Recent Developments in Information Technology and Its Impact on Global Economy

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ABSTRACT

What can be assured is that the underlying forces that will continue to change business (and government), as the transition into the digital era continues are: 1) technological innovation, 2) societal evolution, 3) changing regulatory constraints, and 4) shifting to a knowledge-based work environment. This paper discusses these four forces, and special consideration is given to the expected main areas of technological innovation in information technology. In addition, this paper discusses the fundamental core competencies which enterprises must develop in order to survive the transition into the digital era.

INTRODUCTION

Information technology (IT) has become a key, if not a pervasive, focus in all sectors of the global economy. This is largely due to the number of issues where the use of computer and software, as applied to global policy, has become so closely entwined. The use of software and computing technology is expanding at a rate, which requires its practitioners to stay current with the state-of-the-art software methodologies and hardware (or platform) technology. The continually decreasing cost of microprocessor and PC technology has significantly influenced the choices available to those wishing to either initially create, or upgrade and/or enhance their current management information systems.

In the global economy which characterizes the last two decades of the twentieth century, and certainly epitomizes the economy today, the basis of competition and wealth generation is efficiently using information, quality, process re-engineering, speed, decision making, employee empowerment, or a number of other popular management "techniques". It is in the innovation of new, highly flexible and adaptable business models that information technology is viewed as the primary tool by which these business models are implemented.

Until the end of the twentieth century, the wealth generation was achieved by means of an organizational approach conceived during the Industrial Revolution. In this model, the organization was established upon various assumptions. The organization was structured based on relatively standard hierarchies with set reporting relationships based on the response to internally focused economic models. Marketing the goods and/or services of the organization became largely based on print and broadcast technology. Manufacturing plants and processing having similarities across industries, became fairly standard practice. Information technology and associated software packages and applications were developed to satisfy these models and practices.

The development of the Internet and Internet-based (or Web-) technologies during the latter years of the 20th century threw all of these assumptions, models and practices into question, as well as into disarray. As computer networks became more dense and pervasive, new and completely different models of how business is managed, and how wealth is created and deployed are emerging. Information technology, as a structural underpinning of all this, must adapt in order to continue to permit implementation of these new models and approaches.

EVOLUTION OF INFORMATION TECHNOLOGY

Since first appearing in the 1950's, Information Technology (IT) has been a central underpinning of business. From its beginning as an electronic adjunct and the replacement of mechanical tabulation machines and other mechanical methods used in accounting, IT has grown in sophistication and complexity. Today it encompasses virtually every aspect of business [1].

As information systems progressed from those which were first experienced in the early 1950's and applied networking technology, the following tools were developed and used across these networks:
- Electronic Data Interchange (EDI)
- Electronic Funds Transfer (EFT)

Electronic Data Interchange

EDI is the electronic communication of business-related transactions (orders, confirmations, invoices, etc.) between companies [2]. Third parties provide these services that enable organizations with dissimilar hardware to effectively communicate and connect.

Value Added Networks (VANs) emerged to provide secure and dedicated interchange of data through intermediaries. These VANs were closed in that the connections between businesses were by agreement and the relatively high cost of installation and maintenance precluded all but the larger organizations from participating in this approach. It is currently estimated that approximately 100,000 companies, on a global basis, are utilizing some form of EDI transaction [3].

Electronic Funds Transfer

EFT is the transfer of funds, electronically, between organizations by computer [2]. It became possible with the development and implementation of secure encryption standards and private, highly guarded and heavily audited networks. The global economy as we know it today, could simply not exist without EFT [1].

In parallel with the development of computer hardware, networking, EDI, EFT and a host of other technologies, software applications and operating systems were also evolving from basic accounting and manufacturing control systems. Enterprise Resource Planning (ERP) systems came into play and represented the technology and software necessary to run the business. These systems became the facilitators for informational exchange.

Until now, there has been no universal and secure way for companies to communicate more broadly. EDI and EFT exemplify what can result when businesses work collaboratively to push their business processes across electronic networks. Yet this success requires the construction, maintenance, and continued enhancement of secure and closed networks that have been built for highly specialized tasks. These networks are inherently too expensive for all but he largest, most financially able, businesses to participate in. This explains the limited penetration of EDI technology The fixed nature of the associated transactions and the general reluctance to incur the high cost factors has restricted the advancement of this type of inter-business functionality.

The question should now arise as to how, then, can the Internet be utilized more effectively? What types of interactions will the Internet support and what will be the manner in which this will be accomplished?

Enterprise Resource Planning

ERP works like an information lubricant and facilitates the exchange of information within the enterprise by unifying key business processes.

Recently, many companies had fully embraced the Internet as the corporate computing platform because it offered a more affordable, practical and flexible solution to the client/server environment. In order to survive, the ERP suppliers had to embrace the Internet as well as transform their systems to make them viable in the new century as well as in the new economy. As such, they had to get themselves interfaced into eCommerce, customer relationship management (CRM), eProcurement, and supply chain management (SCM) [3]. Alll of the large systems (SAP, Oracle, PeopleSoft, and J.D. Edwards) have done a lot of updating their technology and providing solid eBusiness applications to their customers.

ERP vendors deliver only 60-80 percent of the functionality found in eBusiness related point solutions. While many recognize that haring information, mainly, will be controlled by their core ERP package, the competitive advantages to be gained will be obtained only through the successful implementation and utilization of additional best-of-breed point solutions where the opportunity for quantum leap gains is possible [7].

Customer Relationship Management

Most companies consider themselves to be customer-centric. All too often the reality is that they are product-focused. Unfortunately, eCommerce has increased customer expectations and these expectations have raised the standard with respect to expected levels of service.

Three phases of Customer Relationship management (CRM) have been defined [4] and each has a different impact on the relationship with the customer.
1. Acquiring new customers-by the promotion of highly effective product and service leadership to offer a superior product backed by an excellent service to the customer.
2. Enhancing the profitabilty of existing customers—thus deepening the relationship.
3. Retaining profitable customers for life—by delivering not what the market wants, but what the customer wants. Leading companies of today are focusing on retention of existing customers much more than on attracting new customers.

In order to do all of the above effectively, organizations must integrate multiple applications to their back-end (ERP) systems. No longer is it sufficient for a manufacturing company to link its CRM to its ERP system every few days. Instead, the message is real-time, end-to-end integration across all channels giving the customer a truly "single view" of the organization. This requires linkages to information on orders, support and payment for a complete, positive customer experience [5].

Consequently, CRM functionality is one of the key factors being considered when a company is looking at any ERP software vendor. For example, the new PeopleSoft CRM suite, released in July 2001, includes modules for marketing, field service, sales, help desk, and support—all fully integrated back into their core ERP functionality [6].

In addition to the proper linkage between ERP and CRM functionality, the CRM strategy must also incorporate the appropriate data-collection tools and analysis software. Analysis software allows for the assessment of customer profiles and thus the development of appropriate marketing and sales campaigns and competitive strategies.

Supply Chain Management

In today's new business arena, organizations need to be able to deliver their products and/or services immediately, if not sooner. This "business time compression" factor requires organizations to be a lot more intelligent in how they manage their supply chains. As compa-

nies are linking their ERP and CRM systems, there will be a need to provide similar linkages to Supply Chain Management (SCM) and Supply Chain Planning (SCP) functionality.

Very simply, SCM is the coordination of material, information and financial flows between and among participating enterprises [4]. More specifically:
- Material flows involve the flow of physical product from suppliers to customers through the chain as well as the reverse flow defined by product returns, servicing, recycling and disposal.
- Information flows involve demand forecasts, order transmissions, and delivery status reports.
- Financial flows involve credit card information, credit terms, payment schedules, and consignment and title ownership arrangements.

Web EDI

Traditional EDI consists of formatting transactions and providing some form of communication most often through a value-added network (VAN). In Web EDI, users must have applications that are able to extract data from internal systems and format it in EDI transaction sets. Partners, on the receiving end, must be capable of accepting this information and must also establish acceptable levels of data security and other issues such as the timing of the communications. Additionally, the resulting message needs to be managed on an end-to-end basis.

Most companies using Web EDI favor use of extensible Markup Language (XML) because it has a flexible architecture that is easy to change and maintain. When XML is used to transmit EDI, systems on both ends must be able to import and export XML documents.

Another issue associated with Web EDI is that of security. Many companies get very uncomfortable moving from the privacy afforded by the VAN to the "wide world" perspective of the Internet. Encryption and data authentication tools are available that solve the problem of integrating disparate information systems residing in different parts of the supply chain. These approaches gather data from these systems and translate it into XML messages.

The benefits of Web EDI are large. The ones most often first noted are higher speed and lower cost of entry since infrastructure costs are eliminated. Secondly, Web EDI encourages transmission of transactions in real time rather than in a batch-oriented mode. Web EDI serves to create more of a real-time environment and thus helps to reduce the user's order-to-cash cycle.

DESIGN AND DEVELOPMENT OF INFORMATION SYSTEMS

The design and development of information systems and their associated infrastructure needs to draw more upon those sources providing insight into organizational dynamics, social psychology, sociology and strategic management. Organizations are complex, dynamic, non-linear systems that do not evolve in any type of steady or predictable fashion [10].

Developers and designers try to adapt the structured nature of computer science to the gray, often confounding world of management.

GENERAL REQUIREMENTS OF A MODERN INFORMATION SYSTEM

Information technology has become one of the most valuable and vital investments made by an organization. Although many studies have evaluated return on investment and the economic value added, the global evidence of the benefit of information technology to the economy has been lacking [1].

Very soon, all organizations will need to conduct eBusiness in order to survive. Easy access to current information and Web-based forums for information exchange will no longer be reserved for large companies, but will become basic tools available to all companies.

While the majority of manufacturers are committed to eBusiness, they remain lacking with respect to many of the essential software components necessary to achieve their goals. For many companies, the building of an eBusiness infrastructure will entail a nearly complete systems' overhaul. This will include the consideration of the main software components detailed below [7] :

a. ERP
b. SCM
c. Order Management/fulfillment
d. Warehouse Management
e. CRM
f. Direct Procurement software
g. Product development tools that include Web-based computer-aided design (CAD)
h. Manufacturing Execution Management Systems (MES)
i. An integration platform that covers both internal and company to company integration

CLOSER VIEW ON THE PRESENT SITUATION OF IT APPLICATIONS IN LARGE-SCALE ENTERPRISES

Present day information technology infrastructure in large-scale enterprises consists of a large computer environment, usually mainframe. Besides, there has generally been a very large investment in the associated software applications that have been always designed to best adapt to the business environment. As a result, these legacy systems normally contain a significantly large repository of knowledge that is used to drive daily business operations and very often cannot be replaced. In many of these environments, old and new technologies co-exist — side by side.

The Internet has caused a revolution by diminishing business boundaries as well as potentially creating the opportunity for transactional volume that will be far in excess of the ability of these legacy systems to process. Besides, the Internet has afforded organizations a way to easily and rapidly access the attention of the maximum number of customers.

The challenge of how to best adapt these existing systems to current and future technology is now a challenge. Most organizations wish to reach a successful adaptation for the following reasons:

• It permits them to reuse the existing business rules that support the current business processes.
• Time to market is shortened since Web-enablement will have the benefit of the time-tested and organizationally acceptable legacy environment.
• Processing costs will theoretically be reduced because existing processes can be reused.
• A dependable and reliable solution is assured because the existing system remains in operation as a part of the newly Web-enabled environment.

While this is certainly a good idea, and financially one that provides minimal risk, it is also one that can create a lot of frustration. It is frustrating because of the amount of time and energy that it requires to make some of these old legacy systems interface to the new technologies that are today prevalent. Some of the fundamental challenges that must be overcome include the following [8]:

• Monolithic architectures
• Valuable data but obsolete access mechanisms
• Diversified user profiles
• Need for more diversified personnel skills

FACTORS AFFECTING BUSINESS EVOLUTION IN THE NEAR FUTURE:

What can be assured is that the underlying forces that will continue to change business as the transition into the digital era continues, are:

a. **Technological Innovation:**
The main areas of technological innovation, at least in the near term will remain the following:
• Wireless communication, which includes cellular communications and satellites.
• Miniaturization of components that will result in the production of new products and services.
• Increases in bandwidth that will allow the capacity of network links to continue to increase.
• The Internet, where the number of public data networks will continue to increase to a point where virtually all data will be stored on a public network of some sort.
• Cryptography, which will permit more secure communication and additional privacy.
• Artificial intelligence will bring more functionality into information systems through the ability to observe patterns in data and experience and help users make more informed decisions based upon this information.
• Optical storage will continue to increase at a very dramatic rate, such that it will soon allow entire movies to be stored on a disk approximating the size of the old three and one half inch floppy disks.
• Electronic Data Interchange (EDI) will become more compatible with the Internet and present networking protocols making itself more affordable to the smaller enterprises.
• Digital imagery is advancing at such a rate that video conferencing will soon be viable from virtually any location on the globe.
• Electronic payments will move from stored value cards to digital cash.

b. **Evolution of Society:**
Society will also inevitably change in the near future. Some of the changes that are foreseen and that will affect business evolution are:
• Ergonomics will flourish as stressed-out consumers indulge themselves in affordable luxuries.
• The vigilant consumer will emerge to manipulate marketers through the tactics of pressure, protest and politics.

c. **Changing Regulatory Constraints**
Today there are in place, a great number of regulatory rules that have an impact on business. Every time a regulation changes, business is forced to conform. The following regulatory trends are emerging which are causing substantial change in the business evolution.
• Globalization of regulatory authority.
• Global free trade has made the concept of trading blocks very effective. The Internet has made location meaningless in the electronic marketplace.
• Privatization and deregulation represent trends that will continue to develop and expand. The implication of the new global economy is that no industry or business an remain protected from competition.
• Regulatory environments of different countries will evolve in a similar fashion as the amount of trade being experienced increases, which will lead to a steady move toward a common set of laws and regulations.

d. **The Transition to Knowledge-Based Work:**
This represents the final shaping force transforming the global economy. This is a shift from the creation of physical value to the creation of intellectual value. During the industrial era, value was added on an incremental basis to physical products at each stage of the value chain. Today, as the transition into the digital era occurs, any product or service increases in its value as additional information is applied.

In the vernacular of the digital era, the addition of information to products and services is termed "knowledge work". Those workers performing this knowledge work need to have the ability to absorb multiple sources of information, as part of their training process as well as in their daily work regimen.

FUNDAMENTAL CORE COMPETENCIES OF ENTERPRISES IN THE DIGITAL ERA

In order to survive the transition into the digital era, enterprises must develop the following set of fundamental core competencies:

- Serving the individual customer rapidly, completely, and on a first contact basis.
- An appreciation and understanding for global electronic commerce: The enterprise must learn to compete in the environment in which everything and everyone is connected. This means communication that is fully electronic and includes real-time response to sales and marketing related issues which are solved on a "first call basis". Any other way of doing business cannot even be considered [11].
- High Trust Culture:
  In the hyper-competitive, speed of light environment being forecasted, it will be imperative for an organizational culture to be developed that is rich in trust and one where class distinction and structure has been eliminated. This must be a culture where information, ideas and communication, flow freely and where workers are not afraid of reprisals due to failure.

CONCLUSIONS

1. Globalization of the economy does not enhance the value of information and its associated systems and infrastructure, rather it is mandatory for survival.
2. Information technology brings together people and information, often with substantial sharing going on between internal departments, but with outside business groups as well.
3. For the last twenty years, there has been a trend that is bringing together the technology related to computing with that of telecommunications. Ever more recent has been the wireless nature of this interconnection.
4. The paper discusses in full details the evolution of information technology stressing the recent developments in this field.
5. The paper discusses, also, the factors affecting business evolution in the near future.
6. The fundamental core competencies, which enterprises must develop in order to survive the transition into the digital era are also discussed.

APPENDIX

eCommerce / eBusiness

Along with the age of the Internet, has come the term "eCommerce" which represents buying and selling over digital media. EBusiness, while encompassing eCommerce, also includes both front-and-back-office applications that form the engine for 21st century information technology infrastructure within the organization. Therefore, eBusiness is not strictly applied to eCommerce transactions; moreover it has to do with the redefinition of old business models, leveraged by technology, to maximize customer value. Thus eBusiness is the overall strategy and eCommerce is an internal facet.

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