

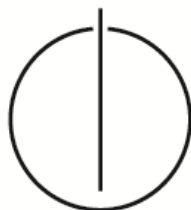


DEPARTMENT OF INFORMATICS
OF THE TECHNISCHE UNIVERSITÄT MÜNCHEN

Bachelor's Thesis in Information Systems

**A Prototypical Implementation of a
Smartphone App for Ad-Hoc Process
Documentation**

Alexandra Fritzen





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**Konzeption und prototypische
Implementierung einer Smartphone-
App für ad-hoc Prozessdokumentation**

**A Prototypical Implementation of a
Smartphone App for Ad-Hoc Process
Documentation**

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Submission date: 15.12.2014



I confirm that this bachelor's thesis is my own work and I have documented all sources and materials used.

Date

Alexandra Fritzen

Abstract

Business processes need to be documented to increase their value for the business. In order to do so, business process documentation methods such as BPMN, EPC and CMMN were introduced. These methods are utilizable by people who have been trained to use them. However, an increasing number of novice business participants need to be able to read, write and understand these documentations as well. In order to help these non-experts in documenting and executing processes efficiently, a prototypical tool is introduced that combines informal documentation methods from Q&A sites, DIY tools and wikis with the area of business processes. This thesis describes the requirements for such a system, details its implementation and determines the usefulness of the prototype in a small evaluation. An in-depth literature review of the topics of (informal) business process documentation was conducted.

Keywords: Ad-hoc Process Documentation, Informal Process Documentation, Prototype Implementation, Tutorials, Do-It-Yourself (DIY), Business Process

Research Areas: Information Systems, Computer Science, Human-Computer Interaction (HCI), Process Documentation, Business Modeling

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List of Abbreviations

ACM	Adaptive Case Management
BPM	Business Process Modeling
DIY	Do-it-yourself
Q&A	Question(s) & Answer(s)

1 Introduction

Process documentation in its most rudimentary forms has existed since the middle of the 20th century (Rosemann 2006a, p. 249). Since then, a variety of notations and tools have become available to support process documentation through modeling or case management. However, these languages and tools often prove to be too complex to be carried out by modeling novices and any resulting models are often not understood by them. Still, since increasingly more employees of organizations need to use these notations, tools and models in their daily operating life, process documentation for non-experts is quickly gaining importance. In order to support documentation novices, it is crucial to understand how processes are documented and how knowledge is shared in a more informal, non-business related environment. Examples of popular knowledge sharing opportunities are online Question-and-Answer (Q&A) forums, wikis as well as tutorials. While Q&A sites and wikis document process knowledge, tutorials have a more structured, step-by-step character that is easily understood by and familiar to most users. Especially tutorials that are part of the do-it-yourself (DIY) movement offer a great variety of multimedia resources to enhance the tutorial experience and make it more self-explanatory.

Incorporating this trend of step-by-step DIY tutorials into a more business-related environment, a new tool for process documentation is being proposed in this thesis: 'Stepster'. Tutorials created with Stepster can consist of various media resources such as text, images, videos, audio recordings, maps, etc. with the goal of improving the understandability and simplicity of process documentations. A rating system can help users to distinguish good from bad practices and encourages the emergence of 'best' process documentations. Problems or improvement suggestions can be voiced by commenting on tutorials or tutorial steps. The tool is developed for smartphone devices in order to lower the barrier of entry (most people nowadays own a smartphone), to allow for ad-hoc process documentation and to enable the manipulation of process elements via touch screen. Compared to traditional business process modeling and adaptive case management, this approach promises to

- increase the rate of successfully executing process documentations
- decrease the number of discontinuations of a process
- increase the understandability of process documentations by using informal, multimedia resources
- reduce process documentation creation and execution time
- lower the error rate of process documentations due to the ad-hoc creation character of the application

This thesis tries to answer the following questions:

- What are the strengths and weaknesses of existing process documentation approaches?
- What are the challenges involved in documenting a process accurately by a step-by-step guide and how can these challenges be overcome?
- To what degree are step-by-step guides easier to read than standard process documentation?

To answer the first two questions, a literature review was conducted, of which the results can be found in section 2. The first part of the literature review focuses on business process documentation, its challenges and the need for a new tool while the second part looks at informal knowledge sharing, introducing particularly web-based process documentation tools and communities and providing an insight into step-by-step guides and the advantages and constraints offered by different media types. Section 3 states the methodological approach to this thesis. The functional and non-functional requirements as well as the core use cases of the proposed tool are introduced in section 4. The implementation of the tool, including the data model, system design and user interface evolution, is subject of section 5. Furthermore, section 6 describes the experiment that was conducted in order to answer the last research question. Section 7 concludes the thesis by discussing the results of the evaluation and proposing future research endeavors in the area of informal business process documentation.

2 Literature Review

2.1 Business Process Documentation

Business processes are “the basic unit of business value within an organization” (Verner 2004, p. 83). Executing them efficiently is therefore a key goal of businesses. In order to do so, a lot of work has been directed at the way these processes can be documented. In order to understand how processes can be documented, a short introduction to knowledge types and organizational knowledge creation is necessary.

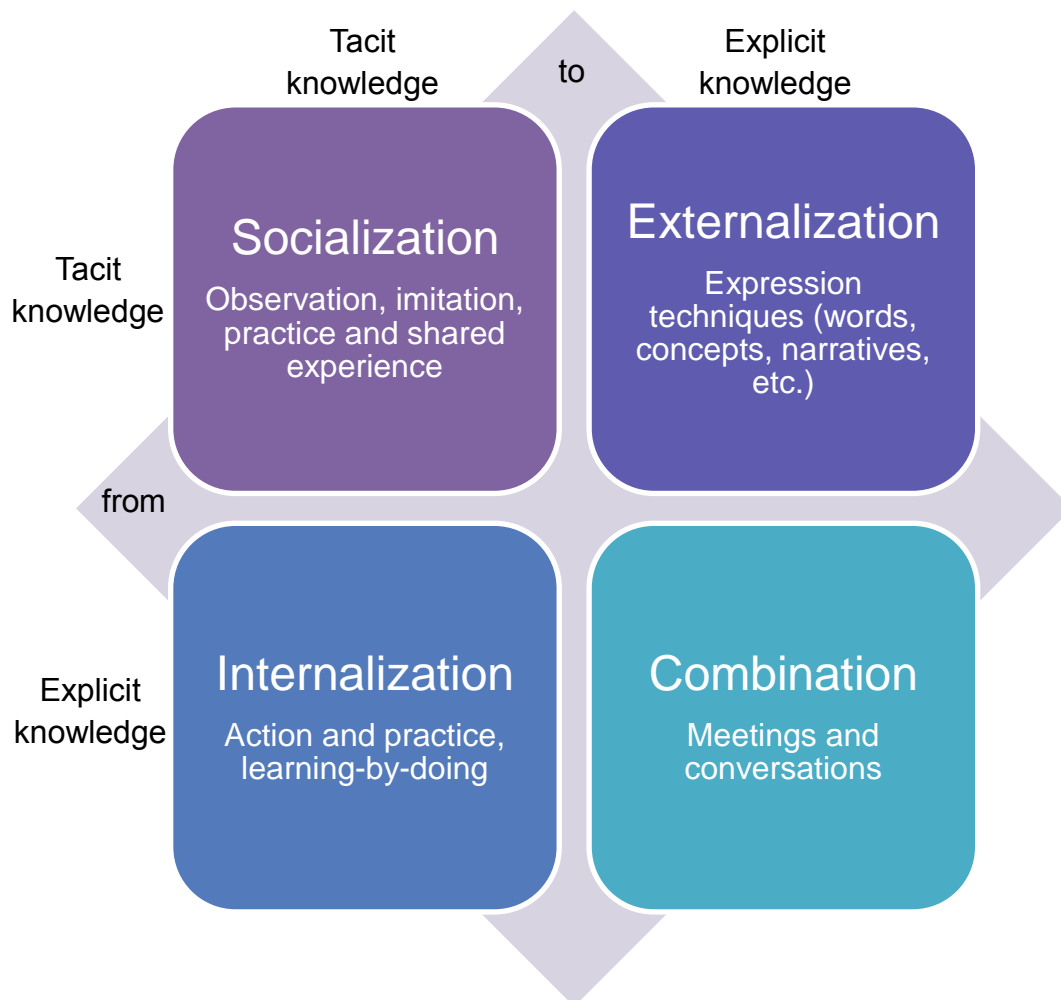


Figure 1: Modes of knowledge creation, adapted from (Nonaka 1994, p. 19)

According to Nonaka (1994, pp. 14–37) and Panahi et al. (2013, p. 380), tacit knowledge is knowledge with a personal quality that is grounded in an individual’s action and experience, beliefs, ideas, paradigms, values, intuition and involvement in a particular context and can only be formally expressed or communicated with difficulty (Nonaka 1994, p. 16). Explicit knowledge, in contrast, can be formalized

using some form of systematic language involvement (Nonaka 1994, p. 16). In order to understand how knowledge can be documented in a business-related environment, a look at Nonaka's (1994, pp. 14–37) Theory of Organizational Knowledge Creation is necessary. It depicts how knowledge can be transformed from tacit to explicit or any combination of the two (see Figure 1). First, there are two pure transformation modes: socialization – knowledge acquisition through observation, imitation and practice – and combination – knowledge exchange through reordering and combining existing knowledge. Then, there is the transformation from tacit to explicit knowledge – externalization – in form of documenting and other expression techniques as well as internalization – a learning-by-doing approach based on putting knowledge into action (Nonaka 1994, p. 19). In order to document processes, usually tacit knowledge will need to be transformed into explicit knowledge. Process documentation, in turn, acts as a catalyst for internalization.

Currently, there are two main approaches to business process documentation that will be presented in section 2.1.1 and 2.1.2 and contrasted in section 2.1.3.

2.1.1 Business Process Modeling

The most popular form of process documentation is (business) process modeling. There are many modeling techniques available (Recker et al. 2009, p. 334), ranging from flowcharts that graphically represent the control flow with step-by-step illustrations (Rosemann 2006a, pp. 249–250; Recker et al. 2009, p. 334; Aldin, Cesare 2009, p. 5) to techniques initially used as part of software design such as UML (Recker et al. 2009, p. 334). Specific modeling notations have been created, for example Event-driven Process Chains for event-oriented representations (Recker et al. 2009, p. 335) or the more formal state-based Petri nets that are typically used for analyzing and executing processes (Recker et al. 2009, pp. 334–335; van der Aalst, Wil M. P. et al. 2003, p. 7).

These process models have a variety of purposes. In the beginning of a project, they are a core element to defining and communicating requirements and to determining whether these proposed requirements can be met (Groth et al. 2009, p. 2; Mendling et al. 2010, p. 127; Rosemann 2006a, p. 250; Verner 2004, p. 88). A process model provides a business with the ability to analyze and simulate the process, to identify errors or problems (Groth et al. 2009, p. 2) and to improve or re-engineer the process (Ungan 2006, p. 400; Rosemann 2006a, p. 252; Nolte, Prilla 2012, p. 57; Aldin, Cesare 2009, p. 3), addressing factors such as efficiency, effectiveness and timeliness (Ungan 2006, p. 401; Groth et al. 2009, p. 1; Brantley 2012, p. 268). As a result, having a process model leads to a more standardized, consistently executed or automatically enacted process (Ungan 2006, p. 2; Mendling et al. 2010, p. 127; van der Aalst, Wil M. P. et al. 2003, p. 9) and simplifies the introduction of best practices in terms of structure, content and overall guidance (Becker-Kornstaedt et al. 2000, p. 1; Rosemann 2006b, p. 382; Verner 2004, p. 83).

Process models and the act of modeling also increase process participants' awareness and understanding of the process as a whole (Rosemann 2006b, p. 380; Recker et al. 2009, p. 335; Nolte, Prilla 2012, p. 67; Rosemann 2006b, p. 250; Aldin, Cesare 2009, p. 3). This leads to an easier and more efficient information exchange between involved parties and facilitates the cooperative communication and discussion of process elements (Nolte, Prilla 2012, p. 67; Aldin, Cesare 2009, p. 3).

Process documents are also unavoidable when trying to share a process with other stakeholders (such as external companies) or new process participants as part of a company's training efforts (Ungan 2006, p. 403). There, process documents offer the possibility to quickly understand, learn and execute a previously unknown process.

Other reasons for modeling a business process can be the need to comply with certain standards such as ISO (Rosemann 2006a, p. 252), saving costs (Verner 2004, p. 83), being able to reuse the model for future executions of the process (Aldin, Cesare 2009, p. 3) or deconstructing process complexity (Recker et al. 2009, p. 335).

2.1.2 Adaptive Case Management

In the past few years, a new means for documenting business processes has been introduced: Adaptive Case Management (ACM). It supports knowledge workers – employees that need knowledge and experience with different work situations (cases) – in carrying out unique, unpredictable, unstructured, constantly changing, goal-oriented and collaborative processes (Brantley 2012, pp. 265, 268; Motahari-Nezhad, Swenson, pp. 264–265; Sem et al. 2013, p. 103; Hildebrandt et al. 2013, p. 166; Martens et al., p. 639). These processes cannot be defined or modeled at the beginning of their execution but emerge as new information and knowledge is collected and similar issues appear in a number of cases (Brantley 2012, p. 268). In order to enable guidance for knowledge workers, ACM provides community-built case templates that include possible tasks, documents and their placeholders, best practices, business rules, goals and the ability to add, modify or remove any of these on-the-go, depending on the individual case (Sem et al. 2013, p. 103; Brantley 2012, p. 268; Martens et al., p. 639; Motahari-Nezhad, Swenson, p. 264; Motahari-Nezhad et al. 2012, p. 550; Tran et al. 2013, p. 172). Knowledge work is especially common in the healthcare, legal, social work and government sectors (Motahari-Nezhad et al. 2012, p. 550; Motahari-Nezhad, Swenson, p. 264). In summary, ACM can thus be described as a 'do-it-yourself' system for knowledge workers (Motahari-Nezhad, Swenson, p. 265).

2.1.3 Shortcomings of Existing Process Documentation Standards

After having introduced these two methods of documenting processes – BPM and ACM –, it is important to examine their focuses and shortcomings in order to identify

potential areas of research and improvement. For that purpose, a morphological box was created (see Table 1) that maps different values of characteristics of documentation standards. Combining all elements with a dark blue background leads to a very basic definition of business process modeling: routine work that is often documented by experts before its execution in a formal language. Template-based documentation of knowledge work by semi-experts in semi-formal ways (light blue) as it is done in ACM focuses on quite different aspects of process documentation. Both of these methods seem to leave open a gap (red) for new tools to support the informal, ad-hoc documentation of semi-routine work by novices. The application that will be proposed in this paper tries to fill that gap.

Documented Work	Routine	Semi-routine	Knowledge work
Time of Documentation Effort	Before execution	During execution	After execution
Knowledge of Documentation creators and readers	Expert	Semi-expert	Novice
Degree of Formality	Formal	Semi-formal	Informal
Focus of Documentation	Process	Data	
Documentation Outcome	Models	Templates	?

Table 1: Morphological box: BPM (dark blue), ACM (light blue) and the gap they leave (red)

As will be outlined below, this gap has also been recognized by other researchers.

With increased demands and purposes of process models (Rosemann 2006a, p. 250), the notations and tools that support them have grown increasingly elaborate (Rosemann 2006a, p. 251). For example, the trend for extension rather than revision and the accompanying high degrees of overload, excess and redundancy in recent modeling techniques has led to an increased modeling complexity (Recker et al.

2009, p. 353). As a result, more complex models are created (van der Aalst, Wil M. P. et al. 2003, p. 6) and the modeling tools and techniques have grown less understandable (Rosemann 2006a, p. 251).

Over the past few years, the activity of modeling processes and reading process models in organizations has spread from modeling experts to all stakeholders as part of their daily operations (Reijers et al. 2011, pp. 339–340). However, most employees are not skilled in process modeling notations (Nolte, Prilla 2012, p. 59; Recker et al. 2010, p. 29) and it is therefore difficult for them to interact with or follow process models and their creation tools (Nolte, Prilla 2012, p. 59). In order to satisfy an increasingly heterogeneous group of stakeholders, process models, their notations and their creation tools need to become more self-explanatory (Rosemann 2006a, p. 254) and thereby increase their understandability for novice users (Rosemann 2006a, p. 250; van der Aalst, Wil M. P. et al. 2003, p. 6; Reijers et al. 2011, p. 340). As mentioned by (Rosemann 2006a, p. 254), “the academic world did not pay sufficient attention to an appropriate visualization of process models” that are user-oriented and intuitive. Since most process models and corresponding languages are rather puristic from a visual point of view (Reijers et al. 2011, p. 340), a better use of graphical representations is needed (van der Aalst, Wil M. P. et al. 2003, p. 6). After conducting a study on novice modelers, (Nolte, Prilla 2012, pp. 57–72) identified five “minimal requirements for non-expert model interaction”. Most importantly, they call for simpler elements of the modeling notation, tools with less features to support the creation of simple tasks and simple ways of manipulating the model e.g. using a touch screen (Nolte, Prilla 2012, pp. 68–69). Based on their findings, (Nolte, Prilla 2012, pp. 69–70) introduced two prototypical implementations of modeling tools to support process modeling by non-experts. The first one allows for annotating process elements and thereby starting a collaborative conversation while the second uses meta modeling and a searchable database of models to offer an easy approach to complex modeling situations (Nolte, Prilla 2012, pp. 69–70).

In order to improve the readability of process models especially for non-experts/novice users, Reijers et al. (2011, pp. 339–349) propose highlighting related process model elements, suggesting a sentence structure. An experiment conducted by them confirmed that especially novice users benefitted from highlighting connectors, as it helped them understand the semantics and recognize process patterns.

In an evaluation of process representations drawn with pen and paper by business process modeling novices conducted by Recker et al. (2010, pp. 29–44), five unique types of process designs emerged. The Textual design only consisted of algorithm-like text elements, while the Canvas design was essentially a drawing of process parts. Most similar to a traditional process model was the Flow-chart design which complemented text with abstract geographical shapes such as arrows and boxes.

The Hybrid design added onto this Flow-chart idea with graphics (e.g. stick figures, planes, cars) and the Storyboard design focused mainly on graphics and abstract shapes that were supplemented by textual aids. More than 70% of study participants drew a flow-chart design, while 15% preferred the Storyboard design (Recker et al. 2010, p. 41). It was found that domain knowledge was significantly associated with drawing flow-charts and that participants without knowledge of object-orientated modeling methods tended to prefer the Storyboard design (Recker et al. 2010, p. 38).

Stoitsev et al. (2007, pp. 213–226) presented a framework for supporting multiple process participants with varying levels of expertise and skill in executing knowledge-intensive ad-hoc business processes. It builds on email as the main communication component for exchanging tasks and task-related information in organizations and provides personal to-do lists for task management. According to the framework, tasks have attributes with context information such as title, description and status and can be represented as best-practices in the form of task patterns. All participants of a task can be grouped into one of two roles: either owner, responsible for task execution, or recipient, a delegatee of a task. These human actors as well as all artifacts used or generated during task execution are connected to a task.

Building on this framework, Stoitsev et al. (2008, pp. 84–99) introduced the Collaborative Task Manager (CTM) as a Microsoft Outlook add-in with improved end-user development. Its main purpose is to support the “composition of weakly-structured process models for ad-hoc process support [and the] formalization of weakly-structured process models for automation of rigidly recurring processes” (Stoitsev et al. 2008, p. 89). Tasks are represented as hierarchical to-do lists that can be delegated to other users and changes are tracked via web services. The tool was perceived as “adequate and efficient” in the conducted case study, with one participant stating that this “kind of checklist with all things I need to do and the documents I need is very useful ... especially if she [Chief Sales Officer] is not in the office [vacation]” (Stoitsev et al. 2008, p. 96).

Conducting questionnaires and expert interviews on process models, Mendling et al. (2007, pp. 48–63) studied the factors that limit or enhance the understandability of process models. It was found that personal characteristics, such as the amount of theoretical knowledge, analytical skills and familiarity with modeling positively influence the understandability of process models positively. Model properties were also significant in increasing understandability – e.g. size, unambiguity, structure, simplicity and modularity. Modeling experts stated that textual support can also improve understandability, either in form of a textual description of a model element or an overview of the complete process model and its context.

Mendling et al. (2010, pp. 127–136) proposed seven guidelines for modeling processes: Firstly, to increase understandability and reduce the likelihood of errors, a process model should contain as few elements as possible. Relatedly, if the model

contains more than 50 elements, it should be decomposed into sub-models. Thirdly, as few routing paths should be set to and from elements as possible and fourthly, only one start and end element are to be used in order to increase the understandability of the model. Structuring the process model using connectors as brackets and not using OR connectors will also lead to fewer errors and a more intuitive understanding (fifth and sixth guideline). Lastly, Mendling et al. (2010, pp. 127–136) propose to use “verb-object activity labels” such as ‘Inform complainant’. In turn, process modeling tools could use these guidelines to warn users of dangerous behavior, for example too many elements or routing paths.

Pfister, Eppler (2012, pp. 372–382) propose using sketching – drawing ideas, problems etc. onto a piece of paper, a blackboard or a graphics computer program – to facilitate knowledge creation, sharing and documentation. Benefits of such a technique include idea generation as a team effort, allowing team members to participate and thereby engraining this new knowledge into their memory. Sketching also creates an instant documentation of the discussed elements that is accessible and easy to understand.

Differing from a traditional process model, a process guide is a reference document that guides readers through all of the steps of carrying out a process. Its goal is to lead process participants to an efficient and effective execution of the process, to let them track their progress and process state, to help them return to a partially complete project and to promote communication between all participants. According to Kellner et al. (1998, pp. 1–19), a process guide should include all artifacts (products modified during the process), activities, agents (entities carrying out activities), roles (obligations and permissions) and resources (anything needed to perform activities) that are involved in the process. While paper-based process guides, such as manuals and guidebooks, have been used for many years, their deficiencies – mainly difficult navigation and unreliable version control – have led to the preferred use of electronic process guides (EPG). These EPGs can be accessed and created using web technology. They increase guide navigation by using links to guide entries, templates and examples and are structured in an easy-to-use and easy-to-learn way. Changes in information or process can easily be integrated and distributed to all participants (Becker-Kornstaedt et al. 2000, p. 1; Kellner et al. 1998, pp. 1–3; Phongpaibul et al. 2007, p. 64). Kellner et al. (1998, pp. 1–19) created such an EPG which includes a graphical hierarchy frame, an overview frame, a description frame and a glossary frame. Becker-Kornstaedt et al. (2000, p. 1) introduced a tool that automatically generates and manages EPGs from the Spearmint process modeling tool. Phongpaibul et al. (2007, pp. 61–72) compared the Spearmint/EPG tool with the EPF Composer. It was found that EPFC surpasses Spearmint in terms of usability and functionality.

Panahi et al. (2013, pp. 379–397) analyzed literature to examine whether IT and especially social web tools can adequately help share tacit knowledge. It was found that multimedia content and applications enable the discussion, demonstration and imitation of skills while communication tools (forums, chats and social networks), user-generated content sites (wikis, blogs), collaborative systems and online communities encourage storytelling, sharing experiences, collaboration and interaction. The openness and ease of use reduce the time and effort needed to share knowledge. However, there has not been undertaken enough research to determine to which degree these social web tools actually influence the sharing of tacit knowledge.

2.2 Informal Process Documentation and Knowledge Sharing

The studies and techniques that were summarized above were all conducted in business settings. However, the idea of this paper is to create a tool that connects informal, mostly web-based knowledge documentation and sharing methods that are used by people in their daily lives with business process documentation. The following section therefore addresses literature from the area of informal process documentation.

2.2.1 Q&A sites

One of the most popular ways of online knowledge sharing occurs on question-and-answer (Q&A) forums. There, users can ask questions on a wide variety of topics and other users try to answer these questions. Usually, there is also a possibility to mark or vote for an answer as the best answer.

In 2008, Adamic et al. (2008, pp. 665–674) examined one of these Q&A websites: Yahoo! Answers. They were able to group all 25 high- and 1002 low-level categories into three clusters: seeking advice, discussions or technical expertise sharing. These clusters differed in thread length and user participation. On the one hand, discussions and advice inquiries tended to consist of long threads, with users being both askers and answerers in the same category. On the other hand, users usually did not occupy the same role in the same factual knowledge forum – they were either askers or answerers, not both – and question threads in these forums were usually shorter. Based on thread length, number of answers and users' track records, Adamic et al. (2008, pp. 665–674) were able to predict which answer would be selected as the best answer.

Focusing on one of these clusters proposed by Adamic et al. (2008, pp. 665–674) – technical expertise sharing –, Bouguessa et al. (2010, pp. 1–49) introduced an algorithm that identifies authoritative users. These community members are very actively engaged on Yahoo! Answers and provide high-quality, detailed answers to factual questions. By answering, voting for best answers and reporting misuse, they

were a key component of the website. Bouguessa et al. (2010, pp. 1–49) were able to identify clusters that form around dominant authoritative users, creating small sub-communities of knowledge transfer based on “trust, cooperation, and closer communication” (Bouguessa et al. 2010, p. 46).

In recent years, Yahoo! Answers has experienced a decline of its traffic, making way for new websites, such as StackOverflow or Quora (Wang et al. 2013, p. 1341). While StackOverflow is similar to Yahoo! Answers except for focusing mainly on computer programming questions, Quora has integrated social networking ideas into its basic structure. Users can follow other users or topics and receive updates on their followee’s activities or on questions and answers posted in these topics. Another important feature is to display related questions next to a question. According to Wang et al. (2013, pp. 1341–1351), these three aspects – the user-to-user ties, the user-topic connections and the related question feature – are strongly tied to user behavior. For example, the user-topic relationship generates user interest in browsing and answering general questions and the Twitter-like stream of followees’ activities attracts views and ‘best answer’ votes.

2.2.2 Wikis

Apart from Q&A forums, knowledge sharing is also apparent in online collaborative, user-generated content outlets called wikis (Chu, Kennedy 2011, p. 582). One of the most popular examples of a wiki is Wikipedia, an online encyclopedia where users from all over the world can create and edit encyclopedia entries. In order to discover what motivates users to contribute to Wikipedia, Nov (2007, pp. 60–64) surveyed 150 registered users of the website. It was found that having fun, expressing one’s values and understanding or learning new things all have a positive influence on motivation and on contribution levels. Factors such as social engagement, protection and job-related advantages were not as motivating.

Chu, Kennedy (2011, pp. 518–597) compared another wiki tool, MediaWiki, with a web-based, collaborative word processor, GoogleDocs, concerning their usability and knowledge management ability in educational group projects. It was found that both tools were easy to use and provided a friendly user interface. However, MediaWiki was perceived to be more effective in knowledge management than GoogleDocs.

Fernandez (2004, pp. 1–5) introduced the tool Scaki to support distributed software development processes and the teams that execute them. Scaki is made up of two components: scaffolding, a supportive framework with step-by-step instructions that is gradually removed as process knowledge is gained, and WikiWikiWeb, a user-editable server of content with links to entries within text passages. When creating a process, a cover page with a title and a description is generated. Users are able to add new entries to that cover page to create or link to artifacts, participants, activities or tools. Activity pages are comprised of title, description and pre- and post-

conditions, while the other elements only contain property text fields. Each page also includes an event log which displays important events that involves the page content. As scaffolding, these documents can be reused for multiple projects as long as an instance – a copy of the scaffolding that is completely independent from that scaffolding – is created for each project.

2.2.3 Tutorials

The web 2.0 has also been widely popular for online tutorial tools as a part of informal and formal knowledge sharing. The two most common types of tutorials are static and video tutorials. Static tutorials are made up of step-by-step text passages and accompanying images (Chi et al. 2012, p. 93; Wang et al. 2014, p. 4027). They have the advantage of being easy to navigate – fewer steps than usual are accidentally skipped due to the ability to switch back and forth – and catering to people who like to learn by reading and to those who prefer to learn by looking at images (Chi et al. 2012, p. 93). However, static tutorials often fail to effectively explain complex dynamic interactions (Chi et al. 2012, p. 3). Conversely, video tutorials, often (screen) recordings of someone performing a task, sometimes with voiceover instructions, are able to show a task in detail, including a program's response to user interaction (Chi et al. 2012, p. 93; Wang et al. 2014, pp. 4027–4028). However, within a video, it is hard to navigate, and using play, pause, rewind and fast-forward to find the correct step can be time-consuming and may lead to missing steps (Wang et al. 2014, p. 4027).

These tutorials can have a multitude of uses and goals. Section 2.2.3.1 will focus on tutorials on information literacy created by universities. The next section will explain the do-it-yourself (DIY) movement that popularized tutorials for crafts, home improvement, electronic hacking etc. Then, section 2.2.3.3 will focus on other tutorial types and the tools used to document and share them. There, many tutorials teach interested parties how to use a specific computer application, especially in the field of graphic editors and drawing applications.

2.2.3.1 Online Tutorials to Increase Information Literacy

Following the growing trend of online teaching and learning opportunities at universities all over the world, a fair amount of research has been directed at the way in which online tutorials are created by university libraries to improve students' information literacy. The goal of these web-based instructions is to provoke active learning and critical thinking in students' minds by “connect[ing] instructional content with media features to assist active learning and ultimately improve students' learning outcomes” (Zhang 2006, p. 296).

Anderson et al. (2008, pp. 61–63) analyzed online tutorials created by medical libraries concerning common topics and design, elements of active learning and links

to third-party tutorials. They found that more than half of the inspected library websites created their own tutorials, the most popular topics being evidence-based medicine, information literacy and the library's catalogue. The most common tools for creating these tutorials were HTML, PowerPoint, Flash and PDF. However, only seven percent of the tutorials were seen to support active learning by providing interactive experiences, such as performing searches, clicking on boxes for additional information and taking part in quizzes or exercises during or at the end of the tutorial. 63% of the websites contained links to third-party tutorials. Anderson et al. (2008, pp. 61–63) conclude that interactive elements, printable tutorials and screen recording software should be used in future to support students' active learning.

100 colleges and universities in the USA and Canada were studied by Yang (2009, pp. 684–693) to see which kind of information literacy tutorial content they offer their students. Among the 33% of universities that developed their own tutorials, the most common technology used was tutorial software/Flash, followed by HTML and PDF. Most of these tutorials focused on improving students' search skills in a specific database (40%) and general introductions to using Boolean operators or evaluating Internet resources. Based on these findings, Yang (2009, pp. 684–693) proposed using more game-like components that mix learning with fun and combining Flash, HTML and CGI to create “a combination of good contents, logically connected links with clear verbal explanation, and animated, interactive demonstrations” (Yang 2009, p. 692).

Zhang (2006, pp. 294–306) suggests that the user interface of a tutorial and its visual components are key factors to “capture students' attention, orient them for learning, and encourage them to actively participate in the learning process” (Zhang 2006, p. 297). As seen in many online instructions, the display of too much information can be overwhelming and even prevent the student from starting or continuing with a tutorial. To avoid this, text elements should be kept short, simple and well organized, preferably delivered in small paragraphs. Three to five colors should be used consistently. Graphics should be added to text passages in order to decrease the students' cognitive load and to emphasize important information, however only when serving a context-related purpose. Arrows or other navigational elements should be displayed at consistent positions to help students navigate through the tutorial and know their position within. Auditory content should be short and direct in presenting the most important information and only be used when directly associated with the text or task to be performed. Video content is especially recommended for summarizing, displaying abstract information, and illustrating movement. Audio and video elements need to provide the possibility to play, pause, rewind, and fast forward. One critical element to web-based tutorials is interactivity, which can be achieved by providing quizzes and exercises or by communicating with students via email, chats or forums. The latter can also be used as a way of sending feedback to librarians or tutorial creators.

Gustavson et al. (2011, pp. 725–740) describe the process of designing and creating The Library 101: Introduction to Research, an online tutorial module teaching students the core elements of information literacy such as navigating the library's website, searching for, evaluating and citing sources as well as avoiding plagiarism. Tools such as Camtasia, Audacity, Microsoft's Photo Story 3, Power Point and Google Docs were used to create the multimedia tutorials.

WebTA is a hybrid learning tool for creating and using web-based exercises/tutorials on the topic of chemical engineering. It allows for immediate feedback, automatically generates random numbers for problems, integrates necessary calculation software (e.g. Matlab) and offers a scoring system with multiple attempts (Cular et al. 2004, pp. 5621–5631).

2.2.3.2 DIY and Maker Culture and Their Motivations

According to Kuznetsov, Paulos (2010, p. 295), DIY or 'Do It Yourself' is "any creation, modification or repair of objects without the aid of paid professionals". This activity can range from home improvement and decoration over cooking and crafting creating electronics such as radios or mobile phones. The DIY movement has been gaining more and more popularity over the last few decades, influenced by factors such as media, social contacts, manufacturers and retailers (Watson, Shove 2008, p. 74). There are 'Maker Faires' all over the world where creators can meet, share their passions and sell their creations (Torrey et al. 2007, p. 394) and even a Maker's Bill of Rights (Jalopy et al. 2006) has been popularized. It is comprised of 17 statements on what all hardware devices should or should not be. Next to replaceable batteries and accessible supplies, it is also important that schematics are included in order to understand the workings and functionalities of the device. Through new technologies, especially the Internet, the way creators communicate and share DIY projects and process documentations has changed significantly. There are many tools and emerging communities available to support this knowledge exchange between creators which will briefly be explained below, with a more detailed overview of these tools and communities in Table 8 in the Appendix A – DIY Tools Overview.

Instructables, "a place that lets you explore, document and share your creations" (Instructables 2014), was created in August 2005 at the MIT Media Lab, first as an internal way of sharing projects and processes between PhD students, and later as a public DIY community. It can be accessed via the Internet or the app for iOS or Android devices. Over 100,000 guides – so-called Instructables – have been posted to the 6 categories Technology, Workshop, Living, Food, Outside and Play. One example of such an Instructable can be seen in Figure 2. Members can create and edit their own step-by-step guides, share guides via social media platforms (Facebook, Twitter, Google+, Tumblr and Email), comment on, rate and favorite guides, take part in contests and send private messages to each other. Each

Instructable is composed of an introduction and a list of steps which can contain text, images, videos, other files or links. A basic Instructables membership is free of charge, however, for complete functionality, it costs \$2-4 per month. In 2011, Instructables was acquired by Autodesk.



Figure 2: Example of an Instructable

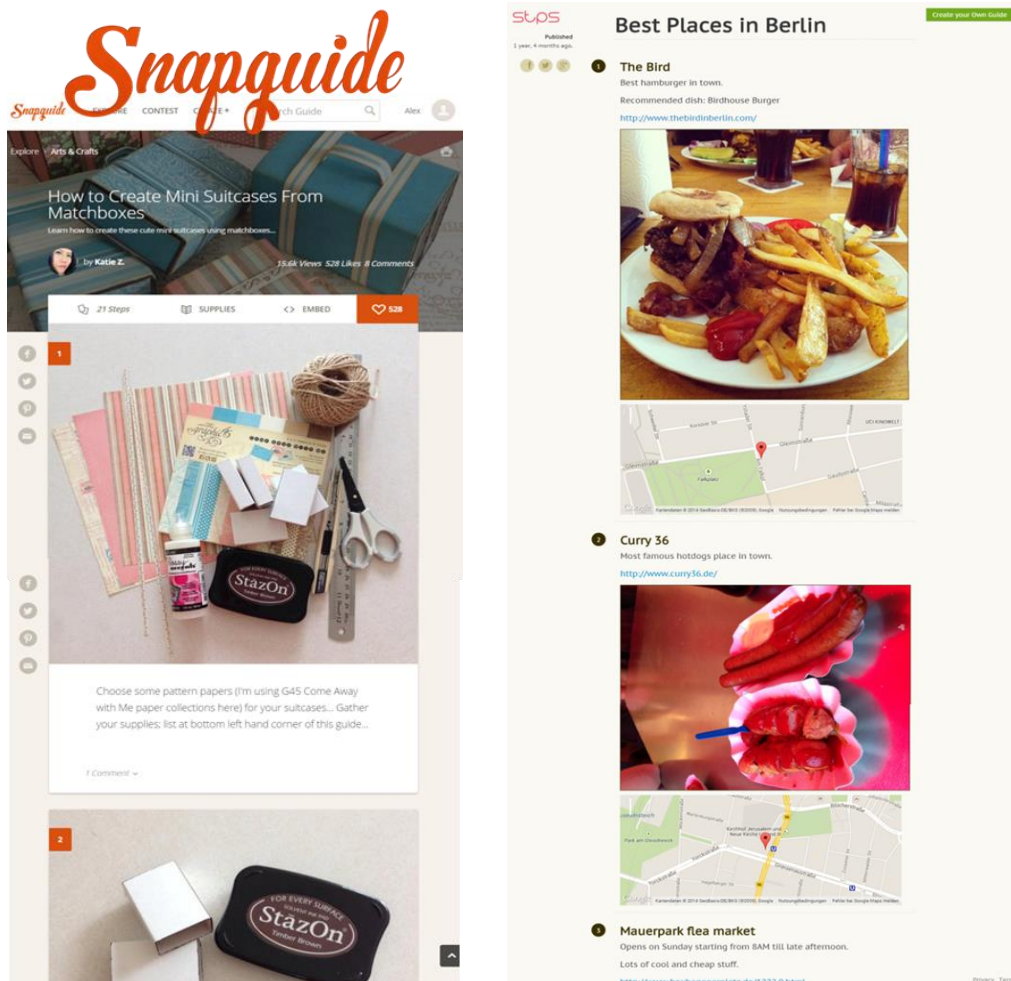


Figure 3: A tutorial on Snapguide via web view (left) and a guide on Stps.co (right)

Similar to Instructables, Snapguide is an online DIY community for sharing step-by-step how-to guides such as the image on the left of Figure 3. There are 17 categories, including Arts & Crafts, Food, Home, Music, Outdoors, Pets, and Technology. Users can favorite and share guides and interact via commenting on guides and steps. They can also follow other users to be kept up-to-date with a creator's newest guides and activities (Snapguide 2014) .

Stps.co is a website for creating step-by-step guides with text blocks, images, videos, maps and source code as possible step elements. These guides are not publicly visible; however, a direct link to the created guide can be obtained and shared via Facebook, Twitter and Google+. Due to this exclusivity and no (DIY) community, Stps.co can be used in very versatile ways, not only for crafting instructions, but also for city guides or collections of favorite restaurants (see Figure 3 on the right) (Stps 2014).

Ravelry was founded in 2007 as an online community for crocheting and knitting. Members can create projects and share their progress from start to finish via annotated blog posts, photos and status updates. Different hooks, yarn types and patterns can be added to every project in order to enable other users to try the project for themselves. It is also possible to leave comments on projects and discuss topics and ask questions in a forum. Ravelry also includes a patterns store and a marketplace with products sold by Ravelry members. In February 2014, Ravelry reached four million members (Ravelry 2014).

Craftster is an online crafting community with about 300,000 members and over 1 million readers every month. Guides are created as entries in the corresponding craft forum and can be shared and commented on by all users. Craftster was founded in 2003 and sold to Internet Brands in 2009 (Craftster 2014)

Dorkbots are regular, mostly monthly, meetings for people that are interested in projects ranging from electronic art to new gadgets, aiming at

“creat[ing] an informal, friendly environment in which people can talk about the work they're doing and foster[ing] discussion about that work; help[ing] bring together people from different backgrounds who are interested in similar things; giv[ing] us all an opportunity to see the strange things our neighbors are doing with electricity.” (Dorkbot 2014)

These meetings are scheduled in cities all around the world by volunteers and often include guest speakers and presenters to elicit a discussion and information exchange of projects and ideas. The first Dorkbot happened at the Columbia University Computer Music Center in 2000 (Kuznetsov, Paulos 2010, p. 297).

Etsy is a platform for buying and selling unique and (mostly) homemade products, ranging from jewelry and clothing to decoration items. It was founded in 2005 and currently has more than 40 million users (Etsy 2014).

Adafruit sells electronic parts, such as Arduino boards, LEDs, and displays, which can be used in completing the DIY tutorials on their website. It was founded in 2005 (Adafruit 2014).

Kuznetsov, Paulos (2010, pp. 295–304) surveyed 2608 members of six DIY communities (Instructables, Craftster, Adafruit, Ravelry, Drokbot and Etsy) and got 5 qualitative answers from a more detailed follow-up questionnaire. They found that more than 90% of community members participate via commenting, posting questions and responding to answers, 43% doing so on a daily or weekly basis. For many, the information exchange via comments is the core element of DIY processes. On the one hand, comments can act as feedback and thereby provide great opportunities for creators to learn or improve their skills even after having published their work process. On the other hand, questions and answers can help to understand and overcome users' unique obstacles in following the process. Both of these factors highly contribute to connecting users and creators. The most common motivating factors for taking part in DIY communities were getting inspiration and new ideas for future projects, learning new concepts as well as meeting people with similar interests. 'Having fun' was also mentioned by many. Working on DIY projects is motivated by a desire to express oneself, to learn new skills, to create things one cannot buy, to personalize objects and to challenge oneself. While 90% of the survey participants share some of their own projects, less than 10% showcase all of them. The most commonly agreed with factor for not sharing a work process is the lack of time, followed by the feeling that the project is too easy, not creative, not new or, simply, not interesting. Images, step-by-step instructions and comments were found to be the most influential aspects of DIY communities. Since most DIY projects cost less than \$50, the barrier of entry for building up a set of skills and participating via comments is very low, enabling an "exchange of ideas with [...] many different persons with different technical, artistic and professional backgrounds" (Kuznetsov, Paulos 2010, p. 301). Kuznetsov, Paulos (2010, p. 303) suggested that "images and tutorials can be made more powerful through voice annotation, interactive features, and graphical search, among others" and called for tools and future work on media for expressive knowledge transfer.

Two publications focus solely on the online community Instructables. On the one hand, van Ittersum (2014, pp. 227–246) examined the communication of information in Instructables. Contrary to popular short and precise step descriptions, tutorials in which authors mix the actual task with an ad-hoc narrative of their experiences, including problems, conditions, better approaches and possible alternatives, can not only be good guides for other users, but also teach the core DIY approach of

repurposing and reusing objects that are already around or easy to acquire. This results in a motivational boost for users who do not have all the required materials or who need to try a different approach. They may identify with the author's problems and be thankful for the ideas and debugging he/she has already done. The author is often seen as an expert who can be consulted at any time during challenges and uncertainties. Thus, these narrative instructions have a reassuring and de-dramatizing character that encourages participation and engagement.

On the other hand, Tseng, Resnick (2014, pp. 425–428) studied users of Instructables concerning their creation and sharing process of DIY project documentations by conducting semi-structured interviews with five creators and surveying 230 users. The five interviewees stated that they documented their projects in order to preserve them and provide others with the ability to learn and try out something new. It was found that executing a process and documenting it on-the-go are two commonly conflicting activities – taking a picture in the middle of a task is often forgotten and the to-be-documented moment has to be recreated after finishing the project. Tseng, Resnick (2014, pp. 425–428) also found that translating the documentation into the Instructable format was done in two different ways. Some would present their process as a simple replicable recipe, only containing activities and materials. Others would try to tell their story, including mistakes and fallbacks, to provide even more opportunities for readers to learn from the documentation, to debug their problems or to find solutions in mentioned suggestions. Nevertheless, in both cases, creating the Instructable is a time-consuming activity that includes selecting, editing and uploading pictures and writing text to explain or accompany them. Therefore, Tseng, Resnick (2014, pp. 425–428) suggested to integrate designing and documenting in a more time-saving and simple way in one tool. Most survey participants use Instructable to get ideas for new projects or to learn new techniques, whereby users that had created their own Instructable (70%) were not as interested in learning new techniques as non-authors. 60% stated to have recreated other users' Instructables, usually using them as a guide rather than a strict specification. Often, modifications and customizations are needed to cope with missing tools, different materials or other handicaps. Users are thus usually more interested in the story of the documentation than the recipe, since they might have to substitute parts of the guide and it is possible that the author tried something similar and encountered problems from which the users can learn.

After examining regular DIY guides, Dalton et al. (2014, pp. 1405–1410) recognized a number of challenges in online tutorials: the list of supplies or ingredients is often incomplete, the sequencing of the guide steps is not presented correctly, and important information is often missing or lost within a text block. They propose a guide structure similar to cookbook recipes with short, simple and accurate user instructions and a perfect placement for displaying the materials needed. This is achieved by adding the supplies and tools to the exact moment of the guide in which

they are needed and highlighting them in a bold font to allow for a quick skimming of the text and the needed materials. Each activity to be carried out is presented in its own new paragraph. The guide starts with an image and/or a written representation of the guide result in order to emphasize the purpose of the tutorial. However, with this simplistic version of a guide, media elements, such as images, videos or maps, are not included even if they lead to a better understanding of the process described. Dalton et al.'s (2014, pp. 1405–1410) recipe style tutorials have not yet been assessed for their improvement of the understandability, readability or usability of guides.

Hughes, Gonzalez (2009, pp. 138–145) studied video instruction sharing websites. There, the most commonly viewed (clusters of) categories were 'Crafts & Hobbies' and 'Technology & PCs'. More than half of the comments left on videos are of a congratulatory or complementary nature. Other common remarks are critiquing and suggesting improvements. Hughes, Gonzalez (2009, pp. 138–145) also identified three factors that motivate creators to share their videos: helping other users, building up a reputation or winning a competition or a prize.

Analyzing the comments sections of 42 tutorials, Lafreniere et al. (2013a, pp. 303–310) found that more than half of the comments contained praise, encouragement or thanks. 10% of all comments contained suggestions for improvement. Motivations for using the tutorials ranged from needing immediate help for carrying out a task to expanding one's skillset. Lafreniere et al. (2013a, pp. 303–310) suggests several improvements for comments sections: adding tags to comments to see their intent, the ability to edit or annotate the tutorial as a non-author (much like a wiki), and integrating the application for which the tutorial was created into the tutorial.

Roeck et al. (2012, pp. 170–179) presented a manifesto for developers of DIY guide creation tools and sharing platforms. Out of the 13 demands, the most important ones for this paper will be summarized below. Firstly, the tool should "inspire to be creative" (Roeck et al. 2012, p. 173), motivate users to try out new and uncommon ideas and limit them in carrying out their passions as little as possible. Secondly, the manifesto states for the system to offer different levels of complexity for amateurs, professional-amateurs and professionals. The third demand is that the platform enables users to start their projects based on ideas, materials or other projects, supporting an emerging picture of the end result as the artifact is being created, shaped and enhanced. As a fourth important requirement, the guide creation tool should support the existence and sharing of unfinished work-in-progress so that users can experience the evolution of the process, help each other in overcoming obstacles, and motivate one another to continue and finish projects. The platform should remind users of unfinished projects and coach them into continuing their work on them. Fifthly, the system should provide opportunities for users with different roles (such as creators, spectators, debuggers, enhancers, etc.) to collaborate and

communicate in a playful and motivating fashion. Lastly, language and terminology should be adapted to the current user (neither too 'cute' nor too many unclear technical terms), support multiple operating systems and platforms and provide added value for all stakeholders and participants. Since these guidelines are presented from a very high-level point of view, Roeck et al. (2012, pp. 170–179) suggest using this manifesto as a framework for examining the future end users of the to-be-developed system and their goals, demands, wishes, levels of expertise, etc.

Watson, Shove (2008, pp. 69–89) discussed the relationship between product, competence, practice and project. Depending on the type of consumer – 'Confident Enthusiast', 'Pragmatist', 'Newbie', or 'Hobbyist' – companies create different products that meet each group's needs. For example, affordable tools with multiple clear purposes are targeted at the segment of 'Newbies'. Combining humans and products, competence is defined as "a characteristic of the human subject [...] distributed between practitioners and the tools and materials they use" (Watson, Shove 2008, p. 78). This combination of humans and objects creates completely new capabilities and possibilities for engaging with the world. In this context, new technological developments that provide opportunities for amateurs are simply seen as a shift in competence within a network of human and non-human entities. In the DIY practice, however, it is often necessary to combine a multitude of tools, materials and human knowledge and skills in order to reach a certain level of competence and gain the ability to perform a specific task. Plans, decisions, practices, time, effort and tools and materials are combined in a project to achieve an observable goal, often driven by events, circumstances and an economic rationality.

Due to their complexity and uncertainty, electronic products are not as common as craft and home improvement projects in DIY instructions. Mellis and Buechley organized a couple of workshops, such as for creating a set of speakers and a 3D-printed computer mouse (Mellis, Buechley 2012, pp. 268–277) and a mobile phone (Mellis, Buechley 2014, pp. 1723–1732). The goal of these workshops was to understand how amateurs can be introduced to completely new materials, tools and techniques, how well they are able to work with them and how high-tech DIY can empower them. They found that DIY opportunities and possibilities in the electronic sector heavily depend on the decisions of industrial manufacturers or hobbyist services in providing materials and tools. The degree to which creators are able to get involved is often connected to the suspected usability of what they create (e.g. a phone for daily use or a phone to understand how phones work). Due to a lack of time, tools or materials, tradeoffs had to be accepted in order to be able to continue working on the device (robustness, usability, design). It was found that creating an electronic device helped participants by making them realize that they can choose to produce electronic products on their own, by giving them the opportunity to understand the workings and construction of these products and by letting them see

how questionable the power and control of technology and technology companies is. These factors indirectly empowered the participants (Mellis, Buechley 2014, p. 1731). However, Phillips et al. (2013, p. 75) see both examples and challenges in the empowerment of people who create artifacts as part of the 'Maker' movement. Bean, Rosner (2014, pp. 26–27) pointed out that while DIY and the 'Making' culture may empower to be creative, it has opened up a whole new market for tools, magazines, books and supplies for hobbyist makers. As a result, they suggest referring to DIY and 'Making' as a brand, as opposed to a movement.

Tanenbaum et al. (2013, pp. 2603–2612) examined the democratization of technological practices, “a broad cultural shift in how people engage with technology” (Tanenbaum et al. 2013, p. 2604) by studying Steampunk Makers, Thai crafters, hobbyists and professional programmers. They discovered four key elements of democratized technology: playfulness, tools for production, industrial infrastructures and knowledge sharing. Playfulness encompasses the joy of working with certain materials and of being able to transform these materials into new creations. The tools needed to work with these materials are also very important and often provide the rediscovery of old market segments – knitters tend to prefer wooden needles to metal ones, even though the latter are more efficient. Materials in industrial infrastructures can be used as a starting point for makers (e.g. hacking Ikea furniture to adapt it to personal needs) and industries' standards can be basic collaborative components. Finally, knowledge sharing is important to establish literacies for understanding and applying these materials, tools and other media such as blueprints or patterns. In conclusion, Tanenbaum et al. (2013, pp. 2603–2612) suggested to create more knowledge sharing platforms that support people who have not yet taken part in the maker culture, but who want to.

In order to find connections between mental models and the instructions derived from these models, Phillips et al. (2013, pp. 74–79) examined on-paper instructions made by Maker Faire visitors on the topics of making tea and making a fire. Since there were no constraints on the format of the instructions, differences in length, complexity and detail were identified. Both structural diagrams giving a general overview and process diagrams with step-by-step instructions were submitted. Many participants used images; written instructions were given in a simple and understandable language. Even though all participants had the same objective, there were many diverse solutions. For instance, some participants applied case distinction for milk or sugar in the tea, whereas others used loops or warning annotations.

The goal of Torrey et al. (2007, pp. 391–410)'s semi-structured interviews was to examine hobbyists' practices and tools and their motivations for using them. It was discovered that an author's activities include knowledge retrieval and creation as part of the knowledge sharing of tutorials. The interviewees' motivations for sharing their tutorials range from gaining website traffic to helping the community.

Torrey et al. (2009, pp. 1371–1380) identified two main approaches to translating information into actions. Firstly, the Backburner Approach iteratively processes knowledge, lets it sink in, tries to progress and then sets the project aside for a while. This means that usually creators work on a couple of projects at the same time. Secondly, the Just Keep Moving Approach: here, limitations such as time, space or materials force creators to only work on a single project at once. It was also found that crafters can be separated into three groups: gathering knowledge for professional reasons, crafting as a hobby and working with unique and new artifacts.

In a study conducted by Roy (2007, pp. 147–162), participants were given a set of cards of frames of an assembly task as well as either a written explanation of each frame or graphical outcome cards. Their task was to reorder the set of cards into their proposed sequence. It was found that 90% of all participants misplaced at least one frame and that graphical aids lead to fewer errors than textual aids. However, while participants who were using written explanations made more errors in the beginning of the assembly, the overall amount of errors declined. Contrarily, users of graphical aids increasingly made more errors as their work progressed. Roy (2007, pp. 147–162) recommends for designers of instructions to provide supplementary rather than complementary information as redundancies tended to interfere with participants' comprehension abilities.

The four key principles for user affect and delivery modes in the context of designing minimalist learning-to-use software were studied by van der Meij, Hans (2007, pp. 295–305). They recommend delivering information in a just-in-time format. Compared to the conceptual, learning-by-reading mode where information is presented in sections at the end of task explanations, this workflow mode presents information just before the step that it is needed in. This leads to a 10% higher and more accurate information processing as well as better learning outcomes. They suggest this is due to an ideal exploitation of the moment in which the user is motivated to process this information in order to accomplish an immediate goal. Van der Meij, Hans (2007, pp. 295–305) also contrasted tutorials that had a co-user as an emotional buddy with basic warm tutorials ('warm' in the sense of friendly tone, positively influencing motivation and feelings, especially in case of error recovery). They found that the co-user had no effect on learning outcomes and even a negative effect on time taken to complete the tutorial. Thus, they recommend providing a good mixture of 'cold' and 'warm' cognition for instructions in a tutorial.

2.2.3.3 Other Tools

This section introduces tutorial creation and knowledge documenting tools that are not directly linked to the DIY culture.

In order to improve users' success rates when following a tutorial, Chi et al. (2012, pp. 93–102) propose to combine the benefits of both static and video tutorials in a

mixed media tutorial with static instructions and step-by-step videos. Four design guidelines for mixed media tutorials were suggested. Firstly, an overview of all of the steps of the tutorial should be available, with easy navigation back and forth between steps. Secondly, videos should be presented using a minimum amount of screen, while still being legible. Thirdly, if there is a screen recording, interactions with the application should be visualized. Lastly, the user should be able to choose the medium he/she wants to use as reference for each step. Such mixed media tutorials can be created with MixT. The tool records the screen, cuts the video into steps and highlights interactions with the application. For each step, users can choose whether to watch the video or simply view the images. A formative study testing static, video and mixed media tutorials conducted by Chi et al. (2012, pp. 93–102) affirmed the usefulness of mixed media tutorials: the fewest amount of errors were made and less extraneous work was done.

DemoCut is a semi-automatic system for editing videos in order to create a tutorial video Chi et al. (2013, pp. 141–150). Tutorial creation starts with the user recording a one-take video of completing a physical task. Then, he/she watches the video in DemoCut and adds markers at certain events. Such events could be the beginning of a new step, an important action, a need for a close-up, a certain material or tool used or a scene to cut out. Based on these markers, DemoCut analyzes the footage and automatically suggests video segments, edits and effects. There are a multitude of effects available – temporal such as speeding up or skipping parts of the video, or visual with subtitles, annotations and zooms. After reviewing the video and changing any of the effects in case of audio misses and cut-offs or any other inaccuracies, the tutorial video is completed. In a user evaluation, adding markers was perceived as easy and the automatically generated effects were seen as especially useful in speeding-up or skipping a part of the video. While most evaluation participants were satisfied with their outcome, some noted that it was too simple and didn't allow for enough manual adjusting.

Mura et al. (2013, pp. 1–14) introduced a tool for creating multimedia, step-by-step tutorials from a video: Instructions Based on Event Segmentation (IBES). This process starts by segmenting a video of the task the user wants to create instructions for into its frames. These image sequences can be imported into IBES in order to begin with the four steps of tutorial creation. First, the user needs to segment the video frames into corresponding steps by using time markers. Second, he/she chooses appropriate frames from each of these steps that best represent the (sub-)task to be carried out. Third, text descriptions can be added to each step. Lastly, the user is presented with the finished tutorial that can be printed out. On average, executing these four steps takes about 12 minutes.

Lafreniere et al. (2013b, pp. 1779–1788) described four possibilities of connecting applications with tutorials designed for them. First, in the isolated architecture,

application and tutorial are in two different domains (desktop and web), with no communication between the two. Second, the connected architecture provides a one- or two-way communication path that allows for a tutorial's reaction to the user's actions. However, the user still needs to switch back and forth between tutorial and application. The third proposed connection is the Tutorial-in-Application architecture where the tutorial is part of the application's domain and can be presented in context to the application. One of its downsides is the fact that the tutorial's web presence is taken away and the authors' motivation for receiving recognition or ad money will be lost. Therefore, Lafreniere et al. (2013b, pp. 1779–1788) introduced the fourth category, the Application-in-Tutorial architecture, a web-based tutorial with ready-to-use software. One example of such an architecture is FollowUs, a community enhanced tutorial system created by Lafreniere et al. (2013b, pp. 1779–1788). It records every user's workflow in following a tutorial and displays these workflows as a library of example usages to other users. It also allows for asking questions after every step in a per-step Q&A. An empirical study conducted by Lafreniere et al. (2013b, pp. 1779–1788) showed that such a tool that provides multiple demonstrations of a task leads to less frustration and a greater overall quality, among others.

Another Application-in-Tutorial system is Sketch-Sketch Revolution. It is a tool for creating and using tutorials in a drawing application environment. Tutorial authors record their workflow of manipulating the canvas and interacting with user interface elements and the tool automatically generates a tutorial based on that workflow. Using features such as stroke preview – a display of individual strokes made by the author that can be repeatedly referenced to –, users can more easily recreate a complex drawing and interactively learn digital drawing techniques and the structure of the drawing application. Results of a user study conducted by Fernquist et al. (2011, pp. 373–382) show that the usability, assistance and clear goal presentation of Sketch-Sketch Revolution reduce the fear of complex drawing tasks and lead to greater success in carrying them out. However, it was also found that relying on the interactive help and guidance features may lead to a decrease in learning effect.

EverTutor, created by Wang et al. (2014, pp. 4027–4038), is a Tutorial-in-Application tool for smartphones that records touch events on the screen and creates an interactive step-by-step tutorial based on these touch events. The tutorial is shown as a full screen overlay on top of an application and has so-called cling holes that suggest where the user should lay his finger as well as the sketch of a hand that says what kind of gesture to perform and in which direction. These tutorials guide users through an application or help them accomplish a task within an application on the smartphone without having to switch back and forth between instructions (video, text, and images) and application. EverTutor allows both creating and browsing of tutorials. After conducting two user experiments, Wang et al. (2014, pp. 4027–4038) found that EverTutor was the fastest and preferred method for creating tutorials (as

compared to video and static tutorials) by all participants. It was found that tutorials created with EverTutor were rated best in all categories (easiest to follow, to understand and to recall) and were completed three times as fast as video and static tutorials. Especially older participants spent only half of the amount of time when using the EverTutor tutorials.

An isolated architecture system for uploading, editing and organizing images and screenshots in order to create step-by-step instructions for GUI applications has been introduced by Miura, Yoshida (2013, pp. 1164–1171). By using this tool, PastePost, users were able to halve their working time and increase task satisfaction and efficiency.

3 Methods

The basic timeline of the process of writing this thesis is depicted in Table 2. The official start date was July 15th and the date of the submission was December 15th. Originally, a waterfall-like step-by-step approach was laid out where one part of the thesis would be completed before starting another part. However, mainly due to a vast amount of interesting literature, many of these time periods had to be extended and moved.

	July	August	Sept.	October	Nov.	Dec.
Literature Review						
Initial presentation						
Concept						
Implementation						
Evaluation						
Writing						
Final presentation						

Planned time Actual time
 Table 2: Gantt chart of the research process

The following sub-sections further detail how the particular areas of this research project were executed.

3.1 Literature Review

At the beginning of the research project, a literature search was conducted. Based on an initial table of possible search terms and key word combinations (see Table 3), the databases Scopus and Web of Science were used for in-depth searches on the topic of informal and business process modeling and documentation from the beginning of August 2014 to mid-October 2014. Occasionally, Google Scholar was also made use of, usually when searching for one of the informal process documentation tools (such

as Snapguide or Instructables) in an academic research context. The corresponding literature search diary for exact dates, search results and reasons for elimination of publications in the context of this thesis can be found in Table 9 in the Appendix B – Research Diary.

Ad-hoc	Process	Documentation	Smartphone
Extemporaneous	Operation	Reporting	Web-based
Offhand	Procedure	Registration	App
Improvisational	Activity	Declaration	Application
Impromptu		Modeling	iOS/mobile device
Improvised		Modelling	Prototype
On-the-go		Models	Tool
On impulse		Model	Handheld Computer
Immediate		Document	Electronic
Informal		Documenting	Technology

Table 3: Initial collection of search terms

The process of filtering out suitable research publications from a list of search results was as follows (see Figure 4). First, the title of each search result was examined in order to determine whether the paper could have a possible connection to this particular research project and the research questions. Publications fitting into the research topic were added to the search diary. Then, the abstracts of all diary entries were further analyzed and not suitable papers were marked as such and excluded from any further analysis. The next step for the residual diary entries was to locate the articles using the on- and offline access possibilities offered by the Technische Universität München. However, quite a number of potentially interesting publications could not be accessed and were therefore eliminated. After skimming the content of all remaining diary entries, a last few were excluded and the rest was used to construct the literature review found in section 2.

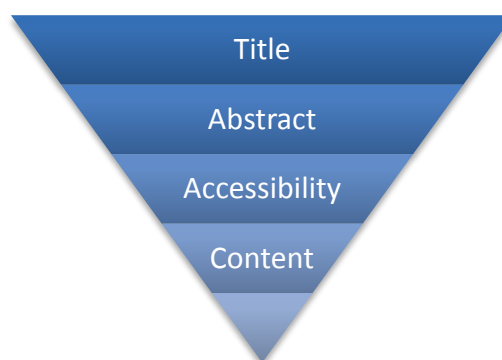


Figure 4: The process of filtering literature search results

Some papers that are referenced in the literature review were not included in the search diary because they were either directly recommended by other parties (e.g. (Nonaka 1994)) or they were taken from a previous personal unpublished seminar paper on Adaptive Case Management.

3.2 Requirements Elicitation

The requirements that will be presented in section 4 were based upon the functionality of already existing process documentation tools and approaches. The iPhone applications and web pages of the products Snapguide, Instructables, Stps.co, Craftster and Ravelry were analyzed with respect to their functionalities, capabilities and limitations (see Table 8 in the Appendix A – DIY Tools Overview). These tools all implement four main use cases: creating tutorials, searching for tutorials, giving feedback via ratings or sharing possibilities and user authentication.

3.3 Concept and Implementation

Title	Size	Priority	Title	Size	Priority
Create tutorials	XL	1	Publish tutorials	S	1
- Tutorial title	S	1	Edit tutorials, steps and step elements	S	1
- Tutorial description	S	1	Delete tutorials, steps and step elements	M	1
- Tutorial image	M	2	Search tutorials	M	1
- Tutorial tags	S	4	User authentication	M	1
- Step title	S	1	Profile	M	2
- Step text	S	1	Favorite tutorials	M	2
- Step image	M	1	Share tutorials	S	3
- Step video	M	1	Comment on tutorials	M	1
- Step audio	M	1	Comment on tutorial steps	M	2
- Step map	M	1	Rate tutorials	M	2
- Step checklist	M	1	Track tutorial progress	M-L	1
- Step list	M	2	Transfer progress to other user	M	2
Rearrange steps and step elements	M	1	Localization	S	3

Table 4: Basic backlog (size S→XL, priority 1→5)

Based on the requirements elicited in section 4, the basic system design, data structure and user interface were created (see section 5 for more details). A prioritized backlog of all needed functionalities was generated (Table 4) and its elements were continuously implemented until all were fulfilled. During the time of conception and implementation of the prototype, weekly meetings with the advisor Marin Zec acted as small review meetings of the current development status. There,

drawbacks of user interface elements, ideas for the database to be used as well as re-prioritizations of certain backlog items (e.g. localization) were discussed.

3.4 Evaluation

The evaluation of the prototype was mainly prepared and conducted in November 2014. 25 randomly selected students at the Informatics building of the Technische Universität München participated. They were between 17 and 28 years old, mostly male (1 female, 24 male). The most common fields of study were Mathematics, Informatics and Informatics: Games Engineering. Please refer to section 6 for the design, results, limitations and discussion of the evaluation.

4 Requirements

This section introduces the minimal requirements for the prototypical implementation of an ad-hoc process documentation app.

4.1 Roles

The system must be developed to support two types of roles. On the one hand, the **creator** executes processes and documents them using the application. On the other hand, the **consumer** reads the process documentation provided by the creator and imitates the execution of the process in order to achieve a similar outcome. It should be noted that both of these roles can be assumed by the same person.

4.2 Use Cases and Functional Requirements

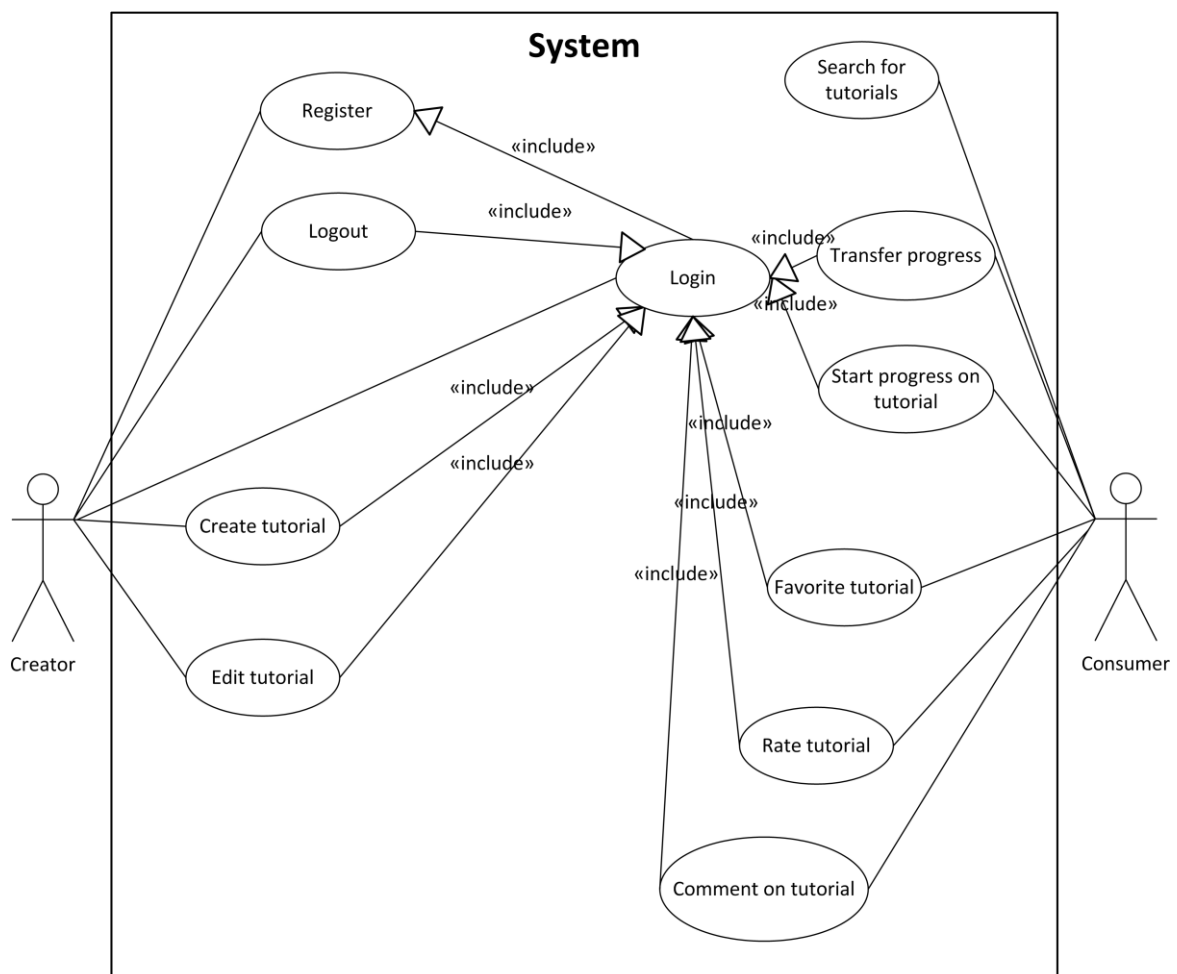


Figure 5: Overview of use cases

There are five main use cases that were mostly derived from DIY process documentation applications such as Instructables and Snapguide that the system is based upon. These tools all provide a way to create tutorials, to search for tutorials and to give feedback to the creator. Additionally, the possibility of tracking one's own progress in executing the documented process emerged as an interesting new feature. Lastly, a registration and login system is necessary when storing user-specific data and differentiating between creators and consumers.

The following sections (4.2.1 to 4.2.5) will illustrate these five use cases in further detail.

4.2.1 Tutorial Discovery

Users should be able to launch the application and immediately start looking for suitable process documentations. There should be a search function that allows the user to type in search keywords, searches the database of tutorials for and displays results according to fit, rating and number of times it was added to users' favorites.

After having found or discovered a tutorial, the user should be able to view all tutorial information (see section 4.2.2) in order to determine whether the tutorial fits his/her personal needs and abilities.

4.2.2 Multimedia Step-by-Step Tutorial Creation and Editing

Users should have the possibility to create a new tutorial. Each tutorial consists of a title describing the goal of the tutorial in as few words as possible, a more detailed description of the activity, one image of the result and a number of tags for better discovery.

Most importantly, a tutorial must consist of at least one step. Each step has a title and must contain at least one of the following step elements: a text block with written instructions, an image depicting an important step moment, a video displaying movements or interactions, an ad-hoc sound recording with voice instructions or exemplary noise, a street map for easier navigation, a checklist or a list. Images and videos can either be selected from the photo library of the smartphone or taken on-the-go.

Next to the ability to create tutorials, a creator must also be able to edit his/her own tutorials in order to update the content in tutorials, steps and step elements. New technologies, new techniques or grammar/spelling mistakes can thereby easily be corrected or inserted. Rearranging of steps or step elements must also be supported as well as deleting tutorials, steps or step elements.

When logged in, newly created tutorials should be uploaded to the server immediately. In case no authentication can be detected, the current user's tutorials

should be stored on the device and provide the possibility to be uploaded as soon as the authentication changes.

4.2.3 Registration and Login

For any other activities apart from 4.2.1 and 4.2.2, the user is required to have an account and be logged in. In order to register for an account, the user must enter a valid email address, a preferred username and a password into corresponding fields. After having created an account or entered a correct email-password pair, the user will be logged into the application and stay logged in for 30 days without having to re-enter his/her credentials.

4.2.4 Tutorial Progress

After having located a specific tutorial, the user should have the possibility to start progress on that tutorial. This means that a new instance of the tutorial is created just for this user and that steps or certain step elements can be marked as 'completed'. The system will track each user's progress and upon returning to a particular tutorial instance at a later point in time, the same tutorial state as before will be generated.

In order to encourage and increase tutorial completion, the user should be offered a list of his/her unfinished tutorials on the main page.

The user should also be able to transfer the progress he/she has made on a tutorial to another user so that that user can continue with the work that has already been done (e.g. in case of illness or vacation).

4.2.5 User Feedback

The system must also offer the user various possibilities to give feedback on tutorials and tutorial steps.

A 5 star rating system should be used that depicts the rating of a specific tutorial as generated by all users or, if available, by the current user in order to ensure high tutorial quality and support the emergence of best practices.

Users should also be able to express their opinion concerning understandability, replicability, complexity, problems or workarounds in form of comments. These comments can be added to the general tutorial or to specific tutorial steps.

In order to show appreciation or to mark tutorials for later revisiting, users should be able to save a tutorial to their list of favorites. This list of favorites needs to be available to the user at any point in time when he/she is connected to the Internet.

4.3 Non-Functional Requirements

Apart from the functional requirements mentioned above, the system in general must adhere to certain behavioral requirements:

- **Performance:** The system shall display an activity indicator when elements take time to be loaded.
- **Availability:** The system must be available at all times, except when upgrading or restarting the database. In case of no network connection on the client, the system shall enable the user to create tutorials and to upload them to the server once the network connection becomes available again.
- **Maintainability:** The app shall be developed following the 'iOS Coding Handbook - Guidelines, Conventions, and Tips' from June 25, 2014 by Stephan Krusche and Tobias Haeberle at the chair of Prof. Dr. Brügge at the Technische Universität München (Krusche, Haeberle 2014, pp. 1–39).
- **Usability:** Error messages shall only be presented when the user can (try to) perform an action that could potentially fix the erroneous situation. Therefore, error messages shall always include a proposed solution to the problem.
- **Security:** The system shall insure that data is protected from unauthorized access. All authorization communication between client and server needs to be encrypted (username and password data).
- **Localization:** The app must be available in German and English, depending on the smartphone's language preference settings.
- **Implementation:** The app shall be built in Xcode 6 and run on all official iOS8.1 iPhones.
- **Capacity and Scalability:** The system shall not store any tutorial information on the local client device except in case of an unauthenticated user creating tutorials

5 Implementation

Based on the requirements elicitation in section 4, a prototypical application was developed. Its system architecture, underlying data model and user interface will be introduced in the following sections.

5.1 Data Model

The basic data model that the system is based upon can be seen in Figure 6. The central element of the data model is the AFTutorial. It contains all tutorial data, such as the title, the description, the image and any number of tags. Each AFTutorial also includes at least one or more AFSteps. Each step, in turn, has a title and a number (starting at 1) for identifying the order and must also consist of at least one AFStepElement. An AFStepElement is a single component with a unique ordering number and a specific type, such as Text, Image, Video, Audio, Map, Checklist or List. This allows for multiple elements of the same type within a step, in an order that is completely decided upon by the tutorial creator.

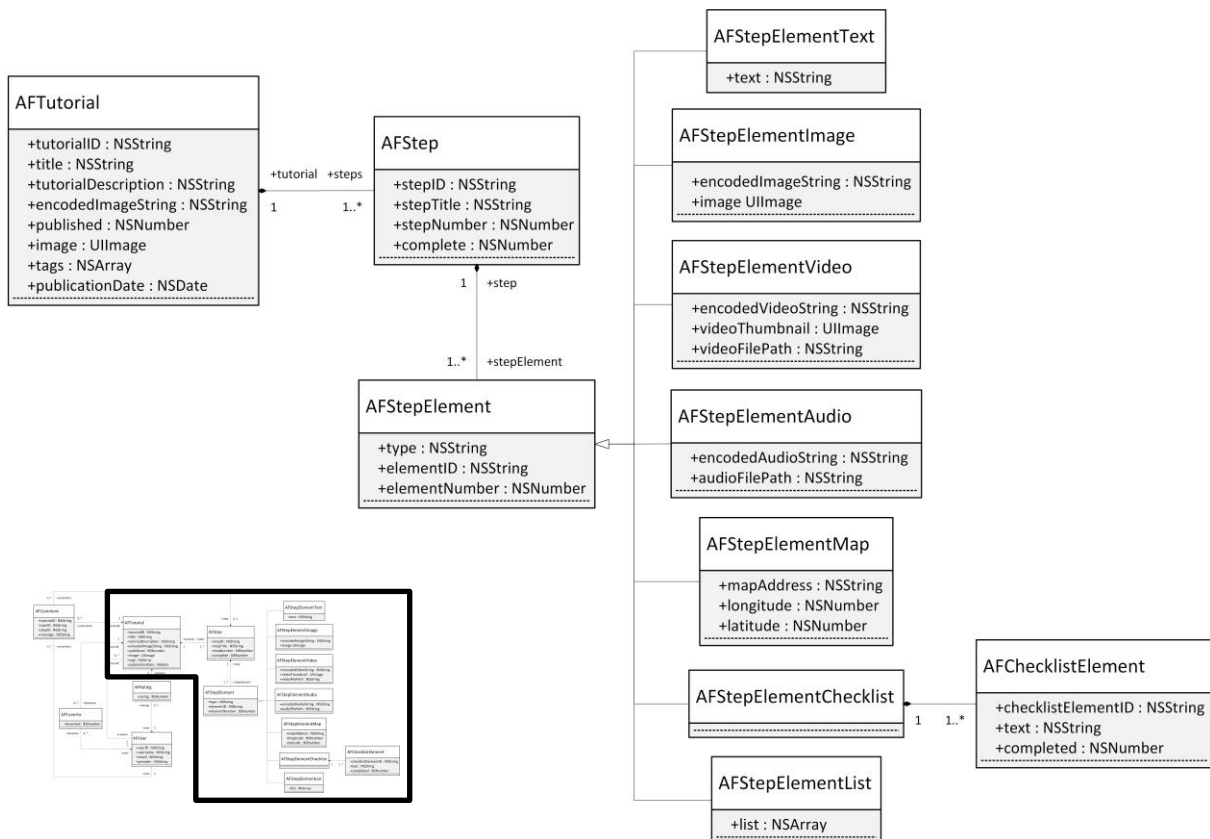


Figure 6: The basic data model of the prototypical application

An extension of the initial data model (see Figure 7) introduces user-specific data and functionality such as rating, adding to favorites, commenting and progress tracking. Each AFTutorial can only be created by one AFUser who has the single right to change or delete the tutorial, steps and step elements. An infinite number of other users can favorite or rate the tutorial or comment on an AFTutorial or on an AFStep.

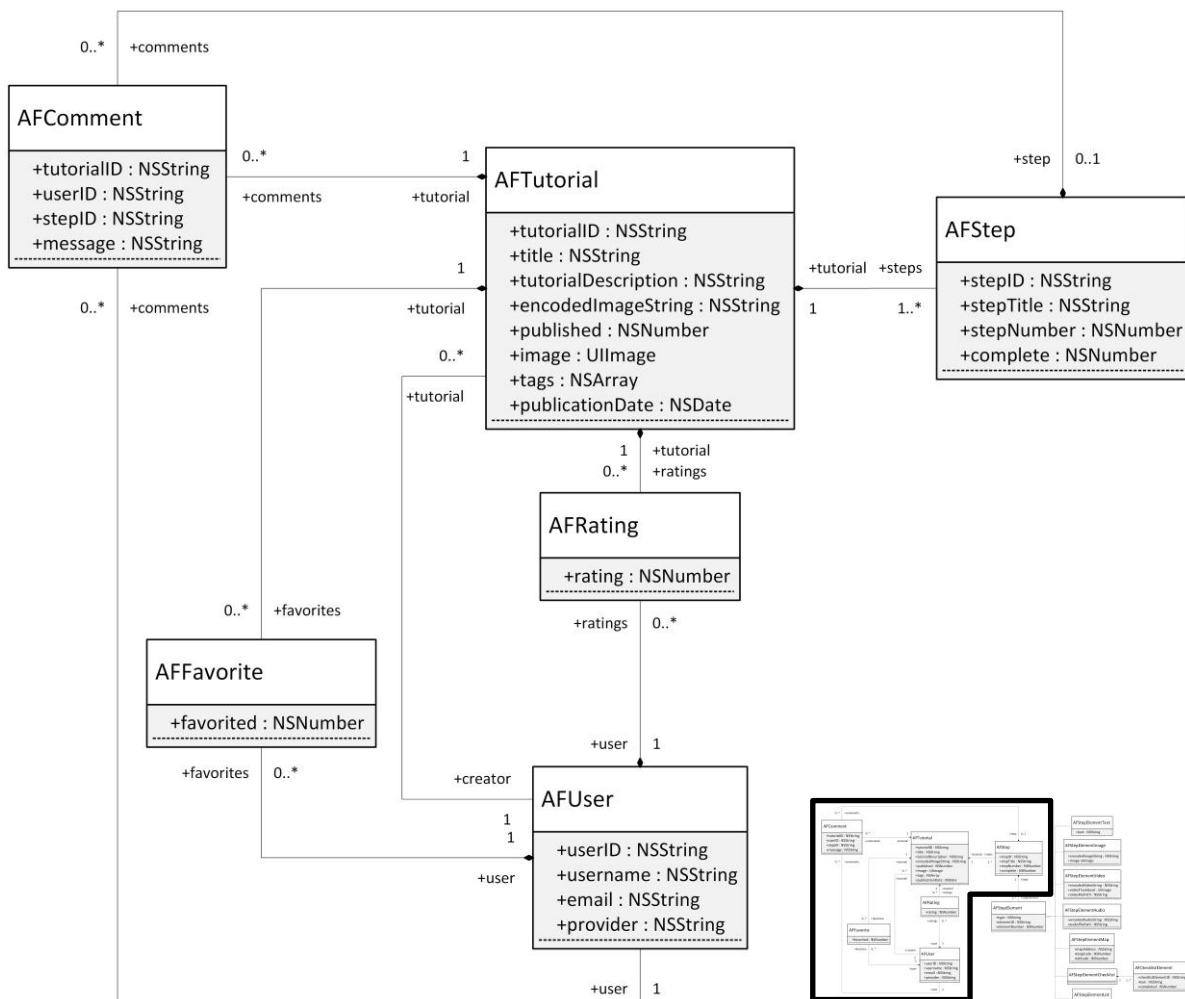


Figure 7: The extended data model

The application receives most of its model content from a database server with the root node located at <https://stepster.firebaseio.com/>. More information on the system architecture can be found in section 5.2.

On the server, all data is stored as JSON objects, thereby increasing the extensibility of the prototype. A flat hierarchy is implemented so that loading one node does not also invoke loading its potentially vast number of children. This is especially useful when searching for keywords in the title or tags of all tutorials – the steps and step elements of the fitting tutorials do not automatically have to be loaded as well.

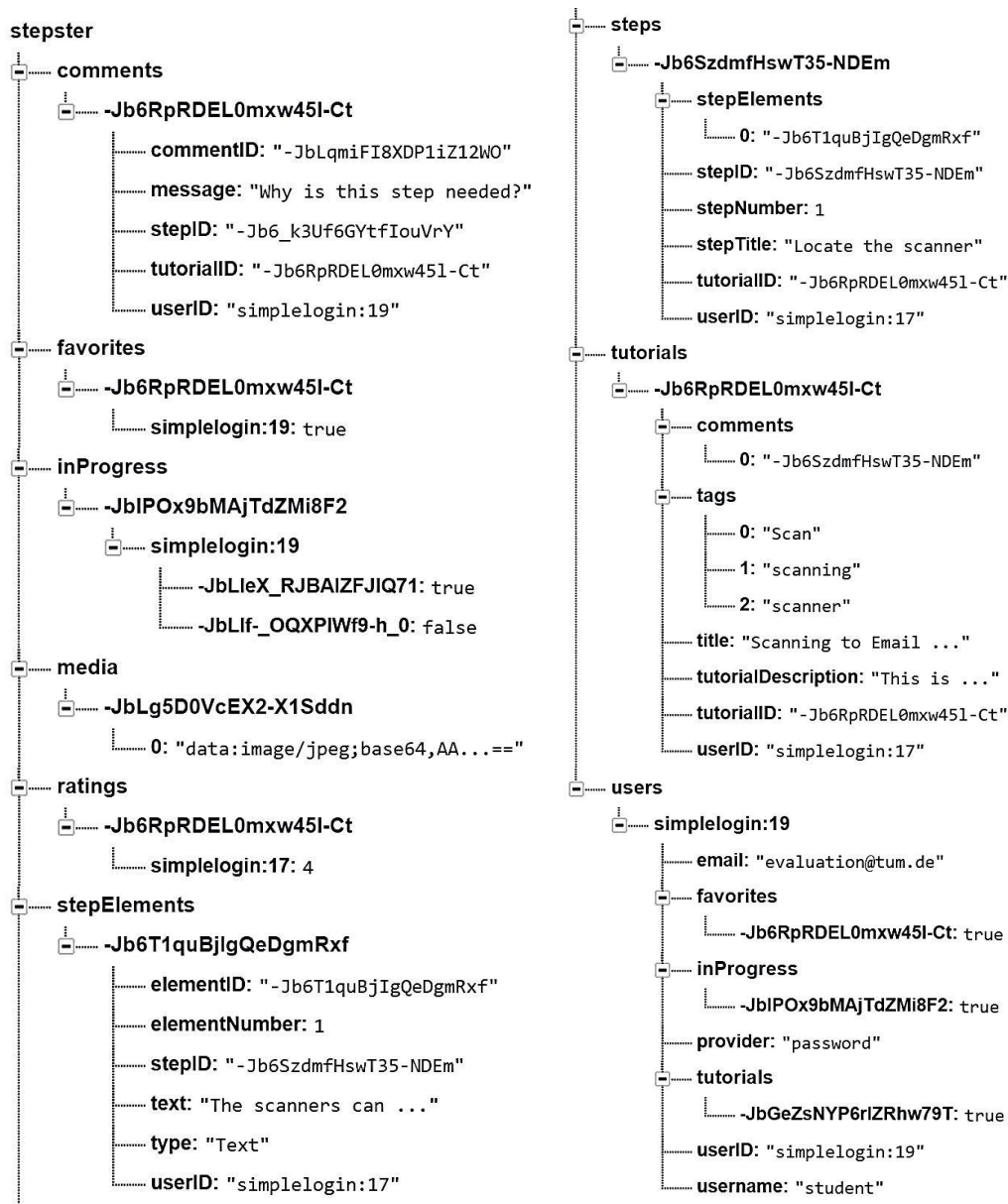


Figure 8: An example of the data model as a simplified JSON file on Firebase

The data model on the server is distributed over nine different locations as can be seen in a very simplified version of the content structure in Figure 8. Firstly, all basic information of a tutorial with the identifier `tutorial_id` is stored at `tutorials/$tutorial_id`. Instead of a list of step objects, the `steps` array only includes the unique identifiers of all steps. The JSON objects for these step ids can then be retrieved at `steps/$step_id`. Like the tutorial, the list of step elements of a step solely contains step element ids. The matching JSON files, in turn, are located at `stepElements/$stepElement_id`. Media elements such as images, videos and audio recordings are stored separately at `media/$stepElement_id` to allow for asynchronous downloading. Each user that has signed up for a Stepster account using the application can be found at `users/$user_id` where authentication method and username are noted. For a quick allocation of a user's tutorials, favorites and 'In

Progress' tutorials, the user object on the server also stores the corresponding tutorial ids at `users/$user_id/tutorials`, `users/$user_id/favorites` and `users/$user_id/inProgress`. All ratings of a tutorial are stored as numbers at `ratings/$tutorial_id/$user_id`. Similarly, favorites are Boolean values at `favorites/$tutorial_id/$user_id`. Comments are stored with a unique identifier at `comments/$comment_id` – each tutorial contains a reference to the ids of its comments. Lastly, a user's progress is stored at `inProgress/$tutorial_id/$user_id`

5.2 System Design

The system is designed as a simple model-view-controller application (see Figure 9). The views are constructed in the iOS Interface Builder and stored in a file called `Main.storyboard`. Each view is connected to a controller that loads and sets the dynamic view content from the server and carries out button actions. Any server communication is done using a singleton instance of the class `FirestoreDAO`. This class contains all calls that create, update, remove and read content on the server as well as methods for the parsing of JSON objects from the server and converting the local model to JSON objects. In order to communicate with the server, the `FirestoreDAO` class makes use of the Firebase SDK that is part of the free Hacker Plan offered by the service Firebase.

In case the user of the application is not authenticated when creating a tutorial, the class `AFSerializationController` offers methods to add this tutorial to a file called 'tutorials.json' on the local device and to update and load all tutorials from this location if needed. The `AFModelManager` encompasses basic methods for creating data objects while the `AFMediaManager` provides methods for working with media resources, e.g. resizing images and en- and decoding media content (images, videos, audio recordings) into JSON-conform byte64 strings. These four classes – `FirestoreDAO`, `AFSerializationController`, `AFModelManager` and `AFMediaManager` – were created to reduce the code redundancy in the view controller classes and to consolidate similar methods in a respective class.

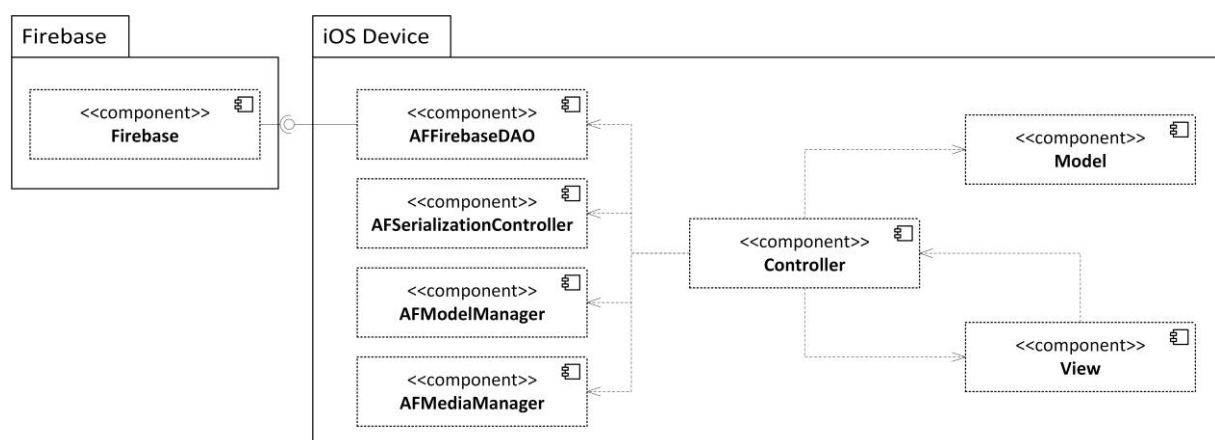


Figure 9: The system architecture

As stated in section 4.3, the target operating system for the application was iOS 8.1 and the development environment Xcode 6.

5.3 User Interface

For generating a feeling for the application without having to write any code, the first version of the user interface was simply mocked-up using (Balsamiq Mockups). Trying out the application as a simple PDF file with clickable buttons resulted in noticing and resolving a number of shortcomings. Since the application targets novice users with little to no experience in process documentation, its user interface needed to be as intuitive and easy-to-use as possible. Therefore, a few different alternatives were reviewed that structured the content of the application differently. One example of this user-friendly restructuring can be seen in the evolution of the 'Discover' screen in Figure 10.



Figure 10: The evolution of the 'Discover' screen in mockups

The 'Discover' screen is the first functional screen the user is presented with when starting the application. The image on the left in Figure 10 depicts one of the first versions of the 'Discover' screen in which links to all functions and the user's personal content were displayed on one page. However, this screen appeared to be too overwhelming as a user's first look into and impression of the application and, as a result, a tab bar at the bottom of the screen was introduced. It divides the application into five main areas – Tutorial Discovery, Progress Tracking, Tutorial

Creation and Editing, Profile and Settings – that can be easily navigated to from any screen (see Figure 11).



Figure 11: The tab bar: Tutorial Discovery, Progress Tracking, Tutorial Creation and Editing, Profile and Settings

Each tab bar item is connected to a navigation controller that stacks view controllers (objects managing the content of the screen) on top of each other in the order in which they were activated. It allows for navigating to new screens via segues and back to old screens with chevrons in a navigation bar at the top of the screen (see Figure 12).

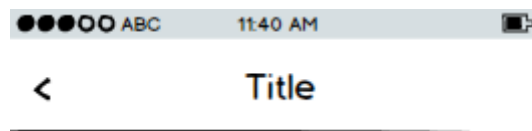


Figure 12: An example of a navigation bar at the top of the screen

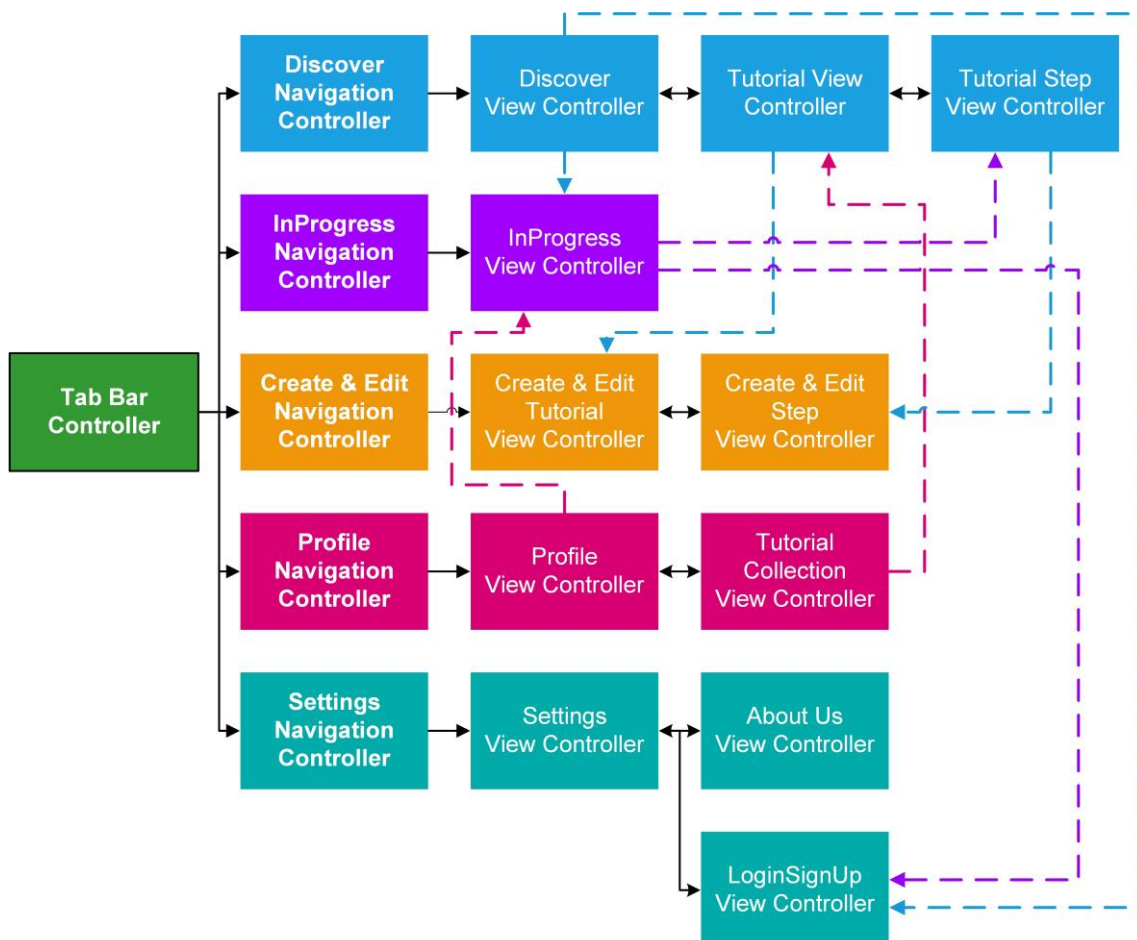


Figure 13: The app controller hierarchy

A better visualization of the hierarchy of the tab bar controller, the navigation controllers and the view controllers can be seen in Figure 13. The arrows with solid lines represent the natural segues available via the navigation controllers, while the arrows with a dotted line point to a more complex changing of views. There, the tab bar item and the corresponding navigation controller have to be programmatically modified to switch between views.

With this new structure introduced by the tab bar, however, the two main use cases of the application – creating a tutorial and finding a tutorial – still needed to be adequately incorporated into the ‘Discover’ screen. While the center screen in Figure 10 provides an easy way of discovering tutorials with a built-in search bar, tutorial creation is still hidden away in the innermost item of the tab bar. It was suspected that this extra tap might impede the concept of using the application for ad-hoc process documentation. As a result, extra buttons on the ‘Discover’ screen were introduced that allow for immediate recording of step elements and automatically creates a tutorial and step for the current user on the server or locally (see image on the right of Figure 10).

After having settled on a basic version of the user interface using mockups, this version was implemented and more changes and modifications were gradually added as easier alternatives were noticed and too complex structures were reduced. The following sections further detail the final structure, look and content of all tab bar items.

The color palette that was used was based on the Adobe Color CC theme ‘Cherry Cheesecake’ and is depicted in Figure 14.



Figure 14: The color palette of the application

The prototypical application uses icons from the sets (Ionicons) and (Octicons).

While most of the user interface elements that were made use of are basic iOS features provided by Apple, there are a few add-ons that will be mentioned below. A visual overview of these software products can be seen in Figure 15. The iCarousel developed by Lockwood is used in the application for displaying information and images of tutorials (Lockwood 2014). By swiping across the images, connected content can be updated and the user can navigate between a variety of tutorials. As a customizable checkbox allowing for user interaction, M13Checkbox by McQuilkin was also added to the project (McQuilkin 2014). MarqueeLabel by Powell is a simple label that scrolls its content if the size of the label is smaller than the NSString it is

supposed to represent (Powell 2013). It was mostly used in navigation bars to avoid long tutorial or step titles to be cut off. García developed the EDStarRating, a star rating mechanism that was incorporated to allow users to rate tutorials and display the tutorial ratings accordingly (García 2014).

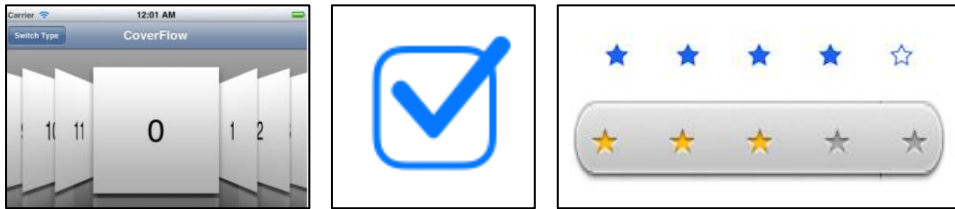


Figure 15: The features iCarousel (left, (Lockwood 2014)), M13Checkbox (center, (McQuilkin 2014)), and EDStarRating (right, (García 2014))

5.3.1 Tutorial Discovery

The first item of the tab bar is depicted in Figure 16 to Figure 20. It corresponds to the use case Tutorial Discovery and also incorporates the use cases

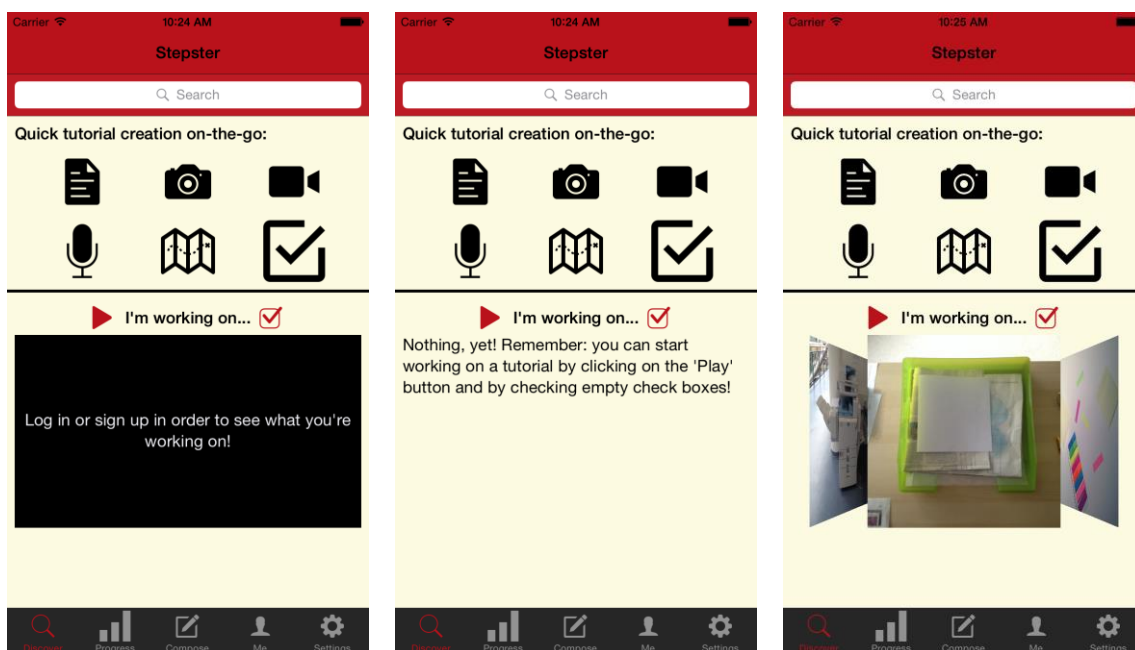


Figure 16: The 'Discover' screen if user is not logged in (left), if he has no in progress tutorials (center) and if he does have in progress tutorials (right).

As discussed above, the first screen of 'Discover' is the screen the user is initially presented with when starting the application. It contains a search bar, tools for quick tutorial creation as well as an iCarousel of tutorials the user is currently working on. While the top half of the screen remains the same, the second half below the black line changes depending on the user's state (see Figure 16). For example, if the user is not authenticated, the 'In Progress' tutorials cannot be loaded from the server and therefore a message notifying him/her to log into his/her account or sign up for one

will be presented. If the user is authenticated but has not started progress on any tutorials, a message will remind or teach him/her to do so by tapping 'start' buttons or by checking empty checkboxes.

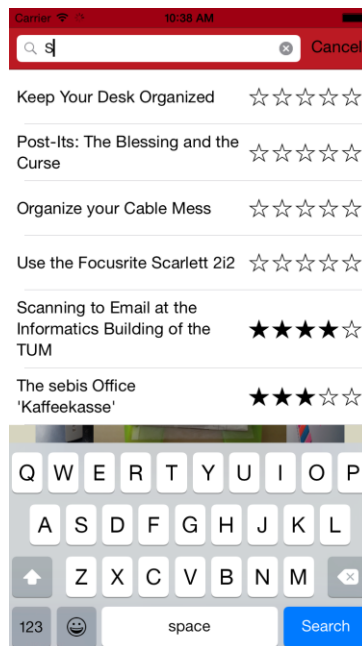


Figure 17: Searching for keywords in the 'Discover' screen

By tapping on the white field at the top of the 'Discover' screen, a keyboard appears and allows for entering search keywords (see Figure 17). While typing words, the application displays all matching results in a table, allows the user to select any of the list entries and (after selection) presents the user with the screen of the specific tutorial.

The navigation bar at the top of the 'Tutorial' screen displays the tutorial title in a single line and automatically scrolls the title if it is too long for the screen (see Figure 18). Next to the title, a number of buttons can be present. If the user is authenticated, a 'play' button appears that leads the user to the first step he has not completed yet. If the tutorial was created by the current user, he can switch to the tab bar item 'Create & Edit' by tapping on an 'edit' button. In the case of Figure 18, the user is authenticated but not the author of the tutorial. Below the navigation bar, a so-called segmented control lets the user navigate to four different sections. The section that is initially present when entering the 'Tutorial' screen contains general information on the tutorial that is being displayed such as the tutorial image and description as well as a count of how many times it has been added to users' favorites (number next to the heart) and the general user rating (five star system). If the current user has added the tutorial to his/her favorites, the heart will be tinted red instead of black, if he/she has rated the tutorial, the five stars will show his rating and will also be red. This main 'Tutorial' screen is the top left image of Figure 18. To the right of it is the second section of the segmented control that displays a list of all steps the tutorial contains.

The steps are ordered numerically with the number being displayed to the left of the title of the step. If the current user of the application is authenticated, (un-)checked checkboxes are shown to the right of the step title. Checking or unchecking them changes the current user's progress on the tutorial.

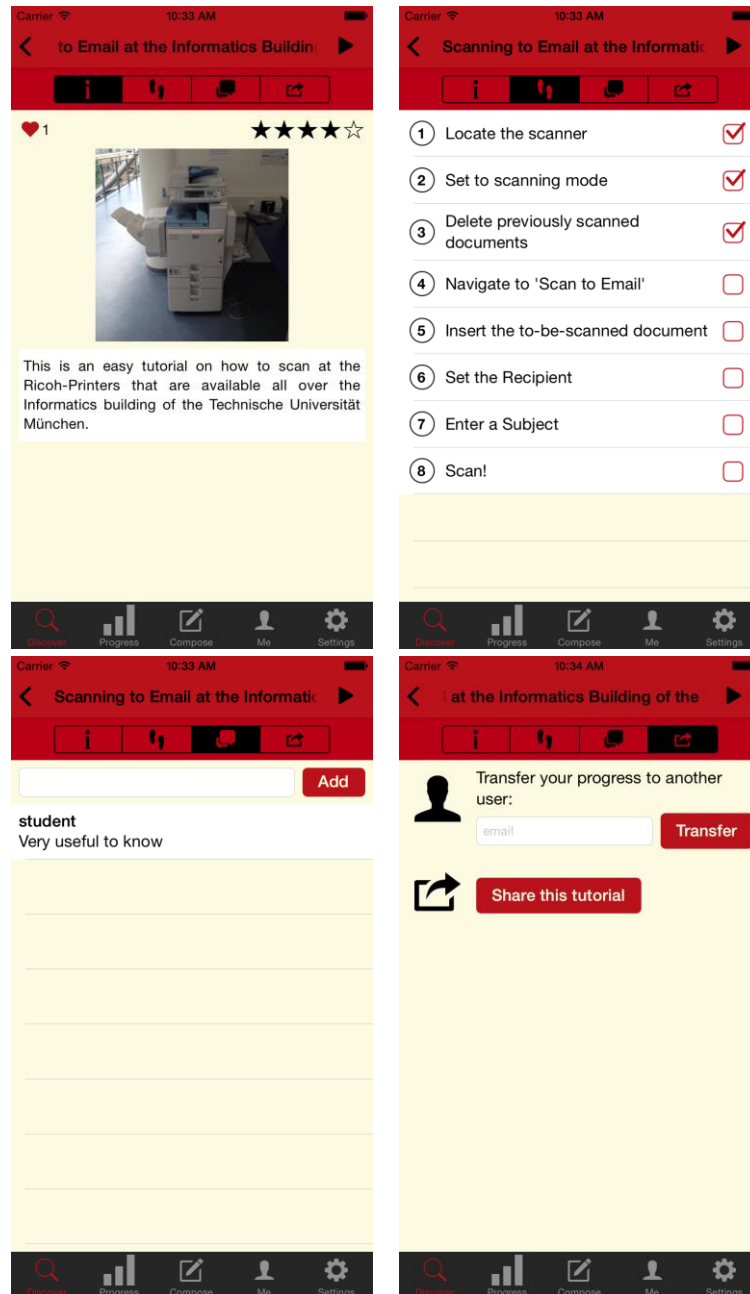


Figure 18: The 'Tutorial' screen - basic tutorial information (top left), list of steps (top right), list of comments (bottom left) and sharing and transfer possibilities (bottom right)

The bottom left image of Figure 18 shows the third section of the segmented control: a list of all comments that have been added to the tutorial or any of the tutorial steps in the backwards order of having been created. If the user is authenticated, an empty text input field and an 'add' button are displayed that allow for adding new comments.

Finally, the last section of the segmented control (the bottom right image of Figure 18) contains the possibility of transferring one's progress on the tutorial to another user and sharing the tutorial with any social media applications installed on the device.

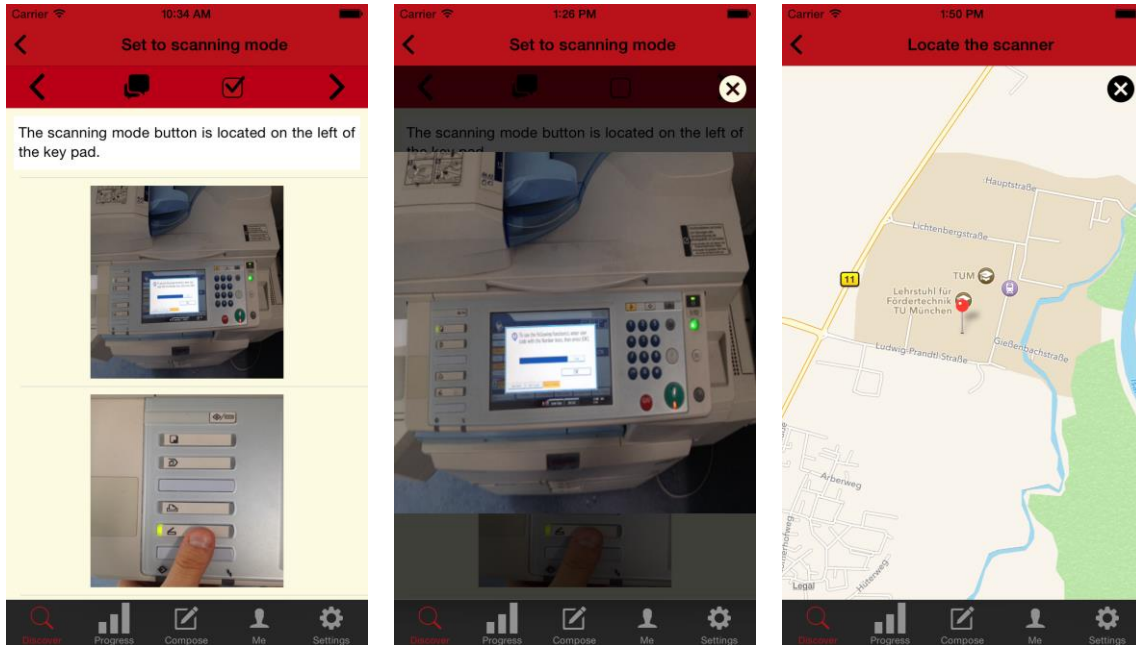


Figure 19: The 'Tutorial Step' screen displays all step elements in a list (left) and allows a user to zoom into images (center) and orient themselves via a map (right)

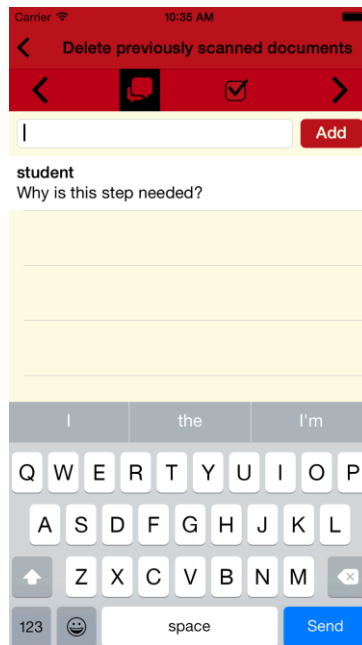


Figure 20: Step comments

As stated above, tapping on an entry in the list of steps in the second section of the segmented control leads to the 'Tutorial Step' screen as seen in Figure 19. It displays

the step title in the navigation bar and adds chevrons below the navigation bar to navigate between step elements. The main part of the screen is used for presenting a scrollable list of all of the step elements of the current step. Tapping on an image enlarges it and allows the user to zoom in and out of image sections while tapping on a map presents an Apple map view (Figure 19, center and right images).

Selecting the icon with the two chat boxes below the navigation bar replaces the list of step elements with a list of all comments that are linked to the current step (Figure 20). If the user is logged in, he/she can add comments as well.

5.3.2 Tutorial Progress

As shown in the screen on the left in Figure 21, the tab bar item 'Tutorial Progress' consists of a single screen containing a simple representation of a user's 'In Progress' tutorials. It displays the tutorial image and title as well as how many steps have been completed so far and the title of the step that needs to be completed next. The tutorial image is part of a so-called iCarousel that contains all images of all 'In Progress' tutorials. Swiping horizontally across the tutorial image therefore allows the user to navigate to his/her other 'In Progress' tutorials. By tapping on the red button in the second half of the screen, the user is directed to the tab bar item 'Discover' and to the Step screen, the content of which is updated with the information of the next to-be-completed step. However, a user must be logged in to see any information on his/her 'In Progress' tutorials. As a result, a screen prompting the user to sign up or log in is displayed when no authentication can be detected. This scenario is depicted in the screen on the right in Figure 21.

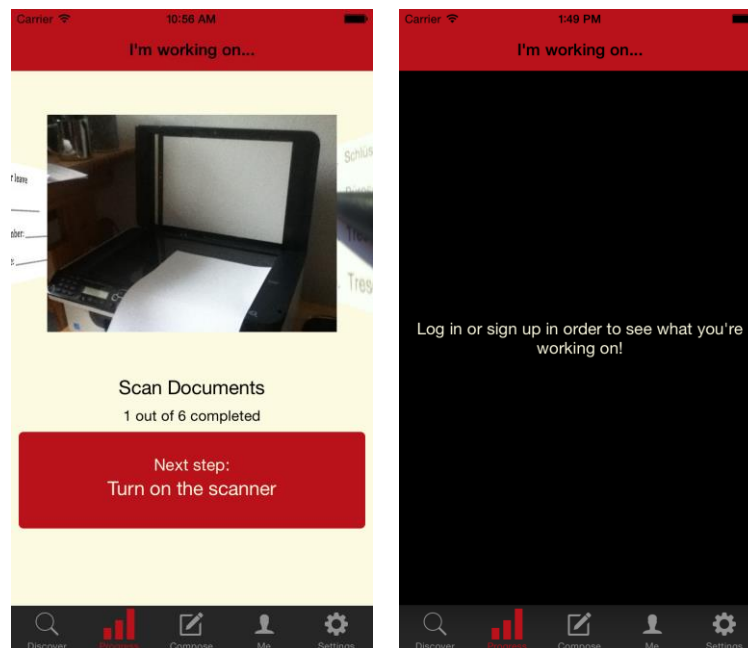


Figure 21: Tab bar item 'In Progress' when authenticated (left) and when not (right)

5.3.3 Tutorial Creation and Editing

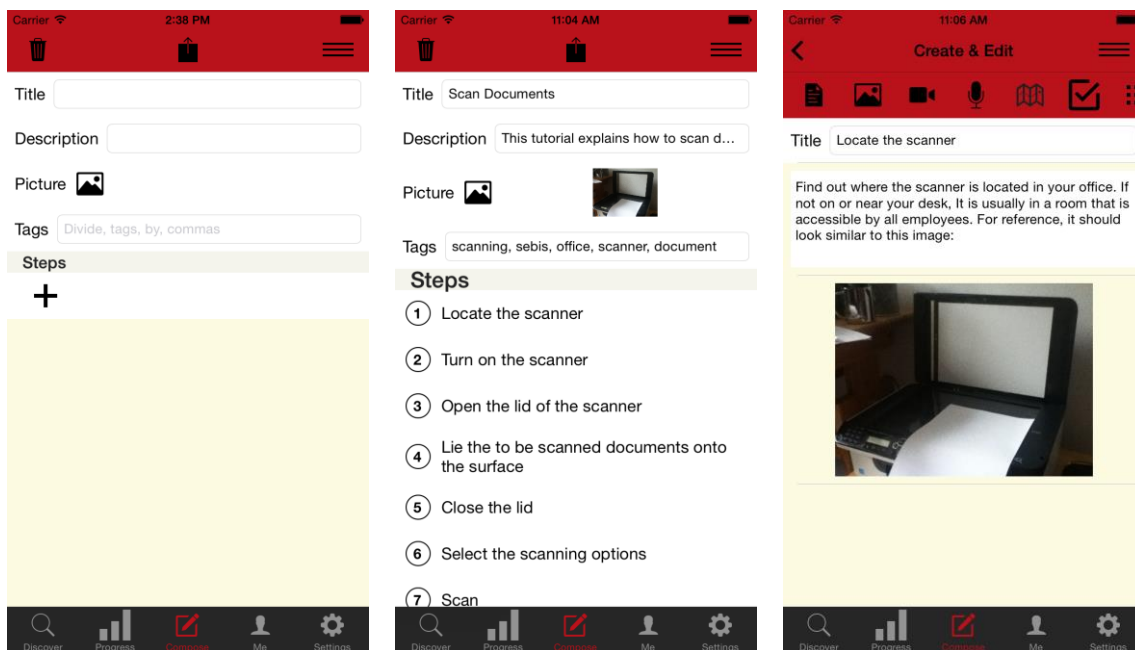


Figure 22: Create & edit tutorial screen empty (left) and filled with information (center); create & edit step screen (right)

The user interface for the tab bar item 'Create & Edit' is depicted in Figure 22. The left and center image of Figure 22 display the screen that is used to enter all basic tutorial information – the title, description and tags, amongst others. When creating a completely new tutorial, the user will be presented with a screen like the one on the left in Figure 22. If values already exist for certain fields (e.g. when editing an already existing tutorial), the blank fields to the right of the text are already pre-filled with these values, as for example in the center screen of Figure 22. The navigation bar at the top contains three buttons: the trash can button deletes the tutorial from the server, the upload button publishes the tutorial and thereby grants all users access to it and the three horizontal lines on the right allow for the reordering of steps. Tapping on the plus sign below 'Steps' leads the user to the 'Create & Edit Step' screen that can be seen in the screen on the left in Figure 22. There, the creator can choose step elements from the scrollable bar of available components below the navigation bar. As with the previous screen, it is possible to edit the order of the step elements with the button of three horizontal lines in the top right corner.

5.3.4 User Profile

The section 'User Profile' is a simple representation of the tutorial images of a user's own tutorials, his/her 'In Progress' tutorials and the tutorials he/she added to his/her favorites (Figure 23, left). By tapping on one of these categories, the user is either sent to the Tutorial Collection screen (Figure 23, right) or, if the 'In Progress' tutorials were selected, the app switches to the 'In Progress' tab bar item. The Tutorial

Collection screen is built similarly to the In Progress screen, with an iCarousel that enables the user to navigate between different tutorials. However, the tutorial information is displayed differently. Instead of showing completion and step information, the number of favorites and comments as it is done in the In Progress screen, the general (or current user) tutorial rating as well as the tutorial description is presented. A button at the bottom of the screen leads the user to the tab bar item 'Discover' and the Tutorial screen.

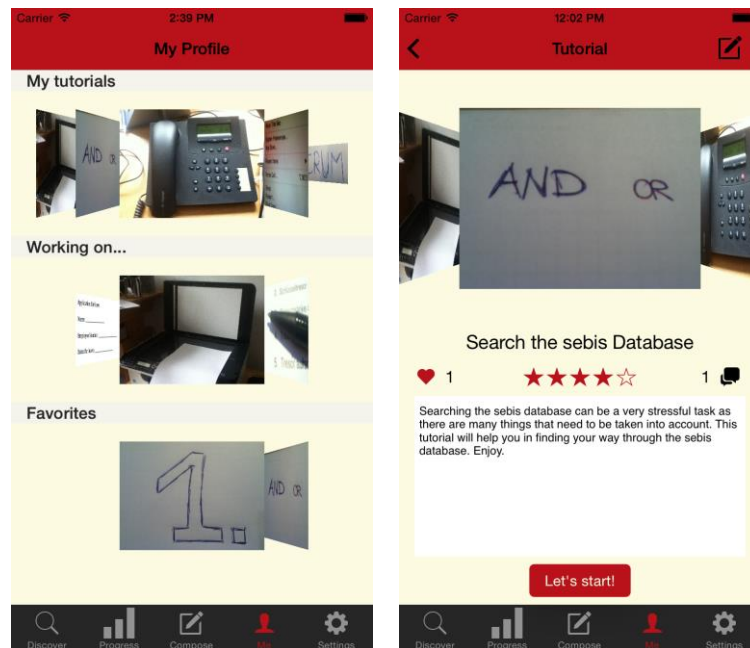


Figure 23: Profile and Tutorial Collection screen

5.3.5 Settings

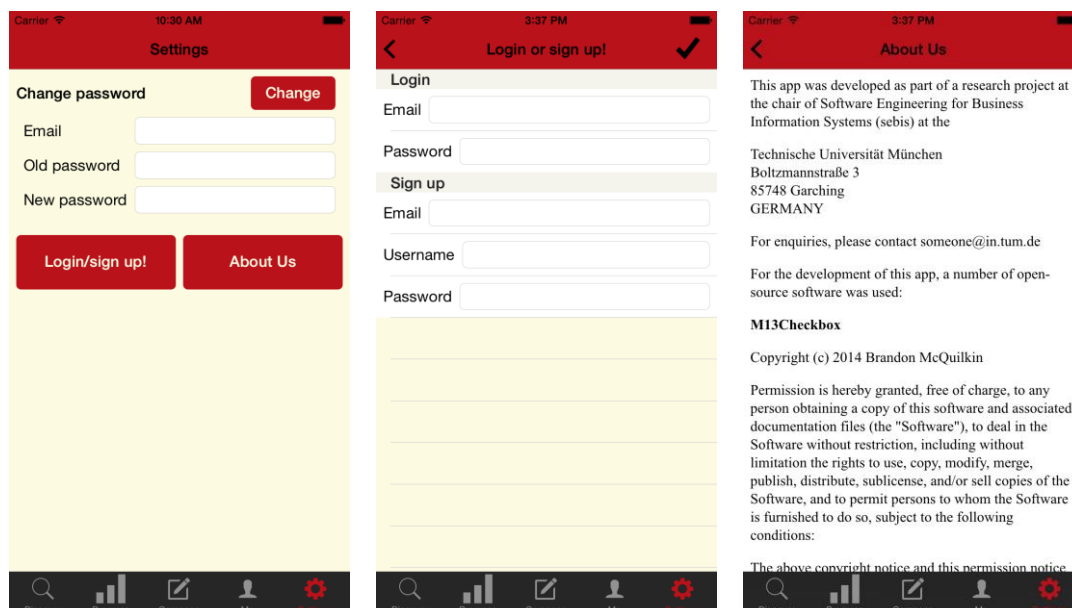


Figure 24: The screens of the tab bar item 'Settings'

Lastly, the tab bar item 'Settings' contains three screens (see Figure 24). The first one (on the left of Figure 24) includes functionality to reset a user's password as well as two buttons leading to the next screens. By tapping the button 'Login/sign up!', the user is navigated to the center screen of Figure 24 and there, he/she can enter his/her email address and password to log into his/her account or create a new account by entering email address, username and password. The button 'About Us' leads to a basic HTML view stating that the application is part of a research project. Furthermore, the open-source products, components and libraries used in the application and their licenses are listed.

6 Evaluation

In order to answer the last research question – ‘To what degree are step-by-step guides easier to read than standard process documentation?’ – an evaluation of the prototype was conducted. Section 6.1 introduces the general structure and setting of the evaluation and section 6.2 presents the results of the evaluation. Any limitations of the study and modifications made to the survey results due to anomalies are explained in section 6.3 and section 6.4 discusses these results.

6.1 Evaluation Design

The participants of the evaluation were asked to carry out the relatively simple task of scanning both the front and the back of a given document at the printers available in the Informatics building of the Technische Universität München. The scans should then be sent to the email address `evaluation_tum@web.de` with the subject ‘ID: \$id’ and the name of the scanned file ‘ScannedDocuments\$id’ (where \$id is a unique identifier given to the participant). In order to fulfill this task, each participant was given one of five possible process documentations that all included the step-by-step instructional text seen in Figure 25. This text was based upon printed brief instructions from the manufacturer of the printer that are posted next to the printers in the building.

Scan to email at the Informatics building of the TUM	
1. Switch to scanning mode: <i>Press the ‘Scanner’ button</i>	c. Press the ‘File Name’ button on the screen
2. Delete all previous data: <i>Press the ‘Delete All’ button</i>	d. Enter the file name
3. Navigate to ‘Scan-to-Email’: <i>If the screen displays the tab ‘Scan-to-Folder’, switch to the tab ‘Scan-to-Email’</i>	e. Press the ‘OK’ button on the screen
4. Place the document in the scanner	f. Press the ‘OK’ button on the screen
5. Set the recipient:	7. Enter a subject
a. Press the ‘To’ button on the screen	a. Press the ‘Subject’ button on the screen
b. Press the ‘Manual Entry’ button on the screen	b. Press the ‘Text Entry’ button on the screen
c. Enter the email address of the recipient	c. Enter the subject
d. Press the ‘OK’ button on the screen	d. Press the ‘OK’ button on the screen
6. Set the file type and name	8. Scan
a. Press the ‘Send File Type/Name’ button on the screen	a. Press the ‘Start’ button
b. Select multi-page PDF	b. If you want to scan more than one page, change the document and press the ‘Start’ button again
	c. Once you’re done scanning, press the ‘#’ button
	d. You’ve scanned a document! Don’t forget to take your document out of the scanner!

Figure 25: Basic instructional text used in all 5 groups

The groups of process documentations were the following:

- *Group 1:* The text (Figure 25) printed on paper
- *Group 2:* The text (Figure 25) printed on paper with an image of the control panel of the printer (Figure 26)
- *Group 3:* The text (Figure 25) embedded in a tutorial on the prototypical application and supplemented with images
- *Group 4:* The text (Figure 25) embedded in a tutorial on the prototypical application and supplemented with videos
- *Group 5:* The text (Figure 25) embedded in a tutorial on the prototypical application and supplemented with audio recordings

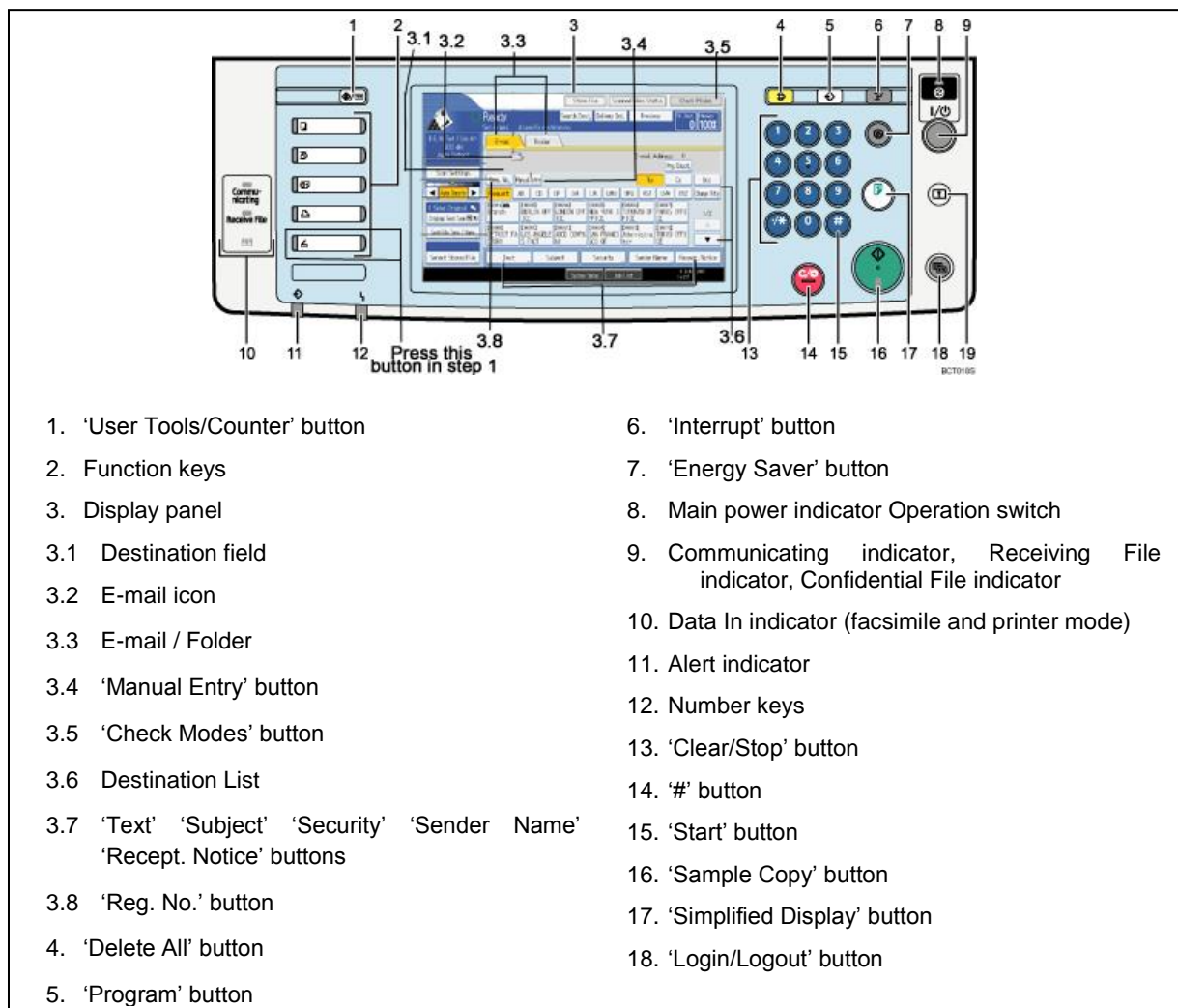


Figure 26: Control panel and button names

The participants of groups 3-5 were given an iPhone 6 Plus with the prototypical application opened on the 'Discover' screen. They had to first search for the tutorial using the search bar and then navigate to the tutorial steps before being able to start the scanning process. An example of how the text in Figure 25 was translated into a

tutorial using the prototypical application can be seen in Figure 27 and Figure 28. Figure 27 shows the basic tutorial information screen on the left and a list of all steps on the right. The step titles correspond to the words in bold in Figure 25. Any other text is part of the steps as seen in Figure 28. When a task such as pressing a button or placing the document in the scanner is to be executed, a media resource is added with the hope of simplifying the locating of elements or avoiding mistakes.

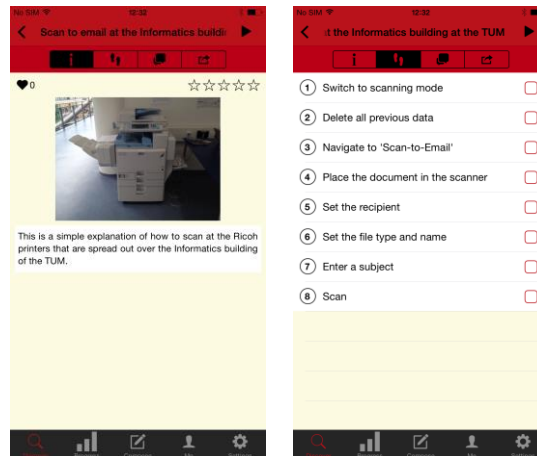


Figure 27: Group 4 tutorial screen (left) and list of steps (right)

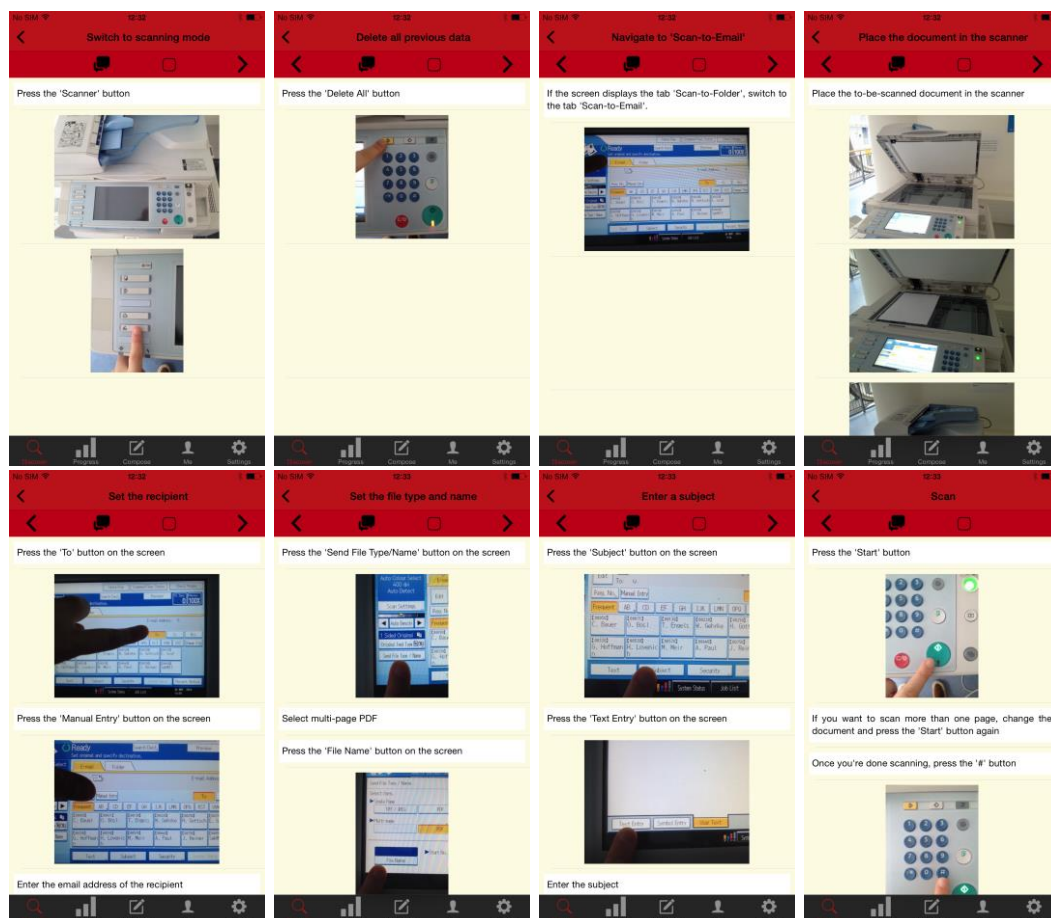


Figure 28: Group 4 steps 1 (top left) to 8 (bottom right)

6.2 Evaluation Results

Over the course of two days (November 25th/26th 2014), 25 randomly selected students at the Informatics building of the TUM participated in the evaluation. They were assigned a unique identifier and drew the group number of the to-be-used process documentation from a box containing 5x the numbers 1-5 (sampling without replacement). After having read the instructions, they were given the process documentation or the smartphone and a timer was started to measure their completion time. After completing their task (successfully or not), the timer was stopped and the participants were asked to fill out a survey containing 26 questions (see Figure 37 and Figure 38 in Appendix C – Evaluation Survey). The core findings of this evaluation will be introduced in the following sections. For the exact results of the evaluation, please refer to Table 10 – Table 13 in Appendix D – Evaluation Results.

6.2.1 Success Rate and Number of Discontinuations per Group

The results of all 25 task performances can be seen in Table 5. 64% of the participants were able to successfully complete the task. This means the pdf file of the scanned document that was sent to the email address `evaluation_tum@web.de` contained the two complete pages (front and back with no part cut off) of the document they were given. Since the format of the scans was not stated, the document sent by one participant that was unlike the rest not in DIN A4 was also counted as successful. Four participants sent some form of incorrect document to the email address – only the front page or no page at all scanned or the scans cut off the document content – and were counted as unsuccessful. Another four participants discontinued the task completely.

Group	Complete	Complete but DIN A3	Incomplete	Cut-Off	Empty	Dis-cont'd	Success Rate
1	3		1			1	60%
2	3				1	1	60%
3	5						100%
4	2	1				2	60%
5	3			1	1		60%

Table 5: Completion status and success rate per group

6.2.2 Average Completion Time per Group

Table 6 shows the average completion time per group of all participants that successfully completed the task. The shortest amount of time – 05:35,1 minutes –

was accomplished by a member of group 1 while 17:23,9 minutes is the longest amount of time spent completing the task by a group 5 participant.

Group	Average completion time in minutes
1	07:04,6
2	06:49,6
3	09:29,4
4	09:03,9
5	14:01,6

Table 6: Average completion time per group (if successful)

6.2.3 Level of Prior Knowledge

The questions 5-11 addressed the topic of the participants' experience with smartphones and their knowledge about process documentation methods. As can be seen in Table 7, at least 80% of all participants own a smartphone and about 50% are adept in handling other smartphones.

Group	Own smartphone	Experienced with other smartphones
1	100%	100%
2	80%	20%
3	80%	20%
4	80%	60%
5	100%	60%

Table 7: Prior knowledge about smartphones

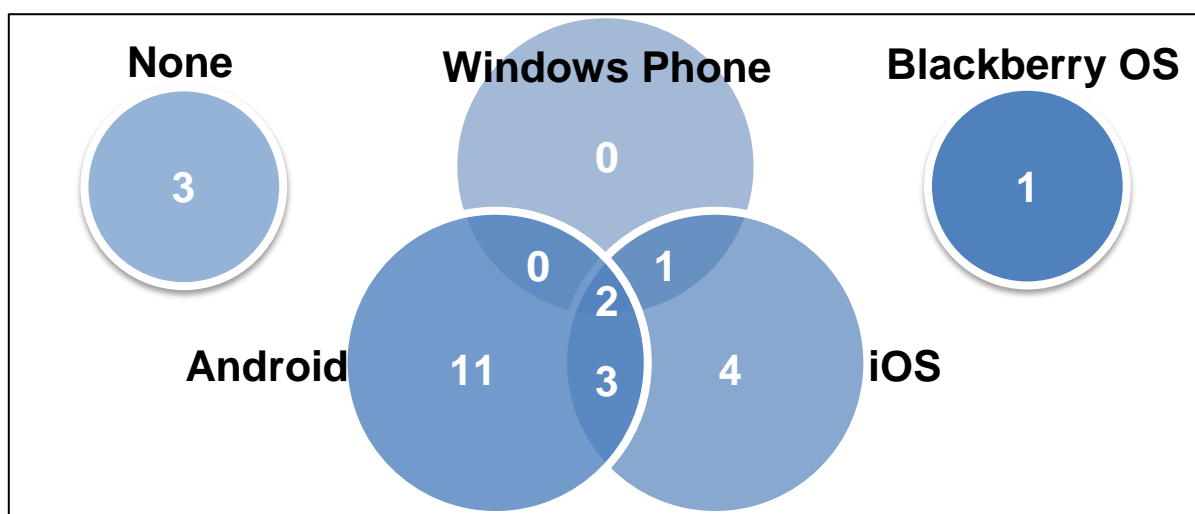


Figure 29: Participants' experience with smartphone operating systems

The operating system that most participants were experienced in was Android (16 participants), followed by iOS (10 participants), Windows Phone (3 participants) and Blackberry OS (1 participant). 6 of these participants were well-versed in using multiple operating systems (see Figure 29). Three participants stated not to have any experience with smartphones.

In question 10, the participants were asked to specify their degree of proficiency in a number of given popular process documentation methods. The most well-known of these was UML for which 48% stated to have at least a beginner level of expertise while only 20%, 12% and 8% did so for EPC, BPMN and CMMN respectively. The average proficiency of each group and documentation method can be seen in Figure 30.

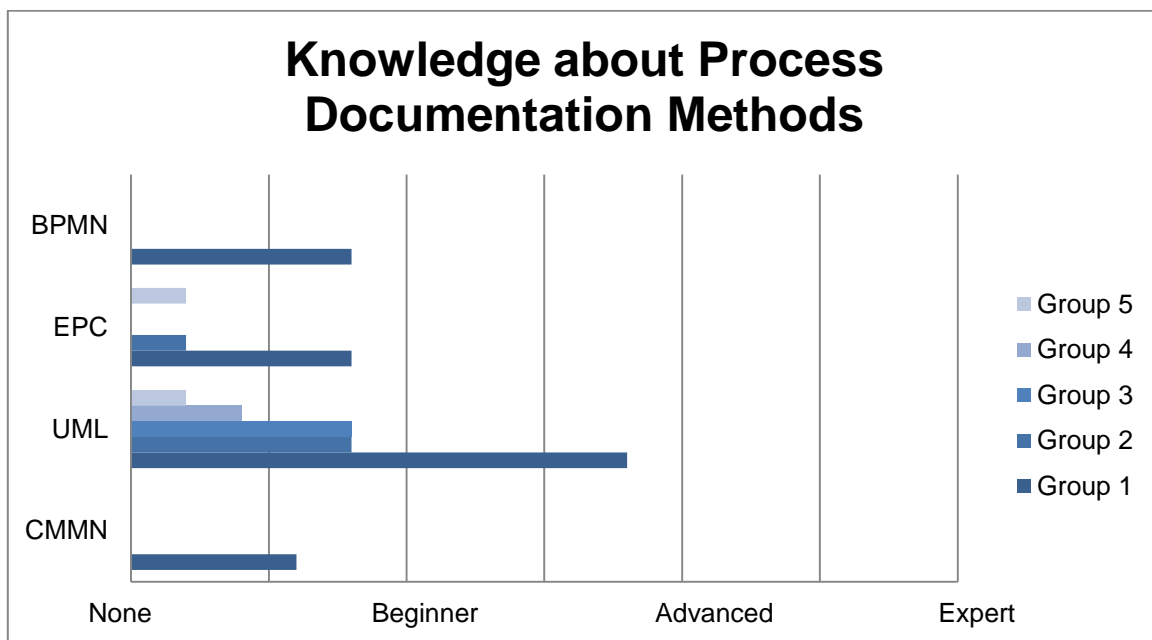


Figure 30: Average participants' knowledge about process documentation methods

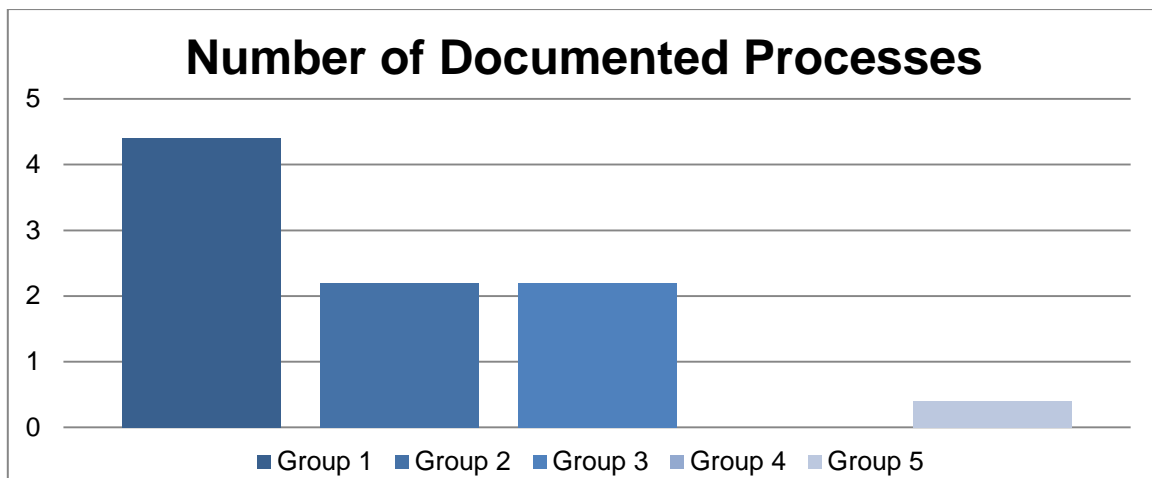


Figure 31: Number of previously documented processes per group

Since the average level of expertise stated by the participants was found to be between 'None' and 'Beginner' for all groups and process documentation methods except for group 1 – UML (Figure 30), the mean number of processes documented by the participants is also quite low and only varies from 0 to 4.4 (see Figure 31). It is interesting to notice that group 1 peaks at all of the categories in Figure 30 and Figure 31 because it was the only group that included students who majored in Information Systems. Students of that field of study are introduced to process documentation methods and languages from their first semester onwards.

6.2.4 Rating of the Process Documentation per Group

After establishing the participants' level of experience with smartphones and process documentation methods, the questions 12-19 asked about the quality of the process documentation that was used to fulfill the task. It is important to note that none of the participants had carried out this specific task before taking part in the evaluation and were therefore unfamiliar with the machine and sometimes with the act of scanning itself (see questions 12-14 in Table 12). The average rating per group of the process documentations concerning understandability, helpfulness and assumed prior knowledge is depicted in Figure 32. As can be seen there, group 3 is the best-rated in all three categories while group 4 received the lowest but still positive response. This trend is also apparent in Figure 33 where group 3 received an overall grade of 1.4 – 1 being the best possible rating – and is followed by group 2, group 5, group 1 and, lastly, group 4.

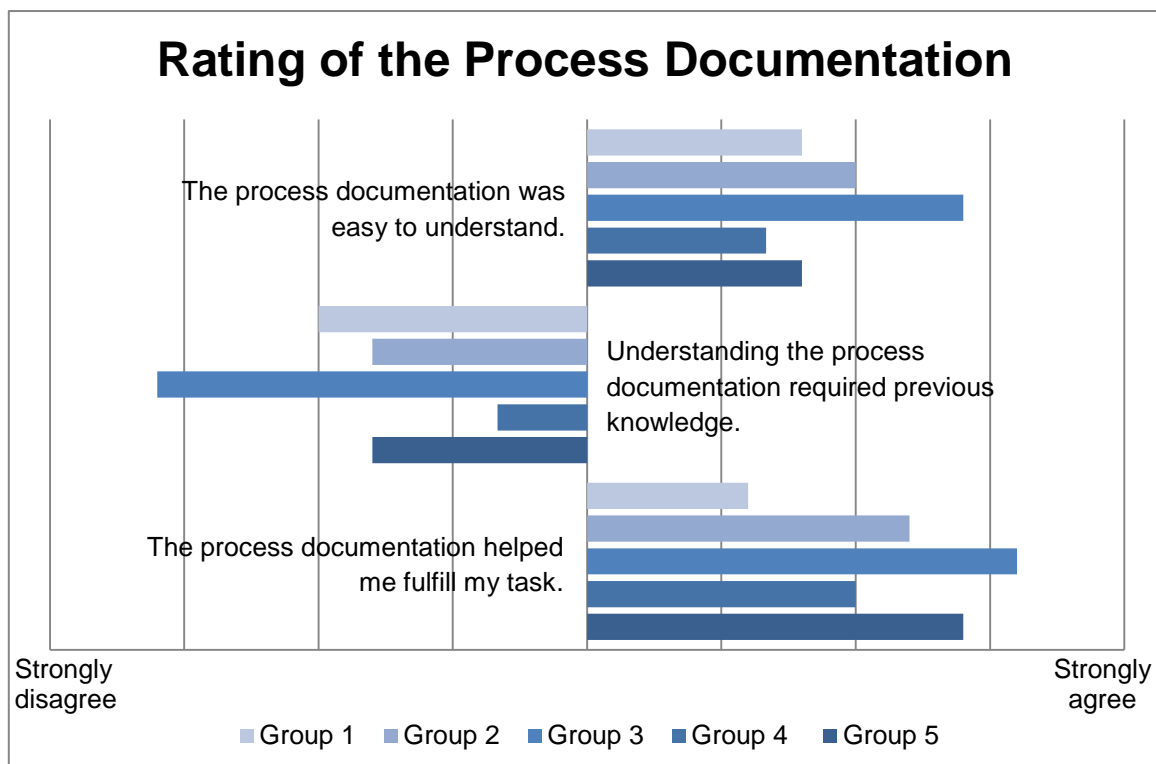


Figure 32: Rating of the process documentation per group

When asked for ideas to improve the process documentation that was used, the members of group 1 and 2 mostly mentioned pictures or other visual representations of the buttons that had to be pressed or a cross-reference between the buttons in Figure 26 and the ones mentioned in the process documentation. One participant of group 4 also asked for more appropriate pictures – he did not realize the images he was seeing were video thumbnails and could be tapped to play these videos. Lastly, a participant of group 5 suggested to use gifs, videos as well as pictures.

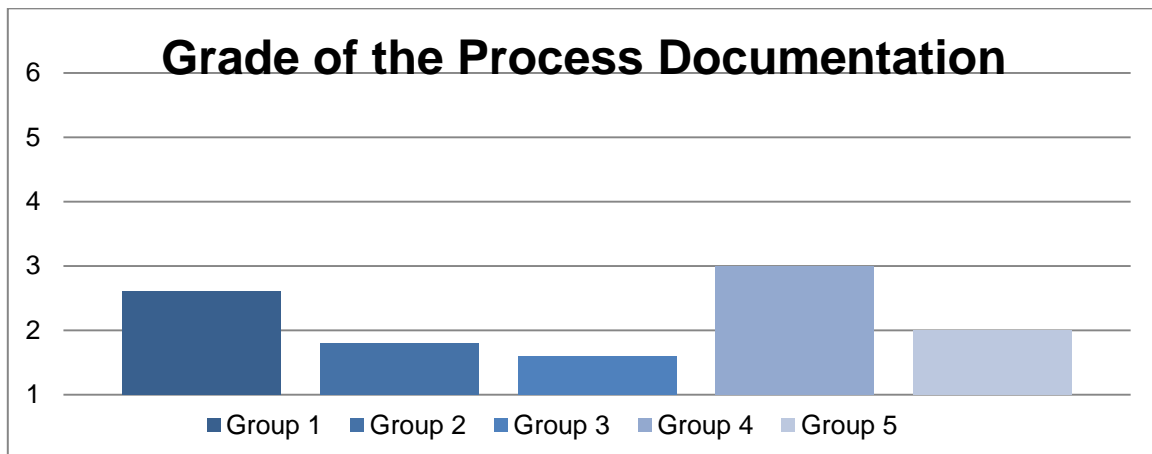


Figure 33: Average overall grade of the process documentation per group (1 = best, 6 = worst)

6.2.5 Rating of the Application per Group

Questions 20 – 26 of the survey addressed the prototypical application and were thus only answered by the participants of group 3, 4 and 5. Since discontinuing the task heavily influenced the participants' view of the application, a subgroup of group 4 excluding the rating of participants that discontinued the task was introduced.

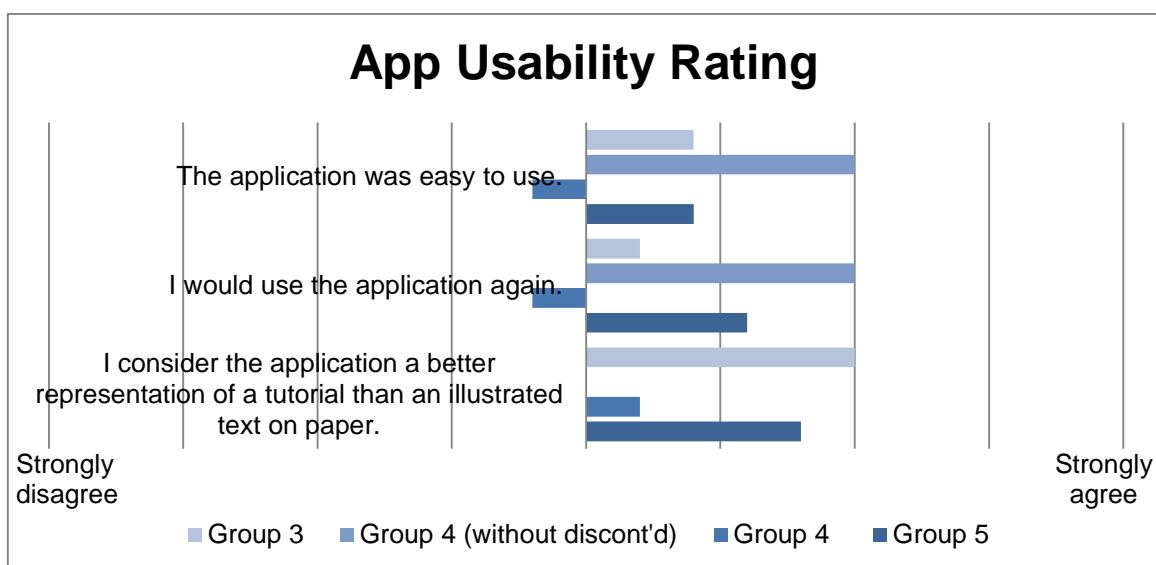


Figure 34: App rating on a Likert scale

Figure 34 depicts how users rated the application on a Likert scale concerning ease of use, potential of reuse and better representation of a tutorial. The answers tend to trend slightly to the positive 'strongly agree' in all aspects. The overall grade given to the application is 2.93 with the values ranging from 2.0 to 3.6 (see Figure 35).

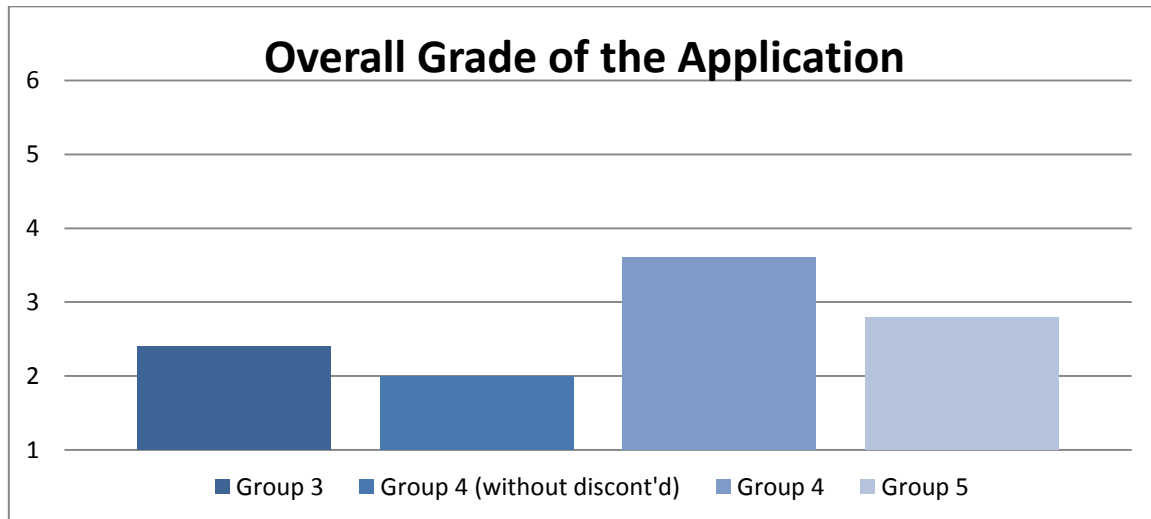


Figure 35: Average overall grade of the application per group (1 = best, 6 = worst)

While most participants were unaware of the possibility of tracking their progress by tapping on empty check boxes, a few did use that mechanism. The participant with the ID 37 used the 'Play' button on the Tutorial screen to begin with the tutorial. Two participants (ID 28 and 29) handed the iPhone back with all of the checkmarks checked and they both successfully completed the task.

The last question of the survey, question 26, asked the participants for any suggestions for improvement of the application. The answers (some of which have been translated from German) that were given are summarized in the following paragraph.

Some participants asked for an assistance function 'Help' button that explains which functionality is offered and which buttons exist and need to be pressed to achieve a certain result. Others suggested a simpler main screen with not as many symbols and buttons. Relating to this main screen, it was proposed to make tutorials available with more than just a search function – possibly a list of recent or popular tutorials. One participant mentioned to introduce a better structure with two separate areas for consumers and producers of tutorials. Lastly, it was recommended to use more prominent 'Back' and 'Next' buttons and to increase the size of the buttons.

6.3 Limitations and Survey Anomalies

Firstly, it is important to mention that the conducted evaluation is limited in a number of ways which could lead to potential threats to the validity of its results. Since the

evaluation was conducted in the Informatics building of a university with a sample size of 25, a limited diversity of the population was actually investigated: 24 out of the 25 participants were male and all participants were students at the university. Therefore, the findings of this study cannot be generalized to a broader population.

In retrospective, more measures to collect data should have been taken. After a first number of participants used the application to complete their task, it was apparent that they were all confused by the main screen and unable to locate the tutorial for a few minutes. As a result, to increase the fairness of comparing the two main types of process documentations, a recording of the screen of the iPhone would have been useful to determine the exact point in time at which the participants located the tutorial and to start taking the completion time from that point onwards.

When looking at the results of the survey, a few anomalies were noticed and corrected. These alternations will be justified below.

The participant with the ID 01 from group 3 strongly agreed that the process documentation was easy to understand and helped him fulfill his task. He strongly disagreed that the process documentation required previous knowledge. However, he graded the application with a 5, the second worst value possible. Since that rating does not match up with the rest of his answers, it was assumed that he misinterpreted the rating system and his rating was changed to the second best – a 2.

Since each participant who used the application was given a specific tutorial with only one type of media resource (image, video or audio recording), the surveys that stated that the participant used more than one of these resources were corrected.

6.4 Discussion

In section 1, a number of hypotheses were introduced. It was proposed that the application would be able to:

- H1: increase the rate of successfully executing process documentations
- H2: decrease the number of discontinuations of a process
- H3: increase the understandability of process documentations by using informal, multimedia resources
- H4: reduce process documentation creation and execution time
- H5: lower the error rate of process documentations due to the ad-hoc creation character of the application

The evaluation that was conducted was able to investigate H1, H2 and H3 as well as the second part of H4 – execution time.

As can be seen in Table 5, the average success rate for processes executed with the help of the application (group 3-5) is 73.33% as compared to 60% for group 1 and 2 which leads to a corroboration of H1.

Concerning the number of discontinuations, four out of ten participants aborted their task in groups 1 and 2 (40%) whereas only 2/15 (13.33%) did so for the groups that used the application. It should also be noted that discontinuations in group 1 and 2 always occurred due to not understanding the instructions. Especially the steps where buttons were supposed to be pressed, which were not displayed with their name on the screen or not part of Figure 26, were vast obstacles. As participant 18 put it: "I've done it before with an office printer – Why can't they put a button [there with the title] 'Scan'? It's so complicated!" In groups 3-5, discontinuations of the evaluation only occurred in group 4 when the participants were not able to locate the tutorial within the application even after more than six minutes of trying to do so. Once the instructions were located, all members of groups 3-5 completed the tutorial and sent an email. These results point to a corroboration of H2.

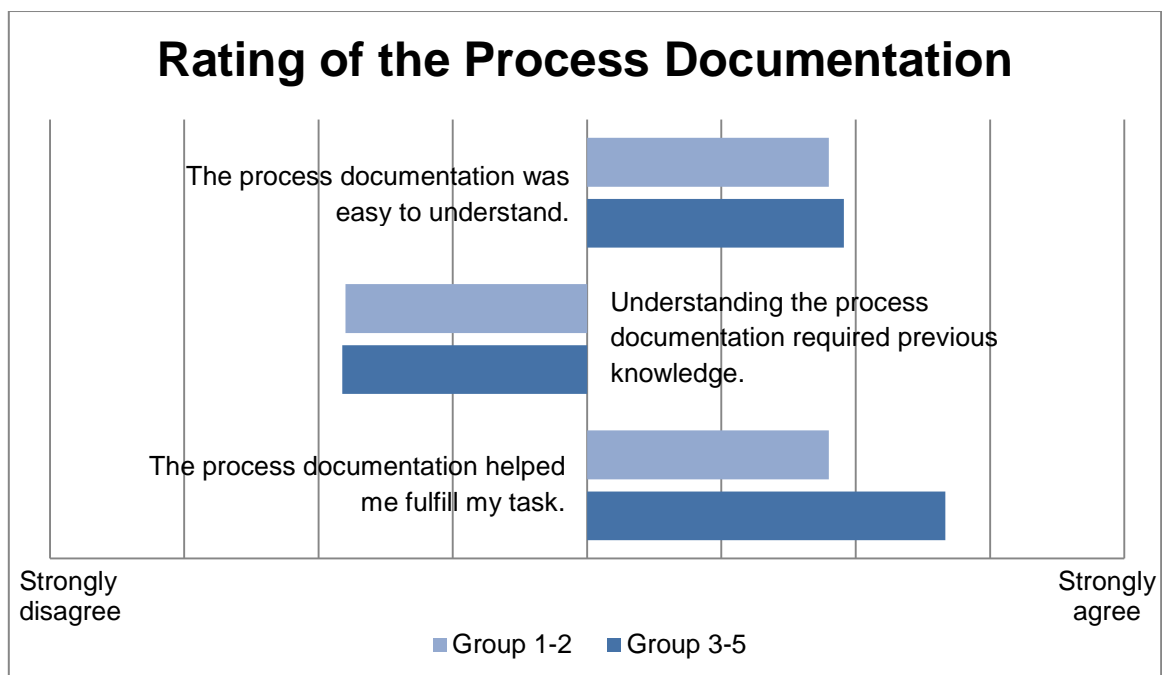


Figure 36: Rating of the process documentation

With regard to H3, Figure 32 and Figure 33 show that the process documentation of group 3 – text supplemented with images – is perceived as the most useful and understandable. Both group 2 and group 5 seem to follow closely behind group 3 regarding the understandability and overall grade. Finally, group 1 and 4 were the least well-rated. The fact that the process documentation used in group 4 is not as well-rated as the other two groups that used the application could be attributed to the fact that two out of the five participants of that group discontinued their task after several minutes of trying to locate the tutorial. These participants did not submit a

rating of the documentation and therefore, the rating of group 4 on process documentation is slightly more biased as the rest. The average rating of the two groupings can be seen in Figure 36. It is apparent that groups 3-5 have a slightly better rating than groups 1-2. However, the overall grade for both is 2.2. It is suggested to conduct another evaluation with a bigger sample size to determine whether this slight lead is significant or not.

Lastly, Table 6 shows that the groups 1 and 2 have a significantly lower average completion time than groups 3-5 - 06:57,1 vs. 10:51,6. This result contradicts the second part of H4 – reducing process execution time. However, since the participants of group 3-5 did spend a remarkable amount of time looking for the tutorial on the application, it could be argued that another, more balanced evaluation should be performed in which either the tutorial is locatable with one tap or the user is already presented with the tutorial.

7 Conclusion and Future Work

7.1 Conclusion

In conclusion, the work and contribution of this thesis is summarized below. A literature review was conducted that revealed a gap in current business process documentation methods and languages concerning the support of ad-hoc process documentation and execution by modeling novices. Informal process documentation methods were examined to determine how this gap could be bridged with methods and resources available and familiar to all process participants. Requirements for a system that fills this gap were elicited and a prototypical application was implemented. An evaluation of the prototype revealed that there is a potential for increasing understandability of documentations for non-experts. However, the user interface of the application was not user-friendly and simple enough to fully support novices in carrying out their tasks.

7.2 Future Work

While the potential of the application and its supportive structure for novice users are apparent, there is a need for a review of the user interface of the application in order to decrease its complexity and tendency to overwhelm users. As mentioned in section 6.3 and 6.4, many participants struggled with the initial user interface of the application. Especially the 'Discover' screen with its quick tutorial creation buttons made them confused and discouraged. Therefore, it is suggested that a better distinction between creator and consumer space is (visually) defined and that the user is guided more apparently to the search bar or any other method of discovering a tutorial.

Apart from a user interface re-design, there are also many capabilities and functionalities that could potentially increase the usefulness of the prototypical application. New step elements such as 'Contact', 'Role', 'Calendar' and 'Alarm' could be defined to broaden the variety of business-related process documentations and to further distinguish the application from available DIY tutorial tools. Another useful addition would be a 'Case Distinction' feature that allows users to implement and follow a less narrow path of actions. More sharing possibilities and login via social platforms could increase the usage rate of the prototype. Due to a lack of time, the feature of being able to transfer one user's tutorial progress to another user was only implemented as a simple overriding of a potential already in-use progress of that tutorial.

As stated in section 6.3 and 6.4, the evaluation that was conducted is limited in its sample size and fairness. In order to combat these two factors, it is recommended that the current or a future prototype is evaluated in a bigger setting by not only students but potential users from a business-related environment. Additionally, a number of processes with varying levels difficulty and complexity should be executed.

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Appendix

Appendix A – DIY Tools Overview

	Instructables	Snapguide	Stps.co	Ravelry	Craftster
Number of guides	100,000+	-	-	-	-
Number of members	-	-	-	4 mio (February 2014)	300,000
Focus on specific type of content	-	-	-	Craft with yarn and dyes	Craft
Categories	6 (Technology, Workshop, Living, Food, Outside, Play), for each many Channels	17 (Arts & Crafts, Automotive, Beauty, Desserts, Drinks, Food, Games & Tricks, Gardening, Home, Lifestyle, Music, Outdoors, Pets, Photography, Sports & Fitness, Style, Technology)	-	5 (Knitting, Crochet, Loom Knitting, Weaving, Machine Knitting)	18 (Bath and Beauty, Clothing, Cooking, Crochet, Fiber Arts, Glass Crafts, Home Sweet Home, Image Reproduction Techniques, Jewelry and Trinkets, Knitting, More Art and Less Craft, Needlework, Paper Crafts & Scrapbooking & ATCs, Pottery & Ceramics & Polymer Clay, Purses & Bags & Wallets, Quilting, Sewing, Toys & Dolls & Playthings)
Create step-by-step guide	X (user must be logged in to start creating)	X (user must be logged in to publish or save)	X (user must be logged in to start creating)	~ (projects)	X (forum post can be arranged)
Guide elements				>> project elements	
Cover/Intro	X	X	-	-	~
Ingredients/supplies		X	-	-	~
Tags	X	-	-	X	X
Steps	X	X	X	-	~
Step elements				>> project elements	
Text	X	X	X	X	X
Image	X	X	X	X	X
Video	X (embed online videos)	X (upload videos from library, only on app)	X (embed online videos)	-	-
Audio	-	-	-	-	-
Map	-	-	X	-	-
Files	X	-	-	-	-
Highlighted Source Code	-	-	X	-	X
Link	X	-	-	X	X
Other elements	-	-	-	Yarn, hook, pattern	Smileys

Platforms					
iOS	X	X	-	~ (not official)	-
Android	X	-	-	~ (not official)	-
Website	X	X	X	X	X
Sharing					
Facebook	X	X	X	X	X
Twitter	X	X	X	X	X
Google+	X	-	X	-	X
Tumblr	X	-	-	-	-
Email	X	X	-	-	X
Pinterest	~ (pinning of step images possible)	X	-	X	X
Embed	-	X	-	-	-
Other	-	-	-	-	StumbledUpon, reddit, Wists
Comment on guides	X	X	-	X	X
Comment on guide steps	~	X	-	-	-
Rate guide	X	-	-	X	-
View Count	X	X	-	-	X
Favorite guides	X	X	-	X	X
Add guides to collections	X	-	-	X	-
Edit guides	X (only as creator of guide)	X (only as creator of guide)	X	X (only as creator of project)	X
Download guide as PDF	X (Pro)	-	-	-	-
Forums	X	-	-	X	X
Contests	X	X	-	-	X
Track progress	-	-	-	X	-
Mark guides as 'I made it!'	X	-	-	X	-
Private messages	X	X	-	X	X
Marketplace	-	-	-	X	-
Public & private guides	X (Private only with Pro)	-	X (guide only accessible via direct link)	-	-
Membership cost	Free and Pro Membership (1.95/Month billed annually, 3.99/Month billed quarterly, 39.99/2 Years one-time payment)	Free	Free	Free	Free

Table 8: Overview of DIY communities and creation tools

Appendix B – Research Diary

Date	Database	Search	Results	Elimination Cause
01.08.2014	Scopus	Ad-hoc process documentation 70 results	Cossentino, M., Gómez-Rodríguez, A., González-Moreno, J.C., Molesini, A., Omicini, A. Process documentation standardization: An initial evaluation (2010) CEUR Workshop Proceedings, 627, pp. 29-42.	Content
			Spieß, D., Anderl, R. Application of business rules in design processes to tackle uncertainty in product development (2010) ASME International Mechanical Engineering Congress and Exposition, Proceedings, 13, pp. 229-237.	Abstract
			Stoffel, K., Davis, J.D., Rottman, G., Saltz, J., Dick, J., Merz, W., Miller, R. A graphical tool for ad hoc query generation. (1998) Proceedings / AMIA ... Annual Symposium. AMIA Symposium, pp. 503-507. Cited 1 time.	Abstract
		"Process Documentation" *phone 1 result	Navarro, C.X., Cristóbal-Salas, A. Mobile wireless infrastructure for teaching-learning process documentation (2008) Proceedings of the 2008 International Conference on Frontiers in Education: Computer Science and Computer Engineering, FECS 2008, pp. 175-179.	Access
		"Process Documentation" tool 64 results	Saarsen, T., Dumas, M. The process documentation cube: A model for process documentation assessment (2013) Lecture Notes in Business Information Processing, 132 LNBIP, pp. 501-512.	Content
			Talley, D.W. A process documentation model for DCMI (2012) SIGDOC'12 - Proceedings of the 30th ACM International Conference on Design of Communication, pp. 289-294.	Content
			Salassa, F., Carcangiu, C.E., Rafele, C., Piloni, M. Process modelling and knowledge transfer in healthcare (2009) Proceedings of the European Conference on Knowledge Management, ECKM, 2, pp. 717-727.	Access
			Groth, P., Miles, S., Moreau, L. A model of process documentation to determine provenance in mash-ups (2009) ACM Transactions on Internet Technology, 9 (1), art. no. 3, . Cited 20 times.	Content
			Ungan, M. Towards a better understanding of process documentation (2006) TQM Magazine, 18 (4), pp. 400-409. Cited 8 times.	-
	WoS Core Collection	Ad-hoc process documentation 41 results	Title: The benefits of sketching for knowledge management Author(s): Pfister, RA (Pfister, Roland A.); Eppler, MJ (Eppler, Martin J.) Source: JOURNAL OF KNOWLEDGE MANAGEMENT Volume: 16 Issue: 2 Pages: 372-382 DOI: 10.1108/13673271211218924 Published: 2012	-
		Process documentation smartphone 6 results	Title: Evidence of Effectiveness of Health Care Professionals Using Handheld Computers: A Scoping Review of Systematic Reviews Author(s): Mickan, S (Mickan, Sharon); Tilson, JK (Tilson, Julie K.); Atherton, H (Atherton, Helen); Roberts, NW (Roberts, Nia Wyn); Heneghan, C (Heneghan, Carl) Source: JOURNAL OF MEDICAL INTERNET RESEARCH Volume: 15 Issue: 10 Pages: 111-119 Article Number: DOI: 10.2196/jmir.2530 Published: OCT 2013	-
02.08.2014	WoS All	Ad-hoc process	Title: Scribble: Closing the Book on Ad Hoc	Content

Databases	documentation tool 48 results	Documentation Tools Author(s): Flatt, M.; Barzilay, E.; Findler, R.B. Source: SIGPLAN Notices Volume: 44 Issue: 9 Pages: 109-20 Published: Sept. 2009	
		Title: The benefits of sketching for knowledge management Author(s): Pfister, RA (Pfister, Roland A.); Eppler, MJ (Eppler, Martin J.) Source: JOURNAL OF KNOWLEDGE MANAGEMENT Volume: 16 Issue: 2 Pages: 372-382 DOI: 10.1108/13673271211218924 Published: 2012	Duplicate
	Ad-hoc "process modeling" tool 13 results	Title: From Personal Task Management to End-User Driven Business Process Modeling Author(s): Stoitsev, T (Stoitsev, Todor); Scheidl, S (Scheidl, Stefan); Flentge, F (Flentge, Felix); Muhlhauser, M (Muehlhaeuser, Max) Book Author(s): Shan, MC (Shan, MC) Related/References: Stoitsev, T., Scheidl, S., Spahn, M.: A Framework for Light-Weight Composition and Management of Ad-Hoc Business Processes. In: Winckler, M., Johnson, H., Palanque, P. (eds.) TAMODIA 2007. LNCS, vol. 4849, pp. 213–226. Springer, Heidelberg (2007)	-
		Title: REVIEW OF RESEARCH IN TOOLING TECHNOLOGY, PROCESS MODELING AND PROCESS PLANNING .1. TOOLING AND PROCESS MODELING Author(s): MAROPOULOS, PG (MAROPOULOS, PG) Source: COMPUTER INTEGRATED MANUFACTURING SYSTEMS Volume: 8 Issue: 1 Pages: 5-12 DOI: 10.1016/0951-5240(95)92808-8 Published: FEB 1995	Content
	Ad-hoc "process modelling" tool 7 results	Title: Knowledge-based process management - an approach to handling adaptive workflow Author(s): Chung, PWH (Chung, PWH); Cheung, L (Cheung, L); Stader, J (Stader, J); Jarvis, P (Jarvis, P); Moore, J (Moore, J); Macintosh, A (Macintosh, A) Source: KNOWLEDGE-BASED SYSTEMS Volume: 16 Issue: 3 Pages: 149-160 Article Number: DOI: 10.1016/S0950-7051(02)00080-1 Published: APR 2003	Abstract
		Title: REVIEW OF RESEARCH IN TOOLING TECHNOLOGY, PROCESS MODELING AND PROCESS PLANNING .1. TOOLING AND PROCESS MODELING Author(s): MAROPOULOS, PG (MAROPOULOS, PG) Source: COMPUTER INTEGRATED MANUFACTURING SYSTEMS Volume: 8 Issue: 1 Pages: 5-12 DOI: 10.1016/0951-5240(95)92808-8 Published: FEB 1995	Duplicate
	Tutorial smartphone 13 results	Title: Web 2.0: Easy Tools for Busy Clinicians Author(s): Phillippi, JC (Phillippi, Julia C.); Buxton, M (Buxton, Margaret) Source: JOURNAL OF MIDWIFERY & WOMENS HEALTH Volume: 55 Issue: 5 Pages: 472-476 DOI: 10.1016/j.jmwh.2010.05.009 Published: SEP-OCT 2010	Abstract
	Informal "process modelling" 20 results	Title: From human knowledge to process models Author(s): Desel, J (Desel, Joerg) Edited by: Kaschek R; Kop C; Steinberger C; Fliedl G Source: INFORMATION SYSTEMS AND E-BUSINESS TECHNOLOGIES Book Series: Lecture Notes in Business Information Processing Volume: 5 Pages: 84-95 Published: 2008	Content
		Title: Formal support for an informal business modelling method Author(s): Chen-Burger, YH (Chen-Burger, YH); Robertson, D (Robertson, D); Stader, J (Stader, J) Source: INTERNATIONAL JOURNAL OF SOFTWARE ENGINEERING AND KNOWLEDGE	Content

		ENGINEERING Volume: 10 Issue: 1 Pages: 49-68 DOI: 10.1142/S0218194000000055 Published: FEB 2000	
	Informal "process modeling" 51 results	Title: What makes process models understandable? Author(s): Mendling, J (Mendling, Jan); Reijers, HA (Reijers, Hajo A.); Cardoso, J (Cardoso, Jorge) Edited by: Alonso G; Dadam P; Rosemann M Source: Business Process Management, Proceedings Book Series: LECTURE NOTES IN COMPUTER SCIENCE Volume: 4714 Pages: 48-63 Published: 2007	Content
	Ad-hoc "process modeling" 59 results	Title: Rule-Based Ad-Hoc Workflow Modeling for Service Coordination: A Case Study of a Telecom Operational Support System Author(s): Jung, JY (Jung, Jae-Yoon); Bae, J (Bae, Joonsoo) Source: IEICE TRANSACTIONS ON FUNDAMENTALS OF ELECTRONICS COMMUNICATIONS AND COMPUTER SCIENCES Volume: E93A Issue: 12 Pages: 2740-2743 DOI:10.1587/transfun.E93.A.2740 Published: DEC 2010	Access
		Title: Hypergraph-Based Modeling of Ad-Hoc Business Processes Author(s): Polyvyanyy, A (Polyvyanyy, Artem); Weske, M (Weske, Mathias) Edited by: Ardagna D; Mecella M; Yang J Source: BUSINESS PROCESS MANAGEMENT WORKSHOPS Book Series: Lecture Notes in Business Information Processing Volume: 17 Pages: 278-289 Published: 2009	Content
		Title: From Personal Task Management to End-User Driven Business Process Modeling Author(s): Stoitsev, T (Stoitsev, Todor); Scheidl, S (Scheidl, Stefan); Flentge, F (Flentge, Felix); Muhlhauser, M (Muehlhaeuser, Max) Book Author(s): Shan, MC (Shan, MC) Edited by: Dumas M; Reichert N Source: BUSINESS PROCESS MANAGEMENT Book Series: LECTURE NOTES IN COMPUTER SCIENCE Volume: 5240 Pages: 84-99 Published: 2008	Duplicate
		Title: REVIEW OF RESEARCH IN TOOLING TECHNOLOGY, PROCESS MODELING AND PROCESS PLANNING .1. TOOLING AND PROCESS MODELING Author(s): MAROPOULOS, PG (MAROPOULOS, PG) Source: COMPUTER INTEGRATED MANUFACTURING SYSTEMS Volume: 8 Issue: 1 Pages: 5-12 DOI: 10.1016/0951-5240(95)92808-8 Published: FEB 1995	Duplicate
	Ad-hoc "process modelling" 22 results	Title: Knowledge-based process management - an approach to handling adaptive workflow Author(s): Chung, PWH (Chung, PWH); Cheung, L (Cheung, L); Stader, J (Stader, J); Jarvis, P (Jarvis, P); Moore, J (Moore, J); Macintosh, A (Macintosh, A) Source: KNOWLEDGE-BASED SYSTEMS Volume: 16 Issue: 3 Pages: 149-160 Article Number: DOI: 10.1016/S0950-7051(02)00080-1 Published: APR 2003	Abstract
		Title: REVIEW OF RESEARCH IN TOOLING TECHNOLOGY, PROCESS MODELING AND PROCESS PLANNING .1. TOOLING AND PROCESS MODELING Author(s): MAROPOULOS, PG (MAROPOULOS, PG) Source: COMPUTER INTEGRATED MANUFACTURING SYSTEMS Volume: 8 Issue: 1 Pages: 5-12 DOI: 10.1016/0951-5240(95)92808-8 Published: FEB 1995	Duplicate
Scopus	Ad-hoc process documentation tool 20 results	Pfister, R.A., Eppler, M.J. The benefits of sketching for knowledge management (2012) Journal of Knowledge Management, 16 (2), pp. 372-382.	Duplicate
	Ad-hoc "process	Stoitsev, T., Scheidl, S., Flentge, F., Mühlhäuser, M.	Duplicate

<p>modelingⁿ tool 15 results</p>	<p>From personal task management to end-user driven business process modeling (2008) Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 5240 LNCS, pp. 84-99. Cited 4 times.</p>	
	<p>Maropoulos, P.G. Review of research in tooling technology, process modelling and process planning part I: Tooling and process modelling (1995) Computer Integrated Manufacturing Systems, 8 (1), pp. 5-12. Cited 20 times.</p>	<p>Duplicate</p>
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		creat* step-by-step (tutorial* OR guide* OR instruction*) (software OR tool* OR web-based OR *phone) 174 results	Patent Number(s): US2013061138-A1 Title: Computer-implemented method for creating step-by-step electronic web-based instruction manual to provide directions for e.g. assembling product, involves detecting entered title and entered step and storing manual in database Inventor Name(s): SPECTOR S L Patent Assignee(s): SPECTOR S L (SPEC-Individual)	Content
			Title: IBES: a tool for creating instructions based on event segmentation. Author(s): Mura, Katharina; Petersen, Nils; Huff, Markus; Ghose, Tandra Source: Frontiers in psychology Volume: 4 Pages: 994 DOI: 10.3389/fpsyg.2013.00994 Published: 2013-Dec-26	Duplicate
			Title: Creating Electronic Tutorials: On Your Mark, Get Set, Go! Author(s): Plumb, T. Source: Journal of Electronic Resources Librarianship Volume: 22 Issue: 1-2 Pages: 49-64 Published: Jan. 2010	Duplicate
			Title: MixT: Automatic Generation of Step-by-Step Mixed Media Tutorials Author(s): Chi, PY (Chi, Pei-Yu (Peggy)); Ahn, S (Ahn, Sally); Ren, A (Ren, Amanda); Dontcheva, M (Dontcheva, Mira); Li, W (Li, Wilmot); Hartmann, B (Hartmann, Bjoern) Book Group Author(s): ACM Source: UIST'12: PROCEEDINGS OF THE 25TH ANNUAL ACM SYMPOSIUM ON USER INTERFACE SOFTWARE AND TECHNOLOGY Pages: 93-102 Published: 2012	Duplicate
09.08.2014	Google Scholar	"Snapguide" 17 results	Intergenerational learning practices—Digital leaders in schools Don Passey Education and Information Technologies September 2014, Volume 19, Issue 3, pp 473-494 Date: 28 Mar 2014	Content
			Technische Konzeption und Realisierung einer mobilen Anwendung zur Durchführung von Lernübungen anatomischer Strukturen am Beispiel des Apple iOS Diplomarbeit Daniel Kopf April 2013	-
		„Instructables“ 1190 results	Product versus process: representing and appropriating DIY projects online Tiffany Tseng, Mitchel Resnick DIS '14 Proceedings of the 2014 conference on Designing interactive systems Pages 425-428	Duplicate
			Spice it up?: mining refinements to online instructions from user generated content Gregory Druck, Bo Pang ACL '12 Proceedings of the 50th Annual Meeting of the Association for Computational Linguistics: Long Papers - Volume 1 Pages 545-553	Content
			Learning how: the search for craft knowledge on	Duplicate

			<p>the internet Cristen Torrey, Elizabeth F. Churchill, David W. McDonald CHI '09 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Pages 1371-1380</p>	
			<p>How-To Web Pages Published in: Computer (Volume:40 , Issue: 8) Date of Publication: Aug. 2007 Page(s): 96 – 97</p>	-
			<p>Hybrid crafting: towards an integrated practice of crafting with physical and digital components Connie Golsteijn, Elise Hoven, David Frohlich, Abigail Sellen Personal and Ubiquitous Computing Volume 18 Issue 3, March 2014 Pages 593-611</p>	Content
			<p>DIY for CHI: methods, communities, and values of reuse and customization Leah Buechley, Daniela K. Rosner, Eric Paulos, Amanda Williams CHI EA '09 CHI '09 Extended Abstracts on Human Factors in Computing Systems Pages 4823-4826</p>	Content
			<p>→ result of the workshop: DIY HCI — A Showcase of Methods, Communities and Values for Reuse and Customization Von Leah Buechley et al.</p>	Content
			<p>Watch & Learn: Studying the Sharing of Everyday Knowledge with Instructional Videos Hugues, G.K., Gonzalez, V.M. Published in: Web Congress, 2009. LA-WEB '09. Latin American Date of Conference: 9-11 Nov. 2009 Page(s): 138 – 145</p>	-
12.08.2014	Google Scholar	“Wunderkind” (english results only) 68 results	<p>Individual differences in personal task management: a field study in an academic setting Mona Haraty, Diane Tam, Shathel Haddad, Joanna McGrenere, Charlotte Tang GI '12 Proceedings of Graphics Interface 2012 Pages 35-44</p>	Content
15.08.2014	Scopus	Rise of the expert amateur 9 results	<p>Sweet, C. Wikipedia's success and the rise of the amateur-expert (2012) Social Software and the Evolution of User Expertise: Future Trends in Knowledge Creation and Dissemination, pp. 13-36.</p>	Access
30.09.2014	Google Scholar	“Snapguide”	<p>Pey-Yu Chi - DemoCut: generating concise instructional videos for physical demonstrations</p>	-
09.10.2014	Scopus	Challenge* “business process management” 420 results	<p>Pflanzl, N., Vossen, G. Challenges of social business process management (2014) Proceedings of the Annual Hawaii International Conference on System Sciences, art. no. 6759082, pp. 3868-3877.</p>	Content
			<p>Alotaibi, Y. Business process modelling challenges and solutions: a literature review (2014) Journal of Intelligent Manufacturing, . Article in Press.</p>	Access
	Google scholar	Challenges business process management	<p>Indulska, M., Recker, J., Rosemann, M., Green, P. Business process modeling: Current issues and future challenges (2009) Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 5565 LNCS, pp. 501-514. Cited 39 times.</p>	Content
			<p>Bruno, G., Dengler, F., Jennings, B., Khalaf, R., Nurcan, S., Prilla, M., Sarini, M., Schmidt, R., Silva, R. Key challenges for enabling agile BPM with social software (2011) Journal of Software Maintenance and Evolution, 23 (4), pp. 297-326. Cited 38 times.</p>	-

	Van Der Aalst, W.M.P., Ter Hofstede, A.H.M., Weske, M. Business process management: A survey (2003) Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 2678, pp. 1-12. Cited 189 times.	-
Other	Rosemann, M. Potential pitfalls of process modeling: Part A (2006) Business Process Management Journal, 12 (2), pp. 249-254. Cited 30 times.	-
	Rosemann, M. Potential pitfalls of process modeling: Part B (2006) Business Process Management Journal, 12 (3), pp. 377-384. Cited 67 times.	-
	Verner, Laury BPM: The Promise and the Challenge (2004) Queue Magazine, 2 (1)	Content
	Van Der Aalst, W.M.P. A decade of business process management conferences: Personal reflections on a developing discipline (2012) Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 7481 LNCS, pp. 1-16. Cited 4 times.	Content
	Hull, R., Mendling, J., Tai, S. Business process management (2012) Information Systems, 37 (6), p. 517. Cited 2 times.	Content
	Ko, R.K.L., Lee, S.S.G., Lee, E.W. Business process management (BPM) standards: A survey (2009) Business Process Management Journal, 15 (5), pp. 744-791. Cited 115 times.	-
	Reijers, H.A., Freytag, T., Mendling, J., Eckleder, A. Syntax highlighting in business process models (2011) Decision Support Systems, 51 (3), pp. 339-349. Cited 19 times.	-
	Kowalkiewicz, M., Lu, R., Bäuerle, S., Krümpelmann, M., Lippe, S. Weak dependencies in business process models (2008) Lecture Notes in Business Information Processing, 7 LNBIP, pp. 177-188.	Access
	Recker, J., Rosemann, M., Indulska, M., Green, P. Business process modeling- A comparative analysis (2009) Journal of the Association of Information Systems, 10 (4), pp. 333-363. Cited 116 times.	-
	Aldin, L; de Cesare, S A comparative analysis of business process modelling techniques (2009) Proceedings of the UK Academy for Information Systems (UKAIS) 14th Annual Conference, Oxford, April 2009. 17 pages	Content
	Cabanillas, C., Resinas, M., Ruiz-Cortés, A. RAL: A high-level user-oriented resource assignment language for business processes (2012) Lecture Notes in Business Information Processing, 99 LNBIP (PART 1), pp. 50-61. Cited 3 times.	-
	Kherbouche, O.M., Ahmad, A., Basson, H. Using model checking to control the structural errors in BPMN models (2013) Proceedings - International Conference on Research Challenges in Information Science, art. no. 6577723	Content
	Schnabel, F., Gorrionogitia, Y., Radzinski, M., Lecue, F., Mehandjiev, N., Ripa, G., Abels, S., Blood, S., Mos, A., Junghans, M., Agarwal, S., Vogel, J. Empowering business users to model and execute business processes (2011) Lecture Notes in Business Information Processing, 66 LNBIP, pp. 433-448. Cited 1 time.	Content

10.10.2014	Other	Becker, Jörg; Rosemann, Michael; von Uthmann, Christoph Guidelines of Business Process Modeling (2000) Lecture Notes in Computer Science Volume 1806, 2000, pp 30-49	Content
		Recker, J., Safrudin, N., Rosemann, M. How novices model business processes (2010) Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 6336 LNCS, pp. 29-44. Cited 7 times.	-
		Recker, J., Safrudin, N., Rosemann, M. How novices design business processes (2012) Information Systems, 37 (6), pp. 557-573. Cited 5 times.	-
		Mendling, J. Empirical studies in process model verification (2009) Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 5460 LNCS, pp. 208-224. Cited 25 times.	-
		Nolte, A., Prilla, M. Normal users cooperating on process models: Is it possible at all? (2012) Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 7493 LNCS, pp. 57-72.	-
11.10.2014	Other	Prilla, M. Models, social tagging and knowledge management - A fruitful combination for process improvement (2010) Lecture Notes in Business Information Processing, 43 LNBIP, pp. 266-277. Cited 1 time.	Content
		Prilla, M., Nolte, A. Integrating ordinary users into process management: Towards implementing bottom-up, people-centric BPM (2012) Lecture Notes in Business Information Processing, 113 LNBIP, pp. 182-194. Cited 3 times.	Access
		Fleck, R., Fitzpatrick, G. Teachers' and tutors' social reflection around SenseCam images (2009) International Journal of Human Computer Studies, 67 (12), pp. 1024-1036. Cited 16 times.	Access
14.10.2014	Other	Gottanka, R., Meyer, N. ModelAsYouGo: (Re-) design of S-BPM process models during execution time (2012) Lecture Notes in Business Information Processing, 104 LNBIP, pp. 91-105.	Access

Table 9: Literature search diary

Appendix C – Evaluation Survey

Technische Universität München
Chair for Software Engineering for Business Information Systems (sebis)

Survey on Ad-Hoc Process Documentation and Evaluation of 'Stepster' Application

All data is collected anonymously and will be treated confidentially.

Group: _____

ID: _____

Time: _____

Success: _____

I. General Information

1. Gender
 Female Male

2. Age: _____

3. Current occupation (Cross as many as applicable)
 None Student, field of study: _____ Other: _____

4. Please state your proficiency in English.
 Beginner Advanced Expert Native tongue

II. Questions on Existing Knowledge about Smartphones

5. Do you currently own a smartphone?
 Yes. Model: _____, Operating System: _____ No

6. Do you have experience with other smartphones?
 Yes.
 Model: _____, Operating System: _____
 Model: _____, Operating System: _____
 Model: _____, Operating System: _____
 Model: _____, Operating System: _____

7. How often do you approximately use your smartphone?
 Less than a few times per week A few times per week A few times per day A few times per hour More than a few times per hour

III. Questions on Existing Knowledge about Process Documentation

8. What kinds of tutorials do you use?
 None I use _____

9. Where do you usually get tutorials from? (Cross as many as applicable)
 Instructables YouTube Snapguide Stps.co Ravelry
 Craftster Adafrit MAKE wikiHow Ray Wenderlich
 Other: _____

10. What kinds of formal process documentation methods do you know? Please state your level of expertise.
 Business Process Model and Notation: Beginner Advanced Expert None
 Event-based Process Chain: Beginner Advanced Expert None
 Unified Modeling Language: Beginner Advanced Expert None
 Case Management Model and Notation: Beginner Advanced Expert None
 _____ Beginner Advanced Expert
 _____ Beginner Advanced Expert
 _____ Beginner Advanced Expert

11. Approximately how many processes have you documented? _____

IV. Questions on the Process Documentation in the Evaluation

In this evaluation, you were given a process documentation to fulfill a task. The following questions relate to that process documentation.

12. I knew how to carry out the task before the evaluation.
 No ⇒ Please continue with question 15 Yes

13. Approximately how many times did you carry out the task? _____

Figure 37: Page 1 and 2 of the evaluation survey

<p>22. What overall grade would you give the application? (1 = very good, 6 = very bad)</p> <p style="text-align: center;"> <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 </p> <p>23. I consider the application a better representation of a tutorial than an illustrated text on paper.</p> <p style="text-align: center;"> <input type="checkbox"/> Strongly disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly agree </p> <p>24. Do you have any ideas how you would use this application?</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div> <p>25. I used the following elements of the application: (Cross as many as applicable)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Search function <input type="checkbox"/> Comments <input type="checkbox"/> Favoriting <input type="checkbox"/> Rating <input type="checkbox"/> Progress Tracking <input type="checkbox"/> Watching a video <input type="checkbox"/> Enlarging an image <input type="checkbox"/> Playing an audio recording <input type="checkbox"/> Navigating via map <p>26. What are your suggestions for improvement of the application?</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div>	<p>14. When was the last time you carried out the task? _____ months ago</p> <p>15. The process documentation was easy to understand.</p> <p style="text-align: center;"> <input type="checkbox"/> Strongly disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly agree </p> <p>16. Understanding the process documentation required previous knowledge.</p> <p style="text-align: center;"> <input type="checkbox"/> Strongly disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly agree </p> <p>17. The process documentation helped me fulfill my task.</p> <p style="text-align: center;"> <input type="checkbox"/> Strongly disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly agree </p> <p>18. What grade would you give the process documentation? (1 = very good, 6 = very bad)</p> <p style="text-align: center;"> <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 </p> <p>19. The process documentation could have been improved by</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div>
<p>V. Questions on the Application</p>	
<p>In this evaluation, you were also given an application that allows users to create and read process documentations. The following questions relate to that application.</p>	
<p>20. The application was easy to use.</p> <p style="text-align: center;"> <input type="checkbox"/> Strongly disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly agree </p> <p>21. I would use the application again.</p> <p style="text-align: center;"> <input type="checkbox"/> Strongly disagree <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Strongly agree </p>	
<p>4</p>	

Figure 38: Page 3 and 4 of the evaluation survey

Appendix D – Evaluation Results

Group	ID	Time	Success	Q1	Q2	Q3_N	Q3_S	Q3_StudentFieldOfStudy	Q3_O	Q4	Q5_o	Q5_model	Q5_OS	Q6_O
1	27	09:02,0	Scans correct	2	23	0	1	Math	0	2	1	iPhone 4S		0
1	18	13:30,0	Discontinued	2	24	0	1	Informatics	0	3	1	LG Nexus 5	Android	0
1	30	05:35,1	Scans correct	2	20	0	1	Information Systems	0	3	1	Samsung Galaxy S4	Android KitKat	1
1	4	06:36,8	Scans correct	2	23	0	1	Master Wirtschaftsinformatik	0	2	1	HTC One	Android	1
1	8	16:18,1	Scans incomplete	2	25	0	1	Informatik	0	2	1	Nexus 4	Android	1
2	24	13:23,3	Discontinued	2	20	0	1	Mathematics	0	2	0			0
2	9	06:19,1	Scans correct	2	25	0	1	Computer Science	0	3	1	Samsung Galaxy S3	4.2.2. Cuanogen	0
2	23	07:32,2	Scans correct	2	19	0	1	Informatik: Games Engineering	0	2	1	iPhone 4S/5S	iOS	0
2	17	11:57,3	Scans empty	2	19	0	1	Games Engineering	0	2	1	HTC One	Android	1
2	43	06:37,5	Scans correct	2	23	0	1	Financial Mathematics	0	3	1	iPhone 4	iOS	0
3	37	08:42,8	Scans correct	2	18	0	1	Informatik: Games Engineering	0	2	1	Sony Ericson Xperia M	Android 4.2	1
3	39	12:41,3	Scans correct	1	21	0	1	Mathematik	0	2	1	Samsung Galaxy S2	Android	0
3	16	06:00,9	Scans correct (after 2nd try)	2	22	0	1	Informatics	0	2	1	iPhone 4	iOS 7	0
3	33	07:04,1	Scans correct	2	17	0	1	Bsc Informatik	0	2	0			0
3	1	8:00,9	Scans correct	2	19	0	1	Informatik: Games Engineering	0	2	1	Motorola Razr	Android 4	0
4	7	08:53,9	Discontinued	2	26	0	1	Math & Info	0	2	0			0
4	28	06:00,4	Scans correct (but DIN A 3)	2	22	0	1	Medicine	0	3	1	Micromax A310	Android	1
4	14	06:29,7	Discontinued	2	28	0	1	Physics	0	2	1	Galaxy S5	Android	1
4	21	09:38,0	Scans correct	2	19	0	1	Maths	0	2	1	iPhone 4S	iOS	1
4	2	08:29,8	Scans correct	2	21	0	1	Mathematics	0	3	1	Blackberry Bolt		0
5	25	17:23,9	Scans correct	2	21	0	1	Electrical Engineering & Mathematics	0	3	1	Samsung Galaxy Note	Android	1
5	38	12:28,1	Scans correct	2	25	0	1	Informatik	0	2	1	LG G3	Android 4	0
5	47	13:31,8	Scans empty	2	21	0	1	Informatik: Games Engineering	0	2	1	Samsung Galaxy S5	Android	0
5	15	09:23,3	Scans correct but cut-off	2	18	0	1	Math	0	2	1	Samsung Galaxy Ace 2	Android	1
5	45	12:12,8	Scans correct	2	21	0	1	Inf: Games Eng	0	2	1	Lumia 520	WP 8.1	1

Table 10: Survey results page 1/4

ID	Q6_1Mod	Q6_1OS	Q6_2Mod	Q6_2OS	Q7	Q8_U	Q8_Kinds	Q9_I	Q9_Y	Q9_SG	Q9_St	Q9_R	Q9_C	Q9_A	Q9_M	Q9_WH	Q9_R	Q9_O
27					4	0		0	0	0	0	0	0	0	0	0	0	0
18					3	0		0	0	0	0	0	0	0	0	0	0	0
30	Samsung Galaxy S2	Android			4	0		0	0	0	0	0	0	0	0	0	0	0
4	iPhone 4	iOS			4	0		0	0	0	0	0	0	0	0	0	0	0
8	HTC Kozart	Winows Phone 7.8	iPhone 4S	iOS	4	1	Blog, websites	0	1	0	0	0	0	0	0	1	0	0
24						0		0	0	0	0	0	0	0	0	0	0	0
9					4	1	YouTube, edX, Instructables	1	1	0	0	0	0	0	1	0	0	0
23					3&4	1	Text/video	0	1	0	0	0	0	0	0	0	0	0
17	iPhone				4	1	video, text	0	1	0	0	0	0	0	0	1	0	0
43					3	0		0	0	0	0	0	0	0	0	0	0	Google
37	Samsung Galaxy S3	Android			4	1	Programmirtutorials	0	1	0	0	0	0	0	0	0	0	0
39					3	0		0	0	0	0	0	0	0	0	0	0	0
16					4	0		1	0	0	0	0	0	0	0	0	0	0
33					1	1	Dokumentationen zu Programmiersprachen	0	0	0	0	0	0	0	0	0	0	SO, msdh
1					5	0		0	1	0	0	0	0	0	0	1	0	0
7						1	the ones I find on the internet	0	1	0	0	0	0	0	0	0	0	Homepages
28	Micromax A110	Android	Samsung Galaxy S3	Android	4	0		0	0	0	0	0	0	0	0	0	0	0
14	Galaxy S3	Android	HTC Desire	Android	4	0		0	0	0	0	0	0	0	0	0	0	0
21	Samsung Galaxy S3	Android	Samsung Galaxy S4	Android	3	0		1	1	0	0	0	0	0	0	1	0	0
2					3	0		0	0	0	0	0	0	0	0	0	0	0
25	iPhone	iOS	HTC xDa Diamond	Windows	3	0		0	1	0	0	0	0	0	0	0	0	0
38					4	0		0	0	0	0	0	0	0	0	0	0	Books
47					3	1	videos	0	1	0	0	0	0	0	0	0	0	0
15	Samsung G. Gio	Android			4	0		0	0	0	0	0	0	0	0	0	0	0
45	iPhone 3G S	iOS 6	SE Satio	Symbian	5	1	computer things	0	1	0	0	0	0	0	0	0	0	SO

Table 11: Survey results page 2/4

ID	Q10_B	Q10_E	Q10_U	Q10_C	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22
27	0	0	0	0	0	0		4	2	5	2		Often a picture of the button will be helpful			
18	0	0	3	0	0	0		1	4	1	6		Visual representation of the task			
30	1	2	2	0	10	0		4	2	5	2		adding pictures of the scan button and the start button			
4	2	1	2	1	10	0		5	1	5	1					
8	1	1	2	2	2	0		5	1	2	2		No information about the first step to finish the task. No idea how to start the task.			
24	0	0	1	0	2	0		5	1	4	1		Numbers of used buttons from corresponding button documentation			
9	0	1	1	0	2	0		4	3	5	2		Pictures related to buttons in the context			
23	0	0	0	0	2	0		4	1	4	2		• Eindeutigeren Anweisungen bezüglich WO sich Knöpfe befinden (da große Auswahl) • Mögliche Nennung von Zwischen-Ergebnissen (in Text/Bild)			
17	0	0	2	0	5	0		2	4	3	3		• Highlight relevant buttons • Use screenshots • Leave out unnecessary information			
43	0	0	0	0	0	0		5	2	5	1					
37	0	0	0	0	1	0		5	2	5	2			2	3	4
39	0	0	1	0	0	0		3	2	3	2			3	2	2
16	0	0	1	0	5	0		4	1	5	1			5	4	2
33	0	0	1	0	5	0		5	1	5	1			4	3	2
1	0	0	1	0	0	0		5	1	5	2*		Being easier to find	3	4	2
7	0	0	2	0	0	0								1	1	6
28	0	0	0	0	0	0		2	5	3	6		• stating correctly which button to press in order to select scan mode • showing the latter in an adequate and accurate picture • explaining the right way how to switch to a two-sided original (in the tutorial the essential step was simply left out)	5	4	2
14	0	0	0	0	0	0								1	1	6
21	0	0	0	0	0	0		5	2	4	2			2	3	3
2	0	0	0	0	0	0		4	1	5	1			5	5	1
25	0	0	0	0	0	0		4	2	5	2		• less information on the start screen • labeling the buttons	5	5	1
38	0	1	0	0	0	0		3	4	4	2		Pictures	2	3	3
47	0	0	0	0	0	0		4	1	4	1		größere Buttons, einfacherere Möglichkeit zum 'Zurück-Tippen'	4	4	2
15	0	0	1	0	2	0		5	2	4	1			4	3	3
45	0	0	0	0	0	0		3	2	5	4		Pictures, videos, gifs, etc.	2	3	5

Table 12: Survey results page 3/4 (*anomaly: changed from 5 to 2)

ID	Q23	Q24	Q25_S	Q25_C	Q25_F	Q25_R	Q25_P	Q25_V	Q25_I	Q25_Ao	Q25_M	Q26
37	2		1	0	0	0	0	0	0	0	0	Hilfestellungen, welche Funktionen angeboten werden. Die Symbole auf dem Startbildschirm helfen kaum, sich zurechtzufinden
39	4		1	1	0	0	0	0*	1*	0*	0*	
16	5		1	0	0	0	0	0	0	0	0	
33	4		1	0	0	0	0	0	0	0	0	Erklärung d. einzelner Symbole bzw. ein Hilfe-Button
1	5	For finding simple tutorials as well as creating them	1	0	0	0	0	0	0	0	0	Create two separate areas for consumers and producers of tutorials. Have a start page with recent or popular tutorials
7	2		1	0	0	0	0	0	0	0	0	1. Remove Search Function 2. Make sure everything can be found as fast as before 3. Add Search Function
28	3		1	0	0	0	0	0	0	0	0	• back/forward controls should be more prominent
14	5		1	0	0	0	0	0	0	0	0	
21	4	No	1	0	0	0	0	1*	0*	0	0	Better structure
2	2		1	0	0	0	0	1	0	0	0	
25	5	Review the scanning process	1	0	0	0	0	0	0	1	0	Including pictures to every step
38	4		1	1	0	0	0	0	0	1	0	A easier to use main menu
47	5	Für das Verständnis von Drucken, Fax-Geräten und anderen Bürogeräten	1	0	0	0	0	0	0	1	0	siehe 19. Die App ist auf einem sehr guten Weg und echt nützlich. Mit ein paar Verbesserungen: 5/5 Sterne
15	2	Not a lot, a lot of serious steps need to be done. A tutorial on paper or a website can do the same and is faster to use	1	0	0	0	0	0	0	1	0	
45	3	Not really	1	0	0	0	0	0	0	1	0	Tutorial

Table 13: Survey results page 4/4 (*anomalies: changed to media type that was actually present)