

# USING A TRAIT APPROACH TO ANALYZE THE IMPACT OF GLOBAL INFORMATION TECHNOLOGY APPLICATIONS

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## Abstract

*The objective of this study is to investigate how global IT applications are being used and to develop a means of assessing their impact. Building on the prior work of Palvia (1997), Sethi and King (1994), and Mahmood and Soon (1991), a multi-factor global IT impact model is developed. This model exhibits a high degree of reliability and validity. From a theoretical perspective, this study develops a measurement model that can be used to evaluate the use and impact of IT in a global environment. From a practitioner's point of view, the study provides a better understanding of the factors that influence the use and impact of global IT applications.*

**Keywords:** Information Technology, Global Information Technology, Information Technology Impact, International, Global Information Technology Impact, Measurement of Information Technology Impact.

## Introduction

In recent years, the application of information technology (IT) to support and drive globalization of business has received increased attention. Today IT provides the ability to coordinate the activities of globally dispersed employees, customers and suppliers; increase the efficiency and effectiveness of important organizational functions and processes; and manage data, information, and knowledge across borders. This study develops a typology of how global IT applications are used and recommends a means of assessing their impact. The multi-year window used in the study provides a long-term view of the subject.

Information technology is a broad domain that includes not only information and data processing but also voice, video and image applications and systems. For purposes of this study, information technology is defined to include all aspects of computing and communication including the hardware and software for: management information system applications, office support, transaction processing systems, decision support and executive information systems, telecommunication networks,

Internet, multimedia applications, databases and data warehouses. Information technology provides the means for the preparation, collection, transport, retrieval, storage, access, presentation, and transformation of information in all forms (voice, graphics, text, video, and image) (Boar, 1994). Global information technology (GIT) applications are defined as IT applications that are used across national borders, in two or more countries or regions of the world. This includes IT applications designed to provide a global infrastructure (for example, a global extranet); global inter-organizational systems; as well as functional intra-organizational systems used on a global basis. These are IT applications that make it possible for a business to be efficient, effective, and competitive in a global environment.

The use and impact of global IT applications are important issues for businesses today. Information technology is an essential ingredient for business expansion, providing strategic competitive advantage in worldwide markets (Ives and Jarvenpaa, 1991) and facilitating globalization (Palvia, 1995). It also serves as a magnifier of business competitive strategy and as a vehicle for building new strategies and new business (Bakos and Treacy, 1986). Information technology use by firms can dramatically compress time and distance; facilitate the coordination and movement of worldwide goods and services; allow for the sharing of human expertise and other resources; and provide the infrastructure necessary for operating new services that generate real competitive advantage (Huff, 1991). In the past three decades, major strides in the use of IT have been made in the United States, Europe, and Asia. As multinational, international, global and transnational companies continue to invest in IT infrastructure and GIT applications, it becomes increasingly important to define a typology of how such systems are being used, and to develop a means of assessing the impact of GIT applications.

The objective of this study is to address the following questions:

1. How do worldwide firms **use** global information technology?
2. What are the dimensions and critical factors that can be used to measure the **impact** of global information technology applications?

## Prior Research

There is a large body of literature on the general subject of information technology. Clarke (1994) describes how the applications of IT have evolved over the years: from the initial role of IT in the 1960's as a way of automating business processes, through the recognition in the 1970's of IT's role in helping to better manage and control an organization, to the ideas in the 1980's of using IT for strategic advantage. Zuboff (1985) uses the terms **automate**, **informate**, and **transform** to categorize different ways IT can be used. **Automate** is the label that covers transaction processing and other IT applications designed to support and facilitate normal everyday business processes. **Informate** describes management support, decision support, and data warehousing types of applications, while **transform** refers to IT applications that significantly change the market and business environment, often labeled as "strategic applications." Global information technology applications fall into all three of these categories. For example, data warehousing, data mining, On-Line Analytical Processing (OLAP), decision support, and executive information systems (all of which fall into the informate category) are used extensively by global firms.

Over the last decade, the literature has emphasized the various roles of IT in fundamentally changing the way firms operate and in generating a strategic impact. One of the more important roles of IT is in "extending" the enterprise. IT can be used to transform organizational boundaries, inter-organizational relations, and marketplace competitive and cooperative practices (Konsynski, 1993, Simon and Grover, 1993). Other examples in the literature that describe ways in which IT can be used to transform the enterprise include the strategic opportunities matrix of Benjamin et al. (1984), the information intensity matrix to assess IT's role (Porter and Miller, 1985), the strategic thrusts framework of Wiseman (1985), and McFarlan's strategic grid (1984). However, these studies address the issues of strategic IT applications in a general way without explicit consideration of the global environment and strategic global IT applications.

A study that specifically addresses global IT applications and the alignment of IT applications with global business strategy is the 1993 study by Ives, Jarvenpaa and Mason. In this study, examples of global business drivers for strategic IT applications are developed. These drivers include the use of IT on value chain activities to:

- Make it possible to share valued human resources on a global scale.
- Disperse a firm's operations around the world to take advantage of economies of scale and cost savings.
- Reduce risk by globally managing a firm's cash flow and assets.

- Help develop global or world products.
- Improve quality by benchmarking against world-class standards.

In addition, the study stresses the importance of using global IT to help manage relationships with external entities on a worldwide basis, including those with suppliers (making world wide procurement possible), and customers (providing worldwide or global customer service and support).

A common thread in much of the literature is the use of IT as a competitive strategy. The global competition theory of Porter (1986) and his use of the value chain concept to highlight the role of IT in competitive strategy (Porter and Miller, 1985) provide some useful insights into the subject. Competition, Porter writes, “is at the core of the success or failure of firms... and competitive advantage is at the heart of a firm’s performance in competitive markets. Today, the importance of competitive strategy could hardly be greater. Firms throughout the world face slower growth... and global competitors are no longer acting as if the expanding pie were big enough for all.” (Porter, 1985) Global IT applications will clearly play a role in shaping global competition. The purpose of this paper is to understand how global IT applications are being used and to define a way to measure their impact.

## Measuring the Impact of Global Information Technology

Most research on the subject of IT stops short of looking at impact measures. Studies are often limited to addressing the question of “fit” (Jarvenpaa and Ives, 1993; Gibson, 1996; Sankar and Palvia, 1993; Karimi and Konsynski, 1991; Gordon, 1993; Deans and Ricks, 1993) or, in some cases, analyzing the correlation between economic performance (or productivity) and IT investment (Brynjolfsson and Hitt, 1996; Mahmood and Mann, 1993). Three studies that address the subject of measuring the strategic impact of IT are Palvia, 1997; Sethi and King, 1994; and Mahmood and Soon, 1991. These studies have shown that the strategic impact of IT is a multidimensional, latent construct worthy of more research. These three works provide the foundation for developing the survey instrument used in this study.

Mahmood and Soon (1991) developed an instrument for measuring the strategic impact of IT. They included both firm and industry level variables in their model. However, their model was primarily limited to domestic issues and did not consider the broader global environment. Although their study was comprehensive and identified many significant components of IT strategic impact, the measurement instrument they developed cannot be used without some modification. Additionally, their sample size was not sufficient to conduct a factor analysis.

Palvia’s work in 1997 extended the Mahmood research to the global environment. He developed an instrument to measure the strategic use of IT and to identify strategic opportunities for using IT in a global business environment. Although Palvia’s instrument was developed using a relatively small sample (~40), it has undergone extensive statistical testing and exhibits a high level of reliability. The overall model is basically a 3-level hierarchy. The first level describes the total strategic impact of IT on a global business. The second level subdivides the total impact into 20 latent variables identifying how IT can be used. The third level breaks each variable down into constituent items or indicators that make up the actual measurement model. The Palvia study does not provide any specific data or conclusions regarding the use of IT by global firms, but recommends an approach that can be used to measure the strategic value of IT to firms operating in a global environment.

The Sethi and King (1994) study is the most comprehensive of the three and has the largest sample set (~130). Sethi and King developed a set of measures for the latent construct they labeled “Competitive Advantage Provided by an Information Technology Application” (CAPITA). A confirmatory factor analysis was made using structural equation modeling to assess the measurement properties of CAPITA. The Sethi and King study, which focused on the analysis and evaluation of specific IT applications, was domestic in scope and did not explicitly cover the global environment.

Although these three studies have some limitations, they provide a strong base for this study and establish the validity of IT impact as a construct that is important and worthy of research. With the exception of these studies, little quantitative research has been done on the subject of global IT strategic impact. There are works on individual components of the subject - for example, the impact of telecommunication networks, EDI, Electronic Commerce, etc. - but no research to date has taken a macro level view of the use and impact of global IT.

The primary focus of this study is on the impact of GIT applications at the firm level. The Sethi and King (1994) study describes two fundamental approaches to measuring IT impact. The one most commonly used is called the **outcomes approach**. This approach relates the use of IT to outcome measures at the enterprise level, such as revenue growth rate,

return on assets, profits, net worth, etc. A limitation of this approach is that these outcome variables are aggregate and thus insensitive to the effects of a single IT application. The second approach, labeled the **trait approach**, identifies traits or attributes that reflect how IT impacts an organization. The advantage of this approach is that it provides insights into the ways IT can impact organizational performance. This is more likely to measure first order impacts while the outcomes approach measures second and higher order impacts (Barna, Kriebel, and Mukhopadhyay, 1995). The trait approach was used in the Sethi and King, Palvia, and Mahmood and Soon studies and will also be used in this study.

The Mahmood and Soon, Palvia, and Sethi and King studies identified a number of important variables that need to be considered in measuring IT impact. The earlier work by Mahmood and Soon (1991) identified twelve variables (see Table 1).

**Table 1. IT Impact Variables Used in the Mahmood and Soon Study**

New entrants	Search costs & switching costs	Internal organizational efficiency & effectiveness
Entry barriers	Market	Inter-organizational efficiency
Customers	Products and services	Pricing
Competitive rivalry	Economies of scale	Suppliers

Recall, however, this study considered only a domestic environment. Palvia, in extending the work of Mahmood and Soon to a global environment, identified twenty variables (see Table 2).

**Table 2. IT Impact Variables Used in the Palvia Study**

Customers	Learning curve
Competitive rivalry	Flexible operations
Suppliers	Resources
Market	Government and County requirements
Products and services	Human resources
Economies of Scope	Alliance and growth
Internal organizational efficiency	Time zones
Inter-organizational efficiency	Coordination
Business risk reduction	Integration
Downsizing/outsourcing	Information systems

Sethi and King, using confirmatory factor analysis, developed a measure with seven factors (see Table 3).

**Table 3. Impact Variables Used in the Sethi and King Study**

Primary activity efficiency	Threat
Support activity efficiency	Pre-emptiveness
Resource management functionality	Synergy
Resource acquisition functionality	

Sethi and King attempted to go one step further and reduce the number of factors to three (efficiency, functionality, and sustainability). However, their data did not support this three-factor model.

In our study, variables identified in all three of the previous studies were included in the survey instrument used to measure GIT impact.

## **The Effect of GIT Use on GIT Impact**

An important premise in this study is that GIT impact is influenced by the manner in which GIT is used (i.e., to automate, informate, or transform). The distinguishing characteristic between GIT impact and GIT use in this study is that GIT use focuses on the intent or the original reason for the GIT application. How was it intended to be used? Why was it implemented? On the other hand, GIT impact focuses on the firm's perception of the impact or value of the GIT application. How has it helped the company?

## **Research Methodology**

This study utilized both archived case data and survey data. The case data provides an understanding and characterization of GIT use and supplemental information about specific firm level variables. In addition, the case data provides details about a firm's perception of the GIT application impact. The case data used in this study was collected by the Smithsonian Institute and is archived at the Smithsonian National Museum of American History. IT applications in the data set were nominated for the Computer World/Smithsonian Award for innovative and creative applications of IT. These nominations were made by a panel of more than 100 senior executives representing companies that are world leaders in the use and development of IT. Although nominations included applications used by firms throughout the world, a high percentage of nominated firms have headquarters in the United States. Nominations were submitted in the following categories:

- Business and Related Services
- Education and Academia
- Environment, Energy and Agriculture
- Finance, Insurance, and Real Estate
- Manufacturing
- Government and Non-Profit Organizations
- Media, Arts and Entertainment
- Transportation
- Science and Medicine

The companies whose IT applications were nominated answered a detailed set of questions related to the IT application including benefits, importance, originality, success, and difficulty. In each of the above categories five finalists, and ultimately a single winner, were selected for the Smithsonian Award.

Global IT applications in the Business and Related Services; Finance, Insurance, and Real Estate; Transportation; Science and Medicine; Manufacturing and Media, Arts and Entertainment categories were selected for this study. There were a total of 278 GIT applications in these categories.

## **Survey Questionnaire Development**

An important component of this study is the development and testing of a questionnaire to measure GIT use and GIT impact. The starting point for this task was the prior research of Palvia, Mahmood and Soon and Sethi and King. The 99 items in the questionnaire are a composite from those studies (see Appendix A for the survey instrument). Because the Palvia study is the only one of the three that explicitly considered the global environment, most of the items were from his study. Many of the items in the Palvia study, however, focused on the strategic impact of GIT. In our study, efficiency and effectiveness were also postulated to be important. Therefore, several of the Sethi and King items were also used.

The survey was mailed to the 278 firms nominated for the Smithsonian award. To increase quality, each survey was addressed to the specific individual identified in the Smithsonian database as the key contact person for the particular IT application. Data analysis is underway. The results of the study will be presented at the SAIS meeting in February 2004.

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