13 User-Experience and Usability Review of a Smartphone Application

Case Study of an HSE Management Mobile Tool

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CONTENTS

13.1 INTRODUCTION

This book chapter starts with a comprehensive description of related texts covering the user-experience (UX) and usability of various types of mobile applications. Then it addresses issues related to recent developments in the design and evaluation process, proposing some quite appropriate and opportunist discussions as Industry 4.0 advances in the transformation of human and, needless to say, social fabric as well. At last, it presents a case study of the implementation of a mobile app called PrüfExpress, developed by Graubner Industrie-Beratung GmbH. This mobile application is part of a Health Safety and Environmental (HSE) Management System

DOI: 10.1201/9780429343513-18

outlined by one of the largest automotive manufacturers in the world, with a pilot project in Gaggenau, Germany.

It is important to emphasize that the theoretical background describes not only particularities in the study of usability and user-experience subjects. The advent of the digital – now more mobile – society of the past few decades shortened the conceptual gap that used to exist between the product design and its use. A mobile device is, as some describe, an extension of a modern man. And as men and women are forced to evolve along their "extensions," the creative process of mobile apps is somewhat "tainted" by user needs. In fact, a great portion of this chapter deals with the issues related to the implementation of the mobile system, approaching even indirectly the Usability and UXD implications within the process.

As it will be read further, the development of an industrial mobile application always starts with "organizational user" requirements or needs. This user will most likely never try the app once it is implemented within a particular work system. But it will definitely receive feedbacks that should encourage or not the pursuing of similar new strategies of bringing mobile functionalities to management systems. In the case of the PrüfExpress system, the operational results and its integration within the production process – by employing Radio Frequency Identification(RFID) sensors, for example – and also as an Enterprise Resource Planning (ERP) resource, are definite proofs that mobile applications are not only a trend tool but rather a muscular accessory for the manufacturing and management systems.

13.2 THEORETICAL FRAMEWORK

This text intends to reach multiple aspects of the system's design from its preconception to its use phase and further evaluation. So, a general overview of user-experience and Usability in the Design development is necessary to introduce the specific issue of mobile application for industrial environments, which in fact emerges as another important topic to be addressed in this theoretical framework.

The ISO 9241-11 standard defines usability as the "extent to which a product can be used by specified uses to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." A more pragmatic definition of usability would be the property of an object to adequately serve its purpose by all means, with qualities ranging from technical efficiency to its conformity and configuration or as being easy to use when looked at as a function of the context in which the product is used. Or as Nielsen (1994) puts it, "a property of the system: it is the quality of use in context." He suggests five attributes of usability:

- Efficiency: the quality of resources appropriated in a product in terms of the relation to the accuracy and completeness by which users achieve goals;
- Satisfaction: the quality of positive attitudes towards the *comfortable* use of the product, emphasizing individual susceptibility as for the highlighted condition;
- Learnability: the quality in which a product should be easy to learn so that the users can rapidly start getting work done with it;

- Memorability: the quality in which characteristics of the product are easy enough to remember so that the casual user is able to return to it after some time without having to learn everything all over again;
- Errors: the quality of having a low error rate, so that users can easily recover from them and that gross errors must not occur.

As heuristics to generic usability standards is employed along with Apple's, Google's and Nielson's usability rules for mobile apps, Table 13.1 sums up some guidelines that can be followed by developers in any OS or platform.

In the case of the PrüfExpress 2 mobile application, whose details will be further addressed in a specific session, it was based on a previous version, called PrüfExpress 1, a personal digital assistant (PDA) application for Windows Mobile. PrüfExpress 1 evolved over more than 10 years. It was developed and perfected in close communication with the users. The development team was permanently on-site and met very frequently with the user team, at least monthly, sometimes weekly or even daily once technical issues would arise. In some events, the chief developer would interact with a leading user, responsible for the process, and by this mutual learning approach they managed to continuously improve the application. Because it derived from an extensively tested and validated previous version, PrüfExpress 2 did not go through a formal usability verification process. Instead, it was developed in close exchange with power users, by observing how they got along with the programmer's ideas and then rectified if necessary. It is fair to say that it also followed, intuitively, Google Usability Guidelines.

User-experience, on the other hand, covers the whole product or service acceptance. It encompasses all aspects of an object, from its pragmatic, practical features to the hedonic aspects of a given product. The pragmatic or instrumental refers to the utilitarian aspects, such as usefulness and ease of use. The hedonic or

TABLE 13.1.
Sample of Mobile Apps Usability Heuristics

Usability rule	Nielsen rule (1993)	Google usability guidelines	Apple usability guidelines
User control	User control andfreedom	Decide for me, but leave the final decision to me	User control
Consistency	Consistency and standards	Apps use consistent design, typography and contents Apps use familiar patterns, same iOS, UI standards(navigation bars, buttons, etc.) Looks alike; performs alike	Consistency
Information and visual hierarchy	–	Information hierarchy and structure	–

Source: Swaid; Suid, 2017, adapted by Authors.

non-instrumental to the emotional and experiential aspects of product use (Partala; SAARI, 2015). The fact is that research related to user-experience has gained considerable interest from both scholars and practitioners. Generally, the research field of user-experience is seen to include all factors which affect the user's interaction and experience of a system or product (Yazid; Jantan, 2017). Based on a comprehensive bibliographical review (de Paula; Menezes; Araujo, 2014; Ibrahim; Ahmad, Shafie, 2015) and Nielsen's Usability criteria (Nielsen, 1993 & 1994) the UXD elements that should be taken into account for mobile application development is summarized – not necessarily in that particular order – in Table 13.2.

As Yazid and Jantan (2017) point out, it is no surprise that UXD has become so important in the development of mobile applications, thus having a huge influence on product success or failure. The combination of utilitarian and non-utilitarian properties in a mobile app application brings a new paradigm in UXD, since the app cannot be evaluated without a context. Likewise, a context depends on time and scope issues, which brings into play the product and the system in which the app becomes fully functional. In other words, the device that runs the app and its "drivers" become part of the assessment context. Hence, this creates a totally different scenario for assessing how a user feels and how he or she perceives the kind of relationship with a mobile app. In fact, it is difficult to define a successful mobile application because it is tied directly to user acceptance, which may vary immensely.

Mobile apps are basically software applications designed to run on smartphones, tablets and other mobile devices. In a recent paper, as Swaid and Suid (2019) cited info on the growth of the mobile apps business, they went ahead and outlined some projections. Back in the year 2016, it was expected that by 2020, mobile apps would generate around 189 billion US dollars in revenues via app stores and in-app advertising. But the explosion of mobile apps that came in just about every industry and the multitude of possibilities of their use was about to amaze the most skeptical tech-savvy geek on the planet. As of 2018, the updated prediction shows almost half-trillion dollars of revenues for 2020 and just a bit shy of US$ 1 trillion by 2023 (Statista, 2019).

TABLE 13.2.
UXD Elements for Mobile Apps Design

Number	UXD elements
1	Ease of use
2	Learnability
3	User interface
4	User satisfaction
5	Security
6	Behavioral intent
7	Environment

Source: Swaid; Suid, 2017.

Due to facts like these and bound to the numerous advantages of mobile applications, designing a good mobile application has become a primary issue for companies, software programmers and designers, which gave birth to an interdisciplinary development effort to maximize the effectiveness of mobile apps. For industrial applications, for example, there are additional requirements or constraints, such as the need for integration with Integrated Management Systems, ERP models and so forth. Plus, sometimes it may involve change management issues, particularly in situations in which mobile apps eliminate human tasks or even human efforts. This is fast becoming a major problem as artificial intelligence (AI), automation and the whole IoT evolution come to play.

13.3 DEVELOPMENT OF A MOBILE APP FOR HSE MANAGEMENT

In order to contextualize the discussion presented herein, an HSE (Health Safety and Environmental) Management support system, the PrüfExpress Mobile App, was used as a case study. The goal is to illustrate how a mobile app can deliver an effective UXD approach that is required to achieve both user acceptance and organizational expectation when it incorporates the end user input and provides adequate usability. This section deals with issues involved in the process of ideation of such HSE Management control support system. In other words, how did all different elements in the system design came about, like motivation, planning and the development itself of a Mobile App, specifically designed for optimizing HSE Management?

Since 2006, the PrüfExpress software is being used by Daimler Corporation to manage HSE equipment and routines, especially for documenting the testing of work equipment. Currently, the system is only designed for Daimler and is used in six plants. In general, the plants differ in the types (or groups) of plants that are managed with PrüfExpress. While the Gaggenau(Germany) plant documents the testing of load handling attachments (see the left picture in Figure 13.1) or shelving units with PrüfExpress, the Ulm plant checks cranes (see the right picture in Figure 13.1) and documents them with PrüfExpress.

Each system type has its own characteristics and properties that must be observed and documented during testing. These properties are also known as master data. In the case of cranes, for example, the residual usability of the tested system must be

FIGURE 13.1 Source: Graubner Industrie GmbH.

calculated after each test –the residual usability communicates how long the tested system can still be used. In addition, there are situations in which two plants are dealing with the same asset group. This is where the difference between these plants lies in the way the data is entered (the name of the installation, the required characteristics). The data recorded at Gaggenau or the designations of Gaggenau do not necessarily correspond to those of Ulm or Rastatt. In other words, the general conditions for the use of PrüfExpress vary from factory to factory.

Previously, each work was treated as a separate case. This means that each plant has its own system (from the database to the client application) and this is maintained independently of the others. The problem in the current situation is the inefficient maintenance and expansion of these systems. However, it often happens that new features must be implemented for the six works. In such cases, this function was written six times for the six systems. With only one system, one could have saved the time for the implementation in five other plants. A universal system for all these works and possibly for external companies must be developed within the framework of this work, since the demand for mobile applications on the shop floor increases at a fast pace, never seen before with other technologies.

In fact, if the advancements in mobile technology may surprise many, the fact is that most people do not realize the speed of the transformations the world is going through, as everyone becomes a mobile citizen of planet Earth. As eerie as it may sound, mobile phones only started to be used as personal computing devices in 2007. Thus, the mobile apps industry coincides with Apple's introduction of the iPhone, although its phenomenal growth is due to the entry of several competitors into the marketplace, notably Motorola, Samsung and LG, to cite some. This competition has given rise to an entirely new product that has become known as smartphones (Rakestraw;Eunni;Kasuganti, 2013).

Smartphones brought far greater functionality and usefulness than normal mobile phones exactly due to their ability to run mobile apps. According to Mobilewalla .com, a website dedicated to cataloging and rating apps, the one-millionth app was made available to users in December 2011 (Newark-French, 2011). Amazingly, it was not long ago that today's Smartphones and their associated mobile software applications or "apps" became a ubiquitous part of all human being's daily life. Most mobile apps are basically compact versions of regular computer software, designed for facilitating peoples' lives as they are on the run. However, some apps are much more useful, doubling as work tools for operational performance and productivity. It is possible to cite numerous examples of such applications, from physician's aids that can help to diagnose a disease by analyzing a photo taken with a smartphone to managerial tools that can be embedded in complex ERP Systems of large industries.

As one of the largest statistical mobile data repositories states, "most articles on mobile marketing and mobile usage statistics are terribly outdated" (Blue Corona, 2020). Thus, taking into consideration that mobile technology adoption is speeding at an ever-increasing pace, any data older than a couple of years might be considered only informative, not a definite trend. Take for instance the data on Spending on mobile apps worldwide 2009–2015, published by Statista Research Department, in 2018, on their website. It shows a stairway shape graph of evolution from 4 to 35 billion dollars spending on the sector. However, it fails to consider the geometric progression as the timeframe advances and other important variables, such as the number of free apps available and special usage apps, such as the ones designed for the industry. They “escape” the reach of the commercial data statistics.

With the new decade approaching, it is wise and quite timing to analyze the past, assess the present and embrace the future of data. Most people involved with high-tech research agree that those who do not aggressively embrace artificial intelligence (AI) and machine learning to optimize the use of data will be left behind and lose performance and profitability. Data collection is more than widespread; it shapes the way that the best companies in the world do business nowadays. When compared to non-data-driven companies, data-driven organizations are 23 times more likely to acquire customers, 6 times as likely to retain customers and 19 times more likely to be profitable (Bokman et al., 2014).

There are two main types of mobile applications: native and mobile Web. Native applications integrate directly with the mobile device’s operating system and can interact with its hardware much like the software on a personal computer. Mobile Web applications are apps that run directly from an online interface such as a website. Some applications are hybrids that combine the interface and coding components of a web-based interface with the functionality derived from native applications. Institutional applications would be a subcategory that has only recently started to spread out throughout businesses. Rakestraw, Eunni and Kasuganti (2012) present a Graph showing a breakdown of the various categories of applications used within a span of 30 days (Figure 13.2). There is no reference to an organizational or institutional category. This leads to a double conclusion: (a) the novelty of using endogenous apps as management control tools in the shop floor and (b) the more recent growth in the development of industrial apps has probably affected this graph trends.

Mobile computing devices are smart consumer products that are usually used by a heterogeneous group of users. This introduces three main reasons that signify the importance of an integrated approach to usability heuristics for mobile apps. First, mobile devices have inherited limitations due to the nature of mobile devices themselves such as the small screen size of the device, display resolution, limited input mechanisms, connectivity-based issues, security, and limited performance capabilities. Other constraints to consider when discussing mobile devices are the huge variability among the different brands and variability within one brand. For example, when designing apps for iPhones, the user interface is standardized. However, when designing for Android or Blackberry phones, there are different screen sizes, and interaction models to consider (Swaid; Suid, 2018).

Despite the fact organizational users do not adhere to the same rules as regular consumers, one should consider the possibility that work systems’ apps must follow some basic usability principles. Florence and Liotta (2007) pointed out that users or consumers take a significant role in the success/failure of any software. Therefore, as for the PrüfExpress System App, used to contextualize this chapter is presented in the following section, there will be more emphasis given to the user-experience and usability issues reported during its implementation in the shop floor, rather than in its development process.

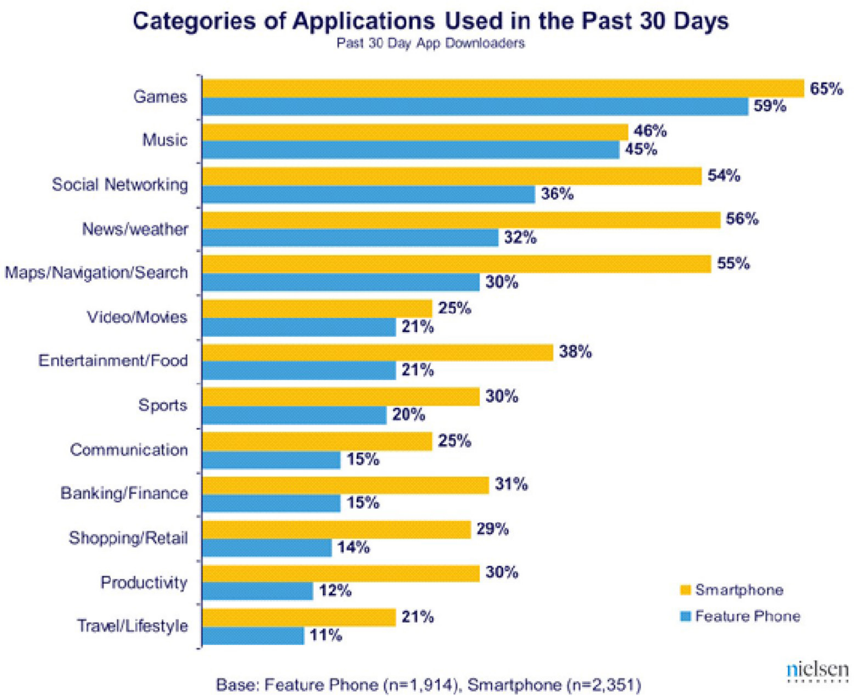

FIGURE 13.2 Source: Rakestraw, Eunni & Kasuganti (2012).

13.4 THE PRÜFEXPRESS SYSTEM CASE STUDY: PLANNING, DESIGN, OPERATION, USER-EXPERIENCE AND USABILITY REVIEW

13.4.1 State-of-the-Art Mobile Application for Testing and Documenting Work Equipment

A perfectly functioning tool is the most important prerequisite for high-quality services in the industry. Therefore, the periodic checking of work equipment for functionality and accuracy is indispensable. This means that the inspection of work equipment in the company has not become a new topic, yet it has become routine for a long time. Before the spread of mobile devices, especially smartphones, many companies, including Daimler, had documented the test on paper. In the previous inspection, an inspector would receive an Inspection Report, outlining in detail each system to be inspected. The test report contained information about the plant, the client, the inspector, the test questions and a part for the feedback. The documentation of the test is called in this case, the completion of the test protocol.

In contrast to that, with the PrüfExpress System App the examiner receives a mobile device for the electronic documentation of the exam, with the help of which he can document the exam. This alternative is now very popular and represents the electronic documentation of the testing of work equipment. This form offers a noticeable advantage over the paper form solution as it can be carried out much faster. In addition, it frees up qualified personnel to work on more important things related to the production process.

The electronic documentation of the testing of work equipment is used nowadays in many companies, with numerous applications that convey similar innovations and changes on the way paperwork is being dealt in the shop floor today. PrüfExpress is not only developed for the control of work equipment but also oriented towards maintenance. According to Germany's Ordinance on Industrial Safety and Health, by maintenance one must consider the totality of all measures for maintaining or returning an installation to a safe condition (BJVDE, 2015). This means ensuring the functional condition of the equipment or restoring it in the event of a failure. From this point of view, maintenance is an issue that can be subdivided into inspection, maintenance and repair. In view of this definition, the following question arises: What happens if a company does not want to take care of the complete maintenance (the maintenance or repair, for example, is usually done by external companies)?Would the company still be responsible for buying all the software or there are already applications that only take care of the inspection (and control) of the work equipment?

Apart from PrüfExpress, there are few applications that deal with documenting the testing of work equipment, for example, the "Darwin CheckMaster" from the Darwin company and the "Dekra application" from the Dekra company. The Darwin application differs from PrüfExpress in functionalities such as voice control and digital signature. Since this application only runs on Windows Mobile 5.0, PrüfExpress has the advantage that it can run as a cross-platform application on all operating systems. Due to time constraints and the need to stay on course to the main theme, a detailed comparison of these applications is not included in this text.

13.4.2 LegalDocumentation

The testing of work equipment is carried out in accordance with the Industrial Safety Regulation. Each test must be documented. The resulting document must be kept in a safe place as it will be used as recognized evidence in court in the event of an accident or personal injury(Arbeitssicherheit, 2017). Since the resulting documents can be used in court, they must be audit-proof. The term revision security refers to electronic archiving systems that point to the following characteristics after pounds: (a) the contents of the document are stored unchanged and forgery-proof, (b) the contents of the document are recallable through a search and (c) all actions in the archive are logged for reasons of the comprehensibility (Pfund, 1995).

In the event of an accident, the competent court system will evaluate in detail whether the work equipment has been regularly inspected, when the last inspection was carried out, what was inspected (the activity of the inspector) and who carried out the inspection (identity of the inspector) (Neumann, 2015).

13.4.3 Testing and Documentation Process

The testing of work equipment and its documentation is a two-stage process that must be carried out by a trained inspector. However, the inspector must know which parts of the work equipment are to be inspected and how the inspected parts are to be documented. The process consists of a passive and an active component. In the first phase, the examiner is an active component that does all the work. For example, he can carry out a visual inspection. The application, on the other hand, plays a passive role because it provides the test questions that the examiner can use as a guide to perform the test.

The second phase is the documentation itself of the test carried out. In contrast to the first phase, the application plays an active role in the process. The examiner describes what he has done (responding to the question, entering the time feedback and describing his activity) and the application takes care of storing the registered information in a database. In this chapter, the term performance of the audit is used to refer to the audit and documentation process.

13.4.4 Concept, Technology and Programming Languages

The system to be developed should be as flexible and modular as possible in order to be open for extensions and maintenance. This requires a clearly structured and documented architecture. In the following, the architecture of the new application is presented considering the technical requirements and trying to adhere to Usability and User-Experience issues. The system focuses on the following two technologies: RFID and barcode. These are contactless identification methods and are used for automatic data transfer, which saves the user the trouble of entering information manually. This technology makes it easy to read and store data from the database.

While the identification with RFID is done via electromagnetic waves, the data is scanned in the barcode. It is not possible to use Apple's NFC mode in this work for some reasons, for instance, an NFC interface would have to be implemented for Android and Windows. Since the new application must be platform-independent, the idea of using NFC for all platforms was no longer pursued. Instead, a different strategy was used to continue to allow automatic data transfers between the application and the object.

The most recent alternative is to use the Bluetooth function from all mobile devices. An external Bluetooth reader is used in addition to the smartphone. This reader has the advantage that it can read all RFID tags and can be connected to iOS as well as Android and Windows Smartphones via Bluetooth. After the pairing between the smartphone and the reader, the reader is recognized as a "keyboard input" (Bluetooth keyboard) device on the smartphone. Another reason for using this alternative is the reduction of development costs. There is no need to develop a new interface between the smartphone and the application, only an entry field in the application with a focus on where the data is entered.

Naturally, the use of this alternative generates additional costs for the company, as Bluetooth readers must be acquired. However, during the discussions prior to the system's implementation, it was decided by Daimler that the application had to be platform-independent. The Xamarin tool with Visual Studio was used to implement the requirements. For the structure of this application, the Xamarin Forms is used using Portable Class Library because it not only offers more flexibility than the others, but it is also easy to test and extend.

An important aspect of the application is the ability to process and store data with or without an Internet connection. A SQLite database is used for the local storage and processing of the data. An external service (Zumero) is then used to implement automatic synchronization between the local database and the server-side database. This text also does not deal with the structure of Zumero. It is only necessary to understand that Zumero offers a web service and a management tool to synchronize data between databases. It also takes care of resolving conflicts that may arise during synchronization. For conflict resolution, rules are defined during the configuration of the managers. Zumero thus offers bi-directional synchronization. The use of this framework offers the advantage that the developer saves a lot of time during development.

SQLite is used for the local database. This defines a limited SQL program library designed for embedded use. It fulfills most of the standardized SQL voice commands and does not require an SQL server or SQL software. Likewise, no process is started in the background that is to be used for database administration. Another advantage of SQLite is that there is only one database file where all database entries are stored. Xamarin is a component of Visual Studio and since Visual Studio is associated with the C# programming language, the C# programming languages are as specified.

In summary, the identification of work equipment is not read by the NFC chip of the smartphones, but by the RFID tag using a Bluetooth reader and passed on to the application for processing. The barcode technology is used as before, since the application only needs to access the camera API of the respective devices. The task of synchronizing the data between the devices and the server is done by an external component –the Zumero.

13.4.5 The Architecture of the System

The application was meant to be implemented as a distributed architecture, more precisely as a client-server architecture. It consists of a mobile application for collecting the data and a desktop application for managing the collected data. The testing of work equipment is carried out by means of a mobile application. This work does not deal with the development of the desktop application, but due to the distributed architecture of the new system, the desktop application must be built with little effort. This implementation is not done within the scope of this work. This section presents a synthesis of the implementation results for the PrüfExpress App. At the beginning of the operation, the inspector must start the application on a smartphone. Once the app initializes itself, Figure 13.3 is displayed.

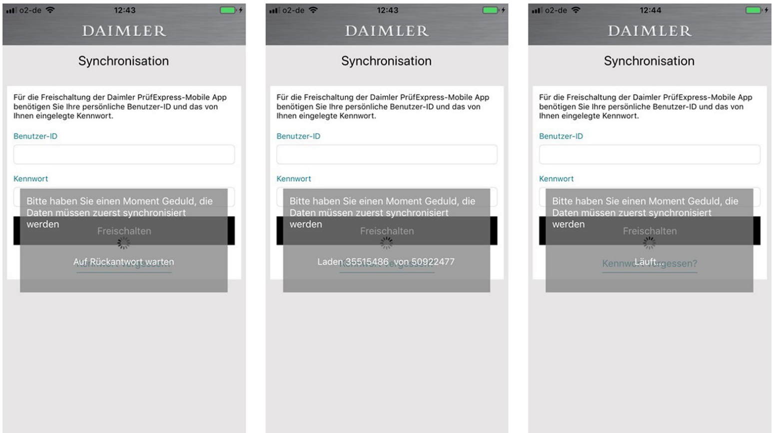

FIGURE 13.3 Source: Graubner Industrie GmbH.

Then, the user must wait until the data has been completely synchronized before logging in. During the first synchronization process, the user must expect a waiting time of approx. 5 seconds because the total database is transferred locally to the device. After the synchronization process has been successfully completed, the registration form is displayed. The user must register now before beginning to work. In the next image (Figure 13.4), the user is asked to enter his username and password in order to log in. With a successful login, he or she can then access the application. Once the logon information is set, all attachment groups are displayed, and proper authorization of access is required.

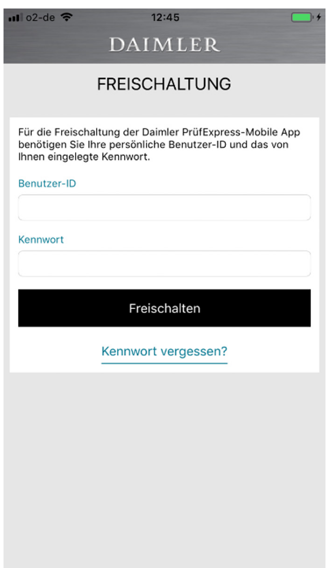

FIGURE 13.4 Source: Graubner Industrie GmbH.

Then, a list of all installation groups is shown to the logged user (Figure 13.5). In this case, the user has only one installation group: the “LASTAUFNAHMEMITTEL” (load handling attachment) and is abbreviated as “A.” Here the user has a business role (KMadmin) for about 466 cost centers. This means that he can not only create the documentation for the tested work equipment but also manage the data. If he clicks on “LASTAUFNAHMEMITTEL,” he is forwarded either to the administration view (left picture in Figure 13.6).

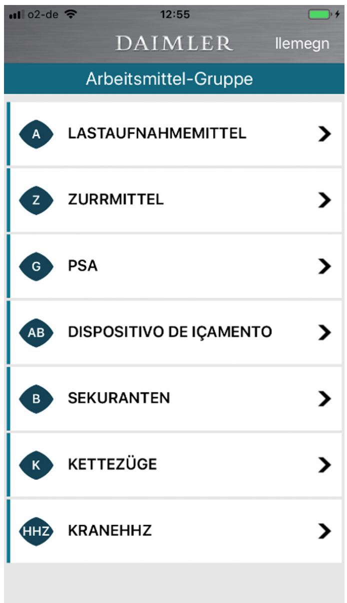

FIGURE 13.5 Source: Graubner Industrie GmbH.

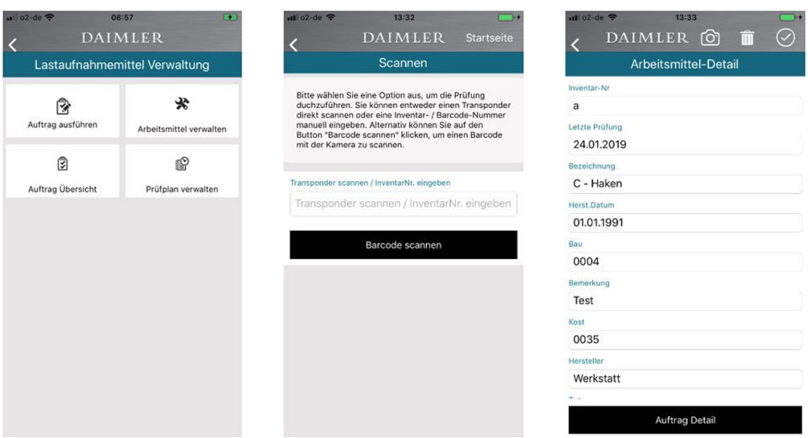

FIGURE 13.6 Source: Graubner Industrie GmbH.

The administration layer (left picture of Figure 13.6) offers the user four possibilities to further interact with the system. He can call the "Execute Job" function in order to be able to carry out the inspection of a piece of equipment (center image – scanning layer – in Figure 13.6). Or he can call up the administration function for the work equipment, the order or the inspection plan. Figure 13.6 shows the management, scanning, and attachment detail view. A user is directed to the plant detail view after searching the plant for his transponder, barcode or inventory number.

The button "ORDER DETAILS" on the left side of Figure 13.7,on the plant detail page, is used to generate the test order for this work equipment. If the user clicks on it, then the right image of Figure 13.7 is displayed (in the PruefPlan Select page), where he must select the test plan (template) of the order to be generated in order to be able to continue working. The user selects the test plan and presses "Next." The order is generated in the background.

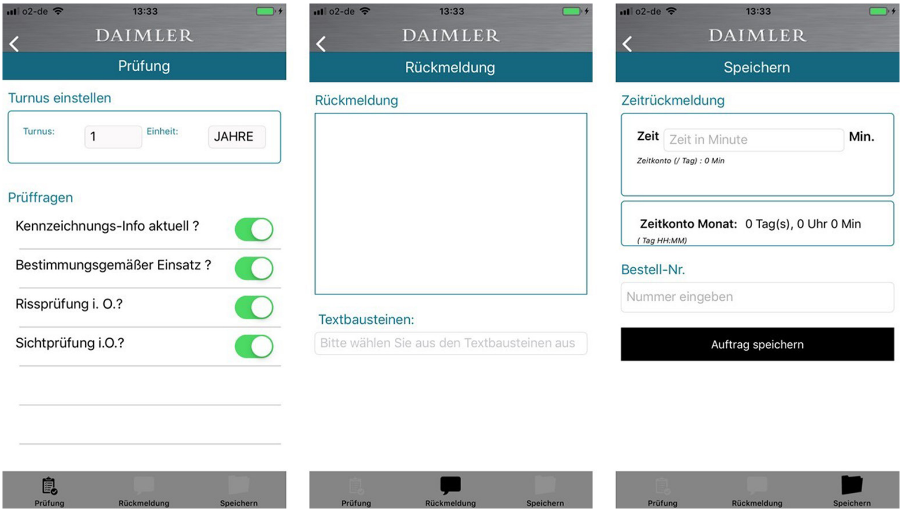

FIGURE 13.7 Source: Graubner Industrie GmbH.

As a result, the user sees the image in Figure 13.8 and can navigate through "tabs" between the pages to complete the order and save it at the end.

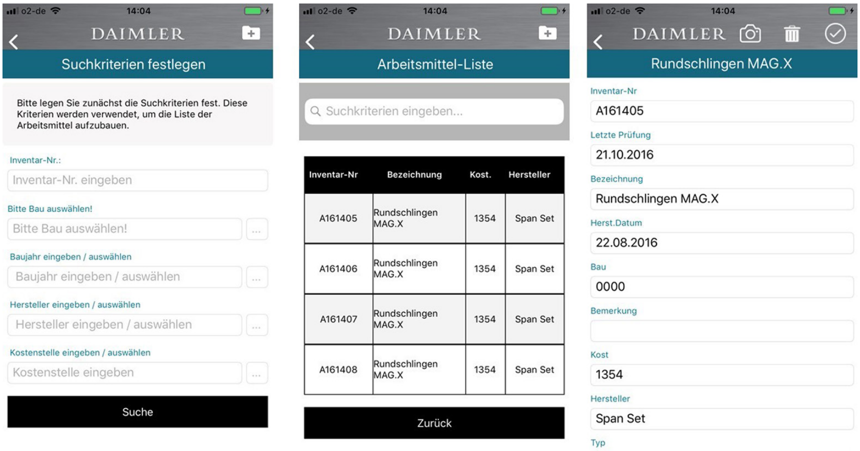

FIGURE 13.8 Source: Graubner Industrie GmbH.

On the left side ofFigure 13.7, the test questions are displayed on the test frequency (cycle). The test questions each have a checkbox that allows the user to answer the question. By default, the checkboxes of the check questions have the “On” status. The “On” or “Off” status here corresponds to the “Yes” or “No” answer. The image in the middle of this figure represents the confirmation page. The user can then select predefined feedback from a picker. The selected confirmation is then written to the editor text. The picture on the right sketches the last step of the audit documentation. If necessary, the user is asked for time feedback. If there is this information then he clicks on the order save button to save the information of the check, feedback and save page.

Figures 13.6–13.8 represent the administrative view of the application and they were designed using Daimler’s usability and user-experience requirements for upper management software systems. While Figure 13.6 shows the work equipment view, Figure 13.8 depicts the order view. Left images of both Figures 13.6 and 13.8 allow the user to filter the work equipment or the orders. Clicking on an element in the list displays the details of that element. It is important that the details of an order cannot be processed.

The right picture in Figure 13.7 shows the details of selected work equipment in this case a “C-hook.” Since the logged-in user has write access, he can edit the details of the work equipment and save the changes in the database with the Save button.

The last diagram (Figure 13.9) illustrates all the inspection plans and the details of an inspection plan.

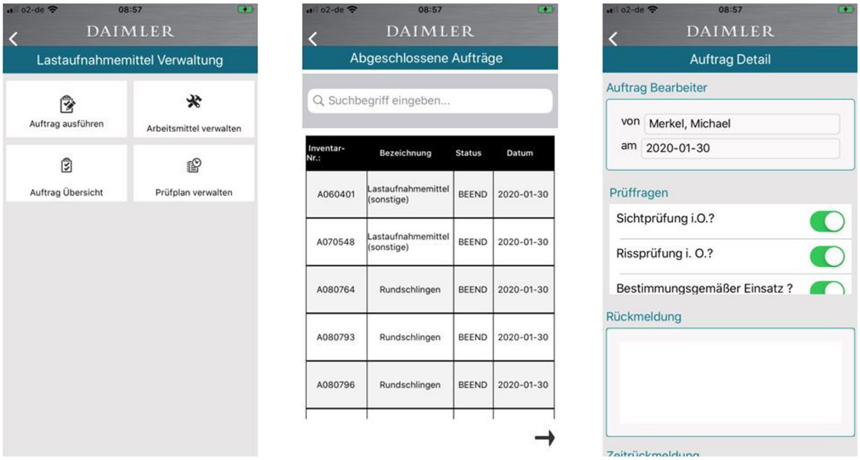

FIGURE 13.9 Source: Graubner Industrie GmbH.

13.5 FINAL CONSIDERATIONS

The primary motive of this research was to entice a reflection. How important are current Usability and User-experience (UXD) design guidelines and parameters when dealing with the planning and design of mobile applications? Interface issues, for example, are crucial for commercial (leisure) usage but are somewhat useless on the shop floor, where other elements of the mobile system's architecture are more relevant. Yes, the methodological aspect of software engineering is still important, but maybe not always a key factor in successfully developing mobile applications.

The study case presented to contextualize this chapter shows that innovation and technology are not transforming and reshaping the social world as we know, but it is also transforming technological innovation itself. Maybe the software development life cycle is losing its importance as a development strategy tool, in the case of mobile apps. Some of the main observations found in this research are mobile app is not a tiny/simple piece of software anymore; mobile apps are continually growing in number, usage possibilities and complexity; instead of modern PM techniques, old process-oriented approaches and techniques are required to handle successful mobile application development in the shop floor.

Usability and User-Experience (UXD) are the key factors for achieving quality in the development of mobile apps, especially for its users, all of them. However, research on mobile apps usability is still fragmented and inconsistent. In this study, it was presented a usability heuristics model. It is based on an integrative approach using Nielsen 10-rules heuristics, and the design guideline put by Google and human-factors design of Apple for their mobile apps developers. This guidance approach has been proved successful in the development of commercial, ordinary apps.

Then, a pragmatic overview of mobile applications for industrial applications was outlined. The subjective assessment resulting from that shows that researchers and software engineers are yet to guide themselves based on any guideline. The particularities and peculiarities of mobile applications are just too broad to allow for a single methodology or development approach. When asked if Nielsen's rules were used in the planning and development of the PrüfExpress Mobile App, the general project manager in charge of the system responded that they did not follow any specific usability guidance, other than regular PM processes carried out by Daimler. However, he added, as I became aware of those guidelines, I must say that all those "rules" were somewhat followed by the work team.

Thus, when organizational idiosyncrasies are added to the formula, it becomes noticeable that a system's overview is needed. The case presented to contextualize this chapter showed the power of mobility as a management tool, which reinforces the need to properly address usability and user-experience issues, especially in cases where the applications are embedded with ERP-like informational systems. The description of the development and implementation process of the PrüfExpress Mobile App is solid proof that process-oriented approaches are required in order to improve design quality. Moreover, it must be emphasized that design quality cannot be dissociated from Usability and User-Experience characteristics.

REFERENCES

Arbeitssicherheit, Arbeitssicherheit und Gesundheitsschutz (Occupational Safety and Health Protection Regulations) by Wolters Kluwer Deutschland (2017), Available at: https://www.arbeitssicherheit.de/de/html/library/document/7331539%2C20, Retrieved on 12 Dec. 2019.

BJVDE - BundesamtfürJustiz, Deutschland, (Federal Bureau of Justice of Germany) Bundesministerium der Justiz und fürVerbraucherschutz, juris GmbH (2015), Available at: https://www.gesetze-im-internet.de/betrsichv_2015/BJNR004910015.html, Retrieved on 5 Dec. 2019.

Blue Corona, 75+ mobile marketing statistics for 2020 and beyond (2019), Available at: https://www.bluecorona.com/blog/mobile-marketing-statistics/, Retrieved on 15 Jan. 2020.

Bokman, A.; Fiedler, L.; Perrey, J.; Pikersgill, A., Five facts: How customer analytics boosts corporate performance (2014), Article in McKinsey website, Available at: https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/five-facts-how-customer-analytics-boosts-corporate-performance, Retrieved on 15 Dec. 2019.

de Paula, D.F.; Menezes, B.H.; Araujo, C.C., Building a quality mobile application: A user-centered study focusing on design thinking, user experience and usability, in *International Conference of Design UXD. Usability*8518 (2014): 313–322.

Florence, A.; Liotta, A., Addressing user expectations in mobile content delivery, *Mobile Information Systems* 3, no. 3 (2007), 153–164.

Ibrahim, N.; Ahmad,W.F.; Shafie, A., User experience study on Folktales mobile application for children's education, in *Next Generation Mobile Applications, Services and Technologies*, 2015, pp. 197–200.

Neumann, T., Die Drei Todsünden des Elektronitechnikers vor Gericht, Article presenting court cases of work accidents (2015), Available at: http://www.dds-cad.net/fileadmin/redaktion/PDF, Retrieved on Dec. 11, 2019.

Newark-French, C., Mobile apps put the web in their rear-view mirror, *Flurry Blog* (2011), Available at: http://blog.flurry.com/bid/63907/Mobile-Apps-Put-the-Web-in-Their-Rear-view-Mirror, Retrieved on 14 Dec. 2019.

Nielsen, J., Finding usability problems through heuristics evaluation. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, June 1992 Pages 373–, pp. 373–380. ACM Press, New York, 1992.

Nielsen, J., Heuristic evaluation. In: Nielsen, J.; Mack, R.L. (eds.), *Usability Inspection Methods*. New York: Wiley, 1994.

Nielsen, J.,Severity Rankings for Usability Problems (1994), Available on http://www.useit.com/papers/heuristic/severityrating.html, Retrieved on 28 Dec 2019.

Nielsen, J., *Usability Engineering*, San Diego: Morgan Kaufmann, 1994.

Partala, T.; Saari, T., Understanding the most influential user experiences in successful and unsuccessful technology adoptions, *Computer Human Behavior* 53 (2015),381–395.

Pfund, A., Document classification in Germany, Andreas P. Informations manager (1995), Available at: http://andreaspfund.de/archivierung/elektronische_archivierung/revisionssicherheit.php, Retrieved on 8 Dec. 2019.

Rakestraw, T.L.; Eunni, R.V.; Kasuganti, R.R., The mobile apps industry: A case study, In *Journal of Business Cases and Applications*, Youngstown State University, 2013.

Silva e Santos, M.S.; Vidal, M.C.R.; Moreira, S.B.; Almeida, M.M., *The RFad Method - A NON Invasive Fatigue Measurement Method Based on Ergonomics evaluation Techniques. SAE Technical Paper Series*, v. 1, p. 2011-36-0012, 2011.

Statista, Total global mobile app revenues 2014–2023, *Statista Data Platform* (2019), Available at: https://www.statista.com/statistics/269025/worldwide-mobile-app-revenue-forecast/, Retrieved on 2 Dec. 2019.

Swaid, S.I.; Suid, T.Z., Usability heuristics for M-commerce apps. In: Ahram, T.; Falcão, C. (eds.), *Advances in Usability, User Experience and Assistive Technology. AHFE 2018. Advances in Intelligent Systems and Computing*, vol 794. Springer, 2019, Available at: https://doi.org/10.1007/978-3-319-94947-5_8. Retrieved on 8 Jan. 2020.

World Mobile Applications Market - Advanced Technologies, Global forecast report (2010–2015), *Elaborated by Markets & Markets* (2015), Available at: http://www.marketsandmarkets.com/Market-Reports/mobile-applications-228.html, Retrieved on 12 Dec. 2019.

Yazid, M.A.; Jantan, A.H., User Experience Design (UXD) of mobile application: An implementation of a case study, *Journal of Telecommunication, Electronic and Computer Engineering* 9, no. (3) (2017), 197–200, Available at: https://jtec.utem.edu.my/jtec/article/view/2902. Retrieved on 8 Jan. 2020.