Interactive and more usable approach towards Customer Product Information

by

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Abstract

Information about complex technical products such as Radio base Stations (RBS) needs to be presented in ways that make them easy to understand. The aim of this project was to investigate Ericsson’s Customer Product Information for complex technical products from the users’ point of view and propose improvements to the user interface. User requirements were gathered from interviews and from literature on digital libraries, search and navigation. Several usability problems were identified and analyzed. A prototype was made that demonstrate proposed design solutions to the found problems. General recommendations for digital libraries of customer information about technical products are given.
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1. Introduction

To understand complex technical products such as Radio Base Station (RBS), one needs Customer Product Information (CPI). The CPI contains safety requirements, instructions for changing of parts, diagnoses and alarm handling situations. The RBS cabinet is a box as shown in figure 1, where different components could be installed for radio network transmission such as Global System for Mobile communication (GSM-2G), Wideband Code Division Multiple Access (WCDMA-3G) and Long Term Evolution (LTE-4G). Ericsson provides CPI for the installation of different components of radio network.

Ericsson is a global company that provides telecommunication equipment and services to mobile and fixed network operators. Ericsson’s network equipment is being used in more than 180 countries and the company is developing and deploying LTE systems around the world. Ericsson’s research still continues into innovative solutions for GSM, WCDMA and Code Division Multiple Access (CDMA). The company’s mobile broadband modules are connecting a wide range of devices and systems [33]. Ericsson’s four global service centers are in China, India, Mexico and Romania. Ericsson is also offering end-to-end solutions for mobile communication standards. The company is among top ten IT service providers [34].
1.1 CPI Users

There are three user groups of CPI which use the CPIs in different ways depending on their roles. The first group is composed of the users who create the CPIs. These users work at one of the Ericsson departments and their job is not only to create the CPIs but also to update and improve them for the users. The second group encompasses people who are stationed at NOCs (Network Operation Centre) which are located all over the world. These NOCs are control centers, and the people who work there receive alarms when there are problems with the products. A person working at NOC is usually equipped with 4 to 6 screens. The job of this person is to monitor the alarms, and then take further action in case of any problems within 15 minutes. If the problem is not so serious, and it is possible to handle it from the NOC, the operator will fix it remotely. However, if it cannot be dealt with by the NOC, the NOC operator will issue a problem ticket which is sent to the field technicians. Restarting the devices is usually enough to solve the problems. The field technicians constitute the third CPI user group which is responsible for repairing, installing and replacing the different components on site. They receive problem tickets from the NOC, and then their job is to fix the problem within two hours.

1.2 CPI Libraries

The CPI library contains the documents which are necessary for the life cycle of the products such as RBS. The library can be accessed by providing login information in the web browser, preferably Internet Explorer. The customer who buys a product like RBS from Ericsson has access to the CPI library in order to get assistance in using the product. The CPI library has a structural-view and a document-view as shown in the figure 2. The structural-view opens to the left side of the screen and the document-view to the right. The structural-view represents the library overview and contains the following folders:
Safety and Environment, Library Overview, Product Overview, Planning, Installation and Operation and Maintenance. These folders contain all the related and necessary information required by the users and the folder layout is the same for all the products. The user can search for documents from the folders (structural-view). When the user selects a document from structural-view, it opens in a document-view. The library has a search functionality which can be used in both of these views. The user can search for folders and documents in the structural-view as well as within the selected document.

![Image of CPI Library](image)

Figure 2, Current system: CPI Library with the structural-view to the left side and the document-view to the right side of the screen

Ericsson has a department which works with the CPI. The responsibilities of updating and creating the CPI documents are divided among different groups within the Ericsson department. The central repository for CPIs is called CPI Knowledge Area which is responsible for creating the CPIs by using different methods and tools. Furthermore, thirteen different expert groups specialized in their particular area of competence are responsible for introducing changes when required in the CPI Knowledge Area.
1.3 The purpose of the thesis

The purpose of this thesis is to analyze and perform the usability evaluation of Ericsson CPI documents on the basis of previous work in the similar field as there was no access to the real users. More importantly, the search functionality and the navigation in CPI documents need to be optimized. Ericsson also wanted to investigate if there is a possibility of modularization with the use of the same CPI document text to improve the linking between the documents. The following section explains the research questions which are to be answered during the study.

1.4 Research questions

The goal of this thesis is to evaluate the navigation and search functionality of the CPI and to suggest design improvements. The following questions need to be answered in order to fulfill the purpose of this thesis:

- What are the most important requirements regarding the navigation and search functionality in information-dense manual from the users’ perspective?
- How well does Ericsson CPI library meet these requirements?
- How can the design of the CPI user interface be improved?
- How can design recommendations for CPI libraries be formulated?

1.5 Limitation of the research

The main limitation of this work due to limited time and resources: the problem is studied with focus on end users only. Even if this is the primary user group, it would be relevant to study also some of the secondary user groups like text authors or library administrators. However, considering other user groups was not possible in the given time.
It was not possible to get direct access to the primary users. All information about the needs of this group was gathered by interviews with representatives from Ericsson’s staff that worked closely to the end-user group. Obviously, first-hand interviews with the primary user group would have been preferable, but that was not possible. Moreover, in the evaluation phase it would have been preferable to do user-testing with the primary user group, this could not be done as the access to the end users was limited.
2. Theory and earlier research

2.1 Digital libraries

Digital Libraries (DLs) [1] are defined in many ways by different stakeholders working with them. Thus, the librarian names them as ”databases”, arts and humanities professionals refer to them as ”electronic archives”, and the DLs are referred to as ”digital surrogates” in the UK and Western Europe [2]. One can say that DLs embody the electronic mapping of physical libraries in electronic format. Consequently, the extension of physical libraries into electronic form provides the broader audience with the access to data [3 - 5].

DLs have gained significant importance in the past two decades [6]. At the end of 1980s, the DL was hardly a concept. By the end of 1990s, research, practical development and general interest in DLs have increased globally. Since 1990s, the internet has become the main source of information and services. Currently, the library users have a variety of resources with rich media and different forms of interactivity. Nowadays, it is easy to find data for the research or various publications at a low cost and with least physical effort. Human interaction with information has changed since DLs appeared, and it depends upon the availability of internet connection as well as appropriate electronic devices. The DLs largely facilitate the information search in academia and for personal use [7]. Therefore, there is a significant increase in the demands for better interactivity and services.

Since the importance and applicability of DLs have been established, questions about usability and utility of DLs have started to arise. The dependency of DLs on different aspects; especially the usability have led to the DL transformation into different areas such as “database structure, network architecture, protocol interoperability, the development of intelligent and adaptive technologies, the performance of retrieval algorithms, collection development, digitization policy assessment, usability, information
architecture, interaction design, information behavior and many others [3, 8 - 10]”

The quality of DLs will be evaluated by the system users who access the knowledge repositories while being connected to the internet anywhere in the world [11]. Therefore, the crucial issue while designing DLs is to take into consideration the user’s perspective. User-centered evaluation method has been used for the assessment of DLs in recent years [12]. User-centered evaluation of DLs has produced different criteria to judge DLs from the user’s perspective. In user-centered evaluation, the user’s perspectives on the visualization of interface for DL were collected for future improvements. According to the study [13], the users preferred the following features in DLs’ interface:

- Standard icons they were already familiar with
- Navigation links on the left side of the screen
- Standard menus
- Search pan to the top right side of the screen

For example, according to the study [13], DLs at one of the Indian universities are easy to use only for experts from the faculty of Engineering/Technology. Mostly, the users from other faculties like Arts and Humanities or people with very little computer knowledge cannot use DLs because of many difficulties. In order to increase the access of DLs at universities, the following interface challenges for DLs were identified after the analysis of a study:

- Users’ characteristics like psychological, social and cultural background
- Users’ experience and skill sets
- Importance of feedback
- Users’ prior experience with technical system
- Search facilities for users
- Feedback for misspelled keywords
- Simple ways of searching methods
• Network speed

Many systems were developed or proposed in past to overcome the design problems and to enhance the usability of DLs’ visual interface. Although the graphical interfaces are considered to be slow and unattractive, one of the very interactive solutions is the DLs’ interface based on 3D action computer game Quake II [14] as shown in figure 1.

![Figure 3 DL interface with Gaming Model](image)

A complete virtual 3-D model of a library was designed to visualize the interface for DLs. The user had to log in to the system so he could use the interface for the selection of the source from the library. Instead of using a textual interface, the user had to enter the virtual 3-D model of library in order to search for the books. Instead of using the mouse icon, a gun shaped object was introduced so that the user can shoot the books to view or to read.

The idea behind the introduction of virtual 3-D model of the library was to attract the teenagers to DL’s. In general, youth prefers to play computer games rather than reading books on computer. Besides, an attractive interface gets the attention of the teenagers easily, so the game lookalike interface which was introduced to motivate them so they
use the DLs more often. The interface was evaluated on the basis of number of visits in different libraries and on the basis of the teenagers’ response. This prototype was appreciated at many universities after the evaluation done by the users.

The next section will cover the area of navigation.

2.2 Navigation

Navigation means moving from one page to another to get an overview of the website [28]. The main purpose of the navigation is to tell the users where they are. If the website is not well structured, then the users will have hard time using it. The relevant issue for the web visitors is to be able to complete the task quickly and efficiently. The designers’ job is to make web pages easy to use and provide the users with navigational tools which will help them to finish the task easily and quickly [15]. According to the research [16], the usability and perceived ability of the websites depend on the ease of navigation.

Jason Alexander has worked on the topic of “Understanding and Improving Navigation within Electronic Documents” in his PhD thesis [17]. Electronic documents, instruction manuals or web pages constitute essential components of modern computer era. In fact, all personal computers can create, display and store their contents. One can access millions of such kinds of documents using the internet. However, the main concern is to present the major content of the document properly to the user. Electronically, the issue could be overcome by introducing a scrollbar in the documents. The view of the document could be modified by adjusting a scrollbar [18].
According to the research [17], the navigation within eBooks or long documents can pose many difficulties. Therefore, in the study students preferred paper documents to electronic ones. There are certain ways to navigate through an electronic document [17]:

- **Browsing** – means reader can look into a document without using any search feature to get an overview.
- **Looking at the table of contents** – means reader can follow the links in the text; e.g. move to specific sections of interest.
- **Searching for keywords** – means reader can move through the elements one by one to find the desired result.
- **Using the index** – means reader gets a perception about the structure and language of a document.

Browsing through paper documents/books differs significantly from browsing through electronic documents/books. In the paper documents, the reader goes through the pages and reads briefly some parts of the text. The reader can also open the document on a random page and start reading it. The reader may use a table of contents to find a specific article [19]. In electronic documents, browsing could be done by pressing page forward or page back button. This functionality makes it convenient for the reader to skim through large documents. Desktop computers, laptops and touchscreen devices like tablets may provide more sophisticated options to browse large documents, e.g. the user can know the length of the document by looking at the progress bar. It is easier to skim through the large document by only scrolling up and down using fingers.

Table of contents and the back button feature are an essential part of the documents. The well-structured table of contents might help the readers to go through the documents quickly to get an overview. The Back button is a very important feature of navigation within a document. For instance, if the reader uses hyperlinks in the document, then he
should be able to return to the starting point, however, most devices do not provide such a feature [15].

Index is another very important feature in navigation. Index helps to explore the document and at the same time it gives an overview of the document. It provides ways of moving directly to the content of specific interest. The concept of indexing is to provide users with a quick link to the required information. By using the index, the users can find the required information with a few mouse clicks, but still they should be able to get back to the starting point.

A better search functionality in long documents makes it easier for users to navigate through them. If the functionality is poor, it is hard to find a searched object even if the reader wants to re-read some parts of the document. If the readers cannot find what they look for; then, they may assume that the information is simply not included in the document. According to the research [20], there is still some room for improvement in the search functionality within the large documents. If the search functionality is implemented in a more effective way, it will be a very helpful tool for eBook readers.

There are few things to be considered when investigating search functions:

- The search results should be shown in a separate window so that the users do not need to move from one result to another in order to find what they look for. The users should be able to get back to the main page easily.
- The search function should be able to give suggestions to the user to find quickly the right word; e.g. when the users misspell, there should be a function which suggests the correct spelling, so that the users do not get frustrated because of the wrong results.
- Users should be able to spot search function easily and it should be easier for them to navigate back to search function to change the perimeters of the search. For example, the search function in Amazon’s Kindle device [21] does not allow for stemming (A search engine feature in which suffix or prefix could be added by the
search functionality. For instance, if the user writes “Search” in the search pan, then the stemming feature will retrieve the results for the words “Searches”, “Searchable”, “Searching” and “Searched”). However, the Kindle does have a separate search box and it is easy to find the search function.

The primary function of navigation is to read and it should not be interrupted in the future development and improvements. Providing simple ways to the readers for what they are looking for will allow them to use the document search functionality within a document optimally. In the future, there should be better ways of indexing and it should be easier to find the index as well. There should be also much more optimal ways for the users to use “go back” functionality.

The next section will explain the PACT framework (People, Activities, Contexts and Technologies).

2.3 PACT

An essential part of designing an interactive system is that it should be human-centered [32]. People, Activities, Contexts and Technologies (PACT) is a useful framework for designing interactive systems [32]. The four parts of PACT framework are explained below.

2.3.1 People

People perform activities with the help of technology depending on a context. For example, I write text messages using my cell phone while running. People do online shopping by using computers while sitting at home.
The figure 3 shows that in order to fulfill the requirements for people, we need the technology which creates opportunities for improvements in the context of different activities. For example, a long time ago, one was able only to send text messages, but now one can send pictures and video clips too. In the early days of the mobile phones, people only needed to write text to send messages, but as time passed and the technology changed, the requirements and demands of people also changed, which in turn changed the context of activities. Therefore, nowadays it is not hard to send colorful messages with pictures and video clips.

People have different personalities and cognitive skills, and they differ a lot from each other in physique, for instance in height, weight and even in five senses, i.e. taste, smell, sight, hearing and touch. Moreover, the number of users with disabilities in Europe is huge and the percentage of the people with color blindness is high [22, 23]. Some people have dexterity impairment (“Individuals with dexterity difficulties experience pain, discomfort, or complete loss of feeling in their fingers, hands, wrists, or arms, making it difficult to use a standard keyboard or mouse.”) especially when use of fingers is involved [24]. Some people might have big fingers and it is hard for them to use small menus on the touch screen of cell phones.
People are also psychologically different, some people are really good in grasping new concept of interaction, but some are slow, so the designer should consider both categories before starting his work. Sometimes, it is essential to consider the cultural differences. For example, the red color in China means a good fortune [25], while the rest of the world considers it as a sign of danger [26]. Similarly, some people are really good in memorizing long numbers, but obviously not all of them. The designers should keep that in mind in order to balance the features for everyone.

It is obvious that a novice user and an expert user will typically have very different requirements. Expert users know all sorts of the system details since they use it regularly, whereas the novice user would need some guidance to use the same system properly. There is another type of people who do not have to use the system on a regular basis; they are called “discretionary users”. When they have to use the system and they find it hard to use, they give up quickly and do not try to learn the system. The designers need to take into consideration the needs of this group while designing the interactive systems.

2.3.2 Activities:

The term activity is used for very simple and complex tasks. The designers need to consider many characteristics of the activities which I present below.

- Temporal aspects describe the frequency of activities. Some activities happen on a regular basis, while some take place once a year. Each of them has a different design. For instance, people can learn quickly how to use a cell phone to make a call, but they might face great difficulties when it comes to changing the battery. The designer should make sure that infrequent tasks are also easy to learn.
- The very important feature of design is to work well in stressful situations. If a design works well only in quiet situations, it will be considered to be deficient especially while used in the busy environment.
- It is relevant to consider the response time from the system. If a normal webpage takes two-three minutes to respond when a server is busy, it may be annoying for a normal query. However, in case of emergency the users expect a response time of about 100+ milliseconds of hand-eye coordination activities and one second for clicking a button (cause-effect relationship). If the response time takes more than five seconds, the users will feel confused and lost.
- If the activities are dependent on others, the coordination and communication become a very important factor.
- The designers need to keep in mind that if tasks are well-defined, they could be accomplished with a simple step-by-step design.
- Designers must pay complete attention to ensure that the mistakes do not have serious effects as some activities are safety-critical which could cause injury or accident.

2.3.3 Contexts:

Context and activities are interconnected and they always appear in a specific context. Two things are important to consider when we talk about the context: physical environment and social context. For example, if a person needs to buy a train ticket to Stockholm from a ticket machine, there are a few things to be considered: the location of the machine i.e. was it under the roof or in open air? If it was in the open air, then is it easy to purchase a ticket during the sunny or rainy weather? The time spent in the queue to buy a ticket would be the social context.

2.3.4 Technology:

The technology constitutes the final part of the PACT framework. The technology for interactive systems consists of hardware and software components that transform some
Kinds of input data into some output data. The significant features of the technology are input, output, communication and content.

The concern of input devices is to make sure that the data entered by people is safe and secure. The selection of input method is important on the basis of the characteristics of the data. For example, touchscreens are useful only when the user needs to choose a few options. Similarly, speech input is useful when there is no background interference. Furthermore, the characteristics of different displays are very important while considering the output devices. For instance, the touch screens are not very useful in sunshine, so it does not matter how important the output is, because it would not be useful if the user cannot read it properly.

The communication between people and devices is also very vital. People need feedback in different difficult situations. Voice or video feedback might be helpful, but it also depends on bandwidth, speed of internet or sometimes on the system itself. Furthermore, the content is useful when it is updated, accurate and well presented. The content is essential in some technologies, e.g. the information dense manual websites are dependent on their contents. If the information is false or outdated, people would not visit that page again.
2.4 Summary

The digital libraries are electronic mapping of physical libraries in electronic format. According to the study [13], the users preferred some features in DLs’ interface such as: standard familiar icons and menus, navigation links to the left side of the screen and search pan to the right. For the users, a few challenges were identified while designing the DLs’ interface in the past such as: better search functionality, prompted feedback for misspelled keywords and simple ways of searching methods.

Navigation means to move from one page to another to get an overview of the website. The main purpose of the navigation is to tell the users where they are? The table of contents and the back button feature constitute an essential part of the navigation within the documents. The well-structured table of contents might help the readers to go through the documents quickly to get an overview. A better search functionality in long documents makes it easier for users to navigate through them.

There are few things to be considered when investigating search functions:

- The search results should be shown in a separate window so that the users do not need to move from one result to another in order to find what they look for. The users should be able to get back to the main page easily.
- The search function should be able to give suggestions to the user to find quickly the right word; e.g. when the users misspell, there should be a function which suggests the correct spelling so that the users do not get frustrated because of the wrong results.

The PACT framework is a systematic way of making sure that an interactive system is designed for relevant users. It helps the designers understand the users of the system as well as the activities they want to undertake in different contexts.
3. Methodology

I chose to follow a methodology approach explained by Benyon [28]. I started my research by understanding the requirements. Afterwards, I did interviews, prototyping and finally the evaluation of the proposed solution. The explanation of the methods used will be explained in the next section.

3.1 Understanding the requirements

A requirement is a necessary feature of the product, i.e. capability and quality [28]. It is very important to understand the behavior of the people using a specific product. When the designers know how people proceed, it helps them to make the system more realistic and enjoyable. The requirements are an essential part of the development process. The requirements when written should be clear enough to facilitate the understanding of the whole development process.

The requirements are divided into two types: functional and non-functional [28]. The functional requirements explain how the system should function. The non-functional requirements describe the quality of the system. While gathering the requirements, it is not necessary to worry about how the technology should meet the requirements. These issues can be solved in a later process. The relevant element for the designers is to understand that target group of the designed system will not be other computer, but average users. In order to understand the requirements of people the designers sometimes need to conduct interviews with real users. Since I did not have any access to the real users, I had to carry out the interviews with Ericsson staff, which I will discuss in the following section.
3.2 Interviews

Talking to people is one of the most effective ways to gather information about the technology they use. The interviews with various groups of users in a specific field are essential for gathering stories. There are different types of interviews explained by Benyon [29]: structured interview, semi-structured interview and unstructured interview.

Structured interview uses questions that are designed beforehand [29]. The wording of the questions remains the same as it was during the interview. This kind of interviews is easy to conduct due to the pre-structuring of questions. However, people are bound to give restricted responses, so sometimes it is very difficult for an interviewer to deal with an unexpected reply. A public opinion poll is a good example of structured interviews. Semi-structured interview uses pre-prepared questions, but additional questions could be asked from the people during the interview depending on their answers [29]. This type of interview helps to gather more information than a structured interview since the interviewer can change or add questions during the meeting. Unstructured interview is conducted when very little information is available beforehand [29]. In this type of interview there are no pre-prepared questions and the interviewer can ask open questions about the specific topic to gather the data and the information.

Since I did not have access to the users due to geographical and technical complications, I conducted three un-structured interviews with Ericsson employees to understand the users. The questions were asked during the interviews with focus on PACT framework. I followed PACT framework because there are different groups of CPI users who work in different scenarios using different technologies. For example, a person who is handling alarms has a constant access to the internet and can work on big fixed screens, whereas a person in the field, who needs to fix the problem with RBS, may not have any access to the internet, but a pile of papers. The PACT framework helped me to categorize different users according to their needs. Due to the busy schedule of Ericsson employees, I had to
conduct three interviews with different workers at different time. I chose to follow unstructured interview approach because the requirements were not clear enough to start work on the development. The interviews were conducted at Ericsson premises Kista Stockholm. Each interview lasted for 60 – 90 minutes. It was allowed to take notes during all the interviews, but it was not allowed to record all of them because of Ericsson privacy laws. I managed to record two interviews which let me understand clearly the requirements.

The next section explains the prototyping I have done during the project.

3.3 Prototyping

Prototyping is a process of gathering information from the users/clients and drawing the design which depicts the partial implementation of a final system design [31]. The prototypes reflect the final system design, and could be used to refine the ideas and minimize the complications in the final design [32]. The prototype may be developed as easily as using a piece of paper or the sophisticated software.

There are two kinds of prototypes, low-fidelity (lo-fi) and high-fidelity (hi-fi). The low-fidelity prototypes are usually called paper prototypes. As the name suggests, they can be drawn with the use of pen and paper or a cardboard. They are used to illustrate an early system design, which can seldom become the final design. Although the lo-fi prototypes are easy to make, yet they have some drawbacks. The paper prototype could be damaged easily if it is handled by lots of people. Furthermore, if the designer wants to draw a detailed system design on a paper, then it is difficult for the users to understand it without the designer’s help.
The high-fidelity prototypes are similar to the anticipated final product. They are drawn with the use of the software in the development phase of the project. They are used to evaluate the final design of the product. The problem with these prototypes is that the users rely on them. Hence, the designer needs to be very careful while drawing them as the hi-fi prototypes are just the representation of final design. Furthermore, they are time consuming and harder to change as well.

I followed the prototyping technique explained by Benyon [30]. Throughout the project I have followed PACT framework as a guideline because I had to develop a final prototype for different groups of users who perform activities in various contexts as mentioned in a background section. I have developed the first low-fidelity prototype on a paper after the first meeting with Ericsson employees and after looking into CPI libraries. Furthermore, I have discovered additional requirements and constraints in the following with Ericsson staff, so I have added some changes to the prototype.

The low-fidelity prototype was evaluated by Ericsson employees. Once, all requirements and specifications were clear, I started to develop the high-fidelity prototype. I was getting constant feedback from Ericsson employees. I have developed the hi-fi prototype using Adobe Photoshop and Illustrator as these tools are commonly used at Ericsson.

### 3.4 Evaluation

The low-fidelity prototype was developed to understand the project requirements. I have got feedback from Ericsson’s CPI experts and started to work on high-fi prototype. I was getting constant feedback throughout the development and the experts were not unanimous about my design ideas. My suggestion about the table of contents was that it should appear automatically to the left side of the screen when the user opens a document. The experts suggested me to change it and go back to the previous version. Therefore I have not included it in my design proposal. I have introduced new and easy
ways to bookmark the document and take notes. According to the experts, many of their users were not even aware of the features such as bookmarking and taking notes due to their complexity.

One of the goals of this thesis was to investigate whether there is a possibility to do the modularization in order to improve the linking between the documents. Ericsson also expected the suggestions for the overall design of the CPI libraries. Hence, I have proposed two different designs in second high-fi prototype. In the first one, keeping the user requirements in mind, I have modified the current design of the CPI libraries by introducing a moveable scrollbar to the right side of the main window. This bar is moveable in such a way that the users will be able to see only the desired information. The users can even hide all the contents to the right side of the document. In the second proposed design the small thumbnails of the documents stored in the same library are shown at the left bottom side. The thumbnails are marked with initials. When the user moves the mouse over the thumbnail it is possible to see the full name of the document. The table of contents is situated above the thumbnail of the selected document to the left side so that the user can explore the document to the right side. Furthermore, the experts asked me to add a few guidelines for the users in the second design as it was completely new; thus I have provided them with some recommendations for the users after getting feedback.
4. Final requirements and problem description

The requirements were gathered during the meetings with Ericsson staff. The staff presented all the user groups and their needs that will be presented in the section about PACT. I have followed the PACT framework as a guideline during the process of gathering the requirements to cover all the user groups. The meetings with Ericsson staff also helped me to understand the users’ needs to accomplish tasks as described in the study [13, 20]. Below I present the problems we have focused on during the meetings.

4.1 Problems in finding the right document

The current user interface for CPI is difficult to use even for the expert users. The “search” feature for CPIs does not work in the efficient and useful way. The feature gives only the results from the keywords which match body text of the document. For example, if the user is typing the word “Installation”, the current search feature will show the results having the word “Installation” in all the documents of a particular library.

The screenshot of the current system is shown in the figure 5. It shows many unwanted result items that make it hard for the users to find the right information. Furthermore, when the users do not get the right information, they just stop using the system.
Spelling mistakes are very common when users want to search something as CPI libraries, when they are from across the world, and if English is not their first language. In the current system, there is no feature of auto correction available in CPI libraries or documents. If the user writes a word with wrong spelling, no results or suggestions will be on the screen. The screenshot of this problem is shown in the figure 6.

The figure 6 shows that the user wants to write “installing”, but ended up writing the word “installig”. The current system does not have any feature that can suggest the users the correct spelling or automatically correct the wrong word; thus the system does not show any result when the user writes some text with wrong spelling.
Figure 6, Current system: Anything with wrong spellings will not show any results
4.2 Problem of navigation between the documents

The navigational structure between the documents is very confusing. The first problem is duplication of the information. In figure 7, the folders are shown twice and the library log files are shown at the end of the page after the basic information about the library. The double presentation of the folders on the same page can lead to some misunderstanding. The page has some inconsistency too as the library log files are shown at the end of the page on right side. The right side of the screen display “Folders”, “Copyright information” and “Library log files”, but these are three different categories which are shown under the same section of the page.

Figure 7, Current system: Duplicate information (Folders are shown twice) and inconsistency (Library log files)
4.3 Problem of navigation within a document

The linking within the documents is not well structured. Mostly the links in the long texts indicate the description, but there is no way to get back to the start. Hence, the user gets lost easily inside the documents. Furthermore, there is no mean to keep track of the user’s history i.e. to view the last visited pages. Every time the user needs to click on the back button to see the last visited page, and he user cannot see all the pages at once. The figure 8 illustrates the problem.

There are some issues with the table of contents of the documents as they are not well structured either. The table of contents is not marked with numbers, so it is very confusing to track a particular topic. The user cannot even see its current location using the table of contents. The illustration of the problem is shown in the figure 9.
Figure 9, Current system: Table of contents neither marked with numbers nor highlighted to keep track of the location
4.4 Problem with notes and bookmarks

In the current system, the method for taking notes is complicated. When the user clicks on a symbol which seems to be an option for taking notes, he can see only all the notes taken in the past as shown in the figures 10 and 11.

Figure 10. Current system: When the user clicks on the notes taking symbol
In order to take one’s own notes the user needs to click inside the document and find an option “Add Note”. When the user clicks on this option a new window opens and shows many options such as “Select category”, “Selected text”, and “Enter your comment here”. Following these steps the user can write down a comment in the document. These steps are too complicated to write a simple note. According to Ericsson staff, most of the users are not aware of these steps, so they assume that there is no option in the current system for taking the notes. The illustration of this problem is shown on the figure 12.
Figure 12, Current system: Taking notes inside a document
The figure 13 illustrates the problem with the bookmark symbol. The available bookmark symbol, which is a star filled with yellow color, stays always yellow. It creates user’s confusion about which page is bookmarked and which is not. Besides, when the user wants to bookmark a page the system saves the complete document instead of a particular topic. To save a particular topic the user needs to click in the document on a particular topic. According to Ericsson staff, most of the users do not know about this function.

Figure 13, Current system: How to Bookmark?
5. Proposed solution

5.1 Improved search feature

According to the study [20], a better search functionality in long documents makes it easier for users to navigate through them. If the functionality is poor, it is hard to find a searched object even if the reader wants to re-read some parts of the document. According to the study [13], the search function should give the user some suggestions so he finds quickly the right word; for instance, when the users misspell, there should be a function which suggests the correct spelling so that the users do not get frustrated because of the wrong results.

![Proposed design: Introducing a feature “Auto-correction”](image-url)
The introduction of a spell checker or auto-correction feature will provide the users with some feedback and the required results if the spelling is not right. This feature will help the users to correct the spellings and use the search functionality in an efficient way. The proposed design is shown in the figure 14.

The study [13] recommends also that the search results should be shown in a separate window so that the users do not need to move from one result to another in order to find what they look for. The users should be able to get back to the main page easily. The proposed solution for improved search feature is illustrated in the figure 15.

Figure 15, Proposed design: Improved search functionality shows the important results with the addition of “More options”

This suggestion for the search feature is to find the appropriate results which will not distract the users from a long list of unwanted results. The added feature “More option” contains all the required information for the user. This new feature will show the results
in a more categorized way. For example, when the user writes “Installation” there will be appropriate suggestions related to this word, and then the important results will be shown in the main window like before. However, if the user is interested in exploring more the results that match the body text of the document, he needs to click on “More Option”. In this option the user will be able to see “Hits in a body text”, “Recently viewed pages” and “mostly viewed”.

Figure 16 shows that the user will be able to see the useful and required results on the right side of screen, but the user will be able to track its history in the option, “Recently viewed”. The user can also track its searching pattern by viewing an option “Mostly visited”. In such a way there will not be any unwanted results that distract the user from getting the required information.

![Proposed design: Exploring “More options”](image)

Figure 16, Proposed design: Exploring “More options”

If the resulting links do not fit in the window, then the user can click on “More” to view the remaining results. The illustration is shown in the figure 17.
The new proposed feature in the figure 17 is very easy to adapt. When the user will click on “More”, the expanded view will pop up in front of the current page with tainted background so that the user does not feel lost. To exit this expanded view the user just needs to click on “X” or in the tainted area.
5.2 Improved navigation between the documents

In the proposed design, as shown in the figure 18, the “Folders” and “Library log files”, are placed to the left side of the screen, as they fall under the same category. There is no need to represent the “Folders” twice, so I removed them from the right side. The “Library log files” are placed at the bottom of “Folders”. In this way the duplications are removed, and the structure looks consistent as the left side is for “Folders” and “Library log file”, and the right side of the document is to explore the documents.

Figure 18, Proposed design: Duplication removed and “Library log files” moved to the left side at the bottom of “Folders”
5.3 Improved navigation within a document

The table of contents and the back button are essential features of the documents. The well-structured table of contents might help the readers to go through the documents quickly to get an overview [15]. The table of contents is very important to keep track of the location. With the help of the table of contents the user can move to any topic within the document with a few clicks. The proposed solution illustrates the introduction of the table of contents connected to the document as it is shown in the figure 19. The design suggestion shows the table of contents marked with the exactly same number as the headings in the document. When the user wants to scroll down to the next topic in the main window, then the highlighted yellow rectangle will move down to the next topic as well. This suggestion will help the users to keep track of their position.

Figure 19, Proposed design: Table of contents are marked with numbers and highlighting current location of user
The Back button is a relevant feature of navigation within a document [15]. The proposed design for checking history with the use of the back button will allow the users to see twelve recently visited pages. The user just needs to click a bit longer than usually and the tab with recently visited pages will be opened. The top of the tab also shows the current location which is illustrated in the figure 21.
Figure 21, Proposed design: Long press on back button shows history
5.4 Improved notes and bookmark features

According to the study [13], the users preferred standard menus and icons they were already familiar with. For a better design I have suggested a new symbol for taking notes which remains in the same place so that the users can find it easily. To take a note the user needs to click once on this symbol, and then click anywhere in the document. A small box to take a note with a time stamp will appear on the screen. Having written the note the user just needs to click on “X” to close the box. After clicking on “X” the box will disappear, but the symbol will stay there. In this way the user can find easily the written notes in the future just by scrolling through the document. Besides, the user can list all the notes inside the documents by clicking in the document in the same way as previously. The figure 22 illustrates the proposed design.
Figure 23 shows the moment when the user clicks on “x” and the note symbol stays where the user has taken the notes.

![Figure 23. Proposed design: After writing a note the symbol will stay exactly at the same place](image)

The design suggestion for bookmarks provides an easy and quick way to bookmark a document. The bookmark symbol star stays blank until a topic is bookmarked. When the user wants to bookmark something, then there is a choice between saving the whole document or a particular topic. After saving a topic, a yellow star will appear next to the particular topic so that the user knows about bookmarked topics. The proposed design is illustrated in the figure 24.
Figure 24, Proposed design: The bookmark symbol stays white if nothing is bookmarked.

Figure 25, Proposed design: Bookmark symbol is yellow as the topic is bookmarked and the symbol stays besides the topic.
5.5 Modularization

One of the goals of this thesis was to investigate whether there is a possibility to do the modularization with the use of the same text of CPI documents to improve the linking between the documents. Ericsson also expected the suggestions for the overall design of the CPI libraries. I am proposing two different types of CPI design transformations in the next two sections. The first design starts with the figure 26.

5.5.1 Proposed design 1

One can access millions of long documents using the internet. However, the main concern for the designers is to present properly the major content of the document to the user. According to the study [18], the issue could be overcome electronically by introducing a scrollbar into the documents. The user could modify the view of the document by adjusting a scrollbar.

Keeping the user requirements in mind I have modified the current design of the CPI libraries by introducing a moveable scrollbar to the right side of the main window, as shown in the figure 26. This bar is moveable and in such a way the users will be able to see only the desired information. The users can even hide all the contents to the right side of the document. The illustration is explained in the figures 26 - 29.
Figure 26, Proposed design: Introducing a moveable bar

Figure 27, Proposed design: Separation bar explained
Figure 28, Proposed design: Separation bar can hide all the contents

Figure 29, Proposed design: To view the contents again, user needs the pull the bar down
In the figure 30 the user selects a document to read. This particular document will be highlighted and the user will be able to explore it below the moveable bar. The table of contents will be shown to the left side when the user will click on the tab “Document” like in the current system. The selected folder will be highlighted for the user’s awareness. In such a way the user will even know its location in the folders as well as in the document.

Figure 30, Proposed design: The new suggestion for modularization explained

In the figure 31 the user moves the bar to the top to get the maximum view of the document. If the user seeks to read another document, he just needs to slide down the bar to get a full view of the documents of the library, and then select a chosen document.
Figure 31, Proposed solution: For better view, just slide the bar to top
5.5.2 Proposed design 2

The design transformation is illustrated in the figure 32 which has nothing to do with the search feature I have explained earlier. This design is for Ericsson’s future implementations. In the design proposal the small thumbnails of the documents stored in the same library are shown at the left bottom side. The thumbnails are marked with initials. When the user moves the mouse over the thumbnail, then he can see the complete name of the document. Above the thumbnails there is a table of contents of a selected document, and to the right side the user can explore the document.

Figure 32, Proposed design 2 for modularization
The figure 33 shows the guidance for the users since this design is completely different from the current system. The user can switch to the library view by just clicking on the folder, and it will take the user to the current system design.
6. Discussion

6.1 Limitations of the study

This study meets the following limitations due to the limited amount of time and resources:

- It was not possible to work with the real users because of the geographical and technical circumstances.
- In order to gather the requirements I had to conduct the interviews with Ericsson employees who were the second hand informants.
- The final prototype was evaluated by the Ericsson staff since I could not reach the real users due to the limited amount of time and the geographical circumstances.
- Only a small section of the CPI libraries was evaluated as it was not possible to conduct the study on all CPI libraries in the limited time framework.
- The section of the CPI libraries that was investigated was selected on a random basis as I believed the selected part was representative of the rest of the material.

6.2 Answers to the research questions

1. What are the most important requirements regarding the navigation and search functionality in information-dense manual from the users’ perspective?

On the basis of the previous research, the users preferred the following points which could improve the navigation and search functionality in the information-dense manual: The users should be able to spot search function easily and it should be simple for the users to navigate back to search function to change the perimeters of the search. The search results should be shown in a separate window so that the users do not need to
move from one result to another in order to find what they look for. The users should be able to get back to the main page easily. The search function should give suggestions to the user to find quickly the right word; e.g. when the users misspell, there should be a function which suggests the correct spelling, so that the users do not get frustrated because of the wrong results.

The table of contents and the back button feature constitute the essential part of the navigation through long documents. The well-structured table of contents could help the readers to go through the documents quickly to get an overview. The Back button is also a significant feature of the navigation within a document. For instance, if the reader uses hyperlinks in the document, then he should be able to return to the starting point, however, most devices do not provide such a feature [15].

2. How well does the Ericsson CPI library meet these requirements?

Based on the evaluation of the CPI library the following problems are discovered:

The “search” feature for the CPIs does not work in an efficient and useful way. The feature only gives the results from the keywords which match body text of the documents. For example, if the user is typing the word “Installation”, the current search feature will show the results having the word “Installation” in all the documents of a particular library.

The linking in the documents is not well structured. Mostly the links in the long text take the user to the description, but there is no way to get back to the starting point, so the user gets lost easily in the documents. Furthermore, there is no mean to keep track of the user’s history, i.e. to view the recently visited pages. Every time the user needs to click on the back button to see the recently visited pages, the user cannot see all the pages at
once. There are some issues with the table of contents of the documents which are not well structured. The table of contents is not marked with numbers and it is very confusing to track a particular topic. The user cannot even see its current location using the table of contents.

3. How can the design of the CPI user interface be improved?

I suggest the following general design recommendations for the CPI libraries:

The important features such as “search”, “notes” and “bookmarks” should be noticeable and easy to use by the users. The linking within and between the documents should work properly, so that the users do not feel lost. The users should have the possibility to get feedback from the system in case of errors. The users should always be able to see the library folders, the selected document and the table of contents of the selected document in the same browser window. Finally, the users should be able to switch to the full-screen view to get the maximum view of the presented information.

4. How can general recommendations for CPI libraries be formulated?

As of author’s knowledge to date, there are no general design recommendations for CPI libraries. There are some ideas which could not be implemented due to the limitations of the project, but they could be investigated in the future. The following recommendations are:

The implementation of ranking algorithms for sorting the search results and on the basis of users’ patterns for searching the information the search functionality could give suggestions to the users for what they are looking for or tell the users what topics have been searched a lot. Furthermore, the implementation of filters in search functionality could help the users to hide the unwanted results. For instance, if the user wants to search
for “Installing Remote Radio units” in “WCDMA” category so the user should only see the results from the required category.

Moreover, the rating and short feedback about the articles by the users could help others to find the right document. Last, but not the least, the implementation of helpdesk which would provide the quick and effective assistance for the users in case of CPI related problems.
6.3 Future work

The research presented in this thesis has raised more questions to be answered in the future. Most importantly, the search functionality for the CPI libraries needs to be improved. First of all, the developed prototypes need to be tested by the real users. It is relevant to get users’ feedback so as the final product will be used by them. Their feedback would be helpful to improve the design or to introduce more features according to their requirements. Without the users it is not possible to solve the current issues of the CPI libraries so that the proposed design will be helpful. Secondly, the mobile/tablet version of the CPI libraries or information dense manuals should be designed in such a way that there is some freedom and flexibility left for the users. The users would not have to consult the CPI libraries using only the computer. If the information is presented in a simpler way in the mobile/tablet version, then it could be very helpful for the users to access the CPI libraries anywhere via internet in order to solve the problems with the products. The mobile/tablet design would require access to the real users to gather the requirements. The final product should be tested by the users to improve the design.

The ideas and thoughts that were not implemented during this project due to the time limitations would be interesting to be investigated in future. Firstly, the implementation of ranking algorithms for sorting the search results would help the users to find the desired information simply and rapidly. Moreover, on the basis of users’ patterns for information search, the functionality could give suggestions to the users on the basis of the topics which have been frequently visited. For example, if the user writes “Installing” in the search box, then the suggestions might be “Installing RBS”, “Installing Optical Cables” or “Installing RRU support”. Secondly, the implementation of filters in search functionality would help the users to filter the results, and in this way the users would be able to hide the unwanted results. For instance, if the user looks for “Installing Remote Radio units” in “WCDMA” category, the user should see only the results from the selected category. The users would also be able to search on the basis of topics within the
documents. Additionally, there has been an idea of articles’ rating by the users. If the users were allowed to give feedback or give the ratings to the articles, it would be easier for others to find the right document. One of the ideas to help the users was the establishment of quick assistance which could be given via phone or online.

Another idea was to make use of the term *seeding* in the search functionality. In other words, if we use a given word or phrase as a *seed*, we can retrieve other terms that occur frequently with the seed. The general principle is that the documents which contain the term *seed* will show the related items based on the frequency of occurrence. For example, if Stedman is the seed author, it is easy to retrieve other authors with the most frequent occurrence with him in the references of journal articles. This mechanism could be useful in finding short information from large documents. Lastly, the methodology I have used during this work could be validated or investigated in future as I have evaluated the Ericsson’s CPI libraries on the basis of the past work as I had no access to the real users.
7. Conclusion

I have participated in a project led by Ericsson Stockholm whose goal was to investigate the Customer Product Information (CPI) libraries of Radio Based Stations (RBS). The examination I have done revealed that the CPI libraries pose some obstacles which need to be overcome. These obstacles refer to two substantial areas embracing navigation within and between the documents and usability issues.

First of all, I have encountered the problem with the linking inside the documents and the table of contents, either of them was not properly structured. Taking into account the users’ requirements I have suggested the solution to improve the mechanism of CPI libraries by designing the interface in a clearer and user-friendly way. To my knowledge, the research I have carried out had not been done before and it is the first analysis of CPI of such a kind. Therefore, my analysis of the CPI may contribute to the future work on its research and design.

Furthermore, I have faced a barrier with the “search” functionality which constitutes a double aspect of both navigation and usability issues. The “search” function was not giving relevant results, thus I have introduced two new solutions. I have recommended three options such as “Hits in the body text”, “Mostly viewed” and “Recently viewed” and I have proposed a spell checking feature.

Secondly, I have tackled the usability issues, in other words, the visual side of CPI libraries. The notes’ and bookmarks’ features were designed in such a complicated way that the users were not even aware of them. I have suggested new icons for taking notes and bookmarking options so that the users can easily take advantage of these features.

The future research might examine further the three following issues. First, the implementation of ranking algorithms for sorting the search results would be helpful for the users to find the required information. The search functionality could give suggestions to the users on the basis of the topics which have been visited frequently. The
implementation of seeding in search feature would also be useful to find quickly the required information. Moreover, the implementation of the filters in search functionality would enable the users to easily filter the results. Second, the research I have done was based on the previous work since I had not had direct access to real users. Hence, the methodology I have used in my work might be investigated further to validate whether it meets the needs of the real users. Third, I would recommend the implementation of the helpdesk which would provide the efficient assistance for the users in case they face any CPI related problems.
8. Appendix

The evaluation form I have used in the evaluation of the prototypes:

1. Problems in document search:
   - Auto correction of search terms
     Not Good 1  2  3  4  5 Very Good
   - Reduced hit list
     Not Good 1  2  3  4  5 Very Good
   - More options to explore during search
     Not Good 1  2  3  4  5 Very Good
   - Moving body text hits to overview.
     Not Good 1  2  3  4  5 Very Good

2. Confusion of the navigational structure between documents:
   - Clean-up the representation of the library structure
     Not Good 1  2  3  4  5 Very Good
   - Remove redundant information
     Not Good 1  2  3  4  5 Very Good
   - Reserve the right-hand area for the document level information
     Not Good 1  2  3  4  5 Very Good
• New “history” function in the back-button.
  Not Good 1  2  3  4  5 Very Good

3. Confusion of the navigational structure within the document:

• Introduce dynamic table-of-content connected to the document
  Not Good 1  2  3  4  5 Very Good

• Highlight of current location
  Not Good 1  2  3  4  5 Very Good

4. Complicated interaction for notes and bookmarks:

• Topic-anchored bookmarks
  Not Good 1  2  3  4  5 Very Good

• Graphic indication of bookmark content
  Not Good 1  2  3  4  5 Very Good

• New interaction design for note-taking functionality
  Not Good 1  2  3  4  5 Very Good
9. Bibliography


