



The Integrated User Experience



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AT OVSOFTWARE

**Bachelor Thesis Industrial Engineering
and Management**

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OF TWENTE.**

Bachelor thesis Industrial Engineering and Management

The integrated user experience at OVSoftware

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Preface

Dear reader,

You are about to read the bachelor thesis “The Integrated User Experience at OVSoftware” The research has been executed at OVSoftware in Enschede as final assignment for my bachelor Industrial Engineering and Management at the University of Twente. This thesis aims to improve an existing Document Management System called ATLAS Online in a user-friendly way.

At OVSoftware, I got the opportunity to work at the office in the difficult Covid-19 period. I want to thank them for giving me this space because, in this way, I came in contact with a lot of pleasant OVSoftware colleagues. Furthermore, I want to thank them for their enthusiasm and interest in me as a person and their contribution to my assignment. We will see each other in the future.

Special thanks to my company supervisor, Rune de Groot. For his time, great feedback and help regarding a topic that was new for me. Next to the informative meetings, there was always room for a good conversation. That gave me a lot of inspiration and insights into my project and the software world.

And, of course, a special thanks to my UT supervisor Ipek Seyran Topan. The feedback was helpful and in such a positive way that it kept me motivated for making progress. In addition to this, the meetings lifted my confidence in achieving decent results.

Additionally, I had like to thank my second UT supervisor, Adina Aldea. For her expertise and feedback that came at the right moment and pushed me in the right direction.

Lastly, I want to thank my family, friends and roommates for their support during the execution of this research. They always supported me. Special thanks to my two groups of peer buddies for their feedback and inspiration.

Jimmy van Santen

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Management summary

This research is conducted at OVSoftware in Enschede. Their goal is to make work easier and more efficient by developing software. Within OVSoftware, there is a Document Management System speciality. They tried to serve the changing markets by developing a Cloud-based Document Management System (DMS) called ATLAS Online. A DMS is a system used to manage and store digital documents in a structured manner. This system makes it possible to keep records of revisions of documents created or modified by different users. OVSoftware's goal is to sell ATLAS Online as a Software as Service (SaaS) solution. They prefer sales through a third party like the Microsoft Store but, they are not ready to serve the market yet. They want to reach the market in a few steps but, they cannot differentiate themselves from competitors. Although, this is possible by providing integrations with communication applications and so, increase the User Experience (UX), resulting in the main research question:

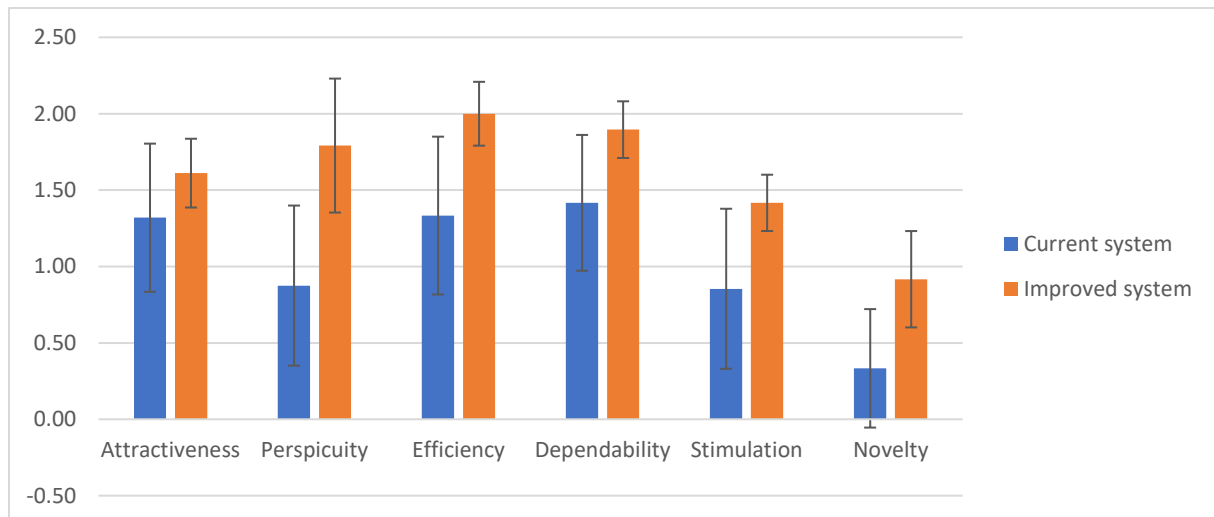
How to integrate ATLAS Online in a user-friendly way?

The Design Science Research Methodology (DSRM) for Information Systems supports answering the main research question. This method provides continuous improvement and process iterations. But, before designing a new system, it is essential to analyse the current system by including a class diagram, a data model, an application landscape and multiple Business process models. This analysis showed that ATLAS Online has potential but still has many points for improvement in the document's uploading process. In the current system, the average number of clicks to upload a document is ten. Besides this, the average cycle time is 40 seconds due to manually filling document types and attributes. The desired average amount of clicks and cycle time are respectively: 6 and 25 seconds.

After analysing, evaluating and working with the system, four focus points are reached as a scope of this thesis:

1. Make the Add document button clearer in the design of the web application.
2. Automatically fill attributes and document types when saving a document.
3. Providing drop-down lists to search in existing data
4. Create the design to integrate ATLAS Online with Microsoft Outlook in a user-friendly way.

Moreover, the improved interfaces are compared to the current system with a User Experience Questionnaire (UEQ) in the figure below. This UEQ shows that for perspicuity, efficiency and novelty, there is a significant difference in the advantage of the improved system. So, this means the user gets easier familiar with the product, can solve their tasks without unnecessary effort and, the design catches the user's interest.



UEQ Current and Improved System

A literature study on user-friendly DMS interfaces is conducted to realise an organised design. With the help of Adobe XD, this resulted in an interactive design and reduced the average number of clicks to 3 and the cycle time to 15 seconds. The table below presents these KPIs. The overall Key Performance Indicator (KPI) of the user experience for the improved system is significantly better than the current system. The overall KPI for the user experience in the improved system is 1.64 and for the current the KPI is 1.05. This means that the UX went from a good to an excellent assessment.

Comparison Current and Improved system

	Current system	Improved system
Average cycle time (seconds)	40	15
Average Amount of clicks	10	3
KPI Overall User Experience	1.05	1.64

The estimated time to make these improvements is three months of work for one full-time employee and the investment costs around €25,000. That means that an ATLAS Online license with a margin of 10 euros results in selling an additional 105 licences per month to earn back the investment in 2 years.

For further research, the final design of this research still needs extra user involvement to guarantee the best user experience. Furthermore, the functional design first needs elaborated market research because will the revenues outweigh the costs? This market research answers the question: Is it worth it? Is the market waiting for this solution? And what is the value proposition of ATLAS Online? However, if ATLAS Online wants to differ from competitors, it has to make the functional integration based on the final design of the interfaces.

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Reader's guide

This bachelor thesis provides how the research at OVSoftware is performed. We briefly introduce the chapters.

Chapter 1: Introduction

The first chapter introduces the research. The first section describes the main activities of OVSoftware. Furthermore, the following section introduces the research methodology. Finally, the core problem within this research is provided.

Chapter 2: Theoretical perspective

This chapter provides the theoretical perspective. The first section provides theory on class diagrams and modelling methods. The second section provides a literature study regarding user-friendly DMS interfaces. By benchmarking competitors and describing different design guidelines. It concludes with the integration of the theory.

Chapter 3: Current system

This chapter gives inside into the current system of ATLAS Online. It provides a class diagram and a data model to describe the structure of the DMS. Further, the current system explains the users and applications landscape. Next to this, the BPM models discuss the detailed process flows. Finally, a questionnaire evaluates the current system.

Chapter 4: The improved interfaces

This chapter gives the improved designed interfaces. These interfaces are based on user-friendliness and go through multiple design cycles.

Chapter 5: The evaluation of the improved design

The fifth chapter evaluates the improved design by conducting a User Experience Questionnaire (UEQ). That makes it possible to compare the current and the improved system. Furthermore, the evaluation leads to the final designs.

Chapter 6: Conclusion, recommendations and future research

The last chapter provides the conclusions and recommendations about the performed research. In addition to this, the future research and contribution to practice are explained.

List of acronyms

API	Application Programming Interface
BPM	Business Process Model
BPMN	Business Process Model and Notation
DMS	Document Management System
DSRM	Design Science Research Method
GUI	Graphical User Interface
HCI	Human Computer Interaction
KPI	Key Performance Indicator
MPSM	Managerial Problem Solving Method
OCR	Optical Character Recognition
OWL	Web Ontology Language
RQ	Research Question
SaaS	Software as a Service
SLR	Systematic Literature Review
TDMS	Technical Data Management System
UEQ	User Experience Questionnaire
UI	User Interface
UML	Unified Model Language
UX	User Experience
VUI	Voice-controlled Interface

1 Introduction

This bachelor thesis is conducted at OVSoftware. The main goal is to improve an existing Document Management System. Section 1.1 introduces the reader to the company and provides the problem context. In Section 1.2 the problem identification starts with the problem cluster that is ending up in the core problem. Finally, Section 1.3 provides the research design.

1.1 Company description

OVSoftware is a software company located in Enschede, Apeldoorn, the Hague and Münster. Their goal is to make working more efficient by developing software. With 50 years of experience in projects for different large customers, there is still a lot to discover, which is why they research new platforms and tools adjusted to the continually changing markets (OVSoftware, n.d.).

OVSoftware consists of software developers, architects, analysts, test engineers, scrum masters and project managers. They conduct internal projects at multiple different companies or institutions. An example is a project with Company A, an international leader on butterfly valves. In this project, they developed a Technical Data Management System (TDMS). Furthermore, OVSoftware is involved in Blockchain development and research. Besides this, OVSoftware posts developers at, for example, Company B to work on a Combat Management System or posts developers at other companies like Company C, Company D or Company E. Within all their projects, OVSoftware uses the Lean-Agile development that focuses on continuous improvement and delivery (OVSoftware, n.d.).

Problem context

To serve the changing markets, OVSoftware started to develop a cloud-based document management system (DMS) called ATLAS Online. A document management system is a system used to manage and store digital documents in a structured manner. ATLAS Online makes it possible to keep records of revisions of documents created or modified by different users. Examples DMSs in the market are d.3 from Company Z and a solution from Company Y. OVSoftware concluded that their DMS, ATLAS Online, has potential but is not ready to serve the market. Figure 1 provides an overview of the ATLAS Online interface. Unfortunately, this interface is currently only available in Dutch (*ATLAS Online*, n.d.).

OVSoftware wants to improve ATLAS Online towards a Software as a Service solution (SaaS) by adjusting it to customer needs. So, it is possible to differentiate from competitors and find out requirements to go live on platforms like the Microsoft store. In generic terms, this means that the main goal is to generate sales through a third party. Thus, customers can access ATLAS Online through the Microsoft Store and use it for Microsoft applications like

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Microsoft Outlook and Teams.

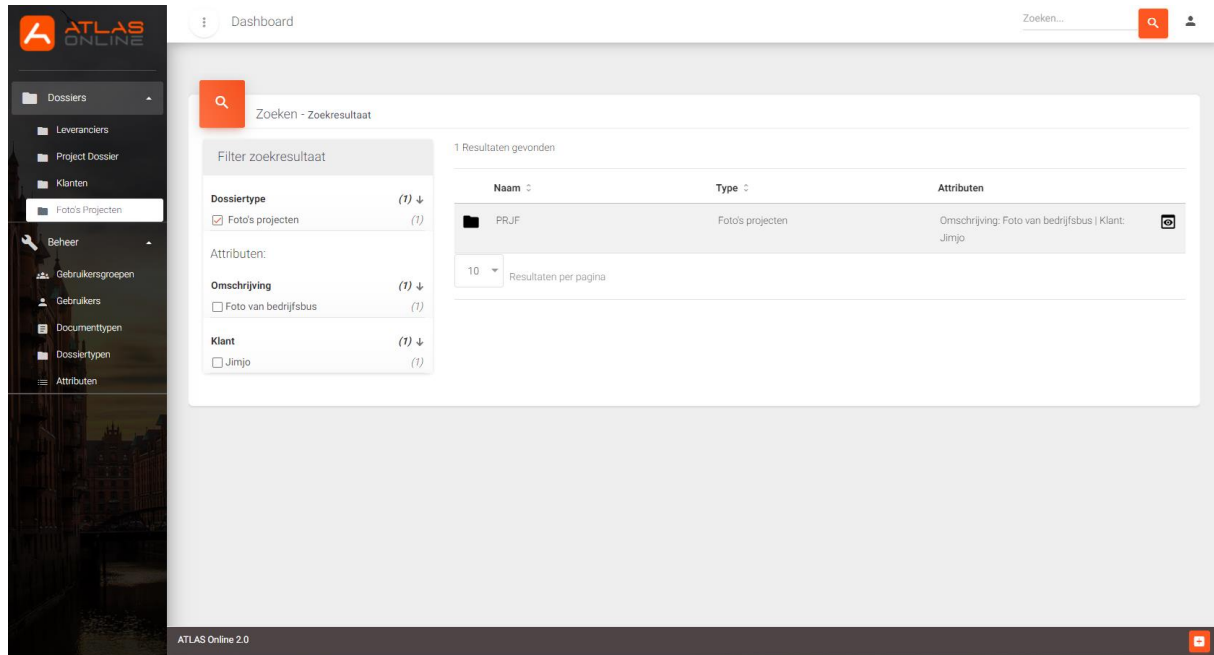


Figure 1: The current interface of ATLAS Online

Moreover, they want to differentiate from other DMS applications by offering a more integrated version that is easy to use and install. Thus, not be an application with a separate web application interface but with an application programming interface (API). It is possible to integrate with communication applications like Microsoft Teams or Microsoft Outlook. Integration means a better User Experience (UX) because if the application connects with Teams or Outlook, the user takes fewer steps in the process. In addition, the Covid-19 situation stimulates the increasing use of communication applications that asks for a solution regarding managing, storing, tracking and receiving documents. The main reason is that companies want a grip on their document flows to keep control of their business processes. In other words, if an e-mail or document comes in, it must be saved in the right place within a few mouse clicks. Thus, for OVSoftware, it is essential to meet customer needs. So, the integration should be user-friendly.

As the final product, OVSoftware asks for the first product in the Microsoft ecosystem. Thus, the product has to connect with the Microsoft Store. In this way, it is possible to use the DMS in, for example, Microsoft Outlook or Microsoft Teams.

1.2 Problem identification

The problem identification phase is conducted to find the core problem. This section uses the first phase of the Managerial Problem Solving Method (MPSM) from Heerkens and Winden (2017). This phase starts with providing the problem context. This results in a list of problems provided in Section 1.2.1 and results in a problem cluster. Finally, ending with the core problem in Section 1.2.2.

1.2.1 Problem cluster

This section constructs the problem cluster after conducting several semi-structured interviews with four stakeholders. It results in a list of issues and is the fundament of the problem cluster. This cluster identifies the core problem by tracking back to the cause of all problems. The core problem is the fundament of my bachelor thesis. (Heerkens & van Winden, 2017).

List of problems/challenges

- There are multiple other Document Management Systems that have more functionalities. As a consequence, ATLAS Online cannot differentiate itself from competitors.
- ATLAS Online and OVSoftware should have a generic standard to release their products on different online markets.
- Requirements are unclear. As a result, it is not possible to launch an application on different platforms. Thus, which requirements does ATLAS Online must have to mark the system as finished and ready to serve the market.
- ATLAS Online does not meet customer demand because the system does not focus on communication applications with the highest document flow.
- Low sales.
- There is no integration with applications used for communication, for example, Microsoft Outlook or Microsoft Teams.
- OVSoftware makes for almost every customer a tailored solution, while a lot of tailored solutions result in high cost.
- Low profit

The list of problems and challenges results in the problem cluster. Figure 2 depicts the problem cluster that shows the relationship between cause and effects. No integration with communication applications (coloured in red) results in not meeting customer demands and no differentiating from competitors. Finally, ending up in low sales. No defined requirements for entering online platforms (coloured in yellow) result in not meeting customer needs resulting in low sales. Besides this, it results in an unclear generic standard that results in tailored solutions. Finally, ending in low sales and high cost because they need more time than generic solutions. With the result that the profit is low.

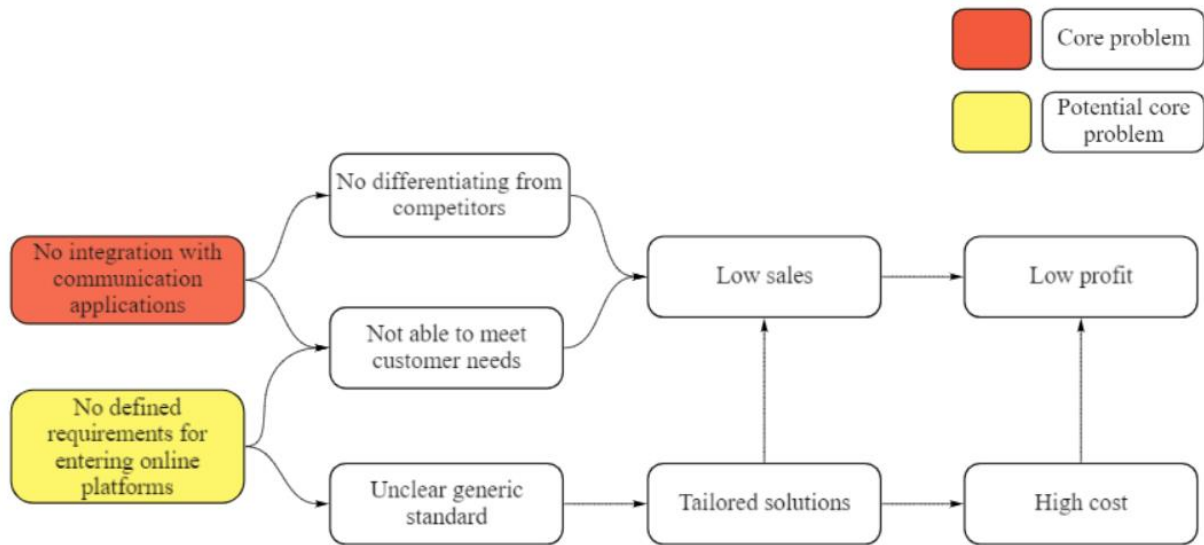


Figure 2: Problem Cluster

1.2.2 Core problem

This section starts to define and motivate the core problem. Figure 2 depicts the core problem in red. Table 1 provides the core problem by using variables, norm, reality, and problem owner. The core problem is the action problem that the research aims to solve (Heerkens & van Winden, 2017).

Table 1: Action problem definition

Variable	Norm	Reality	Problem owner
The cover of customer needs (out of 10) based on the degree of integration and user-friendliness	8 out of 10; an integrated version of ATLAS Online including a user-friendly interface	6 out of 10; No integration, only a separate application which can be ordered manually	OVSsoftware is responsible for this problem
Action problem = [variables + (norm - reality) + problem owner]			
The cover of customer needs is a 6 out of 10 and needs to score 8 out of 10. Thus, in the desired situation, ATLAS Online is integrated with a communication application and includes a user-friendly interface for OVSsoftware. The reality is that there is no integration, and ATLAS can only be ordered manually. Resulting in the action problem: How to integrate a Document Management System in a user-friendly way?			

Explanation: The cover of customer needs is an indicator for an integrated version of ATLAS Online, including a user-friendly interface. After consultation with the company supervisor and operational manager, the reality is that the cover is a 6 out of 10 because, with no integration, ATLAS Online works but does not differentiate from competitors in the market because it is just another separate DMS system. Moreover, the order process of ATLAS Online takes too long because OVSsoftware must tailor its solution. That is why the grade of the cover of customer needs is a 6. To conclude, ATLAS Online has potential but is not ready to serve the market.

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The norm is that the cover of customer needs is an 8 out of 10. It is defined in cooperation with the company supervisor and operational manager. A user-friendly integration increases the cover of customer needs but leaves room for improvement. Finally, ending with the action problem on how to integrate a Document Management System in a user-friendly way.

Table 2: Grade scale of the cover of customer needs

Grade	Meaning
1-2	No integration and no usable application
3-4	No integration possible but separate working application
5-6	Working application and possible integration but not user-friendly
7-8	User-friendly integration
9-10	(Nearly) Perfect user-friendly integration

A **grade scale** for the variable cover of customer needs makes the problem measurable. Table 2 shows the grade scale. The grades are based on **the degree of integration and user-friendliness**. Besides this, they are the result of consultations with the company supervisor and operational manager. Thus, the cover of customer needs is based on the degree of integration and user-friendliness. Besides this Section 3.5, The evaluation of the current system measures the User Experience of the current system.

1.3 Research design

This section provides the research design. First, Section 1.3.1 gives the research objective. Next, Section 1.3.2 provides the research methodology. In Section 1.3.3, the research question is given. Further, Section 1.3.4. provides the research deliverables. Finally, Section 1.3.5 describes the limitations and constraints.

1.3.1 Research objective

Section 1.2 defines the core and action problem. The core problem results in a research objective. The goal is to improve ATLAS Online towards an integrated user-friendly DMS. As a consequence, ATLAS Online must be integrated with a communication application. In the first instance, the integration focuses on Microsoft Outlook.

1.3.2 Research methodology

For improving an existing Document Management System (DMS), the Design Science Research Methodology (DSRM) for information system research is used. This method is used because the improvement on the DMS is designing an integrated DMS that result in a new way of modelling the process, ending up in a user-friendly interface. Figure 3 shows the nominal process sequence of the DSRM (Peffer et al., 2007). Besides this, the first phase from the MPSM method is used to identify and motivate the problem. Section 1.2.2 identifies and motivates this problem (Heerkens & van Winden, 2017). Thus, the DSRM starts at the second phase of defining the objectives for a solution. Section 1.3.2 provides the second phase with the help of research questions and desired deliverables. Next to this, the third phase consists of design and development. The fourth and fifth phases are consisting of demonstrating and evaluating the designs. These two phases lead to new improvement points

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and requirements so, the designs need to be improved because it is an iterative process. Finally, it leads into the final phase of communication.

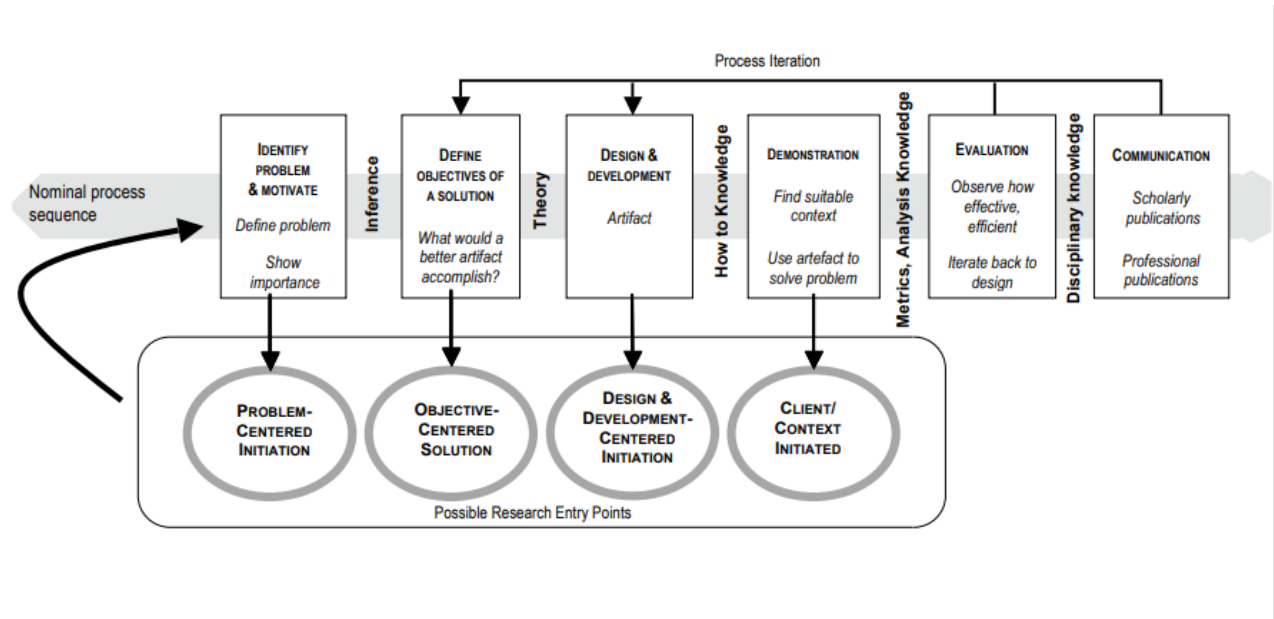


Figure 3: Design Science Research Methodology (DSRM) Process Model (Peffer et al., 2007)

1.3.3 Research questions

This section provides the research questions that solve the initial problem. The research questions answer a phase from the Design Science Research Methodology. This method is described in Section 1.3.2. Table 3 shows how the research questions are addressed in terms of type of research, subjects, method of data gathering, deliverables and which phase of the DSRM method. Besides this, the table addresses which chapter answers the research questions. The following research questions are here to answer the main research question.

“How to integrate ATLAS Online in a user-friendly way?”

This main research question is based on integration and user-friendliness. The main research question results in multiple other research questions.

1. *How to use Business Process Model and Notation (BPMN) to model functionalities and structures of an integrated version of ATLAS Online?*

To improve ATLAS Online theory on BPMN, DMS and databases are analyzed with a Systematic Literature Review (SLR) that makes it possible to analyze and model the existing workflows. Appendix A provides this Systematic Literature Review.

2. *How can we model the current system with the use of Business process modelling and other modelling methods?*

The second research question uses Business Process Model and Notation (BPMN) and other methods for modelling the current system.

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3. What defines a good user-friendly interface for integrated applications?

A literature study on user-friendly interfaces results in a theory in what to include for a user-friendly interface. This theory is used for designing improved interfaces for the integrated application of ATLAS Online.

4. What can we use from existing document management system integrations with communication applications to reach the desired solution?

A literature search and web search on existing solutions make it able to analyze the existing DMS integrations. Thus, analyzing and describing existing integrations resulting in requirements for the improved system.

5. How to design a user-friendly interface?

After analyzing the current system and finishing the literature studies, the design is made with the advice of the company supervisor. Besides this, other colleagues and students make a questionnaire about the current system that leads to new improvement points.

6. How to evaluate the user-friendly interfaces?

Interviews take place with the company supervisor and potential users to evaluate the designed interfaces. The interviews are semi-structured and lead to revisions and further improvements. Next to this, a questionnaire helps to understand how the user experiences the interfaces. The interviews are semi-structured and lead to revisions and improvements.

Table 3: Research cycles for the research questions

Research question (RQ)	Type of research	Subjects	Method of data gathering	Deliverables	Phase of DSRM
RQ1- Chapter 2: Theoretical perspective	Explanatory	BPM modelling, Document Management Systems	Systematic literature review	Visual presentation, qualitative	Define objectives of a solution
RQ2- Chapter 3: Current system	Descriptive	BPM modelling, Databases, DMS	Analyzing current system	Visual representation, qualitative	Define objectives of a solution
RQ3- Chapter 2: Theoretical perspective	Explanatory	User-friendliness, Interface, Integrations	Literature study	List of requirements	Define objectives of a solution
RQ4- Chapter2: Theoretical perspective	Explanatory	Existing integrations	Desk research	List of usable requirements	Define objectives of a solution
RQ5- Chapter 4: Improved system	Explanatory	Designs and interfaces	Interviews	First design, Test design	Design and development
RQ6- Chapter 5: Evaluation improved system	Evaluative	Evaluation, Stakeholder analysis	Surveys, Semi-structured interviews	Final design	Demonstration and evaluation

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1.3.4 Deliverables

This section provides the intended deliverables at the end of the research. These deliverables are the result of answering the research questions.

- *Business Process Model (BPM) for current and improved system*

After analyzing the current system with the use of Business process modelling, it is improved towards an integrated design. The design consists of Business process modelling and shows the process steps of the integration.

- *Integrated and user-friendly interface of a document management system for a communication application*

For the integration, it must be user-friendly. Thus, to make it in practice, the designed interfaces are provided as deliverables.

- *The recommendations*

The recommendations provide advice on how to progress with ATLAS Online.

1.3.5 Limitations and constraints

This section discusses the limitations and constraints. This all, because the research induces possible limitations and constraints.

The research is based on first analysing and modelling the system, then improving the system, ending with modelling and evaluating the improved system. In addition, the interface designs for the improved system are made. These designs focus on theory regarding user-friendly interfaces and other already existing Document Management Systems (DMS). For designing these interfaces, there is a limited amount of time, approximately ten weeks. It is good to know that it is difficult to obtain a perfect result in only ten weeks. By researching with the best intention and preparation, it will result in the best possible design. Due to the time limitation it is essential to have a certain focus on the intended deliverables. These deliverables must be of a high standard. However, if there are 10 improvement points than it can result in 4 points of focus due to time limitation. It is important to research which points are in the scope of this research. Thus, overall, the research time is limited and will result in further research in the future.

Moreover, the research is limited to the acquired knowledge about DMSs and integrations. To make the best integration, we will provide the interface and the Business process model behind it. This knowledge is limited to the necessary technical aspects because the scope of the research is designing rather than implementing the integration. However, if detailed technical aspects are needed the company supervisor is the expert in the technical details. Furthermore, the company supervisor can estimate the potential cost of the integration, in this way, we estimate if the integration is realistic. To conclude, it is essential to communicate well with the company supervisor to understand the technical aspects and know the possibilities of the integrations.

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Furthermore, the access to user data is limited because OVSoftware did not sell ATLAS Online to customers yet. As a consequence, the user experiences are limited. The impact of this limitation is that we need to create a user experience and link this experience to an evaluation survey or questionnaire to get data that can be transformed in quantitative numbers.

Next, validity is defined as the extent to which a concept is accurately measured (Heale & Twycross, 2015). So, the questionnaire needed for evaluating the current and improved system should measure the User Experience (UX) and not something else. As a consequence a well-defined questionnaire should be used to measure the right UX. In addition to validity, reliability focus on the consistency of a measure (Heale & Twycross, 2015). Thus, the if a questionnaire is conducted multiple times the outcome should be approximately the same.

The interviews with stakeholder are semi-structured interviews. In this way, the interview stays flexible and the questions are adapted to the respondent's answer. This results in an increased validity because the interviewer can ask for clarification. However, the limitation is that this style of interviewing can be time-consuming.

Speaking of generalizability of results, it is possible that the respondent group from the questionnaire is too small and need to be bigger to generalize the results

2 Theoretical perspective

This section provides certain theories and explains why a certain theory is chosen. Not all of the theories are used thus, after briefly explaining those theories, a specific theory is chosen and motivated. Because in order to come to an integrated user-friendly application, certain theories are used to explain, visualize and design the desired solution.

2.1 Modelling methods

To model the current and the improved system, the Business Process Model and Notation (BPMN) method is used. To make sure this method is used in the right way for modelling the structures and functionalities of an integrated Document Management System (DMS) a systematic literature review (SLR) is conducted in Appendix A. The SLR answers the following research question: How to use BPMN to model functionalities and structures of an integrated DMS? To answer this research question matching search terms and creating and implementing the right strategy are essential. The search term used are based on DMS and BPMN. The strategy is based on trial and error. The following paragraph provides the results of the SLR. More elaborated information regarding the research question is provided in Chapter 3.

The first model to visualize a business process is the Business Process Model and Notation (BPMN) AS-IS model (Weske, 2012). This model is used to visualize the current system. After improvements and changes made to the AS-IS model the other model, the TO-BE model is used to visualize the desired system. (Khrykova et al., 2021)

The Unified Modelling Language (UML) is widely used due to the quick and accurate design (Pătraşcu, 2015). This modelling language is used to model the class diagram of the current system. Besides the use of the UML, the Web Ontology Language (OWL) is used. Building an ontology is a process that represents the exact description of the system and especially the relations within the system (Pătraşcu, 2015).

2.2 Class diagram

This section provides a class diagram and data model of ATLAS Online. The first part explains what a class diagram is and how to interpret a class diagram. Next, to understand the class diagram of ATLAS Online, a short explanation of the ATLAS Online features is given. Finally, the last part provides the class diagram and data model with explanations.

A class diagram provides insight into the data structure of the current system. This diagram describes the structure of a static system. A class diagram is helpful for developers and other team members because, with this diagram, developers can specify the systems or subsystems. A class diagram contains relationships between classes and relationships between entity classes. Parent-child relationship, dependency and realization represent relationships between classes. Associations, compositions or aggregations represent relationships between entity classes (Pătraşcu, 2015). The graphical notation to develop components of a DMS is the Unified Modelling Language (UML). This notation offers developers the fundament to build a clear structure. Besides this, the UML gives one standard language for object-oriented

methodologies. As a result, there are no differences between symbols, notations or diagram types anymore (Pătraşcu, 2014).

For ATLAS Online the relationships consist of aggregation and composition. An aggregated relationship means that one class is built out of another class. Figure 4 shows the example of the class “library”, and a library is made out of one or more books. In all aggregations and also in this example the class “books” is not strongly dependent on the lifecycle of the class “library”. If the library is gone the class “books” will stay a life. The line from the parent class to the child class represents the aggregation in the diagram with a diamond shape near the parent class (Nishadha, 2020).

Composition relationships are almost the same as aggregation relationships. The difference is that with compositions, the class “books” is strongly dependent on the lifecycle of the class “library”. If the library is gone, the class “books” is destroyed too. Figure 4 shows the line from the parent class to the child class, with a filled diamond shape near the parent class (Nishadha, 2020).

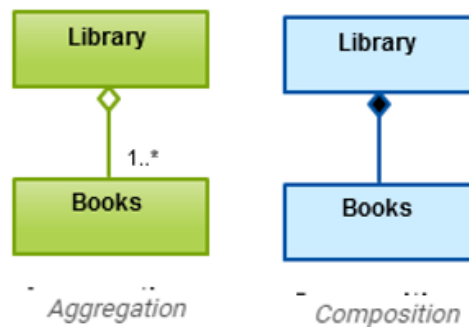


Figure 4: Aggregation and composition in relationships (Nishadha, 2020)

2.3 The user-friendly DMS interface

This chapter describes the theory about user-friendly DMS interfaces for ATLAS Online. Section 2.3.1 benchmarks other DMS solutions and integrations. Further, Section 2.3.2 provides information about the User Interface design. Section 2.3.3 gives more insight into the graphical user interface. Next to this, Section 2.3.4 provides the seven commands when designing for people. Finally, Section 2.3.5 concludes in how to use this theory for the design of ATLAS Online.

2.3.1 Benchmarking

There are seven DMS features: Cloud access, Intelligent organization, Attractive user interface, Robust Search Features, Versioning, Permissions and Universal Format Support (Eisenhauer, 2014). Chapter 3 describes the current system of ATLAS Online and addresses many features. Although ATLAS Online has five of these features, namely: Cloud-access, Robust Search Features, Versioning, Permissions and Universal Format Support, it can still improve on the Intelligent organization and the Attractive user interface. The intelligent

organization makes sure that the user needs fewer steps for performing tasks. The attractive user interface makes sure the application is easily understandable due to the focus on the user. This chapter provides a literature study to improve the user interface and organization.

To jump into the gap and sell ATLAS Online as Software as a Service (SaaS) solution it is essential to look at what competitors are doing. The question is, in terms of features and integration, how competitors differentiate themselves? Thus, competitors sell their DMSs as one unified access point to all information. They do this by creating integrations with SharePoint, Teams, Outlook, Salesforce, Word, Excel, PowerPoint etc. (M-Files, 2019). All these document providers, storage services and communication applications are creating and storing documents in different places. But when integrating the DMS with these applications, the user can get access to all incoming information flows.

Within all these integrations and add-ins, we focus on **Office** integrations because businesses use them widely in their daily operations. With these integrations, it is possible to drag documents from the desktop tab into the DMS. The Teams add-in specifies members within a team through multiple channels because content related to these channels is related to a specific customer, knowledge group, department etc. In the Teams environment, it is nice to add the DMS environment as a tab. Furthermore, content can be related to different repositories, for example, Drive, SharePoint, Dropbox etc. The Outlook integration can look the same as the Teams integration (Microsoft, 2021). Besides this, it is possible to see other documents than e-mails because the DMS is accessible in these integrations. Moreover, the Outlook integration automatically generates attributes and recognizes document types. Thus, the DMS automatically fills with data from the corresponding e-mail message and document.

The DMS acts on keywords like invoice, correspondence, offer etc. These keywords are linked to document types. The user uploads a document and, a few clicks later, it is saved into the DMS. Furthermore, when the user communicates with a customer, the user can easily access the information related to this customer. The user can either copy-paste the data or send it in the attachments.

2.3.2 User Interface design

The following sections of this chapter are based on the book *The Essential Guide to User Interface Design* (Galitz, 2002). In the user-friendly interface design, it is essential to consider the User Interface (UI) design. UI design is concerned with the overall feel and surface. This design is the method designers use to build interfaces in software or computerized devices. Within this method, the designers focus on looks or style. The designers aim to make the interface easy to use and pleasurable.

The UI design refers to graphical and other forms of interfaces, for example, voice-controlled interfaces. A voice-controlled interface (VUI) is an interface users interact with through their voice. Examples of VUIs are Google Assistant and Siri on the iPhone. Another example is gesture-based interfaces. The users interact with their bodies in 3D design spaces in, for example, virtual reality games. The interface of ATLAS Online is a graphical user interface (GUI). The user interacts with a visual representation of ATLAS Online.

Users judge designs quickly because users care about the usability and likeability of an interface. They want to complete their tasks as easy and fast as possible. Thus, the user is not interested in the interface but in finishing their working processes. That is why it is crucial to understand the context and tasks flow of the user. As a result, the user will get a smooth and careless experience. Next to this, users should enjoy their experience as well. A design predicting the user's wishes results in a more personalized experience. This experience increases the feeling of being in control and supports the user to become more engaged with the system. In addition to this, gamification can make sure the users enjoy their experience. With gamification, designers insert gameplay elements in non-gaming settings. In this way, the users feel more engaged. Lastly, a design can touch upon the emotions of the user. With an emotional design, the user associates the design with, for example, a good feeling so, the UI communicates as a brand value and increases user confidence.

Developers use guidelines to create inspiring and flawless designs. Firstly, they place buttons and other common elements in a way that users can use them everywhere. The form should follow the function. Secondly, UIs should maintain high discoverability. Thus, this means that icons should be labelled clearly and include affordances.

Furthermore, the designer needs to keep interfaces simple and create an “invisible” feeling. In addition to this, the designer should consider the user’s eye and attention regarding layout. So, they use proper alignment and draw attention to the main features. With visualization, the goal is to produce the image with the most relevant information. In this way, visualizations can increase productivity. In addition to this, the visual contrast between various components of the screen should draw attention. Moreover, the design should match the medium. Nowadays an interface should align with a smartphone, PC, laptop etc.

Finally, Grouping and structing are fundamental in UI design. Groups and items should match their natural order. Thus, the screen order aligns with the natural order. Designers use boxes to group logical items and fonts to emphasize them. Furthermore, users read from left to right in the text. Thus, the text aligns to the left-hand side (Interaction Design Foundation, n.d.).

2.3.3 The Graphical User Interface

Human-computer interaction (HCI) is the design of how people and computers work together. The Graphical User Interface (GUI) is an extension of the real world. Moreover, the success of a GUI depends on the skills of its designers. Further, it is good to know that nobody ever gets a design right the first time. Besides this, the development is full of surprises.

The input of the graphical user interface is coming from the user. The user communicates with the computer using a mouse and keyboard or with the use of touchscreen etc. The output of the GUI is the result the computer conveys to the user. For ATLAS Online it is the display screen that shows the result. The impact of an inefficient screen design is enormous because they lead to time losses in processing screens. For companies, this means their employees are working slower. For example, one task can take 10 seconds in the ideal situation but, in the current situation, it takes 20 seconds. If the amount is very high, this results in enormous delays.

Humans are limited in their recognition memory. Continuous visibility of objects and actions eliminates the out of sight problem. Thus, “The design goal is to build a hierarchy of menus and pages that feels natural, is well structured, is easy to use, and is truthful” (Galitz, 2002). In this way, the revealed structure is clear to the user so, if users have the intention to do an action, then the outcome of the action should align with this.

Lists, drop-down and combination boxes support the user's memory. These lists do not force the user to remember the key entries. For ATLAS Online it is important to work with list boxes because when entering a sales invoice from an existing customer, there should be a list to select this customer. After all, the sales invoice connects with the dossiers of the customer.

In a GUI, there are two forms of manipulation, indirect and direct manipulation. Indirect manipulation is a textual list of operations by using the keyboard. Besides this, direct manipulation is pointing at a menu icon by using the mouse.

Symbols are less dependent on national languages than words. They make it possible to make one application easily accessible for multiple large groups of users. Different interface styles also have different strengths and weaknesses. That is the reason why it is essential to consider user preferences. In some cases, words are more meaningful than symbols.

Object Orientation

Objects are the components users see on their screens. A system is well designed, as the user keeps focusing on the object and not on how to carry out actions. Thus, make it as easy for the user as possible. The effect of actions on objects should be visible. So, this experience should guide users in the right direction. In other words, this is called movement control. As a result, developers provide large objects for essential functions. The signal to perform an action is called a “click”. The motor activity required to identify the element for a proposed action is called a “pick”. The user should interpret the click and picks in the right way. As a consequence, the performance of the application will increase.

People make use of graphical designs. They are interactive, visual experiences presented through screens. Often, they consist of many similar components, which increases the reliability of the system. As a result, the user can easily understand and use the system. So, the system is easy to learn, which means that the user can use the system without first learn and then use the system. So, the process flow should be optimal. Besides this, the user controls the interaction. Overall, **consistency** helps to learn how the application works. It supports the learning process of users. They can transfer skills learned in one situation to apply them to a new one.

Furthermore, **simplicity** is fundamental for clear designs. It is good to hide objects until they are needed, which is called progressive disclosure. In addition, this results in a hierarchical organization. In this disclosure, a category name is still visible but, the information remains hidden until activated. Moreover, simplicity presents necessary functions first, which results in not too much functionality and keeps it simple because complex systems are often not fully used. Therefore, make frequent actions simple and so, keep them consistent.

An efficient design starts with adopting the user's perspective and understanding the user's point of view. A common mistake from developers is that they think users think the same as they do but, that is not the case. The fundamental principle in interface design is knowing the user. The user **compatibility** happens only if the user and developer understand each other. Moreover, task and job compatibility are essential. The user should never navigate between screens and applications to complete their daily jobs. Thus, the structure of the application should lead to an easy transition between jobs and tasks. Finally, product compatibility values the user's requirements above the technical ones. Thus, when making a new system, the developer considers other interfaces the user worked with in previous applications or systems. As a consequence, the user established habits, expectations and knowledge about previous systems. So, the developer should take this into account when developing a new interface.

In designing a new system, the developer avoids errors as much as possible but, when an error occurs, the system provides constructive messages to help the user. Moreover, the system shows in-process messages and no blank screens. Besides this, the system informs the user, which means it provides feedback when a process takes longer than usual. With help messages, the user can learn by trial and error. If something is missing a recovery system should ensure that user never loses their work. Overall, it needs to have high **responsiveness** (Galitz, 2002).

2.3.4 Designing for People: The Seven Commandments

When designing for people, the designers consider seven commandments. These commandments include team diversity, user involvement and understanding, design and prototype creation, testing, integration of system components, modification and iteration. Moreover, this section addresses usability.

1. Provide a multidisciplinary design team.

In creating a design, it is essential to have a team that consists at least of Development, Interface Design, Visual Design, Usability assessment, Documentation and Training. Because effective design and development require diverse talents but, all the members of the design team have one similarity they need to be user-oriented, which is because user-oriented designers are superior to computer-oriented designers.

2. Solicit early and ongoing user involvement

Involve the users as early as possible and in the whole process. So, involve the user in determining requirements, setting up prototypes, testing prototypes, training to use the system and giving feedback after system delivery. In terms of users, there is a difference between end-users and customers. End-users directly use the system while customers buy the system because they want to use it in their business. Early user involvement leads to a more accurate set of requirements and improved user acceptance.

3. Gain a complete understanding of users and their tasks.

Gain a complete understanding of all users, including end-user, customers and other parties. Each of these customers has different goals that are why it is needed to set performance goals. The end-user wants a fast-working system, the customers and other parties have business goals they want to reach with the system.

4. Create the appropriate design.

To create the appropriate design. It is good to create more than one design simultaneously because, in this way, other designers and users can give feedback to multiple mock-ups. As a consequence, the selection process takes longer but, this prevents going for just one design. Because in this manner, the end design consists of multiple other mock-ups, it avoids dead ends.

5. Perform rapid prototyping and testing

Quick delivery of prototypes and tests increases the chance of success because this will result in a high amount of feedback. Setting up requirements is one thing but working them out is something else. As a result of prototyping and testing, developers quickly identify problems and have time to develop solutions.

6. Modify and iterate the design as much as necessary

Iterative design means continually evaluate and improve, from the start to the end of the design process. The evaluation consists of feedback to ensure the system requirements meet user needs. This feedback results in improvements points whereby the developer modifies the designs. These modifications lead to new prototypes which arrive in the iterative feedback process again. The designers continue this process until they reach the desired solution (Interaction Design Foundation, 2021).

7. Integrate the design of all the system components.

All system components should align with the same design to ensure consistency. Consistency results in a smooth transition between system components and makes sure the users understand the system well.

Usability

Next to these seven commands, usability is fundamental when designing for people. The system should be easy and effective in terms of task orientation. In this way, humans can use the system. However, it is good to question if people want to use the product? Too much flexibility and as many functions as possible result in higher interface complexity. Higher complexity requires more learning and results in less efficient human performance. People learn by trial and error and respond negatively to poor design (Galitz, 2002).

2.3.5 Integration of theory and current system

This section integrates the theory of the previous sections. Thus, this section links the literature to the improvement points and ATLAS Online. In Section 3.5, the current system of

ATLAS Online, there were four focus points: the add document button, manually filling in the attributes and document types, providing drop-down lists and the overall process of adding a document.

Section 3.1 addresses the main features of a DMS. ATLAS Online covers most of the features but can improve on intelligent organization and attractive user interface. These features link to the focus points. The add document button is part of the user interface, manually filling in the attributes, links to intelligent organization. The overall process of adding documents link to both organization and user interface.

Furthermore, competitors are selling their DMS products as one-unified access point to information. They reached this point by having multiple integrations with communication applications, storage applications and writing applications. When focusing on Microsoft Office integrations, the competitors have their DMS accessible in the integration. As a result, this should be of high focus in the overall design process of adding a document. Furthermore, they automatically generate attributes and document types in this way, the user finishes in a few clicks.

The improved design should focus on uploading a document as easy and fast as possible. Thus, the ATLAS Online user focuses on object and finishing actions and not on how to do this. ATLAS Online should provide the optimal process flow with consistent elements. Thus, frequently used buttons need to be in visible locations. So, the add document button is placed in a visible place as well. Further, lists, drop-down and combination boxes should support the user's memory. Therefore, if the system cannot automatically generate attributes, it should provide, for example, a list of already existing customers.

Fortunately, Chapter 3 describes and evaluates the current system from the user's perspective. Explaining the DMS from the user perspective will increase user compatibility. With the consequence of a complete understanding of users and their tasks in ATLAS Online. Moreover, ATLAS Online should keep informing users of guidelines and other messages. The user involvement should be high because this prevents the problem when designers only show the end product to the customer. This end product often results in negatively surprised faces due to a difference in interpretation of functions and requirements. Finally, Chapter 4 provides multiple designs to avoid dead ends.

3 Current system

This chapter describes the current Document Management System (DMS) ATLAS Online. Firstly, Section 3.1 provides a class diagram and data model. Next to the class diagram, Section 3.2 describes the users of the current system. Section 3.3 provides the application landscape. Section 3.4 provides the Business process models of the current system. All these models have an elaborated explanation and evaluation. Moreover, Section 3.5 gives the results of a questionnaire to evaluate the current system. Finally, Section 3.6 provides the focus and improvements points.

3.1 ATLAS Online structures

Before explaining the class diagram, it is good to know the basic features of ATLAS Online. In the first place, it is possible to only save the document after adding attributes. As a result, the document is saved with metadata. In other words, the documents are saved with the descriptive characteristics of the document. Metadata makes searching easier and consists of subject, date, supplier, customer number, document name etc. Next to the attributes, ATLAS Online has document types. A document type is comparable with a category. In this category or document type, the documents are saved. A document type is linked to attributes because these attributes give characteristics to a document type. Next to creating document types, there is the possibility to create dossiers. These dossiers are linked to attributes. These attributes make it possible to create the dossier. A customer number is an example of such an attribute. The dossiers give the possibility to build up a structure where it is easy to search for documents. An example is a customer with an order dossier that consists of correspondence (e-mail), invoice, order, offer. The last feature of ATLAS Online is the possibility to distribute rights on either document type or dossier level. In addition to this, these rights are distributed to individual users or groups of users (*Features – ATLAS Online*, n.d.).

3.1.1 The class diagram

Figure 5 shows the class diagram. First, it is essential to understand what a “Tenant” is. The tenant makes sure that the user’s ATLAS Online application environment belongs to the user’s organisation. The tenant functions as a container where the items of the user’s organisation are stored. Thus as an example, “User A” who works for “Company X” sees the ATLAS Online environment of Company X and “User B” who works for “Company Y” sees the ATLAS Online environment of Company Y (Saxton, 2015).

Next, a “DocumentContentType” represents a new document type. This “DocumentContentType” is connected with a “DocumentContentTypeAttribute”. Thus, each document type connects to 1 or more attribute(s). These attributes have values, namely, a “ContentAttributeValue”, for example, an invoice has a specific date or a customer has a specific customer number. Besides this, an attribute can consist of an attribute list, namely, a “ContentAttributeList”. For example, the list “Customers” can consist of multiple customers. Thus, each attribute list can consist of multiple attribute list items which all have an attribute value. When linking attributes to a dossier type, it is needed to select one or more “DossierContentTypeAttribute(s)”. Next to this, it is required to mark one or more attribute(s)

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as the dossier type's identifier and one or more attributes are required attributes. The attribute values are the document's and dossier's metadata. They make it easier to structure and search for data.

As mentioned in the previous paragraph, to both document and dossier types, rights can be applied. For document types these are "DocumentContentTypeRight(s)" and for dossier type, these are "DossierContentTypeRight(s)". In addition to this, rights are assigned to groups or users. Moreover, ATLAS Online has application rights for groups and users. If the user or group has no application rights, it is only possible to upload, edit, release or delete documents. It is not possible to change the structure. Thus, the user is not permitted to edit user groups, users, document types, dossier types and attributes. Else the user or group has application rights and is a so-called administrator that makes it possible to change the structure. When a user carries out actions with a document the audit is updated. Thus, the audit shows the user who did this and notes the date and time. Next to the audits there are revisions. If a document is released, it is sent to the archive. Then it is possible to upload a new version of the document while the other one is still in the archive.

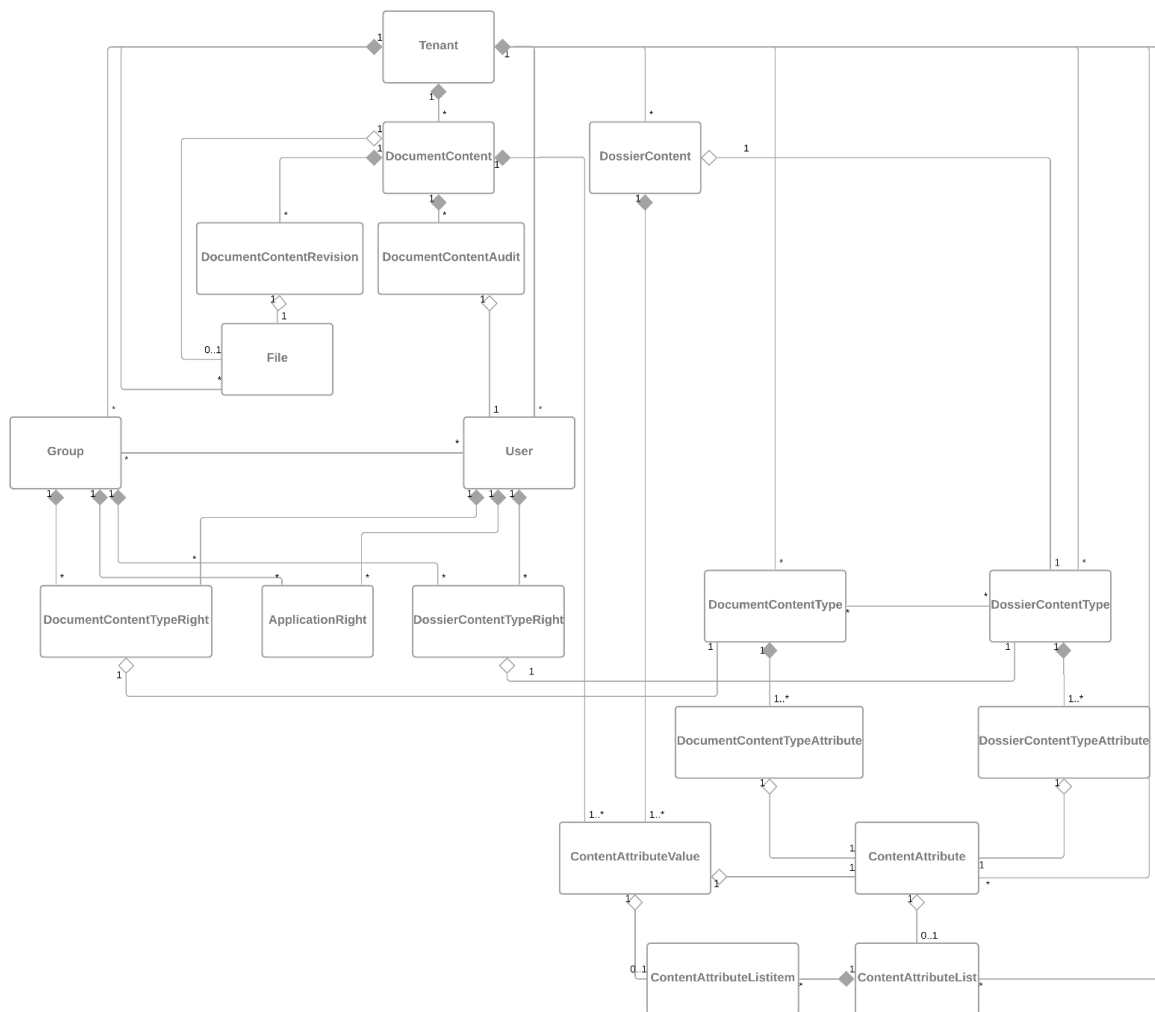


Figure 5: Class diagram

3.1.2 The data model

Data models define how the database is implemented. For ATLAS Online it is interesting to see how the data is related and connected (See Appendix B). In the first place, there is the Tenant that has got a key which is Id. This is the foreign key for lots of other tables in the data model by the name TenantId. This Id makes sure that the user's environment is the environment of the related company or institution. In the Content table, the discriminator differentiates between Dossier or Document related content. In the Content type table, the discriminator differentiates if the Content type is related to a Dossier Type or a Document Type. Furthermore, the data model shows rights are either distributed on the individual user or group level. These rights are related to Application, DocumentContentType and DossierContentType.

3.2 Users

The main focus groups of ATLAS Online are accountancy and advocacy offices. Because many advocacy offices start working with full digital documents, these documents are coming along with deeds and court cases. They mainly consist of correspondence by e-mail with this they exchange Word and Excel documents. For accountancy offices, ATLAS Online is valuable too. The processing of financial documents requires a lot of exchange. In addition to this, ATLAS Online is a Software as a Service (SaaS) solution for small and medium sized enterprises.

A document management system has three types of users, namely, **the end-users, administrators and designers**. The end-users are the ones who are benefitting from the Document Management System. They are using it to look up, view and upload information. The administrators create access profiles for users. Besides this, they ensure the security of the system. The administrator is often an employee within a company. The designers are the makers behind the Document Management System. In the case of ATLAS Online, it is the company OVSoftware. The designers are responsible for the structure behind the system. These are mainly the entities, relations, and views (Visual Paradigm, 2021).

3.3 Application landscape

This section provides the application landscape of ATLAS Online. Figure 7 shows this landscape and further explains the different components in the landscape of ATLAS Online.

The Application Programming Interface (API) is a communication protocol that allows different software programs to exchange data. In the system of ATLAS Online, the API ensures the communication between the ATLAS Online web application and the DMS. Besides this, the API is for integrations with other applications like Microsoft Outlook. With the API, it is possible to let Outlook communicate with the ATLAS Online DMS. The API is the messenger so, if an Outlook user directly wants to upload a document into ATLAS Online, the API brings these messages to the ATLAS Online DMS. As a result, it is possible to directly upload documents from Outlook to ATLAS Online (MuleSoft, 2016).

The Optical Character Recognition (OCR) Service is connected to the DMS. This service makes full-text search possible in written text or image files. So, the text within these files is

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converted into a machine-readable form. Thus, the API gives the document with, for example, a picture to the OCR service and the OCR service gives text back. This means for ATLAS Online that as a picture with text is uploaded, the user can search on words within this picture. This makes it possible to find the picture fast (Hyland, 2021).

Next to the OCR service, the Search Index is connected to the DMS. The index makes it possible to search in a fast way. A search index can be compared with an index often found at the end of a book. This index includes an organised list with keywords. The keywords refer to a page where useful information about the keyword is listed. Of course, a web search index works way faster and has more possibilities than indexes in books. ElasticSearch keeps track of the index and is a database in where it is possible to search and find documents fast. The ATLAS Online API sends all the OCR data and other attributes to ElasticSearch. As a consequence, this results in fast searching. Kibana gives insight into real-time analytical views of all the data (Elastic, 2021). Another difference between a book and a website or application is that a book has a static index while a search index is dynamic since a website and application are constantly created and updated. The search index returns a search result from an index with the use of a specific method. It starts with the user who types in a search query. With the outcome, that the search engine finds the results that include the search query. This method includes searching in the “Google” way by searching through a free-text field. In ATLAS Online the results are returned from the index with the name, document type and attributes. The search results are directly prioritized and thus, some results will stand above others because they are given more weight. In addition to this, ATLAS Online shows facet filters, these filters are automatically adjusted to the date within the system. Figure 6 shows these facet filters in the yellow box.

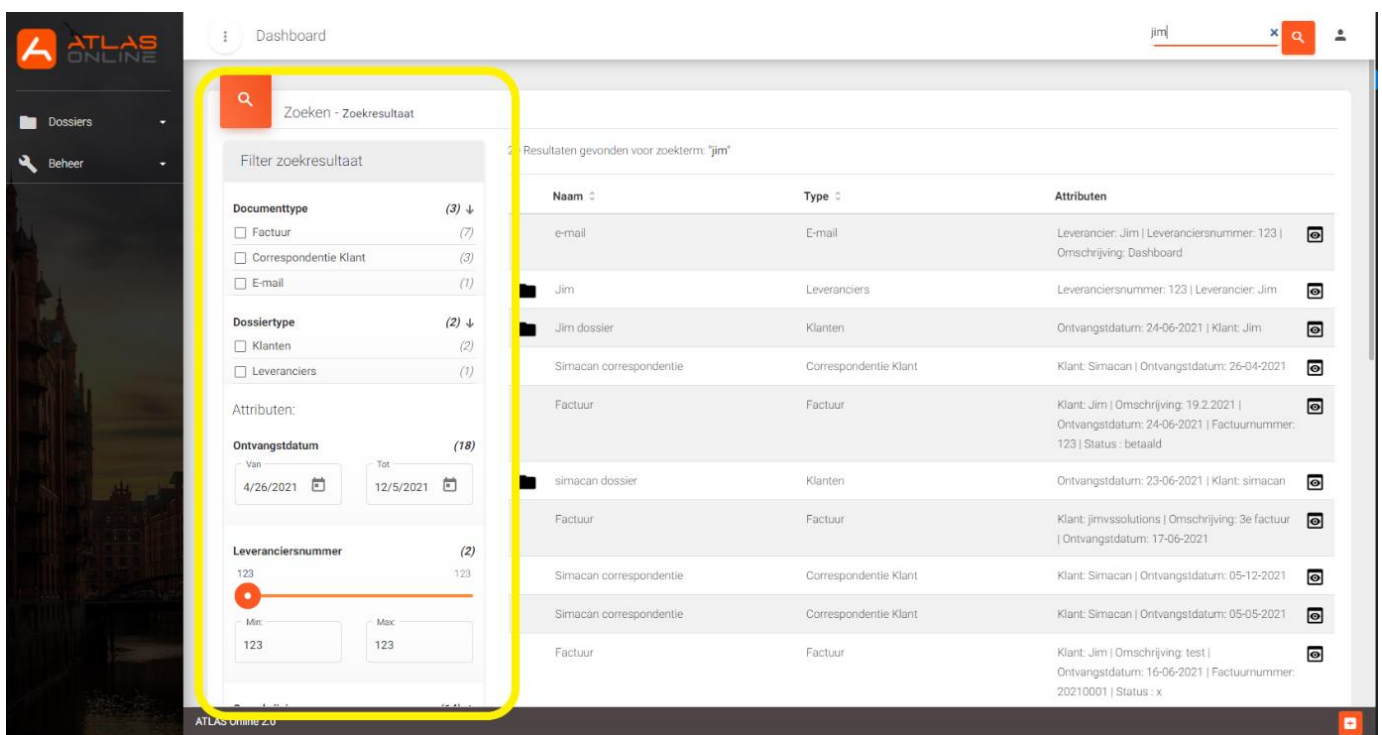


Figure 6: The facet filters

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If the database is not organized with an index, the results will pop up much slower. In addition to this, the Search Index used in ATLAS Online has a certain error margin to still find the right results also when making typing or spelling errors. This means that if the user types in “buke” instead of “bike” the result with "bike" will still pop up high in the search results. Furthermore, it is possible to search on synonyms and is possible to search through the facet filters (AddSearch, 2019).

In order to preview documents a Rendition Service is connected to the DMS. This service is connected to FileShare because the file paths are stored in the database but the files themselves are stored in the FileShare. These web-based viewers convert Office files into PDF files because Office files are difficult to preview without an Office add-in. Images are not converted into PDF files because the user views images without converting them to PDF. Thus, converting is not needed for images. This all makes it possible to preview different files.

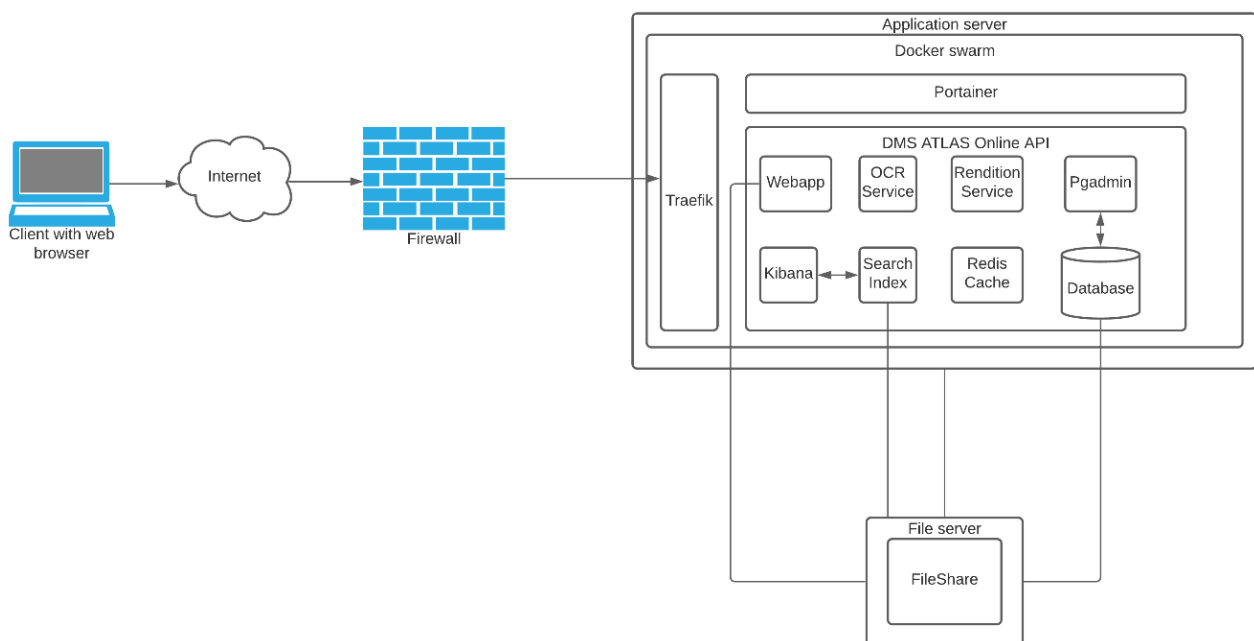


Figure 7: The application landscape

Figure 7 shows that ATLAS Online is a **cloud based DMS**. So, with the use of a web browser, the client is connected to the internet. All the external traffic needs to be authorized by Azure AD. Besides this, due to the firewall, the client can only access the Angular web application which functions as the front end. The web application is connected with FileShare to save and edit documents. The application server is located behind the firewall even as the Docker swarm within the application server and the file server with the corresponding File Share. Traefik is a reverse proxy makes sure that the traffic entering the ATLAS Online is guided in the right directions.

Docker is a platform to run and develop applications. Docker makes it possible to separate the developers' applications from its infrastructure. In this way, it is possible to run applications in an isolated environment called a container. A container contains everything needed to run an application. Containers make it easy to dynamically manage workloads (Docker, 2021).

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Portainer functions as the User Interface (UI) for the Docker Swarm environment. In ATLAS Online Portainer makes it easy to manage the docker containers.

Next to this, pgAdmin is a management tool for PostgreSQL that is a relational open-source database. Finally, Redis Cache is connected to the DMS. Redis stands for Remote Dictionary Server. It is a fast, open-source data store. All Redis data is stored in memory that is different than with databases that store data on a disk. Thus, with the in-memory data Redis can access data in microseconds instead of accessing a disk which takes much longer (Nnakwue, 2020).

3.4 Business process models

To model the current system, we model from the user's perspective. The models are AS-IS models. These models represents the current system of ATLAS Online. Subsection 3.4.1 shows the process of uploading a document. In addition to this, Subsection 3.4.2 provides the process of searching for a document and Subsection 3.4.3 gives the process of performing action on documents. Finally, Subsection 3.4.4 evaluates the current system in terms of bottlenecks.

3.4.1 Upload a document

Figure 8 shows the whole process of an incoming file towards uploading the file in the DMS ATLAS Online. In the next pages this process is explained from macro to micro level. Thus, first the whole Business process model is given and shows the complexity of the current system. The blue box represents Figure 9: The fastest way to save a document into ATLAS Online, the yellow box represents Figure 10: Making a new document type with the possibility to add attributes, the red box represents Figure 12: Dividing rights and the purple box represent Figure 11: Select and create dossier types.

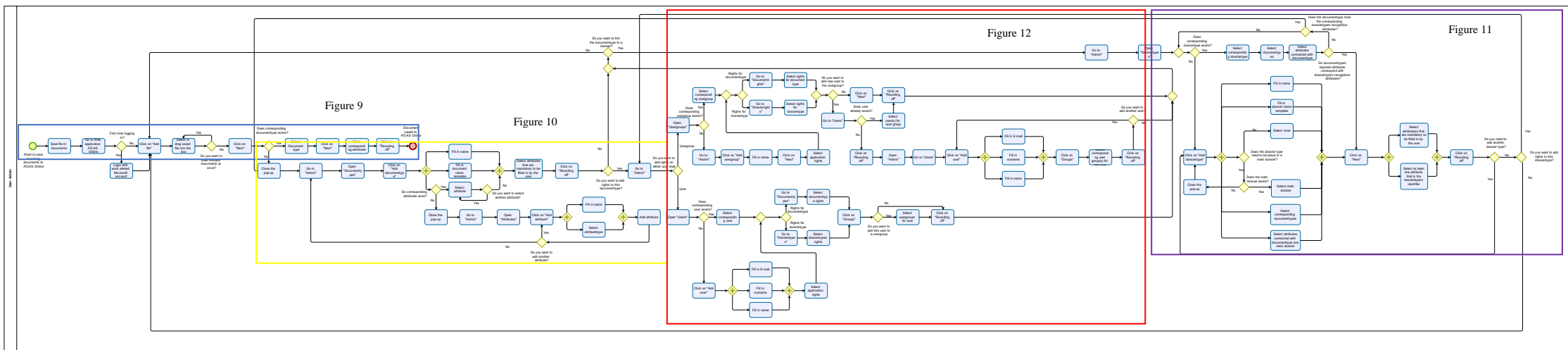


Figure 8: Document's uploading process

Figure 9 shows a smaller part of this process. This process starts with an incoming file or document that has to be saved locally into documents or File explorer. After this step, the web application ATLAS Online is launched. If it is the first-time logging in, the user should log in with its work-related Microsoft account, else the user automatically logs in. The user arrived at the home screen of ATLAS Online. Now, the user has to click on “Add file”, a pop-up is opened. The user selects or drags a previously saved file into the box. If needed the user can select multiple files at once. After clicking on next, the user has to add a document type to the document. If the document type exists, the user can select the document type and fill in the corresponding attributes. When clicking on “Rounding off” the document is saved into ATLAS Online, else the pop-up needs to be closed. This is **the fastest way** to save a document into ATLAS Online, it requires 9 steps.

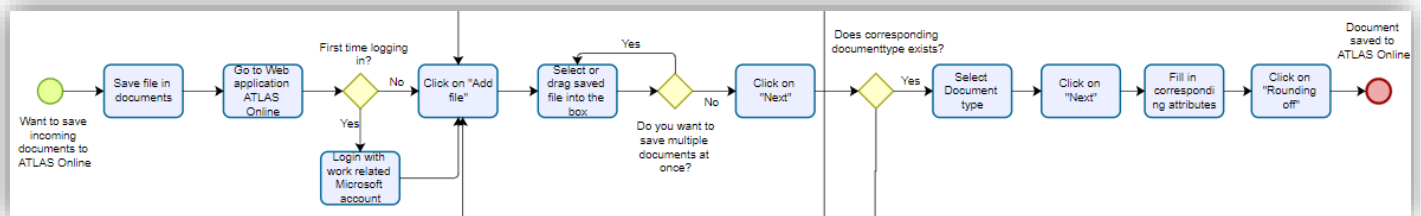


Figure 9: The fastest way to save a document into ATLAS Online

Unfortunately, there are always exceptions where there are many other steps the user has to take to save a document correctly. This means that the user takes these steps to ensure a well-organised document structure. To take these steps in the current system, the user needs to have application rights and is a so-called **administrator**. If not, the user needs to ask the administrator to change the document structure.

If the document type does not exist, then the administrator needs to make a **new document type**. Figure 10 shows the process of making a new document type with the possibility to add attributes. Firstly, the administrator needs to go to “Admin” and open “Document types”. Next, the administrator clicks on “Add document type”. Then a screen pops up where the administrator can fill in the name, document name template and select the linked attributes. In the following step, the administrator selects attributes that are mandatory to be filled in by the user. If it is not possible to link existing attributes to the new document type, the pop-up should be closed and the administrator **creates new attributes** by opening “Attributes” and click on “Add attribute”. A screen pops up where the administrator creates an attributes’ name and type. In the last step, the administrator adds the attribute. Now, it is possible to link the new document type with the right attributes. Thus, the administrator starts the process of making a new document type again by going to “Admin”.

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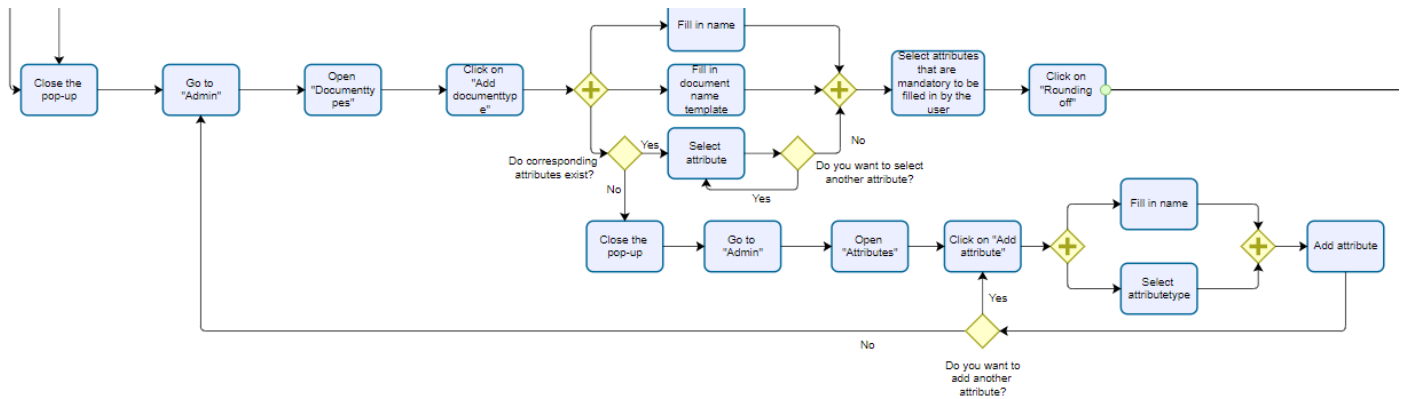


Figure 10: Making a new document type with the possibility to add attributes

After making a new document type, this document type can be linked to a dossier type. Figure 11 provides the process in where the administrator **selects and creates dossier types**. In the first place, the administrator opens “Dossier types” and if the corresponding dossier type exists, it is possible to select this dossier type and then link the new document type to the dossier type. This is done by linking the document type attributes to the dossier type. However, the document type’s required attributes should correspond with the dossier type’s recognition attributes. If this is the case the administrator can select the attributes that are mandatory to be filled in by the user and select at least one attribute that is the dossier types’ identifier. Now, the new document type is linked with a dossier type. If the corresponding dossier type does not exist, then the administrator needs to add a dossier type. The administrator fills in the name, dossier name template, select a main dossier or not, select corresponding document types and select attributes connected with document type and if selected the main dossier. Then the administrator clicks on “Next”. Now, it is possible to select attributes that are mandatory to be filled in by the user and select at least one attribute that is the dossier type’s identifier. Finally, the administrator can round off and the dossier type is made.

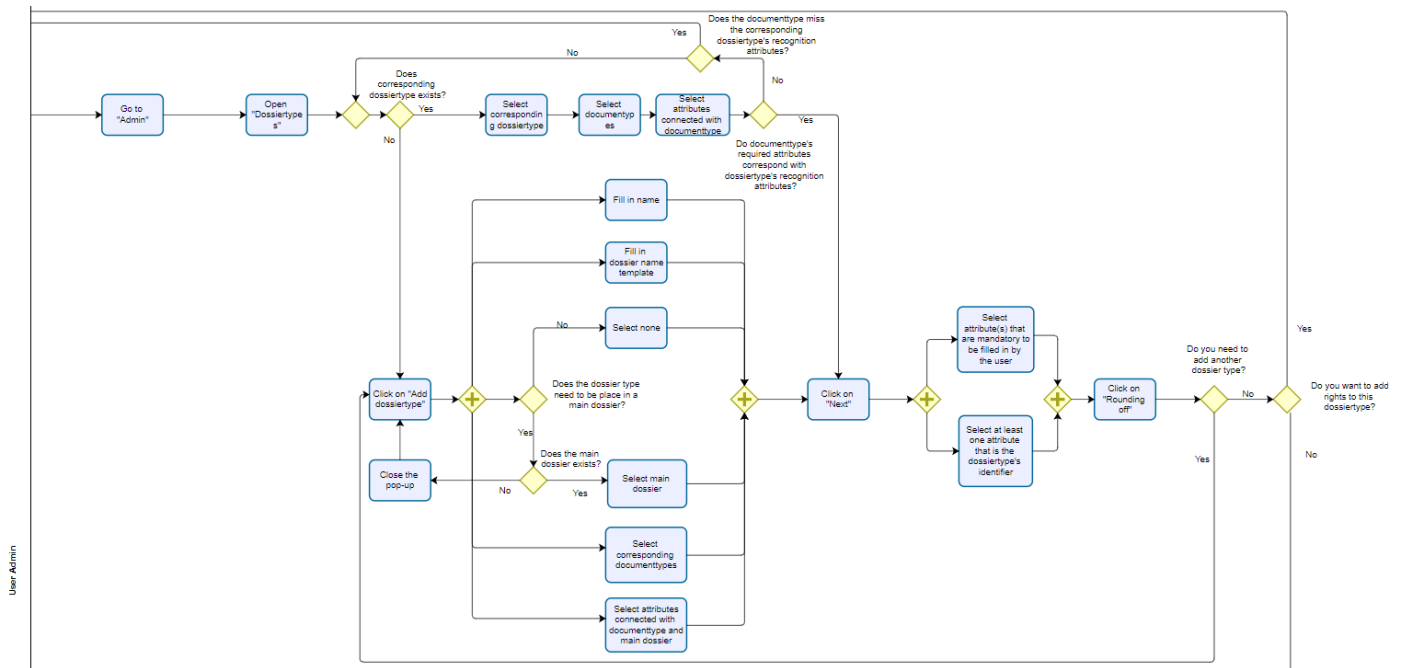


Figure 11: Select and create dossier types

Finally, the administrator can distribute **rights** to document types and dossier types. Those rights can either be divided on individual user level or user group level. Figure 12 shows the process of dividing rights. If the rights are divided to the user group and the corresponding user group exists, the administrator selects this user group. Else the administrator goes to “Admin”, clicks on “Add usergroup”, fills in the name of the group, clicks on next and selects the application rights. The application rights are either administrator rights or no rights. In the next step the administrator can select the rights for either the document type or dossier rights. If the rights are divided to an individual user and the corresponding user exists, then the administrator selects this user. Else the administrator clicks on “Add user”, fills in the e-mail, surname and name and selects the application rights. Next, the administrator can choose to divide rights either for the dossier types or document types. The different rights are consisting of no rights, reading, adding, editing, deleting, add revision, edit revision, delete revision, release revision, archive revision and deactivate revision. Furthermore, the administrator can add users and then add the new user to a user group.

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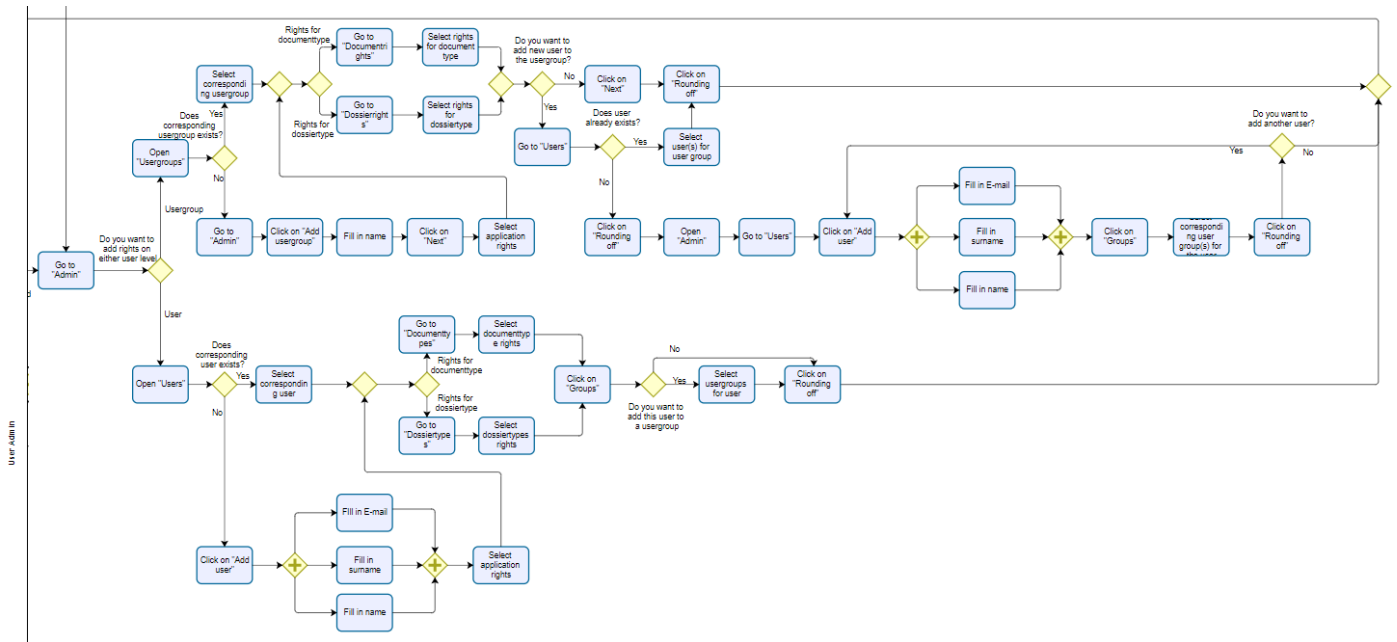


Figure 12: Dividing rights

3.4.2 Search for document

Besides uploading a document, it is possible to search for documents. Figure 13 provides this process. The user can search through dossiers or the user can search through the search bar. If the user searches for dossiers the users have to click on “Dossiers” and select the dossier where the document is in. Then the user selects the corresponding document and can preview and download it. Else the user can type in the search query in the search bar and select the corresponding document.

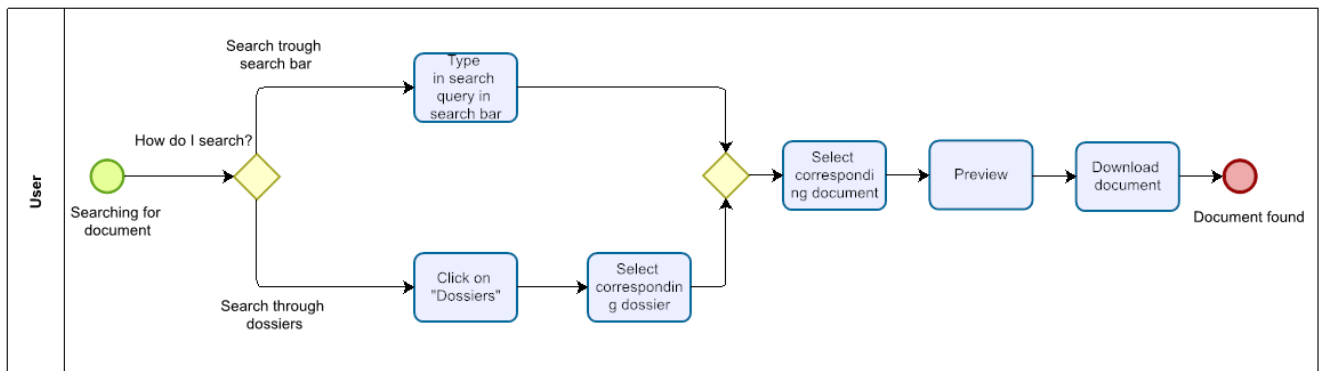


Figure 13: Searching for document

3.4.3 Perform actions on document

The user has also the possibility to edit a document. Figure 14 shows the process of editing a document. This process starts when the document is already found. The user can release a document when clicking on “Release document”. Then the system sends the document to the archive and a first revision is made. In other words, the first version is made. Moreover, a user can delete a document when clicking on “Delete document”. If the user wants to edit a document the user has to download the document. So, the user has to click on “Download document” then it is possible to edit a document and save the document locally. Now, the document needs to be uploaded to ATLAS Online again. Thus, the user clicks on “Upload new document” and choose the previously saved file. Then a document is uploaded and the audit trail is updated. Finally, there is the possibility to edit the document’s attributes. When the user clicks on “Edit attributes”, the user can change the document’s metadata.

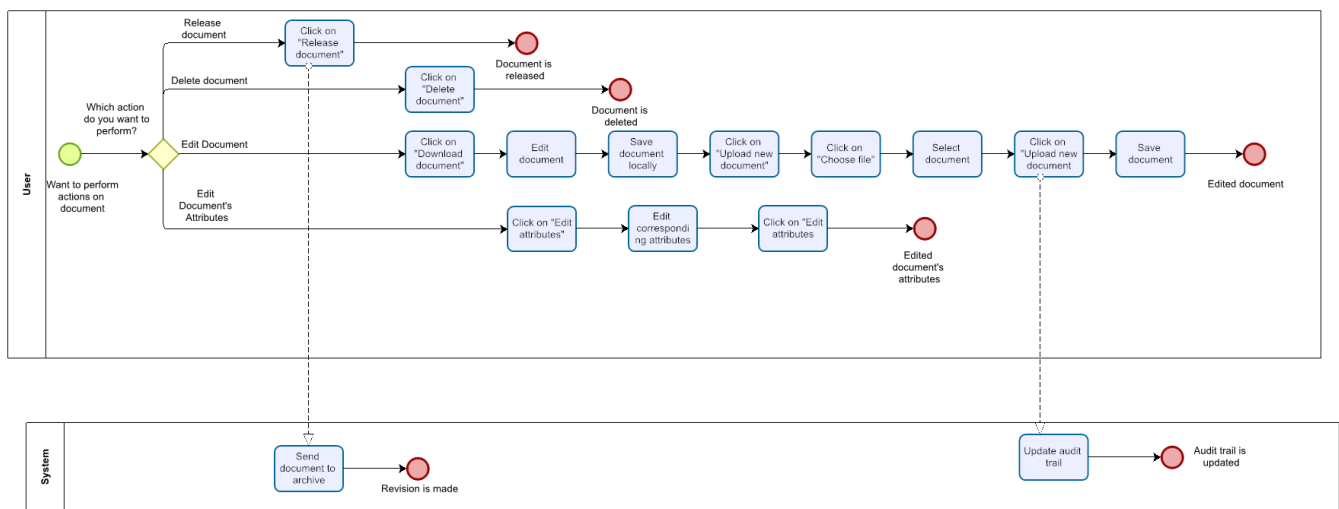


Figure 14: Perform actions on document

3.4.4 Improvement points Business process models

To work towards a TO-BE model, in other words, the improved model, it is fundamental to **automate the functioning process** and decrease the average cycle time to place a document in the right place. Thus, reduce the costs per document save handling (Leyer & Hollmann, 2014).

When looking from a user perspective to the document's uploading and editing process, it is good to consider users who have not the right to change the existing dossier structure. As a result, there are some points of improvement where ATLAS Online can better serve the user. The first point is in the first step of the uploading process: the user wants to save a document to ATLAS Online, then the user first needs to store this document locally. After this step, the user goes to the web application of ATLAS Online. Next, the user can structurally save it to ATLAS Online. This uploading process is not optimal for the user because incoming files and invoices often come from e-mail or other communication applications. As a consequence, the process takes at least ten **clicks** and **the measured cycle time** is 40 seconds. The user would experience it positively if the user can easily save the document in less than six clicks after the inflow and not with a diversion. Thus, the user should be able to directly save documents from the communication application towards ATLAS Online in less than 25 seconds and make this an easy process flow where the flow careless manages the user.

The second improvement point is in **editing the document**. In the current situation, the user needs to download the existing file and store it locally. Then there is the possibility to edit the document, save it locally and finally, upload it to ATLAS Online again. While it should be if the user downloads the document and edit it, the user directly saves it to ATLAS Online due to a Word integration. Thus, not storing the file locally but, when editing, ATLAS Online automatically saves it.

When looking from an administrator perspective to the document's uploading process and consider they have the right to change the existing structure. There are improvement points but, within this research, **the focus is on the user perspective**. Because OVSoftware's approach is to set up a dossier and document type structure leads to an easy entry for potential users. OVSoftware analyses the document and dossier structure. As a result, it is easy for the users to start using ATLAS Online.

3.5 The evaluation of the current system

This section evaluates the current system of ATLAS Online by conducting a questionnaire. The User Experience Questionnaire measures the User Experience of interactive products and is available in more than 30 languages (see Appendix B). It consists of an extensive and short questionnaire: We choose the extensive one that consists of 26 questions because the shorter one is only applicable for some application scenarios. As a result, it measures attractiveness, perspicuity, efficiency, dependability, stimulation and novelty (Hinderks et al., 2018). The questionnaire has 12 respondents: eight within OVSoftware, two students from the Saxion University of Applied Science and two students from the University of Twente. They consist out of men and women with different backgrounds. Six respondents had experience with Document Management Systems (DMS) six did not have experience. The response time was around 10 minutes. First, the demonstration of the current system afterwards the questionnaire. Besides this, respondents had some remarks that are noted and provided at the end of this section.

Figure 15 provides the results from the UEQ evaluation. Values between -0.8 and 0.8 represent a neutral evaluation. While values larger than 0.8 represent a positive evaluation and values smaller than -0.8 represent a negative evaluation. The range of scales is between -3 (horribly bad) and +3 (extremely good). But it is unlikely to observe values above +2 or below -2 because the means base themselves on persons with different opinions. Thus, the respondents evaluate the application positively except for novelty, it has a neutral evaluation because the value is between -0.8 and 0.8.

Furthermore, the UEQ groups the six scales into pragmatic and hedonic quality. The pragmatic quality consists of the scales: Perspicuity, Efficiency and Dependability. They describe task-related quality aspects like: Is it easy to learn how to use the product? Does the application react fast? Does the user feel in control of the interaction? The hedonic quality consists of two scales: Stimulation and Novelty. They describe the non-task related quality aspects, for example, is it exciting to use the product? Is the design of the application creative? The scale attractiveness is standing on its own. It provides the user's overall impression of the product.

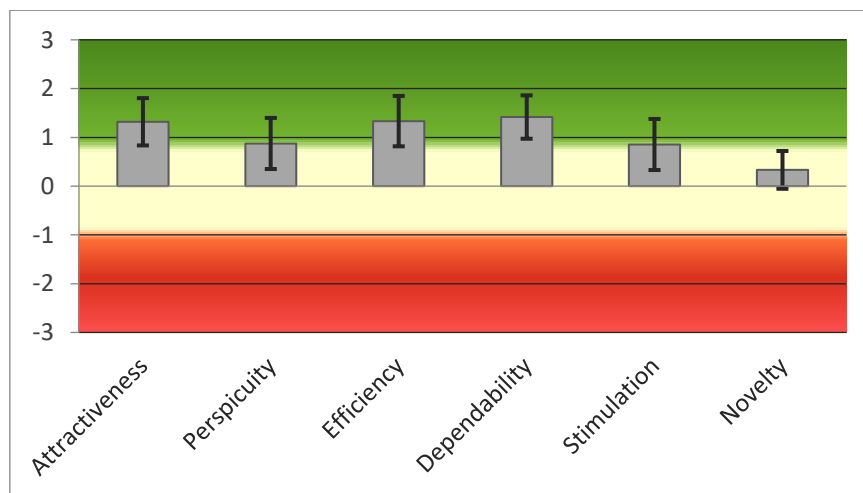


Figure 15: Results UEQ evaluation

Benchmark

This part compares the measured scale means with a benchmark dataset. Figure 16 provides this comparison. This dataset contains data from 20190 persons from 452 studies concerning different products in business software, webpages, web shops and social networks. These comparisons of the evaluated product and the data in the benchmark set make it possible to conclude the relative quality of ATLAS Online compared to other products.

Figure 16 shows that attractiveness, efficiency and dependability score above average compared to other products. While novelty, perspicuity and stimulation score below average. Thus, users are attracted to the application. Besides this, users think they can easily perform tasks with ATLAS Online. As a consequence, it scores above average on efficiency. Finally, ATLAS Online scores above average on dependability, which means users assess the interaction with ATLAS Online as predictable and safe. Unfortunately, users do not assess ATLAS Online as creative, inventive or innovative. Besides this, users do not assess ATLAS Online as clear and easy to learn. Finally, users do not assess ATLAS Online as exciting, interesting, or motivating compared to other products.

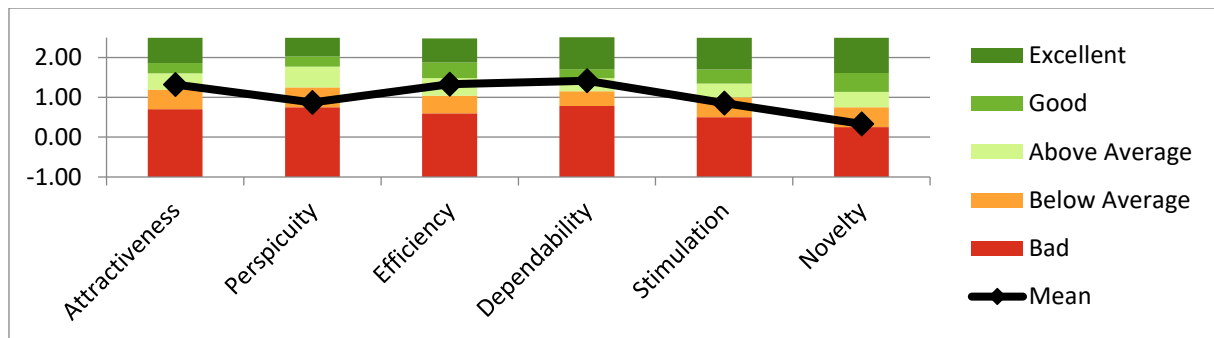


Figure 16: Benchmark results

The questionnaire resulted in some interesting remarks. In the first place, the “Add document” button is misplaced. Figure 17 shows the button in the bottom right corner. From the 12 respondents, only one could find the button in a few seconds. The rest needed help because the button is too small to see. Next, when uploading a document, the user takes three steps. The first one is selecting the file, the second one selecting the document type and, the last step is filling in the attributes. The problem with the final step is that the user fills these attributes manually. Figure 17 shows this process of filling attributes manually. Thus, in this case, the user needs to fill in the client, description and receive date. This process could be improved by pre-filling this data automatically from the document.

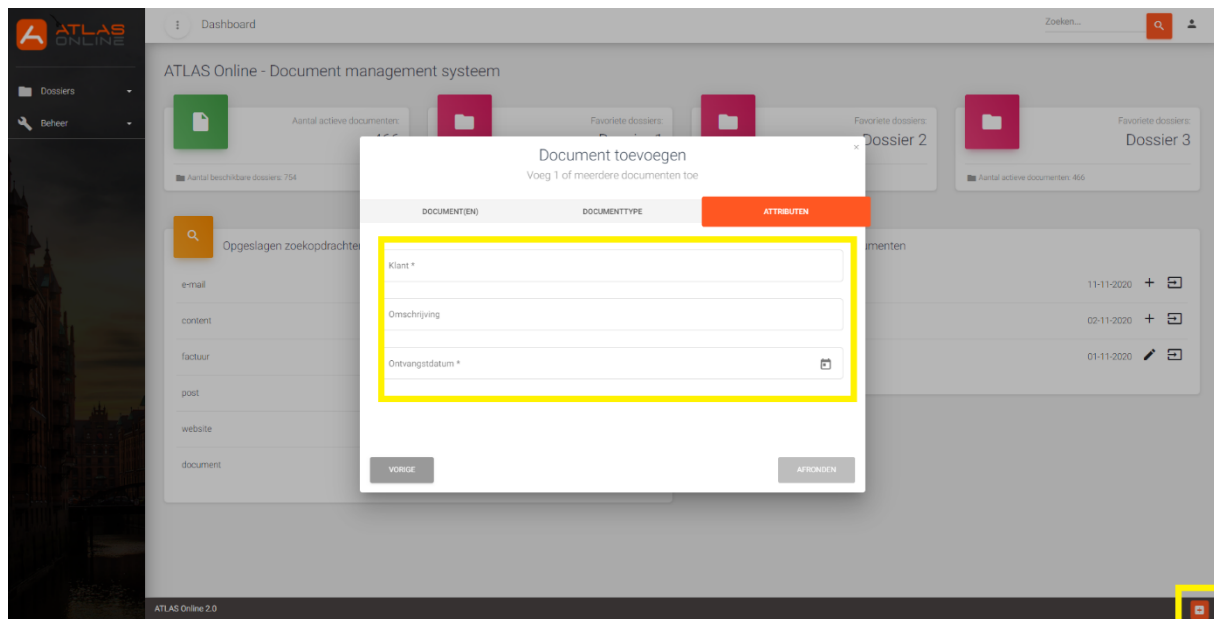


Figure 17: Fill in attributes and the "Add document" button

In the editing process, there is also room for improvement left. To edit a document, the user has to download it and need to save it locally. In the next step, the user can edit it and finally, after the editing, upload the document to ATLAS Online again. The process improves as the document opens automatically in Word. Word can redirect it to ATLAS Online so, if the user saves the document, it automatically saves it to ATLAS Online.

The main problem is that documents are coming in via a communication application, for example, Microsoft Outlook. The user needs to save an invoice locally. In the next step, the user opens the web application of ATLAS Online to upload the document. The user needs too many clicks to store the invoice to ATLAS Online. The user should directly save the incoming file into ATLAS Online in a few mouse clicks.

3.6 Focus and improvement points

By working in longer term with the current system, this resulted in some other improvement points. Besides this, the improvements point of Section 3.4.4 and Section 3.5 finally, resulted in the focus points of Chapter 4: The improved interfaces. **The improvement points** are listed below:

- The buttons that make it possible to add user groups, users, document types, dossier types and attributes are **not finalized**. When hovering over these buttons the correct description is not there, for example, the description is "Adddossier" instead of "Add new dossier". Furthermore, the rounding off button when uploading a document should be orange instead of grey. Grey if uploading document is not possible and if it is possible orange.
- The audit is updated too many times, when looking to a document preview for a few seconds the audit is updated multiple times while the document is previewed once.

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- When uploading a new version of an existing document the button “Choose File” is still unfinalized. To ensure **consistency** this button should be the same as in the normal uploading process of a document. Besides this, when a new version of an existing document is uploaded the preview does not update automatically but only after refreshing the page manually. This is not **user-friendly**, the user thinks that there is something wrong but, instead the document is uploaded correctly into ATLAS Online.
- There should be a possibility to provide ATLAS Online in a different language. Providing ATLAS Online in a different language will result in a larger customer group.
- When filling in the attributes ATLAS Online should provide a list, with for example existing customers, contact persons, supplier numbers etc. Moreover, a drop-down list should be provided when selecting the status of for example an invoice or contract. Now, the user types the whole customer’s name this makes it easy to make mistakes. As a consequence, the document is not saved correctly. These **drop-down lists** support the user’s memory.
- **Automatically generate** the right document type through the file name. If the file name is for example invoice and then a number, ATLAS Online should know that the document type is a purchase invoice.
- The editing process of an existing document should be easier. Thus, when downloading a document, it should be editable in Word and automatically be saved in ATLAS Online.
- It should be possible to add a memo to an invoice. For example, do not order at this place.

To conclude, combining these improvement points with the point in Section 3.4.4 and 3.5 it is possible to improve the user-friendliness. Because of time and knowledge limitations the focus points are on designing new interfaces. Thus, for improving the user-friendliness, **the focus points** consist of:

1. Making the Add document button clearer in the design of the web application.
2. Automatically fill attributes and document types when saving a document.
3. Providing drop-down lists, to search for existing customers, contact persons etc.
4. Creating the design of an integration with Microsoft Outlook to decrease the number of clicks to upload a document from ten to six. In addition to this, decrease the cycle time to upload a document from 40 seconds to 25 seconds.

4 The improved system

This chapter provides the improved interfaces. First, Section 4.1 provides the improved Business process model and compares it with the Business process model of the current system. Finally, Section 4.2 provides the designs of the improved interface with explanation on the functionalities and design choices.

4.1 Improved Business process model

This section provides the improved Business process model of the uploading process. Figure 9 in Section 3.4.1. shows the fastest way of uploading a document in the current system. In this process the number of clicks is at least ten and the average cycle time 40 seconds. Figure 18 provides the improved Business process model of the uploading process. In this model ATLAS Online is integrated within Microsoft Outlook so, an incoming file in Microsoft Outlook can be stored in ATLAS Online in three clicks. Besides this, the cycle time is 15 seconds. This Business process model considers the user perspective. Thus, the dossier and document structure are already generated and the administrator is responsible for creating new document types, dossiers and attributes. Thus, there is a low possibility that a document type or attribute is not present. Besides this, the administrator divides the user and group rights.

In Figure 18, the user wants to save an incoming document into ATLAS Online. For this there are two possibilities: connect the document through a document type or to an existing dossier. The first route is simple, namely click on the **ATLAS Online Fast File**, if Regex knows the document structure than the user can save the document automatically but, check in last step of the automatic generated documenttype and attributes are valid. If these are valid, the user can save the document else the user needs to select the right documents and or fill in the right attributes. Furthermore, if the user wants to upload multiple documents at once, it should check if the document type and attributes are the same for all document if not than the deviating documents should be saved manually. Manually saving is selecting the document type and filling the not automatically generated attributes. The second route is connecting a document to a **dossier type**. First, the user clicks on ATLAS Online Home, clicks on the menu tab of the ATLAS integration, opens dossiers and drags the document(s) to the specific dossier. The next steps are the same as in the first route.

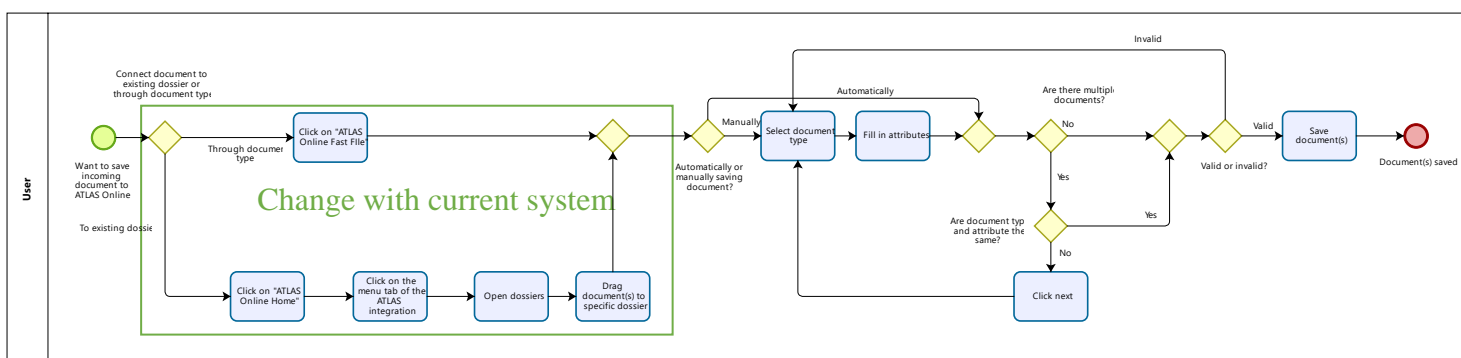


Figure 18: The improved BPM model

4.2 The user-friendly interface

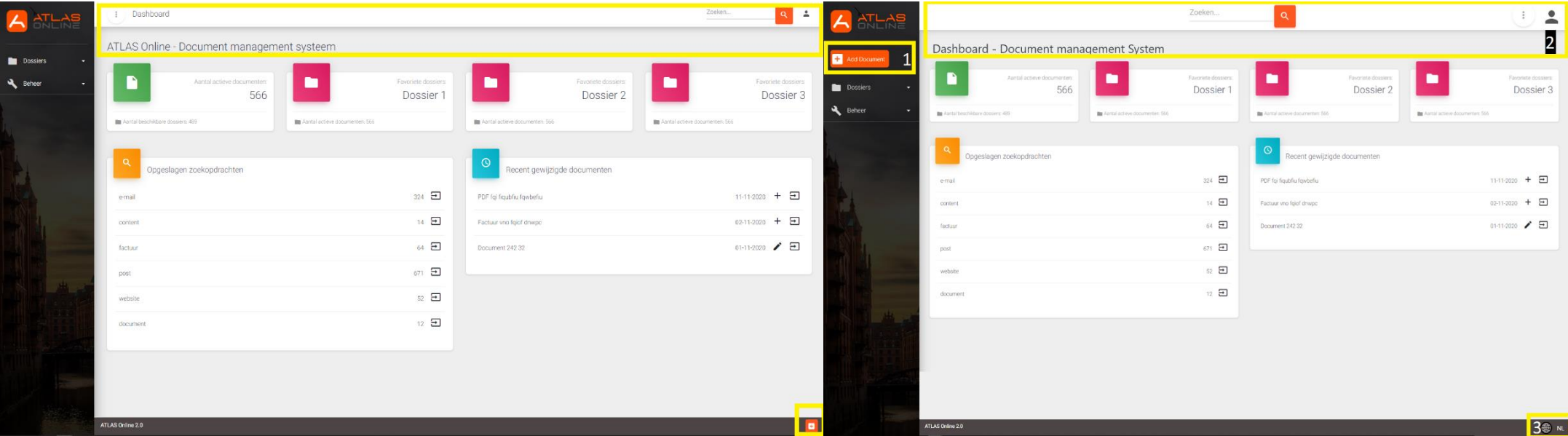
This section consists of two sections: Section 4.2.1 with the web application interface and Section 4.2.2 the integrated Outlook interface. The first section improves the current web application interface by making the designs more user-friendly in terms of visibility. The second section provides the designs of the integration with Microsoft Outlook.

4.2.1 The web application interface

Figure 19 shows the current (a) and improved (b) web application interface. The changes are visible by the yellow boxes. Figure 19 (b) shows the changes in interfaces in numbers. The new designs include:

1. A clearly visible add document button in the upper left corner. Besides this the button is adjusted to the ATLAS Online design.
2. A search bar in the middle of the interface that is more visible than in the (a) current interface.
3. In the bottom right corner, there is a possibility to change the language. Thus, the old add document button in (a) is replaced by the possibility to select another language

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(a)

(b)

Figure 19: Designs of (a) the current web application interface and (b) the improved interface

4.2.2 The integrated ATLAS Online interfaces

This section consists of the first and the improved design of the integrated ATLAS Online interfaces. The final design is generated after validating the design trade-offs.

First designs

This part provides the first designs of the integrated ATLAS Online interfaces and shows how ATLAS Online should be integrated in Microsoft Outlook. The interfaces follow the Business process model in Section 4.1. It illustrates how the user uploads documents with the corresponding document types and attributes. Figure 20 provides the first design with different interfaces.

The buttons activate a new step in the design thus, clicking transfers from interface Figure 20-A to B. The buttons that activate a new design are indicated by a yellow box. In the first step the user wants to upload an incoming document into ATLAS Online, this is possible by clicking on Fast File. This opens a new interface (B), it shows that the user can save the Invoice and the Mail correspondence. ATLAS Online provides the document type Purchase invoice; the user has to validate if this is the correct document type by clicking on the checkmark or cross. Next, the user sees the attributes linked to the document type (C): Company name, Date, Description and Contact person. ATLAS Online provides the corresponding attributes; the user has to validate if these attributes are correct by clicking on the checkmark or cross. In the next interface (D) the user is able to save the Mail correspondence with the same document type and attributes as the Invoice by clicking on the Save all button. If the user wants to save the Mail correspondence in a different way the user has to click on the Next button.

In Figure 20-E, the user can save the Mail correspondence with the same steps as the invoice thus, the validating document type step (E) and the validating attributes step (F). Finally, the user can save the documents (G) by clicking on the save button. The documents are processed (H) and uploaded to ATLAS Online (I)

The corresponding document types and attributes are automatically generated by Regex which can recognize, for example a number in a file name and can connect the contact with the contact person of the company etc. Regex can take over data from the source so, the incoming mail and transfer this to the connected attributes. In the designs there are two buttons one button is the Fast File button with the import window, the other one provides the integrated ATLAS Online web application.

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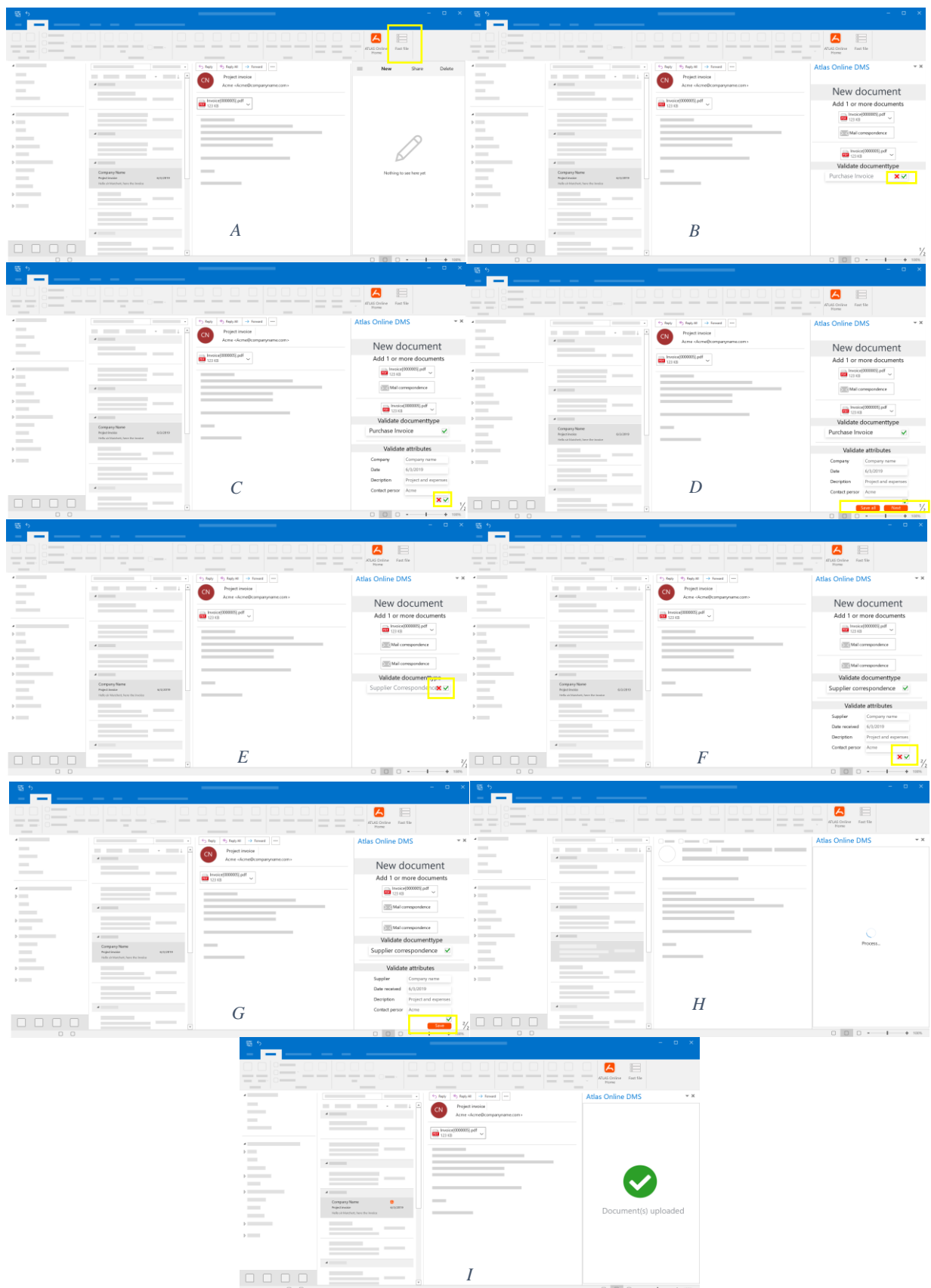


Figure 20: First design integrated interfaces

Design Trade-offs and choices

The second design of the integrated interfaces is made after a design trade-off. For example, the very first design consisted of a whole DMS integration in Outlook, according to the company this was too much and went behind what is possible in terms of cost and time and was not worth it. Furthermore, the first design includes a validation step that is not necessary. These validation steps lead in more clicks thus, a larger cycle time. Next to skipping the validation step, it needs to be clear which document is selected because then the user sees where the document type and attributes are belonging to.

The second and improved design for evaluation

This last part provides the final design that is ready for evaluation. Figure 21 provides the second design.

Figure 21-A shows the start menu, the user can upload a document by clicking on Fast File. As a result, the user arrives at the uploading page (B), here the user can validate the document types and attributes but, not with validation step, the user can adjust the document type and attributes by editing the input field. The user can come to the next document, Mail correspondence (C) by clicking either on Mail Correspondence or on Next. If the user does not want to save the Mail correspondence the user can delete this document. This is also the case for the Invoice. Furthermore, it is possible to save the Mail Correspondence with the same document type attributes as the Invoice by clicking on Save all. Now, the user can save the Mail correspondence (C) with the same steps as for the Invoice. After this the user can save all the documents by clicking on Save all. As a consequence, the documents are processed (D) and stored into ATLAS Online (E).

Besides providing the step of uploading a document through a document type, it is possible to connect a document to an existing dossier. The user starts in Figure 21-A and selects ATLAS Online Home to arrive at the integration of the web application of ATLAS Online (F). In the next step, the user opens the Menu and click on Dossiers (G). Then the user select Suppliers (Leveranciers) (H) and so, it is possible to drag the pdf into the dossier (I). Regex provides the possibility to either save it automatically or manually. This option is only possible when all the mandatory attributes are filled, else the documents need to be saved manually.

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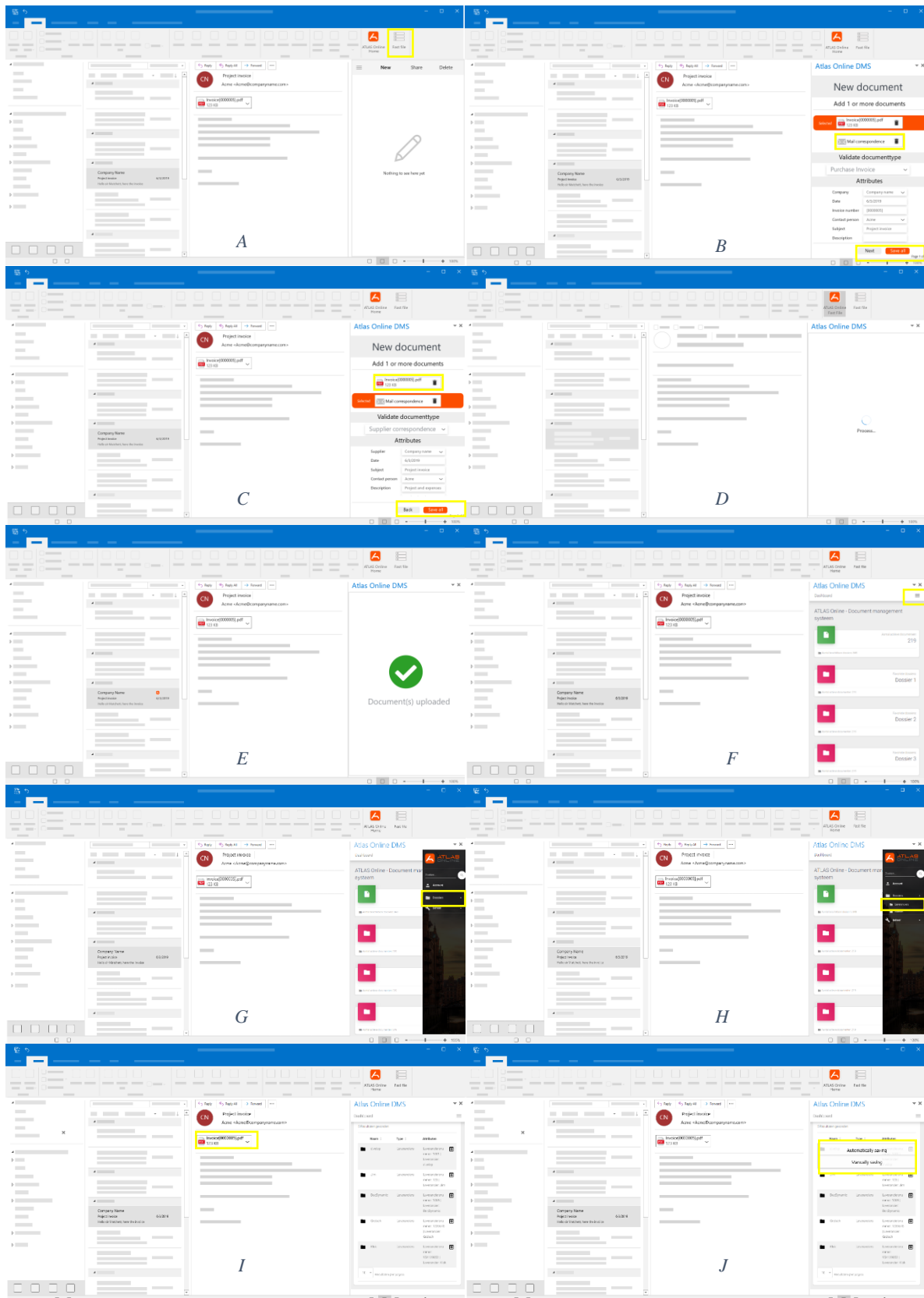


Figure 21: The second design interfaces

5 The evaluation of the improved system

This chapter evaluates the improved designs of ATLAS Online by conducting a User Experience Questionnaire (Hinderks et al., 2018). The questionnaire conducted is the same as in Section 3.5: The evaluation of the current system. This similar questionnaire makes it possible to do a comparison between the current and improved user experience by a statistical test. Besides this, there are six additional questions (See Appendix B) to calculate a meaningful Key Performance Indicator (KPI). The KPI measures the overall User Experience (UX). In this way, the KPI of the current and improved system is compared.

The questionnaire has 12 respondents: three within OVSoftware, one external business consultant and eight students from respectively: the University of Twente, Saxion university of Applied Sciences, Tilburg University, HAN University of Applied Sciences. Thus, they have different backgrounds and four have work related experience with Document Management Systems (DMS), eight did not have work related experience. Due to changing circumstances it was not possible to have the same respondents as for the evaluation of the current system. The group of students is larger than in the evaluation of the current system. However, students are potential users of this DMS. Besides this, respondents had certain remarks that are noted and provided as improvement points for the final designs.

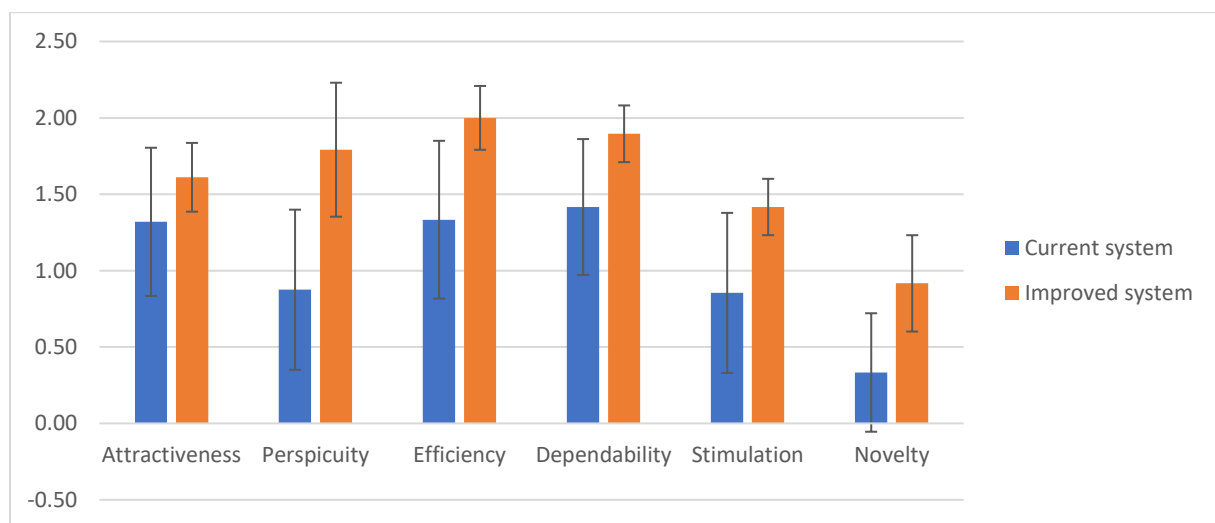


Figure 22: Comparison between current and improved system

Figure 22 gives this comparison and shows on first sight that the improved system is better on all scales. However, the T-Test shows for each scale if the means for the two measurements differ significantly. For perspicuity, efficiency and novelty there is a significant difference. The error bars represent the 95% confidence intervals of the scale means. They show how accurate the measurement is. Thus, the perspicuity, efficiency and novelty in the improved system are better than the current system on a 5% level significance.

The **KPI** extension (See Appendix B) resulted in a KPI for the current and improved user experience. The extension reduces six complex constructs to a single numerical value. This is possible because the extension results in the relative importance of the six UEQ scales. The respondent is asked how important the scales are for their impression on the UX. The overall

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KPI for the UX in the improved system is 1.64 and for the current the KPI is 1.05. Values between -0.8 and 0.8 represent a neutral evaluation. While values larger than 0.8 represent a positive evaluation. The range of scales is between -3 (horribly bad) and +3 (extremely good). But it is unlikely to observe values above +2 or -2 because the means base themselves on persons with different opinions. So overall the improved system scores higher on the overall UX impression because it is 0.59 higher than the KPI of the current system.

Benchmark

This part compares the measured scale means with a benchmark dataset same as in Section 3.5: The evaluation of the current system. Figure 23 provides this comparison. This comparison of the improved system and the data in the benchmark set make it possible to conclude the relative quality of the improved system compared to different products in business software, webpages, web shops and social networks products.

Figure 23 shows that the scale novelty scores **above average**, the scales attractiveness, perspicuity and stimulation score **good**, and efficiency and dependability score **excellent** in comparison to the benchmark dataset. An excellent score means these scales are in the range of the 10 percent best results. Thus, users think they can excellently perform tasks with ATLAS Online and they assess the interaction with ATLAS Online as predictable and safe. Besides this, users are attracted to the improved system, assess ATLAS Online as clear and easy to learn and assess the improved system as exciting, interesting or motivating compared to other products. Finally, the users assess ATLAS Online as more creative, inventive or innovative compared to other products.

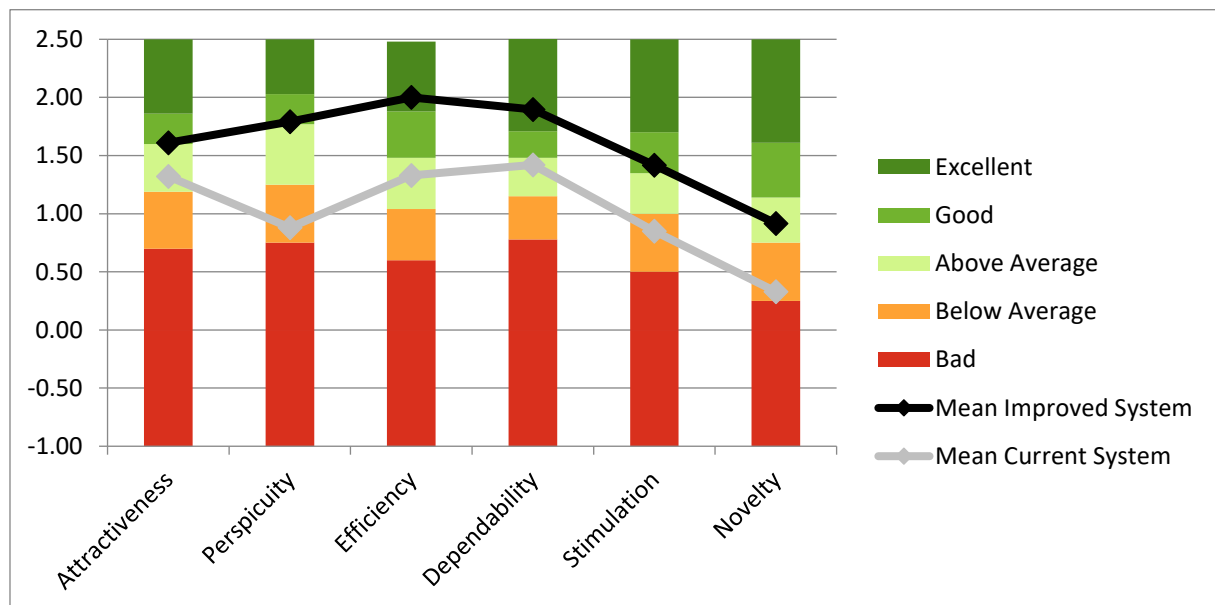


Figure 23: Benchmark results improved system

5.1 Improvement points and remarks

Within the user experience questionnaire, the respondents made remarks that lead into the final designs.

- The menu in the **ATLAS Online Home** should locate on the left side instead of the right side. This gives a more natural feeling because all the menus are on the left side these days. Besides this, everybody looks and reads from left to right.
- The Search bar in the DMS integration needs to be place at the top of the page so, not in the Menu. In this way, it is directly possible to search for a document.
- Drag document to the automatically advised dossier. This results in less unnecessary clicks
 - Regex can link the sender details so, for example the company name to the potential dossier.
- Fix some small details in the design like in Hover state ATLAS Online Home results in ATLAS Online Fast File that is not correct.
- ATLAS Online Home should not only provide the possibility to connect a document to a dossier but also previewing document etc.
- When you want to save, for example, the invoice with the same document type and attributes as the mail correspondence, this must be clear so that both are selected if the user selects save all in the first page
- The field for attributes should be larger and the document type dropdown menu should be adjusted to this.
- Automatically generated attributes have a light font in the improved designs, there is another manner of showing this
- For some respondents it was a difficult first experience. They experienced the system as complex. Help icons can reduce the complexity for the user.

Due to time restrictions not all improvement points and remarks can be included in the final designs.

5.2 Final designs

The improvement points mentioned in Section 5.1 result in the final designs. Connecting a document to an existing dossier type has skipped two steps because ATLAS Online provides the recommended dossier. When the user opens ATLAS Online Home the only step the user has to take is dragging the document into the dossier. Figure 24: Final model uploading process provides the final model of the uploading process.

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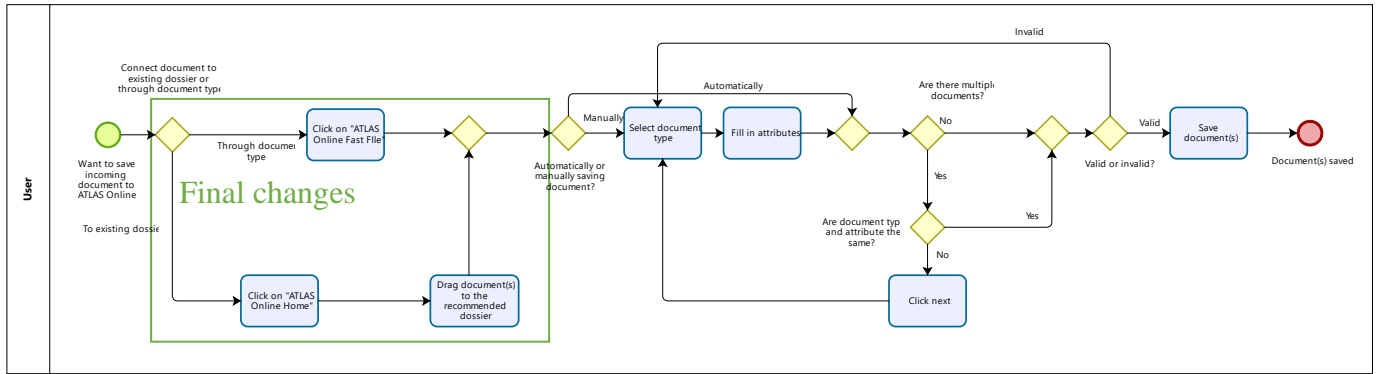


Figure 24: Final model uploading process

Figure 25 provides the final adjusted designs in (A) the attributes fields are enlarged and the document type field is adjusted to this. In (B) the ATLAS Online Home provides the recommended dossier from the company “Company Name”. The user can drag the document into this dossier (C). Moreover, the menu is placed on the left side (D).

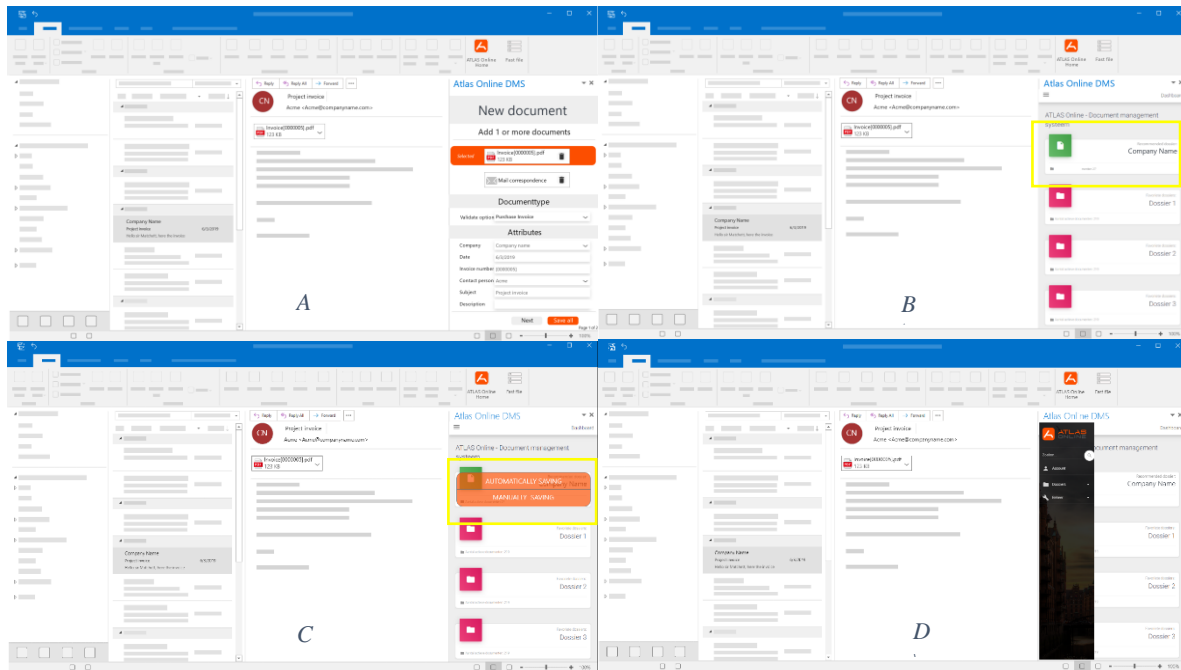


Figure 25: Final design interfaces

5.3 Design trade-offs

This section provides the design trade-offs in terms of cost and time. Estimating the time is done in cooperation with the company supervisor. However, it is still difficult to estimate the time and cost of making the functional designs.

Adjustments current system for new functionalities with estimated days of work:

1. Automatically fill in attributes based on existing values (5 days)
2. Automatic mapping for document types and files (10 days)
3. Suggest a dossier based on automatic mapping (10 days)
4. Interface for searching in Outlook (10 days)
5. Interface for uploading documents (10 days)
6. Drag and drop functionality (5 days)
7. Outlook integration with button and side screen (8 days)

A rough estimation of the time needed to make and test this integration with one full-time employee is three months. The investment costs about €25,000, which means that one ATLAS Online license with a margin of 10 euro per license results in selling an additional 105 licenses per month to earn back the investment in 2 years. This cost estimation is made in cooperation with the sales manager.

6 Conclusion, recommendations and future research

This chapter provides the final conclusions, recommendations, contribution and future research. Section 6.1 and 6.2 provide the conclusions and recommendations. Lastly, Section 6.3 and 6.4 provide the points for future research and contribution to practice.

6.1 Conclusions

It started with one problem, ATLAS Online was not ready to serve the market because it was not differentiating from competitors, this problem has been stated in Chapter 1. It leads to the main research question: How to integrate ATLAS Online in a user-friendly way?

The answer is provided in the final designs in Section 5.2. However, we see it is important to consider the user perspective in the design process. This makes it possible to provide a user-friendly design that significantly improves the User Experience (UX).

Firstly, the theoretical perspective provides a literature study on user-friendly DMS interfaces, it is the fundament for the improved designs. Next, it was essential to analyse and design the current system to come up with improvement points. The improved designs have been developed under continuous improvement. This resulted in the improved interactive interfaces who have been significantly better evaluated than the current system. This evaluation of the improved design resulted in the final designs.

The research has been executed with the Design Science Research Method (DSRM) for Information Systems (Peppers et al., 2007). This method focuses on design process iteration. First, the current system was analysed by providing a class diagram and data model. Next to this, the system users were discussed. In addition to this, an application landscape has been made and the main processes have been modelled. The main processes consisted of: Uploading a document, searching for a document and performing actions on a document. With this analysis and moreover, the user evaluation of the current system, there were some points for improvement. The literature study on user-friendly DMS interfaces resulted in the ability to benchmark and setting the fundament with the User Interface (UI) design for the Graphical User Interface. Furthermore, it helped in starting the design process and avoiding dead ends. This all leads into the improved interface.

A literature study on user-friendly DMS interfaces is conducted to realise an organised design. With the help of Adobe XD, this resulted in an interactive design and reduced the average number of clicks to 3 and the cycle time to 15 seconds. The overall Key Performance Indicator (KPI) of the user experience for the improved system is significantly better than the current system. The KPI of the Overall User Experience went from 1.05 to 1.64. That means that the User Experience (UX) went from a good to an excellent assessment.

CONCLUSION, RECOMMENDATIONS AND FUTURE RESEARCH

Table 4: Comparison Current and Improved system

	Current system	Improved system
Average cycle time (seconds)	40	15
Average Amount of clicks	10	3
KPI Overall User Experience	1.05	1.64

The estimated time to make these improvements is three months of work for one full-time employee and the investment costs around €25,000. That means that an ATLAS Online license with a margin of 10 euros results in selling an additional 105 licences per month to earn back the investment in 2 years.

To conclude, for the implementation phase these designs need to be functional. The interactive design of the interfaces and the Business Process Model for the uploading process are the handles of the functional design. With these handles, ATLAS Online differentiate in user-friendliness and provides an integration based on simplicity and consistency.

6.2 Recommendations

Based on the performed research and conclusions. We set up a list with recommendations for OVSoftware and ATLAS Online. They are mainly on the functionality of designs, user involvement, simplicity and final details:

- There are still some functional improvement points for ATLAS Online these needs to be finalize in order to sell ATLAS Online as a Software as a Service (SaaS) solution
- The final design provides an interactive integration with Microsoft Outlook, but this is not functional. This design should result in a functional design, this will add a lot of value to the product ATLAS Online.
- A lot of competitors built complex systems in where there are many ways to execute one task. ATLAS Online differentiates in simplicity. In functional design, they must ensure this simplicity.
- The Search bar in the DMS integration needs to be place at the top of the page so, not in the Menu. In this way, it is directly possible to search for a document.
- ATLAS Online Home should not only provide the possibility to connect a document to a dossier but also previewing document etc.
- For some respondents it was a difficult first experience. They experienced the system as complex. Help icons can reduce the complexity for the user.

6.3 Future research

Due to a limited scope of ten weeks, the final design of this research still needs extra user involvement to guarantee the best user experience. Furthermore, the functional design first needs elaborated market research because will the revenues outweigh the costs? This market research answers the question: Is it worth it? Is the market waiting for this solution? And what is the value proposition of ATLAS Online?

- During this thesis, the design focus has been on integration with Microsoft Outlook. The final design shows that integration is possible. However, it can also add value to research other communication integrations like Microsoft Teams.

6.4 Practical contribution

In this section, the practical contribution of the research is described.

In this research, literature studies are performed on modelling the DMS with the Business Process Model and Notation (BPMN) method and designing user-friendly interfaces with the fundamental basics. We have proven that it is possible to model the processes of a DMS with the BPMN method by modelling how to upload a document, how to perform actions on a document and how to search for documents. Thus, BPMN gives insight in modelling DMS integrations and need to be used more in software development Finally, the fundamental basics in designing user-friendly interfaces resulted in design guideline for user interfaces.

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Appendix A: Systematic Literature Review

This Appendix gives a Systematic Literature Review (SLR). This SLR answers a knowledge question in a systematic approach.

1. Research question

The research question that is used to conduct the SLR is: How to use Business Process Model and Notation (BPMN) to model functionalities and structures of an integrated DMS? The motivation behind this research question is stated in Section 1.3.3.

The key concepts in the research question are Business Process Model and Notation, model, functionalities, structures, Document Management Systems (DMSs). The review is based on these key concepts.

2. The inclusion and exclusion criteria

It is important to include literature that provides an answer to the chosen research question. The exclusion criteria are subjects that definitely not answer the research question. Inclusion criteria are must-haves.

Table 5: Exclusion criteria

Exclusion	Criteria	Reason
1.	Pre-1980 articles	DMS systems are not existing before 1980

Table 6: Inclusion criteria

Inclusion	Criteria	Reason
1.	Full text has to be accessible	The abstract is not elaborated enough to use in the thesis
1.	Document Management Systems	Key terms in order to answer the research question
2.	BPM modelling	Key terms in order to answer the research question

3. The databases

For the systematic literature review we make use of Scopus, Web of Science and Business Source Elite. These are all qualitative databases for systematic searches and are able to provide a lot of literature related to document management systems and modelling. With this approach we combine two multidisciplinary databases and one specialized database on businesses.

4. The search terms and strategy

In order to conduct good research, it is important to have clear search terms and a clear strategy. Table 6 depicts the search matrix where the research question is divided into constructs where potential search terms and strategies are based on. Related, broader and narrower terms are constructed with the help of Thesaurus.

Table 7: Search matrix

Constructs	Related terms/ synonyms	Broader terms	Narrower terms
Document* management System*	Document Management, archive management, document administration, document, document classification structure, document management software	Documentation, structure	Databases
Business Process Model and Notation	BPM modelling	Modelling	Bizagi modeller
Functionalit*		Process	Component
Structure*	Architecture, system		
Integrat*	Connect, Combination, implementation		

The search strategy is based on trial and error. The search matrix in Table 7 is used to make a relevant query. After conducting a certain query, the number of results is evaluated. If the number of results is above thirty than the query or scope need to be specified. Furthermore, in order to find the best results, the results are sorted on relevance. Besides this it is important to have access to the full text of the document. If this is not directly possible Google Scholar is used.

Table 8: Search results

Data	Where (Which databases)	Search Terms	Scope	Amount of hits
17-03-2021	Scopus	("Document* management* system*" AND ("Business Process Model* AND Notation" OR modelling OR "BPM model*"))	Title, abstract, keywords	73 Results
08-04-2021	Scopus	("Document* management* system*" AND ("Business Process Model*" OR BPM))	Title, abstract, keywords	9 Results
08-04-2021	Business Source Elite	("Document* management* system*" AND ("Business Process Model* AND Notation" OR modelling OR "BPM model*"))	All fields	6 Results
08-04-2021	Business Source Elite	("Document* management* system*" AND ("Business Process Model*" OR "BPM model*"))	All fields	3332 Results
08-04-2021	Business Source Elite	("Document* management* system*" AND ("Business Process Model*" OR BPM))	All fields	3 Results
08-04-2021	Web of Science	("Document* management* system*" AND ("Business Process Model* AND Notation" OR modelling OR "BPM model*"))	Topic	133 Results
08-04-2021	Web of Science	("Document* management* system*" AND ("Business Process Model*" OR "BPM model*"))	Topic	3 Results
12-04-2021	Scopus	("Document* management* system*" AND ("Business Process Model*" OR BPM))	Title, abstract, keywords	10 Results
Total amount of hits				3569
Amount of hits with to broad scope (amount of hits > 30)				-3538
Duplicates				-13
Results in different language				-1
Result inaccessible				-2
Removed after reading abstract /globally				-7
Selected for review				8

5. Conceptual matrix

This section provides a conceptual matrix of eight articles used in the systematic literature review, in which the articles and key concept are listed in Table 8.

Table 9: Conceptual matrix

<div>Concept</div> <div>Articles</div>	Business Process Models	Process Reengineering	Business Process Modelling Notation	Document management system
(Becker et al., 2008)		X		X
(Mędrek & Wiechetek, 2017)	X		X	X
(Wright, 2013)				X
(Leyer & Hollmann, 2014)	X	X		X
(Pătraşcu, 2015)	X			X
(Pătraşcu, 2014)		X		X
Pereira, 201(Pereira et al., 2019)9			X	X
(Khrykova et al., 2021)	X			X

6. Literature matrix

This matrix provides key information about the topics which are needed to answer the research question. The articles' main findings about the key concepts are listed in Table 9.

Table 10: Literature matrix

Articles Topics	Becker, 2008	Medrek, 2017	Wright, 2013	Lever, 2014
Business Process Models		"Implementation of a new management approach and BPM supporting tools needs some agreements and standards for describing business systems and processes in an understandable language for all stakeholders."		
Process reengineering	"These models explicate the implicit knowledge about the process landscape and, therefore, provide the information needed to assess the impact of ICT investments on the processes. By using the whole processes landscape as foundation for the analysis, investments decisions become more transparent and justifiable."			"The aim of this paper is to show how business process simulation (BPS) can be used to forecast the effects of the introduction of electronic documents in the context of a loan application process."
Business Process Modelling Notation		"The BMM, BPDM, BPMM, BPMN™, PRR concern the area of business process design and provide notation that should be understandable for all business users"		
Document management system	"The full impact of ICT investments can only be assessed when considering the	"The main purpose of our work is to create a framework based	"In its simplest form, Document Management Software helps	"A precondition for the equal treatment of

	complete process landscape of a PA [4]. For example a DMS is not only able to support the process “handle building application” but also the processes “handle application to run a restaurant” or “handle application for housing allowance”.”	on event logs of DMS which discover process maps and identify non-optimised paths and bottlenecks in the overall structure of the workflow.”	construction businesses and management interact efficiently with the volume of documentation associated with building things. As the building industry moves toward more collaborative working practices integrated Document and Workflow management systems becomes even more essential to, winning, supporting and maintaining a success. In today’s electronic, collaborative working environment, time and access to the right information is even more critical.”	digital documents is audit-proofed document management systems (DMS) that allow archiving in accordance with the principles of data access and the verifiability of digital documents.”
Articles	Pătraşcu, 2015	Pătraşcu, 2014	Pereira, 2019	Krykova, 2021
Topics				
Business Process Models	“The business processes modelling has become a priority for organizations because it represents an important step in supporting the business by IT methods in order to increase the quality of the offered services and to reduce the order processing time”			“the business process of reconciling a memo and improving it using digital signature technology”
Process reengineering		“The modelling process represents the base process used by analysts in their effort to facilitate the understanding of		

		the phenomena that occur in a system, in order to increase its efficiency and to improve its performances”		
Business Process Modelling Notation			“This provides a framework that allows model design of technological implementation and organizational interdependence architecture. To this supported method, the scientific research call it Business Process Model and Notation”	
Document management system	“offer a graphical notation, behind which lies a proper semantics and support building and documenting the components of the document management software system;”	“The diagrams that are presented in this article represent a starting point in building a document management system for a public administration institution. These diagrams can be easily used by others designers because they have the following characteristics:”	“The DMS workflow must be simple and capable of register the various states by which a document flows, providing its immediate location.”	“the general requirements for the digital signature module were identified, and the possibility of introducing this module into the existing electronic document management system was considered”

7. Integration of the theory

The integration of the theory organized around the concepts of Business Process Modelling and Document Management Systems can be found in Chapter 2: Theoretical Perspective.

8. References SLR

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Appendix B: The Data Model

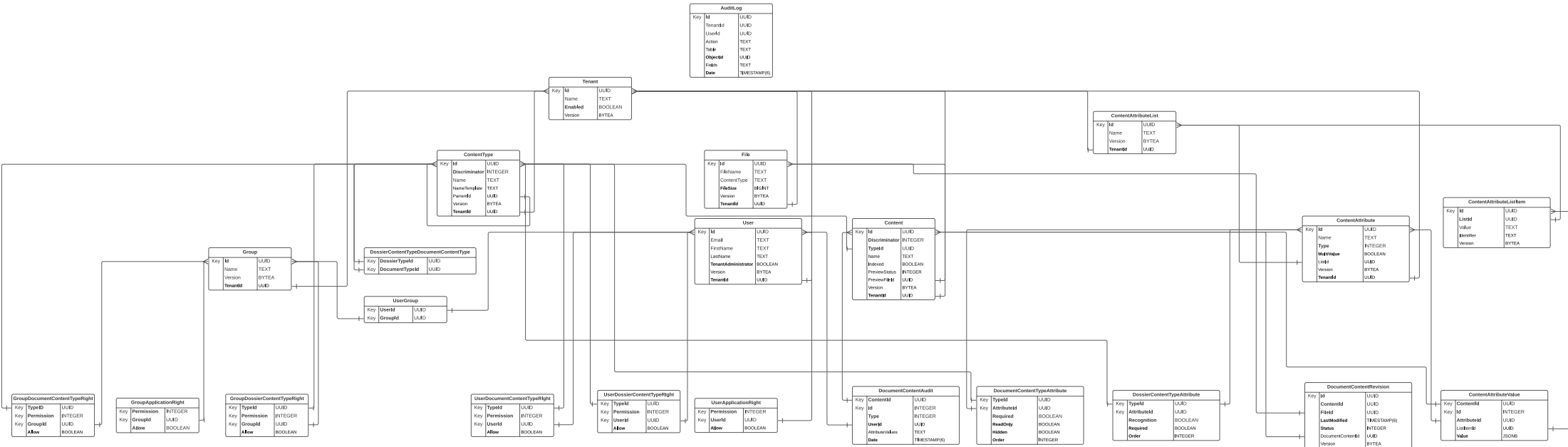


Figure 26: The Data model of ATLAS Online

Appendix C: The User Experience Questionnaire

Please make your evaluation now.

For the assessment of the product, please fill out the following questionnaire. The questionnaire consists of pairs of contrasting attributes that may apply to the product. The circles between the attributes represent gradations between the opposites. You can express your agreement with the attributes by ticking the circle that most closely reflects your impression.

Example:

attractive	○ ⊗ ○ ○ ○ ○ ○ ○	unattractive
------------	-----------------	--------------

This response would mean that you rate the application as more attractive than unattractive.

Please decide spontaneously. Don't think too long about your decision to make sure that you convey your original impression.

Sometimes you may not be completely sure about your agreement with a particular attribute or you may find that the attribute does not apply completely to the particular product. Nevertheless, please tick a circle in every line.

It is your personal opinion that counts. Please remember: there is no wrong or right answer!

APPENDIX C

Please assess the product now by ticking one circle per line.

	1	2	3	4	5	6	7		
annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable	1
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable	2
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull	3
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn	4
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior	5
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting	6
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting	7
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable	8
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow	9
inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional	10
obstructive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	supportive	11
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad	12
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy	13
unlikable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasing	14
usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	leading edge	15
unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasant	16
secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure	17
motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	demotivating	18
meets expectations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	does not meet expectations	19
inefficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	efficient	20
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing	21
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical	22
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	cluttered	23
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive	24
friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unfriendly	25
conservative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	innovative	26

Additional Questions for the KPI Extension of the UEQ

To calculate a meaningful KPI for the UEQ 6 questions must be added to the questionnaire.

Scale	Question
Attractiveness	The product should look attractive, enjoyable, friendly and pleasant.
Efficiency	I should perform my tasks with the product fast, efficient and in a pragmatic way.
Perspiciuity	The product should be easy to understand, clear, simple, and easy to learn.
Dependability	The interaction with the product should be predictable, secure and meets my expectations.
Stimulation	Using the product should be interesting, exiting and motivating.
Novelty	The product should be innovative, inventive and creatively designed.