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technical documentation overview

This white paper seeks to provide an overview of technical documentation for a product or service. It also highlights the tools and technologies used in technical documentation as well as challenges in this field.

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Abstract

This white paper seeks to provide an overview of technical documentation for a product or service. It also highlights the tools and technologies used in technical documentation as well as challenges in this field.

Technical documentation is an integral part of the introduction of a product or service to the market. An inefficient documentation process can have a significant effect on the financial success of a product or service. Technical documentation (User manuals, Installation guides, Warranty information, Maintenance manuals, Troubleshooting guides, Repair manuals etc.) must always provide the most accurate product information. Technical documentation also plays an important role in the product life cycle during operation and maintenance. There have been many incidents/accidents due to improper documentation or incomplete operating / maintenance instructions.

This white paper shows why technical documentation is necessary and also helps the reader understand the tools and techniques used to create technical documentation in today's environment.

Overview

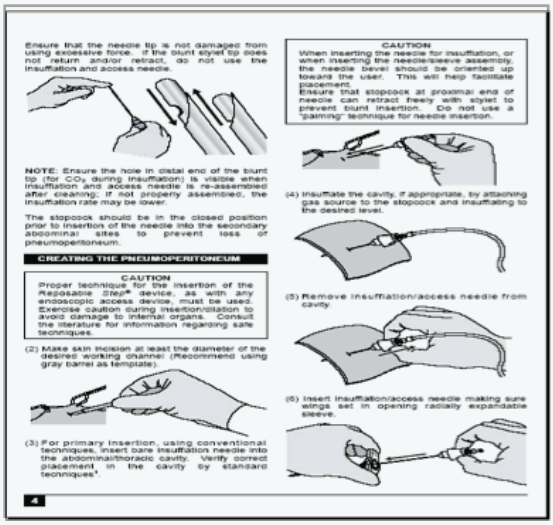
Technical documentation spreads across the entire product life cycle from the design phase to the disposal phase across industries including aerospace, industrial, software engineering, heavy engineering, consumer electronics, oil and gas etc. Typical technical documents used across the product life cycle include specification documents, acceptance test procedures, environmental test procedures, validation and verification documents, FMEAs, operating manuals, service manuals, maintenance manuals, user guides, repair procedures, spare parts lists etc.

However technical documentation mainly associates the term with documents and information passed on to the public by the manufacturer - User instructions, Operating instructions, Servicing instructions, Installation manuals, Maintenance manuals, and Software manuals.

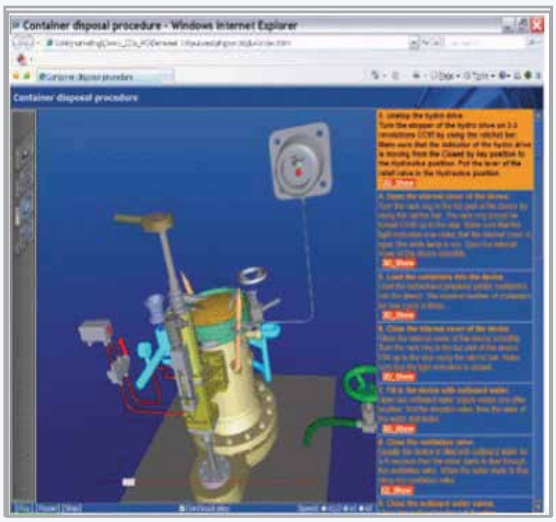
A common practice among companies is to postpone documentation development until the conclusion of the product or service development phase, when all design changes have supposedly been made. Often, this approach leads to product launch delays, missed market opportunities, and hence revenue losses.

Documents that contain product technical information fall under the category of technical documentation. Contents of technical documentation depend upon the requirement for which the document is being produced like for testing the product functionality, assembly of the product, maintenance of the product, repair of the product or technical description of the product.

Technical documentation is an integral part of the product life cycle from design to operation and is very helpful in product verification validation,



Sample traditional technical documentation



Sample interactive 3D animated technical documentation

testing, and repairs. Technical documentation is also very useful for carrying out inspections, audits, and other legal requirements. It also helps in accident investigations to identify the correct causes of failure and come up with solid preventive action.

However, the technical documentation service provider's attention is on the documents that are required when the product goes into the operation field i.e. service manuals, maintenance manuals, part lists, repair manuals, operating manuals, storage procedures, testing procedures etc. There is a huge demand for technical documentation in terms of simplified instructions, clearly illustrated procedures and compliance to applicable standards.

To create technical documentation, a lot of authoring and illustration tools experience is required along with a fair understanding of the product technically. This combination of basic knowledge, experience of fulfilling requirements and documentation-specific specialist knowledge is absolutely necessary for any technical documentation service provider. Generally Technical writers/authors play the role of mediators between manufacturers and users whether within the company or externally.

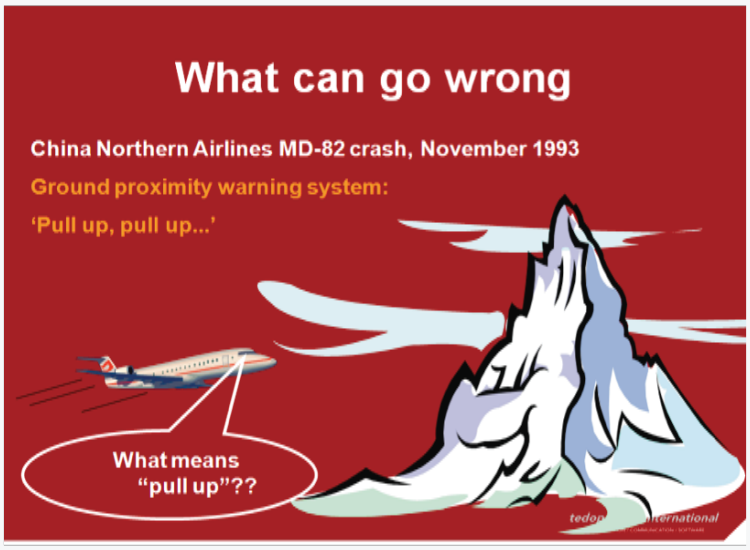
Paper based technical documentation has been almost outdated now and it has slowly changed to interactive 3D animated manuals. Electronic manuals and publications are very useful to streamline processes, facilitate product training, sharing and accessibility.

Challenges

Writing correct and applicable content with supporting illustrations is a real challenge as this not only requires effective technical writing skills but also product/domain knowledge, skills to interpret engineering drawings, visualization skills, and also an end user point of view, since eventually it is the end user who needs to understand technical manuals and documents.

Another challenge faced by technical writers is to make the documents easy to navigate, search, and reuse. If technical documents are not easy to navigate, they can create a lot of delays and may lead to user dissatisfaction.

Language barriers are also a major challenge in technical documentation. Although English is a widely accepted language across the globe, very few countries use English as their native language. Therefore technical data/instructions in the documents have to be written in a simple, short, and concise format so that there is no confusion/misunderstanding on part of users while interpreting the information. Technical documentation should always be clear and unambiguous. Confusion can be frustrating, time-consuming, costly, and even dangerous. Inconsistencies in the sequence and structure of information across similar documents make the information difficult for readers to understand.



Source: 1974-2007 – Tedopres International

Written in Technical English...

Gain access to blade. After removing old blade, new blade may be fitted by proceeding in reverse order, using gloves to avoid injuries by teeth of blade.

Before you attempt any of the above, the power should have been switched off.

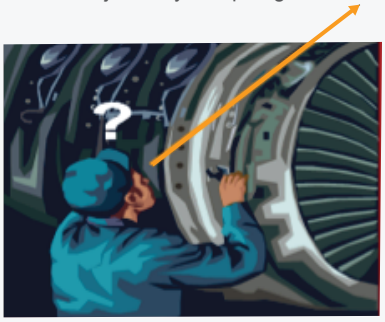
...Written in **Simplified** English

Make sure that the on/off switch is in the “off” position.
Remove the blade cover from the machine.
Warning: wear gloves when you touch the blade.
Remove the old blade. Install the new blade. See figure A.
Install the blade cover.

Source: 1974-2007 – Tedopres International

The Risks

After removing old bolt, new screw may be fitted by proceeding in reverse order, using gloves to avoid injuries by sharp edges of fan blades.



- Confused and frustrated readers
- **Safety risk**
- **Damage** during operation or maintenance
- Potential for **product liability**
- High **localization** costs
- Unsatisfactory **translations**
- Higher training support costs
- Ineffective **customer services**

Source: 1974-2007 – Tedopres International

There have been major accidents due to inadequate or incomplete instructions in technical documentation or due to the given instructions not being followed properly. The following reports specify some such instances:

In the Japan Airlines Flight 123 (Boeing 747SR) accident, the report published by Japan's then Aircraft Accidents Investigation Commission is as follows:

The aircraft was involved in a tail-strike incident at Osaka International Airport on 2 June 1978, which damaged the aircraft's rear pressure bulkhead. The subsequent repair of the bulkhead did not conform to Boeing's approved repair methods. The Boeing technicians fixing the aircraft used two separate doubler plates, one with two rows of rivets and one with only one row when the procedure called for one continuous doubler plate with three rows of rivets to reinforce the damaged bulkhead. This reduced the part's resistance to metal fatigue by 70%. According to the Federal Aviation Administration, the one "doubler plate" which was specified for the job (the Federal Aviation Administration calls it a "splice plate" - essentially a patch) was cut into two pieces parallel to the stress crack it was intended to reinforce, "to make it fit". This negated the effectiveness of two of the rows of rivets. During the investigation Boeing calculated that this incorrect installation would fail after approximately 10,000 pressurizations; the aircraft accomplished 12,318 successful flights from the time that the faulty repair was made to when the crash happened.

The difficulties faced by lack of good technical documents have been widely documented. A report by BP was published following the Gulf of

Mexico oil spill accident. According to the report 'Deepwater Horizon Accident Investigation', reasons leading to the accident were lack of good technical documents and non-adherence to the existing ones. For example, the investigation team could not identify any established industry standards for conducting negative-pressure tests. This is supported by expert testimony during the July 23, 2010, Marine Board of Investigation (MBI) hearings. Another investigation result states that a defoamer additive was used in the cement slurry, whereas supplier's standards included a specific recommendation to avoid using dispersant or defoamer additives with foam cement, indicating non-adherence to the existing recommendations.

The inability to reuse information and to automate publishing is one of the largest areas of inefficiency in today's corporate environment. When totaled, these inefficiencies have a dramatic, but typically unrecognized impact on internal costs, revenue recognition, productivity, time-to-market, and customer satisfaction. In today's competitive environment, customer demands for greater innovation must be met by bringing products to the market in a timely fashion at the lowest possible cost. Although senior management often overlooks the impact of technical documentation, an inefficient publishing process can have a significant effect on the financial success of a product or service.

Accuracy of technical documentation is paramount in assuring that proper maintenance actions are performed. However, integration of OEMs, Supplemental Type Certificate (STC), supplier data, and operator data within the operations environment is also key in delivering on the promise of accurate data (i.e., the right data, at the right time, in a usable format for the environment at hand). The opportunity to address data quality from the user community's perspective is in the integration of data delivery, user feedback, and data updates that address the real-time needs of user groups. Today, organizations have a difficult time applying the right resources, with the right knowledge, skills, and/or system solutions to address the day-to-day issues created by the lack of technical data integration.

Work Flow of Technical Documentation

Technical documentation generally follows a typical workflow as outlined under:

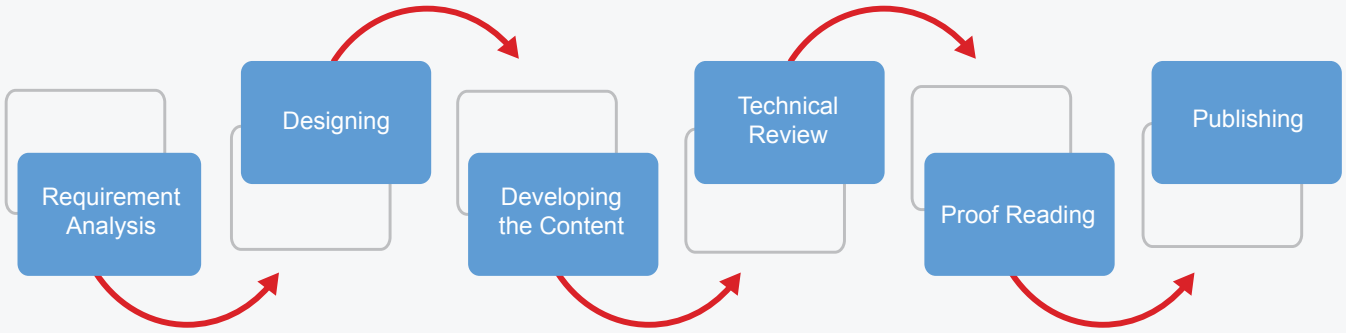
Requirement Analysis: Requirement Analysis is an important step in the technical documentation life cycle. The technical writer studies the input documents i.e. technical specifications, engineering drawings etc. given by the customer and puts the information into a logical sequence as per the required output document. The technical writer analyzes the document requirement, target audience, documentation tools to be used, the complexity and depth of the document, and the level of language to be used.

Lot of effort is required for this process as information is taken from various inputs provided by the customer. This information is then verified by the domain specialists and further doubts and queries regarding the product are clarified with the help of the customer. If any documentation for earlier product versions is available, it is referred to for understanding the product clearly. Online product help is also utilized to understand the product features clearly.

Technical writers need to understand the product from the technical as well as user point of view. They should then list down all the queries and problems found while studying the product inputs. They may need to discuss these problems with domain experts to resolve queries if any and to understand the project clearly.

Designing: In this phase document templates are designed. Formatting requirements, presentation style, fonts etc. are required to design document templates. Estimates are arrived at for the required number of pages, number of illustrations, types of illustrations i.e., 2D or 3D or photographs etc.

Content Development: In this phase, content is written as per the specified requirements using the template and in accordance with previous documentation planning. Smart technical writers use graphical illustrations for better understanding by the reader.



Technical review: In this phase, the document is reviewed by a technical expert for relevancy of the technical content as per the input documentation. This review should be very rigorous because this will determine the authenticity of the technical content for correctness and logical sequence.

Proofreading: In this stage the document is thoroughly reviewed for aesthetics and grammatical errors by a third person. Proofreading is very important for technical documentation as it verifies the presentation of data, formatting, and other aspects of the document. Documents become ready for publishing after a thorough verification for quality.

Publishing of Documents: Technical documents are generally published in electronic format on the internet or as hard copies and distributed along with the module as per the customer's requirement. Distribution depends on what the customer specifically asks for, whether hard copies or soft copies formatted as PDF, Word files, online help, web pages, or a similar format on a CD or on the internet.

Tools and Technologies

Traditional publishing systems such as word processing and desktop publishing software were used in early stages but they have a lot of limitations that waste organizational time and resources. This waste typically arises from the way authors create and publish information in the traditional mode. The primary limitations of traditional word processing and desktop publishing software include:

Manual updates: Copying/pasting content is a common method for making changes when using desktop publishing. Although this method may add to authoring efficiency when creating a standalone document, it greatly complicates the maintenance of documents. Changes to content require authors to manually search and update redundant content in multiple sections within multiple documents. Changes are the writer's nightmare and account for a major portion of authors' "wasted effort".

Manual formatting: Authors typically spend between 30% and 50% of their time formatting documents in traditional publishing applications applying character, paragraph, and page styles. Even when provided with authoring templates, most authors make formatting and style changes to each document as they write. If the document is a small, simple, one-off communication like a memo or an email, the wasted effort of manual design and formatting is usually not significant. However, for long documents composed from legacy information and subjected to repeated revision cycles, this manual effort compounds and leads to an excessive waste of manpower, resulting in inefficiency and production delays.

Revising existing content: Authors will recreate content that already exists if they cannot find it. And when they do find the content, authors typically copy-paste it into the new document.

Both approaches are wasteful because making subsequent improvements to the information requires finding, updating, and reviewing all documents containing the repeated passage, caption, or phrase. Where localized versions of the content are required, translation fees can add exponential costs to a publishing operation. Furthermore, rewriting content instead of reusing it not only increases the cost and time to develop the content, but also raises the risk of inconsistencies in redundant information with other documents, making it difficult to update.

Lack of structure: Inconsistencies in the sequence and structure of information across similar documents make the content more difficult for readers to understand and more difficult for authors to find and update. Unstructured information is impossible to reuse or automatically format. A computer program cannot process inconsistent inputs - the classic “garbage in, garbage out” problem. Lack of structure adds redundant review and editing cycles to the publishing process, as multiple updates must be circulated.

Inefficient process for creating technical illustrations: Technical illustrations are core to technical publications. A typical company develops hundreds to millions of technical illustrations and maintains those illustrations for the life of the product. For most companies, the process of creating technical illustrations is riddled with inefficiencies. First, the vast majority of illustrations are redrawn from scratch or with reference to a 2D product image using general purpose illustration systems. General purpose illustration tools are excellent for drawing free form graphics, photo editing and touch up, and creating high quality color images. However, these tools can't understand the technical aspects of manufactured products, and provide no means to hasten and simplify common tasks performed by technical illustrators.

Over a period of time a lot of changes have occurred in the publishing domain and automated publication systems are now in vogue. When you have to deliver content in print, on the web, in online help, to wireless devices, or to additional formats and media types, traditional publishing software requires you to assign someone to manually format your content for each media type.

Not only does this manual effort waste time and money, it also leads to inconsistencies in the resulting content, which can lead to customer dissatisfaction or legal liability.

Automated publication systems have advantages like Multi-channel Delivery, Multiple Embedded Diagrams, Large Volume Support, Repeatable Processes, Personalized Content, Configurable Products, and support the creation of dynamic and interactive content.

Through XML, one can specify the size of the reusable information components in a consistent way, enabling easy interchange of one component with another. XML makes document structure explicit and ensures absolute consistency of the documentation. In that respect, XML is unique; no other standard data format (except SGML, the predecessor to XML) can represent all types of information – text, data, and graphics. By enforcing consistent structure in all document components, XML facilitates identification and consolidation of redundant content, and reuse and repurposing of information components. XML also enables the separation of content from its presentation. XML represents information in a “media neutral” format that is not constrained by the limitations and capabilities of any particular medium, thereby enabling the author to create information in its “pure” form, and separately process it to produce information products.

Over a period of time, specific tools for creating technical illustrations have been developed, which moved traditional raster images to vector formats. Some of the latest tools like IsoDraw take the product CAD data as the input without the native CAD platform and generate the required vector illustrations with minimum effort and to the smallest sizes. Not only does this greatly reduces the time taken to generate the required visuals, but also eliminates technical mistakes pertaining to the product configurations. Other tools like 3DVia composer are capable of creating 3D animated illustrations along with short instructions thereby eliminating the need to use a separate authoring tool.

Conclusion

Technical documentation must start with the designing of the product to be more effective. Well-structured technical documentation created using new tools and technologies with correct data can reduce a lot of effort put in during development as well as operation and also reduce product downtime. It can also reduce incidents/accidents during the product life cycle if correct and logical content is incorporated and followed properly. As newer tools and technologies have made technical documentation platform neutral and easy to access and share across the organization, most manufacturers are integrating technical documentation in the product manufacturing stage to avail of the associated benefits and advantages.

Author Profile

Hariom Baghel

Hariom Baghel has an overall experience of 14 years in the industry, with over 10 years in development, testing, quality assurance, and maintenance of avionics equipment for defense aerospace. For the last 4 years, he has worked in the engineering services industry. A significant contributor at QuEST, he is also an avionics domain specialist. His technical proficiencies include testing, quality assurance, and maintenance/repair of avionics equipment such as radar transmitters, receivers, power supplies, display units, control panels, ESM/ECM systems, communication and navigation equipment etc.

His significant achievements include:

- Modifications of RADAR systems on board defense aircrafts
- Modification and retro-fitment of Electronic Support Measure systems on defense aircrafts
- QA activities for development of ESM systems in defense aircrafts including environmental testing and functional testing

Hariom Baghel holds a Bachelor of Electronics and Telecommunication Engineering with a PMP certification. He is currently Technical Manager at QuEST Global, responsible for reviewing project estimates and deliverables, participating in and facilitating corrective and preventive action for repeated defects (internally identified and client reported), and arranging and guiding projects based on technical solutions.

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About QuEST Global

QuEST Global is a focused global engineering solutions provider with a proven track record of over 17 years serving the product development & production engineering needs of high technology companies. A pioneer in global engineering services, QuEST is a trusted, strategic and long term partner for many Fortune 500 companies in the Aero Engines, Aerospace & Defence, Transportation, Oil & Gas, Power, Healthcare and other high tech industries. The company offers mechanical, electrical, electronics, embedded, engineering software, engineering analytics, manufacturing engineering and supply chain transformative solutions across the complete engineering lifecycle.

QuEST partners with customers to continuously create value through customer-centric culture, continuous improvement mind-set, as well as domain specific engineering capability. Through its local-global model, QuEST provides maximum value engineering interactions locally, along with high quality deliveries at optimal cost from global locations. The company comprises of more than 7,000 passionate engineers of nine different nationalities intent on making a positive impact to the business of world class customers, transforming the way they do engineering.

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