach (dividing the DSS project into several components or mini-projects) produces a steady stream of system change requests that is manageable, and gives valuable insights.
They proposed delay and cost models useful to predict system acceptance and forecast the profitability of the final DSS product. While DSS developers and end-users have become more concerned with the impact of organizational change on DSS profitability, little research has been conducted to substantiate whether informal management of SCRs offers improved performance of DSS products. The need for applied research of an experimental nature and for practical guidelines for the effective control of SCRs have provided the motivation for the study of the effect of organizational change on the acceptance of a DSS project.

**SCR Control by Adding an Additional Enhancement Phase**

This article uses the standard project process model which consists of the analysis phase, design phase, implementation phase (code, testing, assembly of DSS resources, and fulfilling those SCRs that do not delay DSS delivery), and delivery. Following the delivery, the DSS is installed at the user site. A post implementation phase consisting of DSS user testing and a maintenance/review phase are usually performed by the user while the developer remains available for consultation and assistance according to the acceptance and maintenance contracts signed by the user and the developer.

This article, as in Locket et al. (Locket, 1994), adds to the standard DSS process an optional enhancement phase where the DSS delivery is delayed so that more SCRs are studied and incorporated in the final DSS product. Only those SCRs that can be absorbed by a prescribed point of time, the point of maximum impact, determined by both the user and the developer, are approved and implemented.

The organizational change generates a SCR that is either accepted or rejected. The acceptance/rejection decision is based on the anticipated SCR processing cost and the delay it attributes to the DSS delivery. The delay and cost models proposed by Locket et al. are useful in studying the effect of organizational change on DSS profitability.

The delay \( d \) and cost \( c \) of a single SCR that has been admitted is computed as follows:

\[
d = \frac{(s/n)(T_n - T_0)^2}{(T_m - T_0)^2} \text{ hours (35 hours in a week)}
\]

\[
c = sr
\]

where:
- \( T_{-1} \) = Time when the DSS formal design ends (starting of the implementation phase)
- \( T_0 \) = Project zero point (end of the implementation phase)
- \( T_m \) = The point of maximum impact (the DSS has to be delivered before this time point)
- \( T_n \) = Time of approval of the SCR
- \( s \) = SCR development effort in man hours
- \( r \) = The average charge rate in $/man hours
- \( f \) = number of staff employed on the project during the period \( T_n - T_m \)
Table 1: Implementation and Enhancement Phase Description

<table>
<thead>
<tr>
<th>Phase</th>
<th>SCR Received</th>
<th>SCR Approved</th>
<th>SCR Rejected</th>
<th>Absorption Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation</td>
<td>T-1</td>
<td>-200</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>-150</td>
<td>60</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>-100</td>
<td>100</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>-05</td>
<td>200</td>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td>Enhancement</td>
<td>T0</td>
<td>50</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>300</td>
<td>250</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>200</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

The example shown in Table 1 provides an illustration of the SCR control process. The first segment of Table 1 presents important SCR control events during the implementation phase from T-1 to T0. Of a total of 400 SCRs have been received, only 200 have been accepted. The absorption intensity of the SCR control method is represented by the percentage of the accepted SCRs (assuming that the enhancement period is sufficiently long so that every accepted SCR is processed before the maximum impact point). The second segment of Table 1 shows SCR control events that have occurred during the additional enhancement phase T0 to Tm. This phase is usually associated with a higher rate of SCR arrival and a higher number of accepted SCRs. The point of minimum impact is 150 because this is the first time a significant decline in the arrival rate was observed.

The literature has not explicitly discussed how DSS management assimilates organizational change in ongoing DSS projects, nor how they decide whether or not to accept a SCR, or how SCRs are processed and transformed in system changes. Nonetheless, delay and cost have been mentioned to be the most important decision parameters involved in studying the effect of organizational change on DSS acceptance (Locket, 1994).

This article considers four SCR processing rules: the base cost rule, the delay cost rule, the total cost rule, and the open-acceptance rule.

Base cost rule. The base cost processing rule studies the labor capacity of the developer team before a SCR is accepted. Those SCRs which require a large number of man hours are rejected.

Delay cost rule. The delay cost processing rule studies the SCR development time before a SCR is approved. Those SCRs which require a lengthy processing time are rejected because they result in delaying the delivery of the DSS product.
Total cost rule. The total cost (base plus delay) processing rule studies the labor capacity of the developer team and the SCR processing time before a SCR is approved. Those SCRs that are too costly and the ones that require a lengthy processing time are not accepted because they result in producing an unprofitable DSS and in delaying the delivery of the DSS product.

Open-acceptance rule. The open-acceptance SCR processing rule does not distinguish between desirable and undesirable SCRs. It assumes that any request of system change by end-users is worth the implementation effort (cost and delay).

Research Methodology

Simulation experiments were conducted to analyze the effects on performance of various design parameters for methods of controlling SCRs generated by organizational change. Our major concern is how to select a SCR control method with a SCR processing rule that permits the absorption of those SCRs that (1) do not delay DSS delivery beyond the point of maximum impact and (2) are such that their effect on the resulting system is so significant that the DSS project obtains users' acceptance.

In the real world, when DSS developers panic at the final stages of the project, they will become myopic and more concerned about the short-term project acceptance. They will become anxious about how to complete the project with the minimum system change that does not kill the project. The absorption of a minimum number of SCRs without killing the DSS project has been used as an objective for the SCR control method employed in Locket et al. (Locket, 1994).

In the next sections we discuss the experimental criteria, the research hypotheses, the experimental design, and the data analysis.

Experimental Criteria

A computer simulation model was used to study two SCR control methods, the maximum impact and minimum impact, under the four SCR processing rules, defined earlier. The experimental criteria used include the 9 performance parameters defined below.

The measures of performance considered in this article were articulated from several developers, end-users, and DSS project managers. Acquired knowledge was useful in identifying a set of parameters that were used to determine ways to deal with the effect of last-minute organizational change on ongoing DSS projects and how the generated SCRs are transformed into system change. Only nine of those parameters were retained, redefined and named.

It is important to note that some of the parameters are redundant and interdependent. We intentionally decided to retain all of the nine parameters and examine them despite their redundancy and interdependence. This will provide more insights for a larger population of developers, end-users, and DSS managers who have their own interpretations of performance measures of SCR control methods.
The nine performance measures used were:

1. Absorption intensity. Among received SCRs, only a fraction are accepted and processed. This fraction scaler is called the SCR absorption intensity of the SCR control method.

2. SCR base cost tolerance. Upon the arrival of a SCR, its processing base cost is estimated. If the SCR processing cost is judged too high, then the SCR will be rejected. Base cost tolerance is computed as the ratio of the average base cost of an accepted SCR to the overall average base cost of a SCR (accepted or rejected).

3. SCR delay cost tolerance. At the arrival of a SCR, its processing delay cost is estimated. If the SCR processing delay is judged too high, then the SCR will be rejected. Delay cost tolerance is computed as the ratio of the average delay cost of an accepted SCR to the overall average delay cost of a SCR (accepted or rejected). The delay cost is computed as in Locket et al. (1994) (Locket, 1994).

4. SCR total cost tolerance. At the arrival of a SCR, its total cost (base cost plus delay cost) is estimated. If this cost is judged too high, then the SCR will be rejected. Total cost tolerance is computed as the ratio of the SCR cost of an accepted SCR to the overall average cost of a SCR (accepted or rejected).

5. SCR absorption rate. For some DSS projects, the arrival pattern is relatively slow. The SCR absorption, computed as the number of SCRs processed per time unit, may be an indicator of the performance of a SCR control method.

6. Base acceptance rate. The SCR processing cost, base cost, is also an important criterion in the decision of whether or not to accept a SCR. The base (process-based) acceptance rate is the number, per time unit, of SCRs accepted based on their base cost alone.

7. Base rejection rate. The base (process-based) rejection rate is the number, per time unit, of SCRs rejected based on their base cost alone.

8. Delay acceptance rate. The SCR delay cost is an important criterion in the decision of whether or not to accept a SCR. The delay-based acceptance rate is the number, per time unit, of SCRs accepted, based on their delay cost alone.

9. Delay rejection rate. The delay-based rejection rate is the number, per time unit, of SCRs rejected, based on their delay cost alone.

**Research Hypotheses**

The research hypotheses concern the effect of changes in the design parameters of SCR control methods on various performance measures when the maximum and
minimum impact delay enhancement phases are adopted. The first hypothesis is concerned with determining if DSS delivery delay control in SCR management has an effect on SCR control methods performance. The second hypothesis is concerned with determining if SCR process control in SCR management has an effect on SCR control methods performance.

DSS delivery delay control is achieved through the selection of either the maximum impact SCR control method; or the minimum impact SCR control method. In the first method, DSS delivery is postponed until $T_m$, the point of maximum impact. In the second one, the DSS is delivered before $T_m$, if a significant decline of the SCR arrival rate is observed. That is, the first hypothesis also tests whether switching from one SCR control method to the other, has a significant effect on the performance measures.

SCR process control is achieved through the selection of one of the four SCR processing rules. That is, the second hypothesis also tests whether switching from one SCR processing rule to the other, has a significant effect on the performance measures. In addition to testing the effect of switching from one SCR control method to the other (DSS delivery delay control), and the effect of switching from one SCR processing rule to the other (SCR process control) on the performance measures, it is equally important to study the effect of changing both the SCR control method and the SCR processing rule on the performance measures.

In other words, it is equally important to examine the joint effect of both of DSS delivery delay control (two SCR control methods) and SCR process control (four SCR processing rules) on the performance measures. The third hypothesis is therefore concerned with determining if the DSS delivery delay control and SCR process control, in SCR management, have joint effect on SCR control methods performance.

The three hypotheses are written as follows:

H1. DSS delivery delay control has a significant effect on each of the nine performance measures.

H2. SCR process control has a significant effect on each of the nine performance measures.

H3. The SCR process control and the DSS delivery delay have a joint effect on each of the performance measures.

Experimental Design

Factorial design was used to evaluate the research hypotheses. The performance of alternative SCR control methods were compared under a variety of SCR processing rules characterized by the independent variables included in the design.

The SCR control methods were studied over a range of operating conditions: the base cost rule, the delay cost rule, the total cost rule, and the open-acceptance rule. The SCR arrival process is characterized by a Beta probability distribution of the random variable time between arrivals of SCRs. The service of processing a SCR is uniformly
distributed between 0 and 500 hours (implied from real data provided in Locket et al. (Locket, 1994)).

A simulation model was written in Sigma (Schruben, 1992). The graphic version, as well as Pascal code, C code, and the English version are provided upon request. The simulation model uses the SCR control framework described in the example shown in Table 1.

Pilot experiments indicated that 1000 hours are sufficient to eliminate warm-up effects. At the end of every 1000 hours, the required statistics were recorded and the performance measures were again initialized. Because of space, we do not provide actual performance levels observed in the experiments and their averages, standard deviations, and ranges for actual performance levels achieved under each of the four SCR processing rules when the maximum and minimum impact SCR control methods are used.

Our system has fixed starting conditions, to which the system returns after each termination, and finite events defining the natural end of the simulation; it is hence a terminating system. Because we cannot manipulate the number of SCRs processed at each simulation run, the only way to control the sample size is to determine the number of replications of the simulation to execute. The independent replications approach requires repeating the simulation a number of times with all conditions the same except for the random numbers seeds used. The performance measures from each replication are then taken as statistically independent observations (Pegden, 1990) (Watson, 1989).

The system was initially operated for 1000 hours (simulation time units) and at that time the performance measures were re-initialized. Because of the large number of performance parameters treated in this simulation, and the differences in their variation ranges, the number of replications is set to 100, even though for some of the parameters 10 replications were sufficient (i.e., the upper \( \frac{1}{2} \) point of the student-t distribution with \( n-1 \) degrees of freedom, where \( n \) is the number of replications, equals the desired interval's half-width over the standard deviation of the mean).

**Experimental Results and Data Analysis**

The experimental data were analyzed separately for all the performance parameters using the ANOVA procedure. Before employing the ANOVA procedure, the standard deviations were checked and heteroscedasticity was tested. The ANOVA results are provided in Tables 2 through 10.

The experimental results are divided into two parts. The first part presents the results of testing the hypotheses regarding the SCR processing rules when the maximum and minimum impact SCR control methods are used. The second part presents regression models that examine several SCR design parameters and operating factors, when the total cost SCR processing rule is used.

An examination of F-statistics values obtained for the ANOVA main effects (i.e. items D and P) in Tables 2 through 10 indicates that DSS delivery delay control produces significant effects on all performance measures considered in this study, except for the SCR base cost tolerance and the SCR total cost tolerance. There is therefore no full support for the first hypothesis. However, if one removes the latter two performance measures from the first hypothesis, it becomes H1: "DSS delivery delay control has a
significant effect on all the performance measures, except, the SCR base cost tolerance and the SCR total cost tolerance." The new hypothesis H1' will therefore not be rejected at the p<.05 significance level.

The second hypothesis is concerned with the effect of using alternative SCR processing rules on various performance measures. An examination of F-statistics values obtained for the ANOVA factor main effects (i.e. items D and P) in Tables 2 through 10 indicates that changes in SCR process control produce significant effects on all performance measures considered in this study. There is therefore full support of the second hypothesis at the p<.05 significance level.

For all performance parameters, except for the SCR absorption rate and the delay-based acceptance rate, the F-statistics values for SCR process control are much larger than the corresponding values for DSS delivery delay control. SCR process control has therefore greater effect on those performance parameters than DSS delivery delay control.

The third hypothesis is concerned with the joint effect, of DSS delivery delay control SCR process control, on various performance measures. An examination of F-statistics values obtained for the ANOVA joint effects (DxP) in Tables 2 through 10 indicates that SCR process control and DSS delivery delay control produce significant effects on all performance measures considered in this study. There is therefore full support of the third hypothesis at the p<0.05 significance level.

For DSS delivery delay control, the parameter SCR delay cost tolerance has the lowest F-statistics; that is, DSS delivery delay control has the lowest effect on this performance measure, with out counting the two performance measures on which this approach has no significant effect, the SCR base cost tolerance and the SCR total cost tolerance, as shown earlier. On the other hand, for SCR process control, the delay-based acceptance rate has the lowest F-statistics; that is, SCR process control has the lowest effect on this performance measure. For the joint change in SCR process control and in DSS delivery delay control, the process-based rejection rate has the lowest F-statistics; that is, the joint effect is minimum on this performance measure.

Table 2: ANOVA results for absorption intensity

<table>
<thead>
<tr>
<th></th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay Control (D)</td>
<td>1</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.04</td>
<td>0.843</td>
</tr>
<tr>
<td>SCR Process Control (P)</td>
<td>3</td>
<td>60.86039</td>
<td>20.28680</td>
<td>3110.53</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>60.89376</td>
<td>8.69911</td>
<td>1335.70</td>
<td>0.000</td>
</tr>
</tbody>
</table>
### Table 3: ANOVA results for base cost tolerance

<table>
<thead>
<tr>
<th>Significance</th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (D)</td>
<td>1</td>
<td>13.2691</td>
<td>13.2691</td>
<td>161.88</td>
<td>0.000</td>
</tr>
<tr>
<td>SCR Process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (P)</td>
<td>3</td>
<td>7.7317</td>
<td>7.7317</td>
<td>718.61</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>97.7728</td>
<td>13.9675</td>
<td>1785.67</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Table 4: ANOVA results for delay tolerance

<table>
<thead>
<tr>
<th>Significance</th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (D)</td>
<td>1</td>
<td>0.0032</td>
<td>0.0032</td>
<td>0.04</td>
<td>0.836</td>
</tr>
<tr>
<td>SCR Process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (P)</td>
<td>3</td>
<td>55.94028</td>
<td>18.64676</td>
<td>4589.80</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>55.94696</td>
<td>7.99242</td>
<td>1961.46</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Table 5: ANOVA results for total cost tolerance

<table>
<thead>
<tr>
<th>Significance</th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (D)</td>
<td>1</td>
<td>0.9343</td>
<td>0.9343</td>
<td>10.12</td>
<td>0.002</td>
</tr>
<tr>
<td>SCR Process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (P)</td>
<td>3</td>
<td>65.9770</td>
<td>21.9923</td>
<td>2020.61</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>69.56229</td>
<td>9.93747</td>
<td>1549.78</td>
<td>0.000</td>
</tr>
</tbody>
</table>
### Table 6: ANOVA results for absorption rate

<table>
<thead>
<tr>
<th>Significance</th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (D)</td>
<td>1</td>
<td>0.000040</td>
<td>0.000040</td>
<td>0.35</td>
<td>0.553</td>
</tr>
<tr>
<td>SCR Process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (P)</td>
<td>3</td>
<td>0.0748975</td>
<td>0.0249658</td>
<td>1192.64</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>0.0750469</td>
<td>0.0107210</td>
<td>514.19</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Table 7: ANOVA results for base acceptance rate

<table>
<thead>
<tr>
<th>Significance</th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (D)</td>
<td>1</td>
<td>6.1361</td>
<td>6.1361</td>
<td>204.55</td>
<td>0.000</td>
</tr>
<tr>
<td>SCR Process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (P)</td>
<td>3</td>
<td>7.4253</td>
<td>2.4751</td>
<td>86.99</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>19.3897</td>
<td>2.7700</td>
<td>205.32</td>
<td>0.000</td>
</tr>
</tbody>
</table>

### Table 8: ANOVA results for base rejection rate

<table>
<thead>
<tr>
<th>Significance</th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (D)</td>
<td>1</td>
<td>17.885</td>
<td>17.885</td>
<td>36.17</td>
<td>0.000</td>
</tr>
<tr>
<td>SCR Process</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (P)</td>
<td>3</td>
<td>177.624</td>
<td>59.208</td>
<td>200.68</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>209.694</td>
<td>29.956</td>
<td>117.00</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Table 9: ANOVA results for delay acceptance rate

<table>
<thead>
<tr>
<th></th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay Control (D)</td>
<td>1</td>
<td>0.65331</td>
<td>0.65331</td>
<td>174.15</td>
<td>0.000</td>
</tr>
<tr>
<td>SCR Process Control (P)</td>
<td>3</td>
<td>0.59663</td>
<td>0.19888</td>
<td>51.90</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>1.97725</td>
<td>0.28246</td>
<td>133.98</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 10: ANOVA results for delay rejection rate

<table>
<thead>
<tr>
<th></th>
<th>Degree of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR Delay Control (D)</td>
<td>1</td>
<td>1.5657</td>
<td>1.5657</td>
<td>92.15</td>
<td>0.000</td>
</tr>
<tr>
<td>SCR Process Control (P)</td>
<td>3</td>
<td>9.92754</td>
<td>3.30918</td>
<td>506.94</td>
<td>0.000</td>
</tr>
<tr>
<td>DxP</td>
<td>7</td>
<td>14.38153</td>
<td>2.05450</td>
<td>2192.53</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Regression Results

Further experiments were conducted to investigate the structural relationships between several design parameters, used in the maximum impact and minimum impact SCR control methods, and their performance measures. Those experiments are however limited to one SCR processing rule: the total cost processing rule. Because it applies both the base cost and the delay cost criteria in studying the feasibility of an incoming SCR, the examination of this SCR processing rule alone will provide more insights into the usefulness of all performance measures in the selection of a SCR control method.

We varied the base cost and delay thresholds (from $0 to $1000, and from 0 to 500 hours, respectively), the size of SCR staff (from 1 to 20 persons), and the maximal SCR arrival rate (1 to 30 SCRs/hour). The results of these experiments were analyzed using the regression technique to characterize the relationships between the variables and the response measures. The results of these analyses are presented next.

The independent variables, used in the regression models of Table 11 and applied to the maximum impact SCR control method, are x1: size of SCR processing staff, x2: maximum tolerated base cost (base threshold), x3: maximum tolerated delay (delay threshold), and x4: maximum SCR arrival rate used in the simulation to control the SCR Beta-distributed arrival pattern. The same independent variables are used in the regression models, of Table 12, applied to the minimum impact SCR control method. All
the coefficients of the regression models in Table 11, except for those of x1 for all the models and those of x4 for the second and fourth models, were significant at the .05 level. No more than 1% of the observations in all the models were outside three standard errors.

All the coefficients of the regression models in Table 12, except for those of x1 for some of the models and those of x4 for the first and the third models, were significant at the .05 level. No more than 1% of the observations in all the models were outside three standard errors.

Unfortunately, the literature does not contain similar studies using regression analysis in SCR management that we can use as references to discuss the goodness of our regression models. Nonetheless, R-squared values of regression models built on simulation data appear to be accepted at relatively lower levels. We however retain all those regression models despite the low R-squared values for most of them, and suggest that they be used only as additional decision aids to formal analytic and more rigorous models.

Table 11: Performance Regression Results of the Maximum Impact Point SCR Control Method

<table>
<thead>
<tr>
<th>Performance Parameter</th>
<th>R-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Absorption intensity</td>
<td>39.3%</td>
</tr>
<tr>
<td>y1=-0.0288+0.00151x1+0.000060x2+0.000135x3-0.000028x4</td>
<td></td>
</tr>
<tr>
<td>2. SCR base cost tolerance</td>
<td>28.7%</td>
</tr>
<tr>
<td>y2=-0.0302+0.00270x1+0.000034x2+0.000121x3+0.000015x4</td>
<td></td>
</tr>
<tr>
<td>3. SCR delay cost tolerance</td>
<td>42.0%</td>
</tr>
<tr>
<td>y3=-0.0147+0.00034x1+0.000059x2+0.000148x3-0.000752x4</td>
<td></td>
</tr>
<tr>
<td>4. SCR total cost tolerance</td>
<td>30.5%</td>
</tr>
<tr>
<td>y4=-0.0289+0.00250x1+0.000036x2+0.000123x3-0.000055x4</td>
<td></td>
</tr>
<tr>
<td>5. SCR absorption rate</td>
<td>60.6%</td>
</tr>
<tr>
<td>y5=0.00007-0.000104x1+0.000008x2+0.000017x3-0.000189x4</td>
<td></td>
</tr>
<tr>
<td>6. Process-based acceptance rate</td>
<td>37.4%</td>
</tr>
<tr>
<td>y6=-3.35+0.489x1+0.0119x2+0.0287x3-0.276x4</td>
<td></td>
</tr>
<tr>
<td>7. Process-based rejection rate</td>
<td>37.8%</td>
</tr>
<tr>
<td>y7=904-14.9x1-0.272x2-0.695x3-10.5x4</td>
<td></td>
</tr>
<tr>
<td>8. Delay-based acceptance rate</td>
<td>59.7%</td>
</tr>
<tr>
<td>y8=-0.001-0.0120x1+0.00156x2+0.00357x3-0.0399x4</td>
<td></td>
</tr>
<tr>
<td>9. Delay-based rejection rate</td>
<td>37.9%</td>
</tr>
<tr>
<td>y9=93.6-1.47x1-0.0303x2-0.0790x3-1.03x4</td>
<td></td>
</tr>
</tbody>
</table>
### Table 12: Performance Regression Results of the Maximum Impact Point SCR Control Method

<table>
<thead>
<tr>
<th>Performance Parameter</th>
<th>R-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Absorption intensity</td>
<td>57.9%</td>
</tr>
<tr>
<td>( y_1 = -0.207 + 0.0188x1 + 0.000205x2 + 0.000454x3 + 0.00602x4 )</td>
<td></td>
</tr>
<tr>
<td>2. SCR base cost tolerance</td>
<td>55.3%</td>
</tr>
<tr>
<td>( y_2 = -0.150 + 0.00812x1 + 0.000425x2 + 0.000557x3 + 0.00026x4 )</td>
<td></td>
</tr>
<tr>
<td>3. SCR delay cost tolerance</td>
<td>61.5%</td>
</tr>
<tr>
<td>( y_3 = -0.150 + 0.00267x1 + 0.000470x2 + 0.00107x3 - 0.00246x4 )</td>
<td></td>
</tr>
<tr>
<td>4. SCR total cost tolerance</td>
<td>58.2%</td>
</tr>
<tr>
<td>( y_4 = 1.59 + 0.00740x1 + 0.000429x2 + 0.000639x3 - 0.00079x4 )</td>
<td></td>
</tr>
<tr>
<td>5. SCR absorption rate</td>
<td>67.0%</td>
</tr>
<tr>
<td>( y_5 = 0.00383 + 0.00137x1 + 0.000025x2 + 0.000043x3 - 0.000541x4 )</td>
<td></td>
</tr>
<tr>
<td>6. Process-based acceptance rate</td>
<td>58.2%</td>
</tr>
<tr>
<td>( y_6 = 2.24 + 0.705x1 + 0.00949x2 + 0.0131x3 - 0.174x4 )</td>
<td></td>
</tr>
<tr>
<td>7. Process-based rejection rate</td>
<td>39.7%</td>
</tr>
<tr>
<td>( y_7 = 175 - 1.31x1 - 0.0876x2 - 0.186x3 - 1.51x4 )</td>
<td></td>
</tr>
<tr>
<td>8. Delay-based acceptance rate</td>
<td>69.1%</td>
</tr>
<tr>
<td>( y_8 = 0.720 + 0.212x1 + 0.00353x2 + 0.00652x3 - 0.0809x4 )</td>
<td></td>
</tr>
<tr>
<td>9. Delay-based rejection rate</td>
<td>40.5%</td>
</tr>
<tr>
<td>( y_8 = 54.8 - 0.487x1 - 0.0275x2 - 0.0631x3 - 0.442x4 )</td>
<td></td>
</tr>
</tbody>
</table>

### How end-users interpret our results

End-users' individual differences were not studied in this article but will be examined in a future research study. Individual differences in attitude, motivation, and skills may have considerable impact on how those user-developer conflicts regarding SCR management may be resolved. The end-user individual need of one or more aspects of system change in the ongoing DSS project will determine the SCR control method performance measure of interest, and hence, the end-user desired SCR control method and the appropriate SCR processing rule.

For those users who are concerned about the SCR processing rules and not informed about the SCR control method adopted by developers, then the selected measure of performance may be an important determinant of the most appropriate SCR processing rule. The same is valid for users who are concerned about the SCR control method as well as the SCR processing rule.

DSS delivery delay due to organizational change is determined by the length of the enhancement phase which is in turn determined by the SCR control methods adopted by DSS project management. The DSS delivery delay has significant effect on most of the SCR control methods performance measures usually employed, as shown earlier.
That is, if end-users are willing to wait for a longer period, then the maximum impact SCR control method is also appropriate, provided that this method shows its superiority to the minimum impact SCR control method for the performance measure adopted by the developer.

On the other hand, if end-users are reluctant to set a maximum impact point that satisfies the developers, then the minimum impact SCR control method is their only choice. End-users may however discuss with developers some of the controllable operating factors that transform more SCRs into system change. Examples of controllable operating factors on which end-users may have indirect influence, are the size of the SCR staff, the SCR arrival rate, and several other parameters related to SCR processing rules.

In the real world, while developers try to process less SCRs in more time, the end-users insist that developers should process more SCRs in the least possible time. Because end-user groups may differ in their views of SCR management, the measures of performance of SCR control methods and their preferences of the adopted SCR processing rules can vary considerably. For instance, for a large volume of small-size SCRs, end-users who are under pressure to use the DSS will be interested to adopt a SCR control method that utilizes a SCR processing rule that maximizes the SCR absorption rate. In this manner, they make sure that a maximum number of SCRs will be processed in a fixed time period. However, the same inpatient end-users who hold a small number of very costly SCRs will be interested to select a SCR control method with a SCR processing rule that minimizes the base cost rejection rate. In this fashion, they are sure that none of their costly SCRs will be rejected.

For an ongoing DSS project, the transformation of organizational change into system change is a necessity for DSS acceptance. End-users and DSS developers have to overcome their major differences in viewing the profitability of the new DSS. While developers do not want to see their project killed by the excessive system change requests, the end-users expect most of their SCRs to be implemented.

End-users and developers have to compromise to keep the DSS project. Our findings may be very useful to resolve the conflict.

End-users and developers have to select three items that best matches their needs: 1) a SCR control method from a set of two methods, namely, the maximum impact and the minimum impact; 2) a SCR processing rule among four available rules, namely, the base cost rule, the delay cost rule, the total cost rule, and the open-acceptance rule; and 3) a performance measure among nine parameters, namely, SCR absorption intensity, SCR base cost tolerance, SCR delay cost tolerance, SCR total cost tolerance, SCR absorption rate, process-based acceptance rate, process-based rejection rate, delay-based acceptance rate, and delay-based rejection rate.

The maximum impact SCR control method is recommended when end-users demonstrate some time tolerance, expressed by the length of the enhancement phase which is limited by the point of maximum impact. The SCR total cost processing rule provides a higher acceptance rate independently of the SCR processing cost; and lower base rejection rate, independently of the size of the SCR staff.

That is, when the base cost threshold is not known to end-users, then the minimum impact SCR control method is recommended. In this situation, the SCR total cost processing rule will yield a higher absorption intensity, independently of the base cost threshold. On the other hand, when users have no estimate of the delay threshold, the
minimum impact SCR control method is recommended. Using the SCR total cost processing rule will provide higher absorption intensity, higher SCR absorption rate, and a lower delay rejection rate. The minimum impact SCR control method is also recommended if the size of the SCR staff cannot be estimated. The SCR total cost processing rule will render a higher absorption intensity, a higher absorption rate, and a lower delay rejection rate.

The regression models provided in the article grant partial support for the selection of the most appropriate SCR control method that uses the SCR total cost processing rule, when end-users possess estimates for the size of the SCR staff, the SCR arrival rate, and the maximum delay and maximum base cost tolerated.

Nonetheless, if end-users prefer to adopt a SCR control method that applies the base, delay, or the open-acceptance SCR processing rules, then they have to use subjective judgement to identify the method that is more likely to grant a better value for the desired performance measure. Our experimental models failed to produce significant results to provide support when the SCR control method does not apply a SCR total cost processing rule.

Conclusion

This article examined the conflict that rises between end-users and developers of ongoing DSS projects when organizational change generate excessive system change requests (SCR) that menace the successful completion of the DSS project. While end-users pressure the developers for an early delivery of the DSS they also urge then that their SCRs be implemented. On the other hand, the developers feeling end-users pressure become alarmed about system acceptance and become worried about how much system change can they realize that does not result in killing the project.

This article considered two SCR control methods, the maximum impact and the minimum impact. Four SCR processing rules were applied to SCR control methods: the base cost rule, the delay cost rule, the total cost rule, and the open-acceptance rule. Nine performance measures were used to study the superiority of a SCR control method.

Sigma simulation experiments were conducted to analyze the effects on performance of various design parameters for methods of controlling SCRs generated by organizational change.

Further experiments were conducted to investigate the structural relationships between several design parameters used in the maximum impact and minimum impact SCR control methods and their performance measures. Those experiments were however limited to one SCR processing rule: the total cost processing rule. We varied the base cost and delay thresholds, the size of SCR staff, and the SCR arrival rate. The results of these experiments were analyzed using the regression technique to characterize the relationships between the variables and the response measures.

The article reported findings regarding when a SCR control method and a SCR processing rule are recommended, in terms of end-user desired performance measures. The article also studied linear relationships between each of the SCR control method performance measures and the base cost and delay thresholds, the size of SCR staff, and
the SCR arrival rate. These linear models provide partial support to end-users in situations, described in this article, where the simulation did not grant significant results.

References

Impact of Strategic HRM Practices on Corporate Financial Performance

Morsheda T. Hassan, Louisiana Tech University

Abstract

This study examines the impact of seven strategic Human Resource Management (HRM) practices (internal career opportunities, training programs, results-oriented appraisals, profit sharing, employment security, participation and voice mechanisms, and job description) on corporate financial variables. The corporate financial variables include three profitability variables (return on assets, return on equity, profit margin), two liquidity variables (current ratio and quick ratio), and two leverage variables (debt-asset ratio and debt-equity ratio). The results of this study reveal that four of the seven strategic HRM practices (profit sharing, results-oriented appraisals, employment security, and training) have significant impact on return on assets, return on equity, and profit margin. The research findings also show that the same four strategic HRM practices have marginal impact on current ratio, quick ratio, debt-asset ratio and debt-equity ratio.

Introduction

Scholars from different disciplines have suggested various conceptual frameworks as explanations for the links between progressive HRM practices and organizational outcomes. For example, Pfeffer (1994) claimed that employee participation and empowerment job design (team-based production system, extensive employee training, performance-contingent incentive compensation, and others) are widely believed to improve performances of organizations. Similarly, Huselid (1995) concluded that HRM practices affect turnover, productivity, and financial performance of organizations. However, not all HRM practices have the same effect on organizational outcomes. While some HRM practices have a significant effect, others have a marginal effect. According to Delery and Doty (1996), strategic HRM practices have the most significant effects on organizational outcomes such as productivity, turnover, and firm financial performance.

Previous research did not focus on the relationship between strategic HRM practices and organizational financial performance. For example, Delaney and Huselid (1996) examined the relationship between HRM practices and organizational outcomes including financial variables, productivity, and turnover. Although the authors examined the relationship between strategic HRM practices and financial performances of organizations, they limited their study to one job and one industry (the loan officer and the banking industry) and selected two financial variables (return on average assets and return on equity).

We extend Delery and Doty's (1996) study, and include various types of industries and more financial variables to examine the impact of strategic HRM practices on firm financial performance. The results of our study provide a better understanding of the role of
strategic HRM practices in creating and sustaining firm performance and competitive advantage.

**Background of This Study**

This section deals with how HRM practices affect organizational outcomes, the emergence of strategic HRM practices and their impact on firm performance, the identification of strategic HRM practices, and the selection of related firm financial variables.

**How Do HRM Practices Affect Organizational Performance?**

There is substantial uncertainty as to how HRM practices affect organizational performance, whether some practices have stronger effects than others, and whether synergies among such practices can improve organizational performance (Milgrom & Roberts, 1995). Conceptually, HRM practices can be classified in terms of their impact on employee skills and ability, motivation, and their work method structure. For example, organizations can adopt numerous HRM practices in order to enhance employee skills.

One such approach concentrates on improving the quality of the individuals hired, or on raising the skills and abilities of current employees, or on both. Employees can be hired via sophisticated selection procedures designed to screen out all but the very best of potential employees. Indeed, research indicates that selectively in staffing is positively related to firm performance (Becker & Huselid, 1992). Another approach deals with how organizations can improve the quality of current employees by providing comprehensive training and development programs after selection. Considerable evidence suggests that investments in training produce important beneficial organizational outcomes (Knoke & Kalleberg, 1994).

However, the effectiveness of the skilled employees will be limited if these employees are not adequately motivated to perform their jobs. The structure of an organizational HRM system can affect employee motivation levels in several ways. For example, organizations can implement merit pay programs or incentive compensation systems which provide rewards to employees for meeting specific goals. A substantial body of evidence has focused on the impact of incentive compensation and performance management systems on firm performance (Gerhart & Milkovich, 1992). In addition, protecting employees from arbitrary treatment, via a formal grievance procedure, may also motivate employees to work harder because they expect their efforts to be justly rewarded (Ichniowski, Shaw, and Prennushi, 1994).

Moreover, the manner in which a workplace is structured should affect organizational performance to the degree that skilled and motivated employees are directly involved in determining what work is performed and how this work gets accomplished. Employee participation systems (Wagner, 1994), internal labor markets that provide an opportunity for employees to advance within a firm (Osterman, 1987), and team-based production systems (Levine, 1995) are all forms of work through which the provision of job security encourages employees to work harder. It is also unlikely that rational employees will identify efficiencies that will enhance changes in work structures if such
changes would eliminate their current jobs (Levine, 1995). Based on these arguments, we expect that strategic HRM practices significantly affect organizational performance.

The Emergence of Strategic HRM Practices and Their Effect on Firm Performance

During the last decade, there has been a dramatic shift in the field of HRM. This shift has broadened the focus of research on HRM from micro analytic research that has dominated the field of HRM in the past to a more macro or strategic perspective. The strategic perspective of HRM has grown out of many researchers interest to demonstrate the importance of strategic HRM practices for organizational performance (Delery & Doty, 1996).

The basic premise underlying strategic HRM practices is that organizations adopting a particular strategy require HRM practices that are different from those required by organizations adopting an alternative strategy (Jackson & Schuler, 1995). If this fundamental assumption is true, then much of the differences in HRM practices across organizations should be explained by the organizational strategies. Thus organizations that have greater congruence between their HRM practices and their strategies should enjoy superior performance (Delery & Doty, 1996). There is some support for these assumptions. For example, Arthur (1992) concluded that organizations following different strategies utilize different HRM practices. Other researchers (e.g., Arthur, 1994; Huselid, 1995) asserted that HRM practices can influence organizationally relevant outcomes such as productivity and profitability.

To emphasize the impact of HRM practices on organizational performance, numerous researchers have developed a universalistic perspective and argued for a "best practices approach" to strategic HRM practices, and proposed that all organizations should adopt these best practices. For example, Pfeffer (1994) argued that greater use of his 16 management practices (employment security, participation, empowerment, incentive pay, training programs, promotion from within, skill development, etc.) would produce higher profit and productivity across organizations. Likewise, Osterman (1994) demonstrated that a number of innovative work practices (teams, job rotation, quality circles, total quality management, etc.) would result in productivity gains for all American organizations. In general, the practices identified by Pfeffer (1994) and Osterman (1994) have been labeled "high performance work practices" or simply "best practices."

Focusing on the financial performance of organizations, numerous authors have explored the links between individual strategic HRM practices and some financial variables. Cascio (1991) suggested that the financial returns associated with investments in strategic HRM practices are generally substantial. Boudreau (1992) concluded that the value of a one-standard deviation increase in employee performance measured in dollars is equivalent to 40 percent of salary (per employee), and the HRM practices that can produce such an increase are very significant.

Although most of the empirical work on this topic has been conducted in laboratories, Becker and Huselid (1992) presented field data suggesting that an increase in standard deviation may in fact benefit well in excess of 40 percent of salary. Similarly, Terpstra and Rozell (1993) found a significant and positive link between the extensiveness of recruiting, selection test validation, and the utilization of formal selection procedures and profits of organizations.
Russell, Terborg, and Powers (1985) also demonstrated a link between the adoption of employee training programs and financial performance. Borman (1991) developed a similar link between performance appraisal and compensation. Gerhart and Milkovitch (1992) claimed that such performance appraisal and compensation have also been connected with increased profitability of the organization.

The Identification of Strategic HRM Practices

Strategic HRM practices are those that are theoretically or empirically related to overall organization performance. Although not all HRM practices are strategic, there is growing consensus among researchers about which can be considered strategic HRM practices (Delery and Doty, 1996). Drawing on the works of several researchers (Osterman, 1987; Sonnenfeld & Peiperl, 1988), Delery and Doty (1996) identified seven practices that are consistently considered strategic HRM practices. These are:

1. internal career opportunities;
2. formal training systems;
3. appraisal measures;
4. profit sharing plans;
5. employment security;
6. employee participation and voice mechanisms;
7. job description.

All these practices are among Pfeffer's (1994) sixteen most effective practices for managing people.

First, internal career opportunities refer to the use of internal labor markets. In other words, organizations can choose to hire predominantly from within or from outside. Second, training systems refers to the amount of formal training given to employees. Organizations can provide extensive formal training, or rely on acquiring skills through selection and some socialization. Third, appraisal is defined as the degree to which performance appraisals focus on outputs or results measures, rather than on behavioral measures.

Fourth, profit sharing refers to the extent to which employees receive bonuses based on organizational profit. Profit-sharing plans can be an integral part of a strategic human resources system. Fifth, employment security refers to the degree to which employees are secure in their jobs. Sixth, participation or voice mechanisms refers to the degree to which employees are allowed to have input into their work and the degree to which the organization values their input. Both formal grievance systems and participation in decision making have emerged as key factors.

Seventh, job description refers to the extent to which jobs are clearly and precisely defined. The degree to which jobs are tightly or narrowly defined is very important. Tightly defined jobs are those jobs in which employees know the exact job specification. The job is limited in scope, and incumbents only perform duties that are considered part of the job. The job duties are shaped by a well-defined job description rather than by individual action.
We concur with Delery and Doty (1996) that these seven practices are the most critical characteristics of employment systems in organizations. Therefore, we used these practices as the basis for our hypotheses investigated in the study. Although there are other HRM practices that might affect the performances of organizations, the seven practices listed above appear to have the greatest support across a diverse literature. We restrict our arguments and analyses to these seven strategic HRM practices.

Selected Organizational Financial Variables

Prior work on the measurement of corporate financial performance is extensive. Weiner and Mahoney (1981) stated that the number of independent variables is almost infinite when measuring firm performance. Hence, the selection of variables used in measuring financial performance of a corporation is left to the discretion of researchers. Because corporate financial performance is less straightforward, we have selected three profitability variables (return on assets, return on equity, and profit margin), two liquidity variables (current ratio and quick ratio), and two leverage variables (debt-asset ratio and debt-equity ratio).

Hypotheses

The literature review suggests that HRM practices affect firm performance. Therefore, strategic HRM practices should be related to at least some relevant outcomes of firms. Arthur (1994) claimed that because progressive HRM practices increase employee discretionary effort, strategic HRM practices would affect firm outcomes such as turnover and productivity. Bartel (1994) asserted that because returns from investments in HRM practices exceed their real costs, lower turnover and greater productivity should in turn enhance the firm’s financial performance.

In the hypothesis listed below, the strategic HRM practices refer to the seven practices identified earlier, namely, internal career opportunities, formal training programs, result-oriented appraisals, profit sharing, employment security, employee participation and voice, and a well-defined job description. Based on these arguments, the following hypotheses have been formulated:

- **Organizational profitability variables**

  H1: There is a positive and significant relationship between return on assets (ROA) and strategic HRM practices.

  H2: There is a positive and significant relationship between return on equity (ROE) and strategic HRM practices.

  H3: There is a positive and significant relationship between profit margin (PRM) and strategic HRM practices.
• **Organizational liquidity variables**

  H4: There is a positive and significant relationship between current ratio (CR) and strategic HRM practices.

  H5: There is a positive and significant relationship between quick ratio (QR) and strategic HRM practices.

• **Organizational leverage variables**

  H6: There is a positive and significant relationship between debt-asset ratio (DAR) and strategic HRM practices.

  H7: There is a positive and significant relationship between debt-equity ratio (DER) and strategic HRM practices.

**Research Methods**

The research methods used in this study included sample and procedure of data collection, survey questionnaire, measures, and data analysis. Each method was carried out according to the following procedures:

**Sample and Procedure**

While Delery and Doty's (1996) study was limited to the banking industry, our study included various types of industries because strategic HRM practices may vary across industries. In addition, the results of one industry need to be validated in other industries to rule out industry as an important factor. While the previous study was also limited to a single job within the banking industry (the loan officer job), our study included various jobs because the best HRM practices for one job may differ from those that are the best for other types of jobs. The description of one job may also limit the external validity of the findings of any study that uses one job.

A stratified random sample was selected of 1,050 firms according to a procedure used in previous research studies. First, the total population of industries was stratified into three categories: (1) Assets greater than $25 million and less than or equal to $100 million; (2) Assets greater than $100 million and less than or equal to $300 million; and (3) Assets greater than $330 million. Subsequently, 350 firms were randomly selected from each asset category, resulting in a total sample of 1050 firms. The data from HR managers were collected by using the survey questionnaire which was adapted from Delery and Doty's (1996) study. Each mailed questionnaire was given a code to identify each surveyed firm.

Only data from fully completed questionnaires returned by HR managers of surveyed firms were collected. The data included responses of HR managers, financial variables and control variables.
Measures

This study required measures for the strategic HRM practices (independent variables) and the firm's seven financial dimensions (dependent variables).

- **Strategic HRM practices**—The adapted survey questionnaire was used to measure the seven practices identified in this study. Each HRM practice was measured by the mean scores assigned by respondents to the items associated with each practice. Each item was used into a statement expressed on a five-point Likert scale. Higher scores indicated the existence of the measured item (The Appendix presents the survey questionnaire items associated with all measures).

- **Corporate financial performance**—This study incorporated seven financial measures in order to measure the seven financial variables identified in this study. Financial data for the responding firms (identified by certain codes) were collected from Compact Disclosure, Moody's Industrial Manual, the Standard & Poor's Guide and annual reports. The surveys were completed in 1998 and the year end measures for 1998 were therefore taken as the measures of financial variables.

- **Control variables**—The control variables included the size and the age of the firm. The firm size was measured as the total dollar value of assets. The age of the firm was measured by the number of years from the founding date.

Results

A total of 294 (28%) usable questionnaire were received from the responding HR managers of the surveyed firms. Data analysis in this study included the obtained responses of the responding HR managers to the seven strategic HRM practices, and the required data for the seven financial variables and the two control variables.

The matrix correlation presented in Table 1 shows moderate correlations between several strategic HRM practices. These correlations indicate that strategic HRM practices are not completely independent. Table 1 also shows correlations between the four strategic HRM practices (employment security, profit sharing, training, and result-oriented appraisals) and several of the seven financial variables.

Although we could have used hierarchical regressions, we decided to conduct factor analysis due to correlations between some of the strategic HRM practices and between the four strategic HRM practices and the financial variables. The seven financial ratios for the 294 firms, and the mean scores of the response of the responding HR managers for the seven strategic practices were used as input to the SPSS-PCA computer program in order to extract the principal components. Subsequently, the varimax rotation was utilized to obtain factor loadings from the extracted principal components.

The generated factor loadings for the seven financial variables (the dependent variables) were regressed against each of the factor loadings for the seven strategic HRM practices (the independent variables). The outcomes of the seven multiple regression analyses are presented in Table 2. The results provide strong support for the first three
hypotheses (H1, H2, and H3), and marginal support for the last four hypotheses (H4, H5, H6, and H7).

Discussion

The results of this study provided relatively strong support for the universalistic perspective of the best HRM practices. Four individual strategic HRM practices (employment security, profit sharing, training, result-oriented appraisals) have strong and positive relationships with the three profitability variables (return on assets, return on equity, and profit margin). The same four strategic HRM practices have marginal and positive relationships with the two liquidity variables (current ratio and quick ratio) and the two leverage variables (debt-asset ratio and debt-equity ratio).

The relationship between profit sharing and financial performance of organizations supports the explanation of agency theory (Eisenhardt, 1988) and behavioral theory (Katz and Kahn, 1978). Agency theory suggests that basing employee rewards on profits ensures that employee interests are aligned with the owner's interests. However, many profit sharing plans do not distribute profits equally among employees. Instead, profits are distributed differently according to employee performance. In terms of the behavioral perspective, profit sharing may be seen as universal because all business firms strive for profit. By tying employee compensation to firm profit, the firm is rewarding the behavior that is consistent with its overall performance (Delery and Doty, 1996).

The effective relationship between results-oriented appraisals and the firm's financial performance is consistent with agency theory (Eisenhardt, 1988), control theory (Snell, 1991), and the transaction cost perspective (Jones and Wright, 1992). Each theoretical perspective claims that results-oriented appraisals will enhance performance when measures of the desired results are either readily available or are less costly to obtain than other performance measures (Delery and Doty, 1996).

The effects of employment security on the firm’s financial performance are more difficult to explain in terms of the theories mentioned above. Granting employment security without monitoring employee performance does not guarantee the employee engagement in appropriate behavior. However, employment security may marginally align the interest of employees and owners. If employees fail to perform in a way that produces continued profits for the firm, the firm may not exist, thereby ending the guarantee of employment security. Moreover, employment security sends a signal that a firm is committed to its employees. If employees reciprocate this commitment, the firm should have a workforce with a high level of commitment and motivation (Delery and Doty, 1996).

The effects of training programs are consistent with the perspectives of the resource-based theory (Barney, 1991), resource-dependency theory (Pfeffer and Cohen, 1984), and human capital theory (Becker, 1964). Resource-based theory assumes that each organization is a collection of unique resources that provides the organizational returns. This theory also argues that a firm is a collection of evolving capabilities that is managed in pursuit of above-average returns. According to the resource-dependency theory, differences in firm performances across time are driven primarily by their unique resources and capabilities rather than by the structure or characteristics of industry. Resources are inputs into a firm's production process (e.g. the skills of individual employees).
Human capital theory views employees as human capital. Human capital refers to the knowledge and skills of the entire workforce of a firm. Much of the development of U.S. industry can be attributed to the effectiveness of its human capital. One-third of the U.S. gross national product between 1948 and 1982 was attributed to increases in the educational level of the U.S. workforce (Hitt, Ireland, and Hoskisson, 1998)

**Implications, Conclusions, and Recommendations for Future Research**

The results reported in this study indicate that the seven strategic HRM practices are viable and lead to different assumptions about the relationships between these respective practices and organizational performance. The results reveal that there are explicit relationships between the characteristics of the employment system of an organization and its performance. Strategic HRM practices can have significant effects on organizationally relevant performance measures. The results also imply that organizations that adopt best or strategic HRM practices can generate greater returns. Such practices include profit sharing, employment security, results-oriented appraisals, and training programs. Pfeffer (1994) pointed out that the implementation of these practices is not always an easy task. Therefore, he argued that it is unlikely that organizations can quickly or easily imitate the practices of the best organizations. Consequently, organizations that adopt a greater number of these practices are likely to gain a short-term competitive advantage and enjoy superior performance.

We recommend longitudinal studies to address the causal relationship between HRM practices and organizational performance. In addition, future studies including other organizational attributes related to both HRM practices and organizational performance are needed to provide more accurate estimates of the full effect of HRM practices on organizational performance.

**References**


Appendix: Measures

Strategic HRM Practices

1. Internal career opportunities (4 items):
   • Individuals in this job have clear career paths within the organization.
   • Individuals in this job have very little future within this organization (reverse coded).
   • Employees' career aspirations within the company are known by their immediate supervisors.
   • Employees in this job who desire promotion have more than one potential position they could be promoted to.

2. Training (4 items):
   • Extensive training programs are provided for individuals in this job.
   • Employees in this job will normally go through training programs every few years.
   • There are formal training programs to teach new hires the skills they need to perform their jobs.
   • Formal training programs are offered to employees in order to increase their prospects for promotion in this organization.

3. Results-oriented appraisals (2 items):
   • Performance is more often measured with objective quantifiable results.
   • Performance appraisals are based on objective, quantifiable results.

4. Employment security (4 items):
   • Employees in this job can expect to stay in the organizations for as long as they wish.
   • It is very difficult to dismiss an employee in this job.
   • Job security is almost guaranteed to employees in this job.
   • If the bank were facing economic problems, employees in this job would be the last to be terminated.

5. Participation (4 items):
   • Employees in this job are allowed to make many decisions.
   • Employees in this job are often asked by supervisor to participate in decisions.
   • Employees are provided the opportunity to suggest improvements in the way things are done.
   • Superiors keep open communications with employees in this job.
6. **Job description (4 items):**
   - The duties of this job are clearly defined.
   - This job has an up-to-date job description.
   - The job description for this job contains all of the duties performed by individual employees.
   - The actual job duties are shaped more by the employee than by a specific job description (reverse-coded).

7. **Profit sharing (1 item):**
   - Individuals in their jobs receive bonuses based on the profit of the organization.

### Table 1: Correlations Among Strategic HRM Practices and Financial Variables in American Organizations

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Appraisals</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Job descriptions</td>
<td>-.24** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Job security</td>
<td>-.19** .11 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Career opportunities</td>
<td>-.31** .28** -.10 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Training</td>
<td>-.18** .21** -.10 .32 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Participation</td>
<td>.21** .18** .06 .27** .32** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Profit sharing</td>
<td>.08 -.05 .06 .07 .11 .16** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. ROA</td>
<td>.22** -.21** .11 .10 -.08 -.146 .24** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. ROE</td>
<td>.07 .07 -.08 .13* .20** .14* -.07 .29** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. PRM</td>
<td>.08 .26** -.22** .09 .10 -.06 -.22** .43** .22** 1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05
**p < .01
Table 2: Regression Analysis of Variance for Strategic HRM Practices and Financial Variables

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>ROA Beta</th>
<th>ROE Beta</th>
<th>PRM Beta</th>
<th>CR Beta</th>
<th>QR Beta</th>
<th>DAR Beta</th>
<th>DER Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Appraisals</td>
<td>.16824 (.05)</td>
<td>.23418 (.01)</td>
<td>.28251 (.10)</td>
<td>.14262 (.10)</td>
<td>.1322 (.10)</td>
<td>.14721 (.10)</td>
<td>.16204 (.10)</td>
</tr>
<tr>
<td>2. Job descriptions</td>
<td>.07253 N.S.</td>
<td>.08471 N.S.</td>
<td>.03631 N.S.</td>
<td>.04417 N.S.</td>
<td>.09011 N.S.</td>
<td>.10022 N.S.</td>
<td>.09011 N.S.</td>
</tr>
<tr>
<td>3. Job security</td>
<td>.23725 (.01)</td>
<td>.26183 (.01)</td>
<td>.28417 (.10)</td>
<td>.13782 (.10)</td>
<td>.14112 (.10)</td>
<td>.12111 (.10)</td>
<td>.14221 (.10)</td>
</tr>
<tr>
<td>4. Career opportunities</td>
<td>.11257 N.S.</td>
<td>.09846 N.S.</td>
<td>.03761 N.S.</td>
<td>.06842 N.S.</td>
<td>.08261 N.S.</td>
<td>.09116 N.S.</td>
<td>.11021 N.S.</td>
</tr>
<tr>
<td>5. Training</td>
<td>.31425 (.01)</td>
<td>.18846 (.05)</td>
<td>.22731 (.01)</td>
<td>.16125 (.05)</td>
<td>.16884 (.05)</td>
<td>.16224 (.05)</td>
<td>.15524 (.05)</td>
</tr>
<tr>
<td>6. Participation</td>
<td>.06628 N.S.</td>
<td>.02744 N.S.</td>
<td>.07572 (.05)</td>
<td>.08001 (.05)</td>
<td>.03331 (.05)</td>
<td>.02994 (.05)</td>
<td>.01989 (.05)</td>
</tr>
<tr>
<td>7. Profit sharing</td>
<td>.35112 (.01)</td>
<td>.24221 (.05)</td>
<td>.19224 (.10)</td>
<td>.12828 (.10)</td>
<td>.13421 (.10)</td>
<td>.13110 (.10)</td>
<td>.12648 (.10)</td>
</tr>
</tbody>
</table>

R-squared = .4827 | .4122 | .3847 | .2161 | .1825 | .1975 | .2638

Adjusted R-squared = .3746 | .3421 | .3128 | .1858 | .1821 | .1663 | .2218

F-Ratio = 2.4 | 13.2 | 6.8 | 2.8 | 2.6 | 2.3 | 3.4

Significant levels are reported between two parentheses
N.S.: Not Significant
Institutional Subscription

Please enter a subscription to:

The Journal of e-business and Information Technology

☐ Check enclosed  ☐ Visa  ☐ American Express  ☐ Master Card

Name
Library/Institution
Address:
City/State/Zip
Credit Card Number  Expiration Date

☐ $120.00 USA/Canada  ☐ $140.00 International

Signature  Date

Call (914) 773-3448
Fax to (914) 773-3533
email: braggad@pace.edu

ISSN 1531-0981
Published Twice a Year

Edited by:
Bel G. Raggad, Ph.D.
School of Computer Science and Information Systems
Pace University
Pleasantville, NY 10570

(New York residents add sales tax: 6.00-8.00%)
Individuell Subscription

Please enter a subscription to:

The Journal of e-business and Information Technology

☐ Check enclosed ☐ Visa ☐ American Express ☐ Master Card

Name ___________________________ Title ___________________________

Institution ___________________________

Address: ___________________________

City/State/Zip ___________________________

Credit Card Number ___________________________ Expiration Date ___________________________

☐ $32.00 USA/Canada ☐ $42.00 International

Signature ___________________________ Date ___________________________

ISSN 1531-0981
Published Twice a Year

Edited by:
Bel G. Raggad, Ph.D.
School of Computer Science and Information Systems
Pace University
Pleasantville, NY 10570

(New York residents add sales tax: 6.00-8.00%)

Call (914) 773-3448
Fax to (914) 773-3533
email: braggad@pace.edu

The Journal of e-business and Information Technology
The American Institute of Management and Information Technology

www.aimit.org

861 Bedford Road
School of Computer Science and Information Systems
Pace University
Pleasantville, NY 10570

President: Bel G. Raggad, Ph.D.

Advisory Board:

Abdur Choudhary, Ph.D.
Bell Labs, N.J.

Hassine Saidane, Ph.D.
NCR, CA

Kamal Jedidi, Ph.D.
Columbia University

Art Hagen, Ph.D.
Grambling State University, LA

Bel G. Raggad, Ph.D.
Pace University, NY

Helping the Business Community:

-----------------------

Data Warehousing and Data Mining Group:

Michael Gargano, Co-Chair
Stuart Varden, Co-Chair

Information Security Group:

Bel G. Raggad, Chair

e-Business Group:

Chuck Tappert, Chair
Journal of e-Business and Information Technology

Instructions for Authors

Aims and Scope of the Journal

The Journal of e-Business and Information Technology is a semiannual international journal which aims to publish articles of high quality dealing with how online business technologies relate to the information technology, addressing various e-business forms and their evolution, and covering all aspects of IT, particularly those touching the Internet.

The intention of the Journal of e-Business and Information Technology is to help the local and global business communities to efficiently exploit IT towards the creation of business value in e-business. The journal welcomes all types of applied research studies in global computing that add value to e-business owners, customers, developers, and evaluators. That is, applied studies in IT, online business technologies (all e-business forms, e-commerce, etc.), and Internet security are particularly sought.

Areas of interest for the Journal include:

- all forms of e-business
- EDI
- e-commerce
- Decision Support
- Data Warehousing
- Data Mining
- Biometrics
- Internet Security
- Cyber Law
- Knowledge Management
- Information Security Auditing

Relevant manuscripts from the field of IT, not in the areas of the Internet or online business technologies, are also considered if they bear implications for the creation of business value in e-business.
The audience of the Journal are members of the local and global business communities, researchers, students, and industrial practitioners doing global computing.

**Preparation of a manuscript submission**

Five copies of the manuscript should be sent to the Editor-in-Chief or one of Associate Editors of the Journal.

Manuscripts should be printed on 8½x11” paper, one side only, leaving 1” margins on all sides. Please single space all materials, including footnotes and references. Number pages consecutively with first page containing the title, the authors, the affiliations, a short abstract (between 150 and 300 words), and five to 10 key words.

It is important that your abstract and key words are as most informative as possible since they are used in identifying appropriate reviewers for your manuscript.

**Exclusivity of submission**

The first page of the manuscript should include the statement “This manuscript has not been submitted elsewhere in identical or similar form, nor will it be during the first 6 months after its submission to the Journal of e-Business and Information Technology.”

**Illustrations**

Only clear reproductions of artwork should be submitted. Authors should keep original artwork until the manuscript is accepted. All figures should be in a form suitable for reproduction.

Each figure and table must be mentioned in the text and numbered consecutively using Arabic numbers in the order of appearance in the text. For the initial submission of the manuscript, the figures and tables should be integrated into the text as much as possible, rather than being inserted at the end of the manuscript.
References

References should be inserted, for books, journals, and articles in proceedings, and technical reports, as follows


Permissions

Authors are responsible for obtaining permission from copyright owners if they use an illustration, table, or lengthy quotes from material published elsewhere. The authors should write to both the publisher and the author of material they are seeking to reproduce.

Copyright

The copyright will be established in the name of AIMIT.

Offprints

Each author will receive a free copy of the Journal issue containing the published article.

Further information

Further information may be obtained by writing (see address below) or emailing to the Editor-in-Chief at braggad@pace.edu or by accessing http://www.aimit.org.

Bel G. Raggad, Editor-in-Chief
861 Bedford Road
School of Comp. Sc. and IS
Pace University
Pleasantville, NY 10570
Phone#: (914) 773-3448
Call for Papers

Data Mining Conference

Pace University and the AIMIT group, provide the opportunity for researchers, practitioners, and students to exchange research, and professional development ideas in the data warehousing and data mining areas under the common theme of “How to Secure Competitive Advantage with Data Mining.”

The conference seeks proposals for Papers, Panels, Workshops, and Demonstrations for three separate tracks:

(1) Technical papers,
(2) Professional development papers, and
(3) Panels, Workshops, and Demonstrations.

Each track will include sessions on completed research and research-in-progress.

The best papers in each track will receive awards and special recognition at the conference. Selected papers will be published in the Journal of e-Business and IT.

Each submission should start with a title page containing the type of submission, the title of the submission, each author's name and affiliation, the contact author's physical and e-mail addresses, phone number, a 150 to 300-word abstract, and a list of keywords.

There are no additional restrictions on the submission format. Guidelines for final versions of the submissions will be provided with the acceptance notice.

Important dates:

Early-submissions deadline: Nov 30, 2001
Late-submissions deadline: Jan 28, 2002 (will not appear in Proceedings)
Notification of acceptance: September 10, 2001
Final version submission: December 18, 2001
Conference: February 22-23, 2002

Authors are strongly encouraged to send their submissions electronically to braggad@pace.edu for:

Dr. Bel G. Raggad
School of CS and IS
Pace University
861 Bedford Road
Pleasantville, NY 10570
Call for Papers

e-Business Conference

Pace University and the AIMIT group, provide the opportunity for researchers, practitioners, and students to exchange research, and professional development ideas in the e-business area under the common theme of

“How to Create Business Value in e-Business.”

The conference seeks proposals for Papers, Panels, Workshops, and Demonstrations for three separate tracks:

(1) Technical papers,
(2) Professional development papers, and
(3) Panels, Workshops, and Demonstrations.

Each track will include sessions on completed research and research-in-progress.

The best papers in each track will receive awards and special recognition at the conference. Selected papers will be published in the Journal of e-Business and IT.

Each submission should start with a title page containing the type of submission, the title of the submission, each author's name and affiliation, the contact author's physical and e-mail addresses, phone number, a 150 to 300-word abstract, and a list of keywords.

There are no additional restrictions on the submission format. Guidelines for final versions of the submissions will be provided with the acceptance notice.

Important dates:

Early-submissions deadline:       June 30, 2001
Late-submissions deadline:       September 30, 2001 (will not appear in Proceedings)
Notification of acceptance:      April 2, 2001
Final version submission:       September 10, 2001
Conference:                    October 5-6, 2001

Authors are strongly encouraged to send their submissions electronically to ctappert@pace.edu for:

Dr. Chuck Tappert
School of CS and IS
Pace University
861 Bedford Road
Pleasantville, NY 10570
In This Issue:

A Management Guide to Data Warehousing
Hassine Saidane, Ph.D., Lucent Technologies

Business Value Creation: How Do Aligned Firms Organize IT for Value?
Thomas F. Brier, IBM Advanced Business Institute

SCR Control for Large DSS: Base vs. Delay Costs
Nazar Younes, Ouman University
M.S. Gouider, ISG de Tunis
M. Zaghdoud, ENSI de Tunis

Impact of Strategic HRM Practices on Corporate Financial Performance
Morsheda T. Hassan, Louisiana Tech University

PACE UNIVERSITY

Dr. Bel G. Raggad, Editor
School of Computer Science and Information Systems
Pace University
861 Bedford Road
Pleasantville, NY 10570
Phone: (914) 773-3448  Fax: (914) 773-3533
email: braggad@pace.edu