

Hardware or Software Products: What Impact on Technical Documentation?

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Abstract

As apprentices in the software, hardware and embedded systems industries, we wondered whether the type of product had an impact on documentation. After collecting the existing literature on the subject, we sent a questionnaire to technical writers with hands-on experience in order to learn more about their methods and skills. Their answers on the subject underlined that having direct access to the product is essential, but that the methods and skills are different depending on the type of product documented. Indeed, for security reasons, hardware industry documents contain more legal requirements than software documents and have a different documentation structure. The type of deliverables and whether the product is published online or in hardcopy depend on how the product is used on site. Terminology and syntax, the illustration workload, and project management methods are also discussed in this article.

Keywords: hardware; software; product; documentation; technical writer; embedded products; certification; technical writer's skill; communication

7,670 words

Introduction

Technical writing simplifies the complex, translating complex topics into simple and accurate discourse so that an end user can accomplish a specific task. The documentation produced by technical writers includes all necessary product information, covering both operation and maintenance. Technical writing relates to any technical field including software (computer programs) and hardware (industrial equipment). This is why, in this research article, we contrast and compare software and hardware documentation.

In our current apprenticeships, we mostly document one type of product, be it hardware or software. However, throughout our careers, we are likely to document both types of products. This was confirmed by a significant number of technical writing professionals at the International Symposium on Communication that was held on January 30th at Paris Diderot University. Our main concern was thus to study the impact of the product on documentation. Do hardware and software products require different documentation methodologies

and tools? Technical writers need to master specific skills: are they different according to the industry? Can writers easily switch from hardware to software? The first part of the article will focus on the information upon which it is based and on our team organization. We will then study technical writers' working methods, and finally, the content of the documentation.

I. Research and methodologies

Literature about our subject is scarce and we encountered difficulties in collecting articles in the allocated time. Most articles only touch on the subject without going into much detail on the differences or similarities of documenting hardware or software products. However the literature we found enabled us to go deeper into some topics of the research, and to confirm or to refute the initial assumptions. The types of literature we found useful included books, university

papers, institution websites, international, regional, or national laws and standards, Subject-Matter Experts websites, blogs, and conference presentations.

Existing literature on laws and standards that govern technical writing for the software and hardware industries is scarce. Some articles elaborate on certain standards used in the technical writing world but they are neither detailed nor comprehensive. The standards of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) are not available online. ISO standards are not free; therefore the only way to have access to the content is to read articles related to the impact of ISO standards on technical writing. These articles are usually written by people in the technical writing world who have access to these standards because their companies have purchased them. These articles are usually very short and incomplete, so knowing what these ISO standards contain can be very difficult.

Technical writing across domains, a paper written by Douglas R. Wieringa and David K. Farkas, deals directly with this question. The software industry has significantly evolved since the publication of the paper in 1991. Nevertheless, we investigated the same aspects of the subject, namely the organization of technical documentation teams, the single sourcing methods, the terminology and phraseology techniques, and the legal aspects of documentation. Wieringa and Farkas (1991) focused on the comparison between nuclear plant procedures and software documentation. Their theme is highly technical and only concerns a specialized hardware field. We gave our research a broader approach as the diversity of our own work experience gave us the opportunity to look at hardware documentation in general.

In order to overcome this lack of literature, we designed and sent a questionnaire to several technical writers who work in various fields and thus have different backgrounds and experience. Thanks to this method, we obtained crucial information regarding our subject from a wide range of people.

To create our questionnaire, we drew from our personal work experience. We defined eleven questions which covered the entirety of the theme at hand, namely the types of products documented and deliverables provided, the sectors of activity, whether the writer has hands-on access to the product, the project management methods, the legal aspects of the documentation, its structure, and the terminology and type of illustrations used. All of the questions were open and not compulsory, so that the respondents could be free in their answers. The questionnaire was written both in French and English and hosted on a shared online platform. It was sent to approximately 60

people, including our classmates, the alumni association, colleagues and teachers, all of whom were encouraged to forward it to anyone who would be interested in contributing to our project. A feature on the online platform enabled answers to be gathered in a separate spreadsheet, which made it easier for us to analyze and compare them.

Thirty technical writers answered the questionnaire: sixteen of them document software products, nine document hardware products, four document embedded products, and one creates e-learning materials [Fig.1]. The respondents work in different sectors, all of which are highly technical, for instance the medical sector, banking and finance, IT (connected objects, audio equipment, software), or network and messaging security [Fig.2].

Generally speaking, the respondents gave exhaustive answers to our different questions. These answers were our most important source of information as they enabled us to be more accurate. They guided us during the writing of this paper as they were our only source of information when Internet searches failed us. Moreover, the diversity of profiles provided a unique source of firsthand experience which allowed us to have a clearer idea of the influence of the product on its documentation.

This research article is based on an analysis of the answers to our questionnaire, Internet research and our own experience as technical writers. It was written during our apprenticeships, sharing our time between work and university in alternating weeks. This rhythm enabled us to develop the content of our article, taking in account our daily experience. Sharing our research progress with our work colleagues helped us develop and/or reconsider our content. However, the major issue we had was organizing ourselves to be able to work separately on this project in a coordinated fashion. So as to work efficiently, our solution was to use an online drive to centralize our research. Each one of us was therefore able to follow the progress of the others, develop ideas, share experiences, and correct each other. We also organized meetings to review the work and to set new deadlines. The distribution of the workload was decided based on our work experience and our own interests. Once the article was written, each team member proofread the entire article in order to harmonize the content. Finally, the article was submitted to a native English speaker to ensure the quality of the language. The comments that arose from this multiple proofreading enabled the team to scrutinize every argument and to discuss different aspects of the article in depth. We realized the importance of coordination methods and that a significant amount of time had to be spent on proofreading.

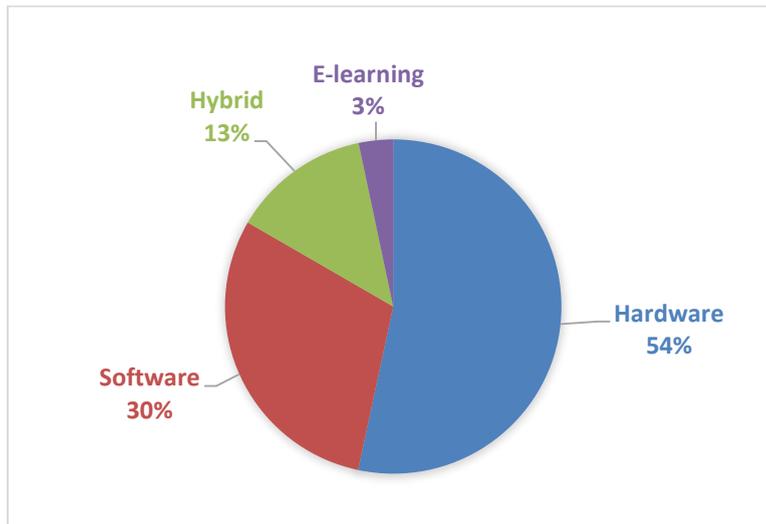


Figure 1. Distribution of answers according to the type of product documented

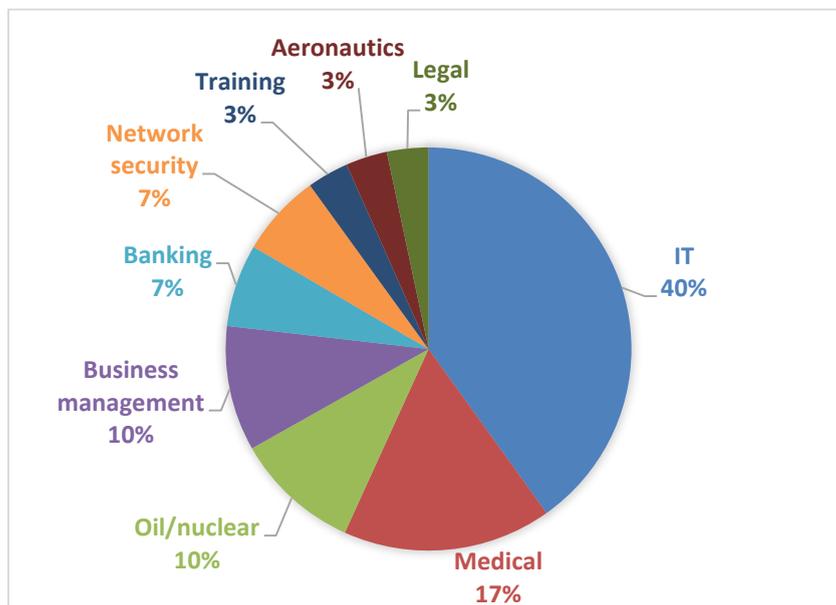


Figure 2. Distribution of answers according to the sector

II. Technical writers' working method

This second part of this article focuses on the technical writers' working methods, namely the way they collect information, their access to the product, the project management methods used and the types of deliverables produced.

To write a new document on a given product, writers have different ways to collect the information they need. They often rely on existing documents to create new ones. Access to existing documentation is essential to know what has been written before and how

it was structured. When a product is updated and the documentation needs to be modified, having access to existing documents is key to knowing how the previous product worked and to determining what needs to be changed in the new documentation. Furthermore, seeing how the information has been laid out and what style has been used enables technical writers to adapt the update so that the unity remains intact throughout the documentation.

In the hardware industry, one way to collect information is to read the Technical Specifications of the product. These documents, usually written by the engineers, contain general information about the product, such as its design requirements, its assembly (weight and dimensions), the environmental conditions under which the product is tested and a list of the features indicating the technical solution the engineer selected to implement them. Some of the information found in these specifications can be adapted for inclusion in product documentation. This is especially true if writers do not have access to the product itself such as in aeronautics or oil equipment fields. Another type of document that can be useful, for instance in the aeronautics industry, is the Kick Off Meeting (KOM) report that details what has been said during the meeting at the start of a project. Depending on the industry, the report details what product will be used or manufactured for that program or project, and the engineers will usually give information about the product. They will explain how or why the product is different from the ones manufactured previously and point out any new feature added to this new version. There is often less information in KOM reports than in technical specifications, yet crucial information technical writers need can often be found in them, not only for writing the documentation but also regarding deadlines.

However, the software industry not only produces technical specifications but also functional specifications, which is specific to software. This document indicates the functions and behavior of the software. The software industry also produces roadmaps and release notes. A roadmap answers the question "What's coming next" by listing the improvements that will be made to existing features in the upcoming release. This document is written ahead of time, unlike the release notes, which are delivered with each software release. They list all the new features and software bug fixes.

In both industries, technical writers can refer to a comprehensive set of internal documents on which they can base their documentation upon.

After collecting enough information, technical writers need to understand the product they are documenting before they can write about it. The writers' required skill set depends on the subject matter they are documenting. Indeed, in software companies, the development of documentation requires knowledge in two different domains. Software technical writers do not need to be programmers but understanding programming languages is a benefit and

helps them to work better with programmers. Nevertheless background knowledge of programming and of user interfaces is enough. For example, in a company that sells accounting packages, the knowledge fields would be accounting and software. In this case, there are two types of Subject-Matter Experts (SMEs). A SME is an authority in a particular field to whom writers can turn. This means that SMEs are not only developers or programmers; they may also be product managers who specialize in the software business field, such as accounting. In the hardware industry, SMEs may be engineers, technicians, or managers. Indeed, there is usually only one domain of expertise to handle in the hardware industry. Moreover, in industries such as electricity or mechanics, technical writers need to know how to read technical illustrations like schemas, line drawings, and 3D views. Thus writers tasked with documenting aircrafts, for instance, do not necessarily need to be engineers but they will be expected to handle much engineering information.

When writing documentation for hardware or software, having access to the product is essential for technical writers as they need to know how to use it. Hardware technical writers test the product in the engineer's workspace (laboratories, factories, etc.) – which means they sometimes need to travel to handle the product – whereas software technical writers usually stay in their own office. Indeed, in the software industry, writers usually have direct access to the product and its prior versions on their own computer. They also have access to beta versions that enable them to test the software and its user interface before the software is released; however, the product can change at any time, without notice, and writers have to wait until the final release to finish the documentation.

In some hardware industries, such as shipbuilding or aeronautics, the product is only produced on the client's order and is not intended to be manufactured in large volumes, usually for cost and storage reasons. This means that writers do not have their own copy of the product, unlike software technical writers who are free to install an application at no extra cost. This is why, in most hardware industries, in order to have access to the product, writers have to organize a meeting with the experts and, if necessary, travel to where the product is located. Moreover, in the medical sector for instance, technical writers can have free access to equipment such as mammography machines, but to operate it, a respondent explained that a minimum of four people need to be present to ensure the safe and correct usage of the product, namely the field engineer, a trainer, the project manager, and the writer. Such meetings must thus be planned several weeks in advance.

When technical writers have the right to use the hardware they are documenting, they need some security training from SMEs beforehand, especially in the hardware industry where the product may harm the user or other people if not handled properly. In both industries, writers attend training sessions, but software technical writers can often do without training. The hardware writers might also be required to wear safety gear, called Personal Protective Equipment (P.P.E.), such as helmets, blouses, boots and goggles. On the software side, technical writers install the software themselves: it is either installed locally on the writers' machine or remotely on another computer. As a consequence, the writers, though using the product, cannot do any harm to the company IT system.

If technical writers cannot use the product, they have to resort to interviewing the engineers and watching their gestures so as to write procedures. The writers may not have access to the product for safety reasons, or because the product is still in its prototype phase, therefore the number of prototypes is limited and engineers test the product themselves. Moreover, for security reasons, in a military environment, it may happen that the writers cannot even see the product. In that case, they must rely on the SMEs. However, in the software industry, an SME cannot provide the writer with enough documentation to write technical documents. Indeed, writers need to have access to a product to know how the technical specifications were implemented. We came across a technical writer who had to document a software product in the telecommunications industry to which he had no access. The piece of software was still being developed and its guide had to be ready for review at the time of the product release. The main problems the writer met were the absence of previous documentation on which he could have based his guide and the absence of communication between the writers and the developers. The only piece of information the writer had was a screenshot and a few paragraphs about the software. In the end, a guide of 30 pages was written, which was mainly made possible by the writer's knowledge of the subject. However, the exactness of this process can be questioned and this is a very rare situation in the software industry.

When documenting a product, it is necessary to follow a project management method. Project management is the planning, monitoring, and control of all aspects of a project and the motivation of all those involved in it, in order to achieve the project objectives within agreed criteria of time, cost, and performance (Lester, 2013).

Our analysis shows that the following project management methods are applied to the production of documentation. Most traditional project management methods are used in the software industry, while they do not often apply to documenting hardware products. The Waterfall- and V-models (Fig.3) have been adopted by two of the respondents who document software. Both methods observe a sequential process, which means that each phase must be completed before the next can start. They follow a typical cycle, from conception to maintenance, including initiation, analysis, design, construction, testing, production, and implementation. These methods enable to clearly define the tasks and roles of everyone involved in the product development process, and are useful especially when the project involves a lot of people. They integrate quality assurance in the development process and numerous verification and validation concepts, which explains why they are mostly used in software development processes.

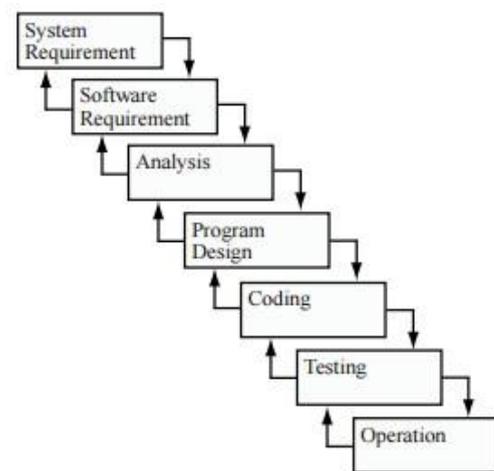


Figure 3. The Waterfall model

Source: *Technical Documentation of Software and Hardware in Embedded Systems*, B. Muranko and R. Drechsler, Institute of Computer Science, University of Bremen (2006)

Some technical writers do not follow specific project management methods. On the other hand, in some development teams, the only structured process is documentation. However, there is no particular product development method. The main reason for this is the lack of time; indeed project management is time-consuming and is a luxury that small teams cannot afford. Other writers follow company-specific methods that are less restrictive. One of the respondent said he followed an approach based on the creation of a Gantt chart where all the tasks and durations are predefined and are to be respected. Everything is

planned in advance, which allows more security and avoids unexpected events. Another respondent said their project management consists in daily and weekly meetings during which the whole team reviews each task individually.

However, the most widespread project management method is the Agile method, along with its numerous variants. Agile methodology is an alternative to traditional project management. It is a methodology for the creative process that anticipates the need for flexibility and applies a level of pragmatism into the delivery of the finished product. Agile methods are an alternative to waterfall, or traditional sequential development (M. Rouse, 2007). The Agile approach is unique to software development. Yet, one of the respondents documenting solely hardware products said he follows this method. The Agile method consists in quickly providing documentation for each internal software release. The production cycle is therefore very dynamic. The writers usually have one or two interlocutors, and need to gather information rapidly, and make sure the documentation stays consistent with the product. The main Agile method is Scrum in which the steps and tasks of product development, called sprints, are clearly defined beforehand. The documentation is quickly updated, which minimizes outdated information and mistakes. However, the Agile method can also have negative impacts on the documentation, the development process being possibly too fast for the documentation to keep up.

We can conclude that the type of product does have an influence on the project management method used. Agile was designed specifically for the software industry, whereas at this stage of our researches, we have not found such method in the hardware industry. For all hardware and software projects there is a management method, but there is no specific one when it comes to documenting a product. Technical writers usually adopt the method applied to the whole project, or the one mainly used in their company.

The production of deliverables such as hardcopy comes last in the project management process. The questionnaire results imply that the respondents tend to print their documentation less and less. For example, in the software sphere, products are often downloaded directly from the Web, and are not purchased retail as a shrink-wrapped package, so all the software documentation is available online. However, some Business to Business (B2B) companies have taken the decision to restrict access to their documentation by storing it on a dedicated portal onto which clients have to log. Companies may also ship their product to

the client along with a short Quick-start guide, or a product information sheet that acts as an introduction to the product. Some supply a DVD or CD in the package to install the product. However, for further details, the client has to go on the product Website to read the manuals. In the software industry, the PDF format exists purely for contractual reasons. Indeed when a PDF is delivered to clients, it is left up to them to decide whether to print the documentation or not. In the case of B2B, where the user cannot access a computer, such as on a building site or in a factory, hardcopies must be provided. Some hardware companies use DVDs or CDs, and the Web to deliver their documentation but only for Business to Customer (B2C) products where the end user is at home and can access a computer. In general, B2C companies make their documentation available online on their Website. However, in the hardware industry, hardcopy is still widely used.

The kind of deliverable suited to the product mainly depends on the type of product. For example, for software specifically, Web helps and screencasting are a growing type of deliverables. Screencasting consists in the end users watching a n instructional video of someone using the software. This results in a much better understanding of the product. A Web help is a type of online help which is integrated in the software itself. Each window contains a Web help button that opens a new pane displaying a table of contents, index navigation, text search capabilities, etc., all of which would not be available in printed documentation. This shift from the traditional printed user guide to online help is natural, as online help is directly integrated into the software which thus bridges a gap between the product and its documentation and increases user ergonomics. This explains why some software companies are now forsaking paper entirely and store their manuals online. These new types of deliverables that have appeared in the last two decades are specific to software and do not apply to hardware. Indeed, screencasting a hardware product is not possible as the product is not software, and an e-learning presentation is not adapted to the user's context. To make a video for hardware products, technical writers would have to film the product and thus invest in professional equipment, and maybe hire professionals to do the job themselves as the skills are very different from writing. Indeed, online help or e-learning do not work for the average builder using a bulldozer, for instance. So, in the hardware industry, hardcopy manuals are more common than online documentation.

Indeed, in the hardware industry, manuals tend to be printed more often as the target users, such as maintenance technicians and mechanics, do not use

computers while they work. This means that the type of documentation depends on the users' environment and is produced in order to suit the way it is used. In medical imaging, though, it is not a question of user environment. Writers are obliged to print their documentation so as to conform to relevant industry standards and to respect legal obligations. Documentation is thus usually printed for practical reasons or when standards regarding security are concerned. Yet another pitfall for printed documentation concerns updates. While online documentation can be modified daily, printed documentation cannot be updated. Moreover, once users have a printed manual, they tend to keep it even when the document version has expired. However, in the past few years, the use of on-board documentation is rising. With the modernization of vehicles, notably aircraft, display screens are now increasingly implemented on dashboards. In the case of these "hybrid" products, called embedded systems, two types of deliverables co-exist: paper and online. This means that, in the hardware industry, hardcopy manuals are more common than online documentation, except where software and hardware are combined. Furthermore, printed documentation is more passive whereas online documentation is more task-orientated. Indeed, software users generally follow online manuals or Web help for real-time instruction, whereas hardware documentation contains much more descriptive information. This implies that reading hardware documentation includes a lot of preparation before the user gets to actually carry out a task. Moreover, software products tend to use interactive documentation as they have direct access to the user interface. This explains the appearance of new types of documentation such as wikis. These collaborative databases enable end-users to contribute to online manuals and blogs. They allow technical writers to directly answer clients' questions online. All in all, whether it is printed or not, most documentation, software or hardware, is available online.

III. Documentation content

The third part of this article deals with the content of the documentation. Here we will see what tools technical writers choose to structure their documents, the syntax and terminology used, the illustrations that accompany the text, and the legal aspects.

For both hardware and software products document structure has a major impact on readability and usability. The different parts of the document should be

as independent as possible. A document properly structured allows readers to find the information easily. It also enables a good reuse of items, thus improving the efficiency of the documentation process.

According to the questionnaire answers, fully-structured documentation is not predominantly used, but there are nearly as many fully-structured documentation departments as departments producing non-structured or pseudo-structured documentation. In one particular case, hardware and software products are documented in the same company and by the same person; the hardware documentation is DITA-structured and the software documentation is not structured.

We identified three major structuration languages: DITA, Docbook, and S1000D. DITA was first created ten years ago in the software industry where there is more need to reuse content. The standard DITA model concerns software in its basic state (with the three main topics: concept, task and reference). Software or IT firms have the highest DITA adoption rates. DITA is suited to fast release cycles where there is a need to track content, and for industries where the need to follow regulatory compliance is strong. Apart from the software and IT industries, DITA is now adopted in a number of other sectors, including telecommunications, semiconductors, medical devices, financial services, and the automotive industry. From the basic state, it is possible to add new topic types to represent the sort of information a hardware manufacturer is concerned with. DITA is also especially suited to industries with big data as it enables a significant level of reuse. DocBook was created in the IT and electronics industries. It is widely used within the free software/open source community and is mostly computer programming-oriented, but it has been used in some cases to document both software and hardware. Concerning S1000D, it is very specific to hardware. As it is focused on aircraft maintenance, there are elements and attributes in the model that are specific to the aeronautics industry. S1000D can be applied to any industry or field that involves maintenance and/or operation tasks.

In deciding the way to structure documentation, the type of product is not the only criterion. The more documentation there is, the more likely it is that the documents will be structured with DITA or a similar system as there is a critical need to reuse the content. Moreover, it may also depend on the number of years the documentation department has existed; a more mature documentation department is more likely to produce structured documentation. Whether engineers or technical writers produce documentation and whether the company is large or small are also factors that determine the use of structured documentation. Indeed,

implementing a structured documentation system is a costly investment that smaller companies may not be able to afford.

Regarding the terminology and syntax used to write the documentation, the field and sub-fields of work have a greater impact on documentation than the type of product. The questionnaire shows that many documentation departments follow external and internal conventions and rules on terminology and syntax so as to have documentation which is as consistent as possible. Brevity, clarity, simplicity, active voice, good choice of words, and adapting to the audience are the writing principles that all technical writers should follow. The aim is for the documentation to be legible, comprehensible, and useful.

Information structured according to specific rules and reader-oriented is understood better by the users. This is the role of controlled languages and especially of Simplified English, which is specific to the aeronautics industry and also used in many hardware industries. Simplified English is part of the ASD-STE100, an international specification for the preparation of maintenance documentation in a controlled language. The Specification, which was first released in 1986, is fully owned by the AeroSpace and Defence Industries Association of Europe (ASD) based in Belgium. English is often not the readers' native language. Such readers can easily be confused by complex sentences and by the meanings of some words. Any misunderstanding concerning a piece of equipment may expose users to hazards they would not face with software products. To make the documents easier to understand, Simplified English uses a limited vocabulary and a set of writing rules. The terminology and syntax used also depend on the company itself. Indeed each company has its own jargon and uses specific terms and acronyms, which are often contained in glossaries or translation memories.

In a nutshell, we cannot say whether structured documentation is more widespread in the hardware or in the software industry. However, it is certainly true that using structured documents requires the technical writers to have specific skills in information analysis, mapping, and modularization as well as in structured languages. Hardware and software products have their own terminology and syntax, so writers who worked in one type of product for years must take steps to adapt to another type of product. The technical writers' skill is to master the terminology and syntax that are used in the particular field and company.

Illustrations have a crucial role in technical documentation. We first assumed that the illustration workload was more important in hardware documentation than in software documentation, since illustrations for hardware products take longer to produce and are more diverse. We also thought that the particularity of hardware illustrations was the physical presence of the products; the users can actually see its complexity and size, instead of only seeing a software interface. Moreover, we thought that, as some hardware products have to be assembled by the user, the procedures might require illustrations.

The respondents to our questionnaire who work in the hardware industry document a wide variety of products, namely loudspeakers, magnetic resonance scanners, toys, pipeline equipment, and so on. Their answers showed that we were misled in our assumptions. According to the respondents, the main difference between software and hardware documentation is the type of illustrations used. Indeed, most of the software documentation includes screenshots, diagrams, icons, or even video tutorials. Hardware documentation however includes mostly line drawings, photos, and 3D views.

The illustrations are made by different people and serve different purposes. The technical writers, whether they are in the hardware or in the software industry, will often be asked to produce the graphics themselves when it comes to screenshots or basic illustrations. They therefore need to be skilled in analyzing the need of the users, making decisions about the structure of the graphics, and choosing the accurate format and type of illustration according to the aim of the documentation project. These decisions will be made depending on the type of product and the type of deliverable. On rare occasions, writers will be asked to make more technical drawings. For software products, screenshots are mainly made by the writers themselves. This enables them to decide what illustration should be used and where. Only one respondent working in the software industry did not have access to the product and was not able to take screenshots. For hardware documentation, the illustrations can be made by the writers if they have technical drawing training, the knowledge of specialized software, and skills in ergonomics and user experience applied to illustrations.

However, most of the time, illustrations are made by professionals specialized in graphics and 3D view software. Working with graphic designers implies teamwork, hence requiring good communication skills. Teams that do not work directly with a graphic designer use illustrations produced by other departments, for instance Research and Development (R&D) department, as they generally work with 3D views. Technical writers

need to work well with other departments; in the best scenario, illustrations are automatically shared to facilitate the work of technical writers. However, most of the time, the technical writing team needs to find the one individual who produces the illustrations within other departments. This can become an arduous search for information, especially when the departments or individual is not at the same location, or in the same region or country, or when the person in charge of creating illustrations changes from project to project. In other cases, both for software and hardware products, the marketing department can provide graphics to be included in the documentation. These are often suitable for the front cover of the deliverable but illustrations of a general nature may not be relevant to the procedures being documented. Integrating graphics from other departments in the technical documentation can be more delicate for hardware than for software as the illustrations do not always correspond to the textual content. Adapting textual content to the illustrations is more often done for the average user of a simple hardware product. As the documentation is short and often printed, and delivered with the product, it can be used as promotional media and hence highlights that the product is easy to use. As illustrations stand out from the text, the more understandable the illustration, the less text is needed.

In hardware documentation, illustrations may have a role that does not exist in software documentation. When technical writers do not have access to the product, illustrations are a very valuable source of information. Indeed, they help the writers to understand a product they do not have access to. All these characteristics are common to embedded systems as they bring together hardware and software concepts. Both hardware and software documentation need to demonstrate visually the use of the product. In the software industry, a video tutorial, such as screencasting, is often made by the technical writer with specialized software. In hardware documentation, the writer needs to visit the equipment on site in order to produce any video. This requires considerable planning. Moreover, the documentation process often takes place when the product is not completely finished, which means it is either in beta version for the software industry or is in a prototype phase for the hardware industry. This implies that demonstration videos may not match the final version of the users' product.

In both industries, writers have to respect some crucial points: illustrations cannot be modified as easily as text and must be designed so as to minimize future changes. To avoid translation problems, no text should appear on illustrations. Indeed, when a document is

translated, if an illustration contains text, the translator might have to ask a third party to retouch it. Moreover, the graphics must be as generic as possible in order to remain valid for throughout product updates. The advantage of hardware products is their long production runs: it is expensive to modify a mass production process. Thus, the production cycle has a great influence on illustrations in documentation. Another issue for hardware and software technical writers is the legal aspect of illustrations. When writers do not produce the illustrations themselves, they must ensure that they comply with all the legal aspects of the products. For example, drones cannot legally be flown in the Paris area, so the illustrations should not show a drone flying over Paris. In software documentation, technical writers must ensure that icons and schemas belong to their own company.

To conclude, whether the industry concerned is software or hardware, illustrations are essential to give a better understanding of the product to the user. Only one respondent declared not using illustrations at all. This is not because of it being unnecessary but because the documentation software that the respondent uses is not able to include graphic files.

For both hardware and software certain documents have to be written according to legal standards concerning production methods and the level of quality and security. User manuals also have to follow strict rules as they are vital for the end-users' basic understanding of the product. Certification is a process used to prove that the product follows specifications or standards. This is why it imposes various rules on documentation. According to the *NATO Glossary of Terms and Definitions* (2008), certification is the *process of officially recognizing that organizations, individuals, material or systems meet defined standards or criteria*.

Certification is mostly used for hardware products because the human and financial consequences of faulty products can be severe. Safety in the workplace is important; the risks involved in using the product must be identified and the user informed. That way security is guaranteed and the responsibilities of each party involved in an incident or accident are clear. Some industries, such as the medical sector and aeronautics, are highly regulated as inappropriate use of the product may have grave repercussions. For example, the medical sector must follow the International Electrotechnical Commission (IEC) standards. The IEC creates global standards for all technical writers documenting electronic products. A conformity assessment process ensures that all documentation and

products following the IEC standards meet performance or safety expectations. In the medical sector, documentation needs to include the “Danger”, “Warning” and “Important” indications because the regulations are more focused on safety issues.

According to the results of our questionnaire, not all people in the technical writing field know whether their documentation is subject to laws or regulations. Those sometimes require the documentation to follow a certain structure or to have certain content. For most consumer products, be it hardware or software, a Quick-start guide containing terms and conditions is compulsory. For example, with telephones, clients need to know how to switch them on and use the basic functions.

In the aeronautics industry, standards can impose a certain documentation structure depending on the types of documents. For equipment that needs certification, three sets of documents are needed per product. The first document is an Acceptance Test Procedure (ATP), which describes the tests to be performed on the equipment as well as the acceptance criteria. This first document is accompanied by an Acceptance Test Report (ATR), which is filled out when the tests are performed on the equipment to indicate whether the test is “Pass” or “Fail”. The second document is a Component Technical Specification (CTS), which brings together all the performance and testing specifications. The third document is a Statement of Similarity (SoS). It states the specifications under which the tests were performed on similar equipment, and the Qualification Test Procedure (QTP) and Qualification Test Report (QTR) that apply. As equipment is certified by similarity with other equipment, a table of comparison with the Bill of Material (BOM) of each equipment needs to be created. This table identifies the differences between the equipment and explains whether each difference in the two items of equipment has any impact on their performance.

In the aeronautics industry, some companies have to comply with standards and specifications from manufacturers such as Boeing and Airbus. For cabins and seats, the companies supplying Boeing will follow the “D6-36440 Vol.1 rev G: Cabin System Requirements Document, Volume 1” and those supplying Airbus the “2520 M1F 0012 00 Issue 03: Electrical Seat Actuation System”, as well as the “ABD0100.1.5: Off-Aircraft Test & Testability Requirements”. These documents specify what tests the equipment needs to undergo and what the criteria for acceptance are. Often companies in this industry will work for both Airbus and Boeing, and it is important that they know the differences between these standards

as they are very subtle and a mistake would waste lot of time and money.

Many hardware industries in the European Union must meet the “CE marking” certification. The CE marking, which was enforced in 1995, applies to all products marketed or put into service in the European Union for the first time, including products already used and/or second-hand products imported from third countries. Products that are CE marked have the manufacturer’s declaration that the product meets the requirements of the applicable EC directives. A CE marking and a data plate are affixed on the equipment. As a first step in the obtaining of the CE mark, risks implied with the use of the product must be assessed. CE marking means compliance with European directives which are transposed into the law of each Member State. There are approximately 20 directives in force, including 2006/95/EC (Low Voltage), 2004/108/EC (Electromagnetic Compatibility), 1999/5/EC (Radio & Terminal Telecommunication Equipment), 2006/42/EC (Machinery), 93/42/EEC (Medical Devices), 97/23/EC (Pressure Equipment), 89/686/EEC (Personal Protective Equipment). When documenting a product, technical writers must refer to the directives that are relevant for the product.

The manufacturer has various obligations. If these obligations are not fulfilled, sanctions are imposed. Through the technical file, the manufacturer must provide evidence that the compliance of equipment has been checked. The technical file is a set of documents which compose hardware documentation. The writer must write most parts of the documentation in one of the European Union languages. The technical file is not fully produced only by the technical writer; indeed part of this documentation is also produced by engineers who provide raw data on the equipment such as “technical datasheets” and “risk assessments” for example. The compulsory content varies according to the product and its corresponding directives. It must cover the design, manufacture, and operation of the equipment. In general, the technical file should comprise, among other documents, a description of the product and its use, diagrams, plans and layouts, descriptions and explanations necessary for the understanding of these diagrams and plans, the list of standards applied, datasheets, instructions, quality control and commissioning procedures, and the Declaration of Conformity (Dock).

The questionnaire respondents who worked in the software industry did not usually have to follow any law or regulation in particular. They told us that content and structure of the documents was mostly left to their discretion. However certification can also be applied to

software, but in a slightly different way than for hardware. For software, certification is used to prove that the product underwent a series of tests to establish whether it complies with the requirements and that it possesses certain characteristics in terms of usability. Among the standards that technical writers must apply, ISO/IEC 26513:2009 provides the requirements for testers and reviewers of software user documentation. Other standards include: ISO/IEC 26514: 2008, ISO/IEC 26511, ISO/IEC 26512, and ISO/IEC 26515. The first standard mentioned, ISO/IEC 26513:2009, helps ensure that software users are provided with consistent, complete, accurate, and usable documentation. It states the minimum requirements for the testing and reviewing of user documentation. It concerns printed user manuals, online help, tutorials, and user reference manuals. It applies to both initial development and subsequent releases of the software and user documentation. The standard deals with the evaluation of documentation only and not with the evaluation of the software it supports. ISO/IEC

26513:2009 was developed to assist those who test and review software user documentation as part of the software lifecycle process. Documentation evaluations are performed throughout the development, production, and maintenance of the document. The standard also contains informative checklists useful at every single phase of the quality control process, a procedure that allows reviewers to highlight any defect or nonconformity.

Nevertheless, software certification is less common than hardware certification because software companies have to rely on a third party to perform software certification. Furthermore, on the software side, the Quick-start guide or other types of deliverables are not always compulsory. Though, in the banking sector, some documents are mandatory as they may stipulate the dates when the company is subject to audits. Software is usually sold directly to consumers; therefore there are fewer legal obligations than in the hardware industry, though some software documentation needs to include information about licenses.

Conclusions

The software industry leads the way to modernizing documentation. It has indeed been able to answer the need for a new kind of documentation. Today software documentation has to be updated frequently and must be immediately accessible within the product itself. On the other hand, paper-based documentation is mostly produced in the hardware industry where the users' working conditions do not allow electronic documentation. Hardware documentation has to take into account security and contractual aspects.

Particularities specific to these two industries have been identified in this article. We illustrated how software can be easier to document than hardware because of an easier access to the product, but we also underlined the fact that there are two aspects to software, namely the business sector (such as finance, manufacturing, aeronautics) and software development, both of which technical writers must be familiar with. Writers in the hardware industry need to master specific skills, such as the ability to understand or even produce technical illustrations, and integrate certification to the documentation. Moreover, the legal aspects are particularly important for hardware products, as human safety is much more at stake in the hardware industry.

Yet, the technical writers' basic skills are common for software and hardware, and many similarities remain. For example, writers need to abide by specific rules and regulations, either imposed by the company itself, such as Simplified English, or by standards set by international organizations. Project management skills are also required, but the management approach used in the documentation team is not specific to any industry; technical writers have to adopt the approach used for the whole lifecycle of the product. Other similarities are the finding of information and relying on SMEs, having a good grasp of structured documentation and, most importantly, possessing excellent writing skills.

In order to work in both industries, writers need to easily adapt to new kinds of products and be able to acquire new skills. Such flexibility is illustrated in the embedded systems industry where the technical writers' skills are common to hardware and software. In the near future, technicians equipped with "wearables" could take hardware documentation into aircraft repair shops, nuclear power stations, etc. Thus, wearables might revolutionize hardware documentation, which would enable hardware to catch up with software.

References

- D. R. Wieringa and D. K. Farkas, *Procedure Writing Across Domains: Nuclear Power Plant Procedures and Computer Documentation*, University of Washington, 1991
- I. Sommerville, *Software Documentation*, University of Central Florida, 2001
- Mike West, [Writing, Editing and Design](#), last consulted in June 2015
- N. Kelley, *Sentence Structure of Technical Writing*, Program in Writing and Humanistic Studies, MIT, 2006
- Collectif, *La rédaction technique*, éditions Duculot, 2000
- Tanguy Wettengel and Jacques Fontanille, *Technical Writing and Information Analysis*, Presses universitaires de Limoges 1999
- H. Kaiser, *A close look at Simplified Technical English*, TC World, 2013
- [What is Technical Writing?](#), Techwhirl, INKtopia, last consulted in June 2015
- R. Kurtus, [Process of Writing a Technical Manual](#), School for Champions, 2006
- A. Lester, *Project Management, Planning and Control: Managing Engineering, Construction and Manufacturing Projects to PMI, APM and BSI Standards*, Butterworth-Heinemann, 2007
- K. Schengili-Roberts, *Not just for software: How and why DITA has spread to other industry sectors*, April 2015
- North Atlantic Treaty Organization (NATO), *NATO Glossary of Terms and Definitions*, 2008
- R. Bloomfield and J. Voas, *RTO-TR-IST - Validation, Verification and Certification of Embedded Systems*, National Aerospace Laboratory NLR, 2005
- [What does a technical writer do?](#), Learn.org, last consulted in July 2015
- B. Muranko and R. Drechsler, *Technical documentation of software and hardware in embedded systems, Very Large Scale Integration*, 2006 IFIP International Conference, IFIP, 2006
- European Commission, http://ec.europa.eu/index_en.htm, last consulted in June 2015
- The Content Wrangler Inc., <http://thecontentwrangler.com/>, last consulted in June 2015
- [ISO](#) Website, last consulted in June 2015
- M. Rouse, [Agile software development \(ASD\)](#), last consulted June 2015
- N. A. Bleiel, [Evaluating software documentation projects quickly](#), TC World, 2010

Appendixes

Appendix A. Questionnaire

Hardware vs software: the influence of a product on documentation

What is your company's activity and what type of product do you document (software/hardware)?

What type of deliverables do you produce?
Is your documentation printed?

Is your documentation structured?

What type of terminology/phraseology do you use? What kind of pictures do you use (screen shots/photos)?

Can you access the product? Do you test it?
If this is the case, how do the tests take place?

What are your project management methods? In what way do they impact your documentation?

According to you, what are the differences in the documentation process for a software and for a hardware?

Do the required skills for a writer depend on the product he/she is documenting?

Is your documentation exclusively user orientated or must it also contain legal content (such as certifications)?

In the second case, to which standard/law must it comply with?

Could you recommend any bibliographic references in relation to our article?

Any comments?