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Improving and Automating the Order-to-Cash Process of Small Photographic Studios

Master's Thesis (30 ECTS)

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Abstract:

Throughout the 2000s, a significant number of small photographic studios were established in Estonia to satisfy the increasing demand for photo sessions. At the end of this decade, a small photo studio called Stuudio.com was founded in Tartu. This studio took the approach of not only selling photo sessions, but also the outputs of the sessions. The studio started to print paper pictures and fulfil orders. Soon, it became clear that the process of handling order fulfilment was time-consuming and not scalable during high season. This situation prevented the implementation of the envisaged output-driven business model as opposed to the traditional approach of selling photo sessions on a small scale.

In this context, this thesis investigates how the Business Process Management (BPM) Life-cycle can be used to analyse, redesign and implement a small photo studio's order-to-cash business process, using Stuudio.com as a case study. BPM was chosen as a business improvement method because previous case studies have indicated that there is a significant untapped potential in applying BPM for optimising operations in small businesses.

In this thesis, process identification methods are used to find out the existing business processes. Following established process discovery practices, the order-to-cash process is modelled in the Business Process Model and Notation tool and the model is used to compile a detailed analysis. Process steps are classified as value-adding or not value-adding and possible waste is identified. Occurring issues are registered and the *Five why* analysis is employed to find the root causes of problems. As the next step, the order-to-cash process is redesigned according to analysis results, and the to-be process is modelled. Finally, a software-as-a-service platform is developed and deployed under the label of Pildipood. The platform automates the redesigned order-to-cash process, eliminating the dependence on human resources for scheduling and coordinating work.

The thesis shows that process-oriented thinking is suitable for small businesses such as photo studios. Moreover, as an outcome the thesis, the author implemented a software service platform, Pildipood.ee, that supports more than 50 small photo studios in Estonia in addition to supporting the processes of Stuudio.com.

Keywords:

Business Process Management; Photo Studio; Small Business; Order-to-Cash Process

Väikeste fotostuudiote tellimuste täitmise protsessi täiustamine ja automatiseerimine

Lühikokkuvõte:

2000. aastate kestel loodi Eestis hulganisti väikeseid fotostuudioid, et rahuldada suurenevat nõudlust pildistamissessioonide järele. Sama kümnendi lõpus asutati Tartus väike fotostuudio nimega Stuudio.com. Selle stuudio tegevuspraktika kohaselt ei müüdud mitte ainult fotosessioone, vaid ka nende tulemust ning Stuudio hakkas ise tellimusi täitma ja paberkujul fotosid printima. Peagi sai selgeks, et tellimuste täitmine on aeganõudev ning polnud kõrghooajal ettevõttele võimetekohane. Sellises olukorras ei saanud rakendada ettevõtte visioonikohast tulemipõhist ärimudelit, vastupidiselt traditsioonilisele lähenemisele, mille põhjal müüdi ainult väikeses mahus fotosessioone.

Kirjeldatud kontekstis uurib käesolev töö Stuudio.com näitel, kuidas kasutada äriprotsesside juhtimise (Business Process Management, edaspidi BPM) elutsüklit väikese fotostuudio *order-to-cash* äriprotsessi analüüsimiseks, ümberkujundamiseks ja rakendamiseks. BPM valiti ettevõtte äriprotsessi arendamise meetodiks, kuna eelnevad juhtumiuuringud on näidanud, et meetodil on palju kasutamata potentsiaali väikeettevõtete tegevuse optimeerimiseks.

Magistritöös kasutatakse levinud protsesside tuvastamise meetodeid olemasolevate äriprotsesside kirjeldamiseks. Autor järgib väljatöötatud protsesside tuvastamise praktikaid ning modelleerib toodete müügiprotsessi äriprotsessi modelleerimise notatsiooni (*Business Process Model and Notation*) tööriistas ning kasutab saadud mudelit üksikasjaliku analüüsi koostamiseks. Protsessi osad jagatakse lisandväärtust loovateks ning väärtust mitte lisavateks; lisaks tuvastatakse protsessi potentsiaalne prügi. Registreeritakse kõige levinumad probleemid ning nende juurpõhjuste välja selgitamiseks kasutatakse *Five Whys* analüüsi. Järgmise sammuna kujundatakse toodete müügiprotsess ümber vastavalt analüüsitulemustele ning modelleeritakse tulevane protsess. Lõpuks arendatakse ning juurutatakse Pildipoe kaubamärgi all välja vastav tarkvarateenuse platvorm, mis realiseerib ja automatiseerib ümberkujundatud müügiprotsessi, eemaldades sealt inimtööjõu rakendamise vajaduse.

Töö näitab, et protsessikeskne mõtlemine sobib väikeettevõtetele, näiteks fotostuudiotele. Lisaks lõi autor magistritöö tulemusena tarkvarateenuse platvormi Pildipood.ee, mis toetab lisaks Stuudio.com protsessidele veel rohkem kui 50 väikese fotostuudio müügiprotsessi üle Eesti.

Võtmesõnad:

Äriprotsesside juhtimine; fotostuudio; väikeettevõte; tellimuste täitmise protsess

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1 Introduction

With the arrival of digital photography and the inkjet printer, and, more recently, of mobile phones and online sites for distributing photographs, many of the assumptions about photography are becoming more ambiguous and changing [1]. Camera prices are dropping continuously and people can buy more and more technically advanced gear for the same amount of money every coming year. As a result, everyone could be a photographer and the demand for professionals is decreasing. Taking a digital photo includes no costs and the easiness of sharing pictures in web galleries created the situation where the demand for paper pictures became very low.

In 2008 a new photographing studio was established in Tartu. Many new hobby photographers began their work and new theme sessions, including pre-wedding, pregnancy, newborn, family, etc. sessions became very popular. In these market conditions, the small one-man photo studio[1] (hereinafter Studio) started its business, first year at home, and then in a new modern well-equipped studio. At the beginning, all photographers sold their services in the same way and only session time was offered to customers. Full shooting results were given to customers as files and no up-selling was done. Studio innovatively learned from the sales process that customers were ready to pay for files and paper products. They opened a new business segment to earn extra profit from after-sells. The Studio bought a large inkjet printer to optimize profit from printing services and hired a full-time assistant to manage and fulfil orders. Soon it became clear that in increasing demand conditions (up to 60 sessions in month) they had to hire more employees or optimise and automate Studio business processes to fulfil orders in time.

There are some existing solutions in the market regarding photo products' sales services, for example, Fotograafid.ee and Shootproof.com. The main factors because of which we did not use them were that the solutions did not offer full control and an overview of own orders, products like KAPA® boards[2] and canvases were not included in the selection, there was no functionality that would enable customers to fulfil orders by themselves, the user interfaces were too complex or of low quality. Global services did not correspond to the local market's needs—they had not been localized and the payment methods used in the local Estonian market were different.

There are basically no systems that support the core processes of a photo studio in a systematic, end-to-end and integrated manner. This forces operators and workers in small photo studios to use ad hoc approaches to manage their day-to-day work, which makes their work less efficient and error-prone. For example, some photo studios use common office productivity tools (e.g., MS Word and Excel) to manage a big part of their day-to-day operations. There is potential to develop measures for managing business processes in photo studios in more efficient and less error-prone ways.

The focus of BPM in practice and related research has been its application in large organisations. The general value proposition of BPM, however, is also of significance for small and medium-sized enterprises (SMEs) [2].

This thesis addresses the question of whether it is reasonable to apply the Business Process Management (BPM) Life-cycle in Small Business processes. While much of the available research provides good guidance to larger, established organisations, there is less commentary addressing the challenges of and approaches to the adoption of BPM within Small

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[1] http://www. stuudio.com
[2] A tough lightweight board with polyurethane hard foam core manufactured in-line.

Businesses in the early stages of their establishment [3]. Several case studies [3] [2] have shown that mainstream BPM tools and techniques can be applied in a Small Business environment to yield benefits similar in nature to those that would be targeted in larger businesses. BPM has also been applied in small businesses in the film industry, indicating that BPM is applicable in the creative industries [4]. To find the answer, common methods and techniques are adopted to model, redesign and automate the core process of a small photo studio in Estonia, specifically its order-to-cash process. This is a sales process that starts from the moment when an order is received from a customer, and this order is paid for, fulfilled and delivered.

As result of this thesis, BPM Life-cycle is documented and software-as-a-service is created to automate the Studio's order-to-cash process. This service has been designed to be used by other photo studios in the market independently and with a minimal setup and configuration effort. The service was launched in 2009 under the label of Pildipood[3]. Full automated functionality was introduced at the end of 2013. As of May 2015, about 50 studios in Estonia use this service as a part of their everyday work processes. In the last six months (November 2014–April 2015) more than 1,200 orders were handled by photo labs through the automated work path described in this thesis.

The remaining parts of this thesis are structured as follows. Chapter 2 explores the state of the photography business at the time when research for this thesis was started, and Studio's existing processes. The chapter ends with an overview of the BPM Life-cycle and methods used in the other parts of the thesis. Chapter 3 contains process identification and discovery, and is followed by analysis and redesign in Chapter 4. The 5th chapter gives an overview of the implemented software-as-a-service and contains some measures for key performance indexes.

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[3] http://blog.pildipood.ee

2 Background

This chapter explores the photography business in general, and provides a specific overview of the photo studio, where this project was performed. This section is followed by a short discussion about the business processes of the respective studio. The final part of the chapter features an overview of the Business Process Management method used for analysing and improving the photo studio's business processes.

2.1 Historical context of the photography business

About a decade ago (2003) the worldwide sales of digital cameras transcended film camera sales [5] [6]. The industry was revolutionized by digital photography owing to reducing costs and delays. It became easy to take pictures; view, transfer and edit digital photos with ordinary home computers [1]. Prices of digital SLR (single-lens reflex) cameras became affordable for more people. Photo printing prices dropped so low that the cost of a 10x15 cm printout is only 0.09–0.15€ [7] [8] in the most popular labs today (in 2002 it was about 0.32€ [9]). Still, it is important to stress that low price also means low resulting quality and short durability. A lot of amateur photographers practised taking photographs as a hobby and classic photographing services started losing their position. Session prices were low because of the high concentration of hobby photographers, and, instead of selling photo products, full session results were given to customers for free.

The Studio that we consider in this thesis was established in these low-profit market conditions. In this case study, the Studio is a micro company but it is quite process-centric in its everyday work. The Studio's owner is very innovative and is looking for technology to improve existing processes and make them more efficient. In 2009 the owner realized that there is a big need in the market for high-quality shooting sessions. Existing old-school studios offered only "press the button" services. In 2009 the new modern Studio that was equipped with a set of the best photo gear was opened in Tartu, offering a wide range of thematic shooting sessions. The Studio designed new concepts and methods to provide new high quality shooting sessions upon offering professional level shooting results available and affordable to a wider range of customers. Different attributes were added to sessions, different themes and role shootings etc. were offered to customers (Table 1).

Social media became the best sales supporting channel—when people shared beautiful and emotional photos in social networking websites (Facebook, MySpace, Google Plus), their friends also started to want similar photos. Also, the Studio has proved during its day to day work that customers want to get high-quality printouts and are willing to pay many times more for them in comparison to photo lab prices. A lot of explaining has been done in the following years to change the thinking of other photographers and to prove to them that there is a lot of revenue in selling photo products.

The photo studio business is fully based on customers' emotions, not rational thinking. Customers buy emotions and they are ready to pay more for beautiful and high-quality products.

Table 1. Examples of the Studio's different photographing styles

© Stuudio.com, Andres Jalak

2.2 Studio's existing processes

The studio studied in this thesis (hereinafter called Studio) has two main business segments where they attract customers. The first and more traditional business is selling shooting sessions. The company has a very modern custom-designed and custom-built studio with the latest shooting equipment installed. The Studio is used for the company's own photographers' sessions and rented out for other professional photographers. In the studio, common shooting sessions are devoted to the topics of pregnancy, babies, families, etc. Out of the studio, the shooting sessions include pre-wedding sessions, photographing weddings, birthdays, balls, school graduation events, product shoots, etc. Wedding shooting sessions include debriefing before the session with the bride and groom during which all details are agreed upon, and some intense pre-selling is done in view of the sales of possible photo products afterwards.

The second strategic business area is selling photo products after shooting sessions. Products are divided into two bigger segments: small paper photos and big products. Small photos include photos in paper sizes up to A3. Big products are paper photos bigger than in size A3, KAPAs, canvases, etc. The Studio has a high quality photo printer and a medium selection of high-end photo papers and canvases. Small paper pictures are printed in the Studio and other products are ordered from specialized photo labs. It is more profitable to print paper pictures in the Studio as materials and printing is cheaper there. However, printing is quite time consuming, while a full-time assistant is performing all this work, and this is not efficient. The Studio owner sees an opportunity for optimising and automating the order fulfilment processes to maximise performance, reduce costs and cycle-times. In view of this situation, we consider how the BPM life-cycle can be used to improve the existing core processes.

2.3 BPM lifecycle

Business process modeling (BPM) in systems engineering is the activity of representing the processes of an enterprise, so that the current process may be analysed or improved upon [10]. Business Process Management is the art and science of overseeing how work is performed in an organisation to ensure consistent outcomes and to take advantage of improvement opportunities [11].

In this thesis, the BPM methodology and techniques described in the book "Fundamentals of Business Process Management" [11] are used.

This methodology is organized into the so-called BPM lifecycle, which encompasses a set of methods to continuously help to design, model, execute, monitor and optimise the enterprise's processes (Fig. 1). The BPM lifecycle helps to understand the role of technology in BPM. Technology in general, and especially information technology (IT), is a key instrument for improving business processes.

In this methodology, the BPM lifecycle starts with a phase known as process identification. Process identification is a set of activities aiming to systematically define the set of business processes of a company and establish clear criteria for prioritising them. The output of process identification is a process architecture that represents the business processes and their interrelations. The process architecture serves as a framework for defining the priorities and scope of process modeling and redesigning projects [11].

To get a list of processes, we use a technique that involves the identification of case types and business functions that are performed in view of these case types. *Case type* is different dimension classified by the type of case that the organization handles. A case can be a product or service that the company delivers to its customers. A case type can be represented by different channels through which the customer is contacted. It can be also different customer groups that are distinguished between. The result is a case/function matrix that is divided into reasonable processes. Then relations between processes are described and every process is evaluated to find the best candidates for the redesigning phase.

The next phase in the BPM lifecycle is *process discovery*. Process discovery is defined as the act of gathering information about an existing process and organising it in terms of an as-is process model. This definition emphasizes gathering and organising information [11].
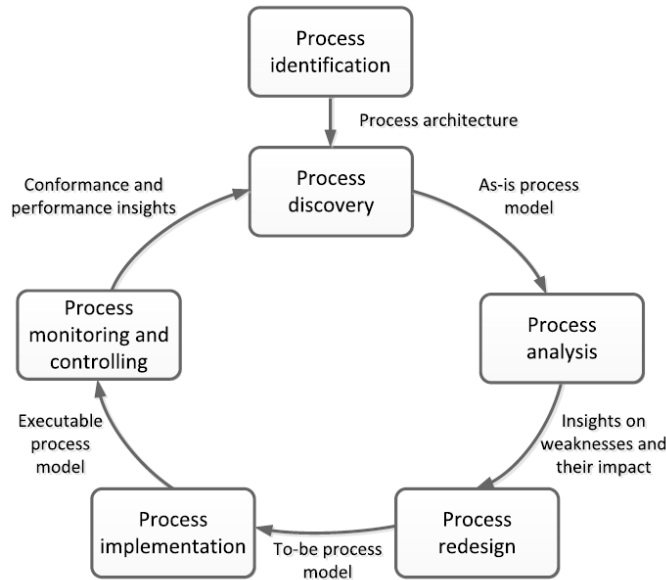

Fig. 1. BPM Lifecycle steps and related artefacts (taken from [11]).

We can distinguish between three different techniques for gathering information about a process: evidence-based, interview-based and workshop-based discovery. In this case study, the interview-based method is used. Interviews provide a rich and detailed overview

of the process and people working on it, and they help to understand the process in detail. The downside of this method is that successful case scenarios are described. Some extra effort must be dedicated to uncovering variations and exceptions that have a sufficient impact on the process.

In the process discovery (or modelling) phase, we identify the process boundaries, activities, events, resources and their handovers. We identify the control flow and all additional elements. The results are high-quality BPMN 2.0 diagrams representing the full process in detail. The process diagrams in this thesis are created with the Signavio BPMN Tool[4], one of many process modeling tools supporting the BPMN notation.

BPMN diagrams contain activities, decision points and participants of the process. Accurate workflow is also defined with possible exceptions. The process is defined in the context of participants; the entire message flow is modelled. Data objects involved in the process are also added to the diagram. The main goal of the diagrams is to make the process clear and easily understandable for participants or some external persons reading the diagram. Furthermore, these diagrams will be the input for the process analysis and redesign phase.

As part of the discovery phase, the BPM lifecycle relies on a set of guidelines to ensure the quality of process models. In particular, the syntactic quality of diagrams is verified by following the Seven Process Modeling Guidelines (7PMG) [12]:

G1. **Use as few elements as possible in the model.** Larger models tend to be more difficult to understand and have a higher error probability than small models.

G2. **Minimize the routing paths per element.** The higher the degree of an element in the process model, the harder it becomes to understand the model.

G3. **Use one start and one end element.** The number of start and end events is positively connected with an increase in error probability.

G4. **Make the model as structured as possible.** A process model is structured if every split connector matches a respective join connector of the same type.

G5. **Avoid OR routing elements.** Models that have only AND and XOR connectors are less error-prone

G6. **Use verb-object activity labels.** People consider the verb-object style, like ''Send invoice'', significantly less ambiguous and more useful than the action-noun label "Customer billing''.

G7. **Decompose a model with more than 50 elements.** Personal practice with the modeling process shows that for better readability and understanding, this number can be even as low as 20.

7PMG does not relate to the content of a process model, but only to the way this content is organised and represented. All diagrams are also validated against BPMN Modeling Guidelines[5].

The BPM lifecycle includes a set of tools to analyze business processes in order to identify weaknesses and improvement opportunities. For example, some principles and techniques to make the process leaner by finding unnecessary steps in the process with the perspective of eliminating them are used in the analysis phase. Weak parts are also identified and analysed. Weak parts are process tasks that create issues negatively impacting the process outcome or performance.

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[4] http://www.signavio.com/products/process-editor
[5] http://www.modeling-guidelines.org

To identify unnecessary steps, a value-added analysis which consists of two steps—value classification and waste elimination—is performed. In this context, a step can be a process task, part of a task or sending-receiving activity (handover) between tasks. Steps can add value to a customer (VA), add value to the business (BVA) or be non-value adding (NVA). A step is value adding if it directly contributes to the outcome of the process and this is what a customer is willing to pay for. For example, imagine a car repairing service. Diagnosing the problem and repairing the vehicle are value adding steps, and contribute to achieving the outcome the customer is interested in. Now we can imagine that the repairing process includes a step during which information about the vehicle is stored—the next service time, owner's contacts, technical data of the vehicle. This is a necessary step for the company to build a customer database and to make the selling process more effective in the future. Customers do not gain satisfaction from these steps of the repairing process and are not willing to pay for them. Nevertheless, this step adds value to the company's other processes and that is why the step is classified as business-value adding. Typical non-value adding steps do not fall into any other categories. Common NVA steps are handovers from one process participant to other. In case of this car repairing example, an NVA steps is when incoming work is registered at the front desk and the clerk takes the work description papers to the technician in the workshop. These non-value adding steps are potential candidates for automation or complete elimination.

The next analysis step is to identify as many issues as possible that a process suffers from. No matter how improved some non-trivial business process is, there are always errors, misunderstandings, incidents, unnecessary steps, duplications or other issues that affect the process outcome and performance. This step is called root cause analysis and the outcome of this is a registry of all known issues related to the process. Issues are categorized by 6M:

M1. **Machine** (technology) — includes malfunctions in software and hardware, poor user interfaces, data losses.
M2. **Method** (process) — participants' lack of understanding in view of the process, miscommunication, inconsistent decision making.
M3. **Material** — factors including raw materials or information as the input of a process, which leads to quality issues in the output products or wrong decisions in the process flow.
M4. **Man** — incorrect performance during process steps by process participants. Factors include inaccuracy, inattention, lack of training or skills for working during times with a higher work load.
M5. **Measurement** — factors related to measurements or calculations made during the process.
M6. **Milieu** — process environment factors that are outside of an organisation's control. All third party providers, suppliers, customers, etc.

All factors are classified as either causal or contributing factors. Causal factors are the factors that would prevent the issue from occurring in the future, if corrected, eliminated or avoided [11]. For example, if an order is taken into processing only after the prepayment has been received, the issue of unpaid invoices is eliminated. Contributing factors are those that set the stage for or increase the chances of a given issue occurring [11]. For example, a badly designed user interface increases the possibility of getting invalid input data as a customer does not understand the interface well. Good UI is where it is very easy to do what a customer wants to do and very hard to do what a customer does not want to do.

The method used in this thesis is called the Five Whys Technique. The main idea behind this technique is to find the root causes of issues. The common belief is that repeating the question *why* up to five times can help uncover the root problem [13].

Finally, the issue register is put together. It provides a detailed analysis of each issue and the impact it causes. Typically, the issue register includes the following fields: name of the issue, description, priority, assumptions, qualitative and quantitative impact. Other fields may be added, for example "caused by" and "is the cause of" to display the relations between issues.

In the process redesign phase, business decisions are made and new to-be process models are created.

For the implementation of the redesigned process, new software-as-a-service is built from scratch. This service will fully automate the photo studio's sales process. The running process will be monitored and some key performance indicators will be collected and analysed. Current issues and some functional feature requests for changing or adding functionality are also listed.

3 Identification and discovery of processes

3.1 Process identification

First of all, it is necessary to find out the Studio's process architecture and get a general overview of the processes, roles and their relationships in the organisation. When I started to designate core processes, I found out that there is some process-oriented thinking in the organisation but nothing is documented or described in writing.

The first thing in identifying existing processes is to identify the case types. In this context, case types are products and services that the Studio is selling.

Case types:

- Photo session in studio
- Photo session on site
- Photo products
- Studio time

We can identify selling sessions in the studio and on site separately, since even though they are similar, they are handled in different ways.

The next step is to identify the business functions that are performed for the case types developed before.

Business functions

- Managing the studio schedule
- Managing the photographers' schedule
- Doing photo session
- Editing photos
- Verifying queries
- Fulfilling orders
- Billing
- Monitoring invoice payments

Once the case types and business functions have been developed, they are used to construct a Case/Function matrix (Table 2). The matrix includes case types as columns and business functions as rows. If a business function can be performed for a case type, the corresponding cell has an X in it.

Table 2. Case/Function matrix

		Case type			
		Shooting session		Photo products	Studio time
		In studio	On site		
Business function	Managing the studio schedule	X			X
	Managing the photographer's schedule	X	X		
	Doing photo session	X	X		
	Editing photos			X	
	Verifying queries			X	
	Fulfilling orders			X	
	Billing	X	X	X	X
	Monitoring invoice payments	X	X	X	X

We can identify the following business processes from the Studio organisation's case/function matrix:

- Renting out the studio (purple)
- Doing sessions (yellow)
- Selling photo products after sessions (green)
- Billing and payment monitoring (grey)

Table 3. Consumer-producer relationships between processes

Consumer	Producer
Billing and payment monitoring	Renting out the studio
Billing and payment monitoring	Doing sessions
Billing and payment monitoring	Selling photo products after sessions
Selling photo products after sessions	Doing sessions

Firstly, there are core processes, while others are supporting processes. The first three are also upstream processes in comparison to the financial and accounting processes.

To find out which process will be the best target for BPM we can perform some evaluations in view of three parameters: strategic importance for the organisation, dysfunction of the process and feasibility of improvement (Table 4).

- Organisation's strategy (importance)
  The Studio management prioritises after-session sales because paper pictures, canvases, photo books add value to the customer and there is a great potential for increasing revenue in that field. After the digital revolution in photographing occurred, people have become used to storing digital files in computers and not maintaining paper pictures in albums. Low-quality cheap photo printing has also become a standard. According to the real-life selling experience, it is clear that people want beautiful studio pictures to be on high-quality paper, a canvas, KAPA or in a handmade album, and they are ready to pay for it. Thus, the Studio is focused on selling more after-products and wants to do this effectively.
- Known dysfunctions
  There are some dysfunctions in billing and payment monitoring. Mainly, the faults are connected to forwarding issued invoices to the accountant, as well as monitoring unpaid invoices afterwards and reminding the customers. Known dysfunctions in the photo products' selling process are related to understanding customers' wishes, printing photos and shipping.
- Feasibility issues
  Photographers are quite conservative, so every change in processes that includes them needs new instructions. After-session customers are more unique but the new process must be very simple and understandable to avoid having to provide extra support in the future.

Table 4. Process evaluation

	Importance	Dysfunction	Feasibility
Renting out the studio	3	1	2
Doing sessions	3	1	1
Selling photo products after sessions	3	3	2
Billing and payment monitoring	2	2	1
On the scale of one to three: 1—no; 2—some; 3—yes			

A strategically important process has the biggest potential for gaining the most value after the redesigning and automation in the photo products' sales process. This process adds value to the photo-session process and includes most of the tasks and participants in the organisation. If measured in time, this process takes approximately 90 work hours in a month for a full-time assistant. This process also has many potential issues that cost extra money.

3.2 Process discovery

The next step is to engage upon an interview-based discovery process to find out all the details of a selected process. All the data collected from an interview is quite objective and

rich in details. As a result of the interview, the sales process (order-to-cash) is described as follows:

The order-to-cash process starts after the end of the photographing session and all session files are stored in the local server. A notification is sent to the assistant who cleans session pictures by deleting duplicates and failed shots. Additional editing and retouching is done where needed. Then the assistant generates a static gallery from Lightroom and uploads it to the Studio's website. An email with a link to the gallery, pricelist and ordering information is created and sent to the customer. An album entry is added to an Excel sheet to keep track of the notifications. Once in a month, albums without orders are detected and a notification is again sent to the customer.

If a customer query is received (email, sometimes even on paper), containing file names, respective products, amounts, special retouching wishes etc., several emails are exchanged to verify all these parameters. Some personal recommendations are also added to offer a better solution for the customer and Studio. Sometimes several reminders are sent until a customer confirms the order. When the order has been finally confirmed, pictures are digitally retouched according to a customer's wishes and the product types in the order. Small paper pictures are printed in the Studio with the company's inkjet printer and cut into the correct size. Large products are sent to the photo lab. The photo lab delivers printouts to the Studio after completing the order. If an order includes files, these are loaded to Dropbox and the link is sent to the customer.

After the order is completed and all products are collected to the Studio, the order is packed into a parcel and shipped, if needed. If a customer wants to collect the package by herself, some possible pickup times are emailed to the customer. An invoice is issued and sent to the customer and the Studio's accounting. Sometimes session costs are added to the invoice.

If a customer has not collected his package from the Studio or initial pickup times were not suitable, new possible pickup times are sent to the customer monthly.

Once in a month, the accountant sends a list of unpaid invoices to the Studio and the assistant reminds customers about this. Until an invoice is not paid, the email thread with the customer is marked as unread in the Gmail inbox. Album and order related statuses and activities are tracked in an Excel file. Invoices are created in Excel and another Excel file is kept to track invoices. When an invoice is paid, the order-to-cash process is finished.

Firstly, we can identify process boundaries—this means the triggering events that start the process, and possible outcomes. This process starts when a shooting session is finished and all files are stored on a server. The positive outcome of the process is a fulfilled order. The negative outcome may be a cancelled order, and the process is terminated when no orders are placed.

Editing pictures can be a separate process but in this thesis it is treated as an atomic one. However, digital photo processing workflows are thoroughly documented in other works and are not within the scope of the current work [14].

Fig. 2. Activities and events in the order-to-cash process.

Now we can identify activities, events (Fig. 2), resources and their handovers (Fig. 3). As the organisation being analysed is a small business, it has only a few resources—photographers, an assistant and accountant. We can make assumptions that some tasks must be completed before the next are started. As a result, we get a model with pools, lanes, stakeholders and handovers:
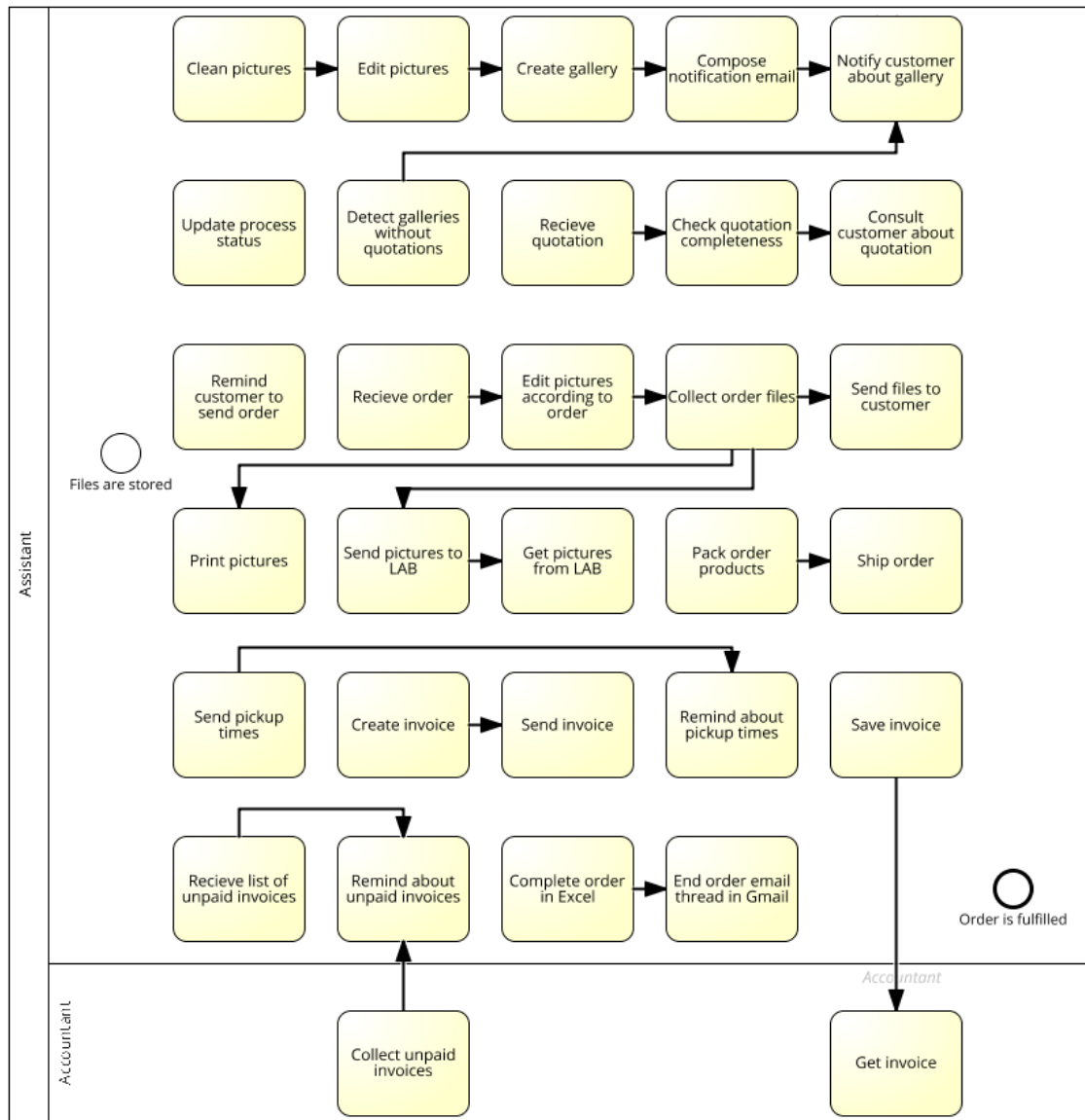
17

Fig. 3. Resources and handovers identified in the order-to-cash process.

Finally, the full process is modelled in a BPMN tool. All the as-is diagrams are in the next figures. The first one is the main process and all collapsed sub-processes follow.

The order-to-cash as-is process (Fig. 4) is treated as one long process. The logical sub-processes are part of the modeling phase and they are the tasks with the small plus sign in the diagram. All the sub-processes are visualized in the next diagrams (Fig. 5–Fig. 11).
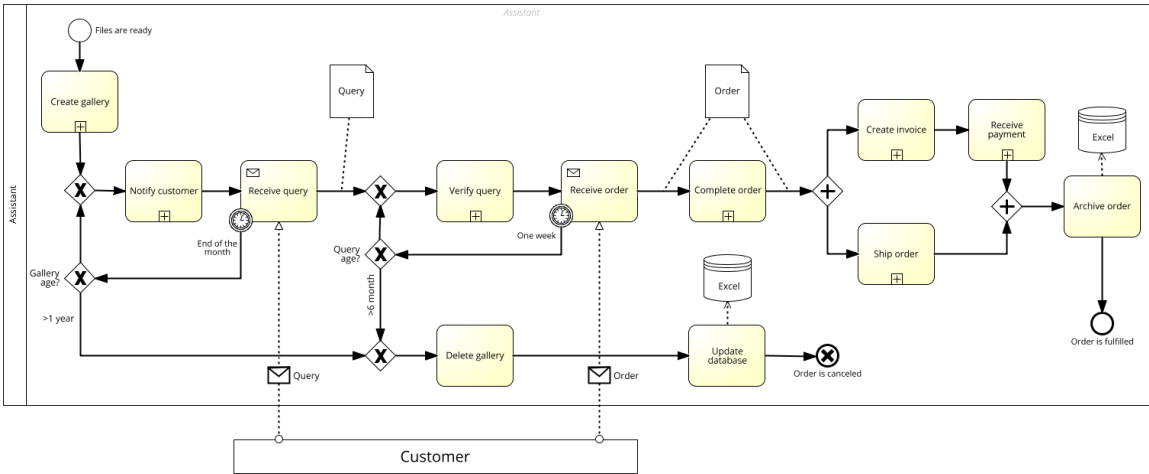
Fig. 4. Order-to-cash main process.
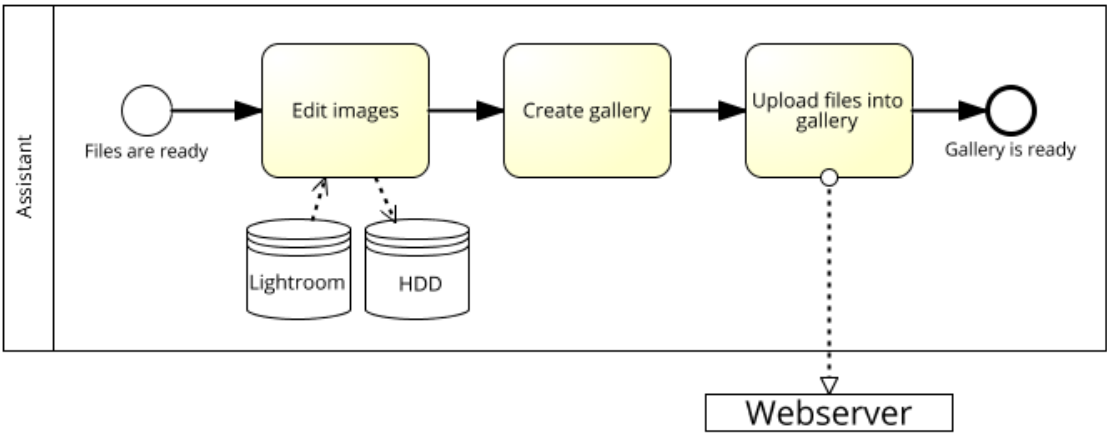
Fig. 5. Create gallery sub-process.
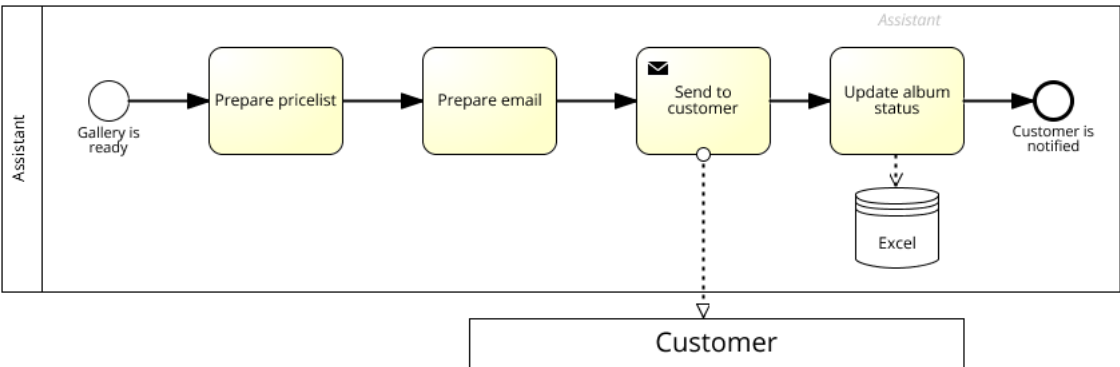
Fig. 6. Notify customer sub-process.
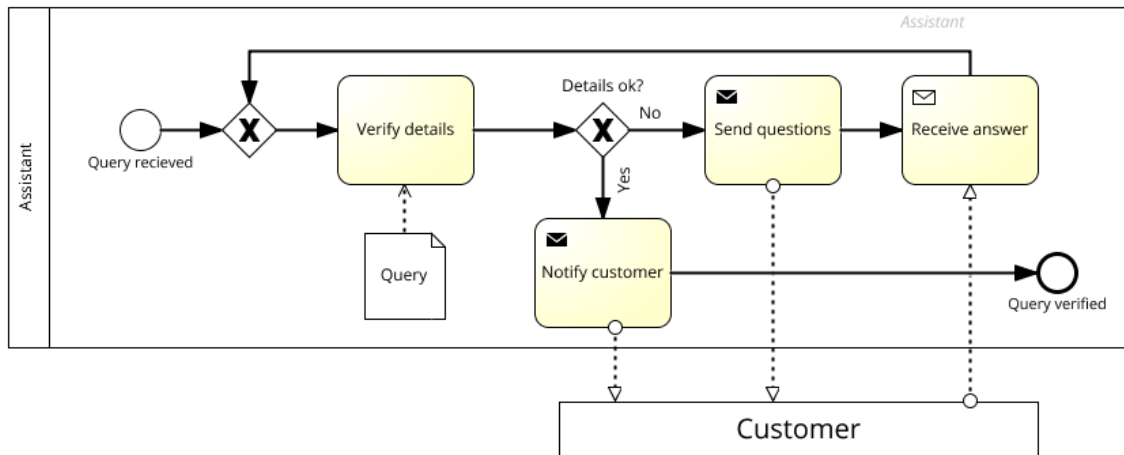
Fig. 7. Verify query sub-process.
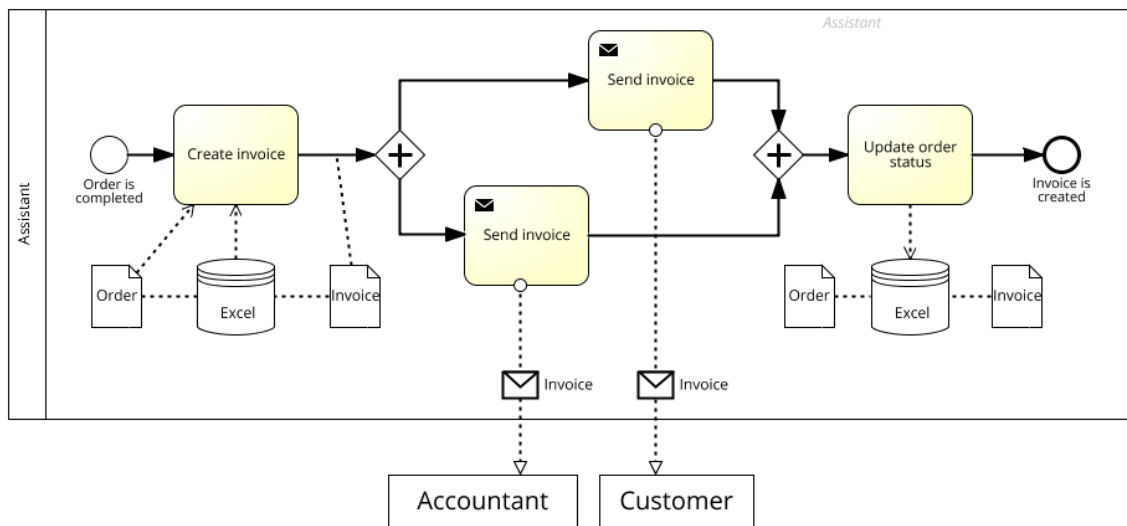
Fig. 8. Create invoice sub-process.
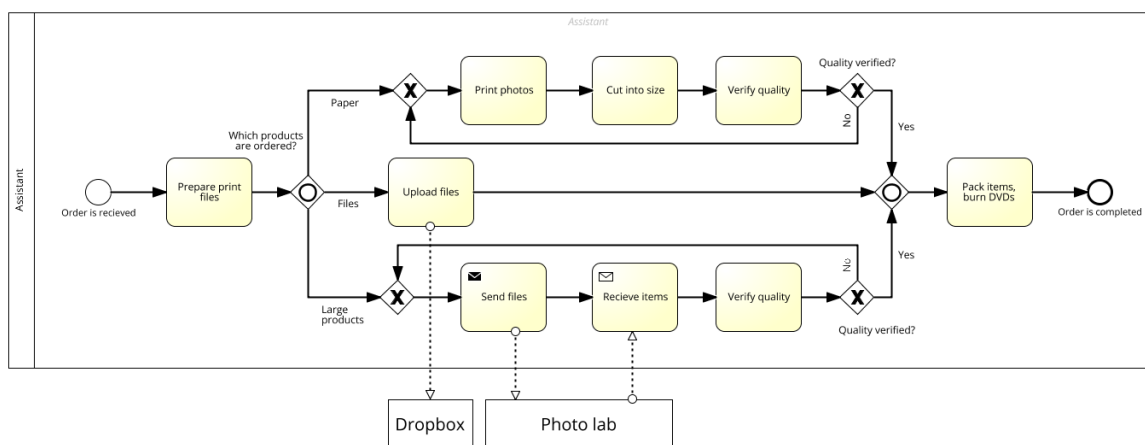
Fig. 9. Complete order sub-process.
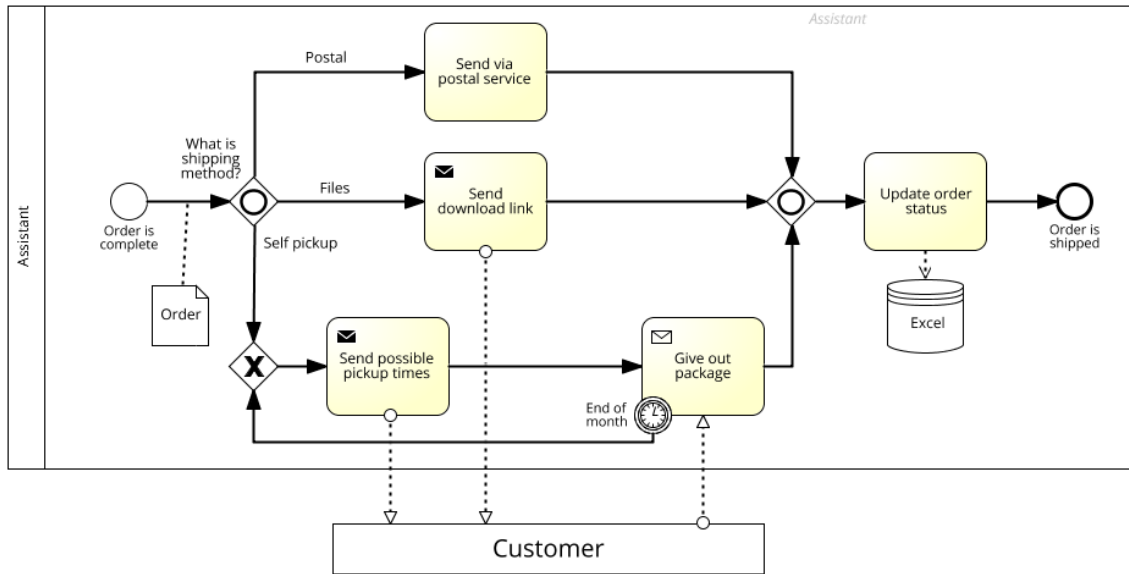
Fig. 10. Ship order sub-process.
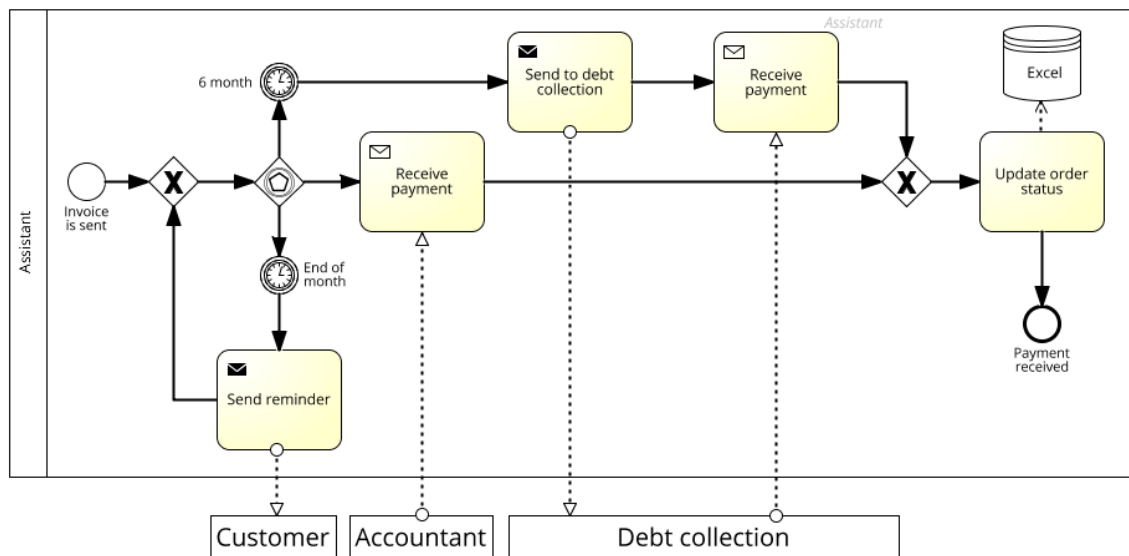
Fig. 11. Receive payment sub-process.

4 Analysis and redesign

4.1 Value-added and waste elimination analysis

The outcome product for the customer in the sales process is the photo products' order. Thus, value-adding classification (Table 5) is applied for that perspective. All steps that add value to the outcome are value-adding steps. Values that a customer is willing to pay for include editing, printing, verifying, quality checks and shipping. All steps that are done to keep the business running smoothly are business value-adding. These steps include documentation, accounting, and order tracking tasks. Non-value adding steps are the rest, mainly sending, receiving and handover steps.

Table 5. Value-adding classification.

Create gallery		Create invoice	
Decide need of editing	BVA	Create invoice	BVA
Edit images	VA	Send to customer	NVA
Create gallery	NVA	Send to accountant	NVA
Upload files into gallery	NVA	Update order status	BVA
Notify customer		**Ship order**	
Prepare pricelist	NVA	Send via postal service	VA
Prepare email	NVA	Send download link	VA
Send email to client with link to gallery	NVA	Send possible pickup times	NVA
Verify query		Give out package	NVA
Verify details	VA	Update order status	BVA
Send questions	BVA	**Receive payment**	
Receive answer	NVA	Send to debt collection	NVA
Notify customer	NVA	Receive payment	NVA
Complete order		Send reminder	NVA
Prepare print files	VA	**Sales process**	
Print paper photos	VA	Receive query	NVA
Cut photos into correct size	VA	Delete gallery	NVA
Verify quality	VA	Receive order	NVA
Upload files to Dropbox	NVA	Archive order	BVA
Send files to LAB	NVA		
Receive items from LAB	NVA		
Verify quality	VA		
Pack items, burn DVDs	NVA		

4.2 Issue register

The issues in the registry are collected by interviewing the Studio owner and assistant. As there is no existing registry or documentation on previous issues, all data is reproduced from memory and is quite subjective. The three most common issues are documented. The

first two are directly related to customer satisfaction and the third one causes financial losses to the Studio in the form of loss of profit.

Issue 1: Customer receives faulty package

Priority: 1

Description: a customer's package does not include the products he ordered. Problems include missing products, the wrong type of products, products with defects or the package having been damaged during the delivery.

Assumptions: In a high-load season, the rate of faulty issues is very high, up to 25% of orders.

Qualitative impact: Customers complain and are frustrated.

Quantitative impact: Extra labour costs, additional material costs on refilling an order.

Issue 2: Customer's order is not delivered

Priority: 3

Description: Parcel is returned by the postal service or customer has not picked it up from the Studio

Assumptions: Possible pick-up times offered to the customer did not fit.

Qualitative impact: Customers complain.

Quantitative impact: Extra work time is spent and financial expenses are incurred upon re-sending the package and communicating the customer.

Issue 3: Invalid invoice is issued

Priority: 1

Description: Invoice content or customer credentials are wrong in some cases. Something is missing or some extra articles have been added.

Assumptions: If the total amount of the invoice is too big, a customer notifies about this. If something is missing, customers generally will not pay attention to it. Sometimes, session costs are meant to be added to an invoice but the employee forgets to add them.

Qualitative impact: Customers complain if the invoice amount is too big.

Quantitative impact: Unknown amount of unpaid sessions.

4.3 Root Cause Analysis

We try to find out the root causes that plague the sales process for each identified issue from the issue registry. For that, the Five Whys technique (*why-why*) is used:

- **Customer receives faulty order package. Why?**
  - Some products are missing from the package. Why?
    - Wrong pictures have been added instead of the ordered ones. Why?
      - Wrongly decoded customer order. Why?
        - There is no standardized order form.
    - Inaccuracy.
    - Wrong number of copies. Why?
      - Wrongly decoded customer order. Why?
        - There is no standardized order form.
      - Mistakes in printing. Why?
        - Inaccuracy.

- - - o Wrongly decoded customer order. Why?
        - There is no standardized order form.
    - Mistakes in ordering from the photo lab. Why?
        - Inaccuracy.
        - Wrongly decoded customer order. Why?
            - There is no standardized order form.
        - Photo lab has fulfilled orders incorrectly.
  - Some products are in the wrong size. Why?
      - Invalid printer settings. Why?
          - Inaccuracy.
      - Mistakes in understanding order. Why?
          - There is no standardized order form.
      - Mistakes in ordering from the photo lab. Why?
          - Inaccuracy.
      - Photo lab has fulfilled orders incorrectly.
  - Pictures are not retouched as the customer wished. Why?
      - Customer's wishes were misunderstood.
      - Retouching is not possible as requested.
  - Products have physical defects. Why?
      - Printer toner head needs cleaning. Why?
          - Problem related to printer and accessories.
      - Paper has defects. Why?
          - Problem related to printer and accessories.
      - Photo lab has fulfilled orders incorrectly.
      - Products are damaged. Why?
          - Invalid packing. Why?
              - Inaccuracy.
          - Postal clerk's rough handling.
- **Customer's order is not delivered. Why?**
  - Parcel is returned. Why?
      - Invalid address. Why?
          - There is no standardized order form.
      - Customer leaves the parcel to the post office. Why?
          - Customer forgot the parcel
      - Invalid cell phone number (SmartPost). Why?
          - There is no standardized order form.
  - Parcel stays in the studio. Why?
      - Pickup times have not been communicated.
      - Customer forgot the parcel.
- **Invalid invoice is issued. Why?**
  - Mistakes in adding lines. Why?
      - It is easy to make mistakes in Excel
  - Mistakes in calculating taxes. Why?
      - It is easy to make mistakes in Excel
  - Wrong order data as input. Why?
      - There is no standardized order form.
  - Session costs are missing or have been added extra. Why?
      - Unclear information about the customer's billing so far.

The results of the *why-why* method are summarized in Table 6. The two most common root causes are related to the Method and Man categories. This strongly indicates that the automation and standardisation of processes and eliminating human participation in the redesigned processes can improve the whole process very effectively.

Table 6. Overview of root causes identified in the sales process.

Root cause	Count	6M category
There is no standardized order form	8	Method
Inaccuracy	6	Man
Photo lab has fulfilled orders incorrectly.	3	Milieu
Problem related to printer and accessories	2	Material
It is easy to make mistakes in Excel	2	Method
Customer forgot the parcel	2	Milieu
Retouching is not possible as requested. Unclear information about the customer's billing so far. Customer's wishes were misunderstood. Postal clerk's rough handling. Pickup times were not communicated.	1	

4.4   Quantitative process analysis

The original processes were measured in terms of performance. It was possible to deduce the following performance measures from the interviews:

Time—The order-to-cash process cycle time for one shooting session was roughly estimated to be 3–4 hours:

- o   1 h for editing pictures after shooting and creating gallery
- o   1 h for fulfilling orders
- o   1 h for communicating with the customer, billing, payment monitoring

One month contains 160 working hours and this allows to process 40 sessions in a month. In reality, 30 sessions per month were the maximum performance.

Cost—main cost articles were the assistant's salary and printing consumables. When the quality of the printing and cutting process was low, extra costs were related to reprinting. Costs were not monitored daily per order.

Quality—there are some quality problems related to human attention and skills. In times when the workload is greater, the quality suffered a lot and customers were complaining.

Flexibility—in times with a greater workload, the assistant was not capable of handling all the processes in the promised time (2 weeks). More than 30 sessions in a month caused remarkable delays in fulfilling orders.

4.5   Redesign

After classifying tasks and sub-processes, detecting waste and identifying issues, the re-design decisions are made. Conclusions from quantitative performance measures are also included in the redesign decisions. It is not enough to restrict the innovations only to some automation. Some business related decisions must be made to gain maximum value from the process.

The main purpose of the planned redesigned process is to fully automate the order-to-cash process for the Studio and other interested photo studios in Estonia. To achieve this, all manual tasks must be eliminated or automated.

Decisions related to sub-processes:

Create gallery—this step will remain manual.

Notify customer—sending gallery invitations to customers will remain a manual task.

Verify query—this step will be eliminated. Analyses show that most of the contributing factors originate from this step. Custom editions and non-standardised orders create opportunities for misunderstandings. If a customer has the possibility to request custom editing ("remove wrinkles", "make me beautiful") he will use it, but he does not want to pay for it. So the elimination of this step will reduce the number of issues and editing costs as well as make fulfilling orders more efficient and faster.

Complete order—full automation. All files must be sent to the photo lab automatically; the lab prints all the products and ships these directly to the customer. As most of the quality issues relate to printing and packing, outsourcing these activities makes the process issue-free for the Studio.

Create invoice—full automation. In case of a manual workflow, hundreds of invoices are issued and sent to the accountant monthly. In the redesigned process, there will be only two invoices forwarded to the accountant monthly: a summarised customers' invoice and lab service invoice.

Ship order—orders are shipped directly by the lab. The Studio can still collect orders from the lab and deliver orders in a customised way.

Receive payment—full automation. When orders will be fulfilled only after the payment has been received, all steps and issues related to payment monitoring, reminding and debt collection are eliminated.

Sales process—receiving customer queries will be eliminated. The process will start with receiving the order and custom editing is not allowed anymore. Payments are received automatically from the bank.

The first business decision in the redesign phase was to minimise human-related steps and work time. It is done by automating and outsourcing some parts of the process. As lot of manual work originated from and issues were created by query verification and customer communication steps, a decision was made to eliminate these steps from the process. Another change that helps reduce human work time is fulfilling orders only after the payment has been received. It allows automating billing and payment monitoring; monitoring payments and reminding customers about unpaid invoices are eliminated.

The second important business decision was that all printing and shipping will be outsourced. After analysing printing and time costs in-house in comparison to outsourced costs, it was clear that after outsourcing it is possible to work without a full-time assistant. All quality and shipping issues are also the responsibility of the photo lab in this case.

After redesign, the three main processes are separate:

1. Gallery creation process (Fig. 12). All files are edited as final print files so no additional editing is needed. Print files are uploaded and the software creates thumbs, watermarks are automatically added and print files are stored in Amazon S3 storage. A predefined pricelist is associated with the album and, finally, a notification email is sent to the customer. All order-related instructions are visible for the customer in gallery view.
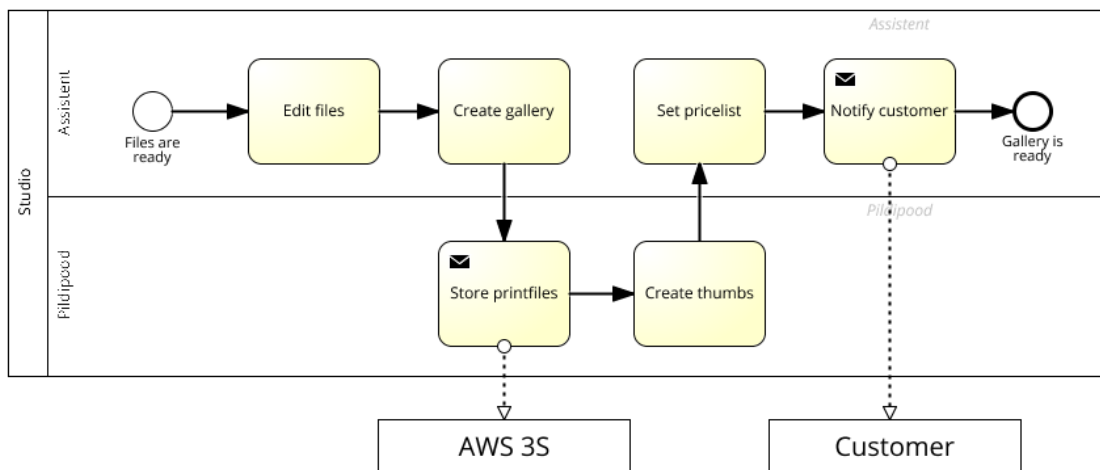
Fig. 12. Create gallery process.

2. Order-to-cash process (Fig. 13). The process starts with a customer order. No special editing requests are allowed. If payment has been received, a notification email is sent from the bank to the Pildipood mail server and the related order is identified (Fig. 14) and marked as paid. Software processes will take care of the email and order fulfilment steps. An invoice is generated and sent to the customer. Print files are downloaded from AWS and sent to the photo lab and customer (if needed) (Fig. 15). The full printing and shipping process is performed by the photo lab.
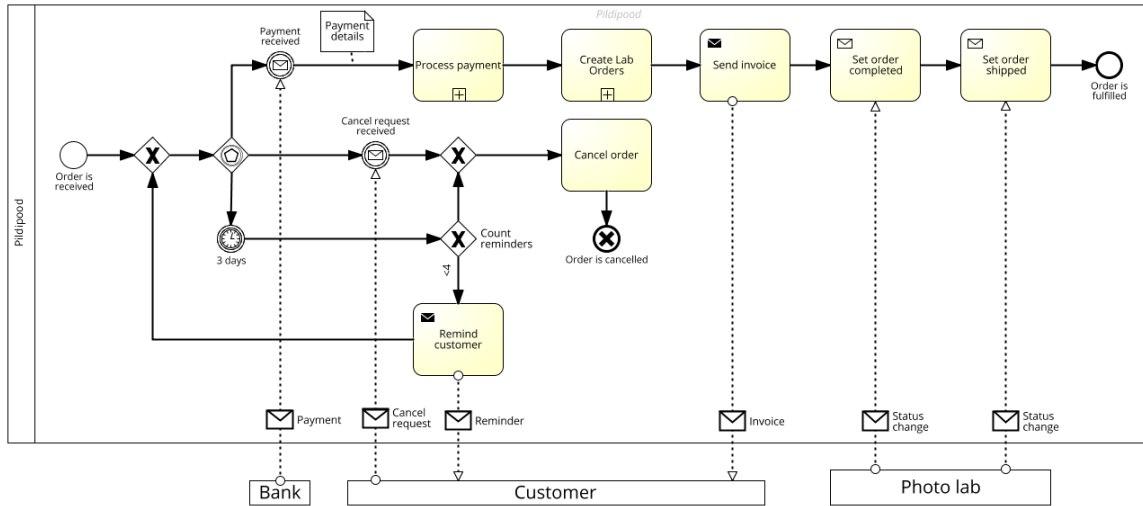
Fig. 13. Order-to-cash process.
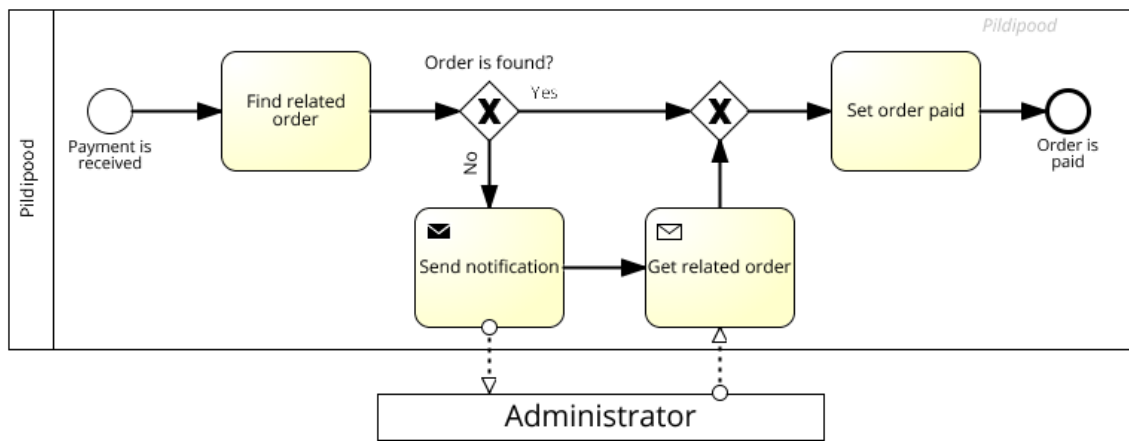
Fig. 14. Process payment sub-process.
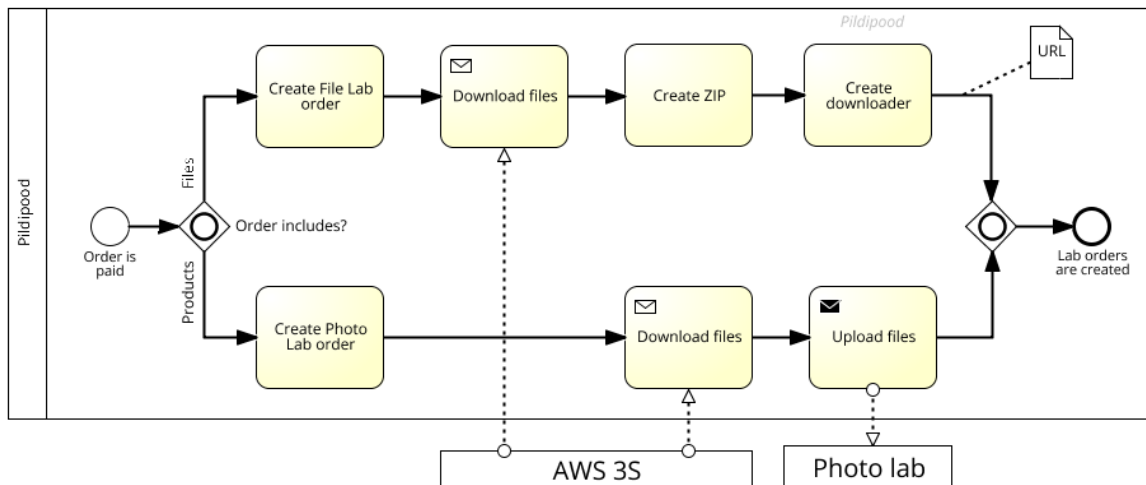
Fig. 15. Create lab order sub-process.

3. When the month is over, the previous month's accounting actions are done (Fig. 16). The previous month's summarised invoice is created for the Studio. It includes all invoices sent to customers on behalf of the Studio. The other invoice created is

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for the lab services used in the previous month. The earned money is sent to the Studio.

Fig. 16. Monthly accounting process.

5 Implementation and monitoring

The software (Pildipood.ee) is a business-to-business web solution implemented for photo studios to let them provide a business-to-customer photo products' purchasing service.

5.1 Software Architecture

The software is designed in a clear three-tier structure (Fig. 17) in the manner of software-as-a-service (SaaS). It supports multiple studios so that each tenant can only view its own system in isolation from others. The main business functionality the software service provides is the management of galleries, orders and invoices. Screenshots of the software are available in the appendix.

End-users are grouped into four categories and each of them has a different interface. Frontend is developed in JS and HTML, backend in PHP. Communication between frontend and backend is done with AJAX.

Photographers can upload albums and receive orders from customers who want to buy photo products. The photo lab can access its requests and print files to fulfil orders. The admin is the owner of Pildipood who can manage users, orders, albums, financial accounts, etc.

There are two types of albums: regular and full automate. Regular albums are for photographers who want to fulfil orders manually. The main focus in the software is on the fully automated lab albums and order-to-cash process.

Custom functionality and photographer profiles are managed by different user groups and settings. Different user groups are for trial accounts, full functionality accounts, freemium[6] accounts. Some accounts can use financial credit to order products from the lab. A freemium account has limited capacity for storage (300MB) and a limited number of albums (10). Full functionality accounts have no limitations.

Customer interface functionality:

- Step 1: Browse album pictures and mark pictures for ordering.
- Step 2: Add products to the picture, edit amounts, remove selected pictures.
- Step 3: Review order; set customer's name, email, phone; select shipping method, accept EULA.
- Step 4: Bank details for payment.

Photographer interface functionality:

- User settings management: edit user name, email, phone; change password; connect account with Facebook or Google for login; set public album header logo; set maximum width of normal sized pictures for automatic resizing; add watermark used when pictures are uploaded; edit invoice credentials; view accepted EULA.
- Album management: create and delete albums, upload and delete pictures, create and edit folders, move pictures between folders, set album pricelist, change public access key.

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[6] Freemium is a pricing strategy according to which a product or service is provided free of charge, but money (premium) is charged for proprietary features, functionality, or virtual goods.
(http://en.wikipedia.org/wiki/Freemium)

- Manage pricelists: create and delete pricelists, select products, set product price, edit paper and select frame type configuration, select automatic shipping methods, define self-managed shipping methods.
- View lab orders: browse paid orders.
- Manage manual orders: change content, update status, create invoice based on order.
- Browse automatic invoices: no editing is allowed.
- Manage invoices: create invoices, set payment status, convert into PDF, send PDF with email.
- Manage invoice articles: create and edit predefined invoice articles.
- Manage customers: add new customers and edit details of existing customers.
- Browse financial account history.
- Statistics of order.
- Statistics of invoices.
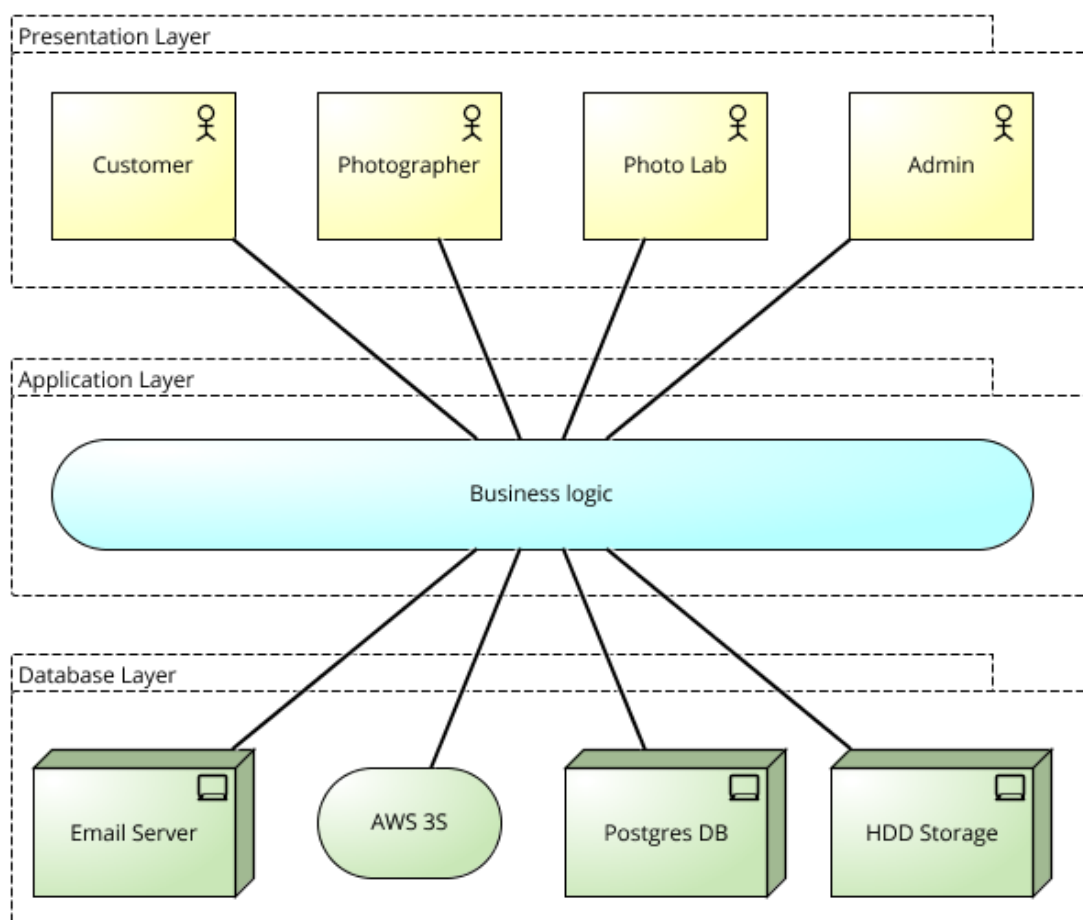
Fig. 17. Three-tier structure of Pildipood.ee.

Photo lab user interface functionality:

- Browser orders: view order details, change order status.
- Browse financial account history.
- User settings management: edit user name, email, phone; change password, connect account with Facebook or Google for login; view accepted EULA.
- Lab has FTP access for downloading orders' printing files from the server.

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Admin user interface functionality:

- Manage photographers: add new customer; edit name, username, email; send new password; login as user; add user into groups.
- Manage lab users: add new user; edit name, username, email; send new password; login as user.
- Browse Studio statistics: album, order and invoice count; HDD usage; total sum of orders.
- Browse all albums.
- Browse all orders: waiting payment, in lab, completed; change order status; set payment.
- Browse the statistics of all orders.
- Browse all invoices, edit details.
- Detailed overview of orders: fixed time range; orders grouped by financial account; details include date, customer order number, lab order number, customer name, amount paid by customer, sum of lab service, amount of service fee; totals of amounts.
- Overview of accounts' balance.
- Browse the financial history of all accounts
- Create financial transactions: withdraw, add money, transactions between accounts.

Higher level classes are shown in Fig. 18 and domain model in Fig. 19.
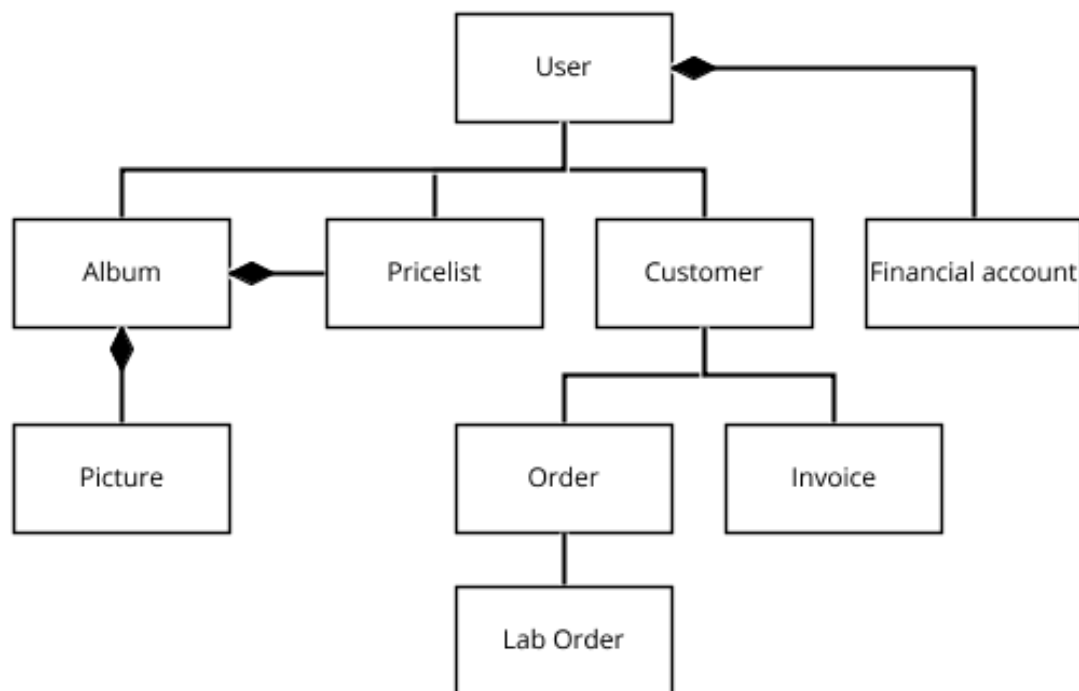
Fig. 18. Higher level classes.
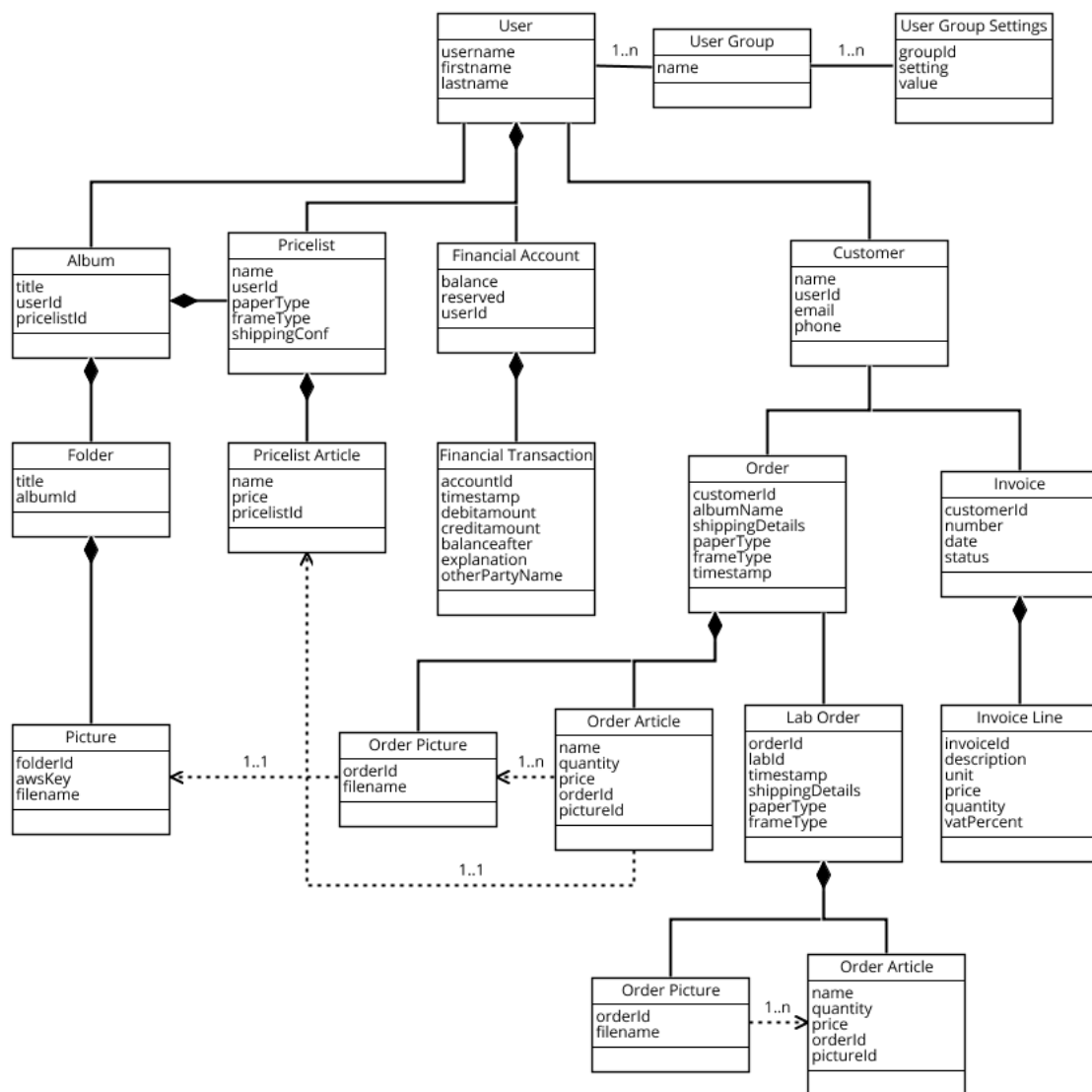
Fig. 19. Domain model

Automated functionality

- Picture resizing for an album. A photographer can define the customised maximum width for album gallery pictures.
- Adding watermark to thumbnails. A photographer can add his own watermark to be used with an album's pictures.
- Print files are stored in AWS 3S. Cloud storage prevents storage scalability issues.
- Payment checking. The bank sends an email to the email account when money has been received, and Cronjob checks it regularly and tries to match the emails with orders awaiting payment.
- If payment is not received, a reminder is sent to the Customer by Cronjob a maximum of 4 times in a 3 day cycle.
- After the payment and order are connected, the invoice is created and sent to the customer in behalf of the photographer.
- All necessary pictures are downloaded from AWS 3S to fulfil the order.

- If the order includes original files, a ZIP file is created and a link to this is sent to the customer.
- Files are copied into the lab's FTP folder.
- When an order is defined as completed, the lab FTP folder and files are deleted.
- When an order is completed, an email with delivery or pickup information is sent to the customer (if needed).
- All financial transactions between the customer, photographer, photo lab and Pildipood are completed.

Known issues in the current service:

- Photographers create and upload original files in the wrong colour space.
- Duplicate orders are created by customers.
- It is not possible to cancel orders created by a customer. Cancelling is needed when a customer wants to change his order or decides not to order and gets tired of the reminder notifications.
- Customers transfer less or more money by bank transfer. There is no procedure for handling this and it is dealt with case by case every time.
- Payment is received so late that a photographer has deleted the related album.
- The photographer has changed the album pricelist, so creating a lab order fails.
- It is possible to set invalid shipping methods for an order.
- Customers have complained (a couple of times) that payment details do not work. When investigated, it was found that the customer had problems with understanding bank transfer details.
- Bank transfers take a long time. Transfers between banks are performed only on workdays about 6 times 9–17 and receiving the transferred amount can take up to 4–5 days if the payment was made on a Friday night.

Functional and feature requests:

- Possibility to add vouchers and discount coupons to albums. Studios want to offer discounts or free products to customers.
- Layout and colour customization for customer galleries. Currently, only the Studio logo can be changed.
- Russian language content is needed for the customer gallery. Currently, the choices are Estonian and English.
- From the Admin side, more automated monthly fees and accounting is needed.

5.2 Performance measures after implementation

Bigger studios have more than 1,200 albums and approximately 200 GB of HDD in use today (May 2015). The whole database consists of 4,500 albums and 556,000 pictures using 675 GB of HDD storage. From its beginning in May 2011 Pildipood.ee has fulfilled 33,000 orders (Fig. 20), including 2,200 lab orders (Fig. 21) for 29,000 customers, the total amount earned by photo studios being 730,000€.
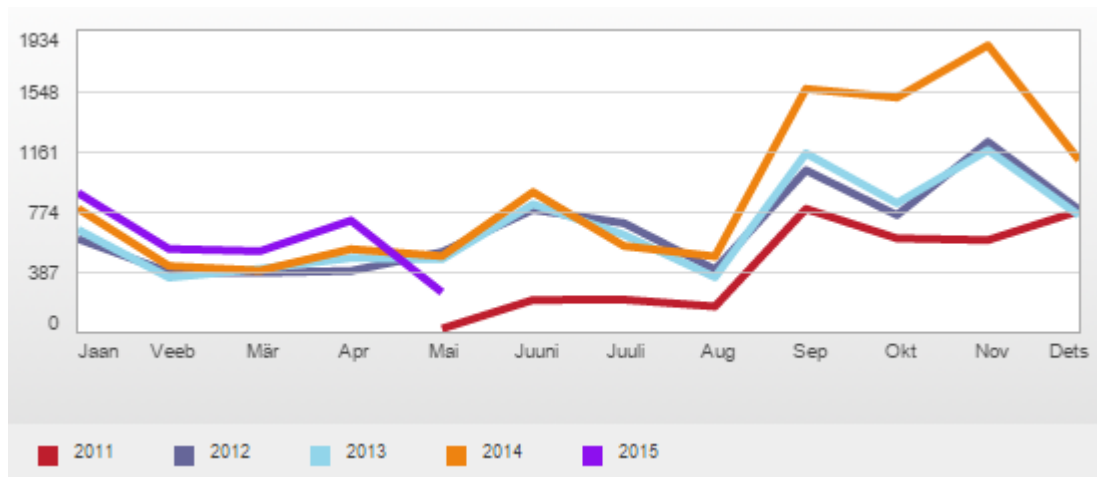
Fig. 20. Monthly total order count from May 2011 to May 2015.
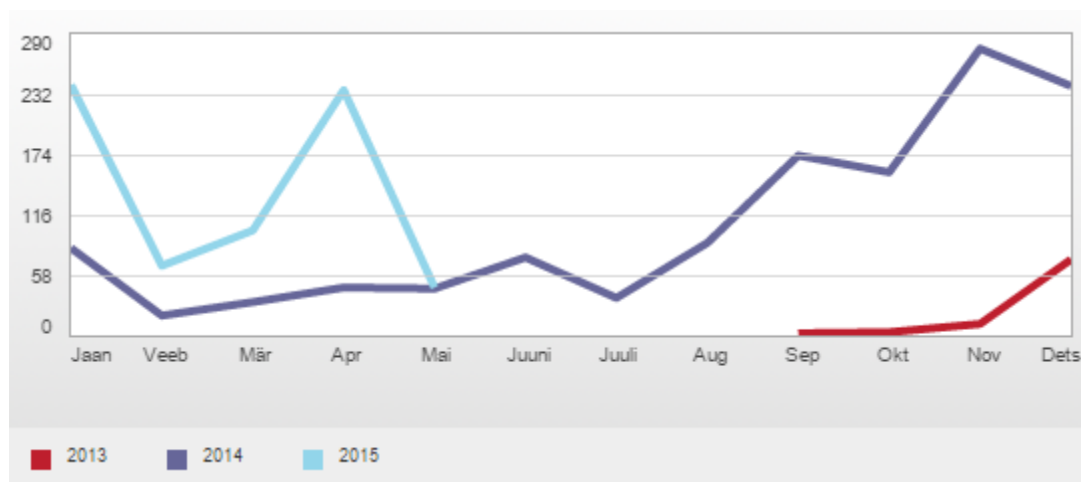
Fig. 21. Monthly lab order count from September 2013 to May 2015.

Cycle-time analyses are based on the data from a 6 month period (December 2014–April 2015.

Table 7 shows the duration of receiving payments. A quarter of the payments are received in an hour and 79% in a day. The three day delay is mainly caused by weekends when bank transfers do not work. The remaining 11% includes orders in case of which several reminders are sent to the customer before payment is received.

Table 7. Payment reception process's cycle-times

Duration (h)	Frequency	Percent
1	294	26%
24	601	53%
72	127	11%
>72	121	11%

An important measurement is the duration of the Complete Order cycle-times (Table 8). It is promised to customers that orders will be completed in three working days; delivery depends on the selected method. As seen from Table 8, 98% of orders are completed in 3 days. Only 2% of orders are completed in more than three days.

Table 8. Cycle-times of the Complete Order process

Duration (h)	Frequency	Percent
1	925	87%
3	118	11%
7	20	2%
>7	1	0%

Important statistics contain information about the necessity for payment reminder notifications. As seen from Table 9, about 15% of customers need reminders to make payments. This is also an important argument supporting the use of automated order services like Pildipood—it is very time consuming to monitor and remind about unpaid orders.

Table 9. Fulfilled orders that needed reminders to be sent to the customer for receiving payment

Reminder	Frequency	Percent
none	1069	85%
1	111	9%
2	38	3%
3	25	2%
4	8	1%

About 3% of orders were cancelled. Table 10 shows the reasons for cancellations.

Table 10. Reasons for cancelling the orders awaiting payment

Reason	Frequency	Percent
No feedback from customer	15	38%
Customer cancelled	9	23%
Duplicate order	7	18%
Need to change the order	7	18%
Invalid order	2	5%

Quality monitoring shows that the integrated photo lab provides very good quality. In the whole operating period, there have been less than 5 issues about product quality, and all were related to the original print files' quality, not to the photo lab's work.

6 Conclusions

In the year 2009, a small photo studio started business. Soon, they discovered a growing need for photo products among their shooting session customers. The Studio started to fulfil orders with its own resources and it became clear quite soon that this activity was not really labour effective. After researching existing solutions in Estonia and abroad, the Studio owner decided that the market is ready for a new software service for fulfilling the photo studios' sales process needs. The goal was to design and implement software-as-a-service to fully automate the photo studio's sales process. This service can be used by other photo studios as well.

This thesis focuses on the question of whether it is effective to use BPM tools and methods to analyse and redesign a small photo studio's processes. How can process-oriented thinking be used in a small business context? In this work, the order-to-cash process was chosen for analysis and redesign as the most labour consuming process that created greatest the greatest number of issues. Different BPM life-cycle steps and artefacts are documented in this thesis. A new process is designed and implemented as the Pildipood.ee service.

The conclusions of this thesis include:

- Process oriented thinking works well in a small business and great benefits are gained from BPM tools.
- There is no need to use all methods offered by BPM. The methodology is very flexible and different levels of details can be selected.
- The implemented software service Pildipood.ee fulfils all designed needs and works with no major problems. More than 50 small photo studios in Estonia use this service as a part of everyday business processes.

Future plans for Pildipood.ee include user gallery redesign to turn it into a modern interface. It is planned to add more branding possibilities to galleries and parcels from the photo lab. New features like discount coupons and different vouchers for the lab albums will be introduced. An intensive marketing campaign must be organised to encourage more high-volume studios to use Pildipood.ee as their core business process. As many photo studios are printing products in-house or use other photo labs, one possible service would be offering support for payment collection and accounting processes.

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Appendix

I.   Screenshots of Pildipood.ee
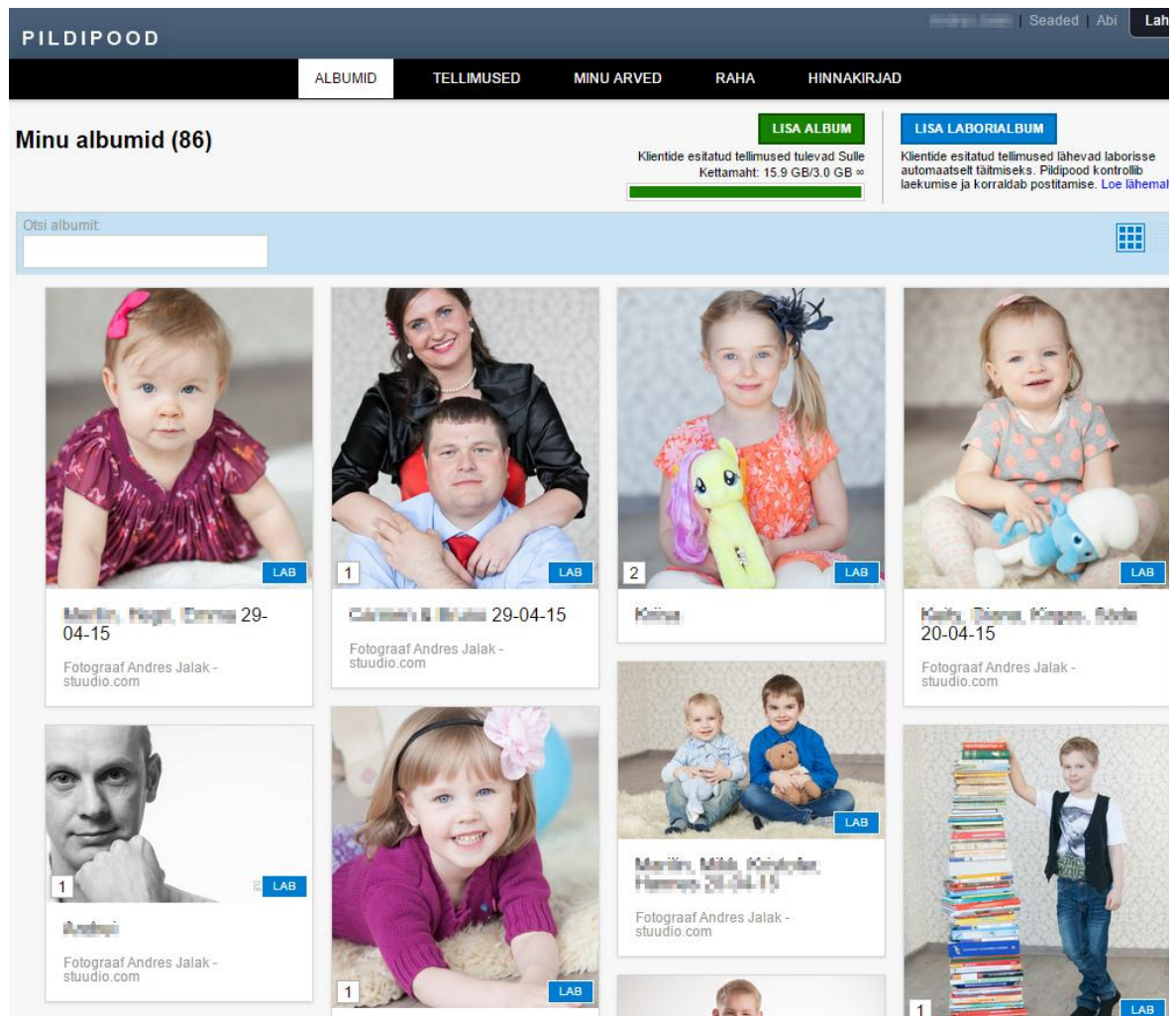
Screenshot 1. Photographer's album list view.

Screenshot 2. Photographer's order list view.

Screenshot 3. Customer gallery view step 1, selecting pictures for ordering.

Screenshot 4. Customer gallery view step 2, selecting products for ordering.

Screenshot 5. Customer gallery view step 3, entering customer and shipping data.

Screenshot 6. Customer gallery view step 4, payment details.

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