THE DESIGN OF DIGITAL DOCUMENT: STRATEGIES, PRINCIPLES, AND PROCESSES

by

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A Research Paper

Submitted in Partial Fulfillment of the

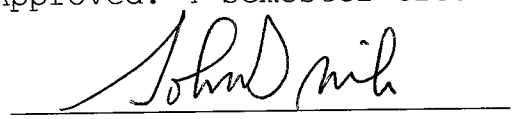
Requirements for the

Master of Science Degree

in

Management Technology

Approved: 4 Semester Credits



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ABSTRACT

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The design of digital document: strategies, principles, and processes

Management Technology

Dr. John Dzissah December/2003 77 Pages

American Psychological Association, 5th edition

Digital documents have evolved to be a cornerstone in support of e-business, which is a new approach designed to provide users with an instant access to information online. The purpose of this thesis is to design a digital brochure for the Material Handling Industry of America. The digital brochure's main features would include pre-defined navigation tools, indexing, and keyword searching functionality. For instance, when a user needs to access a product's detail, the user just needs to click a link in the brochure. From this simple action, the user is able to access the information instantly, which gathers and presents the information according to certain

criteria the user selects. In addition, the user should be able to request and obtain the most updated information by the organization instantly. The digital document is still in an infant stage of development. As the pressure of competition and rapid response to changing requirement continue to mount, the Portable Document Format (PDF), or its successor, will be driven by the corporate world to grow and evolve with society until it is an integral part of business.

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my thesis advisors, Dr. Tom Lacksonen and John Dzissah, for their advice and guidance throughout the development of this thesis.

To Claudia Johnston, thank you for everything you have done for me. I thank you and respect you with all my heart.

Special thanks to Baboopower, who is always beside me, and has faith in me. Thank you for your noise and smiles. Without you I would not make it. Your love makes my life a beautiful place to be. I love having you in my life.

I am most thankful to my beloved family, especially my mom and dad for their love and encouragement. You did all the hard work for me. I am so fortunate to be your son. I would like to extend my love to my only sister, Ying. I appreciate your love and caring. Because we are family, we share a bond. Because we are family, we share a love that will last a lifetime. Life is full of challenges, but our family continues to thrive. That is because it is rooted deep in love. I love you all more each year.

Cheng Li Shan

December 2003

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CHAPTER ONE

INTRODUCTION

Overview of the Study

Effective communication of information is very important to modern business. Whether a firm wants to communicate product information to customers or coordinate with partners efficient communication is crucial to survival. Today companies are expected to deliver more information than ever before, in less time, and with fewer resources. Modern business need to find ways to work more efficiently, without compromising quality.

The majority of Internet marketing and on-line communication requires a digital document delivery system to be in place. This thesis discusses the design principles and how to implement interactive components into digital documents. Programmers today have many options in terms of providing online documentation. The author examines some of the current format options that are capable of delivering information on-line with the aim of developing a PDF file that provides users with the functions of index, navigation tools, text search, and two way communication capability. These components are designed for the purposes of solving potential problems that the user might have with digital documents.

Background

The frequent change in customers' expectation and desires for easy access to information made organizations and companies aware of the importance of digital documents in on-line marketing. A company would typically provide users with product information, and a data sheet. The explosion of digital documents on the Internet and in the workplace has led to an increasing need for a new breed of digital documents that help consumers not only receive information but also be able to communicate with the document's providers to establish better relationships.

Many businesses now skip the traditional printers and publish their products information on-line directly. Doing so provides a few different benefits (Bear, 2003). It expands the marketplace to national and international markets and enables people in other countries and rural areas to receive information and services which otherwise are not available to them. In addition, it decreases the cost of creating, processing, distributing, storing and retrieving paper-based information. Finally, publishing product information on-line enables consumers to access and do their research 24 hours a day, all year round, from almost any location.

Digital documents are now widely available on line; however, the majority of these documents only focus on how to

put pictures and texts on the screen and add more colors in the documents while addressing some file converting issues. What is not covered in these document's designs is whether or not the digital documents provide better user interface than printed documents. The author feels that there is a great opportunity to implement interactive components into digital documents to reach their full potential.

Statement of the Problem

The Material Handling Industry of America (MHI) is a leading nonprofit trade association of material handling and logistics provider. However, some of the data resources are outdated and may not truly reflect the industries in reality. Furthermore, the information is only available in a paper format and there is a growing need for a secure and reliable distribution and exchange of electronic documents and digital forms from the global market. In response, the author will review the literature regarding the developing of interactive digital documentation and develop a framework for converting paper documents to PDF files.

Purpose of the Study

Due to the fact that most digital documents available on-line focus only on digitalizing the original document and not on the advanced features that digital format can provide, many users found that it was hard to navigate through unorganized

digital documents on a computer screen. The purpose of this study is to address these problems and to assess the impact that digital documents has had on the business world.

Objectives of the Study

This study will accomplish the following objectives:

1. Review the current literature in topics of electronic marketing, Web usability, Adobe Acrobat and on-screen navigation.
2. Extrapolate the new trends of digital document in Internet marketing.
3. Determine the new features needed in the revision of "Application Guidelines for Gravity Roller and Wheel Conveyors."
4. Develop easy to follow instructions for other guidelines to follow.
5. Complete an enhanced and interactive digital brochure for MHI which serves as an introductory of roller conveyer.

Significance of the study

The findings of this study will be useful for MHI to update the current "Application Guidelines for Gravity Roller and Wheel Conveyors", as well as for the other brochures that need to be updated. Using JavaScript as a communication channel also provides a new experimental approach that may lead to a new way of document communication.

Limitations of the Study

This study has some limitations that might affect conclusion drawn from the results. They are as follows:

1. The study can only reflect the current software development since the software is rapidly changing.
2. Due to the massive development of JavaScript and the magnitude of the subject, the author can only explore part of whole knowledge within the time given for the study.

Definition of Terms and Abbreviations

The following is a list of terms used in this paper:

ARPANET: A pioneering network. It became operational in 1968 and served as the basis for early networking research (FOLDOC, 2003).

BITNET: An academic and research computer network connecting approximately 2500 computers (FOLDOC, 2003).

CSNET: Computers and Science Network operated by CREN for US computer science institutes (FOLDOC, 2003).

FTP: A client-server protocol which allows a user on one computer to transfer files to and from another computer (FOLDOC, 2003).

HTML: Hypertext, World-Wide Web, standard, a hypertext document format used on the World-Wide Web.

ISP:, a company which provides other companies or individuals with access to, or presence on, the Internet.

JavaScript: (Formerly "LiveScript") Netscape's simple, cross-platform, World-Wide Web scripting language (FOLDOC, 2003).

NSFNET: A high speed hierarchical "network of networks" in the US, funded by the National Science Foundation (FOLDOC, 2003).

OCR: Recognition of printed or written characters by computer.

Portable Document Format: PDF, the native file format for Adobe Systems' Acrobat.

RAND Corporation: The RAND Corporation is a nonprofit institution that helps improve policy and decision-making through research and analysis.

Standard Generalized Markup Language: XML is a generic markup language for representing documents.

Extensible Markup Language: XML is a markup language for documents containing structured information.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter is devoted to presenting a broad overview of the basic concept of the Internet, on-line marketing and the growing use of digital documents. The literature review will also discuss the characteristics of PDF file format. More specifically, the use of JavaScript in PDF files will be explained. For background, the beginning of this section provides basic knowledge about and history of the Internet. The reader should keep in mind that the background material that follows is a bare minimum. There is much more to the world of information and communication than can possibly be addressed here.

Business Customers

According to Perreault and McCarthy (1999), business and organizational customers are any buyers who buy for resale or to produce other goods and services. The business customers act differently from other customers in the following manner:

- The purchase is handled through specialized personnel.
- The customers want to know details and specifications about products.
- The suppliers may need to allow the customers access to all sorts of information.

Application Guidelines

Application guidelines provide descriptions of products in a broad product category to help business customers to develop a better understanding not only of what alternatives exist but also of what specs are best for the particular need (Perreault & McCarthy, 1999). Application guidelines are specially designed to meet the need of "description buying" business customers. Most manufactured items are brought in this manner. In recent years purchasing managers have increasingly turned to the Internet in search of vendors for specific products. This creates a great demand for MHI to digitize their application guideline and publish over Internet. When quality can almost be guaranteed, buying by description may be satisfactory, especially with sufficient information.

Introduction to the Internet

According to Internet Society (2003), the Internet has a world-wide broadcasting capability and is a mechanism for information dissemination, as well as a medium for collaboration and interaction between individuals and their computers without regard for geographic location. In other words, the Internet is a worldwide computer network accessed via modem, special communication lines, or satellite. It can be thought of as a virtual community of cooperation, which covers the entire globe, spanning political, economical, and cultural spectrums. The

Internet is "virtual": it has no physical "home" or dimension, weight, or texture.

A Brief History of the Internet

To understand the importance of the Internet in business today, it is necessary to review the past. Understanding where the online market has been and is currently heading is central guessing where it will go in the future.

The Internet was sponsored by the Pentagon's Advanced Research Projects Agency and initially conceptualized by the RAND Corporation (Internet Society, 2003). The goal of the program was to develop a military communication network that could survive a nuclear war. In 1969, an experimental computer network called ARPANET was created to provide a test-bed for emerging network technologies.

In 1973, Bob Kahn posed an Internet problem that initiated the "Internet" research program to develop communication protocols or agreed-upon standards, allowing networked computers to communicate transparently across multiple, linked packet networks (Internet Society, 2003). From 1980 through 1981, two other networking projects, BITNET and CSNET, were initiated. From 1985 through 1986, the U.S. National Science Foundation connected the nation's six supercomputing centers together. This network was called the NSFNET, or NSFNET backbone, and

today, provides a major backbone communication service for the Internet.

In 1986, NSFNET was created with a backbone speed of 56Kbps (Internet Society, 2003). In 1991, the University of Minnesota developed another network named Gopher. The Web surpassed FTP in March 1995, based on byte count. In 1996, the Internet allowed phone companies to sign up users providing the user access to the Internet and various Internet service providers (ISPs) suffered extended service outages, bringing into question whether they would be able to handle the growing number of users. According to the CIA world Factbook, the Worldwide Internet Population in 2002 estimates 604,111,719.

The Impact of the Internet on Marketing

According to Bock and Senne (1996), digital networking and communication infrastructures provide a global platform where people and organizations interact, communicate, collaborate, and search for information.

The importance of the Internet can not be over emphasized. For marketers, the Web enables products and services to become commoditized due to the constant availability of information to buyers 24 hours a day from anywhere in the world, but more importantly, the Internet provides an information infrastructure that rapidly grows in functionality and bandwidth (Komenar, 1996). The Internet's most important effect is to lower

marketing costs, allowing companies to focus on their market leadership strengths via the Internet to complete the business model. The Internet has also made follow-through easier, which makes tracking and measuring feasible. Brady, Forrest, and Mizerski (1997) categorized four key factors that will contribute to on-line marketing continued growth. They are the growing awareness and use of new media, the growth of the home computer market, the expansion of modern penetration, and the growth of mobile computing and communication.

As a result of all these factors, the use of the Internet for marketing has grown and will keep growing in the future (Bear, 2003). In addition, globalization may also play an important role. Since competing in the global marketplace requires a more efficient marketing method, the Internet also offers the flexibility of different structures and ways to deploy people and resources cheaply and efficiently. Not only is the Internet a new channel to customers, it also transforms all existing channels and can help organizations capture new business globally.

Digital Documents

Throughout history, great people have come up with great ideas. With the invention of the printing press in 1455, these ideas were made available to the masses and the publishing industry was born (Bear, 2003). Now the industry is going

through another revolution as innovations developed during the information age find their way into publishing. Content and ideas are moving from ink and paper into bits and bytes and new technologies are enhancing the publishing process from creation through to final distribution.

According to Bear (2003), there are a few new trends in documents. First, documents are now created and stored in digital format and document distribution is now essentially free when done electronically. Distributing, then printing the necessary information has become the norm. Almost all office workers have a PC and an email address. All document output technologies are going digitally using faxes, copiers, and printers.

The concept of publishing content digitally brings with it many advantages over traditional print publishing (Bear, 2003). Digital documents can be viewed, printed, faxed or sent as an image file to an end-user. Businesses are able to drastically cut printing and postage costs while their clients are able to access information almost instantly from any location. In addition, to handle digital documents, the only equipment required is computing and electronic data equipment. Traditional office equipments like fax machines, photocopiers and file cabinets are not necessary. Handling documents by paper requires more space and equipment and is notoriously prone to error.

Unlike print which can be photocopied and viewed by anyone, digital documents can be safely encrypted and password protected. Large publications can be easily searched with keywords or navigated with a mouse.

Comparing Digital and Paper-Based Documents

Padova states a few advantages of digital documents (2002). First, they require lower operating costs. Digital means smaller, cheaper, better. Hardware and supplies should be substantially less expensive than previous analog technology. To be specific, digital documents can reduce overhead staffing costs, cost spent on delivery, maintenance on printers, long-term retention of documents, and risk associated with fire or theft of documents.

Another advantage of digital documents is that they are efficient (Padova, 2002). There is greater efficiency associated with document retrieval and the access and retrieval of information is increased. Wasted time trying to located documents is eliminated. Documents can be retrieved in seconds not minutes or hours.

The last advantage stated by Padova (2002) is the space saved by digital documents. Organizations are on the verge of not being able to function because of the sheer volume of paper being stored locally.

PDF Documents

PDF is an acronym for Portable Document Format. This format has been designed by Adobe for the exchange of documents on various platforms. Currently the format is used under Windows, MAC, and various UNIX platforms. According to Sahlin (2001), PDF is a format that allows users to display formatted and graphical documents on a computer screen regardless of the originating application. It is a file format used to represent a document in a manner independent of the application software, hardware, and operating system used to create it. PDF is essentially a final format - in contrast to Standard Generalized Markup Language (SGML) based formats which are aimed to be revisable (Anderson, Eisley, Howard, Romano, & Witkowski, 1997). PDF is not primarily aimed at being edited, although it is possible. Final form documents are formatted for visualization on a printer or a screen.

According to Adobe (2003), PDF format includes all the information required to precisely duplicate a formatted page or document for transmission over a network. The major benefit of Adobe PDF files is that they preserve the exact look and feel of any source document, including all the fonts, formatting, colors, and graphics, regardless of the application and platform used to create it and the software installed on receiving machines. It allows for hyperlinks, actions, bookmarks and other

meta-information that makes it suitable for document storage/retrieval. In addition, due to built-in compression and special optimization features it allows for small files and fast downloads, making it suitable for the web. In short, PDF is an electronic version of paper only it can add extra hypertext, links, and other electronic object types, like movies and sounds. PDF files are cheap to create, and are used by many companies to deliver page-formatted information without the high cost of postage (Padova, 2002). Furthermore, the document becomes easier to navigate through and is usually smaller in file size than other formats. It is created virtually for anyone to view, navigate and print in any platform by using the adobe Acrobat reader. According to CNET NEWS (2003), Adobe PDF is gaining tremendous popularity as the basis for new e-business and e-government processes. It supports electronic forms, digital signatures, and electronic mark-ups. It made the ideal platform for converting yesterday's paper-based business documents to fully interactive digital processes.

In addition, PDF format also has the following special features that make it the top choice for digital documents (Adobe, 2003): PDF documents can contain multiple languages; PDF files can be secured with passwords to lock against undesired changes or printing; PDF documents print predictably with proper margins and page breaks; and the view magnification of a PDF

page can be changed which is especially useful for zooming in on graphics or diagrams containing intricate details.

Navigation

The navigation system is design to provide user with faster, easier, and more intuitive searching tools. According to Fleming (1998), a sound navigation system needs to be simple. In navigation design, it is best to avoid burdening users with a steep learning curve. Fleming also believes that navigation systems should be flexible due to the difference in users. It is important to provide alternatives to users.

Acrobat PDF Bookmarks

A bookmark is a type of link with representative text on the bookmarks tab in the navigation pane. Each bookmark goes to a different view or page in the document (Adobe, 2003). Electronic bookmarks are similar to paper bookmarks. In addition, bookmarks can also perform actions, such as executing a menu item or opening a new file.

Acrobat PDF Thumbnails

According to Adobe (2003), thumbnails are miniature previews of the pages in a document. Thumbnails act as hyperlinks. Users simply click the thumbnail to move to that page. However, thumbnails can also be used as zoom tools that let users change the magnification of the selected page.

Acrobat PDF Forms

The definition of an Acrobat form varies greatly among users. PDF forms can be filled in and printed from any application in the Acrobat software and from inside a web browser with the plug-in. the PDF format preserves the appearance of a document, which is especially beneficial for digital forms distribution.

Padova (2002) stated that there are three types of forms. The first is a scanned paper form. These forms are static and intended for the end user to print the file, fill it in, and fax it back. The second type of form is a static form. This type of PDF form is a document authored in the same application, then converted to a PDF. They have a better appearance but the means of completion and routing is the same as that of a scanned paper form. The third type of form is a dynamic form, in which the form's content is created from within Adobe Acrobat. These forms enable users to fill in and route data electronically.

PDF Brochures

According to Hastings, Akselsen, and Cohen (2003), PDF brochures have many advantages over traditional printed brochures. A PDF brochure is like a just-in-time document. People can access information from anywhere at anytime, then they can print it if they want to.

One advantage of a PDF brochure is immediacy: PDF brochures can be distributed electronically quickly and cheaply (Hastings et al., 2003). Information is received almost immediately following a request. Faster and more accurate access would directly reduce contract costs and also help to ensure that relevant information was not as easily overlooked.

Another advantage is that browsing is at the speed of the user's hard drive, not their Internet connection (Hastings et al., 2003). Recipients can store PDF files for viewing later unlike the HTML format which is difficult to save and review off-line.

Cost savings is the third advantage of electronic brochures (Hastings et al., 2003). Printing and distribution costs can be drastically reduced because distributing PDF brochures via web and email costs almost nothing. They can be used in repeat promotions and make the task of distributing documents electronically secure, cheap, and efficient.

The last advantage is that electronic brochures reduce rework: PDF brochures can be created and updated (Hastings et al., 2003). It is possible to keep information current as digital publications can be updated frequently unlike print runs.

JavaScript

According to JavaScript Source (2003), JavaScript is Netscape's cross-platform, object-based scripting language for client and server applications. Scripting languages have been in use long before the Web came around. In the UNIX environment, scripts have been used to perform repetitive system administration tasks and to automate many tasks for less computer-literate users. JavaScript can do many of the same things that other programming languages can do. Unlike C or Pascal, JavaScript is not a compiled language but an interpreted language. The good part about this is that JavaScript can be written by using any text editor, and because no extra compilation steps must be taken before a JavaScript program can be run, development of working scripts is a quick process.

The main characteristics of JavaScript will be explained. First, JavaScript is designed for simple programs (JavaScript Source, 2003). Because JavaScript is a scripting language, it is well suited to implementing simple, small programs. JavaScript is generally used for smaller tasks rather than for full, compiled programs. In addition, JavaScript is designed to perform repetitive tasks and it can interact with users. An important feature of JavaScript is the ability to define event handlers--arbitrary pieces of code to be executed when a particular event occurs. The last main characteristic of

JavaScript is that it can perform arbitrary computation. JavaScript has a floating-point data type, arithmetic operators that work with it, and a full complement of the standard floating-point mathematical functions.

Acrobat JavaScript

Padova (2002) explained that JavaScript is actually a superset of core JavaScript. It is based on the core of JavaScript version 1.5 of ISO-16262. In order to maximize the usefulness of JavaScript in a PDF environment, Adobe added certain extensions of its own to the core JavaScript language. According to Adobe (2003), these core features cover elements such as the language's basic syntax, data primitives, and built-in objects. JavaScript's built-in objects include items such as the Date object as well as String, Array, and Function objects. These Acrobat-specific objects enable a developer to manipulate a PDF file, allowing the PDF file to communicate with a database, modify its appearance, and so on. The Acrobat-specific objects are added on top of core JavaScript; therefore, programmers still have access to standard classes like Math, String, Date, and Array (Padova, 2003).

Acrobat JavaScript Capability

According to Adobe JavaScript scripting guide (2003), JavaScript can control the appearance of form fields: it can change the text font, color, field background color, bounding-

box and type, and other appearance characteristics of form fields at viewing time. In addition, it can perform calculations. JavaScript can create fields on a PDF document that collect numeric data. Like a spreadsheet, JavaScript can specify calculations that can be performed on several field values to yield a desired result.

JavaScript can also respond to a user's actions: When a user interacts with a PDF document, mouse clicks, text entry, and entering or exiting fields are all possible actions that can occur (Adobe, 2003). Acrobat detects when the action occurs and calls the associated script.

Another thing that JavaScript can do is control the behavior of the document: Using document-level scripts can control what happens when a document first opens (Adobe, 2003). Document-level scripts can cause changes that are visible to the user, such as setting up viewing parameters for a PDF. In addition, it can dynamically modify a document's appearance and function. One major advantage of electronic form documents is the ability to dynamically alter their appearance in response to a user's data entry. Some examples include modifying field properties, such as hidden, read-only, required, and do not print; populating list boxes and combo boxes with different choices; altering actions associated with fields and buttons,

such as adding new JavaScript; dynamically creating fields; and generating annotations.

JavaScript is also known for dynamically creating a new page based on an Acrobat page template (Adobe, 2003). Based on user input or action, JavaScript can be used to create or spawn a new page based on a template. In addition, JavaScript can conduct advanced text searches by being used to set up searches that harness the power of the Acrobat search Plug-in.

Introduction to HTML

HTML stands for Hypertext Markup Language. HTML is the major language of the Internet's World Wide Web. Web sites and web pages are written in HTML. Device independence was one of the original design goals of HTML. That means HTML should be able to be used in different computer systems interchangeably. (*The Web developer's virtual library*, 2003).

Problems with HTML

"HTML's simplicity, while making it valuable as a basic way of delivering simply structured information, causes it to fall short of being a long-term method of delivering complex information types" (Travis & Hahn, 1998). HTML format does not provide the fundamental page-oriented formatting capabilities and does not handle multiple-column snaking very well, either. When the file is destined for printing and the precise printed page layout is important, or when there are images which should

be rendered at high resolution on the printed page, HTML format is out of consideration.

Travis and Hahn also stated "Another major problem with HTML is its instability. First, there was HTML, then HTML+, then HTML 2, then a series of decimal-point specifications in the threes, and now a level-4 HTML". The instability creates a serious problem where there are numerous codes that break when presented in a browser. This characteristic of HTML also made HTML format not suitable for delivering digital document.

Introduction to XML

Shall (1998) explained that Extensible Markup Language (XML) is a non-mutually exclusive alternative to HTML and the previously mentioned technologies. In contrast to HTML which describes document structure and visual presentation, XML describes data in a human readable format with no indication of how the data is to be displayed. It is called extensible because it is not a fixed format like HTML (a single, predefined markup language).

Problems with XML

The biggest concern with XML format is the XML specification, which is still relatively new (Walsh, 1998). The potential number of different XML applications is unlimited. There is no magic browser in the market that can handle everything. Flynn (2003) mentioned that Electronic Data

Interchange (EDI) has been used in e-commerce for many years to exchange documents between commercial partners to a transaction. However, when EDI documents have to travel inside XML, it will raise several issues. For instance, when using XML to replace EDI for business to business transactions, the element names and document structure are not usually given. Those vertical XML efforts are usually called "vocabularies" or "taxonomies." The problem is there are over a thousand different business vocabularies based on XML at the time of this article. Mapping business information into XML and EDI can be very complex. In short, XML cannot provide the same consistency of document appearance as PDF format.

CHAPTER THREE

METHODOLOGY

Introduction

The purpose of this chapter is to give readers an overview of the whole project process and the sequence of converting paper based document into PDF file.

Methodology

The following steps are adopted for the design of a digital brochure: needs assessment, problems assessment, strategy development, and procedure development

Needs Assessment

Before we decide on the style of the digital brochure, there are three key questions to keep in mind. Those questions serve as a compass to guide us though design process. They are:

1. Who are our clients?
2. What do we have to do to provide the best information possible?
3. How has the digital driven change in this design?

The main purpose of this digital brochure is to provide industrial clients fast access to information. The usability is the most important part of this project. If users find it difficult to find the information they need, the document is defeating its own purpose. Enhancements that will be used in this project to enrich the user's experience are embedded

thumbnails; and interactive table of contents with a hyperlink; a custom navigation bar; one click function buttons will print, search, and resize a document; interactive forms that can be filled in, reset, and automatically submitted over the web; and detailed bookmarks.

Problems Assessment

PDF has been criticized for the technological state of its user interface. Despite the built-in tools, the document interaction is still predominantly page-based and considered tedious to read on screen. As with digital brochures, there are challenges that need to be addressed before PDF documents can become truly accepted. Following are some of the main challenges that hamper the success of digital documentations.

According to Nielsen (2003), PDF was designed to specify printable pages. Thus, PDF content is optimized for letter-sized sheets of paper, not for display in a browser window. The navigation system is not in a linear manner. In addition, PDF pages lack navigation bars. For a long document, the inability to easily navigate them takes a heavy burden on users.

Another challenge is that PDF is not the standard Web page format; it takes users into a non-standard user interface (Nielsen, 2003). Presenting users with a non-standard Web page that both looks different and follows different rules can make user reluctant to accept the contents.

Another challenge in using PDF a document is that searching is cumbersome (Nielsen, 2003). Most PDF files are large with little or no search function. Lacking a decent search function, users often give up, close the page and go elsewhere. In addition, common browser commands do not work. PDF lives in its own environment with different commands and menus. Even simple functions like printing or saving documents are difficult because often standard browser commands do not work.

Strategy Development

One of the most important features in this project is navigation design (Fleming ,1998). The navigation system needs to provide the user with a faster, easier, and more intuitive searching capability than any other type of build-in browser functions. Users depend on it because they need information and they need it right away. The following is a list of strategies to address those problems describe in the problems assessment.

First, be simple (Fleming ,1998). Poor layout creates a bad initial impact and leads to more confusion. Users of the Internet have little time to sort through content. Many electronic information resources are extensive in their range of content, however, this often frustrates users as they have to browse through large documents to find information that is of relevance to them.

The second strategy is to be compact (Fleming ,1998). In order to make it easier to download a file via the Internet the file must not be larger than three Megabytes. Reduce multimedia usage whenever possible. The rate of change in the computer industry is phenomenal, but bandwidth has not kept up. Multimedia has high impacts on users. It is compelling, but it is not the best media for providing information due when the file size needs to be minimal.

Another strategy is to be compatible by using only the functions that are compatible with older vision of Acrobat. As with any Internet software, many users are slow to upgrade when new formats ship. PDF version 6 was released recently, but even among Internet professionals, there are still many people who have Acrobat version 4 installed on their machine.

The last strategy is to be intuitive (Fleming ,1998). The navigation system has to be able to answer the following questions from users at all time:

1. Where am I?
2. Where can I go?
3. How will I get there?
4. How can I get back to where I once was?

Procedures development

Figure 1 shows the major tasks in the process and the working sequences. The detail procedure is reviewed to a greater extent in chapter four.

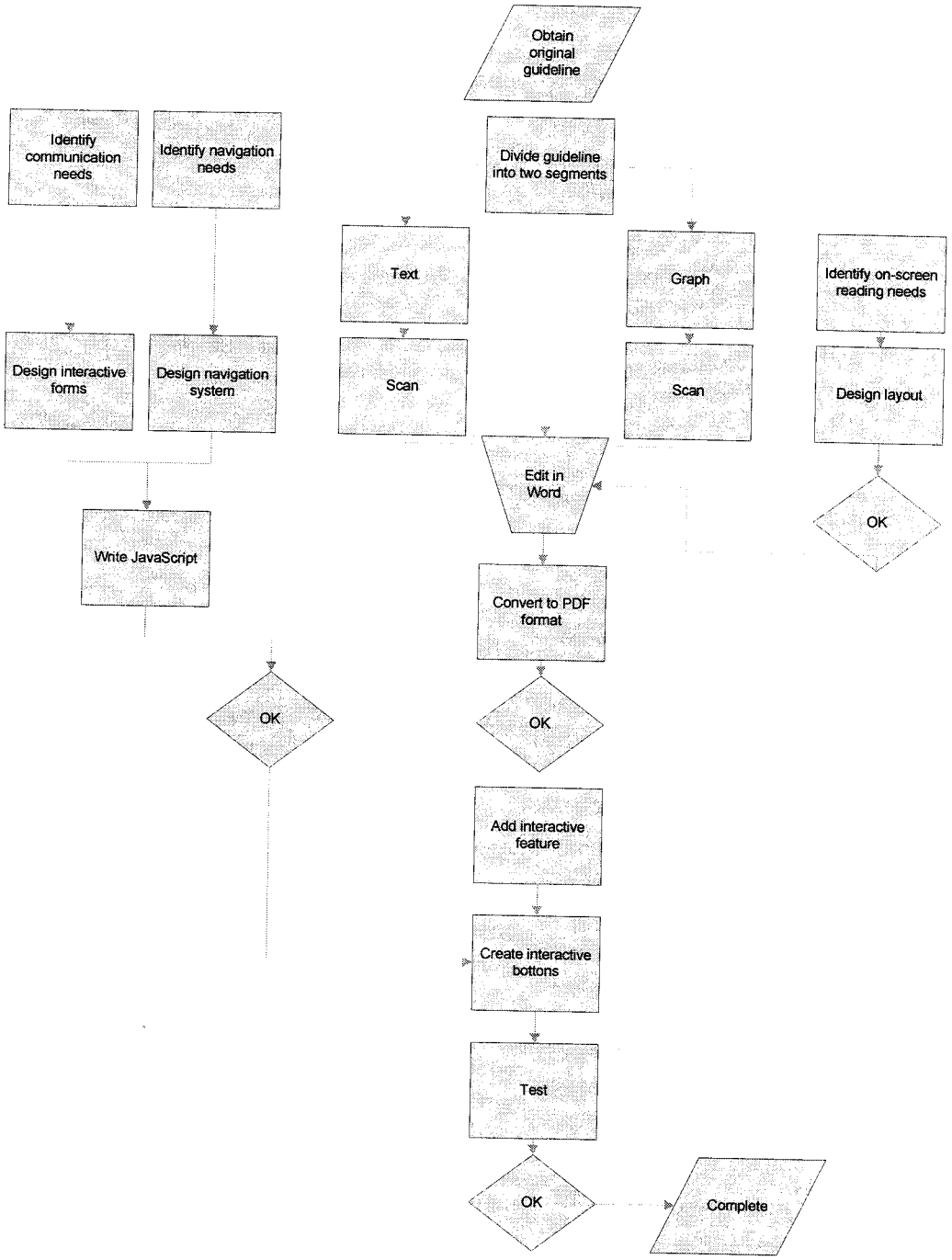


Figure 1. Flowchart

CHAPTER FOUR

DIGITAL BROCHURE CREATION PROCEDURES

Introduction

The basic procedures of creating a digital document can be categorized into four phases which are setup, scan, convert file format, and add file enhancements. This chapter will explain the five essential phases used in this project. It also demonstrates a framework for integrating JavaScript navigation components to enhance PDF documents.

Document Setup

Prior to the actual creation of the document is the design phase. In order to determine the basic form of the document, the following factors were assessed.

1. Layout of document: The primary purpose of document will determine its basic layout. The objective of this project is to provide information to potential customers. Therefore, the document should consist of illustrations and photos plus descriptions of the products depicted.
2. Color selection: Colors have symbolism and meaning that affect readers in many ways. Color adds impact to design; however, printing in color can be expensive and impractical.

3. Font selection: In order to make sure that the document can be opened properly, the font used needs to be one of the build-in fonts.

Text Acquisition

Text acquisition is the method by which text is created (such as typing or scanning) and imported in to a document(Bear, 2003). The main text of this project is scanned from the original text. After the text images are captured, Optical Character Recognition (OCR) is used to convert those images into editable text. There were several techniques used in this project to improve the accuracy rate.

The first technique was to recondition the original document. This was done by ironing it. The second technique was to use a high resolution setting by scanning at 300dpi or higher. In addition, the contrast and brightness should be adjusted to ensure that the background is white and free of smudges. The last technique is to break the original document into pieces because graphics, lines on forms, columns of text, and other formatting will cause problems. By breaking the scanned original down into smaller chunks and running OCR software on each part separately, the accuracy rate will dramatically improve.

Image Acquisition

The images used in this project are mainly scanned from the original document. The major difference between scanning for print and scanning for the web is file size. Finding the right balance between file size and image quality is the major task during the image acquisition.

The following techniques work well for producing good quality, small file size images for digital documents (Bear, 2003). First, change the default image format and use GIF format. GIF is a compressed file format suitable for an image that will be used on the Web or on multiple platforms. In this project, the document contains mainly line art graphics such as logos and technical drawings; therefore, GIF format can achieve consistency of solid detail in any computer environment.

Second, change the default image resolution and use the highest resolution possible. Resolution determines the amount of data in a scanned image. By using the highest resolution, images can provide the most details of original drawings.

Third, edit images. Adjust the black and white threshold. Changing the black and white threshold applies only to images that use the black and white output type. Also use filters to reduce undesirable patterns and noises in printed items. In addition, resize images to the output dimensions.

Creating PDF Documents

PDF documents can be used in a variety of effective ways. In this project, the goal is to create an interactive PDF document. The document will not only be read in linear fashion but also be navigated like a web page. In Acrobat, there are several different options for producing a PDF document: from authoring applications, EPS files, and scanned documents and by using Internet service or capturing websites as PDF documents

This project used Acrobat to create PDF files from Microsoft Word files. It is one of the easiest ways to create a PDF document. The procedures used in the project were

1. In Acrobat, choose File>Create PDF> From File.
2. Select the file type from the files of type menu, and locate the target file to convert.
3. Click the settings button to change the conversion options.
4. Click OK to apply the setting.
5. Click Open to convert the file to an Adobe PDF file.

Or use the Adobe PDF buttons within Microsoft Word.

1. Click the convert to Adobe PDF button in word tool bar.
2. In the save PDF file as dialog box, specify a document name and directory.
3. Click Save to complete the conversion.

Adding Navigation Tools to the Document

When creating a PDF document within an authoring application, there are two types of navigation devices that are created automatically: bookmarks and thumbnails. Page thumbnails are miniature previews of the pages in a document. Thumbnails act as hyperlinks and can also be used as zoom tools that let the reader change the magnification of the selected page.

Bookmarks are an important part of any multi-page PDF document. A bookmark is a type of link with representative text on the bookmarks tab in the navigation pane. They serve as a substitute for a table of contents in documents. Bookmarks function similarly to links in a web browser. When selecting a bookmark, it transports reader to the associated location in the document. However, it is usually necessary to further enhance the functions and appearance of thumbnails and bookmarks.

1. Enhancing thumbnails

    - Embed page thumbnail. To show thumbnails may take several seconds for all the page thumbnails to be drawn. This technique allows documents to show thumbnails without redrawing every time. Do the following:
        - Click the pages tab in the navigation pane.
        - Choose embed all page thumbnails from the options menu.

- Associating page actions with page thumbnail to enhance the interactive quality of document. In this project, the action is set to increase the accessibility of the document. To set this action use the following steps:
  - Click the pages tab in the navigation pane.
  - Select the page thumbnail corresponding to the page.
  - Choose page properties form the options menu.
  - Choose "go to a page in this document."
  - Set the zoom rate in the dialog box.

Figure 2 shows the embedded thumbnail pane created in this project.

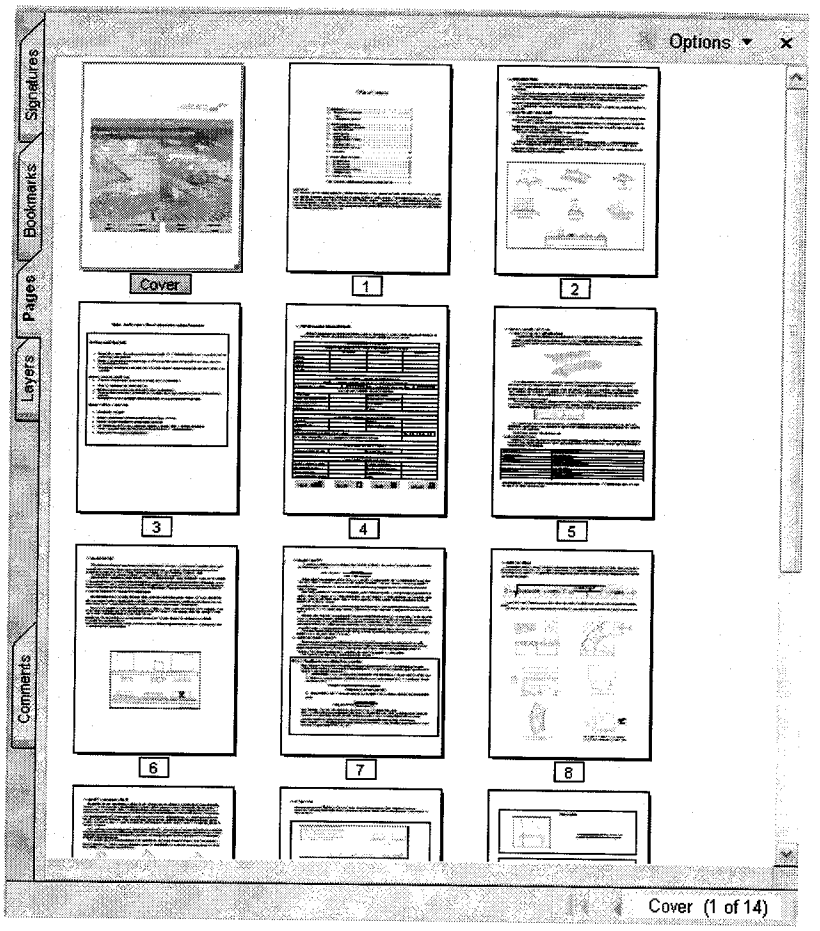


Figure 2. Thumbnail Pane

2. Edit Bookmarks

- Change a bookmark's name and appearance:
  - Select the bookmark in the bookmarks tab and choose rename bookmark in the options menu.
  - Enter a new name for the bookmark, and then press enter.
  - Select the bookmark and right-click and select properties. In the appearance tab, change the color and style of the text.

- Arrange Bookmarks. The original bookmarks are created in descending order from the first page of the document to the last. Due the the large number of bookmarks, rearranging them is necessary.
    - Select a bookmark or range of bookmarks.
    - Drag the icon directly underneath the parent bookmark icon.
    - Release the icon.
    - The bookmark is nested; however, the actual page remains in its original location in the document.

Figure 3 shows the bookmark created in this project.

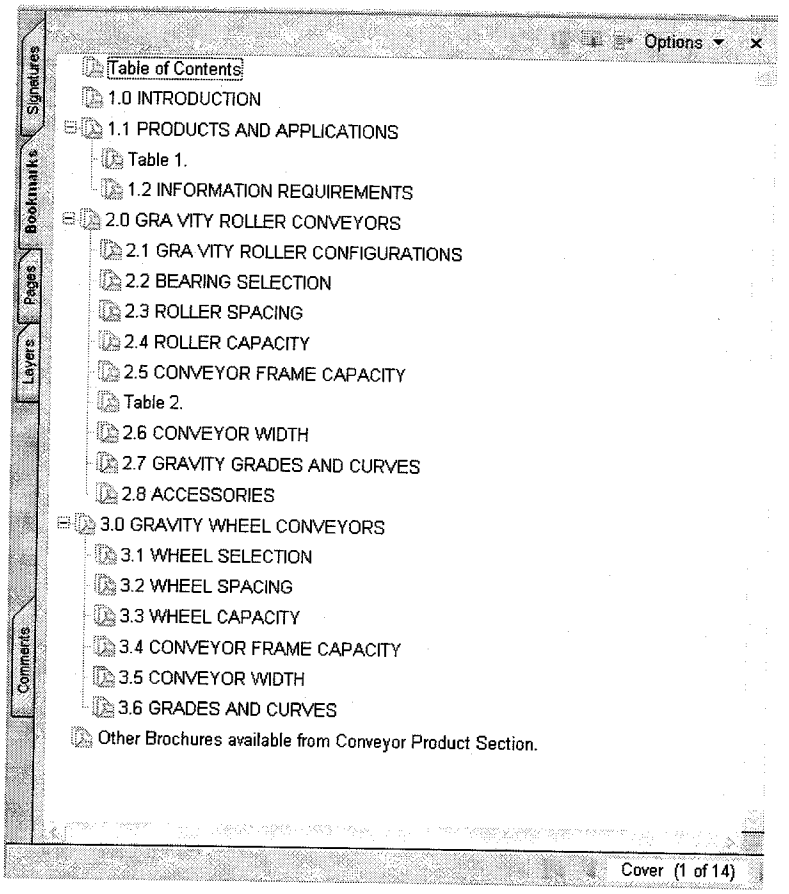


Figure 3. Bookmark

Adding Interactive Elements to the Document

PDF format is well known for its cross-platform page display and publishing ability, but very few people aware of the program's powerful interactive opportunities (Padova, 2002).

Creating interactive buttons.

Buttons are an easy, intuitive way to let users in initiate an action in Adobe PDF documents (Padova, 2002). They offer great potential for enhancing the visual and interactive quality of a document. Buttons can have a combination of labels and icons to lead users through a series of actions or events by changing as a mouse is

moved. A button can trigger multiple actions.

Instead of just moving to a page, a button action can move to a page while playing a movie along the way. Experienced Acrobat users may be familiar with bookmarks and thumbnails used in navigating a document; however, some of the users might find it difficult to navigate multi-page documents. In this project, a typical navigation with menu functions like a web page navigation bar was created to assist viewer. There are many different function buttons used in this project. Each and every button is created in a similar fashion to the following:

1. Select the button tool. Tools> Advanced Editing> forms >Button Tool.
2. Drag the cross-hair pointer to create the button area.
3. Open the Button Properties dialog box.
4. Click the appearance tab, and then specify options to determine how the button will look on the page.
5. Click the Options tab, and select options to determine how labels and icons appear on the bottom.
6. Click the actions tab, and then specify options to determine what happens when the button is clicked.
7. Test the buttons.

Figures 4 and 5 show the navigation bar and interactive buttons created in this project.

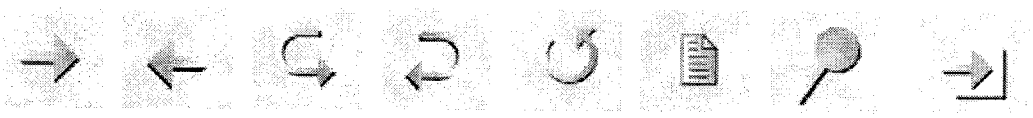


Figure 4. Navigation bar

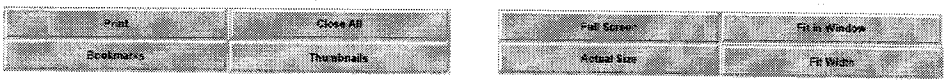


Figure 5. Function bottoms

- Create Forms

Form can be filled in, printed, and sent electronically. Forms allow companies to retrieve information from readers of PDF documents. The form tool can create interactive form fields. There are different types of fields according to their functions. One type is a text field, which can be created for text data entered. Users can fill in text such as name, address, and e-mail address. Another type is a check box field. Check boxes are the simplest type of fields and they share the same tabs as the other form field types. Check box fields are used to check a single item to make choices from several options. Another type of field is a list box field. List boxes are used for selecting one or more options from a scrollable window. Combo box fields are yet another type of field.

Combo boxes are similar to list boxes. They present a list of items in a pop-up menu for the reader to choose from or allow the user to enter their own values. The last type of field includes radio buttons. Radio buttons are similar to check boxes. They present the user with mutually exclusive choices. The user can lonely select only one of the many options.

The procedures used to create forms in this project are as follows:

A. Choose Tools> Advanced Editing> Forms> show forms toolbar.

B. On the Forms toolbar, select a forms tool.

C. Drag the pointer to create a form field.

D. Access Form field properties.

E. Click the General tab, and then specify the general properties.

F. Click the Appearances, and then specify the appearances properties.

G. Click the Actions tab, and specify any action that is desired.

- Use JavaScript to submit the form and feedback.

A. Attaching PDF forms to e-mails.

- Select the button tool
- Click Action tag. Choose JavaScript.

- In the JavaScript Edit dialog box, enter the JavaScript codes listed in Appendix B:

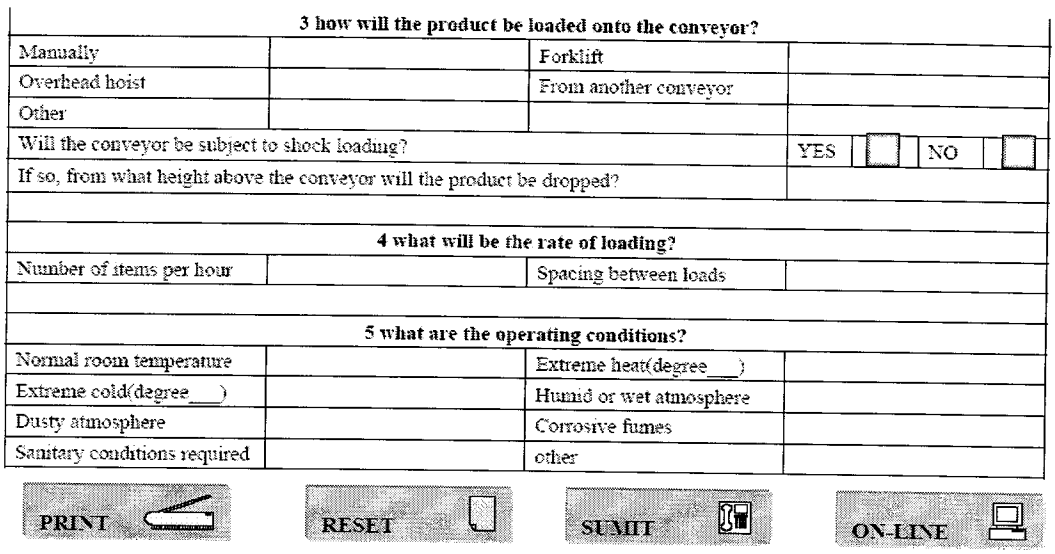
B. Attaching FDF data to E-mails

- Select the button tool
- Click Action tag. Choose JavaScript.
- In the JavaScript Edit dialog box, enter the codes listed in Appendix C.

C. Sending message via e-mail

- Select the button tool
- Click Action tag. Choose JavaScript.
- In the JavaScript
- Edit dialog box; enter the codes listed in Appendix D.

Figure 6 shows the interactive form created in this project.



3 how will the product be loaded onto the conveyor?			
Manually		Forklift	
Overhead hoist		From another conveyor	
Other			
Will the conveyor be subject to shock loading?			YES ☐ NO ☐
If so, from what height above the conveyor will the product be dropped?			
4 what will be the rate of loading?			
Number of items per hour		Spacing between loads	
5 what are the operating conditions?			
Normal room temperature		Extreme heat(degree___)	
Extreme cold(degree___)		Humid or wet atmosphere	
Dusty atmosphere		Corrosive fumes	
Sanitary conditions required		other	

Figure 6. PDF Form

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter summarizes the project results, the significant benefits to MHI, and the conclusions of the study. In addition, recommendations related to this study and future research regarding the issues were addressed as well.

The Results

The final PDF brochure features

- A combination of communication components: Different correspondence is packaged into the same publication creating additional marketing opportunities. For example, user feedback can automatically be included with E-bills and statements.
- End User Convenience including instant navigation, quick downloads, easily searchable content, printing, and search features. Furthermore, the file can be easily forwarded and accessed from the user's system.
- Usability: This digital brochure is designed to represent the ideal method of distributing electronic content for on-screen viewing.
- Immediacy: Content can be distributed almost immediately.

- Security: Private documents can be securely password protected. No changes to content can be made. Print and copy locking is possible as well as password protected content.
- Support personalization of navigation experience: Delivery of highly relevant content specific to even the individual requirements of each recipient is possible. Information likely to be of interest to the user can be preprogrammed.
- Portability: It is easy to forward content that may be of interest to others. The portable nature of this file makes forwarding on by recipients to additional contacts likely.
- Compression: This file is highly compressed to reduce time taken to download.
- Dynamic layout makes it easier to browse content. Index and navigation buttons facilitate user friendly browsing.
- Support Data Calculations: Calculations of input data can be defined within the PDF form if required.
- Friendly for Printing and Saving Forms.

The Benefits to MHI:

- Increase customer acquisition and improve direct marketing.
- Reduce costs through automation of interactions.
- Reduce direct marketing and media expenses.
- Increase customer loyalty and retention.
- Gain insights into customer behavior.

- Resources to identify trends, uncover emerging customer needs, and deliver products or services that meet customer expectations.
- Supports the entire customer interaction cycle.

Technical Limitations

The telecommunications bandwidth is insufficient. Bandwidth constraints can affect end users as well as organizations as large files take time both to send and to download.

Browsing software is often required to view proprietary formats needs to be downloaded. This software is often difficult to download and the file sizes are usually large making email and web distribution inconvenient and costly.

Software development tools are still evolving. Various formats have different strengths and weaknesses depending on the nature of the content. So far there is no single software that can achieve complete functionality, usability, and reliability. Using the incorrect format for a publication can result in the file size of the publication becoming vastly inflated. This is both inefficient for distribution and frustrating for end users. In addition, Internet accessibility is still expensive and/or inconvenient.

JavaScript Limitations

PDF documents have great versatility since they can be displayed in a Web browser via an Acrobat plug-in. However, we

have to be aware that there are differences between Acrobat JavaScript and JavaScript used in a Web browser, also known as HTML JavaScript. Acrobat JavaScript does not have access to objects within an HTML page (Padova, 2003). Similarly, HTML JavaScript can not access the objects within a PDF file. In other words, Acrobat JavaScript executes inside Acrobat or Acrobat reader, not the browser. There is a distinct line between the browser environment and the PDF environment.

The Ultimate Barrier

Harper, a coauthor of *The Myth of the Paperless Office*, stated that new technologies will not reduce the amount of paper used. Often people may simply shift the point at which documents are printed out (Sellen & Harper, 2003). Over the decades, many people have expected the arrival of the paperless age. In recent years technology makes it possible to store electronically almost everything that previously had to be on paper. The web makes staggering amounts of information widely available to anyone with an Internet connection. However, statistics prove that our use of paper has only increased over the years. It is not for lack of technology. The ultimate challenge is human nature: it is the fact that most people simple prefer real papers over electronic documents. Technology has made digital documents easier and faster than ever to read on screen with a

lot of additional features. But in the end, it really comes down to people's preferences.

Recommendations for MHI's Future Work

Customers are the most important people in any business. MHI has the intentions of satisfying the customers' need through a better communication. The business customer expects to know something about the product before the actual purchase; moreover, they need a channel to communicate with their suppliers. This application provides a mean to improve direct marketing, and reduce costs through automation of interactions. However, to achieve profitable growth, it is very important to create a single customer-centric operation and enable collaboration across the organization by providing access to other relevant, personalized information from multiple data sources. Utilizing customers' feedback is necessary for marketing planning, campaign management, lead generation and customer segmentation. The Internet can enable real-time availability communication and ongoing customer care but only when MHI has a customer interaction center and web-based customer self-service capabilities, the fully benefits from Internet-marketing can not be expected.

Recommendations for Further Study

Based upon the working processes and the review of literature, the following suggestions are presented for possible further study.

- This project can be conducted with commercial PDF package to accelerate the speed of digital document creation.
- This project can be conducted at a different file format to explore other software's potential.
- Similar projects can consider other types of multimedia implementation in a digital brochure.
- The newest version of Acrobat now allows inserting Flash objects in PDF document. Another study can investigate this new capability of PDF documents.

Conclusion

Although the future is not certain, it is the author's opinion that the digital document in some form is here to stay. There will be setbacks along the way as the format standards stabilize, but in the next decade or two digital documents will be come an integral part of business marketing plan, almost as common as e-mail today. Business will depend on digital documents for communication, both within an organization and more importantly, to reach customers and potential customers. By the time broadband connectivity becomes widespread and becomes standard practice, the method of marketing will be radically different than we perceive it today.

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Walsh, N. (1998, October 3). Retrieved September 9, 2003, from http://www.xml.com/pub/a/98/10/guide0.html

APPENDIX A

The project document

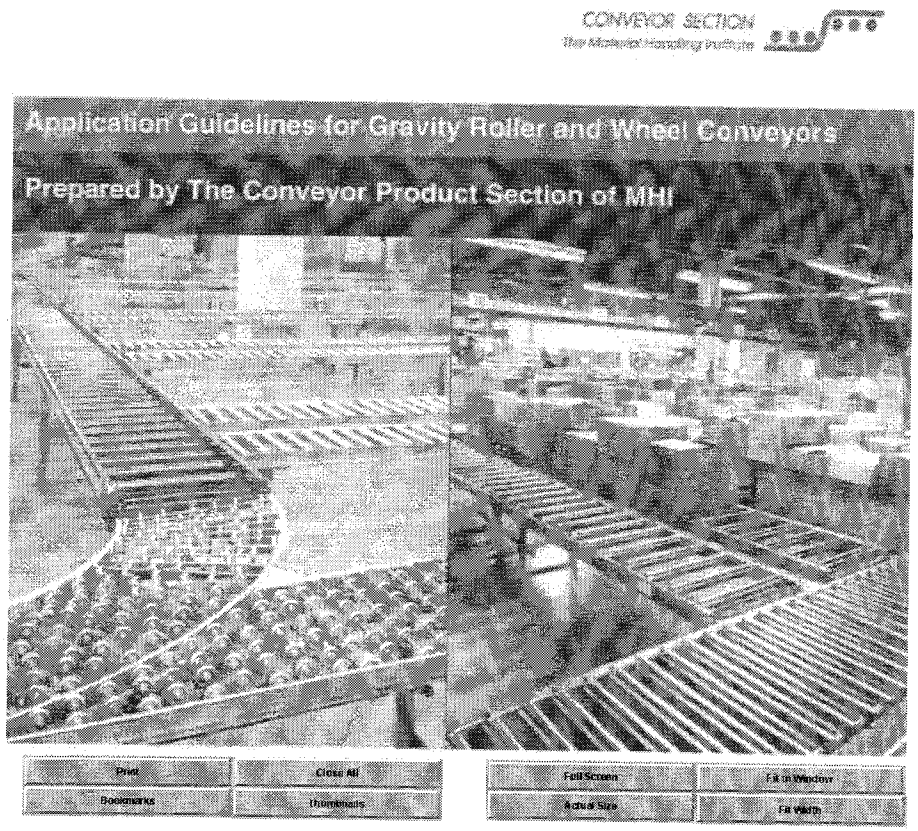


Table of Contents

FOREWORD

This document provides general application guidelines for selecting gravity (non-powered) roller and wheel conveyors. The material presented here incorporates recommendations from the major suppliers of gravity conveyors. It is intended for use as a general reference only. For additional information, CEMA Standard No. 401, "Roller Conveyors - Non Powered," provides design criteria and application data. The individual supplier of gravity roller or wheel conveyors should be consulted for specific equipment capabilities and application requirements. Use of this document does not imply any warranty or responsibility by any of the member companies, the Conveyor Product Section, or the Material Handling Institute, Inc.

1.0 INTRODUCTION

Gravity, or non-powered, roller and wheel conveyors can often provide effective and economical solutions to many handling problems. Gravity conveyors are versatile, with a wide range of applications in processing and assembly areas, packing, and warehousing.

With appropriate engineering, they can be used in a wide variety of industries. For example, sanitary gravity conveyors can be specified in food processing and medical facilities; heavy-duty roller conveyors can be selected for use in foundries or steel processing plants. With special features, gravity conveyors can add flexibility to handling solutions; e.g., portable and/or extendable conveyors can be used for temporary jobs in areas such as loading docks.

In addition, gravity conveyors can be used in conjunction with powered systems to extend the range of potential applications even further.

1.1 PRODUCTS AND APPLICATIONS

Gravity roller conveyors support loads on a series of rollers mounted on axles at fixed intervals in a frame. Similarly, wheel conveyor support the load on a

series of skate-wheels mounted on a shaft in a frame. Roller and wheel spacing are dependent upon the load to be handled. Gravity wheel conveyors are ideal for light-duty handling requirements where the load bottom is flat and smooth. Gravity roller conveyors have a broader range of application.

Both types of gravity conveyors can be used to move products either;

1. Horizontally by means of a manual push, or
2. Down a sloped or pitched decline, by means of gravity.

Safety and damage prevention are of particular concern when product moves freely down a pitched conveyor section. Selection and design of any roller or wheel conveyor system requires a careful analysis of the load to be handled and the requirements of the move. Some general considerations are illustrated below, and Table 1 provides a summary of key concerns when selecting gravity roller and wheel conveyors.

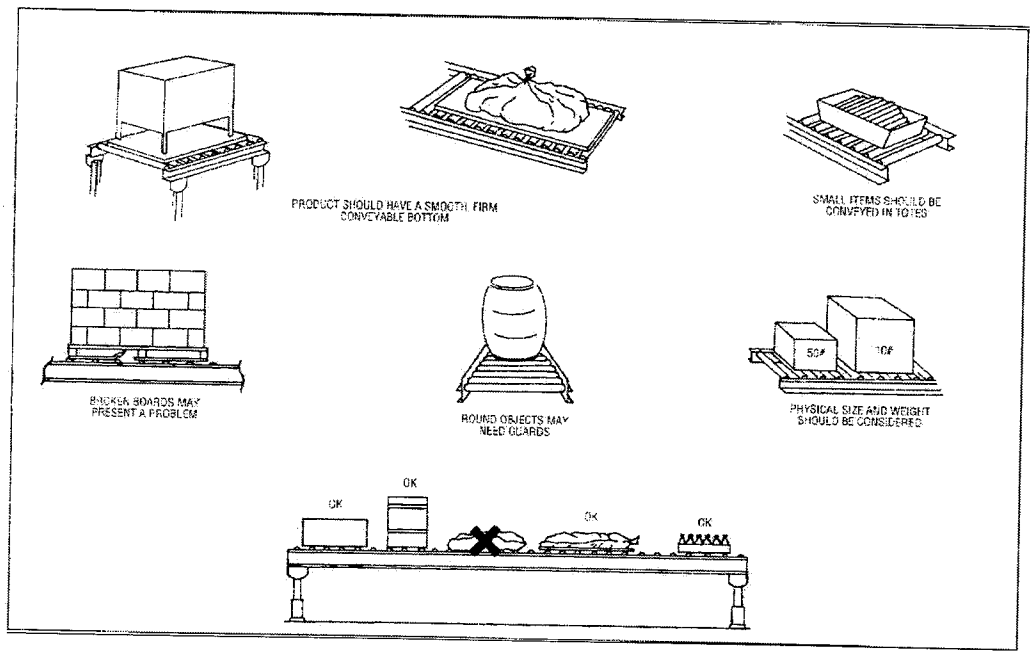


Table 1. Considerations in the selection of roller and wheel conveyors.

GENERAL CONSIDERATIONS

- For pitched conveyors, the maximum practical conveyor length without deceleration devices must be determined, based on product weight, size, pitch, etc.
- Designs which specify long accumulation lines should be examined to ensure that there will be no damage due to load impact or high line pressure.
- Use caution when mixing light and heavy loads with sloped conveyors because optimum pitch selection is difficult when loads vary.

GRAVITY ROLLER CONVEYORS

- Wide range of product types can be conveyed, as compared to wheel conveyors.
- Generally better than wheels for steep declines.
- Roller conveyor has no minimum product width, unlike wheel conveyors.
- The nature of the load bottom is less restricted than for wheels. For example, corrugated cartons can be in good or fair condition.
- Product can be slid onto the conveyor from the side; wheels are not recommended in this situation

GRAVITY WHEEL CONVEYORS

- Most portable conveyor.
- Maintains product orientation better than rollers, particularly around curves.
- Requires less pitch than roller conveyor for gravity movement.
- Load bottoms must be flat, sturdy, and smooth. Cannot convey wire baskets or containers with chimed
- bottoms. Corrugated cartons must be in good condition; wheels tend to indent soft containers.
- Generally the best conveyor for lightweight loads.

1.2 INFORMATION REQUIREMENTS

Successful application of gravity roller and wheel conveyors requires asking the correct questions and properly specifying the equipment needed. The following checklist should be used to insure that all requirements are identified.

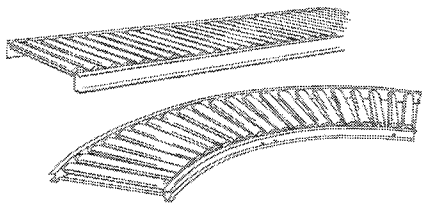
INFORMATION CHECKLIST			
1 What are the dimensions and weight of the products to be conveyed?			
	Minimum	Average	Maximum
Length			
Width			
Height			
Weight			
2 What is the condition or type of conveying surface(s)?			
Ideally, the conveying surface(s)should have the following characteristics:			
Firm, smooth, flat bottom		Free of projections(nails, loose flaps)	
Note any special concerns such as the following:			
Soft surfaces		Boxes with cleats	
Loads with uneven bottoms		Loads that can shift and spill	
Wire-bound boxes		Wire baskets	
Multi-wall bags		Drums	
3 how will the product be loaded onto the conveyor?			
Manually		Forklift	
Overhead hoist		From another conveyor	
Other			
Will the conveyor be subject to shock loading?			YES ☐ NO ☐
If so, from what height above the conveyor will the product be dropped?			
4 what will be the rate of loading?			
Number of items per hour		Spacing between loads	
5 what are the operating conditions?			
Normal room temperature		Extreme heat(degree___)	
Extreme cold(degree___)		Humid or wet atmosphere	
Dusty atmosphere		Corrosive fumes	
Sanitary conditions required		other	

PRINT RESET SUMIT ON-LINE

2.0 GRA VITY ROLLER CONVEYORS

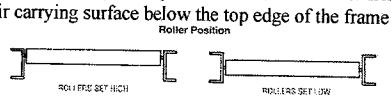
2.1 GRA VITY ROLLER CONFIGURATIONS

A typical gravity roller conveyor configuration consists of straight and/or curved sections. Straight sections are generally available in standard 10' lengths in bed widths *from* 12" *to* 54", depending on the roller diameter. Curved sections typically are available in 45 and 90 degree curves with a range of radii *from* which *to* select. Curves will be addressed in more detail in Section 2.7.



When roller conveyors are sloped for gravity movement of the load without deceleration devices, there is a maximum practical length for the conveyor to avoid damage to the load. The maximum length will depend on a number of factors, including weight, size, condition of the carrying surface, and type of load. Longer conveying distances will permit excessive speeds which can result in damage to products as they stop; cause jackknifing of products; and cause overrun of curves. One supplier recommends a maximum practicallimit in the range of 40 to 50'. Speed control devices or "brake" rolls might be required to minimize excessive speed.

There are two configurations for roller position relative to the frame rail. Rollers set high have their carrying surface above the top edge of the frame rail. This approach provides some measure of flexibility to accommodate changes in product widths. Rollers set low have their carrying surface below the top edge of the frame rail, thus eliminating the need for guard rails.



In addition to standard straight and curved sections, a variety of accessories are available to increase the capability of a gravity roller system. Among these accessories are spur sections, converging sections, gate sections, switch sections, turntables, ball transfer tables, and others.

The following sections outline the major steps

2.2 BEARING SELECTION

Selection of the proper bearing is an important fac*tor* in designing a roller conveyor. Roller conveyor bearings include plain, dust-tight, grease-packed, and greaseable options. Major consideration should be given *to* the conveyor operating conditions in determining bearing requirements.

Area Conditions	Bearings Recommended
Dry and dust free	Plain ball bearing
Dusty area	Dust-tight bearing
Wet, humid area	Pressure-lubricated bearing
	Dust-tight grease-packed bearing
	Stainless steel
Excessive heat	Plain ball bearing
	Pressure-lubricated bearing
	Stainless steel balls

Since lubricants add resistance *to* revolution, they should not be used in gravity applications (see Section 2.7). *For* further information on bearing selection, refer *to* CEMA bearing calculations.

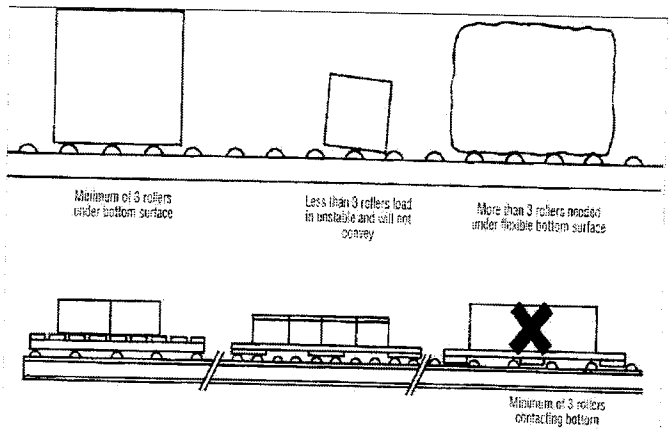
2.3 ROLLER SPACING

When designing a roller conveyor, the most important consideration is roller spacing. A minimum of three rollers must support the smallest load at all times. Loads with less than three roller supports have the potential to tip and jam, disrupting the flow of products on the conveyor. Loads with bumpy, flexible, or soft bottoms should be carried by four or more rollers.

To determine maximum roller center-to-center spacing, divide the length dimension of the load by the number of rollers needed for support (at least three). Choose a roller section with center-to-center roller spacing less than or equal to the number calculated. The calculation must be based on the shortest load length expected. The recommended maximum centerto-center spacing is 12". Always consider the resulting effect of supporting the load on the bottom surface of the load. The deformation that results may prevent loads from starting from stop on a gravity conveyor. Flimsy pallet bottom boards have fractured from this contact. The footprint of the load should be carefully analyzed.

The next consideration is load rating. Will three rollers support the weight of the package? Suppose a 24" load weighs 400 lbs, and the capacity of a roller under consideration is 100 lbs. This means that a minimum of four rollers must be under the load at all times. Taking the 24" load length and dividing by four rollers results in a requirement for 6" center spacing.

The load in this example is equal to the full capacity of the rollers. A 6" center spacing would require that the conveying surface of the load be nearly perfect and that the package length be at least 24". Rarely are loads entirely perfect; they generally will vary slightly both in surface irregularities and load length. This vari
ation presents the problem of the load being properly distributed over the rollers. Rarely is the weight of a load uniformly distributed. This condition will cause
some overloading on certain rollers. Always plan for the worst case. Either specify closer center spacing or a higher capacity roller to accommodate unexpected variation.



2.4 ROLLER CAPACITY

To determine minimum acceptable roller capacity, divide the weight of the heaviest load by the minimum number of rollers that will be carrying the load.

$$\text{Roller Capacity} = \frac{\text{Weight of load}}{\text{Number of rollers carrying load}}$$

Many products have conveying surfaces that are not exactly flat. To compensate for this, it is recommended that only two-thirds of the rollers be assumed to support the the full weight of the product. Therefore, to determine the required capacity of each roller, it is necessary to take the weights of the various products being conveyed and divide by two-thirds of the rollers under the product.

For example, consider a 20" long product weighing 80 pounds. Determine the roller spacing by dividing the product length by three rollers (20"/ 3 rollers = 6.67" roller centers). Since there are three rollers under the product, assume that only two-thirds actually support the load. That is, 2/3 x 3 rollers = 2 rollers supporting the 80 lb. product. The required capacity is 40 lbs. per roller (80 lbs. divided by 2 rollers).

If drop loading is a factor, rollers with greater capacity should be selected. There are several alternatives for achieving the required capacity: (1.) use higher capacity bearings, (2.) select heavier gauge rollers, or (3.) specify closer roller center-to-center spacing.

Roller capacities vary with diameter (capacity increases as roller diameter increases). In selecting rollers, it is also important to note the material characteristics. Steel rollers have a higher capacity than aluminum rollers; aluminum rollers resist corrosion better than plain steel. Choose a galvanized or zinc plated roller to prevent rusting in wet, humid environments. A plastic coating on a roller can reduce shock, will not mar or scratch surfaces of conveyed products, and resists moisture. Selection of heavier gauge rollers results in a decrease in frame capacity because of the increased weight, but impact damage is reduced.

Other considerations include conveyor usage (light duty, medium duty, or heavy duty) and the type load to be moved (light cartons, boxes, metal, pallets, abrasive loads, etc.).

2.5 CONVEYOR FRAME CAPACITY

Frame requirements should be carefully determined to avoid potential damage caused by overloading. It is generally suggested to over-design the conveyor frames to allow for extra loading. As an alternative to increasing frame size, locating supports on closer centers is a way to increase frame capacity. In addition, the required capacity per support should be determined. The weight of the frame must be considered when calculating required support capacities.

Table 2 provides an outline of steps for determining frame capacities:

Table 2. Procedure for determining frame capacities

Step 1. Determine the maximum total load that the conveyor will encounter (live load). When determining conveyor loading, always consider the worst possible loading condition. The conveyor loading, expressed in pounds per foot, can be obtained by one of the following methods:

1. A single heavy load in the center of a span will cause twice as much deflection as the same weight distributed over the length of the span. In such cases, divide the total maximum load on the conveyor by the conveyor length between supports (e.g., 10').

$$\text{Conveyor loading} = \frac{\text{Total load on conveyor (lbs.)}}{\text{Conveyor length between supports(ft.)}}$$

2. When product is back-to-back on the conveyor, the conveyor loading is a function of product weight and product length.

$$\text{Conveyor loading} = \frac{\text{Product weight (lbs.)}}{\text{Product length (ft.)}}$$

Step 2. Determine the dead load requirements (weight of the frame and rollers) for the span.

Step 3. The total frame capacity requirement is the sum of the live and dead loads. Check the standard frames' maximum capacities. If a standard frame capacity provides the capacity required, use it. If total capacity exceeds the standard capacities, consider supporting the span on 5' centers or using a heavier roller which provides a heavier frame.

Step 4. Determine conveyor support requirements including the weight of the frame plus rollers, along with the live load to determine the required capacity of the supports.

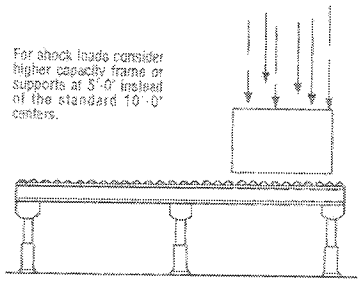
2.6 CONVEYOR WIDTH

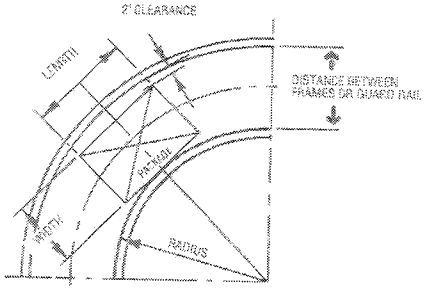
For conveyors consisting of only straight conveyor sections, the recommended conveyor width is 2 inches wider than the width of the widest load to be moved on the conveyor. If curved sections are needed, the conveyor width must be based on the swing the load requires to stay within the conveyor frame. To determine the required distance between the conveyor frame for curved sections, use the following formula:

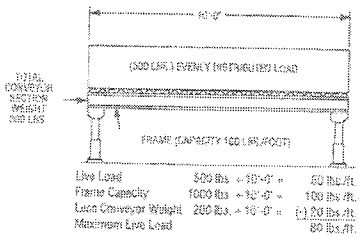
$$D = \sqrt{(loadwidth + radius)^2 + (\frac{loadlength}{2})^2} - (radius - 2)$$

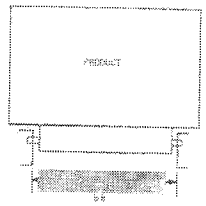
where D is the inside frame dimension, radius refers to the inside radius of the curve, and load width and length are maximum values.

This formula gives the minimum between frame width. Use the same width for straight sections. An example is shown below.

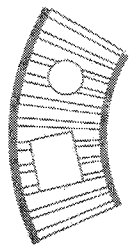




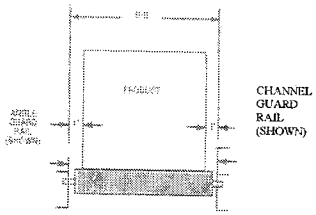




Use handle loads wider than conveyor width. Minimum load width = load for bank x 1.25



When guard rails are installed allow extra width for curves to avoid friction on guard rail.



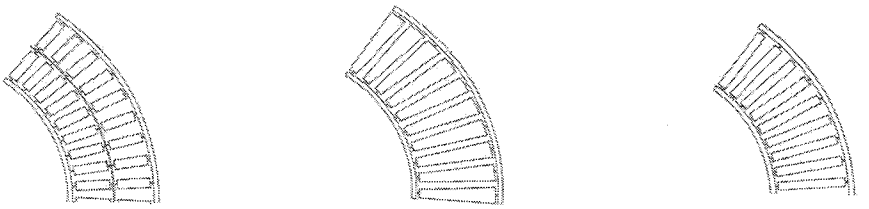
When guard rails are installed allow minimum 1"on each side between product and guard rail.

2.7 GRAVITY GRADES AND CURVES

For gravity to generate movement of a package, the force of gravity must be sufficient to overcome the resistance of the rollers involved. The grade required for a gravity conveyor to operate is affected by several factors. Roller weight influences the grade. It takes more force to start heavier rollers, but once they are turning they will continue to rotate for a longer period of time. When a series of loads enter a gravity roller conveyor, the first load(s) must overcome roll inertia to start the rolls turning; subsequent loads encounter rotating rolls and will accelerate. If two rollers of equal weight have different diameters, the larger diameter will require less grade. Bearing construction also affects the grade. Non-precision bearings require less grade than precision bearings. Grease-packed or regreasable bearings are generally not used for graded conveyors. Product weight is a factor. The heavier the package, the less grade is required.

Grade requirements are extremely variable, depending on the size of the roller and type of bearing as well as the size, weight, and carrying surface of the loads. Generally, heavier loads and items with smooth hard bottoms require less grade. Experience and testing are the only practical methods of determining the proper grade of a gravity conveyor. Suppliers typically provide a list of suggested grades for a variety of conditions.

There are several types of curved sections available. Tapered curves maintain product orientation as it flows through the curve. Double lane curves are suitable if some misalignment is acceptable. Straight rollers do not maintain orientation, but are suitable for drum or other cylindrical items conveyed on end.



TAPERED ROLLER	DOUBLE ROLLER-DIFFERENTIAL	SINGLE ROLLER

In selecting curves for roller conveyor. a number of variables require consideration.

1. Load Considerations. Load characteristics (size, shape, weight, product uniformity, and conveying surface of the load will affect how the load is conveyed through a curve.

2. Product Width. Many times, curves in a system will dictate the width of the conveyor for the entire system. in that the product may require additional space to make the turn. The additional space depends on the width and length of the product. The basic principle is that the inside radius should be greater than the the length of the product.

3. Product Length. For curves, the roller centers on the inside rail are closer together than on the outside rail. Therefore, the wider the conveyor. the more rollers that are required in the curve to keep the roller centers at a minimum. This fanning effect is an important consideration when choosing curves.

4. Product Weight. Product weight is a primary factor in determining roller capacity requirements. roller spacing. and frame capacity requirements for curves as well as for straight section. The rollers and frames selected for curves must be compatible with the straight sections. Roller capacities must be checked. Supports are required at both ends of a curve as well as at the midpoint if the curve is over 45°

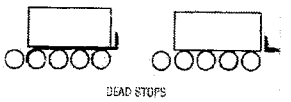
5. Load Speed. The speed of the conveyor line must be kept under control to keep loads from being thrown from the conveyor as it enters the curve.

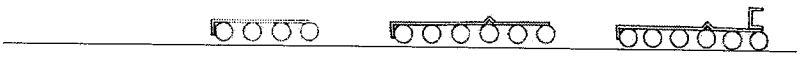
6. Load positioning. Any load negotiating a curve must undergo some physical twisting on the wheels or rollers to result in a turned load. This requires load separation so that each load can make the curve. If a curve discharges a load within five degrees of the relative position with which it was received, the curve is considered effective.

2.8 ACCESSORIES

Accessory equipment adds flexibility to the use of gravity wheel and roller conveyors. These components are incor porated into basic conveyors for turns, transfers, and control of materials moving over the conveyor system. Some examples are illustrated below.

Fixed and removable carton stops and retarding plates are available to stop boxes , cartons, etc. "Dead" type stops and retarding plates, which are simply placed on the roller bed, are illustrated.



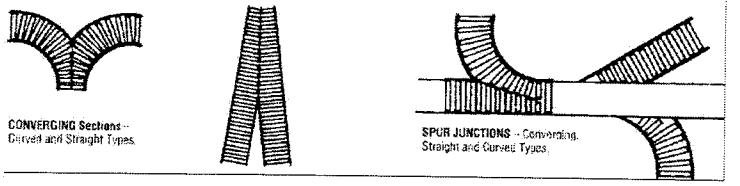


Brake rollers

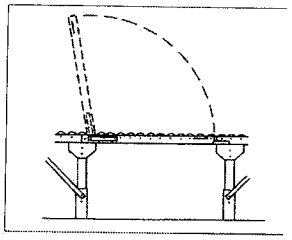
Brake rollers also provide a means of stopping product flow

Spurs and Switches

Spurs and switches provide a means of diverting or converging items.

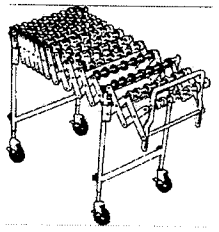


Gate Sections



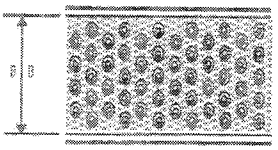
Manual and spring-balanced gates can be used with gravity conveyors to permit movement of personnel or equipment.

Extending Conveyors



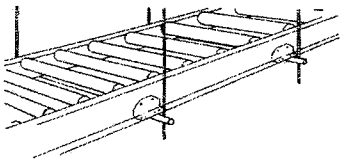
Extendible and portable gravity conveyors permit flexibility in shipping and receiving areas, as well as in other locations.

Ball Transfers



Ball transfer tables or beds are used for manual movement or positioning of material at a workstation or between conveyor lines.

Supports



Flexibility is provided by a variety of floor and ceiling

3.0 GRAVITY WHEEL CONVEYORS

3.1 WHEEL SELECTION

A wheel conveyor is used in light duty applications. There are two primary types of frames and wheels available:

1. 1. Galvanized steel frame with galvanized wheels-used in more permanent applications and more vigorous use.
2. 2. Aluminum frame with aluminum wheels-provides lightweight portability and durability.

3.2 WHEEL SPACING

A wheel conveyer is composed of a series of wheels mounted to a common axle supported in a frame. The axles are located on centers at fixed intervals, and the number of wheels per axle vary with conveyor width

In evaluating the requirements which must be satisfied for a load to be conveyed on a wheel conveyor, the overriding consideration must be the footprint of the

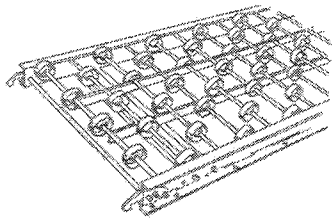
load and the reaction of the load to its weight pressing down on the multiple point contacts. For example, an orange crate could hang on a wheel and not start from its stopped position. Individual suppliers can provide additional information on the particular requirements of their wheel conveyors.

3.3 WHEEL CAPACITY

The specific capacity depends upon the material used for the wheel. For example, one supplier offers a capacity of 30 lbs. for steel wheels and 15 lbs. for aluminum wheels.

3.4 CONVEYOR FRAME CAPACITY

The capacities for the two types of frames are:



3. Steel frames with supports on 10' centers,260 to 350 lbs.
4. Steel frames with supports on 5' centers, 1000 to 1300 lbs.
5. Aluminum frames with supports on 10' centers, 80 to 120 lbs.
6. Aluminum frames with supports on 5' centers, 350 to 530 lbs.

3.5 CONVEYOR WIDTH

Wheel conveyers are available in standard overall widths: 12", 18" and 24". The wheels extend above the frame to allow the loads to overhang the conveyor. The width of the load should not exceed the width of the conveyor by more than 25%.

3.6 GRADES AND CURVES

Grades required for conveying cartons will vary with the weight of the carton and the conditions of its conveying surface. Full cases and cartons will convey satisfactorily on grades of 3" per 10' section or 3" per 90° curve. Empty cartons or cases require about 4" per 10' section. Extremely light articles, loosely tied articles, or soft bottomed articles require much steeper grades.

An advantage of wheel conveyors over roller conveyors is that the load being conveyed better maintains its original lateral position during travel. As a load makes the curve, the individual wheels provide a turning action which enables the load to maintain its original orientation. The required width for a turn is based on the load dimensions. The balance of the conveyor should be the same width as selected for the curve.

For consideration of sloped applications of wheel conveyors, refer to the discussion for selecting roller conveyor grades in section 2.7

Other Brochures available from Conveyor Product Section.

Conveyor Accumulation Brochure.

Informational brochure, developed by the Conveyor Product Section of MHI to set forth considerations for planning accumulation in conveyor systems. It presents, in a logical sequence, steps which must be taken by a prospective user to develop an effective and productive conveyor accumulation system.

Published 1985, Item Number: 1-8
Price: $3.50 ($2.50 for educational institutions)

Considerations for Planning Conveyor Sortation Systems.

This 16-page booklet discusses the sortation function as achieved through the use of various types of conveyor equipment. Text explains how to determine your sortation systems needs and reviews all types of sort devices available from members of the Conveyor Product Section of MHI.

Published 1989, Item Number 1-16
Price: $5.00 ($2.50 for educational institutions)

Application Guidelines for Vertical Reciprocating Conveyors.

Informational booklet developed by the Conveyor Product Section of MHI Text sets forth considerations for the planning and application of vertical reciprocating conveyors. It consists of 28 pages and numerous line drawings.

Published 1991, Item Number 1-28
Price: $5.00 ($2.50 for educational institutions)

APPENDIX B

JavaScript source codes for attaching PDF forms to e-mails

```
if (typeof(app.viewerType)!="undefined")
 if(app.viewerType == "Reader")
 {
  var msg = "You must use Acrobat or Acrobat Approval to send
the application back to us.  You can download Acrobat Approval
for $39 US from Adobe's Web site at: http:www.adobe.com.";
  app.alert(msg);
 }
else
{
  this.mailDoc(true, "management@comany.com",
"supervisor@company.com", "ceo@company.com",
  "Employment Application Form");
 }//*************************************/
/* FUNCTION: lee)      */
/* arg1 TAKES THE   */
/* arg2 TAKES THE   */
/*************************************/
```

APPENDIX C

JavaScript Source codes for attaching FDF data to E-mails.

```
var cResponse = app.response({

cQuestion: "To copy yourself,
 enter your email address.

 Click cancel to send data

without sending a copy to

 yourself",
cTitle: "emailAddress", }); // title of the dialog box
{
if ( cResponse == null)
  this.mailForm(true, "lishan_o@yahoo.com", "", "",
"information");
else
  this.mailForm(true, "lishan_o@yahoo.com", cResponse, "",
"information");
                                    }
```

APPENDIX D

JavaScript source codes for sending message via e-mail

```
     var cResponse = app.response({
     cQuestion: "To copy yourself, enter your email address.
Click cancel to send data without sending a copy to yourself",
     cTitle: "emailAddress", }); // title of the dialog box


var fTo = this.getField("a");
var fSubject = this.getField("b");
var fBody = this.getField("c");


      app.mailMsg(true, fTo.value, "", "", fSubject.value,
                              fBody.value);
```