Designing with autonomy analysis - the possibilities and risks with using autonomy analysis when making computer design

Shant Davidian

Institutionen för informationsteknologi
Department of Information Technology
Abstract

Today we have a great technological development in many fields and this have made an impact on computer systems and their design. For my thesis I am interested to see a concrete example of how an organization prepares and develop their computer system. I will evaluate the requirement specification for the Svenska Kärnbränslehantering AB to see how it was created. I analyzed the process of creating new requirements for the new computer system GADD with autonomous analysis, the analysis is made by the tool EthXpert. The conclusion I can make from this thesis is autonomous analysis gave us a good understanding of how a computer system should be like, how decisions are made for designing them. Even do we analyze a part of a whole network of stakeholders we received useful answers. I think autonomous analysis works for design decisions as long we can verify our answers we received. Our analysis is built on the knowledge from among other things the requirement specification and the requirement specification is based and made of interviews from the stakeholders. Regarding the major difference I discovered between Design rationale and autonomy analysis is where and when the argument for a design is presented and discovered. With Design rationale the argument is already presented while in autonomy analysis the argument will be found in the analysis and therefore new solution is possible to be found.
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1. Introduction

Today we have a great technological development in many fields and this have made an impact on computer systems and their design. Having the opportunity to develop computer system and their design means also we haft to consider the use of it, the function of a new improved system may look updated and new but does it really fulfill its purpose? The purpose should be to make a computer system more useful and convenient, to make this possible we haft to avoid thinking in a heteronymous way. Heteronymous way of thinking is when our decisions are based on some knowledge which feels familiar and we are comfortable with. We choose not to search for knowledge just because of previous knowledge could lead to a result we are comfortable with. The outcome is known from previous actions. To make another approach, an autonomy approach, we skip previous knowledge and what they may lead to and instead go for new thinking. This approach will make us avoid any missing knowledge which may have impact to the computer system and its design. So to fulfill the purpose of more useful and convenient computer system during development the need of an autonomy approach is important. I intend to use autonomous analysis with the help of EthXpert to identify stakeholders and their interests; this will help us understand what kind of computer system is required and what kind of design is needed. Some evaluating is done in collaboration with Emil Wessely.

2. Problem description

For my thesis I am interested to see a concrete example of how an organization prepares and develop their computer system. I will evaluate the requirement specification for the Svenska Kärnbränslehantering AB to see how it was created. I will analyze the process of creating new requirements for the new computer system with autonomous analysis, this will be an excellent opportunity to test and verify our method autonomous analysis and compare to other existing methods like Design rationale. The aim of this thesis is to evaluate the possibilities, advantages and the risks with using autonomous analysis when making computer design. To analyze the Svenska Kärnbränslehantering AB future computer system GADD with help of its system requirement I will use the tool EthXpert.
**2.1 Limitations**

Our limitation is when working with the Svenska Kärnbränslehantering AB only a part will analyze with autonomy analysis with help of *EthXpert*, SKB LOBA. When working with our method autonomy analysis will intend to illustrate arguments for and against when making computer design, the actual design is not executed. The comparison with other method like *Design Rationale* is simply compared and not executed either.

**2.2 Outline of thesis**

This thesis is structured in the following way. Starting with background information where I explain different ways of thinking when designing, heteronomy and autonomy way of thinking. Further in this thesis I compare autonomous analysis with another *Design rationale* where I compare in detail how different stages separates the different methods and which is to prefer depending on how we work and what we are working with. After the comparison I put this base on a real event, the event is SKB. With help of SKB and real examples the comparison can be reality-based. Finally I have a discussion part in which advantages and disadvantages are considered. These will give a base to make a conclusion at the end of my thesis. To make the thesis more convenient to follow a short summary is made after each important part.
3. Background

3.1 Heteronomy

When we make decision without taking all the aspects into consideration then we are thinking in a heteronomy way, conscious decisions occur very regularly in our daily lives. When make these conscious decisions it is always based on some knowledge the decision maker feels familiar with, this is because the result, the outcome is known from previous actions. So the heteronymous way of thinking is based on shortcuts to decision, when we are confronted with taking decisions, heteronomy urge us not to be analytic but rather to make decisions based on the known outcome we had have experience of before. Usually we take the same specific way to work and the same specific way back home, we do this not necessary because it is the shorter way or because it is the most convenient road but we do it because we know the outcome will take us home. There might be an even shorter way to work or even more convenient road, but we do not take the chance to find out and we stick with the choice we are comfortable with.

3.1 Autonomy

Autonomy is unlike heteronomy is a more analyzing way of thinking. It urge us take every single aspect that may have an impact for the decision, in consideration. It makes us look at problems in a broader view and previous knowledge should not make an impact to the decisions. The previous example with the way we choose our way to and from work would maybe have the same outcome but the reasoning to the decision is completely different. Before choosing our road we take facts into consideration, this might be how crowded a specific road is, how many red lights there might be, and how well we know the direction. This way of thinking we avoid neglecting a missing part which may have an impact to how we should make decisions. If taking these aspects in consideration we might change our daily way to work, to a better way.
I can see several and logical advantages with an autonomy method but how can we detect if autonomy is best suited for a specific field. Different field with various organization types, various stakeholders and various interests. Maybe heteronomy is to prefer if beforehand we know this situation. Autonomy method is to prefer in many other cases, to create a view and see how each act affects values of all involved parts. This I consider is suitable to use when analyzing a new field were the outcome is not know and alternative approaches should be considered, by giving alternative approaches we can see how each act gets affected by different decisions.

3.2 EthXpert

The facts we should take into consideration to make a better choice is posted and presented with help of a tool, a tool which helps us decision makers to take make decisions depending on existing and current facts. The tool EthXpert is originally made for the purpose to help the decision maker to make moral decisions. Moral problems involving many aspects to be taken in consideration, the tool EthXpert tries to provide a perspicuous view of the stakeholders and their interests. This way the decision maker can draw conclusions with help of a broader view which EthXpert is offering. The concept with EthXpert is to emphasize autonomy analysis, this is done by identifying elements which is or can be affected to each other, namely the stakeholders. The stakeholders are listed and defined in EthXpert and are represented by dots which may affect other stakeholders by an arrow pointed to it or be affected by an arrow pointed against itself. After the first stage the stakeholders allow us to characterize them, this is done by defining the interest for each stakeholder. Each interest must be based on the stakeholders own needs, it is seen as something benefiting for each stakeholder without taking consideration how this interest may affect others. The third step is where we actually start to built a network between different stakeholders, each stakeholder is to consider how their own interest relates to other stakeholder and of course it should consider how it is affect by others. When all the relationships are completed a well-filled matrix is seen, columns and rows represent the relations. An overview of the matrix with stakeholders listed as rows and the same stakeholders listed as columns makes all the relationships presented at the same time. If there are stakeholders with many affecting interest the matrix will reveal this. When seeing the matrix with all the current relationships we define main options where the solutions are listed as a column. With help of our relationship analysis we define advantages and disadvantages for each solution based on the analysis. EthXpert is in our case to be used for decision making for computer systems, we are going
to use the same method as it is been done for moral and ethical decision but in this case it is going to be applied for design.

### 3.3 Summary 1

So far we introduced a certain way of thinking we are going to analyze, autonomy analysis. A short introduction to the opposite thinking (Heteronomy) is made to just to clarify the difference. I also introduced the tool we used during our work, EthXpert with all its elements and purpose. This is the under work and will be used when I am comparing different methods and analyzing them. To clarify our method I will introduce and illustrate Design rationale, this will make us understand our method better when we have another method to compare with.

### 4. Theory

#### 4.1 Design rationale

When designing with Design rationale there is a couple of building stones symbolizing the process. Design rationale is supposed to tell us how the complete design solution was made. To answer the question how it was made we can divide the question how into smaller parts like how we present the process, how we capture information and how it can be reused in the future. “Design rationale includes all the background knowledge such as deliberating, reasoning, trade-off and decision-making in the design process of an artifact – information that can be valuable, even critical, to various people who deal with the artifact”. (A Survey of Design Rationale Systems: Approaches, Representation, Capture and Retrieval)
There are different approaches for Design rationale. One approach is process-oriented design rationale. This approach is mostly seen when designing with insecurity; this insecurity appears when designers have limited information of the problem. I think every design approaches should see the problem this way, at least initially so no assumptions is done ahead. To present this approach “Design rationale” uses a certain representation schema, a graph-based. This way to represent an area, with insecurity, should be very appropriate. By graph-based representation a wider view is presented. The presentation should also be categorized, to make a wide view presented it somehow must be narrowed so it can easily be distinguishes from each other. To make this distinguish I think the relationship between these elements would be easier to translate and to understand for future use, when wanting to reuse a specific part of “Design rationale” the distinguished sections of “Design rationale” simplifies the process. The important elements here are problem, position and argument which are seen in figure 1. When making the elements distinguished like in figure 1 it clarifies the overview of the work, this will also simplify the review for future work.

The process-oriented is also telling how to process the captured information, how to make the captured information useful, and how to translate it to design solutions. “Incremental formalization aims, first of all, to eliminate the dangers of premature structuring and the cognitive costs associated with formalization that inhibits user input by allowing information to be entered in an informal representation. Secondly, it aims to reduce the burden of formalization by distributing it and making it demand driven and task driven” (FRANK M. SHIPMAN, 1993; RAYMOND J. MCCALL, 1993). According to this statement from Incremental formalization the process is to make the captured information more useful. To make it more useful we haft to make it more formal due to when capturing information some could be useful, other less useful and some could be useful but later on in the process. Organizing and refining captured information is a must to retrieve key factors for design, key factors like important needs and from whom it belongs to. When working with Incremental formalization the initial stage is to have information to start the refining process with, starting information could for example be notes or similar uncompounded material. This type of information is refined roughly said by labeling/categorizing them and making connect to each other. By connecting small textual information we start to build a map where we can see how information
can lead to other relevant information. There are different types of information and they are
categorized under the same name so there is the need to rename them before continuing the process.
This type of categorization makes of course the information process initially more convenient to
handle, but what if we make a wrong assumptions and categorize it wrong? Can this error easily
been seen later? Can this error be misleading for the entire process? After the categorization we
start form associations, which means we built more shorter and meaningful messages with help of
the labels. This later indicates relationships between the different blocks which represent more
meaningful information and is believed as more formal information. The relationships emphasize
the values which occur when many blocks are connecting to each other, issues, argumentation and
answers is elements which we deal with at this stage. These elements set the ground for how the
design is later made. The goal with this stages is to, as previously stated, formalize, but can
information be lost at these stages when we are refining? When a formal representation is
produced, it supplements rather than replaces the less formal representation original message is still
part of the information space at the end of the process (FRANK M. SHIPMAN, 1993; RAYMOND
J. MCCALL, 1993). It is stated here formal information should complement previous informal
information and not replace it in any way. I would say whenever we are translating information the
risk with replacement is present. When we built shorter messages with help of the labels the goal is
to translate information to more meaningful and useful for design purpose but this can easily be
misinterpreted. When we translate to shorter information we summarize and our information can
very easily be replaced.

Table 1 Design rationale prototype system

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<thead>
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<th>Retrieval type</th>
<th>Approach type</th>
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<td>IBIS</td>
<td>User-intervention</td>
<td>Navigate</td>
<td>Process oriented</td>
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<tr>
<td>IBIS</td>
<td>Automatic Rationale Capture</td>
<td>Navigate</td>
<td>Process oriented</td>
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4.3 Representation schema for design rationale.

To make the whole process as effective as possible, design rationale uses a method to capture the
process in detail; it captures the existing alternatives for design and which arguments they support.
The representation schema should represent exactly everything with the design plan, this includes
for example argumentation which was not used but still must be a part of the whole process. The reason for this must be for reuse purpose, the design is seen as a never ending process. It should be possible to consider the unused argumentation to change or make new design proposals. In figure 1 we see how argumentation is used for a certain design proposals represented in different colors; we can also detect the argumentation not used. For future reuse this structure should be convenient for the designers, the representation schema would work like a template. Design rationale presents a technique to make a representation schema, *The Issue-Based Information System* (IBIS).

*The Issue-Based Information System* (IBIS) “uses an issue-based approach that has been used in architectural design, city planning and public-policy discussion” (A Survey of Design Rationale Systems: Approaches, Representation, Capture and Retrieval). An issue-based approach is representation schema for presenting problem, solution and arguments for and against it. This representation is excellent template for city planning, when planning a city the result will only show after a long period. Keeping the argumentation for and against a given solution close and well represented the reuse of this model would play an important role. The relationship of problem, design proposal and argument is presented in figure 1.

![Diagram of problem and argument relationship](image)

*Figure 1: Here we see how different arguments are attached to different colored design proposal.*
4.4 Capture of design rationale

When we are doing research, different methods are used when we are capturing information. Generally we capture the information by writing it down to built our self an opinion, in some fields writing down information is to an advantage but in other areas it is for no use. When making interview to capture information it could be more adaptable to record the information and not to capture it with in writing. “The primary requirement of the design knowledge capture process is that it captures design descriptions in a form that supports the communication and reuse of design knowledge” (A Survey of Design Rationale Systems: Approaches, Representation, Capture and Retrieval). So the primary requirement for the capture according to design rationale is capture in way so it can be useful to designers and for those who want use it in the future. In design rationale two methods is presented for how we capture this information.

User-intervention:
This method captures the documentation by writing down every single decisions made by the designers.

Automatic Rationale Capture:
With Automatic Rationale Capture the documentation is done by recording every conversation leading to decisions from the designers.

4.4 User-intervention

This capture method requires the designers to document their decisions. So this make the method user-intervention pure individual, every designer put their own trademark on the decision. There is therefore no compilation of decisions, the captured information from the decision maker is not resumed or summarize. For a reuse purpose this method is suitable, if decision makers individually
can post their own decisions in detail is to great use for future work. A collection of separate decisions is effective when analyzing for what reason the decision was made, by keeping different decisions apart it can easily be modulated in the future if designers use the collection of decisions as a guide. According to Coklin, “in order to be updated, the design rationale document can grow into a huge bundle. In this case, there are many people involved in the development process, and issues may be repeatedly recorded, which may result in inconsistent information in the design rationale document” (A Survey of Design Rationale Systems: Approaches, Representation, Capture and Retrieval). I do not think the added information in a the document will be inconsistent, if designers in detail put detailed information such as why they did certain way the observer can chose to take the information to consideration or just let it be.

4.5 Automatic Rationale Capture

This method is a different type of documentation, instead of individual designers writing down each decision this method wants to capture the information in raw format. With raw format I mean how to capture all the activity that lead to the decision. Normally a discussion between designers can be resumed and written down as summation of the discussion which then is the basis for the decision. Here, no such thing is done, every single action is recorded for be used later on. This method is a kind of information documentation as the previous method but here we cannot distinguish individual decisions due to there is only records of designers while they are working. I consider this type of method as wanted when we need raw information; raw information is created by this method due to all the conversations between the designers is recorded. I think using this method in some stage turns into User-intervention, sooner or later we need to come to a decision and document it but what this method allows is to literally see and hear how the designers made the decision. In User-intervention detailed information such as why a certain decision was made is documented in writing, here in Automatic Rationale Capture we see how the decision was made in raw format. This method could be considered as unnecessary and overflowed information documentation but this method provides us something User-intervention does not. It provides us a tool to analyze a decision before it has been made, to study an ongoing conversation leading to a decision would tell us more than to study a final decision. But yet again is this necessary and in what context is this method appropriate? I do not think this method is or should be aimed for a
specific context; this should be used for any kind of evaluations. If this method is used then future designers can evaluate more detailed than User-intervention.

5. Analyze

5.1 How we present the design

Starting with how the design methods are represented we could conclude any notable difference. In a process-oriented design rationale the representation is originated from the Issue-Based Information System (IBIS). The relationship of issue, position and argument is presented and we can immediately see a difference from the autonomy. The representation schema for The Issue-Based Information System we have made several conclusive solutions which is represented with positions which is responding to an issue and the positions are either supporting or objecting with an argument. Comparing design rationale and the representation schema with its issue, position and argumentation we can see namely the position of the design solution. Dealing with EthXpert the position of the design is never revealed or appeared at the initial stage as the representation schema does for The Issue-Based Information System, unlike design rationale autonomy is delaying the design solution. When looking at the argumentation in design rationale The Issue-Based Information System is linked to one or several design proposals (figure 1), the argumentation in autonomy analysis is represented how interests relates to stakeholders. So the argument in the representation schema is equivalent to how we translate considerations in EthXpert, the input dialog summarizes all the relevant previously stated considerations. This part contains all the background information for considering a specific design; it considers how the different decisions affect other stakeholders. Depending on what path the user picks it shows how the interest of each stakeholder is affected and therefore we can state this as the equivalent argumentation for design rationale and its representation schema. If we choose a design proposal in “Autonomy analysis” a path leads us through the consequences of the choice. A path telling us initially advantages for and against our choice, telling us which interests are concerned and which stakeholders are affected by the given design proposal. So the main difference in how the representation schema is constructed is not how
but when the design suggestion is made.

An overview of how design rationale can be approached is represented in table 1, where detailed information is listed of every part of the approach to the design. How the representation schema is constructed (IBIS/PHI), how the knowledge is captured (UI/Auto), what type of approaches (PO/FO) is used and how the information is retrieved (Navigate/Trigger) to be reused. In EthXpert there is no labels that represent this type of information. There is no information telling us in what way the design process is represented in EthXpert, IBIS/PHI tells us how detailed and organized the information is when it is represented. The Issue-Based Information System representation is an overview of how the design proposal is built up (figure 1), problem is connected to design proposal which is attached to one or several arguments. Procedural Hierarchy of Issues is a more detailed representation which is to be used for future look up to the design process. So design rationale offers different ways to representation of the design, for different purposes different representation could be useful. If only interested in an overview of how a design progress is done an Issue-Based Information System representation is to prefer, for other purpose like research the Procedural Hierarchy of Issues is better suited. Even if there is different representation between the two methods there is some key elements which are similar. With key elements I mean problem, design proposal and arguments represented in way so it distinguishes from other information. Other information could be surrounding information for the design proposal, for example it is not stated the requirements for the design proposal. In EthXpert the design proposal is stated as the same way like it is in Design rationale. The arguments are also stated in both methods but in completely different shape and deep. We see each single design proposal with tails hanging after it, tails consisting of arguments for and against the design proposal (Figure 1). In EthXpert the tails of the design proposal are construed in a different way, by giving arguments for and against it in the stage where we “Define main options/scenario”. At this stage we can see exactly which interest is affecting and affected the arguments and even more deep, which stakeholders they are connected to.
5.2 How we capture

To capture informational with design rationale it is critical how the information is captured to developing a system. One method how to capture information is to document all the information by recording the history of design activities. Basically it records what decisions designers made, when they were made, who made them and why. In autonomy analysis the documentation is equal to the analysis. The difference between Design rationale and autonomy analysis regarding the documentation is the type of documentation it handle, while autonomy analysis deals with documentation of analysis Design rationale tell us the extended information from who, how and when it came.

The important part of the captured information is not how we capture but the way we handle it assuming we initially got the necessary information to work with. Working with autonomy analysis no notes or other textual information is initially required. Defining existing stakeholder is the first step for our information process so the difference here from design rationale is prepared information, there are no notes and other textual information stocked before we define our stakeholders. One of the steps for design rationale is to identify categorization which are important parts, secondly labels are sorted for different various parts and this process is done just after the notes and textual gathering. When categorizes different parts represented in figure 1 as different colored boxes, this colored boxes can represents for example locations, computers and people. In Autonomy analysis the categorization is not visible, defining our stakeholders which stands for its own category, each individual stakeholders is seen as vital parts who are affecting and are being affected by other parts and therefore cannot be categorized with other similar parts. What this difference does for a design is hard to tell at this stage but generally keeping all stakeholders apart and see them as a source could matter when designing with accuracy.

Incremental formalization aims, first of all, to eliminate the dangers of premature structuring (FRANK M. SHIPMAN, 1993; RAYMOND J. MCCALL, 1993).

Some information in design rationale is overflow and is filtered away when information is more formalize in the incremental formalization scale. More specific it is not filtered away due to the information is still there but in a more formal shape. Hyper text as they call it in (FRANK M. SHIPMAN, 1993; RAYMOND J. MCCALL, 1993). Autonomy analysis handles the overflow in a different way, after defining our stakeholders we are able to set its interests. For each stakeholder
there is a majority group of interests listed in box of the stakeholder. Some interests are more affecting able and therefore more important than others, we have a way to sort them out and give them status of importance. For each interest there is an alternative status to be selected, if the interest is taken to consideration we give it a status by changing the color of the box, the same with if the interests is not important and if the interest has not been taken for consideration at all. Having the interest in this way and not making any hyper text for the notes like it was done in design rationale we actually have better overview when dealing with the relationship between the stakeholders.

### 5.3 Reuse Simplifications

How we earlier presented a design rationale may take too much time and too be demanding for designers or researchers to take part of. A simplification process called *Procedural Hierarchical of Issue* (PHI) is used to make *design rationale* a more useful tool. By just looking at *The Issue-Based Information System* (IBIS) we see a great overview of what the documented solutions but for other designers and researchers who prefer to make their own decisions with the help of the documented knowledge there should be an easy way to find information which are not included in the representation schema. As earlier stated the representation schema is presenting the problem, presents several solutions as a design and then attaches reason for and against these solutions. For those who want to investigate a little bit more *Procedural Hierarchical of Issues* is great use. The problem in figure 2 is broken down to smaller problems, into sub problems where the answer is stated as direct answer or sub answer. By using this method represented in figure X some major advantages is occurred compared to *The Issue-Based Information System*. “The prime issue is by definition the whole project. PHI avoids raising irrelevant and trivial issues” (A Survey of Design Rationale Systems: Approaches, Representation, Capture and Retrieval). To this statement I would say it depends who should avoid this irrelevant information. For designers who are included in the ongoing process they need to document all necessary and “unnecessary” information because the documentation is a part of design rationale, no information is considered overflowing when for design rationale. Overflowing information is promoted in *design rationale* for example when recording information during the process where designers exchange information between each other. The reason for PHI is mainly for reuse purpose, by complementing issue with sub issues it becomes a degree system. By a degree system I do not mean the most important is the issue followed by several sub issues. This is not a rate system but a simplification for those who look for
information in design rationale. As an issue stated in figure 2, “What kind of material should be used when building house?” This issue is broken down to the sub issues “What kind of tools is necessary to build the house?” and “What kind of screws is used for building the house?” The same way the issue is broken down so is the answers, this is not just a great overview by the different degree of information but a guidance of what type of information is found where. This makes a great look up manual for reuse purpose. Design rationale call this system for Viewpoint and this tool makes the look up for design easier, designers can easily browse thru different designs before making a decision. The Viewpoint system is created as the following where issue, sub issue, answers, sub answers and arguments are presented.

ISSUE:

What kind of material should be used when building house?

SUBISSUE:

1. What kind of tools is necessary for building the house?

2. What kind of screws is used for building the house?

ANSWERS:

1. Wood

SUBANSWERS:

1. Drills, hammer
2. Sliced

ARGUMENTS:

1. Price is low and very accessible
2. ........................................

FIGURE 2: Design rationale calls this system for Viewpoint, a problem is broken down into small problems.
5.4 How it can be reused

Design rationale is not just a platform for how designers represent their work and in what way the information is captured. This part is matter of consequence but another vital part is when others want to reuse a previous work. According to “Design rationale” this is stated about the retrievalment; “to retrieve criteria, rules and options to help make design decisions during the design process or to produce documents after a design process” (Regli et al. 2000). To be able to reuse a previous work is to a great value, it can be for the sake of updating the work, researching or just use it as a template for dodging difficulties when working with a new project. I suppose initially before all kinds of preparations a template is to a great help even for a new project which is not similar to the documented process in design rationale. I would consider some part of this retrieving process to be a very difficult task. To have all information captured by recording would create a great challenge to go through all information. If supposed all the captured information was essential this initially captured stage would be to a great use but when the information is untreated, untreated in the sense of it is not useful information before vital parts have been sorted out. Further on when we look at the design proposals in Design rationale we see all the relevant arguments for and against a design proposal attached to it, so a reason for our design is explained and also possibly reasons for not considering the design proposal.

Viewpoint is a hypertext system which provides a manual for the reuse; the reuser should be able to look up issue, answers, arguments and also the proposed design suggestions (Regli et al. 2000). With this hypertext system the reuser avoids some demanding stages to obtain essential information, to be avoided a bunch of raw information is in my opinion a great advantage. There are different approaches to retrieve documented knowledge; one approach is Navigating Archived Design Rationale. As stated before, to be able to find useful knowledge it would take time and effort. Navigating Archived Design Rationale uses an operating manual to find essential and useful information, this manual is to simplify for future look up. VIEWPOINTS “creates an integrated multifaceted design environment with five components: a construction kit, an argumentative hypertext system, a catalog with a collection of design examples, a specification component and a simulation component for exploring the design options” (Regli et al. 2000). By construction kit it means all the necessary criteria is presented in a way so the reuser can create their own opinion and maybe also find their own solutions. By having just a The Issue-Based Information System (IBIS) the reuser could take part of solutions attached to several argument for
and against it. *Procedural Hierarchical of Issues* presents with help of *VIEWPOINTS* enables this so called construction kit (A Survey of Design Rationale Systems: Approaches, Representation, Capture and Retrieval), it is a deeper and more detailed version of *The Issue-Based Information System (IBIS)*. If only IBIS were used no options would be available. Options like a catalog withholding different solutions and more important a catalog with all the essential issues, sub issues, answers and sub answers. I would consider the *Procedural Hierarchical of Issues* is presenting the decision in way which makes analyzing more convenient, the reuser get more evidence for each and every design by introducing issues, sub issues, answers and sub answers.

How do we retrieve information in *EthXpert*? When a reuser wants to capture knowledge saved in *EthXpert* there are no complete design suggestions displayed, we do not have any specific design image saved. Instead of a design suggestion by an image we have a in the flap “Define main options/scenario”, here design solutions is listed as an explanation. If a design solution suggests an example, a 3D map like in figure 3. Here no image of this is represented in *EthXpert*. A simple explanation of the design suggestion is listed. In our case it is a 3D map. Another different is the argumentation for the design, in design rationale we have argumentation attached to the design solution (figure 1). We have this scenario in *EthXpert* but in another shape, if we assume both *EthXpert* and design rationale has a design proposal defined then the arguments attached to it is displayed and presented in a different way. With design rationale, arguments are attached to a design solution; further on the view of this representation is extended so the argumentation is broken down into smaller parts as seen in figure 2, and smaller answers need equivalent amount of answers. This is done with help of Viewpoint hypertext system. In *EthXpert* every single interest is considered when a design proposal is made, one interest from SKB is to get by economically and this is considered when a design proposal represented with “3D” or “Detaljerad märkning av kollin”. Here we list advantages or disadvantages with the respectively design proposal. With the specific interest to get by economically we see 3D map is considered to be expensive, this argumentation stands against “cheaper” as we see in figure 3. This is a simple way to see how a specific interest from a specific stakeholder influences a design proposal. A traditional viewpoint just before taking any decisions we always put advantage in front of disadvantages and this make our decision making much clearer. But what if there is no such thing as disadvantages, there is advantages in different ways. In *EthXpert* this is possible to see and list advantages to a specific design proposal, in design rationale when a design proposal is made all the arguments you could
think of is connected to it and all the arguments which objects to it. In figure 2 we see an issue, sub issue, answer, sub answer and arguments, when the reuser wants to have a look at this manual a comparison between different design proposals is not viewable as the same way we see it in EthXpert. The manual enables to look up several design proposals and all the answers and argumentation connected to it, but to make comparison between different arguments is not visible as it is in EthXpert. “3D” or “Detaljerad märkning av kollin” are two separate design proposal, by having two design proposals next to each other along with arguments for and against the reuser would have an easier task to clarify the situation. In figure 3 we see how the two designs are suggested along with arguments. The arguments for and against the design is connected with the interest for each stakeholder, in figure 3 we see how a “3D” is stated with arguments for and against it. The arguments are attached to the concerned interests. By having this design presented this way I consider there is no strict answer, a certain design do not have any given advantages or disadvantages.

In design rationale and VIEWPOINTS the reuser can see separate for each design proposal as we see in figure 2, when looking at a specific design proposal it is difficult to make a comparison with other design proposals. Basically the reuser has to manually look each design separately and make up his mind. With design rationale we get strict answers, a certain design with given arguments. The meaning with reuse purpose I consider is to analyze and perhaps retrieve knowledge for improvement and I think in EthXpert it allows us to analyze due to we are not given any strict answers and solutions.
Summary 2

I introduced Design rationale, how this method is approached and used. I have declared how we can capture information (User-intervention and Automatic Rationale Capture), how we can present design (Process-oriented and Issue-Based) and finally how we can reuse the information in the future. To clarify and the difference between autonomy analysis I showed the how the different parts of the methods separates from each other. This is a initial step before I apply a real event on our methods, I compared Design rationale with autonomy analysis in general without any reality-based situations.
6. Analyse with GADD

6.1 Lecture from SKB LOMA

A part of SKB needs a new computer system for their daily work. The existing computer system is needed to be upgraded to meet the organization's needs. We intend to use our autonomy analysis on this organization with help of EthXpert. The goal is to illustrate how specific a decision may affect others and how such decisions may look like.

When we started the work our first task was to get an insight in the organization, a lecture was given from the organization so an initial step was to understand how the organization is built. Understanding how the organization was built we could make an appropriate limitation and also make assumptions of possible stakeholders. SKB is an organization with several various tasks and therefore the organization is separated into smaller parts with its own tasks and interests. One example we received was the “Strålskyddsmyndigheten (SSM)”, an outside organization connected to SKB and have an impact to how the SKB work. With this approach we got a hunch not only of possible stakeholders but what kind of interest these stakeholders had. To get more detailed information for our autonomy analysis we were handed the requirement specification for the new computer system which is already in progress at the organization.

6.2 Requirement specification

When handed the requirement specification for the new computer system GADD we immediately went thru without identifying any specific parts of the requirement specification. Briefly important aspects such as stakeholders were taken to consideration and our work with EthXpert began. With earlier experience with requirement specification in mind the work was done differently. For a practice purpose we analyzed earlier a different requirement specification as an initial work before working with the real project with the requirement specification for GADD. We started to analyze the requirement specification commonly and filling out the stakeholders as we found them in EthXpert. Further on we started to characterize the stakeholder by giving them interests, these
interests were found the same way as the stakeholders namely founded commonly and then listed in EthXpert.

For our second attempt and final project we tried another approach angle to minimize the risk of missing out stakeholders and interests. Instead for a common analyze we separately made an effort to list the identified stakeholders with their interests. This resulted in our opinion differently, with a separate approach out thought were never affected by the other one and we sorted out stakeholders and their interests. Given this approach the result of our stakeholders became more complete when consolidated to an entirety. When dealing with our interest from the first requirement specification one remark was made which changed our approach for the second requirement specification work and it was the interest identifying process.

When working to identifying interest it is important to make a summarization of several common interests to one single interest which all the interest fall under. This is seen to be important affect for further work in the process. As an example which is shown in figure 4 the interest “lämna ifrån sig avfall” comes when several common interest could be resumed as one, interest like sending and receiving messages in connection with the waste disposal. During our first practice requirement specification we had to merge several interests unlike our second attempt where we due to previously knowledge stated right type of interest. Right type of interest so we did not had to merge several interests into one. To make this kind of simplifications is shown to be necessary for our work.

6.3 Finding interests and relationships

So before our second attempt to analyze a requirement specification some learning had been done. The building blocks for our entire work the stakeholders are seen as an element which influence other stakeholders and also influences itself. By creating the stakeholders as strict as possible this allow us to better understanding of the organization and therefore also the relationship between the stakeholders. For our second attempt the stakeholders became stricter and completed due to two person created stakeholders by its own opinion and then were complemented by the other one. In our case it was some complementary was done, by doing separate stakeholders identification it allowed us not only to identify possible stakeholders but also identifying the reasons for the existing stakeholders. When understanding the reasons for each of the stakeholders we could build our selves an opinion of what kind of interest they may have or may want to have. When we built our
self an opinion the interest occur as something based on the stakeholders own need, the interest is seen as something which only benefits the one stakeholder without thinking how the benefit may harm or cause some problem to other stakeholders. The stakeholder “Strålsäkerhetsmyndigheten (SSM)” interests is among other things to have “Ha insyn i SKBs verksamhet” and “Kunna lita på rapporter” shown in. To have an organization which the primary function is to get information from SKB the interest “Ha insyn i SKBs verksamhet” is a summation of specific interest and the interest “Kunna lita på rapporter” is an interest based on the stakeholders own need which was found, and this is necessary for the SSM. This interest which is based on the stakeholders own interest is characterized when the interest is not taking the cause in consideration, the thinking of how their own interest may affect the other part. If SSM would take in consideration what their interest would harm or affect another part they would have neglected the interest “Kunna lita på rapporter” just because of the simple reason of trust. If they receive information they should be able to trust it and not suspect anything else. This I state as a interest based on the stakeholders own need and is important interest for obtaining value in EthXpert.
6.4 Interpreting Values

To obtain a valid value from our relationship overview the interest must be based on the stakeholders own needs and are distinct. Like earlier explained we made a summarization to one distinct interest instead of several, this helps us make the relationship overview more fair. To have many similar interests give us the wrong idea of the involving rate estimation. One of the interests from SKB is to “Bra verktyg för att ta emot och leverera rapport”, there are several type of reports handled by SKB. Yearly, safety and other reports are made by SKB but this is not represented as interests but as one single interest, similarly is done with the rest of our interest and this fulfills our distinct requirement. Another example from the stakeholder SKB is their interest in a safe system for the organization, inventing new storage room for nuclear waste and doing “TRAM messages”. These interests have all been merged into more formal and useful interest, before instead of safe system for the organization we had like safe log in, safe supervision etc. These was merged into one distinct interest.
6.5 Validation

At this stage our work in EthXpert seems to be fulfilled and a valid check up needs to be done for possible complements. Our validation should answer some question we might have neglected from the requirement specification or just simply forgot to take into consideration. So before our validation we can repeat our steps in the project. Our project began with a representative from SKB LOMA who gave us an insight into the organization, we created our own initially image without writing down any notes. This presentation from the representative was mainly to illustrate important aspect of the organization, what kind of work is done, how the work is divide and what kind of tools
is necessary. This kind of information could maybe easily be gathered by own research but having a spokesman telling us gave us an approach, an approach telling us the important part of the organization. Further on our project was the requirement specification for the new computer system *GADD*, during the requirement specification our work with *EthXpert* begun.

From the requirement specification we mainly got the stakeholders and their interests. The requirement specification is created to an improvement to the old computer system; the improvement is partly done by interviewing the users.

Our validation as stated earlier should answer some question we might have neglected from the requirement specification or just simply forgot to take it into consideration, this could be as a simple thing as a stakeholder or a hidden interest. Another question should be why we could have missed it, it is one thing to not take certain information into consideration but it is another thing to not notice the information and therefore no action could be taken with the information. The validation we did was an interview with one stakeholder consisting two users of the existing computer system. The interview was made with the help of some questions (see appendix), questions occurring during our work in *EthXpert* and during our analysis of the requirement specification.

Figure 6: Our work illustrated with the different steps.

In this figure we see a complementary part right before the final *EthXpert* version; the complementary interview gave us some direction of important task made by the specific stakeholder SKB LOMA we visited for our interview. One of our interview question were which other groups does SKB LOMA work with; the question received was several internal groups inside the stakeholder SKB LOMA. Groups like “driftavdelning”, “verksamhetsstöd” and “säkerhetsanalys”
were not listed as their own stakeholders in *EthXpert* because they were not mentioned in the requirement specification so possible interests pointed to these internal groups was not taken into consideration at our first attempt to operate with *EthXpert*. To make it more specific, the information was not noticed to take action with it at the first step.

So the conclusion of our validation, an interview took place after our own opinion was created by the requirement specification, insight lecture with help of *EthXpert*. What were we expected from our validation? Is this the most optimal validation? How do we know if our validation is correct and complete?

The expectation we had from our validation is to complete our work in *EthXpert*, by complete I mean looking for missing parts. Parts like stakeholders we found in the requirement specification, interests and possible design solutions needed from the stakeholders. We expected to complement *EthXpert* with information we possibly misinterpreted or just did not included due to lack of importance, maybe also find information which was not included in the requirement specification. So there are three different type of information we try to complement with help of the interview. The complementary information we added after the interview were some irrelevant stakeholders which did not change our work in any way. In the department SKB LOMA where we visited some new stakeholders were found, during the interviews we asked “Which other stakeholders were included in that specific department and who they were working against. Stakeholders like operating personal, safety personal and activity support personal were information found and added in *EthXpert*, information which was not mentioned in the requirement specification. So this information would not been possible to take part of if the interview was not performed, this information did not change our work in *EthXpert* due to their interest were similar to the existing stakeholders the report and prognosis makers. Nevertheless this information was missing and was found thanks to the interview. During our interview with the stakeholders report and prognoses makers we got acquainted with their daily work and their interests. A big part of the daily work for the reporter and prognoses makers is to satisfy the stakeholder SSM. Several reports is needed to declare to SSM both monthly and yearly, besides reports the reporter and prognoses makers have a daily based conversation with the SSM by telephone and email. So the information SSM is requiring from the reporter and prognoses makers is of various type. Some information which does not require preparation and presentation like status report, period report, and activity report, monthly and yearly reports must be considered as more simple information. Simple information could be consulted by a email, simple information like understanding measurement data, property
values and question about waste disposal storage. This is kind of information should be accessible for the stakeholder SSM whenever they need it. During the interview with the reporters and prognoses makers we asked how they handled a large amount of information when it was requested. A large amount of information was printed out and handed to SSM for investigation and analysis. There should be a external log in function so SSM would be able to take part of this information whenever it is needed and does not have to depend on contacting other stakeholders. This log in function was not mentioned in the requirement specification after clearly the needs from the stakeholders were there. This is as I regard it missing information in the requirement specification and should have been included when making the requirements.

Another type of information is the kind we might have misinterpret from the requirement specification, the type of information like how the location and its waste types should be represented. Graphical layouts for SKB and their waste disposal locations with detailed information of its containing, this proposed graphical information we initially did not think had any function. If it was textual or graphical representation should not be any difference functionally, one might just think it is more advanced with a graphical representation (3D map). Our opinion about the graphical proposition changed when understanding how different substance in the waste disposal storage may have affect on each other and with the graphical view this representation is more logical when we see a map how close the substance are to each other. This information about the graphical representation was misinterpreted but was corrected thanks to the complementary interview.

6.6 Is this the most optimal validation?

Our validation is basically on the requirement specification, by doing the interview we want to notify if our interpretation of the requirement specification is a correct interpretation. To make a satisfying complement to EthXpert we need to talk to all the stakeholders and have them present when working with EthXpert, the access to the stakeholders will give us all the necessary interest and how they relates among stakeholders and which relationships occurs. To have access to all of our stakeholders might give us detailed information from each stakeholder but would it be the most optimal validation? This way we would have all the stakeholders beside us when working with EthXpert, this idea many would consider being an optimal validation but would not give us a correct picture of how interest and relationships should be. First and former we haft to understand
the requirement specification is created from interviews from the stakeholders, by choosing alternative two in figure 9 we will miss vital information. We need to create our own opinion of the existing stakeholders, their interest and their relationship towards other stakeholders, to create our own opinion we will need an environment where it gives us this opportunity. This opportunity would not been possible at all if we had the stakeholders at our service while we worked with EthXpert. We see how the two different approaches are illustrated in figure 7, the first approach is our approach and the second is thinkable approach.

Figure 7: Our work illustrated with the different steps compared with a thinkable approach.

For example we found out from the requirement specification several report types which must be used from the stakeholder report and prognoses makers, status, period, activity, monthly and yearly
reports. We summarized the interest “good system to handle reports and prognoses” for the stakeholder. For the SSM the interests “observation and insight in SKB LOMA and its organization” and “be able to see and have an overview of what is stored and where it is stored”. When we defined our interest we got a matrix with all the relationships between the stakeholders. Earlier we defined something called involving rate, when many interest is involved between different stakeholders we see an importance due to the high involving rate, we see a value. When looking at our relationship overview of all the interest between the stakeholders we see several gap, considering our definition we do not have any information of importance here.

In figure 4 see a green gap between the interest “observation and insight in SKB LOMA and its organization” and the stakeholder reporter and prognoses makers. The same gap is also observed between the interest “good system to handle reports and prognoses” and the same stakeholder.

By choosing the first approach we made up our opinion of how interest should be after analysis of the requirement specification, then we observed values in the matrix where many interest were involved with stakeholders. Another aspect we also observed was missing information, gaps in the matrix. If those gaps were there thanks to missing information or misinterpretation from the requirement specification is hard to tell but thanks to a validation interview we could draw some conclusions. During our interview with the stakeholder reporter and prognoses makers we got the impression of many small and unnecessary contacts occurred daily between the stakeholders SSM and “reporter and prognoses makers”. Contacts like emails and telephone calls, this contact could be more flexible by having an external log in system. Thanks to our work in EthXpert we made up several interview questions to make a validation of the requirement specification and our work in EthXpert. By introducing a possible external log in system to the stakeholder reporter and prognoses makers a lot of time would be saved, SSM could whenever pleased log in and fetch a wanted information.

This approach gives us a complete different validation of our work then if we would have chosen the second approach. We must build our own opinion from the requirement specification and analyze for later on make a validation and hopefully find missed or misinterpreted information.

6.7 How do we know if our validation is correct and complete?

I do not think we will be able to say if a validation is correct or wrong but by doing a interview validation it gives us a opportunity to be critical to the requirement specification. By being critical
to the requirement specification we will find important information which was left out during the creation of the requirement specification.

6.8 Improvement of EthXpert

During our work with EthXpert we discovered and introduced some improvements. One of the improvements was when we were dealing with the interests. To get a fair matrix were we can interpret values we need to merge interests. We need EthXpert to allow us to merge for example interests like transport waste, receive waste and store waste. To summarize into one unique interest like manage waste we haft to implement this possibility in EthXpert.

Another improvement is when we are dealing with relation between stakeholders, we want EthXpert allow us to distinguish different level of priority. For example it should be possible by clicking on a relation to determinate status. Status like checked, unchecked and important, theses statuses is represented by different colors so it can easily be separated in the matrix when looking at it. As seen in figure 8 we see the interest “Gott rykte” is not been handled and therefore different color from the ones that been handled. This difference will also appear in the matrix where we the relations.

![Figure 8: Different status on the interests is shown, the second interest "Gott rykte" is not handled and therefore the color white.](image-url)
7. Result

7.1 How we represent

After the validation we believed our work in EthXpert was done and therefore we could also see the representation as completed. The representation is divided in several sections, one section for stakeholders, one for relationships between them and one for options for the design proposals. When having the section “Options” displaying on do not only see design proposals, we also see all the stakeholders with their own interests. How our work is represented is mainly for two reasons, to see in shattered steps how we got to a solution and how the work can assist for future work designing proposals.

When we stated with our stakeholders for the Strålsäkerhetsmyndigheten it gave us the ground to represent the work, our buildings blocks. The building blocks are important because they are the ones who affect and get affected by the solution, to have them stated and see an overview of the stakeholders is to a great value. We stated the stakeholders for an example SSM, SKB Loma, SKB, Public and the Environment under the flap “Defining stakeholder” in EthXpert. I think having this overview of all the stakeholders gives us a clearer view of not only which stakeholder is included in our work but it gives us a more real idea of how the limitation is constructed. If we see all the involving stakeholders obviously then the representation makes more sense, a representation should represent the boundary of a work so the viewer understands how far or how it is. This is best represented by having all the stakeholders separately and distinguished. So this is clearly understood by stating all of our stakeholders in EthXpert under the flap “Defining Stakeholders”. If we compare EthXpert representation to “Design Rationale” and its “Issue-Based Information System (IBIS)” we see the information of the stakeholders is hidden. The information of the entire stakeholder is included but it is distinguished from other information. When looking at the “Issue-Based Information System (IBIS)” representation we cannot interpret the boundaries due to we do not have any stakeholders stated. In figure 2 we see how representation of the “Issue-Based Information System (IBIS)” is constructed by having arguments attached to solutions. The building blocks, the stakeholders, are not pointed and therefore fade away among other information. Instead of the stakeholders SSM, SKB LOMA, SKB, Public and the Environment this information is
attached to other information in *Design Rationale* and *Issue-Based Information System (IBIS)*. Other information could for example be interest, relationships between the stakeholders, different advantages and disadvantages which may occur if the specific design solution is chosen. All this information is separated in *EthXpert*, the stakeholders, the relationships and the design solution. There are different sections, flaps, to visit when we want to take part of certain information. Is it to an advantage to have the information represented the way it is in *EthXpert*? I think both representation methods strive to declare in detail how a specific solution is made and what other possibilities they are but there is a substantial difference between these both representation methods. In *Design rationale* and its *Issue-Based Information System (IBIS)* the design solution is centered, every information is presupposed from a given design solution. Basically we could say the representation is made by presenting a design solution and attach information to it. In *EthXpert* the presentation of the design solution is not visualized the same way, *EthXpert* present the information of how we got to the design solution, “Define Options”. The design solution is not considered to be the key aspect of the presentation, *EthXpert* enables an environment where all the information we consider to be important and useful presented in a way so it can easily be noticed how a specific design solution is developed. In our work with SKB we made a suggestion to a design proposal, a 3D-map, which should be a tool for the stakeholders SKB LOMA and other concerned stakeholders. When suggesting this solution we can list all the advantages and disadvantages for the solution and see which stakeholders affects or gets affected by this solution. Unlike *Design rationale* and its *Issue-Based Information System (IBIS)* this methods creates an environment where we can see how different solution can affects stakeholders. *EthXpert* is not trying to tell us which stakeholders and their interest affects a solution but it is trying to tell us which stakeholders and their interest may affect a solution. The main difference between these representation methods is one presentation is defined and the other one not defined, *EthXpert* deals with understanding and presenting information of how a certain solution may occur.

### 7.2 How we capture

The way we capture information separates autonomy analysis from *Design rationale*. When we started our work with autonomy analysis we got an insight lecture from the organization, a lecture from an employee was given about the organization so we could get an idea about the organization
SKB. Afterward we were handed the requirement specification for the new computer system GADD we analyzed and gathered information. While we went through the requirement specification we initially identified our stakeholders and other relevant information. All the information we analyzed and discussed such as possible stakeholders, possible interest of the stakeholder and other relevant information is differently captured. If we had done our work in Design rationale then all the processed information had been recorded, recorded either by writing down all our thoughts and discussions we had during the work in EthXpert or just digitally record it with help of camera or dictaphone. What Design rationale does is to create raw information and raw information must always be refined to make it useful. To make the captured information useful, Design rationale uses Incremental formalization “Incremental formalization aims, first of all, to eliminate the dangers of premature structuring and the cognitive costs associated with formalization that inhibit user input by allowing information to be entered in an informal representation. Secondly, it aims to reduce the burden of formalization by distributing it and making it demand driven and task driven” (Incremental Formalization with the Hyper- Object Substrate, FRANK M. SHIPMAN, III).

According to this statement from Incremental formalization the process is to make the captured information more useful.

In autonomy analysis the need of refining information is not there, we do not need to make captured information formal. If information is refined and made more formal that means some information is useful and is not needed for the current work. I consider we did not put in any unnecessary information into EthXpert to refine it and make it more formal. Our initially step was to state all the stakeholders, to make a documentation before this I consider to be something needless. We do not state stakeholders and make it more formal, all our stakeholder affects and gets affected for every single decision we make in EthXpert. The stakeholders we state are static, we do not need to change or make it more formal.

During our work in EthXpert the need for some formalization emerged. To obtain a valid value from our relationship overview in EthXpert the interest must be based on the stakeholders own needs and are distinct. When stating the interests for all the stakeholders some interests were merged into more formal and useful interest. As an example, the interest safe system was represented earlier on by similar interests like safe log in, safe supervision etc. These were merged into one distinct interest to make the value from our relationship overview fairer. I think translating captured information and refine it is logical if the captured information is in raw form. In our case with EthXpert we do proceed from the kind of information we collected we proceed from what kind of information we
might need or not need, and this is done by just stating our building blocks, the stakeholders.

Earlier we stated how we represent information in *Design rationale*, mainly for the purposes to see in shattered steps how we got to a solution and how the work can assist for future work by designing. How well we capture information is a condition to have a decent representation in *Design rationale* unlike with *autonomy analysis*. For complementary purpose I would say *Design rationale* provides us a better view of to what extend the capture information played role in our work. Let say we did our current work with *Design rationale* during our work with SKB we discover substantially information. This substantially information may cause change of opinion of the designers and this information should be declared somehow as distinguished information so it will stand out from other information, this is the information which changed our mind and causes this opinion. In “*Design rationale*” this is possible due to the “*User-intervention*” method; every designer put their own trademark on the decision. There is therefore no compilation of decisions, the captured information from the decision maker is not resumed or summarize. For a reuse purpose this method is suitable, if decision makers individually can post their own decisions in detail is to great use for future work. How can it be to a great use for future purpose we might ask our self, I think if we have the opportunity to observe how and when certain information changed our opinion it will become a sort of a mile-post. We will see how information looked before the mile-post and how the information changed; this ongoing process is easier to observe with “*Design rationale*” than with autonomy analysis and *EthXpert*. When working with *EthXpert* we did not discover any information which totally changed our opinion, to make it a so called mile-post, but if we had discovered some significant information it would have been added in *EthXpert* or replaced information. Either way this information would not be distinguished from other information, we cannot see that this specific information was the reason for our change our mind. If the information replaces information instead of just adding then we cannot see the replaced information. I would consider the replaced information something important, to have it included it enables us to see our thoughts before we changed our mind. The work we did with SKB made us shape our own opinion of how the organization is composed. The foundation and opinion we got to make a conclusion for the design solution we got from the introduction lecture and the requirement specification. During our work with *EthXpert* we posted information about SKB LOMA, their interests and relations to other stakeholders. One of the interests was “Safe system for handling the organization”; when we did our complementary interview we found out with help of our question “How would you like to search in the system?” The answers we got were varying, within SKB LOMA there is different
groups with different need when searching, some group need a simple search engine while others need detailed search engine with for example a interval. Although our initial interests “Safe system for handling the organization” sums up all the need for SKB LOMA we need to state these interest differently to clarify this for our design suggestion. We can add to the originally interest “Safe system for handling the organization” new interest like “different option while handling information” or just remaking the original interest. Either way this information change cannot be noticed, if we want to change this information after our complementary interview we can but it will not be noticed as changed information. If we would have done this change in EthXpert the information would be represented like in figure 9 (replacing information), when adding or replacing blue information into the red then only the blue information is available. In “Design rationale”, if the same operation was made then we would be able to see the change, changed or replaced information is seen like the figure “adding information” is stated.

Another example of changed information was when during our complementary interview asked how a normal day looked liked. According to the staff of SKB LOMA several hours went to responding emails and telephone calls by other stakeholders, the question they were asked could be about handed in reports and its content. With this new information I would have liked to add a new interest to SKB LOMA, an interest saying to have better knowledge about the rest of the organization. To have better knowledge of the whole organization misunderstanding from other stakeholder will decrease, maybe reports will be written more suitable for the addressed stakeholder

Information was changed and replaced through our entire work in EthXpert, some changes we considered more important than others but is it really necessary to submit and declare it? I think it can be useful when dealing with similar work in the future, to have old and new information posted and knowing the reason for the updated information may prevent mistakes and misunderstandings. Let say if we chosen to work with Design rationale and declared the new information and interest “to have better knowledge of the whole organization”, then for future work it can be seen as a need which was missing from the requirement specification it is valued important and must taken to consideration when making the design.
7.3 How we reuse

The purpose of reuse is to understand how and why a certain design solution was produced. So how the work is presented is to a great value if the knowledge wants to be reused, like earlier stated there is different way of presenting the information in EthXpert and Design rationale and its Issue-Based Information System (IBIS) and therefore also the reuse knowledge is handled differently. If designers in the future want to take part of our work with SKB and EthXpert they would retrieve differently kind of knowledge than if our work was done with Design Rationale.

When our work in EthXpert began we had a brief introduction of how the organization SKB is built and then we were handed the requirement specification. After reading the requirement specification we started our work in EthXpert, although we had conversation regarding all kind of information we put in EthXpert only important information was used. Important information like stating all the stakeholders we found and their interests between each other, the information surrounding of how we got to the conclusion to include the specific stakeholders and their interest is not mentioned in

Figure 9: Here we see how information is added but this result in replacement in the left. The right illustration is when information is added and the old information is not replaced.
any way. We just state our stakeholders and their interest and the rest of information is neglected. If we had chosen to do our work in Design rationale all the surrounding information would be available, surrounding information could be represented by all of our conversation. All detailed information we discussed while we worked with EthXpert, our discussions, our considerations and our conclusions. This information could be available by documentation in different ways (by recording it or documenting on paper), if future designers want to take part of detailed information there would be major information to deal with. I think those who want to reuse the recorded knowledge would find the information overflowing; they would want some structured information to work with. Design rationale offers another kind of retriever method, simplification process called Procedural Hierarchical of Issue (PHI), which is used to make the reuse knowledge more effective. For those who want to investigate without going through a whole bunch of raw information the Procedural Hierarchical of Issues is to great use. The problem of the work is broken down to smaller problems, into sub problems where the answer is stated as direct answer and sub answer. Viewpoint provides a manual for the reuser, the reuser should be able to look up issue, answers and arguments. With help of the catalog system the reuser avoids some demanding stages to obtain essential information. If we had done our work with SKB in Design rationale the reuse catalog could have seen like this.

ISSUE:

How should the waste disposal information be presented?

SUBISSUE:

1. What kind information is needed in the presentation?

2. Who should have access to the information?

ANSWERS:

1. Graph-based

SUBANSWERS:

1. Location, location in the storage, waste disposal type.

2.
ARGUMENTS:
1. Easy to locate and make decisions.
2. ........................................

FIGURE 10: An example of how Viewpoint could present an analysis. It is the same presentation as figure 2 but different problem.

I think if we did the presentation as above the reuser would retrieve a defined knowledge, by defined knowledge I mean a type of knowledge which prevent us to establish an opinion of a certain solution. It provides us a given solution with arguments to a specific issue and according to Design rationale VIEWPOINTS creates an integrated multifaceted design environment with five components: a construction kit, an argumentative hypertext system, a catalog with a collection of design examples, a specification component and a simulation component for exploring the design options (Regli et al. 2000). By providing a finished work in this way and declaring the issue as “How the waste disposal information should be presented?” and post the answers and arguments to the issue it does not create a design environment for the reuse. The only thing it provides is if you use the specific issue in the same way and the same environment you will acquire the same answer and arguments, just like a catalog should be. This pretension is a pure catalog, we will be able to browse through tons of design solutions but how does this help designers in the future? If I was a designer and wanted inspiration to a new project I would not prefer Design rationale and it’s Procedural Hierarchical of Issue (PHI). Even if it provides us information like answers and arguments to a specific design solution it keeps out a valuable aspect of the work, namely provide knowledge for reuse purpose. I do not think it provides knowledge for the reuser by presenting for the purpose as it claims. It is hard to make your own opinion if a catalog provides you information in this order. This would be a great information source for those who want perform statistic work but to create a design environment I would prefer autonomy analysis and its tool EthXpert.

What autonomy analysis and EthXpert does is to put the vital parts in relation, we have a reference point. EthXpert does not proceed from a certain design solution as in Design rationale, it proceed from assumptions. When we started our work with SKB the initial task was to state all the stakeholders, then we moved on to all their interest, relations and finally we post a design proposal. When having our design proposal we have the opportunity to take one step back and behold the advantages and disadvantages, one more step back to get our interest and last step to we have all the
stakeholders. So no matter what decisions we take it is presupposed we see the cause of our decision. The cause of our decisions should put us one step back as shown in figure 11, if we now choose the design proposal 3D map we see all the stated advantages and disadvantages of our decision, some advantages attaches from many interests and some non at all. The interests are then attached to the base, our stakeholders.

So the main difference for reuse purpose between Design rationale and its Procedural Hierarchical of Issue (PHI) and autonomy analysis is the knowledge reuse. Design rationale and its Procedural Hierarchical of Issue (PHI) provide us finished design solutions with arguments while autonomy analysis provide the exact same design solutions with arguments but put it in relation with other solutions with arguments. In this way we get a reference point which is important for the reuse because it creates a design environment, the purpose for the reuse.

Figure 11: Illustration of how we begin our work in EthXpert and how the reuse progress.
7.4 Summary 3

This part is my actual event presented, an introduction to SKB is made and then I described what we actually are looking for when analyzing with autonomy. We analyzed the requirement specification for the new computer system GADD, how and why I approached it the way I did. With autonomy analysis I found interests and relationships between the interests, here I understood the reason for each of the stakeholders and their interests and therefore could interpret values. I think this was an important part, to understand the link between interests and interpreting values is crucial when we are working with design because it was our whole mission. The mission to understand different stakeholders with their various interests and supply a design suited just for them.

Furthermore I compared Design rationale with autonomy analysis with a reality-based case namely SKB and the requirement specification.

8. Discussion

Our intention with autonomous analysis was with help of EthXpert analyze SKB future computer system GADD which is not yet created. Could we somehow say we succeeded with our autonomous analysis? How can we verify our success? With the requirement specification we can with help of autonomous analysis create a view of how the computer system GADD should be like. If we found any mismatch between our created view and how the requirement specification was formed we could say we succeeded, to verify the success we had to do interview the concerned stakeholders and their interests.

I must say one of our successes with autonomous analysis was when we found out about the SSM and their interests. When we started the work our first task was to get an insight in the organization, a lecture was given from the organization as a initial step to understand how the organization was built. During this lecture we understood some connection between SSM and SKB LOMA, while doing our autonomous analysis we detected even more connection between these two stakeholders. I would say autonomous analysis helped us with the idea to introduce a possible external log in system to for the stakeholder SSM, a lot of time would be saved, and SMM could whenever pleased log in and get the wanted information instead of always rely on SKB LOMA for information. We
succeeded to introduce an external log in system due to the need was present and was not mentioned in the requirement specification. To verify if the succeeded idea is a succeed we had to interview the involved stakeholders, this external log in system turn out to be a success after introducing it to SKB LOMA.

Autonomous analysis clarified also some thoughts we had; according to the requirement specification a 3D map was required for the computer system. Graphical layouts for SKB LOMA and their waste disposal locations with detailed information of its containing were needed. This graphical information we initially did not think had any function. With autonomous analysis we could give a option for the requested 3D map, our conclusion to the alternative detailed textual log was that it was a better alternative and a 3D map was not necessary. If it was textual or graphical representation should not be any difference functionally. During our interview at SKB LOMA the 3D map was preferred, this because the 3D map better visualized how the storage among different substance could be solved. The 3D map would make a better alternative than the detailed textual log according to SKB LOMA. I think autonomous analysis made is think of question we otherwise would not had been thinking of, in this case with the 3D map was not a great example but to question the idea to use a 3D map will may lead to better alternatives. I think this is the idea of autonomous analysis, if were thinking in a heteronymous way then we would have accept the idea of having a 3D map without question it.

9. Conclusion

I have used autonomous analysis with help of EthXpert for our project. I analyzed SKBs future computer system GADD with help of its system requirement. The conclusion I can make from this thesis is autonomous analysis gave us a good understanding of how a computer system should be like, how decisions are made for designing them. Even do we analyze a part of a whole network of stakeholders we received useful answers, if we had analyzed all the concerned stakeholders we probably would have got more useful answers. I do not think we would have received better answers if we taken all the stakeholders into consideration, but we would have got ineffective
answers if we analyzed a part of the stakeholders and not verify our analysis with them. I think autonomous analysis works for design decisions as long we can verify our answers we received. Our analysis is built on the knowledge from among other things the requirement specification and the requirement specification is based and made of interviews from the stakeholders. Regarding the major difference I discovered between Design rationale and autonomy analysis is where and when the argument for a design is presented and discovered. With Design rationale the argument is already presented while in autonomy analysis the argument will be found in the analysis and therefore new solution is possible to be found.

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11. Appendix

Nuläge:

1. Hur ser en vanlig arbetsdag ut?
2. Vilka delar av det nuvarande systemet använder ni mest? (tex sök isåfall på vad)
   a) Vad är bra/dåligt med ert nuvarande system?
   b) Används den nuvarande databasen för att göra olika beräkningar?
3. Hur navigerar ni mellan olika funktioner?
4. Är det nuvarande systemet plattformsberoende? OBSERVERA
5. Vilka sorters rapporter och prognoser gör ni?
6. Rapporter till allmänheten?
7. Hur kontrolleras, godkänns och kompletteras rapporter och prognoser?

8. Vilka andra användargrupper jobbar SKB LOMA med förutom rapport -och prognosmakare?
9. Hur mycket insyn har SSM i er avdelning? (Hur har dem insyn?)
10. Hur lämnas förslag in till SSM?
11. Hur kontrolleras, godkänns och kompletteras rapporter och prognoser?

11.2 Förväntningar:

15. Hur vill du att historikläget ska fungera för data som fanns innan GADD?
16. Vad förväntar ni er av den nya databasen? (Är det några ändringar ni är oroliga över?)
17. Vad vill kunna lägga till? Vad saknas i dagens system?
18. Hur vill du att gränssnittet är strukturerade?

20. Hur vill du kunna söka i systemet? (intervall?)
21. Hur mycket tror ni att databasen kommer att behöva uppdateras med nya funktioner framöver?
22. Kommer ni att behöva de externa utvecklarna för att göra uppdateringarna?

23. Hur vill du att utbildningen i det nya systemet ska skötas?
24. Hur lång inlärningstid kan ni acceptera?

11.3 Kravspec:

27. Under sökning, till vilken format vill du kunna exportera till?
28. Vart i databasen ska skapa/öppna formulär, rapporter och prognoser finnas?
29. Varför 3-D kartor av förvarsplatsen? Hur mycket vet ni om framtida slutförvaret?
30. Historikfunktionen? Vad har ni för nytta av att kunna navigera i systemet så som det såg ut vid valfri tidpunkt bakåt i historien? Är det tänkt att man ska kunna välja valfritt datum eller bara visa.

11.4 Borde finnas?

31. Login system. Bör det vara möjligt att komma in i systemet från distans? Hur gör leverantörer för att komma åt data/bidra med data?
32. Sparas ekonomisk data i databasen? (Jämföra ekonomiska aspekterna av olika val, se vad som kostar mycket/litet).

11.5 Avsiktsförklaring.

För vårt examensarbete är vi intresserade av att se ett konkret exempel på hur det kan gå till på företag när man förbereder utvecklingen av datorsystem. Vi vill titta på kravställandeprocessen som ni använt för den pågående utvecklingen av SKBs nya databas och hur ni har kommit fram till de krav ni har i er kravspecifikation. Detta skulle vara ett utmärkt tillfälle för oss att testa de teorier som vi utgår från i praktiken. Vi vill, med autonoma metoder (se nedan), analysera de behov som databasen behöver uppfylla, hur det är tänkt att