Business Process Redesign for Healthcare Dermatology Department: Workflow Technology
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Business Process Redesign for Healthcare
Dermatology Department: Workflow Technology

by
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in Business Information Systems

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Preface
This report is the result of my graduation project for obtaining my Master of Science degree in the Business Information Systems program at Eindhoven University of Technology. This project was carried out from September 2012 until April 2013. This master project would not be possible without the support of some people. I would like to use this opportunity to thank everyone who became a part of this project and supported me through the course of the project.

My first word of thank goes to mw. dr. G.A.M. Krekels at the expertise center MohsA for her support throughout the project. Second, I would like to thank specialists, doctors, nurses and assistants from both MoshA and the Catharina Hospital Eindhoven that helped me to get to know the process, for their willingness to provide the information and for the warm culture.

Third, I would like to thank my supervisors, dr. P. Van Gorp en dr. ir. R.S. Mans, for their useful criticism and comments. Next I would like to thank prof. dr. ir. H.A. Reijers for his enthusiasm through the project, his ongoing motivation as well as always tolerating my unplanned office visits and answering my questions.

Last but not least, I would like to thank my parents, my grandparents, my sister and my girlfriend for supporting and believing in me in every thinkable way.

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## Abbreviations

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<td>Actinic Keratosis</td>
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<td>BCC</td>
<td>Basal Cell Carcinoma</td>
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<td>BPM</td>
<td>Business Process Management</td>
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<td>BPR</td>
<td>Business Process Redesign</td>
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<td>CZE</td>
<td>Catharina Hospital Eindhoven</td>
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<td>EPD</td>
<td>Electronic Patient Document</td>
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<td>GP</td>
<td>General Practitioner</td>
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<td>HIS</td>
<td>Health Information System</td>
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<td>PA</td>
<td>Physician Assistant</td>
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<td>PDT</td>
<td>Photodynamic Therapy</td>
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<td>WFM</td>
<td>Workflow Management</td>
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<td>WfMS</td>
<td>Workflow Management System</td>
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<td>7PMG</td>
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1 Introduction
This is the Master Project for completing the master program of Business Information Systems (BIS). The report is composed of three main parts; the first part is the field of exploration and analyzing the current situation, including the different stakeholders. The second parts deals with the design and realization phase of the different outcomes. The last part deals with testing, evaluates and in the end a conclusion.

The introduction provides information about the problem definition, organizational information, purpose & scope of the research project, research question, and the general methodology used in the project. Additionally, the outline of the whole report is given.

1.1 Problem definition
The dermatology department of the Catharina Hospital Eindhoven (paragraph 1.2.2) has introduced, together with dermatology/oncology expertise center MohsA (paragraph 1.2.3), a new process to provide care to patients: with the one-day-shop process patients come by in the morning and have all skin treatment in one day. This way of working is considered to be successful, efficient and effective (Geer-Rutten et al., 2011).

A process is called efficient if, compared to a standard, few resources are used. These resources may include for example time, effort (man-hours), commodities or money. Effectiveness indicates that the outcome of the process is realized. Unlike efficiency, effectiveness does not concern the process itself, but its outcome. Both terms are satisfied within the new process.

An effective and efficient process of the treatment of Actinic Keratosis (AK; precursor of skin cancer) and Basal Cell Carcinoma (BCC; skin cancer) is of high relevance regarding the inflow of more and more people with skin cancer. Given the demographic trends like the baby boom after the 2nd World War and the changed tanning behavior since the 60s (IKZ, 2012), a significant increase in the number of patients with AK and/or BCC is expected. From 2010, an increasing number of patients have been diagnosed with AK and in 2012 there will be approximately 60.000 new BCC-patients.

Looking at the current situation, the main problem is how to deal with the increasing inflow of patients. The focus lies on distributing the activities in such a way the nurses and physicians will work and communicate better. The processes and tasks may vary from administrative activities to operational activities concerning the treatment plans. In the end the process most become effective for both the physician and the patient.

It is expected that benefits can be achieved by the introduction of workflow management technology (Dwivedi, Bali, James, & Naguib, 2001). Workflow involves the automation of a business process in order to support and complement the transition of information and tasks between organizational actors. Workflow becomes important in those sectors or industries that have to deal with vast amounts of information and, in particular, where timely receipt of information is of the essence (Dwivedi et al., 2001). The healthcare domain in general is one such arena which fits the above bill. The difference in the rate of dissemination of information can be the crucial difference between life and death. This is also
applicable to the dermatology domain, where patients can have an extreme sort of eczema where large part of the skins coms off. The research will focus on the identification of opportunities that the use of this technology provides, as well as realizing effective support for the process in general.

1.2 Organizational information
In this project, four stakeholders are represented: dermatology department CZE, the expertise center MohsA, Perceptive Software and Medicore. Background information about the stakeholders can be found below. First a short description is presented about a modern surgery technique called Mohs.

1.2.1 Mohs surgery
Mohs surgery is a microscopically controlled surgery used to treat common types of skin cancer. During the surgery, after each removal of tissue, while the patient waits, the pathologist examines the tissue specimen for cancer cells, and that examination informs the surgeon where to remove tissue next.

Mohs surgery is one of the many methods of obtaining complete margin control during removal of a skin cancer using frozen section histology. Mohs surgery allows for the removal of a skin cancer with very narrow surgical margin and a high cure rate.

1.2.2 Dermatology department CZE
The Catharina Hospital Eindhoven (CZE) is a leader in the treatment of skin cancer, provided with a special skin cancer center. The most modern treatment techniques (like the Mohs technique) are used at patients with skin cancer. The focus lies on identifying, treating and preventing (pre-faces of) skin cancer. The dermatologists treat various diseases of the skin. Examples are wine stains, birthmarks, eczema, varicose veins and STDs. On the special Children Ointment Poli, children with eczema are treated. Due to the unique process, most children after treatment are eczema free or have much less trouble.

1.2.3 MohsA
MohsA is a modern expertise center for dermatology/oncology and Mohs surgery in the Netherlands (Venray) where the emphasis is on a patient-centered treatment of skin cancer by including specialized and highly experienced dermatologists / Mohs surgeons.

The expertise center is equipped with the latest medical technology. Within the expertise center, the focus lies on identifying, treating and preventing skin cancer and the various preliminary stages. The treatments usually take place on one day (one-stop-shop principle).

The dermatologists working within MohsA are specialized in all dermatology/oncology and dermatology-surgical treatment techniques. There is more than 50 years of experience within Mohs Surgery available. All four dermatologists have a PhD on a topic related with skin cancer. They are also involved in drafting the national guidelines; they participate in scientific research and provide education in the field of dermatology-oncology.

1.2.4 Perceptive Software
Perceptive Software is a creator of enterprise content management (ECM) and business process management (BPM) software products and solutions – committed to engineering and unmatched
customer focus. Perceptive’s products and solutions are used by customers across all industries in more than 30 countries worldwide.

1.3 Literature Study
In preparation of this master thesis a literature study (Korremans, 2012) is elaborated. The general subject for in this literature study is “Workflow in healthcare”. To find out how the workflow technology is developing in this sector, several research questions are answered using 21 articles to get a good view on this subject:

- What is already known about workflow in healthcare (pros/cons)?
- Are there any special points of attention?
- How are workflows related to the medical guidelines and pathways?

A medical guideline is a document with the aim of guiding decisions and criteria regarding diagnosis, management, and treatment in specific areas of healthcare. Medical guideline should not be confused with medical processes, although they are closely related to workflows. Guidelines are usually represented in a flow-chart way and define a specific path to take when a particular situation occurs. It is not always the case that these guidelines can be followed straight-ahead. It depends on the medical situation of the patient and the diagnosis of the physicians which actions to take.

The main findings are that to capture the workflow of a healthcare process, it is required to have a clear definition whereas all the different stakeholders of that process need to be in line with each other. The main focus must be placed on the organizational process rather than on the medical treatment process. When designing a WfMS you should keep in mind that its main function is to support and assist the medical treatment process and make it easier for the physician and the patient. Guidelines are there to be followed when performing tasks; they make use of a specific set of standards/criteria/specifications. When they cannot be followed due to decisions of professionals, other workflows, sources, patient data and users become implicated with that patients’ process.

1.4 Purpose of the project
Several purposes are connected to this project. The first purpose is to handle the increasing inflow of patients with AK or BCC. The second purpose is to search and design process-related methods to make the one-stop-shop process more efficient. The overall purpose is to investigate how the workflow technology can apply to the one-stop-shop process. This technology will allow us to manage and closely monitor the processes. Before introducing this technique to the healthcare environment, it is good to have the terms explained and defined.

1.4.1 Workflow
Workflow is fundamentally about the organization of work. It is a set of activities that coordinate people and/or software. Communicating the organization between humans and automated processes is the added value that workflow provides. Workflows are fractal: this means a workflow may consist of other workflows (Green & Evdemon, 2008). Workflow models in general encourage reuse and agility, leading to more flexible business processes.
1.4.2 Workflow Management System

The goal of workflow management is to manage the flow of work such that the work is done at the right time by the right person. A workflow management system (WfMS) is a software package that can be used to support the definition, management and execution of workflow processes. A workflow system (WFS) is a system based on a WfMS that supports a specific set of business processes through the execution of computerized process definitions. As represented in Figure 1 there is a clear separation of processes, resources and applications (van der Aalst & van Hee, 2002). The focus lies on the logistics of work processes, but not on the content of individual tasks.

![Figure 1 – Basic idea of a Workflow Management System](image)

Workflow Management (WFM) and Business Process Management (BPM) are widely applied in administrative processes but not in healthcare (van der Aalst, 2006). Increasingly, clinical decisions need to be based on scientific evidence, social-ethical values and economic factors. Evidence-based care requires transparency, justification and accountability. Besides evidence, medical guidelines need to be followed to emphasize support and prediction. These guidelines can be used passive (to check afterwards) and active (control during the flow). BPM software supports the use of passive guidelines with process mining tools and active guidelines with a WfMS.

There are many different ways in which WFM concepts can be offered (van der Aalst, 2008):

1. Information systems with **hard-coded** workflows (process & organization specific); A company decides to use the programming language JAVA and they start from scratch to support a particular process. Because it is hard-coded, changes can only be made by changing the code;
2. **Custom-made** information systems with **generic** workflow support (organization specific); this type of IS is used for example by larger banks. Most of the time it is a company specific system that can be configured by lots of settings or it is driven by a table. In this table the paths are set; if an activity has been completed then continue with this one. Changes in table will change the behavior of the system;

3. **Generic software with embedded workflow** functionality (e.g., the workflow components of ERP, CRM, PDM, etc. systems); If you look at bigger BPM systems like SAP or Oracle, they have all embedded workflow component in their system;

4. **Generic software focusing on workflow** functionality (e.g., BPM|one, Staffware, MQSeries Workflow, Oracle BPEL, Filenet, etc.).

The first two “workflow-like” systems are more primitive systems compared to the last two, which are more advanced systems. For this project we will focus on the last WFM concept because these workflow systems have the complete package of workflow functionalities concerning the flexibility of the process that has to be dealt with. More on this workflow system can be found in the next paragraphs.

### 1.4.3 WfMC Reference Model

The Workflow Management Coalition (WfMC) Reference Model (Hollingworth, 1995) (Figure 2) defines a generalized target architecture driving the development of most production workflow solutions like number 4 of the WFM concepts (paragraph 1.4.2), whether or not their vendors plan to implement all the WfMC’s standard technical interfaces. The goal of this model is to provide a standard for interoperability among the major workflow subsystems.

Workflow perspectives can be seen from different angles (van der Aalst, 2008):

- Process perspective (tasks and the routing of cases);
- Resource perspective (workers, roles, 4-eyes principle, etc.);
- Case/data perspective (process instances and their attributes) and
- Operation/application perspective (forms, application integration, etc.).

Although everything is seen from a workflow perspective, the processes will dominate the way of work. In this report the focus will be on the first perspective because the other perspectives are in some way connected to this perspective (Figure 1).

### 1.4.3.1 Interfaces

In order to make the workflow system interoperable, the following interfaces should be established:

- **Process Definition Tools Interface (1)** – Definition of a standard interface between the process definition tool and the workflow engine(s);
- **Workflow Client Application Interface (2)** – Definition of standards for the workflow engine to maintain work items which the workflow client presents to the user;
- **Invoked Application Interface (3)** - A standard interface to allow the workflow engine to invoke a variety of applications;
• Workflow Interoperability Interface (4) - Definition of a variety of interoperability models and the standards applicable to each;

• Administration & Monitoring Tools Interface (5) - Definition of monitoring and control functions.

1.4.4 Benefits of Workflow

The workflow technology has much advantages for an organization (DiCaterino, Larsen, Tang, & Wang, 1997). The main benefits are shown in the list below:

• The workflow technology formalizes a business process;
• Productivity improves as staff can be assigned to more important and meaningful work through worklists;
• Paperwork and paper-chasing are reduced and perhaps eliminated;
• Improved tracking options: A staff member (physician e.g.) can instantly know the status of any work item (activity). The "what, who, when questions" are answered by the WFM;
• Interfaces to external databases enable validity checks and external process interactions to be automated and streamlined;
• Decisions that were made by people can be made by the WfMS, based on the same criteria the staff were making;
• Business efficiency can be more accurately measured: you can easily see how much work was done each day;
• The workflow system links to an organization database so you know who does what;
• Security is assured by predefined access control rules, which give access only to those who are being allowed to;

A disadvantages might be that the process is not transparent to the management, as it is not cost-effective to produce reports in a quickly evolving system, and continuous changes tend to corrupt the
software structure (Friesdorf, Plavšić, & Bubb, 2009). I don’t agree because the workflow systems nowadays have precisely those functionalities that it is relatively to make changes to the process without touching the software structure.

1.5 Scope of the project
The scope of this project is on how to make the working process more accessible, efficient and easier, both for the patient and the physician. The process will focus on the process regarding the treatment of AK and BCC spots. To get more information about the process and the way of working, the dermatology department from the CZE together with MohsA will be used as a referential.

From an IT-view, the current information systems will be analyzed and optimized if possible. There will not be made any drastic changes to the information systems, since there is too less time and fund available.

1.6 Research questions
The treatment process of skin cancer is optimized due to the one-stop-shop-principle (Geer-Rutten et al., 2011), but what about the technical support of this medical treatment process? In this report the following questions will be answered:

- How can the dermatology domain deal with the growing inflow of patients with AK/BCC?
- To what extend would the workflow technology be appropriate for the dermatology process?
- How can the process become more efficient and effective regarding overall communication?

These questions will be researched in the sequel of this report. Paragraph 1.7 will explain the methodology and paragraph 1.8 will give an outline of the report.

1.7 Methodology
The application of workflow technology in a medical environment, where exceptions aren’t exclude, is far from trivial (Mans, 2011). Healthcare processes are typically much more complex, variable, and require the involvement of multiple medical disciplines. Furthermore, the success of workflow projects is highly dependent on how the application of workflow technology is planned, organized, and conducted (Weske, Goesmann, Holten, & Striemer, 1999). To this end, Weske et al. use the term workflow application development process for a methodology which aims to improve the planning and construction of workflow applications.

Note that the development of a workflow application is similar to the development of a traditional application system as WfMSs are just a specific category of application systems (Zur Muehlen, 2004). To this end, procedure models for software development can also be applied to the development of workflow applications (Mans, 2011). Weske et al. provide a detailed overview of the required phases and the steps in a workflow development methodology. This is based on experiences obtained during real-world workflow application development processes.
The workflow application development process consists of seven different phases that follow each other sequentially: the (initial) design, the (initial) diagnosis, configuration, execution, control, diagnosis, (re)design, where the last 5 phases are forming a loop. For this research project not all the phases are necessary. Execution will not take place because the developments will be evaluated in a test environment. The other phases are renamed to avoid confusion (e.g. a diagnosis can be seen for a medical point of view or from a development point of view).

Therefor the research in this project is led by the phases Analysis – Design – Development – Evaluation (Figure 3). Each phase represents the start for the next phase. In the analysis phase, the problem is clarified according to the AS-IS situation, the process is identified and the belonging data is investigated. The design phase deals with (re-)designing and the modeling of (new) the processes. In the development phase, the user interface is designed, graphics are set and the test cases are elaborated. The end-users (patients and physicians) perform debugging through a test case followed by an evaluation form and the processes are reviewed and revised according to the feedback received in the evaluation phase.

![Figure 3 – Methodology](image)

1.8 Outline
The remainder of this report is structured according to the four phases elaborated in the previous paragraph. Chapter 2 covers the analysis phase. The design phase is described in chapter 3. The chosen processes are described in chapter 4 and evaluated in chapter 5. The report ends with a conclusion, a discussion about the limitations and possible future work.

In this report the roles are mentioned with “he”, but you may also read “she”.
Analysis phase

In the analysis phase, the problem is clarified, the process is identified and the belonging data is investigated.
2 Analysis phase
The main concept of the analysis phase is to find out what the business requirements are and which process(es) need(s) to be focused on (Weske et al., 1999). After this there will be data mining to substantiate our choices and conceptual process designing. This chapter starts with an identification of the process.

2.1 Identification
As mentioned in paragraph 1.1 the main focus lies on the processes on the treatment of patient with a spot diagnosed as the type AK and/or BCC. The boundaries of the AS-IS process will be restricted to the flow of the patient, not at specific operational actions performed by the dermatologist or general practitioner (GP).

AK is a condition of the skin that can be a precursor of skin cancer. BCC is a common type of skin cancer. Both manifest themselves as suspicious spots on the skin. AK and BCC are more and more common in the general population because of a general increased exposure to sunlight (Gezondheidsnet, 2013).

The high-level judgment of the “health” of the process can be qualified as good. The implementation of the one-stop-shop process is received positively by the physicians as well as by the patients.

But before the actual treatment process can start, there is a waiting time at the dermatology department of approximately 20 weeks (6 weeks before the first consult and 14 weeks before the first Mohs surgery). Looking at this from a strategic perspective, capacities should be used optimally to make queues and waiting times as short as possible.

Before diving into the current information systems, the earlier work (de Groot, 2009) that is done at CZE is analyzed. The work from de Groot focusses on the treatment plan of the process and shows process redesign scenarios that provide the hospital some improvements; the Photodynamic Therapy (PDT) treatment schedule is redefined and a redesign proposal for excising, examining and diagnosing the patient’s biopsy in one day is created. Next to this, a workflow requirements specification was created and this specification turns out to be independent of any process language. This means the dermatology department has been provided with the means for implementing a WfMS and can be used for implementing any WfMS (de Groot, 2009). With this information in mind we can analyze the current information systems.

2.1.1 Information systems
To get familiar with the way employees on the dermatology department work with the information systems, meetings are scheduled where the behavior and interaction of the physician with the system will be observed (Appendix A – Consulting hour) (Appendix B – Outcome interviews MohsA). The main outcome of this meeting is that physicians in general don’t want to spend their time on doing administrative work.

During the treatment plan the medical situation of the patient is continuously updated. At the CZE the dermatology department is supported by the Electronic Information System “CS-EZIS”. This is a highly sophisticated information system which is used at all the departments in the hospital. At MohsA, the
treatment process is supported by Medicore (Appendix C – Meeting Medicore). Medicore delivers logistic and administrative services in different countries, specifically aimed at care providers who specialize in performing plannable medical treatment.

Both IS have their strengths and weaknesses. EZIS is too large for expertise centers like MohsA (too many functions); however the user interface is very suitable; it is easy to switch between different screens. Medicore is too small for the dermatology department; the user interface doesn’t allow the switching which makes it hard to work efficient.

2.2 Overview

The scope of this process is split up into three parts; the beginning of the process, the middle of the process and the end of the process (Figure 5) (Appendix D – Meeting Perceptive Software). A high-level overview is graphically represented in Figure 5. The black objects form the already existing path that a patient follows; he starts with a diagnosis followed by the actual treatment and if necessary there will be a follow-up appointment. The green objects are extensions to the current situation. The content of the green parts will be elaborated in the next subchapters.

The last paragraph of each subchapter will be used to describe the impact and trade-offs that are made by the proposed improvements by using the ‘Devil’s Quadrangle’ (Figure 4) (Brand & Van der Kolk, 1995). The aim of this model is to illustrate that a trade-off exists intending to optimize performance dimensions. The ‘Devil’s Quadrangle’ will be used for evaluating the impact of the proposed improvements looking at the relation between quality, flexibility, cost and time.

![Figure 4 – Devil's quadrangle](image-url)
2.2.1 Trigger of the process

The beginning of the process starts with a trigger. Normally it is the patient himself who reports at the dermatology department. However, there are other ways to start the process:

1. An online trigger where the patient manually logs in and reports the spot. This is a whole new process;
2. The patient reports the spot at the GP’s office (and might be forwarded). A connection between the dermatologist and the GP is already present, however it needs to be optimized;
3. Updating the health status of an existing patient which leads to the necessity to make an appointment.
2.2.1.1 Online trigger

In the AS-IS situation, the process starts with a patient making an appointment at the dermatology department. There needs to be physical contact between the patient and the dermatologist to diagnose the skin disease. This way of working is expensive and time-consuming. To ease the work of the dermatology department, the patient can do much more themselves.

At the diagnosis phase of a patient, personal information is entered into the system, disease-related information is filled in and a photo of the skin is taken and uploaded into the system. These activities can be done by the patient himself. A graphical representation of this phase is giving in Figure 6.

The patient is uniquely registered based on his social security number (BSN). Combining the login with DigiD will secure the connection and the hospital (or external treatment center) will know it is actually you, the patient, which is logged on. After you are logged on, you can look up information (uploaded photos, reviews on earlier spots etc.) or you can ask for a revision on a new spot you have found. This is done by filling in a questionnaire about the spot. A predictive model (Jansen, Kleingeld, Snijders, & Krekels, 2010) behind the questionnaire determines the likelihood that a spot is AK or BCC based on your answers.

The predictive model is based on a scientific research on previous spots and generates a prediction that is comparable in accuracy to that of a trained professional (Jansen et al., 2010). If the spot is categorized as a potential AK or BCC, the request is send to the dermatology department where it will be added to the worklist of the nurse/physician assistant. Here distinction in work takes place. The knowledge and the ability of the dermatologist will be used in special cases. The more simple tasks can be done by nurses and PAs.

The physician who diagnoses the request has a few options; he can look at the request (in a difficult case with help of the dermatologist) and diagnose that it is no (precursor of) skin cancer. In this case he can recommend to use a specific cream or to fill in the questionnaire again at a later point in time to spot possible changes.

It could also be the case that with the received information it is unclear to give a fully substantiated diagnose of the spot. In that case an appointment will be made with the patient. The patient receives an e-mail with a request for an appointment, which

![Figure 6 – Sub process – External trigger by patient (concept version)](image_url)
he can plan himself in a proposed day/week. Here ends the trigger process. If the spot turns out to be risky, there always needs to be physical contact between the patient and the physician.

Referring to the Devil’s Quadrangle, costs will decrease due to the fact that no (assistant-)physician needs to ask the patient the key-questions. Time will decrease since the patient can register the spot in his own time and the physician can continue with other work. The same applies for flexibility. If the quality will increase determines on how the questionnaire is filled in by the patient. If the patient forgets to fill in important information, the outcome may result in an incorrect diagnosis.

2.2.1.2 GP trigger
Since people are having unfamiliar spots more often, the first contact they should have is with their GP. When a GP is not sure if he diagnosed the spot correctly, he will refer the patient to the hospital. The patient needs to go to the hospital to get a new diagnosis. The GP needs to contact the dermatologist and inform him about the patient. At the hospital, the dermatologist diagnoses the patient that it is no spot to worry about. The patient leaves the hospital which ends this process.

Looking at the run-up time of a possible treatment/operation of skin cancer, more activities can be done by nurses and PAs, but also by GPs. Analyzing the spot, diagnosing the spot, taking a biopsy and treating the spot are actions that in principle don’t need to be performed at a hospital, but that easily can be done at the GP’s office.

When we apply the workflow technology to this problem, there doesn’t have to be any physical contact between the patient and the dermatologist when a GP has doubts about his diagnosis. A dermatologist receives a notification that he needs to check the spot of a certain patient. Only when he also has doubt or wants to be sure, he can make an appointment with that patient. In all the other cases he can send a message back to the GP telling him what to do. A graphical representation is given in Figure 7, where the process is seen from the role of GP.

Flexibility and quality will both increase; before the final diagnosis is determined, several steps can be taken to guarantee a correct diagnosis (e.g. ask dermatologists, take biopsy). Time will stay the same; it may take about 1 to 2 days before the dermatologist answers the notification for feedback, but on the other hand, a dermatologist will not always have time to speak to the GP on the telephone or directly reply on their e-mail. Costs will go done for the patient if the biopsy can be done at the GP’s office.

![Figure 7 – Sub process – External trigger GP (concept version)](image-url)
2.2.1.3 Updating health status

Once the patient has access to their medical record, he can have rights to certain parts of the record to changes medical indicators like for example blood pressure, cholesterol levels and the in/decrease of certain medicines. When these indicators (alone or combined) reach a particular value, the health status of the patient may changes which could lead to the sending of a notification to the physician. He can diagnose the patient based on his medical information and if necessary schedule an appointment.

At first costs will increase for the patient to procure measuring devices. Flexibility will increase, however quality and time will decrease. There is no one with medical skills to check if the indicators are measured the right way.

2.2.2 During the process

At the middle of the process we look at the communication part. During this part of the process, several improvements are suggested:

1. Uniform communication: letters and notifications can be sent, but they are not consistent;
2. The planning of your own follow-up appointment. A new module is added to the process;

2.2.2.1 Uniform communication

At a certain moment in the process a letter is sent to the GP, providing an update of the patients’ status (Appendix A). The way these letters are generated now, is by adding particular fields in a template letter. This template is built in such a way that the layout of the data in the IS needs to be entered neat and tidy to prevent a garbled letter. A way to prevent this is by sending intern messages. Once a message occurs at the GP, he can check the patients’ medical record and check the changed or updated information.

If the (assistant-)physician has to spend less time one generating a letter, costs will decrease because there is more time to work on other activities. Quality towards the GP will go up. Flexibility decreases a little bit due to the fact that the fields are pre-defined.

2.2.2.2 Appointment planner

A patient needs to go to the hospital to make an appointment. When he leaves the consulting hour and he needs to make a follow-up appointment, he needs wait at the administration desk to make an appointment. The whole process of making an appointment can be shift to the side of the patient.

For example, after the consulting hour the patient receives a notification (e-mail/sms) that he can make an appointment in the online agenda. The process of online booking consists of three main steps:

1. The physician select a time-slot (day or week) for the patient;
2. The patient logs in at the website and makes the appointment by reserving the time-slot;
3. The appointment and customer data is automatically placed in the EPD.

With a specific appointment a pre-defined note could be added. Think of special instructions to the patient, such as that he should be sober.
Costs and time are saved at the secretariat. Quality increases; the patient can unregister on time if he can’t make it to the appointment on time. Flexibility will stay the same; once the desired timeslots are already signed by other patients, the patient needs to contact the secretariat.

2.2.2.3 New York classification
When a patient reports with an odd spot, the position of the spot is saved to the IS. As it is done now, generating reports is too abstract, e.g. 10 spots on legs, 5 on arm etc. By saving the position of the spot this way it is not possible to retrieve specific spot information. To be able to execute data mining for obtaining useful information and generating management reports, it is necessary to use the NY classification.

This classification assigns a number to specific parts of the human body, with a zoom option on the head, arms, feet and genitals. Examples of these pictures can be seen in Figure 8 and in Appendix E – NY Classification. Via this classification is it easy for the physician to indicate the place of the spot on the body of the patient. Since more patients have chronic skin cancer, it is easy to check if a spot returns on the same place.

Quality will increase looking at the possibilities of extracting specific spot information and the fact that every physician exactly knows where the spot is located. Time will decrease because it is much faster to just click on a number than to write the place of the spot. Costs and flexibility will stay the same.

CONCEPT NEW YORK CLASSIFICATION
Click on the number to choose the location of the spot:

![NY Classification of the human head](image)

Figure 8 – NY Classification of the human head
2.2.3  End of the process

2.2.3.1  Appointment reminder
Table 1 shows us the total number of patients per month in combination with the no-shows of patients. The total number of patients refers to the consulting hours that particular month of the dermatology department, which includes consulting hours of dermatologists, physicians and physician assistants.

<table>
<thead>
<tr>
<th>Month</th>
<th>Total # patients</th>
<th>No-shows</th>
<th>Percentages of no-shows</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-2012</td>
<td>3865</td>
<td>199</td>
<td>5,15</td>
</tr>
<tr>
<td>12-2012</td>
<td>2811</td>
<td>79</td>
<td>2,8</td>
</tr>
<tr>
<td>01-2013</td>
<td>2519</td>
<td>120</td>
<td>4,76</td>
</tr>
<tr>
<td>02-2013</td>
<td>2671</td>
<td>204</td>
<td>7,64</td>
</tr>
<tr>
<td>03-2013</td>
<td>2969</td>
<td>238</td>
<td>8,71</td>
</tr>
</tbody>
</table>

Table 1 – No-show of patients per month

Referring to the consulting hour of physician assistant L. Wientjes (Appendix A – Consulting hour), 3 out of the 9 patients did not show up at their appointment (33%). Comparing this percentage with the ones from Table 1 a big differences can be noticed. This is due to the kind of appointment (yearly check or a referral) the patients has.

At first sight it might look that the percentages are not extremely high, but looking at the last four months, an upward trend can be seen. When the physician is having a consulting hour, a no-show may cost him unnecessary preparation time. A way to increase the attendance of patients could be by sending them a reminder, for example one day before the actual appointment takes place. This could be done by e-mail, text message or by a voice message. This has a number of advantages:

- Reduction in number of no-shows. Time and costs will decrease for the physician;
- Extra instruction like sobriety and route number. Quality of the service will increase;
- No letters or phone calls will be necessary. Costs will be reduced;
- Increase customer satisfaction and thereby the quality.

2.3  Data analysis
Patients with an odd spot have two options. They can go to their GP or directly to the dermatologist. In most cases the GP doesn’t have the expertise to actually treat the patient, which will lead to a referral to the dermatologist. The second option is that the patient makes an appointment with the dermatologist. Based on the fact that the number of patients with skin cancer will increase, it is not desirable that the inflow of patients to the hospital will keep growing.
In this paragraph the beginning of the process is analyzed. This is done by a combination of process mining and interviews. Interviews were held with dermatologists from the CZE, Physician Assistants (PA) and experts from MohsA, and GPs in the surrounding area.

2.3.1 Trigger GP

The communication between the GP and the dermatologist is most of the time set with phone calls and referral letters. But when the referral letter is send, the diagnosis is already made. Based on the diagnosis the treatment can begin. In some cases there did not need to be a referral to the hospital. In this section the process can be improved regarding the diagnosis.

A data file from MohsA containing information about the referral data (from GP or specialist/hospital) is analyzed. The data covers the period from 03/07/2012 to 18/11/2012 where 186 patients have been referred to MohsA. 116 Patients have been forwarded by a GP (63%) and 69 patients have been forwarded by a hospital/specialist (37%). Figure 9 shows the number of patients that are treated with the Mohs technique after being forwarded. From the patients forwarded by the GP only 15 of them (13%) have been treated with the Mohs technique. The other patients are treated with other (simpler) methods. From the patients forwarded by the hospital/specialist 34 (49%) have been treated with the Mohs technique.

Looking at total number of patients that have been forwarded, there are only 9 patients that were diagnosed with AK or BCC and from this group only 6 have been treated with the Mohs technology. Dermatologists opine that many activities regarding the treatment of AK and BCC can be done at the GP’s office, which saves the patient lots of time and money. Figure 9 confirms this by the high number of patients that is not treated with the Mohs technology.

Based on the medical education of (most) (beginning) GPs, their knowledge about dermatology is less than a physician assistant working at the dermatology department. The important information and
activities for the treatment of AK and BCC will be taught to the GPs. As for now, we assume that the main knowledge about AK and BCC is present at the GPs.

2.3.2 Trigger WWW
A new option for the patient is to register the odd spot online. The diagnosis is based on the questionnaire developed at the TU/e in combination with CZE (Jansen et al., 2010). An application called OddSpot has been developed for smartphones, but it is still in its early stages. Before the design of the process can start, the target group should be clear. If the possibility of online registering an odd spot exists, it is expected to be used frequently. Especially in this time of having all the information available online, patients are going to look for information about their condition/disease themselves. To prevent that everyone with an odd spot will register the spot, the target group is reduced to only patients that have AK or BCC in their medical history. The physician is authorized to give the patient access to this part of the EPD.

2.4 Conclusion
Based on the problem definition (1.1), the specified research questions (1.6) and the information systems (2.1.1) that are used, four evaluation criteria (EC) are composed:

EC1 – Decreases the inflow of patients at the hospital
EC2 – Improves the process for the physician/patient
EC3 – Improves the communication between physicians
EC4 – Involves the patient in the process

According to these criteria the best required improvements are determined. Table 2 shows the improvements plotted against the election criteria, with the last column showing the total score per improvement. The degree of corresponding with the criteria is indicated with the values -- / - / 0 / + / ++.

<table>
<thead>
<tr>
<th></th>
<th>EC1</th>
<th>EC2</th>
<th>EC3</th>
<th>EC4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Online trigger</td>
<td>++</td>
<td>+</td>
<td>0</td>
<td>++</td>
<td>+/++</td>
</tr>
<tr>
<td>2. GP trigger</td>
<td>++</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>+/++</td>
</tr>
<tr>
<td>3. Updating health status</td>
<td>-</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>4. Uniform communication</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>-</td>
<td>0/+</td>
</tr>
<tr>
<td>5. Appointment planner</td>
<td>0</td>
<td>+</td>
<td>-</td>
<td>++</td>
<td>0/+</td>
</tr>
<tr>
<td>6. NY classification</td>
<td>0</td>
<td>0</td>
<td>++</td>
<td>+</td>
<td>0/+</td>
</tr>
<tr>
<td>7. Appointment reminder</td>
<td>-</td>
<td>++</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2 – Improvements vs. evaluation criteria

Based on the total outcome (last column in Table 2) the focus will be on the beginning, the trigger, of the project: the input site of both the online trigger and the GP trigger will be designed, combined with the NY classification.
Design phase

The design phase deals with (re-) designing and making the (new) processes.
3 Design phase

Based on the gathered information in the analyze phase, the two triggers are elaborated in this chapter. While the processes are designed, we keep in mind that an efficient and effective start of the process is of crucial importance for the continuation of the process. The processes are designed in Petrinets (Jensen, 2005) and are based on the Seven Process Modeling Guidelines (7PMG) (Mendling, Reijers, & van der Aalst, 2010). Besides the Petrinet of the triggers a list of required data and a list of the resources are shown.

3.1 Trigger WWW

3.1.1 Process description

Once the patient notices an undefined spot, he can go to the website of his EPD where he can register the spot (Figure 10). The log-in takes place via the DigiD procedure. If it is the first time a patient enters the website, he needs to authorize DigiD to access his EPD.

When logged on, the patient starts registering the spot by uploading a photo. After uploading the photo, the place of the spot needs to be classified through the New York Classification. When this is done, he can start filling in the questionnaire. The request is now ready to be send.

![Figure 10 – Petrinet trigger WWW](image-url)
Based on the questionnaire, the result is almost immediately known. The patient reads the result and based on that he will be informed about which steps to take next.

3.1.2 Cancelling the process
From now one, we will look at the process as it is being executed as a sunny day scenario, meaning that the patient will always complete his actions (“Cancel request” will not be active). If he cancels the process at any point, there will be no contact between the patient and the GP/dermatologist at all. No intermediate data will be stored, so the next time the patient logs in, he will have to start all over again.

3.1.3 Resources
As shown in Figure 10 the patient is the only user in this process.

3.1.4 Data
The flow is led by the outcome of several decisions. To get a clear picture, an overview is given in Table 3 with an explanation of the data, at which activity they are created and where they can be updated / changed.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Comment</th>
<th>Created at</th>
<th>Updated at</th>
</tr>
</thead>
<tbody>
<tr>
<td>Username</td>
<td>String</td>
<td>The username of the patient’s DigiD.</td>
<td>Logon Authorize DigiD</td>
<td>-</td>
</tr>
<tr>
<td>Password</td>
<td>String</td>
<td>The password of the patient’s DigiD.</td>
<td>Logon Authorize DigiD</td>
<td>-</td>
</tr>
<tr>
<td>Authorize</td>
<td>Boolean</td>
<td>The patient has to give access to DigiD to enter his EPD.</td>
<td>Authorize DigiD</td>
<td>-</td>
</tr>
<tr>
<td>Photo</td>
<td>Picture</td>
<td>A photo of the spot needs to be uploaded.</td>
<td>Upload photo</td>
<td>-</td>
</tr>
<tr>
<td>NY</td>
<td>Integer</td>
<td>Referring to the spot according to the New York Classification.</td>
<td>Upload photo</td>
<td>-</td>
</tr>
<tr>
<td>Q1, Q2, Q3</td>
<td>Integer</td>
<td>Each variable represents a value referring to the answer of a question.</td>
<td>Fill in questionnaire</td>
<td>-</td>
</tr>
<tr>
<td>Outcome</td>
<td>String</td>
<td>List of possible outcome values combined with their status.</td>
<td>Receive result</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 3 – Data trigger WWW
3.2 Trigger GP

3.2.1 Process description

The process starts when the patient reports himself at the secretary of the GP (Figure 11). When the GP is ready, he calls in the patient for the intake meeting. It might be that the patient has already filled in
the online questionnaire via the website, which gives the GP some additional information that he can use for diagnosing the spot. After the intake a photo will be taken of the spot and added to the EPD of the patient.

When the GP has analyzed the spot he can determine the diagnosis. When the diagnosis is ready, the GP has three options:

1. If it is clear what kind of spot the patient has, the GP can start a particular treatment right away, which ends this process.
2. If the GP supposes the spot is of the type AK or BCC, but he does not know for sure, he can contact a dermatologist for a second opinion.
   2.1. Based on the analysis of the spot, the dermatologist can suggest two options:
      2.1.1. He can let the GP take the biopsy.
      2.1.2. The spot is from such difficulty and/or located at a risky place that the dermatologist suggest to send the patient directly to the hospital. The GP informs the patient (see paragraph Contacting the patient) and the process ends.
3. It is clearly a skin cancer spot, which is always followed by a biopsy which the GP can do himself.

We will continue at point 2.1.1/3, where the GP will take a biopsy from the spot. The patient is prepared and the biopsy is taken. The biopsy is send to the pathologist to be analyzed. After a certain time, the GP receives the outcome from the pathologist and he can adapt the diagnosis (if necessary). The GP has two options:

4. The patient is sent to the hospital if the GP isn’t sure of the diagnosis of the spot or that the treatment can’t be done by the GP himself
5. The diagnosis of the spot is determined and the treatment can be done at the GP.

The patient is informed by the GP and the process ends.

3.2.2  Contacting the patient
An import side note to the process is the way patient needs to be informed. In case of a new skin cancer patient, it is desired to inform the patient in person. Patients with chronologic skin cancer know the procedure and treatment that is necessary, so the GP could inform them by phone or e-mail.

3.2.3  Resources
The patient is trigger of the process. Once the process has started, the patient’s role is done and he will be seen as a passive object. The GP will handle most of the activities. The dermatologist can be asked for a second opinion about the spot of the patient. If the patient is sent to the hospital, the process
continues at the dermatology department. The Pathologist enters the picture when the biopsy needs to be analyzed.

### 3.2.4 Data

The flow is led by the outcome of several decisions based on data. To get a clear picture, an overview is given in Table 4 with an explanation of the data, at which activity they are created and where they can be updated / changed.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Comment</th>
<th>Created at</th>
<th>Updated at</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PatientDate</strong></td>
<td>Date</td>
<td>Date of birth of the patient.</td>
<td>Intake patient</td>
<td>-</td>
</tr>
<tr>
<td><strong>PatientName</strong></td>
<td>String</td>
<td>Name of the patient.</td>
<td>Intake patient</td>
<td>-</td>
</tr>
<tr>
<td><strong>Photo</strong></td>
<td>Picture</td>
<td>A photo of the spot needs to be uploaded.</td>
<td>Take photo</td>
<td>-</td>
</tr>
<tr>
<td><strong>DiagnosisBB</strong></td>
<td>String</td>
<td>The first diagnosis is made after the intake and before the eventual biopsy.</td>
<td>Diagnose spot</td>
<td>Contact hospital</td>
</tr>
<tr>
<td><strong>NY</strong></td>
<td>Integer</td>
<td>Referring to the spot according to the New York Classification.</td>
<td>Diagnose spot</td>
<td>-</td>
</tr>
<tr>
<td><strong>Q1, Q2, Q3, …</strong></td>
<td>Integer</td>
<td>Answer to the key questions.</td>
<td>Diagnose spot</td>
<td>-</td>
</tr>
<tr>
<td><strong>StartTreatment</strong></td>
<td>Boolean</td>
<td>Yes/No</td>
<td>Diagnose spot</td>
<td>-</td>
</tr>
<tr>
<td><strong>ContactH</strong></td>
<td>Boolean</td>
<td>Yes/No</td>
<td>Diagnose spot</td>
<td>-</td>
</tr>
<tr>
<td><strong>TakeBiopsy</strong></td>
<td>String</td>
<td>A free field is added for advice/comments (Comment).</td>
<td>Diagnose spot</td>
<td>Forward/biopsy</td>
</tr>
<tr>
<td><strong>SendToHospital</strong></td>
<td>Boolean</td>
<td>Yes/No</td>
<td>Diagnose spot</td>
<td>Forward/biopsy</td>
</tr>
<tr>
<td><strong>FollowPatient</strong></td>
<td>Boolean</td>
<td>The physician at the hospital has the option to follow the patient</td>
<td>Contact hospital</td>
<td>-</td>
</tr>
<tr>
<td><strong>Comment</strong></td>
<td>String</td>
<td>Optional field for the physician</td>
<td>Contact hospital</td>
<td>-</td>
</tr>
<tr>
<td><strong>BiopsyOutcome</strong></td>
<td>String</td>
<td>An outcome of the biopsy is filled in by the pathologist.</td>
<td>Send outcome</td>
<td>-</td>
</tr>
<tr>
<td><strong>DiagnosisAB</strong></td>
<td>String</td>
<td>The second diagnosis is made after the biopsy.</td>
<td>Diagnose outcome</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 4 – Data trigger GP
3.3 Best practices

The designed models will have an impact on costs, flexibility, time and quality. Each designed process is related to a number of best practices (Reijers & Liman Mansar, 2005). The best practices are thought to have a wide applicability across various industries and business processes. For each process the best practices that match the process are elaborated, indicating the strengths and possible weaker points of the practice referring to the Devil’s Quadrangle.

3.3.1 Trigger WWW

Control relocation: ‘move controls towards the customer’

Answering the key questions and taking a picture of the spot are tasks that can be done before actual seeing the physician. Costs are reduced for the patient, but a disadvantage is the probability of a wrong diagnosis. This may increases the costs. Flexibility increases for both the patient and the physician. Time is saved for both roles. Quality may decrease if patients diagnose their spot incorrect.

Outsourcing: ‘consider outsourcing a business process in whole or parts of it’

This best practice in this process is closely related to control relocation. Costs are reduced, time is saved, but if the quality is increasing is doubtful. It is efficient for the dermatologist if the pre-phase of the diagnosis is done by the patient. Obviously, the diagnosis should be done correctly. On the field of flexibility it requires more coordination effort because the process will become more complex.

3.3.2 Trigger GP

Resequencing: ‘move tasks to more appropriate places’

First, GPs needs to gain experience in the field of dermatology; then costs can be reduced and time can be saved for the patient when GP have the opportunity and knowledge to perform biopsies themselves. Assistant-physician can help the physicians with taking over tasks like doing the pre-phase of a diagnosis (key-questions, photo e.g.), where the dermatologist and GP are there to check the diagnosis of the assistant-physician and treat the different spots. The process will become more flexible and the quality will go up.

Buffering: ‘both use the same database’

The main advantage of buffering is having the information directly available which saves lots of time. Designing the shared database may be costly.

Interfacing: ‘consider a standardized interface with customers and partners’

A standardized interface may result in fewer errors (quality), faster processing (time) and less rework (cost). Communication in general between the GP and the physician will be optimized.
Integral technology: ‘try to evaluate physical constraint in a business process by applying new technology’

The implementation of a new technology like the workflow technology can offer positive effects. Less time needs to be spend on logistical tasks. Information is available for all participants and the traditional way of working that is broken which may lead to completely new ideas and possibilities.

3.4 Conclusion
At each process communication takes places between people and software systems. Workflow technology has the possibility to coordinate the flow and the interaction patterns across manual and systematized tasks. Now the design of the processes is finished, we can continue by changing the Petrinets into a workflow-design to investigate the possible added value of the workflow technology. In the next chapter the designed models will be developed, test cases will be shown and the influence of the workflow technology will become clearer.
Development phase

In this phase, the user interface is designed, graphics are set and the storyboards are created.
4 Development phase

The designed models from chapter 3 will be developed in Perceptive Process Modeling (BPM|one). BPM|one is a commercial WfMS provided by Perceptive Software in the Netherlands. BPM|one is a case-handling product and is considered to be the most successful commercial system providing flexible process support. BPM|one is currently used in around 1500 organizations in more than 20 countries and especially popular in the Netherlands where Perceptive Software is the leading BPM vendor.

Case-handling provides process flexibility by focusing on the data aspect rather than on the control-flow aspect of process execution. Case-handling offers four core features (Van der Aalst, Weske, & Grünbauer, 2005). The first one is that all information within a case is available at runtime. Second, the decision which tasks are enabled is based on the information which is available within the case, instead of the tasks which have already been executed. Third, work distribution is separated from authorization. This allows for additional types of roles, like skipping or redoing tasks in the process. In this way, many more (implicit) scenarios are possible within the process. A fourth distinguishing feature of BPM|one is that workers are allowed to view and add/modify data before or after the corresponding tasks have been executed. Related to other WfMS there are some distinguishing deviation features (Perceptive-Software, 2013):

- users can skip a task that is not enabled yet and has not been executed previously;
- users can open a task that is not enabled yet and can fill in data relevant to the task;
- users can re-do a task which has already been executed previously, i.e. the state of the case reverts to that prior to the execution of the respective task.

This software is ideal for giving process participants a quick overview without having to explain concepts like process objects or process constructs. This chapter describes the transformation of the process models to the test cases.

4.1 Process model

First, the designed models from chapter 3 will be reproduced in a “Process Model”, which will be the basis of the workflow. The belonging data fields and resources are added to the activities. The interface of this process is slightly different than the Petrinets we are used to (Jensen, 2005). In Table 5 the main differences between the two modeling styles are elaborated.

| Petrinets | BPM|one |
|-----------|------|
| One start place and one end place. | One start transition and one end transition. |
| Connections go only from a place to a transition to a place. | Transitions can be connected without the intervention of a place. |
| The interface indicates the output (and, xor, or) of a transition. | The output is specified in the transition itself. |

Table 5 – Petrinets vs. BPM|one
4.2 Case type model
To actually make the workflow visible, the process model is converted to a “Case Type Model”. Editing the case let you create the forms that will be visible to a specific role. The flow of the case will be determined by the outcome of the variables. The case type models of the two processes can be seen in Figure 13, Figure 14 and Figure 15. In Appendix F – Mapping Petrinet to Case type model, the Petrinets are linked to the Case type models.

![Figure 12 – BPM|one CaseGuide](image)

As shown in the CaseGuide in Figure 12, the user can see which actions need to be executed (the one on the blue line) and which are finished (the one with a checkmark). The path that is followed is determined by the data that is used in the case. At any time in the process the data may change. BPM|one has the flexibility to support this by allowing activities to be skipped or to be redone. How this is useful will be shown by the test cases in paragraph 4.5.

4.3 Worklists
Three worklists are created, that represent the “to-do”-lists of the GP, the dermatology department and the pathologist. Based on variable values worklists are filled with cases. If a case is moved from the GP to the dermatologist, it does not mean that the case is closed for the GP. The case will only be closed at the end of the process as defined in chapter 3.
Figure 13 – Case type model trigger WWW
Figure 14 – Case type model trigger GP (1/2)
Figure 15 – Case type model trigger GP (2/2)
4.4 Forms

Now the processes are designed as a case type model, they can be visualized to become actual cases that can be executed. First, the forms are created that contain the data elements that need to be filled in. Finally, a walkthrough of the test cases is described.

Although these forms do not represent a real application, the forms need to be convenient and consistent. The forms are designed based on several input factors from the target group:

- The data that is entered in the current IS.
- The lack of uniform communication (e.g. letter to the GP). By reducing the freedom to enter data, it is easier to standardize the data and make it uniform.
- The possibility to generate reports increases if you can compile reports on as many variables as you want to. Think of the key questions that always needs to be answered by the patient.

The use of a workflow system allows us to exchange data during the process, even if there is a change of role. Hereby redundancy will be avoided.

Figure 16 – Example of a form: Positioning the spot
4.5 Walkthrough of test cases

To give you a better insight in the added value that the workflow technology in BPM|one has for the field of dermatology, two test cases concerning the trigger on the GP side are described. The first test case describes a “normal” walkthrough of the workflow process, while the second test case describes a more powerful practice of the workflow.

4.5.1 Test case 1

Test case 1 describes the entering of a patient at the GP’s office. By looking up the patient the worklist of the GP is filled with the case. The spot (see Figure 17) is located on his left upper arm, NY classification 301, and photos of the spot are uploaded. After answering the key questions, the diagnosis can be determined: “It is not a typical form of eczema, but I’m not sure if it is a BCC or AK spot.”. The GP decides to contact the dermatology department.

From this point on, the patient and the GP have to wait for response of the dermatology department. The case has moved from the worklist of the GP to the worklist of the dermatology department. Of course the GP can always open the case, since he started it.

The dermatologist can now open the case and start working. The dermatologist sees all the necessary information and he can adapt the diagnosis if necessary. The dermatologist suggests to first take a biopsy.

The work of the dermatologist is done. The case has moved back to the GP, where the case is added to his worklist. When he opens the case, he will see the feedback of the dermatology department. He will follow the advice of the dermatologist and start with a biopsy. When the biopsy is done it is send to the pathologist to be examined.

The case has now moved from the GP to the pathology department. The pathologist opens his worklist and opens the case. Looking through the microscope, the pathologist concludes that the spot is of the type AK. The work of the pathologist is done. The case moves back to the worklist of the GP.

Based on the diagnosis before the biopsy and the outcome of it, a new diagnosis will be made: “The spot is of the type AK. Start treatment with imiquimod cream.”. Once the patient is informed the actual treatment can begin, which ends this case.

4.5.2 Test case 2

Test case 2 starts the same as test case 1 up to the point where the GP and the patient have to wait for response of the dermatology department. The patient leaves the GP’s office, gets in his car and drives home. Five minutes later the patients calls the GP with the notification that his spot has started to bleed.

At this point, the GP opens the case and adapt the diagnosis. He is now sure that it isn’t eczema. He decides to let the patient drop by for a biopsy instead of contacting the dermatology department. Now the case is automatically removed from the worklist of the dermatology department based on the alteration of the data. The rest of the process continues the same way as test case 1.
4.6 Conclusion

The walkthrough of the test cases are also visually represented in two videos on YouTube (channel WorkflowHealthcare). These demonstration videos give you a better insight in the capabilities that the workflow technology has to offer. Dermatologists can focus on the more special cases instead of taking rather simply biopsies. The possibility to keep track of a patient emerges clearly. Based on the entered information the flow is determined.

To find out if the forms are designed in the right way consisting usability will be evaluated in the next chapter.
Evaluation phase

The end-users perform debugging through a test case followed by an evaluation form. The processes are reviewed and revised according to the received feedback.
5 Evaluation phase
In this chapter the focus will be on the target group and their experiences with the new way of working. After executing the test case an evaluation will be filled in, based on an ISO framework. This chapter starts with the introduction of the ISO framework, followed by the set-up of the evaluation setting and we finish with the outcome of the evaluation.

5.1 ISO 9241-110 framework
The ISO 9241-110 provides a framework for applying those principles to the analysis, design and evaluation of interactive systems. ISO 9241-110 focuses on dialogue principles related to the usability design of the dialogue between user and interactive system. It does not consider any other aspect of design such as marketing or corporate design. This part deals with general ergonomic principles which apply to the design of dialogues between humans and information systems and are represented in a questionnaire (Prof. Dr. Prümper, 2011):

- suitability for the task;
- suitability for learning;
- suitability for individualization;
- conformity with user expectations;
- self-descriptiveness;
- controllability and
- error tolerance.

For this evaluation, the questions about controllability and error tolerance will be eliminated because these parts are not representative for this evaluation and test environment.

5.2 Set-up
For the two cases we have two different groups of participants. The OddSpot case will be tested by dermatologists, GPs and patients with AK or BCC in their medical history. The GP case will be tested by dermatologists and GPs. In the paragraphs below the setting of the two cases are presented. After each evaluation the questionnaire is filled in (Appendix G – Questionnaire ISO 9241-110).

5.2.1 GP case
The participant will stick to his own role that he carries out in his actual work. The activities that are executed by other roles will be done by me. Before the case starts, the dermatologist/GP gets the required information to get him started. At certain moments during the execution of the case I will interrupt the participant and tell him some new information. This leads to a change in the flow like explained in paragraph 4.5.

5.2.2 OddSpot case
Before the patient starts with evaluating the empty/new case, he is handed over a letter with a fictive username and password representing his DigiD username and password. The patient starts the case and after logging on he can start with filling in the questionnaire. At the end of the case the patient immediately sees the results and he can pursue further actions if necessary.
5.3 Evaluation outcome
The evaluation is held among the target group whom experienced the workflow process by testing their case.

5.3.1 ISONORM values
Since the outcome of the framework is based on each bullet points equally (see paragraph 5.1), the outcome, as it defined originally, is multiplied with 5/7. Based on the total point value, a classification of the software is presented in Table 6 (Riesenecker-Caba, 2011).

<table>
<thead>
<tr>
<th>ISONORM value</th>
<th>Practical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>82 to 105 points</td>
<td>Congratulations, your software is perfectly matched to their users.</td>
</tr>
<tr>
<td>59 to 81 points</td>
<td>All right! Currently there is no reason to make change to the software in terms of user-friendliness.</td>
</tr>
<tr>
<td>36 to 58 points</td>
<td>Time for action! Take a closer look at the factors that the users have rated poorly. You should initiate improvements.</td>
</tr>
<tr>
<td>15 to 35 points</td>
<td>With the current situation no effective, efficient nor satisfying work is possible. A detailed survey of the requirements needs to be shown and improvements that are possible need to be explored.</td>
</tr>
</tbody>
</table>

Table 6 – ISONORM values

The participants have to fill in the questionnaire, which is based on five factors. Each factor consists of three questions which can be found in the column ‘Aspect of the question’ (Table 7). A value between 1 and 7 is given and summed up per question. The sum on the individual questions is divided by the number of questionnaires. Finally, everything is summed up to form the ISO NORM-value.

Next, for each case remarkable items are elaborated and the outcome is discussed.

5.3.2 GP case
An option for the dermatologist is to follow the patient when giving feedback to the diagnosis made by the GP. If the patient is being followed, the dermatologist can monitor the patient and follow his treatment plan. But if he decides not the follow the patient, he will not see anything at all, while it is desirable to get a notification about the final choice of the GP for that patient.

The eye catcher of this case is the NY classification. The clarity and ease of use appeal very much to the dermatologists and GPs.

In Table 7 the outcome of the evaluation can be found, filled in by two dermatologists and two GPs.
### Evaluation matrix ISONORM 9241-110-S

<table>
<thead>
<tr>
<th>Software:</th>
<th>BPMone Trigger GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of questionnaires</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor</th>
<th>Question</th>
<th>Value 1 (---) und 7 (+++)</th>
<th>Sum of individual questions</th>
<th>Total individual / number questionnaires</th>
<th>Sum factor</th>
<th>ISONORM-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suitability for the task</td>
<td>aa1 Completeness</td>
<td>5 6 6 6</td>
<td>23</td>
<td>5,8</td>
<td>17,8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>aa2 Effort minimalization</td>
<td>6 3 6 6</td>
<td>21</td>
<td>5,3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>aa3 Fit</td>
<td>6 7 7 7</td>
<td>27</td>
<td>6,8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-descriptiveness</td>
<td>sb1 Information content</td>
<td>5 6 5 6</td>
<td>22</td>
<td>5,5</td>
<td>16,8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sb2 Support option</td>
<td>6 4 6 5</td>
<td>21</td>
<td>5,3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sb3 Support offer</td>
<td>7 5 6 6</td>
<td>24</td>
<td>6,0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conform expectation</td>
<td>ek1 Design consistency</td>
<td>7 6 7 7</td>
<td>27</td>
<td>6,8</td>
<td>19,5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ek2 Transparency</td>
<td>7 6 7 6</td>
<td>26</td>
<td>6,5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ek3 Operating consistency</td>
<td>7 6 6 6</td>
<td>25</td>
<td>6,3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suitability for learning</td>
<td>f1 Learnability</td>
<td>7 7 7 6</td>
<td>27</td>
<td>6,8</td>
<td>19,5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>f2 Knowledge availability</td>
<td>6 6 6 6</td>
<td>24</td>
<td>6,0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>f3 Accessibility</td>
<td>7 7 7 6</td>
<td>27</td>
<td>6,8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Controllability</td>
<td>sk1 Flexibility</td>
<td>7 7 6 7</td>
<td>27</td>
<td>6,8</td>
<td>18,5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sk2 Changing possibilities</td>
<td>6 5 6 6</td>
<td>23</td>
<td>5,8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sk3 Interruption possibilities</td>
<td>6 6 6 6</td>
<td>24</td>
<td>6,0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total point | 95 87 94 92 |

| Factor | Question | Value 1 (---) und 7 (+++) | Sum of individual questions | Total individual / number questionnaires | Sum factor | ISONORM-value |
| Total point | 95 87 94 92 |

**Table 7 – Evaluation matrix outcome**

#### 5.3.2.1 Outcome

There are a few low average values which will be discussed here. Most of them refer to the fact that this is a test case, such a “Support option” and “Changing possibilities”. The low value of completeness points to the fact that not all the required data fields are presents. Each required data field has a red indicator in front of it, but due to the low value of “Information content” this doesn’t seem to be clear enough. With an ISONORM-value of 92 the case is succeeded.

#### 5.3.3 OddSpot case

In the future, more and more people will have to be treated for skin cancer. Right now, the target groups has an average age of approximately 70 years old. In my test case group only 1 out of the 4 patients, that have a medical history of AK or BCC, uses a computer. The one patient that does use a computer has an age of 80 years old. He noticed that the text size was too small and therefore not well readable. The test case is made in English, which may also be seen as a stumbling point. He gave a total of 91 for the test case. Since he is the only one that actually tested the case, no matrix will be filled in.

The other 3 patients were not that excited about registering your spot online. Going to the GP or dermatologist gives them more confidence and trust in a good diagnosis. If the spot is (in the pre-phase of) a malignant one, a GP or dermatologist always needs to examine the spot in real life.

Dermatologists have experienced from previous treatments that patients have difficulties with positioning the odd spot on their own body. Patients attend to look at the mirror to position their spot, which results in a mirror image of the position of the spot.
5.3.3.1 Outcome
This process may work if the patient will be open to a new way of diagnose. Of course a way of working will only work if the target group will be open to it; however, in this case the patient also has the option to physically go to the GP or dermatologist. The answers of the questionnaire are always useful since they can be viewed (and perhaps adapted if the spot has changed) when the patient visits the GP or dermatologist.

Additional to this trigger could be the automatically contacting of the physician in case the result of the questionnaire is negative. A request to schedule a consult with the physician could be show to the patient and a notification could be send to the physician.

5.4 Performance
Besides the usability of the system we also have to take a look at the performance of the system to evaluate the execution of it. The GPs makes use of a Health Information System called “Zorgdomein”, which is used by many healthcare institutions and GP’s offices all across the Netherlands. With a special application called Tele (Consultation) Dermatology, GPs can send a request to their dermatologist. Once the dermatologist sends his advice about the diagnosis, the GP receives a message. This process that is executed has many similarities with the process ‘trigger GP’ in chapter 3.

The main difference is that this process is supported by the workflow technology. This makes the process much more flexible. Based on data changes, the flow of the process changes without any physical contact (by telephone e.g.) between the participants (see paragraph 4.5.2). The performance is hard to measure with specific data, since no actual implementation has taken place.
6 Conclusion, limitation and future work

6.1 Conclusion
The main research question, how to deal with the growing inflow of patients, can be supported by the workflow technology. The focus is on the trigger of the project; where the patient can start their treatment plan himself by registering the spot online and/or by going to the GP.

Once the GPs have had a proper training, the patient should become aware to first go to their GP. This should be done to decrease the inflow of patients at the hospital. The workflow technology is suitable to support this part of the process, based on case handling and the way of work distribution. It is preferable that patients first go to their GP, so the dermatologist can focus on the more difficult cases. The first step is already made by giving the people the opportunity to register their spots at an online questionnaire. The questionnaire is already developed, but the application of registering odd spots online needs to be developed. Not only costs can be saved based on the fact that the treatment by a specialist is much more expensive than by a GP, but also a lot of time for the patient. From a geographically point of view, GPs’ offices are normally much closer by located than a hospital.

The communication that takes place in the designed process “trigger GP” is supported smoothly by the workflow technology. All the necessary information is immediately available (case handling) and patient records are being allocated efficiently to improve the communication between the physicians (work allocation). Optionally, the information can be adapted by entitled users. The way the communication is handled between the dermatology department and the GP in the existing environment works properly, although it is not easy to extend or add (new) activities. Adding an additional step (e.g. by asking a 2nd opinion at another hospital) is much easier to achieve in a working environment based on workflow technology because it interacts easily with other systems and databases. The test cases give a clear view on the possibilities of the workflow technology. Test case 1 shows the value of the distribution of work by data combined with worklists. Test case 2 extends this by showing how the flow, and thereby the work allocation, changes automatically if the data changes.

If the positions of the spots are stored via the NY classification, specific information can be requested by applying relatively simple queries to the database. Think of valued information like if the odd spot occurs often at particular places, at the same patient or at particular groups.

With workflow technology, all processes can be linked which is one of the strengths of this technology. The use of worklists linked with particular data fields makes a controllable and clear basis to perform the actual work. The introduction of the workflow technology brings lots of advantages that will improve the working process in the field of dermatology.

6.2 Limitations
For the designed processes it is assumed that the data transfer is being done through a secure line. The EPD is a hot issue nowadays, especially regarding the privacy and security concerns. General practitioners in the Netherlands think that the professional secrecy is at issue. Not all patients are satisfied that each health provider has access their medical history. For example it is not desirable that
the government of health insurance companies have access to your medical history due sensitive information.

It is difficult for a target group to empathize themselves in a new technology/application (BPM|one, represented by the cases) where they are not familiar with. They are also used to working with their own programs which. Although they might work well, they are not always said to be efficient and effective to their work activities.

The assumption that GPs are trained in making the right diagnosis and knowing how to treat specific diseases is not realistic. The more you see odd spots, the better you can diagnose them. Taking biopsy and applying treatments are activities that can only be learned by practicing.

There are always patients with an exception to the rule. To capture these special cases, the process should be designed in a very dynamical way. With the use of workflow technology this happens to some extent. In the medical world this is always a difficult issue due the fact that patients may be restricted to particular treatments based on their medicines.

6.3 Future work
What needs to be done in the future is the implementation of the NY classification and to make a functional design to store the data. Afterwards, a report tool needs to be designed and developed.

A tool needs to be designed based on the workflow technology to support the process between the GP and the dermatology department. The connection between the GP, dermatologist and hospital need to be a secure line due to the privacy laws of patient-related data.

Future work could contribute to an even more successful use of the workflow technology by giving stand-by/weekend physicians the opportunity to see a patient’s medical record from any location. This saves a lot of traveling time. If it turns out to be necessary, the physician can still go to a specific location.

Once there are a certain number of diagnosis determined, the system can propose a diagnosis based on the key questions and previous diagnosis. This feature could help novice GP to determine the diagnosis.
7 Bibliography

Gezondheidsnet. (2013). from [www.gezondheidsnet.nl](http://www.gezondheidsnet.nl)
IKZ. (2012). Huidkanker te lijf: innovaties voor een chronische ziekte. from [www.ikz.nl](http://www.ikz.nl)


Appendix A – Consulting hour
Dermatology department CZE

Consulting hour L. Wientjes, Physician assistant (PA).

<table>
<thead>
<tr>
<th>Appointment</th>
<th>Medical treatment</th>
<th>Interaction with IS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control</td>
<td>Upper body check</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Control</td>
<td>Head/neck/arm/hands check</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Highlight spots nitrogen</td>
</tr>
<tr>
<td>3</td>
<td>Result CT-scan</td>
<td>Two referrals; lymph drainage and compression stockings</td>
</tr>
<tr>
<td>4</td>
<td>Control</td>
<td>Full body check</td>
</tr>
<tr>
<td>5</td>
<td>Red skin spot on nose</td>
<td>Analyze spot</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Changing mole</td>
<td>Analyze mole and upper body</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8 – Results consulting hours L. Wientjes

Remarks

- After each appointment the PA decides whether the patient should make a follow-up appointment or that it is not necessary to make one (e.g. skin area has healed).
- The letter send to the GP has a standard layout and it copies particular data elements from the IS. If you do not insert you text in the IS in the right format, you have to go through the text after it has been placed into the letter. Employees do not have a standard concerning editing the layout of the letter, which lead to a heterogeneous communication towards the GP.
- You have two different input screens to ask for a photo of the spot. The distinction is made by the fact if it is skin cancer or not. The screens where you have to position the spot are not the same.
- One of the ideas is to have a doctor assistant next the physician at the consultant hour. This could raise irritations since there is only one computer available. The doctor assistants would focus on making notes and planning appointments, what is now done by the dermatologist. They should focus more on the medical treatment, not on entering patient data and making appointments.
Appendix B – Outcome interviews MohsA

Several problems/situations emerge when taking interviews with the employees of MohsA and having discussions about the current way of work and the current information system Medicore.

1) In a surgery room a computer is installed with the application running. When a nurse is logged in, they have specific right to enter and change patient data. When a physician needs to enter specific information, first the nurse has to be logged out and the physician has to log in to the application. With a card reader and the batch employees are wearing, it is easy to switch between users and thereby the rights.

2) Before and after a surgery a so called time-out form is manually filled in by the physician to do an extra check on surgery-relevant patient data. This form contains questions that might influence the operation. After the form is filled in it is scanned by a nurse, saved on a local computer and uploaded to the application. This action is quite devious and is relatively easy to automate. As a start, during a surgery, the physician could ask the questions, while the physician assistant enters the answers in the applications. A possible solution could be to direct upload scanned time-out forms directly to the applications. To make it even more efficient, the output of the time-out forms could be directly transferred into the application by using a touch screen with the questionnaire.

3) It could be the case that a new patient is entered into the application while is GP is unknown. Later on the GP can be added to the patient, but in treatment phase, the GP fields are not automatically updated.

4) The application has a document system containing EPD forms. This module is processed to the treatment phase. After a certain time, a treatment phase is ended and an invoice is dispatched. When a new treatment plan is started, you may need documents, scan or photos from the previous treatment plan. To be able to easily access the document, a possible solution might be to disconnect the document system from the treatment plan and connect them to the EPD instead.
Appendix C – Meeting Medicore
A meeting was scheduled with Jeroen Gent. After a short presentation about Medicore itself it was time to go through the different software modules they offer. One of the modules that caught my eye is Medicore Online Appointments, which allows the patient to schedule his appointment himself.

During the demonstration of the application it became clear to me that there are lot functionalities in it, but you have to know where to find them. A new UI is on the way, which is built up in ‘blocks’. These ‘blocks’ can be re-arranged by the user, to create an ideal and personal UI.

The application is designed based on meetings and interviews with the user, whereas it would be interesting for me to know at what point in the process the IS is addressed.

Appendix D – Meeting Perceptive Software
A meeting was scheduled with John Hoogland and Hajo Reijers. The scope of the project was discussed. We want to apply the workflow technology at the missing parts in the one-stop-shop process. Where this is going to be exactly should be analyzed by further work. For now we focus on the beginning of the process, the middle of the process (follow-up appointment) and the end of the process (wrapping up).

The beginning of the process starts with a trigger. Normally this is a patient who reports his/herself at the dermatology department or at the GP. Other ways of a trigger to start the process could be:

1. Manually login of patient by making a photo of the skin area which need to be checked;
2. Updating personal data (e.g. migration) which lead to visiting another hospital;
3. Updating health status (diseases, blood pressure, cholesterol value etc.) which lead to the necessity to make an appointment;

The middle of the process mainly consists of checking the affected skin. A way to make this part more effective is by letting the patients plan their own follow-up appointment by assigning them a particular week or day and let them decide which timeslot they prefer.

When a skin area is healed, some patients need to come by for a yearly check. Referring to the consulting hour of L. Wientjes (Appendix A), only 6 out of the 9 patients actually showed up. A way to increase the attendance of patients could be by sending them a reminder, for example one day before the actual appointment takes place. This could be done by e-mail, text message or a by voice message.
Appendix E – NY Classification

Figure 18 – Head, eyes and mouth
Figure 19 – Feet and hands
Figure 20 – Upper body (front and back), legs and genitals
Appendix F – Mapping Petrinet to Case type model

Figure 21 – Mapping trigger WWW from Petrinet to Case type model
Figure 22 – Mapping trigger GP from Petrinet to Case type model (1/2)
Figure 23 – Mapping trigger GP from Petrinet to Case type model (2/2)
## Appendix G – Questionnaire ISO 9241-110

<table>
<thead>
<tr>
<th>The software ...</th>
<th>---</th>
<th>--</th>
<th>-</th>
<th>-/+</th>
<th>+</th>
<th>++</th>
<th>+++</th>
<th>The software ...</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>aa1</strong></td>
<td>has not all the functions to handle the necessary tasks efficiently.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>has all the functions to handle the necessary tasks efficiently.</td>
</tr>
<tr>
<td><strong>aa2</strong></td>
<td>requires redundant entries.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>requires no redundant entries.</td>
</tr>
<tr>
<td><strong>aa3</strong></td>
<td>is poorly adapted to the needs of the work.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>is good adapted to the needs of the work.</td>
</tr>
<tr>
<td><strong>sb1</strong></td>
<td>provides an insufficient extent information about which entries are permitted or required.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>provides an sufficient extent information about which entries are permitted or required.</td>
</tr>
<tr>
<td><strong>sb2</strong></td>
<td>provides on demand no situation-specific explanations.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>provides on demand situation-specific explanations.</td>
</tr>
<tr>
<td><strong>sb3</strong></td>
<td>provides by itself no situation-specific explanations.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>provides by itself situation-specific explanations.</td>
</tr>
<tr>
<td><strong>ek1</strong></td>
<td>makes orientation difficult by a uniform design.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>makes orientation easier by a uniform design.</td>
</tr>
<tr>
<td><strong>ek2</strong></td>
<td>poorly informs you about what it is going on.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>properly informs you about what it is going on.</td>
</tr>
<tr>
<td><strong>ek3</strong></td>
<td>cannot be continuously operated by a common principle.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>can be continuously operated by a common principle.</td>
</tr>
<tr>
<td>The software ...</td>
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<td>-/+</td>
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<td>---</td>
<td>----</td>
<td>-----</td>
<td>------------------</td>
</tr>
<tr>
<td>lf1</td>
<td>requires a lot of time to learn.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>requires little time to learn.</td>
</tr>
<tr>
<td>lf2</td>
<td>does require that you have to remember a lot of details.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>does not require that you have to remember a lot of details.</td>
</tr>
<tr>
<td>lf3</td>
<td>is difficult to learn without help or a manual.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>is good to learn without help or a manual.</td>
</tr>
<tr>
<td>sk1</td>
<td>enforces unnecessary processing steps.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>enforces no unnecessary processing steps.</td>
</tr>
<tr>
<td>sk2</td>
<td>does not allow easy switching between menus or screens.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>allows easy switching between menus or screens.</td>
</tr>
<tr>
<td>sk3</td>
<td>enforces unnecessary interruptions of work.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>Enforces no unnecessary interruptions of work.</td>
</tr>
</tbody>
</table>