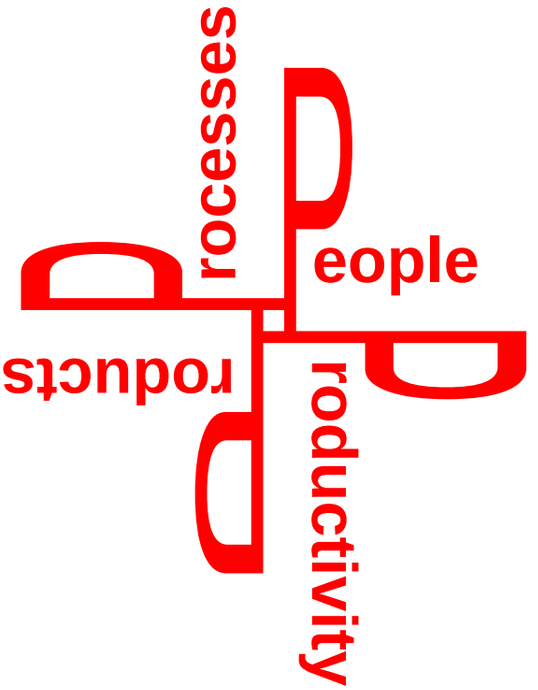
People, Processes, Products and Productivity

An Address to EDGE International

P4.01
Title



by
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Introduction

A few months ago, I was invited to speak to a gathering in La Jolla, California. Logistically, I thought I had the toughest speaking assignment--the speech was scheduled for 1:30 in the afternoon. Let me explain to you what that means -- the west coast folks were ready for their after lunch siesta and the east coast folks were ready for the cocktail hour.

I thought that was probably the most difficult slot in which one had to deliver a speech, until today! If I understand the situation correctly, we have all recently arrived at a magnificent hotel in sunny Florida and I'm the only thing standing between you and a beach party reception! It is a difficult challenge to make anything about work interesting under these conditions, but I will try.

I'd like to invite you to participate with me today. Two very important things are going to happen over the next couple of days:

- You are going to take a few days to decompress and relax. In that process, you will be consciously and unconsciously mulling over the things you do the rest of the year. You may view them in some new and different way. As a result, and in some magic way we don't fully understand, you will bring back to your job new thoughts and new approaches that will make you a better manager.
- You will talk with and share ideas with your colleagues. In that process, you will see some new ways of doing things.

I'd like to invite you to begin that process this afternoon. I've placed sheets at the ends of the aisles. They simply provide a space to note any thoughts you might have as this talk proceeds. The sheet is focused on the four themes I would like to address--people, process, product, and productivity. I invite you to jot down any comments, notions, criticisms, etc., that may occur to you as I talk. Should time permit, I'd like to invite you to share your thoughts at the end of this presentation. Should I run to the end of my time slot--as all university faculty learn to do, I have asked Roxanne if we might find a place to post them. I have asked, if possible, for them to be typed and included as comment on my remarks for inclusion in the proceedings.

It is a particular pleasure to be here for two reasons.

- First and foremost, it is an opportunity to work with Roxanne Sloane. Roxanne, over the last several years, has provided

assistance to my department and to the University of Pittsburgh. It is a pleasure to reciprocate in some small way.
- Second, I have the utmost respect for Xerox. I have had a number of different relationships with Xerox--as customer, consultant, and researcher--over the last twenty years, and they have all been positive.

By way of establishing a perspective, let me say a few words about where I am coming from. If there is a single focus to my research at the university, it is that I am concerned with how people use information, primarily in organizations, and primarily as it is manifest in documents.

I was a line manager for over 12 years, and in that capacity, I managed a technologically sophisticated organization. When I took over the unit, it had an ROI of about .8. Within three years, the ROI had increased to 1.4. where we kept it for the duration of my tenure. In large part that was due to changing the way we used technology in our activities.

My research at the current time is focused on:

- automation of the publishing process, understanding copymarking, developing document handling systems
- understanding organizations, the use of technology in organizations, technological change, and cultural change
- the process by which interactive systems are designed, the use of agents to create intelligent interfaces, and the development of systems for designing interactive systems
- the information technology standards for system interoperation, data interchange, and human-computer interface of systems.

Overview

Some of the major research projects have included Planet Earth--a on-demand custom publishing project; the Unstructured Text Converter--intelligent copymark conversion for Talon(XPS); and Patient Interface Display--Intelligent Interfaces.

P4.02 Overview

I'd like to talk today about the four P's -- people, processes, products, and productivity. It was difficult to decide the order in which these aspects of the puzzle should be addressed. In the final analysis, I decided to begin with people and end with productivity, visiting the processes and the products in the middle. Basically, I will talk about the following:

- People
  - People and Communication

- Technology and Culture
- People, Technology, and Organizations
- Organizations to Support Information Workers

- Processes
  - Technology and Methodology
  - Technological Trends
  - Document Processes
  - Reengineering Document Processing
  - Goals for Corporate Document Processing
- Products
  - Industrial Versus Information Age Products
  - What is a Document?
  - Hyperdocuments and Infobots
  - Corporate Electronic Documents
- Productivity
  - Redefining Productivity
  - Perspectives on Productivity
- PEOPLE

People

P4.03
People Logo

Of the four perspectives, people are without a doubt the single most important. Nothing can be done without qualified, committed, and energized people. A lot of time has been spent over the last several years bashing the productivity of workers, particularly office workers, and particularly US office workers. I suggest to you that this bashing is not particularly well founded. Office workers are hard working dedicated people. Every time I set out to convince myself otherwise, I am brought up short by the facts of the situation. What I find time and again is that it is not the worker who is unproductive, it is the system around them or the conditions they face that make them less than productive. I'd like to say four things about people:

- People are conservative when it comes to communication

P4.04
People Overview

- Technology changes faster than culture
- People make technology work in organizations
- Organizations must support information workers

People and Communication

Technological advances never come automatically. Consider Socrates' condemnation of the written word. The use of technology to improve the communication process -- starting with the written word, is subject to the belief that people have in it.

P4.05
Socrates

> ***This invention of yours will produce forgetfulness in the minds of those who learn to use it, by causing them to neglect their memory, in as much as, from their confidence in writing, they will recollect by the external aid of foreign symbols, and not by the internal use of their own faculties.***

Many people find this quote by Socrates humorous. It was so long ago, and so ludicrous given our current state of wisdom. Consider however, the initial reaction to the new modes of learning inspired by the mass produced book of the fifteenth century:

P4.06 Trust Documents

> ***People had to be persuaded that written documentation was a reliable reflection of concrete, observable events. To the modern mind, the evanescence of the spoken word seems more plastic, quixotic, and undependable than the printed word. To members of a highly oral culture, however, the spoken word was connected to the incontrovertible realities of bodily experience, while the written word was a thin, substanceless scratching whose two-dimensionality seemed highly arbitrary.***[1]

P4.07 Garfield

Indeed, when we see our ability to communicate threatened by technology, we sometimes react less than positively to the technology. It is not an aversion to the technology, it is a reaction to the real or perceived interference.

Technology and Culture

It is important to remember that in a very few years, there has been a major transition in the industrialized world. The pace of technological change has put a tremendous strain on culture, on people. Different countries are at different stages in the transition, but I suggest that by virtue of the fact that you are here, most of you are at the vanguard of the change. Let's think for a second about the magnitude of the change.

P4.08 T&C: Century

- 1870: Agriculture dominates
  - 50% of the workforce is farming
  - 30% of the workforce is manufacturing

Eight out of every ten people are making something

- 1910: Manufacturing surpasses agriculture
- 1960: Information surpasses manufacturing
  - 50% of workforce is information/service
  - 50% of the workforce is manufacturing/agriculture

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1 Zuboff, Shoshana, **In the Age of the Smart Machine: the Future of Work and Power**. New York: Basic Books, 1988, p. 77

- 1990: Information dominates
  - 2% of the workforce is farming
  - 20% of the workforce is manufacturing
  - 80% of the workforce is information/service
- 2000: 90% information/service sector

It is also important to keep in mind the magnitude of the changes as they affect individuals. Some of you may have seen the PBS shows on **The machine that changed the world**. It is the history of the computer. In the last episode, Bob Lucky form Bell Labs is talking about communication and he indicates that some people are concerned about the time it takes to move information from the east to the west coast for financial purposes. There are some who feel that moving information at the speed of light is not fast enough!

With respect to documents, think about some of the things that have changed in the last ten years:

P4.09
T&C: The Decade

- In 1982, the IBM PC and the Xerox Star had just been introduced. Basically, no one had a workstation. Today, 10 years later, it is not uncommon to find organizations that are 90% saturated -- every employee has a workstation.
- Five years ago, and increasing number of people had stand-alone workstations. Today, most organizations are networked or are talking about it. In five years, enterprises will be networked. It is no longer sufficient to communicate internally -- we must also be able to communicate with our partners.
- the volume of electronic information being moved is doubling every 3-5 years.
- in less than 10 years we have gone from 5 day mail delivery, to overnight mail delivery, to the fax, which takes 3-5 minutes, to email which is instantaneous.
- the revision rate for information products, the internal complexity of those documents, and the number of people involved in creating them are all increasing dramatically.

Some people are not reacting well to this pressure. Personally, I don't blame them. I don't want so see it NOW. There are gruesome images of wartime water torture that involves drowning people by forcing water into them with a hose. I apologize for the gruesomeness of the image, but I think it is appropriate if we consider that the poor human brain that has evolved over these millions of years has grown accustomed to a rate of processing information. Over the last several years, we have replaced the water

fountain of information with a garden hose, and most recently an information firehose. Indeed, we commonly talk about this information overload problem, but unfortunately, it is most often in terms of how we can force more into the human brain. The point here is not to suggest we stop. I for one am committed to moving ahead. What we need is to be sensitive to the human components of the problem and to work to build tools to assist in this process. This relates directly to one of the reasons it is so nice to speak at a Xerox function. The Xerox researchers understand better than anyone the architecture and issues that we will face in the information age.

People, Technology, and Organizations

P4.10 Hit any key

We don't yet know enough about the process of introducing technology in the workplace. We know the process can become destructive or non-productive if it is not handled well. Consider the observation that "I just did what you told me."

At the Institute for Research on Interactive Systems (IRIS) at the Rand Corporation, Bikson and other have been studying the process of introducing technology in the workplace.

P4.11 Bikson Overview

We found that site to site variations in the success of implementing new technologies were more fully explained by differences in the implementation process itself than by differences in the systems or in the organizations.[2]

P4.12 Bikson Implement

- Implementation Related Findings

  - Better implementation if social as well as technical issues addressed during implementation.
  - Satisfaction, use, and production increased when learning to use the computer was supported.
  - Implementation is more successful when users feel capable of exerting a substantive, positive influence on the spread of technology.

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2 Bikson,T., Gutek, B., and Mankin, D., Implementing Computerized Procedures in Office Settings. Rand Institute for Research on Interactive Systems, R-3077-NSF/IRIS, p. v.

- System Related Findings

P4.13 Bikson System

  - Implementation success better when users believed software was suited to their needs -- meaningful dialogue.
  - Implementation success better when program was modifiable by user.
  - System use correlated with proportion of the group on electronic mail.
- Sharing workstations correlated negatively with success.

Organizations to Support Information Workers

Consider a change that has occurred over the last 30 years. In 1962, the cost of a computer was near $1,000,000 and the average profession was making in the order of $10,000 when one considered overhead and fringe. When a conflict arose between the human and the computer, the human lost -- they were the less expensive cog in the wheel. Today, a professional, all costs considered probably costs an organization on the order of $100,000 while a computer of the same power as the million dollar computer of 1960 costs about 10,000. Guess who looses when there is a conflict? Lots of things are happening now to make computers more accommodating to humans; here we want to talk about how we might change the organizations to accommodate the people working with the technology.

The nature of work in the information environment is changing. Clearly it differs from the manufacturing environment. While there were early efforts to view office and information work as easily decomposable, we have begun to see the error in that view. Consider, manufacturing automation assumes:

- simple jobs

P4.14 Manufac-Inform Jobs

- isolated tasks
- standardized jobs
- immutable procedures
- predetermined options
- nonsocial functions

Office and information work on the other hand assumes:

- complex jobs
- complete tasks
- varied jobs
- variable scope
- discretionary outcomes
- social functions and support

One of the most important books of the last decade in my estimation, is **In the Age of the Smart Machine: the Future of Work and Power** by Shoshana Zuboff. In the book, she traces the long history of automation -- the application of power technology to the production process. She reviews the impact of Frederick Taylor and the industrial engineers -- you know who they are, they are the people who do the time motion studies, and the document flow studies. They are the people that took the holistic joy out of finishing the job you started. In essence, they are the people who created word processing pools and piece work. They are the people who said anyone can type anything for anybody -- it is simply an I/O process.

Zuboff says that the introduction of the computer has caused something new to occur. Where the steam engine caused automation, the computer causes information. Rather than automating, we are informating. More importantly, while the industrial revolution was characterized by piece work and the fragmentation of work, the information revolution may well be characterized by informated control of the overall process once again. Consider process manufacturing -- a paper mill -- as an early example. Over the last decade, the use of computers has made it possible for a single individual to control the paper making process. No longer the single sheets of the medieval paper mill, these paper mills are massive machines, but it is possible for a single individual to control vast and powerful processes using a computer.

The task then is to make use of this new technology in a way that allows us to help people help organizations. What is needed is a new way to think about people and organizations. In the informated organization:

P4.15 Zuboff Ring 1

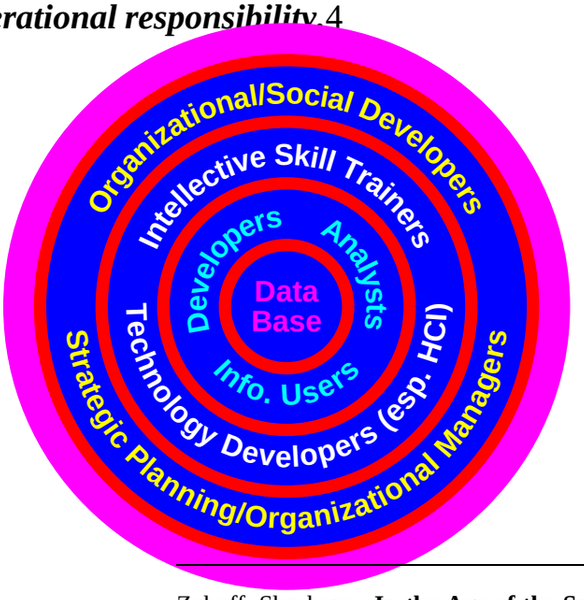
> ***Members can be thought of as being arrayed in concentric circles about a central core, which is the electronic data base. . . On the innermost ring, nearest to the core, are those who interact with information on a real-time basis. They have responsibility for daily operations.***3

What do the concentric circles look like?

P4.16 Zuboff Ring 2

> ***The activities arrayed on the responsibility rings at a greater distance from the core incorporate at least four domains of managerial activity: intellective skill development, technology development, strategy formulation, and social system development. The crucial importance of the intellective skill base requires that a significant level of organizational resources be devoted to its expansion and refinement. This means that some organizational members will be involved in both higher-order analysis and conceptualization, as well as in promoting learning and skill development among those with operational responsibility.***4

P4.17 Ring Graphic

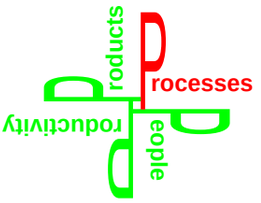


3 Zuboff, Shoshana, **In the Age of the Smart Machine: the Future of Work and Power**. New York: Basic Books, 1988, p. 396

4 Zuboff, Shoshana, **In the Age of the Smart Machine: the Future of Work and Power**. New York: Basic Books, 1988, p.397

Processes

P4.18 Process Logo



Documents are both processes and products. They are artifacts used to store, transmit, and present information. In an important sense, documents are processes -- they are not ends in themselves but mechanisms for communicating information between people.

As we focus on processes, it is important to keep in mind that what is going on today is in many ways fundamentally different from what has gone on in the past. How do we get a feel for the changes that are going to take place in the process as we informate our organizations? I think we can get a better sense of the process by looking at five aspects of the processes we are concerned with. They are:

P4.19 Process Overview

- The relationship between technology and methodology
- The underlying technological trends that will shape the new processes
- The basic processes that can be applied to documents
- The process of reengineering document processing
- The goals of reengineered document processing

Technology and Methodology

For me, technology is a tool that extends human capability. My eyeglasses are technology that extend my capability to see. A car is technology that extends my capability to move from location to location. A book is technology that extends my ability to remember things. A computer is a technology that extends my ability to compute, and more recently to think and reason in some primitive ways. Many people few technology as a tool that allows you to do more of a thing, or as a tool that allows you to do things faster. And indeed there is a lot of support for this way of viewing things. Scholars who have studied technology suggest that the real revolution related to a technology occurs not when we do what we had always done better and faster, but rather when we do things in new ways. Geoffrey James in **Document Databases** discusses the

fact that while technological innovation is required for a revolution, it is not in itself sufficient -- new methodology is also required.

p4.20 James on Methods

> ***Gutenberg's improvement in technology did not by itself cause a revolution in communications. The full impact of his invention was delayed by limitations in the method by which books were produced. Each book was hand crafted to resemble a hand lettered manuscript... The real revolution took place when early forms of mass manufacturing were applied to publications.***[5]

Indeed, there are many who believe that the real revolution related to the book occurred as a result of the efforts of printers such as Aldus Mantius who introduced new book sizes and typefaces. We owe to Aldus, the introduction of a fine italic type in contrast to the scribal gothic of the monks and a new book size -- the pocket book versus the manuscript. It was changes in the methodology of producing books and how people imagined them being used -- as personal belongings rather than social properties -- that caused the revolution.

Technological trends

The new processes that are developed to communicate in our organizations will be shaped by the underlying technologies. It is almost impossible to stay abreast of the of the technological changes, they are just coming too fast. We can hope to stay abreast of the trends, and hopefully, they will help us to see some of the trends in processes that we can anticipate.

Let me ask you?

p4.21 Tech Quest

What is the most significant office/document technology in each of the following eras:
1950-1970
1970-1990

5 James, Geoffrey, **Document Databases**, New York: Van Nostrand Reinhold Co., 1984, p.9

1990-2010

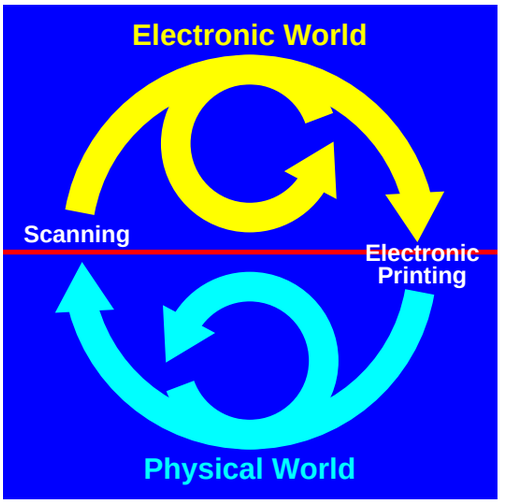
Tech Ques DO.030

p4.22 Base Tech

Technologies today are changing so rapidly, it is almost impossible to stay up with them. I would suggest to you however, that you can stay abreast if you keep your eyes on the underlying technological trends. I believe there are four.

- Digitization:
  - voice transmission and storage(ISDN and AUDIX)
  - image scanning and recognition
  - Digital HDTV
- Accommodation
  - object oriented programming
  - bit mapped displays
    - icons
    - windows
- Standardization
  - SNA/DecNET/XNS
  - OSI/MAP/TOP
  - SGML/ODA/ODIF/FTAM/MHS
  - IGES/TIFF
  - Postscript/Interpress/DDL
  - X windows/NeWS
- Integration
  - The development of multifunction devices
  - Electronic Reprographics (Intelligent facsimile reception, storage, and transmission)
  - Voice/Data workstations with Graphic interfaces

The Importance of Doorway Technologies



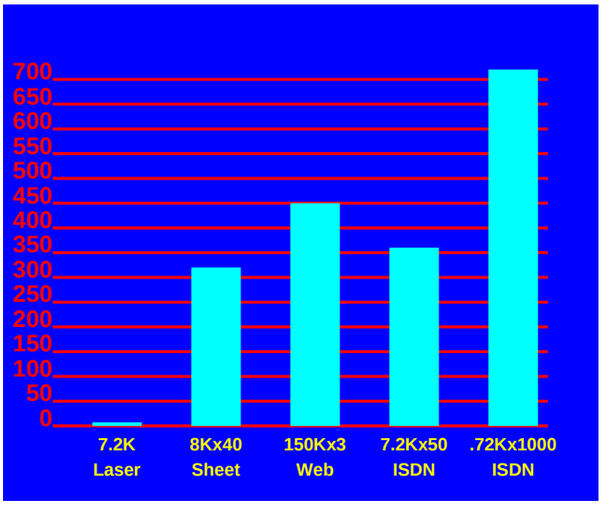
In thinking about these technologies, it is probably important to take one more perspective on them. Computers are and will continue to operate as digital devices in an electronic world. Humans on the other hand are pretty much analog devices in a physical world. Some technologies serve as doorways between these two worlds. There can be significant costs and losses

as information is moved between these two worlds, so some attentions should be paid to these technologies.

p4.23 Doorway Tech-

n o l o g i e s

	Basic ISDN	2.4Kb Modem
210 Text Pgs (@9.6KB)	15 sec	14 min
10 Images (@.12MB)	10 sec	70 min
50 Graphics (@16KB)	6 sec	6 min
Time to Transmit	31 sec	90 min



If one believes that doorway technologies are important, and that multifunction devices are a trend for the future, the movement toward electronic reprographics is clearly important. A single machine can serve as a copier, printer, storage device, facimilie, etc. More importantly, coupled with the right communications pathways, it provides the ability to create a new kind of printing press.

p4.24 ISDN vs Modem

p4.25 ISDN Print

The Basic Processes That Might Be Applied to Documents

We can think about document processes at a number of different levels of detail. For example, creating a document involves the operations of outlining, writing, editing, validating, designing, illustrating, proofing, and displaying. At an overview level:

> ***The processes that may be applied to documents include at very least the processes related to creating them, which are intended to include all the related activities such as editing, deleting, formatting, printing, transferring, disseminating, transforming, etc., and the processes related to accessing them, which include those processes that apply to classifying***

and organizing them for storage and to formulating queries to retrieve them.

p4.26 Doc. Processes

- Accessing
  - Storage
  - Retrieval
- Creating
  - Creation
  - Dissemination

Reengineering Corporate Document Processing

A consultant by the name of Michael Hammer has done a lot of work in the area reengineering work. In essence, Hammer suggests that cutting fat and automating work processes avoid the critical dimension of what needs to be done. He says that reengineering is the process of:

Recognizing and breaking away from outdated rules and fundamental assumptions that underlie operations. Unless we change these rules, we are merely rearranging the deck chairs on the titanic.[6]

p4.27 Reengineering

The basic story is told over and over again -- Ford engaged in an expensive automation process resulting in a 20% headcount reduction in accounts payable personnel. By reengineering the accounts payable process they achieved a 75% reduction in headcount.

The document processing field is replete with processes that need to be reengineered. You perhaps know the examples better than I, but let me give you a couple of personal examples:

- We have known for years that retention of information is increased if text is not justified. I won't go into the reasons why, but the experiments are fairly conclusive. Yet we

6 Hammer, Michael, Reengineering Work: Don't Automate, Obliterate. Harvard Business Review, 90(4), July-August, 1990, pp. 104-112

continue to justify text that we are trying to communicate because justification is aesthetically pleasing.

p4.28 Targets for Reengin

- I can't get my secretary to leave a formatting to the system. For example, she will not use a single carriage return after a paragraph letting the system space it automatically. Tabs and spaces present a problem.
- I recently completed a book on PostScript. In the editing and review process, it became clear that the rule-based component-based document we had created was viewed by the editors as a concrete linear document. We found some interesting things:
  - automated aspects of the document were edited repeatedly -- e.g. header and footer. Not just the title of the book, but the automatically extracted headers.
  - in text changes were made manually rather than by specifying rules. Change all occurrences of x to y.
  - modules that were included multiple times were edited differently at different positions.

What was clear from the experience was that we had two different models of the process of creating a document. The document processing processes need to be reengineered. We know what some of those processes are:

- authoring as a logical design process;
- documents as collected nodes of information;
- storage and retrieval as associationist as well as classificatory processes.

The Goals of Corporate Electronic Document Processing

In general, we are going to look for three kinds of things:

p4.29 Goals of CEP

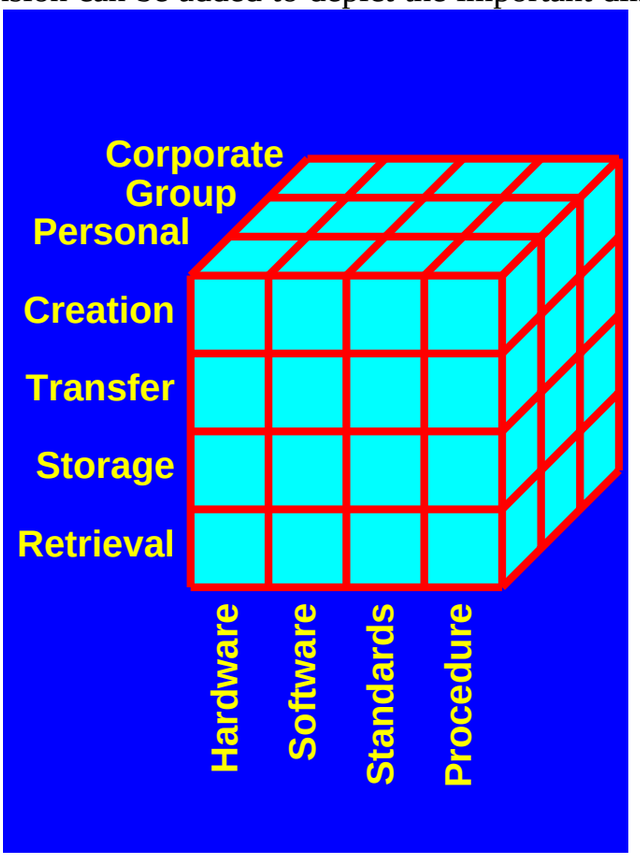
- Significant savings in the time it takes to produce the document, assuming that time is an important aspect of this document production process?
- A reduction in the costs incurred in producing documents. These would generally include the following:
  - reduced printing cost because of reduced pages given typographic fonts;
  - decreased staff time in revision and modification;

  - increased publication value in sales or revenue type uses because of increased readability or attractiveness;
  - decreased costs for historically purchased services -- table layout, org charts, simple graphics, etc.?
- New opportunities to do things previously slightly beyond budgeted capability. For example:
  - updated publications on demand
  - ability do delay processing until the last minute for new data
  - ability to provide (sell) new services
  - increased quality for its own sake

A Framework for Thinking about Corporate Document Processing

p4.30 Doc Proc Matrix

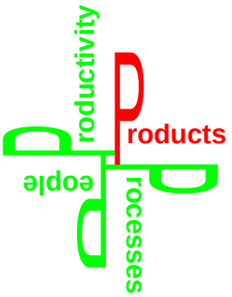
In a lot of my work, I have found it useful to have a matrix which provides a broad picture of the document processing situation in a given organization. By creating a matrix which addresses the major types of document processing activities and crossing it with the major categories of documents, one gets a grid like that shown. A third dimension can be added to depict the important dimensions along which decisions need to be made. Generally there are four -- hardware, software, standards, and procedures.



Products

p4.31 Product

L o g o



Given that so much of our effort is devoted to producing documentS it amazes me we know so little about them. Let me ask you two questions:

Define a document for a Martian?

What will documents of the 21st Century be like?

p4.32 Doc Quest

In this section, I'd like to talk about four things:

- The difference between industrial and information age products

p4.33 Product Overview

- The definition of document
- Two new document types: Hyperdocuments and Infobots
- The likely new products in the near term

Industrial and Information Age Products

In many ways, books as we know them are products of the Industrial Age. I keep books that I will never use again because somehow they make me richer. I think of documents as things to own rather than as containers that transfer information and are then disposed of. There are lots of differences between industrial and information age products. Consider just a few of the characteristics of industrial products:

- products costly to duplicate

p4.34 Industrial Products

- Marginal cost equals average cost
- Assets depreciate with use
- Property ownership singular
- Dividing product diminishes value

- Assets can be identified and protected
- Theft is unambiguous
- Conventional economics applies
  - Value/price can be estimated
  - Costs identifiable
  - Supply demand price understood

In contrast, consider the characteristics of information products:

p4.35 Information Products

- Cheap to duplicate
- Marginal cost approaches zero
- Appreciate with use
- Multiple ownership possible
- Multiple use appreciates asset
- Hard to protect as property
- Theft hard to prove
- Economic theory is lacking
  - True costs hard to isolate
  - Price fluctuates unpredictably

Document

Documents are the quintessential product of the information age. There was a day when a book was a document. Things are no longer so simple.

- Documents include text, graphic, images.
- Documents may be cohesive -- a letter or a report, or disjunctive -- a medical record.
- Documents may be authored by individuals, groups, or organizations.
- Documents may have a lifespan or be archival.

It is difficult to define a document. One effort yielded the following:

> ***A document is an identifiable entity having some durable form, produced by a person or persons toward the goal of communication; it may take a number of forms, but must have a least one symbolic manifestation that used to store or communicate information between people. It is a cohesive***

entity formed of subcomponents in logical, layout, and content form.[7]

p4.36 Doc. Def.

Hyperdocuments and Infobots

I would like to talk briefly about two new forms of documents. The first are hyperdocuments. Vanevar Bush is generally credited with the earliest proposal for a system that has the characteristics that are normally associated today with hypertext, but significant credit goes to many other individuals such as Ted Nelson and Douglas Engelbart. What is significant about hyperdocuments is there base conception. In Bush's mind, they are consonant with the way human's think:

The human mind .... operates by association. Selection by association rather than indexing may yet be mechanized. One cannot hope to equal the speed and flexibility with which the mind follows an associative trail, but it should be possible to beat the mind decisively in regard to the permanence and clarity of the items resurrected from storage.[8]

p4.37 Hyperdoc Association

His initial conception, remember this is 1945, is of a desk and levers.

Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, "memex" will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.[9]

p4.38 Hyperdoc Memex

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7 Spring, Michael, **Electronic Printing and Publishing: The Document Processing Revolution.** New York: Marcel Dekker, 1990, p8.

8 Vanevar Bush,*As We May Think* **Atlantic Monthly**, 176, 101-108, July, 1945.

9 Vanevar Bush,*As We May Think* **Atlantic Monthly**, 176, 101-108, July, 1945.

Hypertext is a manifestation of electronic documents focusing on different modes of creation, storage and retrieval. It is intimately concerned with the interface of human and machine. Hypertext endeavors to allow users to fill text with ideas that can branch off easily, quickly, and naturally from any point in a manner consistent with human thought. Hypertext may provide new methods of document use beyond current physical and electronic handling.

There is another form of document that I have been working on over the last few weeks. In many ways it is related to my work on virtual reality. In an earlier paper, I envisioned a library data space. Rather than creating a virtual physical library where the user would see shelves and book spines, the goal is to allow a user to navigate an idea space:

> ***Consider a system that allows the user to visualize the potential importance of the volumes to a particular research problem. Imagine walking into a virtual library with a query and having all irrelevant data sources appear black, all contrary evidence appear in shades from maroon to bright red, and all supporting ideas represented in shades from midnight blue to blue-white. Related concepts might be depicted in shades of green and yellow. As the researcher proceeds and the research problem is modified, the shades and colors of the entire collection of ideas are modified to reflect the support and contradiction of the new theories....The example could be taken further to associate names in different sizes floating near the bright splotches of color as a mechanism***

for depicting the authors who have written major pieces or are frequently referenced in works related to the query.10

p4.39 Virtual Library

More recently, I have extended this notion:

Finally, returning to the library scenario, imagine a situation where we take the notion of a virtual reality a step further. Borrowing from Ted Nelson, we imagine a hypertext where all human knowledge is stored. This hypertext is situated in a cyberspace. Books and articles are objects in the space.11 ***The document object may be active, like a knowbot (Cerf, 1991, p. 74), but for out purposes more like the converse of a knowbot -- an infobot. Rather than Cerf's knowbot looking for data as a human surrogate, the infobot is a document surrogate looking for humans to inform. The attached procedures include processes to duplicate information, maybe to charge for it, and to navigate the cyberspace looking for readers. Sophisticated infobots might be sent to a sample population--a correlate of the Nielsen families--to***

10 Spring, Michael, Informating with Virtual Reality, **Multimedia Review**. 1(2), Summer 1990, pp 10-11.

11 The scenario assumes a cyberspace infrastructure that is based at the very least on the existence of interconnected and interoperable machines. This particular scenario is based further on the assumption that directory information of the type imagined by the X.400 standard is available--under X.400, information about the user is stored as an adjunct to the user's identifier, and there is a high level of standardization in data interchange formats.

test their attachment rules and to subject them to modification. After suitable testing the objects could be put out on the net to distribute themselves.12

p4.40 Infobots

Corporate Electronic Documents

What will corporate documents look like in the near future? There are several clues based on the current situation. We know today that:

- System documentation continues to grow as systems become more complex. The support documents for the Boeing 747 weigh as much as the 747. Two copies of the documentation for a new drug application will fill the largest moving van available.
- Publishing related expenditures reflect 6%-10% of the gross revenues of the Fortune 1000, and electronic publishing can reduce publishing cost by up to 50%.
- Over two trillion pages were printed in 1986 and nearly 4 trillion were printed in 1990

We know that we need to find ways to deal with the cost, size, complexity, and rapidly changing nature of documents. In response to this, several new forms of documents are emerging. These include:

- custom documents, only what's needed for that customer

p4.41 Corp Elec Doc

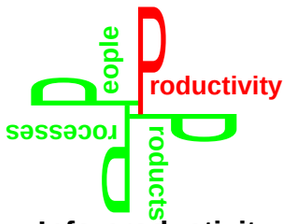
- on-demand documents, documents only when they are needed
- living documents, the source document is always current
- multimedia documents, the needed mode is used
- distributed documents, the document is located near to interested parties
- interactive documents, the document exhibits some intelligence

12 Spring, Michael and Jennings, Michael, Virtual reality and Abstract Data: Virtualizing Information, working paper, Department of Information Science, University of Pittsburgh, in preparation, p 4.

Productivity

P4.42 Productivity Logo

There are a number of different ways to define and measure productivity. This section begins by looking at some of the ways productivity has been defined, and proceeds to an analysis of several of the different measures of productivity that might be used.



Info productivity

What is Productivity

Strassman has suggested that we need new measures of productivity. In the past, in the Taylorian tradition, we have measured efficiency. Strassman has suggested we also need to measure effectiveness.[13] Some of the changes that may be noted as a result of the application of technology to the office are:

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- shift in document creation/distribution work toward the author
- decrease in workload for support personnel as a result of offloading and basic skill automation
- increase in the speed of communication mechanism collapsing the information float
- increased dependence on the new technology for work
- increased rigidity of informal communications
- new forms of electronic networking redefining work group boundaries
- increasingly idiosyncratic personal systems for filing and management of information

Perspectives on Productivity

I would suggest that there are six perspectives on productivity that need to be balanced in examining an organization. These are:

- Playing Field

P4.43 Productivity Measures

13 Strassman, Paul, Overview of Strategic Aspects of Information Management, **Office: Technology and People**. 1(1) 1982, pp 71-89.

- Bottom Line
- Processing
- Transitional
- Standardization
- Procedural Change

Productivity and the Playing Field

The question of whether to employ new technologies is sometimes preempted by conditions in the environment. For example, defense contractors bound by the DOD's CALS initiative14 must use electronic document processing. These organizations have no choice about whether electronic or non-electronic document processing is more productive. If an organization wishes to bid on these government contracts, they must play by the rules specified. As formal and informal requirements for electronic documents spread, the issue of electronic versus non-electronic document manipulation becomes moot. Surely, there will be more or less effective ways to manipulate documents electronically and these will effect productivity as outlined below, but the playing field will be leveled in those cases where electronic document processing is mandated.

Productivity and the Bottom Line

In selected situations, the bottom line productivity measures are easy to find. Drug companies have measures of the time it takes to produce FDA applications for new drugs. If these large composite documents can be produced days or weeks earlier by means of electronic technologies, there are measurable financial benefits to the company. A similar situation applies to airline manufacturers and other companies that produce products subject to government regulations that mandate the delivery of documentation at the same time as product delivery. The cost of holding delivery of a product until the documentation is complete can be measured by the accountants. In general, bottom line measurement of productivity is possible whenever document production is part of a critical path in

14 The Department of Defense has issued a Military Standard(28001) called Computer-aided Acquisition and Logistics Support(CALS) which mandates submission of documentation in electronic form.

the development and delivery of a larger system. In these cases where products or services can be gotten to market sooner, or in greater quantity as a result of better document processing, there are measurable effects on bottom line productivity for the organization.

Productivity and Processing

It is more difficult, but still possible, to examine productivity in document processing in terms of comparative processing paths. The issue at this level is to examine the costs and benefits of a new process applied to a document. Consider the relative productivity of two processes:

- An engineer or scientist, given the technological capability, produces and formats research reports.
- An engineer or scientist produces a written report which is designed, formatted, and finished by a team of graphic artists, secretaries, editors, and printers.

If the engineering department is paying x dollars for production services on a charge back scheme and it costs the department only x/2 dollars to give every engineer access to formatting and printing equipment, then it appears that technology has provided the solution. However, if these additional unfamiliar tasks require more of the engineers time than writing the report and proofing the final copy, and causes the amount of time devoted to research activity by the engineers to be cut in half, it may well be that there is a net loss to the organization in terms of the reduced time devoted by the engineer or scientist to research.

One of the areas in which far too little research has been done is the cost of savings attributable to the decentralization of document processing. The problem can be complex. Imagine a scenario where a manager begins to do more direct keying, thus reducing the time devoted to direct managerial activities, and maintains a secretary who has less to do, but is not eliminated because of selected essential functions that are still performed. In this case, the redistributed workload causes a productivity decrease for both workers. On the other hand, similar situations may yield productivity increases in situations where the consolidation of the document processing task occurs for a worker who currently has a significant amount of unused time.

It is clear that new technologies will allow for a shift in the personnel and workload in the document production process. In

general, there are three aspects that should be examined and assessed when such a shift occurs:

- Most document processing technologies shift effort toward the author. When this shift causes a displacement of other more important functions that can only be done by the author, it is important that mechanisms be provided to prevent the shift. An example of this would be well tailored structural copymarking that minimizes the authors involvement in design while allowing the design to be dictated by the easy and intuitive decisions the author makes about the logical structure.
- When there is a shift, there is not only an increased load, but a decreased load on some other individual. It is essential that the need for support personnel be adjusted either by reduction of personnel or reassignment of duties to offload some other task currently assumed by the personnel being supported.
- Technology may be used to reduce below the line (charge back) costs for document preparation. This can yield an apparent savings in document production at the cost of significantly decreased productivity above the line for functions that are less easily measured(e.g. the research example provided above). It is important to determine in these situations at what cost savings occur, and to adjust the process as appropriate.

Transitional Productivity

Transitional productivity is concerned with the productivity, or lack thereof, that results during a transition period. The introduction of any new system requires that the infrastructures required for both the new and old systems be maintained for a period of time. For example, in the process of moving to a decentralized electronic printing environment, the capability and infrastructure for centralized mass production printing will be maintained. Thus at a given time in the transition, two full systems will be maintained where both are less than optimally used. The cost to the organization may well exceed twice the needed cost in one environment or another. At a more microscopic level, consider that for a period of time secretaries with word processing equipment maintain traditional typewriters. It is likely that either the electronic typewriter or the word processor could handle all the tasks, but because some tasks are more easily handled on one than the other, both systems are maintained. In this

and other cases, capitalization and maintenance cost for both systems are incurred. Perhaps of equal importance, users must maintain old skills while developing new ones. At very least, this doubles the cognitive overhead for users. At worst, there may be negative interactions between the new and old skills, e.g. on an old system, "D" causes a document to be displayed whereas in the new system, "D" causes the document to be deleted.

Transitional productivity is effected by the following factors:

- Full duplicate systems and related infrastructure must be maintained.
- Each system may be used suboptimally for tasks.
- Knowledge and skill requirements for the system are duplicative and potentially negatively related affecting skill acquisition for the target system.

Standardization Productivity

Over time, standards for document processing have developed in the traditional environment. These standards have included the form of business letters, the process of filing, the size of stationery, etc. In the electronic realm, there have been neither formal or informal standards. A document produced on one word processing system could not be edited on another. Standards for file naming have not been forth coming. Productivity decreases when an organization must maintain several different word processing systems because there is no easy migration path for documents produced in one system to documents produced in another. Similarly, the cost of converting documents created in one system to the format for another must result in less productivity. Two types of standards are evolving that will significantly impact document processing productivity. First, technical compatibility standards are emerging which will provide simple and direct machine to machine (OSI, MHS, and FTAM) and program to program (SGML and ODA) transfers. Second, organizational and industry standards are emerging that will allow for these documents to be viewed coherently (EDI, CALS, etc.). In this latter category are also scores of less formal standards that need to evolve. For example, organizations need to establish consistent naming conventions and file organizations for the filing of electronic documents. As structural copymarking becomes *de rigueur*, organizations will need to adopt organizational and industry standards for copymarking of

commonly exchanged documents within the broad technical standards such as SGML and ODA.

Productivity and Procedural Change

The last consideration in measuring productivity has to do with comparing the productivity of changed procedures, by definition an effort to measure productivity in a situation where inputs and outputs can't be normalized -- comparing apples to oranges. If, as has been suggested above, procedures change to make optimal use of the new technology, it is not possible to directly compare the products of the two processes. As an example, consider a company that produces a reference manual for a software system. In the old environment, the documentation is prepared and mass produced for distribution. The documentation is revised and new copies sent out every two years with supplements in between. Under the new process, every system receives updated documentation electronically on a monthly basis. The cost of preparing the master in electronic form is higher than in the traditional mode because of the technology infusion cost. This approach is not productive at that level. The cost of mailing new documentation every month is clearly higher than mailing it every two years. There is no productivity gain from the new technology.

However, consider that the process is taken a step further. The electronic form of the documentation is moved electronically to the installed base of machines. In traditional publishing, the most efficient process is composition, printing, and distribution. Under the new scenario, the source is electronically transmitted and composed and printed at the destination, thus the process is cycled

with distribution preceding composition and printing.15 While the front end costs remain high, overall productivity is achieved by reducing the vendor's production cost, eliminating storage and excess inventory, and reducing shipping costs. If we make the reasonable assumption that the updated manuals are more accurate and, as a result, reduce customer service costs, there are further productivity gains.

In this example, the broad conception of document processing must change before new procedures can be employed that increase the productivity of the document processing function.

15 Consider a document consisting of 100 pages of text with graphic images. At 10,000 bytes per page, the document is 1,000,000 bytes. Bit mapped page images st 1,000,000 bytes per page yield a 100,000,000 byte document. The cost of transmitting the composed document is 100 times greater than transmitting the source. If the source document is transmitted and composed at the destination, there is a cost in CPU cycles at the destination. However, if CPU cycles are virtually free on an underused machine, and assuming appropriate software exists, the cost in this configuration is less. Also consider that it is possible that it could be formatted for any of a variety of output devices relieving the need for multiple compositions at the source.