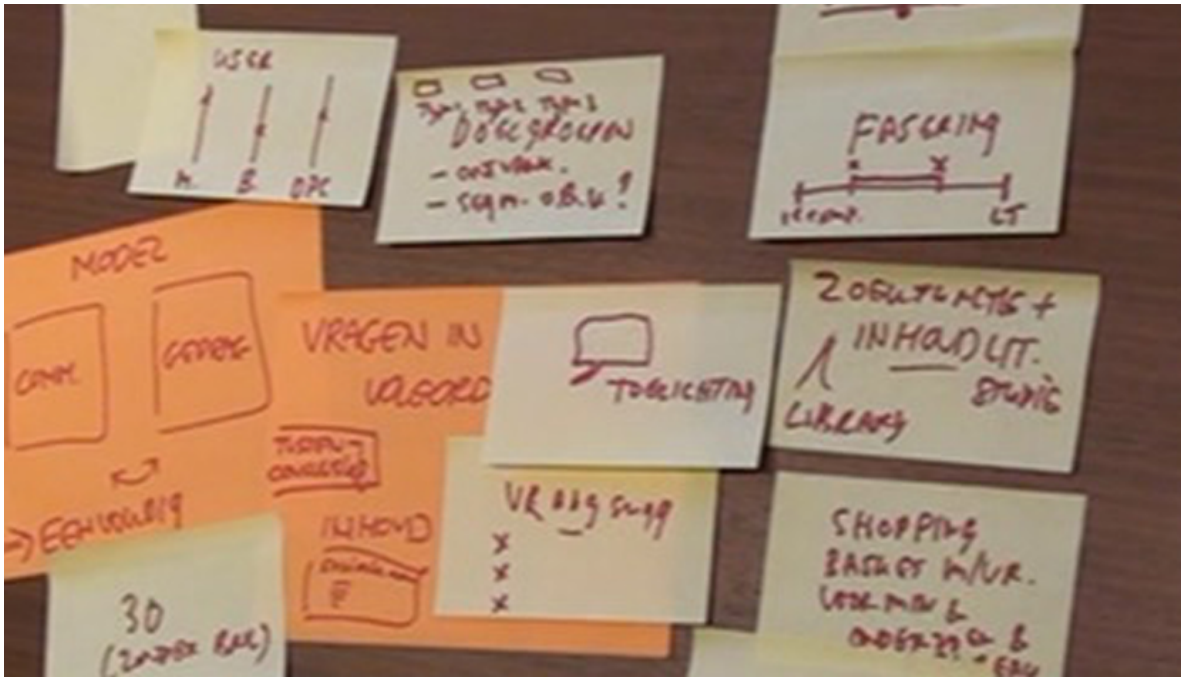
Designing a Designer

Designing a decision support system for designing communication strategies



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Summary

This thesis presents the research on designing a decision support system for designing communication strategies. The importance of this topic comes from the idea that more academic knowledge from social sciences could be used in designing communication strategies. However, often those strategies are not designed by scholars. Therefore a way must be found to transfer knowledge from the academic field to practice. In this thesis it is believed that this can be done with help of a decision support system. The results of this thesis are guidelines on how to design such a decision support system.

The theoretical framework of the design exists of three main topics. Design science, decision making and decision support systems. The first is addressed to become acknowledged with the way in which professional designers work. Most important findings are that especially in ill-defined problems the design process is not straightforward, switching between problem and solution occurs often. Furthermore a design is based on the stance of the designer, separate designers create different solutions to similar problems. Next, it was inquired how decisions are made and which parts of decision making could be supported. Thorough decision making is a very tedious and cognitive effort demanding task. Humans tend to shorten the decision process - consciously and unconsciously - by using all kinds of simplifications. It is expected that professional decision makers are more able to make tedious decisions, but still short-cuts in behaviour are found. As third, from the field of decision support system is found which systems already exist and which kinds of problems they address. Until now, not many systems have been designed to work in ill-defined areas like communication strategy design.

The decision support system was designed by some of the intended end users under supervision of the researcher. The Public and Communication Department of the Dutch government, which arranges all government communication also found that using academic knowledge could improve the effectiveness of their campaigns. Therefore, they issued a request to two social scientists to write a body of knowledge specific for their needs. This is called the Communication Development Model [30]. For this research this was ideal, as a body of knowledge was needed as knowledge of the decision support system and participants were needed to design the system. Both were found at the Public and Communication Department of the Ministry of General Affairs.

During several workshops the participants designed the system according to their needs. Care was taken by the researcher that the discussion was on a level which could be understood by non-computer specialists. Three main workshops were organised: during the first workshop the participants expressed their ideas by drawing on post-it notes and other paper; for the second workshops these ideas were translated to a paper prototype of the decision support system, this prototype was discussed with all participants; these ideas were implemented in a software prototype for the third workshop. The results from this last workshop were used to build a final prototype.

However, it is not the prototype that is the result of this research but the guidelines that are found in the design process. Guidelines specifically for the design of decision support systems for designing communication strategies. Five guidelines have been stated as conclusion of this research: involve the user in the design, show the complexity of the task, give support not answers, enforce justification of decisions and keep the work area small.

Prologue

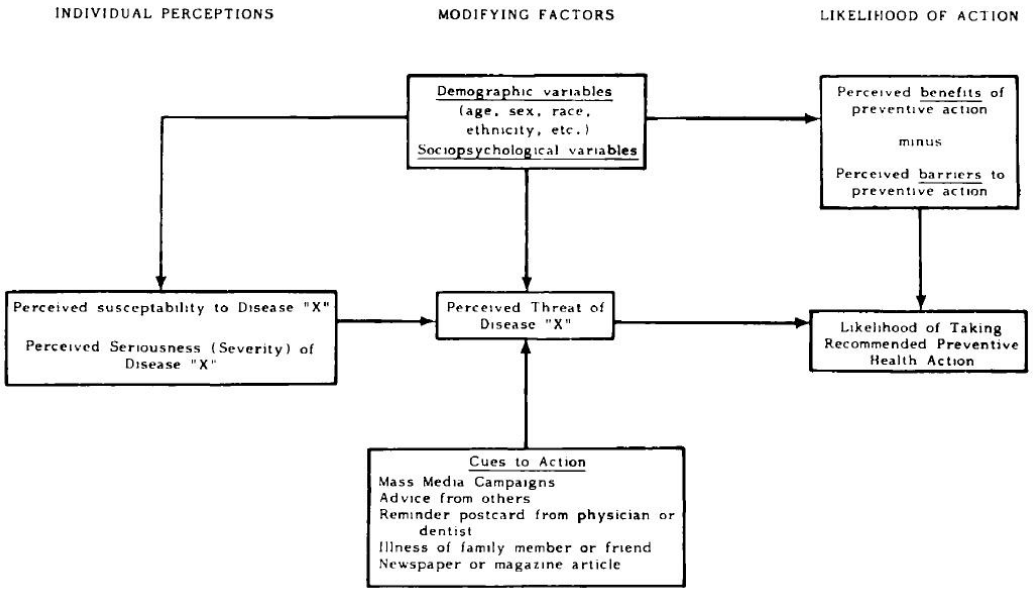

Figure 1: The Health-Belief Model [20].

The idea for the topic of this thesis arose from two lines of thought. First was, a course taken at the department of Computer Science of the TU Delft: 'Agent-Based Modelling'. In this course, agent-based techniques were used to create a realistic model of work practices; the model then could be used to simulate and optimise the current work flow. For this it is necessary that the work practice is broken up in separate elements - agents - which react on each other. Implementing all elements and their cohesion results in a model of which variables can be set, after which separate cases for input can be analysed. The input with the best outcome is the model which reflects real world practice the best.

Second line of thought came from the several courses on science communication taken in the past years. During those courses all kinds of theories from social sciences were discussed. Social sciences analyse human behaviour and interaction with the real world, some researchers try to grasp this behaviour in models. Note that these models are not necessarily the same kind of models as mentioned above, but the combination of the two is intriguing; is it possible to take the rather 'vague' models from social science and use them in an exact technical way as usually is done in computer science?

Take for example the Health-Belief Model as shown in figure 1. The result of this model is the likelihood of taking recommended preventive health action (the bottom box in the 'likelihood of action' column). Several attributes have influence on 'likelihood of action'. E.g. one box above are the 'perceived benefits of and barriers to preventive action'. Furthermore the likelihood depends on the 'perceived threat of the specific disease', which in its turn is influenced by 'demographic and sociopsychological variables' and 'cues to action'. For

this model, the 'cues to action' is the variable which can be controlled to some extent. For different demographic groups, different campaigns must be used; e.g. in several languages.

Is it possible to build a computer program around a model like this? A program which knows the way people behave towards health action and uses this to calculate the kind of campaign which must be designed, in this way combining technical reasoning from computer science with knowledge from social sciences.

Before starting the actual thesis I would like to extend a special word of thanks to Maarten van der Sanden of the Science Communication department of the TU Delft. As a supervisor he broadened the scope of the research and provided additional insights in discussions and lines of thought. Also, I would like to thank Alina Pommeranz and Pascal Wiggers of the department of Man-Machine Interaction and Ann van der Auweraert of the department of Science Communication for their supervision during this research. Furthermore, without the participation of the Public and Communication Department this research would not have been possible. So I am grateful to all people who participated in the research and the discussions.

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Introduction 1

The author of this thesis combined Science Communication and Computer Science in his master studies. Therefore, these two subjects are combined in one master degree project. The introduction gives a description of the line of thinking used throughout the thesis and how the problem addressed lies in both fields of research.

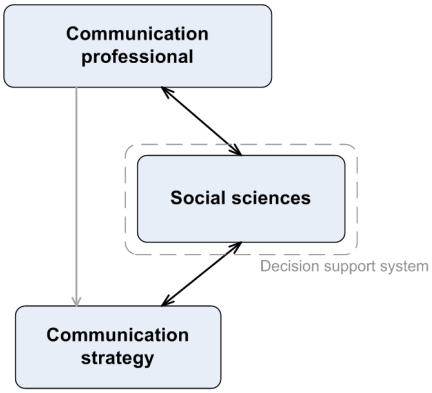


Figure 1.1: Communication professionals design strategies, these strategies could become more effective when knowledge from social sciences is accessible while designing the strategy.

The research conducted for this thesis is situated on the border of Science Communication and Computer Science. This makes that this research has a stance from which it approaches the problem. The problem itself lies in the disclosure of academic knowledge to communication professionals who themselves are not read up on this topic. How this research addresses this problem and where it exactly is situated will be explained in this chapter. After this introduction the research question will be stated and explained, and an overview of the thesis will be given.

1.1 Stance and problem of this research

Every research addresses a specific problem. Some of them are very clear, then finding a solution is tedious but straightforward. For this research the problem is clear, but the solution is one from many others. Therefore first the stance of the author and the view on the problem will be discussed.

1.1.1 Science Communication and Computer Science

The field 'Science Communication' considers how science can be communicated to the lay public but also communication as a science itself. This thesis addresses the science of communication 'communication science', especially how science and practice can be developed

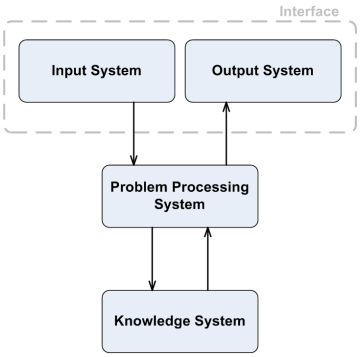


Figure 1.2: Basic architecture of a decision support system [5] - *interface block added by the author* -.

further and improved with the use of computer systems. Furthermore, in this thesis, communication science is seen as applied social science. Knowledge from several social sciences is used to find the best way of communication with the aim to change behaviour.

Professionalising communication is a core line of work in communication research for which several approaches can be chosen. Since the interest of the author of this thesis is, next to science communication, situated in computer science. A computer technological view will be taken on communication in the upcoming chapters. But what does it mean to take such a view?

Roughly said, there are two main steps to be taken. First knowledge from social sciences should be represented in such a way that a computer can reason with this knowledge; and second, a way must be found to transfer the knowledge from the computer to a user. In figure 1.2 is shown what the basic architecture of a software system could look like. The two bottom blocks represent the reasoning engine of the system, this is the part where knowledge from social sciences is embedded in the system. The upper two blocks surrounded by the dashed box, represent the interaction of the user with the knowledge. This part is therefore called the 'interface'.

It is not possible to take one of the two steps without the other, also it cannot be said that one step is more important than the other. At the same time it is not possible to consider them both in full in the same research. Especially when that research is bounded by time. For this reason, it was chosen to focus this research on the design of the interface. As it is not possible to test the interface without knowledge behind it, a reasoning engine will be developed; yet, the development will be very informal.

1.1.2 Communication professionals and academic knowledge

As said, it is believed that communication science can be professionalised by a software system. The system will make knowledge from social sciences easier to access for communication professionals. Is there a problem with the accessibility of academic knowledge then? Yes, there is. As is shown by Wevers and colleagues in [33]. They show that communication professionals who design communication strategies often do not base their design decisions on knowledge from social sciences. Usually, decisions are only based on prior experience, evaluation and pretests of commercials. Communication professionals do recognise the usefulness of academic knowledge, but often it is seen as too complex and not compatible to

real world problems.

The campaign managers of the Dutch government also saw benefits in using academic knowledge while designing government communication strategies. Therefore, they issued the request for a document which described useful theories from social sciences and ways in which those theories could be applicable in their daily work. This resulted in the Communication Development Model [30]. The communication professional uses the knowledge from social sciences embedded in the Communication Development Model [30] to design communication strategies, this is shown in figure 1.1.

Although the Communication Development Model [30] comprises necessary knowledge in a meaningful way and is specifically designed for the communication professionals of the government - campaign managers -; it is still believed that decision making based on this knowledge can be improved by a software system. Reasons for this are fully described in the next chapter, amongst those reasons are: humans do not have a stable preference and will make different choices on different days, humans tend to stop designing when a reasonable solution is found and considering all attributes and their values is too tedious for human designers.

Some of those problems, which mostly are normal human behaviour, can be prevented by using a software system. The system then supports the decision making process of the human. Therefore, the software product is called a 'Decision Support System'. As indicated in figure 1.1, the decision support system is of assistance in making knowledge from social sciences accessible.

As said, it is *believed* that a decision support system could be a solution in this case. Research on this subject has been done and is presented in this thesis. Inquired was how such a decision support system should be designed in order to be useful for the communication professional.

1.1.3 Research and design

This research is about how to design a product that designs communication strategies. Or at least, supports the design of communication strategies by supporting decision making. It was chosen to inquire this topic by actually designing the decision support system, so the method is design based research. The results will be a prototype of the decision support system and guidelines on how to design a decision support system for designing communication strategies.

It could be said that the guidelines are the conclusion of the research, whereas the prototype is a resulting side product. Guidelines must in this case be seen as a set of rules which must be considered while designing a decision support system for the design of communication strategies. The set will not be complete, but it will be a start for further research on this topic. The prototype was just called a side product, but that does not make it less important. As only a prototype can show the usability and usefulness of a product.

Intertwining research and design does make the thesis somewhat difficult to understand sometimes. Therefore, the design and the design decisions are discussed together with the results of the research in chapter 5. The conclusions of the research are also the conclusions of this thesis and can therefore be read in chapter 8. Furthermore, this thesis speaks of the researcher and the designer, they both refer to the same person, namely the author of the thesis. This terminology was chosen because sometimes design decisions for the decision

support system are made, whereas at other times the same person acts as a researcher within the same project.

1.1.4 Research setting

In this research it is investigated whether knowledge from social science can be made more accessible to communication professionals by the use of a decision support system. Therefore a body of knowledge and a group of communication professionals were needed. As said above, the communication department - Dienst Publiek & Communicatie - of the Dutch government issued a request for knowledge which could be useful for them. Because of this, the department was an ideal subject for this research.

The Communication Development Model [30] focuses on government campaigns which are designed to provoke a change of behaviour. For example: improving the use of bicycle lights by cyclists who drive at night. The selection of academic literature in the Communication Development Model [30] is therefore narrowed to theories about human behaviour and how behaviour can be changed. Full details of the model and the communication department will be discussed in chapter 3.

1.2 Research question

The result of this thesis will be a set of guidelines on how to design a decision support system for communication professionals. Because of the strong dependence on actual communication professionals, participatory design was selected as research method. More on this will be presented in chapter 4. First the research question:

What are guidelines for the design of a decision support system which improves the use of the 'Communication Development Model' by communication professionals while designing government communication strategies that aim to influence people's behaviour?

The main question is divided in some sub questions. The answers to the first of them will provide guidelines regarding the practical situation in which the system will be used and the professionals who will use it.

1. When and in which setting will the communication professional use the decision support system?
2. What does the communication professional expect from the decision support system?
3. Which part of the strategy design process can be supported by the decision support system?

The second set of answers focuses on guidelines towards how to embed knowledge from the social sciences and how to make usage explicit.

4. Which tacit knowledge from communication professionals, work bias and implicit practices can be made explicit by the decision support system?
5. Which knowledge, from the Communication Development Model, can be made accessible by the decision support system?

The third and last set of answers will provide a check on the found guidelines and the correct implementation of the Communication Development Model [30].

6. How do scholars from social sciences perceive the suggestions of the decision support system?

The first four of the sub questions will be answered by the research and design method. The fifth involves implementation of the Communication Development Model [30] in a software system, this will be done by the best knowledge of the researcher but will be an informal implementation. The last question will be answered by discussions with several of the authors of Communication Development Model [30].

1.3 Thesis overview

Before this research started, a literature study was conducted on the employability of decision support systems while designing communication strategies. This literature study consists of three main topics: design science, decision making and decision support systems. These topics are recaptured in chapter 2 the *theoretical framework* of this research. The highlighted topics in this chapter guided the analysis of the data.

Furthermore, this research is based on a body of knowledge from social science which is called the Communication Development Model [30]. This model was commissioned by the Public and Communication Department of the Dutch government. Since the knowledge from the Communication Development Model [30] was used as subject of this research and some employees of the Public and Communication Department participated in this research, the two form the context of this research. This is described in chapter 3 *research context*.

Together, those two chapters form an introduction to the concepts and terms used during the research and therefore in this thesis.

In the fourth chapter, the *research and design method* will be explained. This chapter describes the kind of research which is conducted and where the research method is originated. Also the process of the research will be considered in chronological order. After the technical details of the research there will be a discussion on the method.

After the research and design method, chapter 5: *results and design* will present the results from the research as design decisions. For each phase of the research the results are described and it will be showed how the results are taken to the next phase.

The design made during this thesis project will mostly consist of the interface of a decision support system. However, as will be showed in chapter 6, the *reasoning engine* is also a part that may not be neglected. Because a way must be found to put the knowledge from the Communication Development Model [30] in a system. Chapter 6 shows how this is done for this research.

After having showed how the prototype of the decision support system is designed, and after having explained how the system reasons; it is a good moment to actually see how the system could work. Therefore, chapter 7 describes *an example strategy design* which is designed with help of the decision support system.

As last, the sub questions will be answered and guidelines will be given in the *conclusion* of

this research, chapter 8. Thereafter the whole research and the conclusion will be reconsidered in chapter 9 the *discussion*.

Added tot this thesis are the following appendices with extra information: appendix A contains the whole literature study which is summarised in chapter 2; appendix B shows the model as used in this research with the accompanying values of the several concepts and appendix C gives a full explanation of all those concepts.

Theoretical framework 2

The thesis project started with a literature study on design, decision making and decision support systems. This chapter presents the major findings of this study and therefore can be considered as a large summary. For full details one is directed to the literature study, appendix A.

The body of the literature study is built on three main topics: design science, consumer decision making[1] and decision support systems. Those topics are recaptured in the sections of this chapter. For each of the sub topics a 'tag' was made. Those tags were used to analyse the data from the research. For easier reference, the tags will be shown in bold in this chapter and will be listed at the end.

2.1 Design science

The main stance of this thesis is that **designing communication strategies is an act of creative design**. Therefore, the analogy with other creative design fields is chosen as the starting point of the literature study. The distinction between creative design and more mechanical design is shown by the extent to which problems are defined. In creative design the problems are typically ill-defined, so goal specification and a requirements analysis alone is not enough to solve them. Additional information often needs to be found [19].

In fact, design stances is the first point mentioned. Janssen [19] showed designers have a **design stance**, their creative thinking is guided by their principles. Principles which cannot be discussed in terms of right or wrong. Two major designers can have complete opposite opinions on what is beautiful or not, but they can both be very good at their job. Designing cars suits as an example here. When one car is faster than another similar model, everyone has to admit the design of the first car is better on the attribute of speed (technological design). The discussion of which one of the two is the most beautiful is more difficult, people might argue on this subject without ever reaching an agreement. This last is typical for ill-defined design problems, since the designer has to come up with the attributes he is going to consider in the design.

When there is a problem, a solution must be found. Designing starts when a problem is recognised and designing is seen as the route which leads to a solution. Problem decom-

[1]No information about professional decision making could be found, therefore, concepts from consumer decision making have been used in the literature study.

position is one of the first steps. Naming and framing the problem sets the boundaries for the solution [31], the designer's personal way of naming and framing the problem is also referred to as the **problem paradigm** of the designer [13]. This paradigm can be different from designer to designer, depending on their before mentioned design stances.

To express the problem paradigm, designers often make use of known concepts [19, 24]. When explaining an idea, an architect can refer to known buildings which have similar design problems. This does mean the architect has to know a lot of concepts to express all his ideas, that is what makes him an expert in the field. However, it was also shown that expert designers **recognise information** when they see it [31] without actually knowing what they were looking for. So a search engine like Google would be useless, because with Google you have to know what you are looking for. For an architect, a book with known buildings is much more useful, only then it is possible to recognise the problem and with this possible solutions [1].

The route taken from problem to solution is not necessarily a one-way route. Based on the problem paradigm, a set of solutions can be found; when none of the solutions is satisfying, the problem might be reframed. When the architect needs additional ideas he might pick up his book again, recognise an other building as example and change the problem. Especially expert designers do have the tendency to first consider a broad range of possible problems - **breadth-first** - before going into the depth of one specific solution [18, 13]. However, Cross [13] adds to this finding that the distinction between breadth and depth first is not an easy one to make on this subject.

Novel design decisions occur when switching between problem and solution space [13, 14]. So **switching** has to be enabled by the decision support system. In practice, for expert designers it turns out that they like to work with small pictures. When a drawing is made on an A4-sized paper, the overall design, so the problem and the solution, can be seen in one view [24]. So a support system, to be useful, needs to provide **overview**.

2.2 Decision making and preference elicitation

As showed, designing means creating problems and solutions, a combination of those must be chosen as the end product of the design. Making the choice can be supported by a decision support system. Therefore, the second part of the literature study captures decision making.

Closely connected to decision making is preference elicitation. As a system which supports a decision must be aware of the preferences of the user. The system can just ask them you would say; but it turns out that they way you ask the question has high influence on the answer. So elicitation of preferences is also subject under consideration in this section.

Bettman and colleagues [4] suggest the **Weighted Added Strategy** as the normative decision strategy. In this strategy, an importance weight is assigned to each attribute affecting the decision and the decision maker assigns a subjective value to each attribute for the alternative considered. The sum of products of weights and values is the importance of the alternative. The alternative with the highest value should be chosen. One can see that this strategy is very effort demanding as all attributes, which can be hundreds, must be considered. Therefore, human decision makers will often consciously or unconsciously use an easier decision strategy.

This because humans aim to reduce the effort of their work. Unfortunately, this **effort**

reduction does make them more susceptible for salient attributes; attributes which are not necessarily most important for this decision [4]. Especially when put under large cognitive loads and when a person is less experienced in the choice domain, his willpower of considering all information will decrease [25].

On the other hand, differences can be found in expert and novice behaviour. Knijnenburg and Willemsen depict that attribute-based preference elicitation works for domain experts [23]. This supports use of the weighted adding strategy in decision support systems for domain experts. However the user must understand how and on which attributes his preference was constructed [11], otherwise they will be reluctant to use the suggestion of the decision support system which is based on this preference. Therefore the system must keep the **human in the lead**.

Another aspect of preference elicitation is that decision makers are mostly not able to come up with preferences beyond their basic ones [29]. Luckily, they are very well able to criticise on suggestions. It is stated that perceptions of people are attuned to noticing changes, rather than absolute magnitudes of decisions and outcomes [4]. This means, **example critiquing** can reduce biases which are not recognised by the decision maker [16]. Also discussing a decision and making sure that a decision is made in a group reduces the danger of salient information or biases [25].

A decision should be based on the preferences of the decision maker, so when a decision support system assists the process of decision making, it needs to be aware of the human's preference. However, it turns out that **preferences** are not stable; they are **constructive and adaptive** by nature [4, 11, 21]. Bettman and colleagues [4] provide two reasons for this constructive nature: first, humans lack the cognitive resources to generate well defined preferences for many different situations; and second, multiple goals are brought to a given problem. This problem becomes even larger with the rising complexity and amount of products to choose from - recall that these statements come from consumer decision making -. Because decision making can be influenced by many factors, cognitive processes must be supported in such a way that the outcome of the system actually matches the preference of the decision maker. So how to support decision making in a professional setting?

According to Carenini and Poole [11], **decision making can be divided in three steps**: identify alternatives, specify values for evaluation and apply the values in choosing. By broadening the information gathering and decision making scope the decision can become better [16]; however, if too many elements are considered, the framework is compromised [4].

Different ways of framing the problem and solution can influence the decision [4]. Designing can be framed by the problem paradigm of the designer [19, 13], but framing can also cause a negative or positive bias on the decision. Like, reducing the amount of negative trade-offs reduces negative emotions in the decision [4]. The same authors state it is critical to understand the aspects of focus of attention, as a salient attribute can have a negative or positive impact on the choice.

As well as in design theories, a complete overview of the solution is considered to be important in decision making. On the other hand, this does not hold when the solution contains too much detail and attributes influencing the decision must be explicit in the solution [29]. This suggests that a complete but comprehensible **overview** is necessary for a good decision support system. In this way, the effect of a trade-off is made explicitly visible [21]. When visualising is not possible, like in probability outcomes, an analogical visual

experience should be sought [21].

The moment several designers, decision makers, are working together it is likely that they have conflicting paradigms. Even when there is agreement on concepts it is possible that two designers assign a different meaning to the concept, explicit and agreed on **meaning of concepts** should therefore get high attention in support of decision making [12, 16]. Moreover, use of the wrong elicitation tool can circumvent considering alternatives [29]. It should be recognised that there is no path procedure to guarantee that all attributes are taken into account [12].

2.3 Decision support systems

Decision support systems support and improve managerial decision making by connecting the intellectual resources of the individual with the capabilities of the computer [6]. Especially semi-structured problems can be solved with such an approach [8]. In those effort demanding tasks the decision support system should help where necessary, such that the combination of the human and the computer is better than one of them alone [9, 10].

Marketing science was one of the early adopters of decision support systems. Since the 1960's several systems have been developed in a wide range of specialised disciplines. Nowadays, no one approach has been adopted yet [8]. Only some common features can be defined. Like, a decision support system must be easy to understand and pleasurable to work with and it must provide the needed information. Roughly said a decision support system has an interface, which defines how pleasurable it is to work with the system, and a reasoning engine which defines the accessibility knowledge. For a decision support system to be used, the interface must be well designed and the reasoning engine must be well engineered. This thesis focuses on the design of the interface, leaving the reasoning engine as a subject to be considered, but therefore not a subject of less importance.

By regarding design and decision making as addressed above, one can see which parts of the design process must be supported. Reducing cognitive load and decisional stress can be attained by a support system, but goes together with the **usability of the system**. Generally, a decision support system is perceived as more accurate when it is easier to handle [2]. A decision support system which is too restrictive or takes control of the decision process will not be perceived as **useful**, so again the human has to stay in the lead [7, 8].

Furthermore, use of a decision support system is typically optional, therefore the user needs to see the **apparent benefits** [10]. Arnott and Dodson discern six categories for measuring system successfulness [6]: usability of the system, usefulness of the accessible knowledge, system use by intended user group, user satisfaction and the impact of the system on the individual and the organisational level.

For a system to stimulate the creative process of design, it is important to keep up the intrinsic motivation of the designer [7]. A decision support system has several ways to encourage - creativity in - design, such are: encourage discussion, reduce problem complexity and encourage consideration of alternatives [7, 8].

A core task of the decision support system in the design team is provide a **stable reasoning basis**. By being consistent on provided information and suggested solutions, it becomes easier to compare the several solutions. In this way, the designers behave less arbitrary

[5, 10]. Still, the support system also has the ability to do the effort demanding tasks and can provide a good documentation of the choices.

2.4 List of tags

The theory from this chapter was used to tag the data from the research. The tags, which were shown in bold in this chapter, are repeated in the list below.

1. Designing communication strategies is an act of creative design
2. Design stance
3. Problem paradigm
4. Recognise information
5. Breadth-first
6. Switching
7. Overview
8. Weighted Adding Strategy
9. Effort reduction
10. Human in the lead
11. Example critiquing
12. Preferences are constructive and adaptive
13. Three steps of decision making
14. Meaning of concepts
15. Usability of the system
16. Usefulness of the system
17. Apparent benefits
18. Stable reasoning basis

Research context 3

This research was conducted at the Public and Communication Department of the Dutch government. The department, being responsible for all government public communication, is constantly searching for ways to make communication strategies more effective. Applying academic knowledge from social sciences is expected to be a step which improves effectiveness. Since the department did not have this knowledge themselves, scholars from social sciences were asked to write a model which would suit their needs. This model was used as the reasoning engine of the designed decision support system, the users of the model participated in this research.

Dienst Publiek en Communicatie
Ministerie van Algemene Zaken

In this chapter, first the department and de several participants of the study will be introduced. The second section will give a summary of the Communication Development Model [30] and here will be indicated which parts have been used in which manner. Because the research was conducted at a department of the Dutch government, the name of the department but also all the discussions and therefore the data are in Dutch. All used terms have been translated by best knowledge of the author and *van Dale* on-line dictionary. Were deemed necessary, the Dutch translations of terms will be provided. Furthermore, most of the information in this chapter comes from the preliminary analysis by Van Essen; her part in the department and therefore in this research will be discussed in a moment.

3.1 Public and Communication Department

The Public and Communication Department - *Dienst Publiek en Communicatie* - is part of the Dutch ministry of General Affairs - *Algemene Zaken*. The department is responsible for all communication towards the general public or sub groups of this public, mostly done by campaigns known in the Netherlands as 'Postbus-51'. Government campaigns can be started to inform people, like: "Do not forget to fill in your tax form before April."; also, campaigns can have the aim to influence the behaviour of the public: "Do not become a sleeping driver.". Most often, some policy goal or national need is the origin of the campaigns. This can be because of the change of a law or just to call to mind an existing one, which is the case in the tax example. The other example refers to road safety, which is a national benefit.

Within the department several kinds of employees can be found, in this research most work

was done with four of the campaign managers and the chief of the campaign research division; so in total there were five participants. All of them are treated equally in this thesis and referred to as: communication professionals, participants in the study, campaign managers or campaign researcher.

The campaign managers in the department are divided in three groups: junior, medior and senior campaign managers; although the term medior is not actually being used. Basically, the higher the title, the higher the level of work which is done by the manager. The junior managers usually only do organisational work and no strategic design, therefore, no junior campaign managers were participant in this research.

Roughly, campaign managers function as an intermediate between the ministry which has the need to communicate - so the ministry of Finance for the tax example - and the marketing agency which will create the actual campaign. There are three main possible situations for the design of each strategy. In the first case, the people at the ministry exactly know what is needed and give a very clear assignment to the communication department. The campaign manager will then only make sure the assignment is passed on to the marketing agency which will make a commercial, poster, etc. In the second case, which occurs more often than the first, the communication department is only given a policy goal and the campaign manager has to make the decision for the kind of strategy to use. The third and last case occurs most often, the marketing agency designs the whole campaign and therefore also makes the decisions for the campaign strategy.

The task of the campaign researcher is to evaluate the effectiveness of campaigns and to do preliminary research on campaigns. E.g. when the opinion or the size of a target group is not known, the campaign researcher can start a public survey to gather this knowledge. It is known that the effectiveness of most communication campaigns is rather low [30], especially when the goal of the campaign is a lasting change of behaviour. Believed was that better usage of social sciences could help in improving effectiveness of campaigns; but, the campaign managers, who have all kinds of backgrounds, are not educated on these particular sciences. Therefore, the Public and Communication Department has issued the Communication Development Model [30], which will be thoroughly explained in the next section.

Before the explanation, there is still one person to introduce, as promised above. It was acknowledged that just launching the model within the department would not be advisable. Introduction of a new concept in an existing work environment almost always needs some counselling, because humans usually do not like it when there environment suddenly changes. Although campaign managers are constantly changing behaviour and environments, they too are humans. Therefore, Van Essen was asked to introduce the Communication Development Model [30] in the communication department. She is a student of one of the authors of the model and has experience in communication science. Van Essen organised, among other things, several workshops of which some are used as preliminary analysis of this research, actually the information presented above is based on this analysis.

3.2 Communication Development Model

The effectiveness of government communication campaigns currently has high attention. From the campaign evaluation of 2008 can be read that the government is rather successful in transferring knowledge: “Pay your taxes before April.”; but rather unsuccessful in changing behaviour: “Do not become a sleeping driver.”. On the other hand, ministries more and

more evaluate success of campaigns on behavioural change. Based on scientific literature and experience from previous campaigns, it is known that there are possibilities to change behaviour with mass media campaigns. However, the communication department did not know how. Therefore, relevant academic knowledge and experience from previous campaigns is summarised in the Communication Development Model [30] - *Communicatieontwikkelingsmodel* -.

The Communication Development Model [30] is an ideal case for the design of the decision support system in this thesis project, as the relevant scientific information is already gathered in a model. At the start of the practical part of this research, around February, the model had been developed up to a concept version which already contained most of the necessary knowledge. The concept was improved along with this research, so some definitions and names of concepts used in the model did change. Because of this, some of the used terms change throughout this thesis; mostly, minor changes for better clarification were made, so it is believed that the changes did not affect the research. There was even a benefit of the fact that the model was developed during this research as the scholars who wrote the model were also involved in this research. This was in particular useful for answering the sixth sub question: *'How do scholars from social sciences perceive the suggestions of the decision support system?'*. Also, the campaign managers from the Public and Communication Department saw benefits in cooperation with this thesis project, because designing a decision support system does give an other - external - view on the Communication Development Model [30]. Therefore, it was chosen to take this case as subject of this research.

Next, a summary of the Communication Development Model [30] will be presented. This mostly describes the parts that were actually used in this research or which are necessary to know for a full understanding of this thesis. For the complete model one is referred to the Public and Communication Department. In figure 3.1 the model as described in [30] is shown - unfortunately there is no English version, therefore the upcoming paragraphs will provide the Dutch translations of concepts -. To start with, the Communication Development Model [30] can be read in two directions: from right to left, the model works as a development and analysis tool; from left to right, the functioning of the model is described. The model will now be explained from right to left.

The rightmost box describes the desired situation, mostly referred to as the desired behaviour. This behaviour is based on an initial action and in some cases should be enduring. Furthermore, the behaviour can be impulsive or reflective and is influenced by the environment - *omgeving* - in which the behaviour is conducted. The behaviour is analysed by use of determinants of behaviour - *gedragsdeterminanten* -, which can be put on a scale from more unconscious to more conscious behaviour; but, as will be shown in the results chapter, behaviour can consist of both conscious and unconscious parts. In their turn, determinants are influenced by a set of mechanisms which define the communication strategy. A strategy further has a susceptibility - *ontvankelijkheid* - factor. And, a strategy can either be explicit or implicit; and, as will be shown, parts of both. As last, the leftmost box describes the undesired situation, or undesired behaviour which also can be analysed by the determinants of behaviour. When the same thing is read from left to right, the functioning of the model is shown.

Unfortunately, implementing the complete model would have been too much for the scope of this thesis, as the focus is on the design of the interface and not on the reasoning engine.

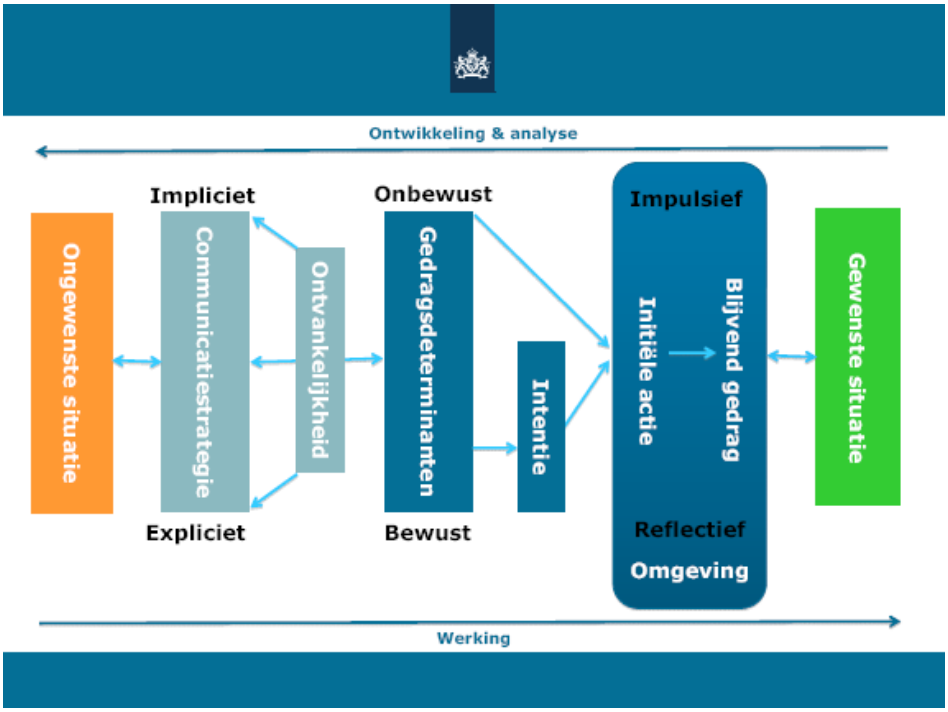


Figure 3.1: The Communication Development Model as described in [30].

Therefore, a simplified version was used as basis for the reasoning engine of the software prototype. Appendix B gives a visual representation of the determinants, links, and mechanisms as used in this thesis - only in Dutch -. Appendix C gives an explanation to each of them and how they have been used in the decision support system and chapter 6 will elaborate on the technical details of the reasoning engine. Now first will be explained what the concepts are. As said, the Communication Development Model [30] was in its final development stage during this research, therefore some of the names of determinants, links and mechanisms change between the several workshops. Presented here are the concepts as used in the final software prototype which are described in the concept version of the model of 18 May 2011 [30].

Determinants of behaviour

The determinants of behaviour - *gedragsdeterminanten* - are as their name says, the deciding factors for the analysis of behaviour. For both, the undesired and desired behaviour, problem specific determinants should be defined. Take for instance the problem of 'the sleeping driver' mentioned above. Too many people drive whilst being too tired. The problem formulation could be that people do not think about how they feel before driving a car. This means that taking the car is defined by the determinant *Habits and Automatisms - Gewoonten en Automatismen -*, according to the model this determinant can be influenced by certain mechanisms. Of course there can be more than one determinant for each kind of behaviour.

Each determinant of behaviour has four attributes. The first two, *unconscious - onbewust* - and *conscious - bewust* - describe how conscious or unconscious the behaviour is. The

researcher used a four point scale - $0, 1, 2, 3$ - to define the amount for each determinant; this information was taken from the document describing the Communication Development Model [30], but one of the authors of the model mentioned that it was only put in as an indication. So the numbers are not meant to be used in such an exact manner. The third attribute describes to which extent the determinant can be changed; either *changeable - veranderbaar* - or *partly changeable - deels veranderbaar* -. The fourth attribute describes in which phase of behaviour a determinant can be used. The three phases are: *preparation of behaviour - voorbereiding op gedrag* - which means the determinant is used before the actual behaviour is enforced; *first/initial behaviour - eerste gedrag* - which is the start of new behaviour or the start of a change of behaviour; and, *lasting behaviour - duurzaam gedrag* - which means behaviour is internalised in the all-day habits of the influenced target group.

Some of the determinants of behaviour have more than one layer of complexity, for ease of use, only the top layer was considered in this research. Also, for each determinant a short summarising text was written by the researcher of the decision support system. This text was used as short explanation in the prototype. For a full lists of the determinants and their attributes see section C.1.

Mechanisms

The mechanisms - *mechanismen* - are a description of the action which can change behaviour. For the tax example mentioned above, it is possible that the mechanism *Knowledge transfer - Kennisoverdracht* - is used to remember people of returning their tax form. In this case, the mechanism only remembers the public that something has to be done. So additionally, *Implementation of intentions - Implementatie van intenties* - could be used to actually motivate the public to perform the behaviour.

The mechanisms are divided in three routes, which refer to more impulsive or more reflective behaviour. In the central route, the mechanisms are placed which take action in a very reflective way. So the subject knows that he is being influenced and rationally chooses either to comply with the influence or not. The automatic route contains mechanisms which take action in a very impulsive way. So the subject is usually not aware of the influence. For instance, the mechanism *Scarcity - Schaarste* - is often used in commercial stores, advertisements with sentences like: "Only a few left.", get the customer to buy products without much thought. This then becomes an impulsive purchase. The third route, the peripheral route, lays between the central route and the automatic route. The mechanisms in this route as well can be used in an impulsive and as in a reflective manner.

Likewise determinants, mechanisms are described in more detail and with more levels of complexity in the original document. Also for each of the mechanisms a short explaining text was written by the designer of the decision support system. Descriptions can be found in section C.2.

Links between determinants and mechanisms

The links are used to connect determinants to mechanisms and vice versa, they are indicated as lines with Roman numerals in appendix B. To emphasise, there is no one particular direction; links are meant to connect determinants to mechanisms but also the other way around. All links can be found in the original document, but they too were not meant to be interpreted this literally. But since the system needs some connection between determinants and

mechanisms, the indicated links were the best which could be found.

Each link consists of six attributes. Those attributes are *conscious - bewust -, unconscious - onbewust -, relevance - relevantie -, attractiveness - aantrekkelijkheid -, susceptibility - ontvankelijkheid -* and *possibility of speech - praatpotentie -*. Chapter 6 will explain how the system makes us of these attributes. Here only their denotation will be explained.

Relevance is the extent to which the problem or the change of behaviour is relevant to the performer of the behaviour. For instance, for someone with obesity, a campaign for healthy food or more exercise is relevant. On the other hand, most obese people are not susceptible to information about healthier food. This is indicated by the *susceptibility* attribute of the link. The next attribute, *attractiveness*, indicates whether a topic can be made more attractive in some matter. Take for instance the tax example again, being remembered of taxes is not attractive; but when the same commercial also states which tax-deductible expenses exist, filling out tax forms becomes more attractive. The last attribute is *possibility of speech*. Which indicates the extent to which persons in a target group will speak about a subject to each other. A very attractive subject will be discussed a lot, whilst a dull or unmentionable subject is not spoken about at all. For some topics it is possible to raise the speech possibility by attaching them to other more interesting topics.

For all attributes, values have been set on a four point scale - $0, 1, 2, 3$ -. All values have been set by and at the best knowledge of the researcher, but it was also taken into consideration that values of separate links would lead to different outcomes.

3.3 A short overview

After having read this chapter, the exact details of the Communication Development Model [30] still will be somewhat confusing. Especially for those who have not seen the model working yet. Therefore, an example scenario is added to this thesis as chapter 7. Also, the thesis has a stance, a way of looking at the model. As holds for all stances, this one is not the only correct one. Discussions among all parties involved have shown that there are more interpretations.

As the end of this chapter, a simple - perhaps too simple - explanation will be given of how the determinants and mechanisms interact with each other. From this simple explanation, one can distract the more complex way in which the model works.

At the start of the design of a new campaign always lies a kind of problem. A current situation which is undesired and should be changed into a desired situation. The undesired and desired situation in this case are undesired and desired behaviour. This behaviour can be determined by the determinants of behaviour. After having selected the determinants which depict the behaviour, the model shows which mechanisms can be used to influence on the behaviour. In appendix B is shown how the determinants are connected to the mechanisms.

The model also works the other way around. For a certain campaign, the campaign manager has some mechanisms in mind he wants to use. He now can use the model to check which determinants connect to the mechanisms he has in mind. In this way checking if he is still on the right track, as it could be possible that unexpected determinants come up. This means that the campaign manager has to reconsider the chosen strategy or he has to be able to give an explanation of why his choice is right and the model is wrong. The latter case is certainly possible as the model cannot give a clear answer to all problems.

The decision support system designed in this project roughly works the same as described above. The user selects determinants and mechanisms and answers some question about the policy goal, the behaviour and the target group. The system will calculate the values and then provides the links between determinants and mechanisms which seem most useful as suggestions. The campaign manager has to consider the correctness and can use the suggestions to base his decision on.

Research and design method 4

This research was conducted while designing a decision support system with a group of the intended end users. Therefore it is a research method as well as a design method. A design method during which something will be designed that also designs itself; hence, designing a designer.

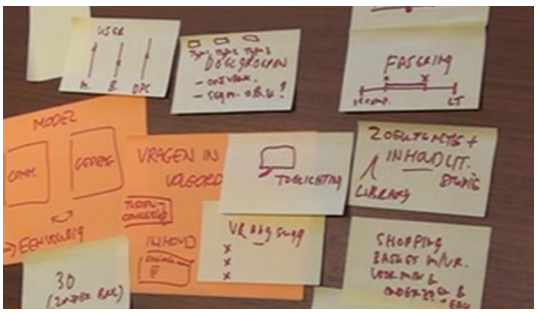


Figure 4.1: The text balloon indicates the need of an explanation device.

The research conducted in this thesis project belongs to a kind of research which is also called design based research. The first section in this chapter will explain where the research method came from and how it varies on existing research methods. In the next section, the process of the research is described together with an overview of what happens in each phase and where the most important steps are made. For validity, the rigour of this research is described in the third section. As last, a discussion on the used research method is provided.

4.1 Design based research

The goal of this research is to develop a set of guidelines to implement a decision support system for designing communication strategies. The decision support system is in this case a software system. Which means that the research is situated in the field of software design, software which has to be embedded in a professional work environment. Nowadays, many people have experience with computers and their software, yet, not all those experiences turned out well. In fact for software designed to be used in specific work environments, failure rates of 80% are reported for decision support systems [6]. So four out of five programs, which usually are intended to make life of the professional easier, are not being used. Reasons for this are that the software is too difficult to understand or has too many options - both do not make life easier -, but also, software often just not fits in the work environment where it is supposed to be used - so it supports processes which do not need support and/or does not support processes which need support-. How come?

4.1.1 Software design

Bluntly stated, one could describe the traditional process of software design as follows:

> *A software engineer will ask the users what kind of system they need - the requirements analysis -. These requirements will be written down by the engineer, but also, they will consciously or unconsciously be interpreted. The engineer will build the system following the requirements and brings it to the users; work is done.*

Of course, this short story is over-simplified and even could be called ridiculous, but it does show some important aspects. First, the software engineer is not the end user. So the engineer will have to ask the users what they want the system to be capable of, but also 'how' they usually do their work. Especially for systems which are intended to work in some kind of professional environment, the engineer has no knowledge of the work itself. On the other hand, professionals can be very good at their work, but they usually have no clue of what designing software means. So there is a gap between the engineer and the user of the software, as they both do not understand each other's work.

Second, the engineer can ask the users what kind of system they would like, but it is very hard to elicit tacit knowledge of the users, the engineer has to interpret what he is being told. Again, in professional work environments the problem of tacit knowledge is even more present because this is the kind of knowledge which is also referred to as 'experience'. This distinguishes the novice professionals from the seniors. In most professions it takes years to become an expert, so being an expert is not something that cannot be elicited by some questions. As an example, try to describe your own work situation. Describe it exactly, because it has to be supported by a software system, the software has to know every step you take. An hour after having written down your work situation, you will probably find out you have missed a step. The moment you do a task you might think: "I haven't written this down in my description.", and you will have to add it. Exactly for this reason, a requirements elicitation is almost never complete.

The third aspect is shown by the last sentence of the short story. The engineer builds the whole system and brings this to the end users. They either use it or, probably, not. This, because the user is not involved in the system given to him. There is no bond between the user and the system. Furthermore, the last sentence shows something that can also be read in the literature study: after having finished the product, the designer is usually not called back when issues arise [15].

As said, above story is a rather bigoted way of describing software engineering. Most of the mentioned problems can already be solved by having iterating the design process. So, elicitation - building - testing - building - testing - ... - product. In this way, the end users see the product more often and the chance that misinterpretations of the engineer are recognised becomes bigger. Still, it is the stance of this thesis that more can be done.

4.1.2 Participatory design

Muller [26] speaks of involving the end users in the decisions that have influence on their work lives. Not only give them the chance to provide input, but also have them make the decision. Since the design, the end product, has to improve their work situation. This kind of design, where the user is also a member of the design team, is called *participatory design*.

The first idea of using participatory design in this project came from the work of Pommeranz and her colleagues on preference elicitation interfaces [27]. This is again based on

the theory that preferences are not stable [4]. Preferences seem to be constructed the moment they are asked for, many influences can make that the preference on one day is different from the preference on another. More on this topic was presented in the literature study (appendix A).

4.1.3 Varying on PICTIVE

Participatory design is still a rather broad term and can include many methods. This particular research was based on Muller's PICTIVE [26]. Muller aims to empower the users to act as full participants in the design, to improve knowledge acquisition and quality of the resulting system by including people with job expertise and to improve the flow of the software engineering process by bringing representatives from that process in the design phase[1].

Originally, PICTIVE means that the participants have a brainstorm session about the design and use low-tech objects to express their ideas. The low-tech objects can be anything: pens, plastics, post-its and many more. These low-tech objects are used in such way that everyone understands what the group is talking about and anything can me made. So the software designer is not stuck in his usual thinking in frames, buttons and panels and the users are not bothered with jargon they do not understand. An example of this is shown in figure 4.1, were the users indicated that they would like some kind of explanation device and drew a text balloon to show how they imagined this device.

In this research a variant on PICTIVE was used. The participants only made use of post-it notes and pens, so they had to draw or write down anything they would like. Furthermore, during the open minded workshop - further described below - the participants were asked to come up with their own ideas and thoughts; without being given any visual hints or thoughts beforehand. This approach was based on the experience of Pommeranz [27], as she found out that the participants had problems with thinking outside the ideas that were initially provided.

Although the end users of the product and the researcher are all equal members of the design team. Implementing the prototype and analysing and preparing the workshops lies in the hands of the researcher. He will therefore make the design decisions, which are then checked and reconsidered in a discussion with the whole team.

4.1.4 Participatory design is research

An important part of participatory design as a research method is the design process. The resulting artefact is a design, but 'to design' is also verb [17]. In this method, most of the information comes from the road towards the artefact. Analysis of the process first brings up the tacit knowledge, second finds recurring topics - which therefore must be important - and third ensures the validity of the designed artefact. Recording and analysing the process therefore gives as much information as the design itself. A video camera captures the growth of the product, adding, removing and altering elements and records the discussion that goes

[1]Software engineering is mostly done in a group of engineers, together working on one project. Mostly, only a couple of them are designers, the rest builds whatever asked. The designers might not always know what is technically possible and the builders might misunderstand the assignment. By involving the builders in the design process, just like the end users, everyone has a clear idea about what the end product can and must do. In this research the software engineering is done by one person so the problem of misunderstanding within the software engineering group will not arise.

along. The resulting film then can be tagged for recurring subjects and extraordinary or expected results.

In other words, participatory design is a qualitative research method. It is "...a way to understand knowledge by doing:..." [32]. Spinuzzi sees tacit knowledge of those who develop and work with technologies as the subject of study of participatory design. He further states that: "Tacit knowledge, which is typically difficult to formalize and describe, has tended to be ignored by the theory of cognition that has tended to dominate human-computer interaction:..." [32]. So tacit knowledge is already a difficult subject to address for software designers. This specific case in which only ill-defined problems arise makes this issue even more prominent.

4.2 Research process

In figure 4.2 a graphical process overview of the whole thesis project is given. The project is split up in five separate phases, each phase contains a specific part of the design process, those will all be considered below. The light - blue - boxes were workshops in which the campaign managers and the researcher participated together. The darker - green - boxes show the parts of the thesis project which were undertaken by the researcher alone. Furthermore, the arrows indicate the way in which information from the previous workshop was used as input for the following workshop. So the arrows show when design decisions were made by the researcher.

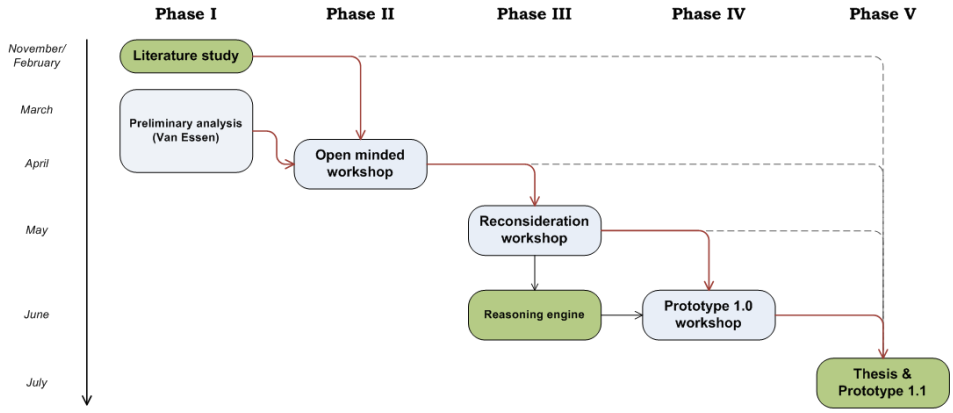


Figure 4.2: Outline of the thesis project.

The three workshops: 'Open minded workshop', 'Reconsideration workshop' and 'Prototype 1.0 workshop' were the data collection moments of this research. Results of those workshops will be discussed in the design and results chapter (chapter 5). In the next sections the specifics and goals of each workshop are considered. - Please note that all the workshops took place in Dutch, where citations from the workshops are used, they have been translated. -

4.2.1 Preliminary analysis (Van Essen)

To start the project, it was necessary to get an idea of how the campaign managers undertake their job. The design method is chosen in such way that the end users will do the designing, and therefore the system inherently fits in their work context; however, that is an ideal situation. In practice it is good for the researcher to be familiar with or at least to have an idea of how the users do their work. Likewise, it is good that the users, professionals, themselves know what they are actually doing and how they are doing it. (These problems were also described in the software engineering section above.)

Since the design of the decision support system took place in the bigger picture of the introduction of the Communication Development Model [30] at the Public and Communication Department of the government. The preliminary analysis activities were organised by Van Essen, who has the task to implement the Communication Development Model [30] in the organisation. This means the model is presented in such a way that it suits the needs of the users. Still, the users need to adapt some of their work to the model. This is about the same problem as the introduction of a decision support system, both the projects need to be aware of the current workflow of the professionals. Therefore this research used the work of Van Essen as a preliminary analysis.

Organization

Van Essen started with some propositions as warming-up exercise. The propositions dealt with the position of the campaign manager between the department which has a communication problem and the marketing agency which has to design the actual commercials, slogans, etc. The two propositions were: “Currently, I am the sparring-partner for the departments when designing a new strategy.” and “Currently, I am the sparring-partner for the marketing agencies when designing a new strategy.”. So the question was to which extent the campaign manager feels he is able to discuss the content and the form of the strategy with the stakeholders.

The third proposition was: “The campaign manager takes the lead in facilitating the process of designing a strategy; he does not design the strategy himself.” So here the question is asked whether the campaign manager actually needs to be able to discuss the content of the strategy, or that he is just there to make sure that all boundary conditions are met.

For each of the propositions the participants expressed their extent of agreement on a kind of thermometer. They who agreed with the proposition indicated a high temperature, they who disagreed indicated a low one. Also, it was possible to be somewhere in between. So the participants did not need to be ‘for’ or ‘against’ the proposition. After everyone indicated his opinion there was room for explanation and discussion.

Next, a longer discussion was initiated about the question: “What makes a strategy a good strategy?”. And a second discussion took place on the question: “Which role does the campaign manager have in designing the strategy?”.

For both discussions, the participants first had to write down their answers to the questions on post-it notes. The several answers were gathered and grouped. Grouping the answers already resulted in disagreement and discussion. Which was of course the goal of the exercise.

Details

Above activities took place in one of the campaign managers' meetings and took about one and a half hour. Participants were not only junior, medior and senior campaign managers, but also other professionals from the organisation.

The results of this workshop were gathered and written by Van Essen and will be presented in the design and results chapter (chapter 5). After these results, the implications for the design of a decision support system are discussed.

4.2.2 Open minded workshop

The workshop for data collection was cut in two separate assignments. During the first half the participants were asked to think freely, so without taking in consideration of what is possible or not. In the second half, some ideas of the researcher were presented. These ideas did consider the information needs of the system and the ways in which interaction with a computer can take place. The workshops will be presented next, their results are again to be found in the design and results chapter.

User's ideas

During the first assignment the participants were asked to design their own system without any limitations. Guiding questions were stated, like: "What information do I expect to get from the system?", "How should the information be presented?" and "What extra features must the system have to be useful?".

The participants got pens and post-it notes of several sizes. They could write their idea down or draw the button or feature in the way they saw it. These drawings were put on the table within the view of a camera. Also, the participants were asked to think about the position of a feature, should it be in the centre of the screen because it is important; or is it a feature of minor importance which can be brought up when needed.

After this first half of the workshop the groups presented their designs to each other. In this way they were forced to explain and motivate their ideas.

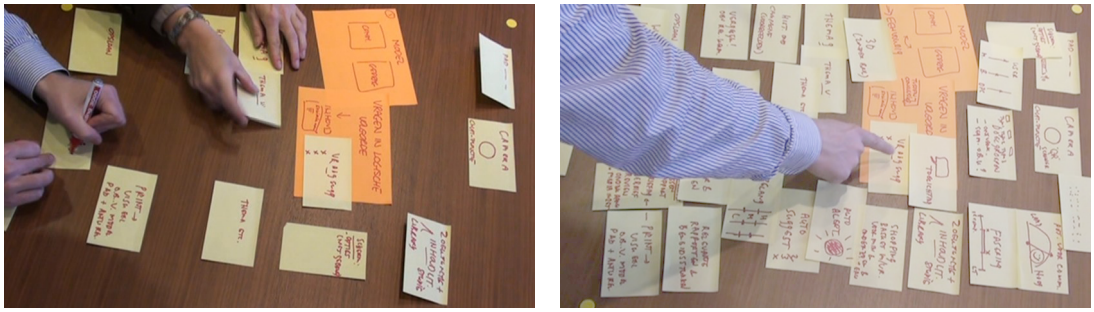


Figure 4.3: Screen shots from the first part of the first workshop, the process halfway and one of the end results.

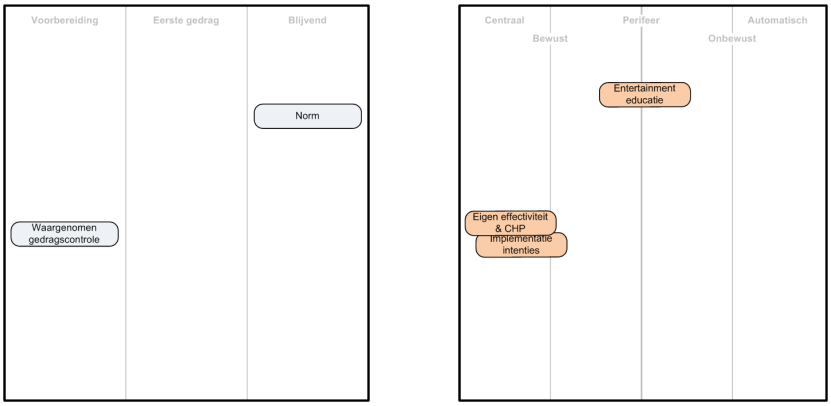


Figure 4.4: Interaction screens. In this idea it was possible to put a determinant e.g. 'Norm' high on the screen when it was considered to be important; the decision support system would then move up the connected mechanisms, in this case 'Entertainment education'.

Researcher's ideas

The next part of the workshop started with a presentation by the researcher about his ideas. These ideas were based on the preliminary analysis, the literature study and the Communication Development Model [30] (in the version of that moment). At this point already more consideration was taken on what kind of information the system needs and how interaction between the user and the system can take place. The researcher's ideas are presented next.

The ideas were presented as two extreme situations. On the one end, there is a system which just asks the questions that come with the Communication Development Model [30]. The answers could then be given in such a way that the computer understands them: numbers, slide bars or several choice options. On the other end it is possible to provide the elements of the model in a visual way. Indicating their importance by putting them higher or lower on an axis of importance, the system could then give direct feedback by moving connected elements up or down, this idea is shown in figure 4.4[2].

The background of these ideas is that a system needs a variable to deal with. Such a variable can be yes or no, but also a number of importance on a one some scale. Here one of the difficulties of the connection between ill-defined problems and solutions and a computer system becomes really visible. Where the strategy designer likes to think in terms of 'a little bit on emotion' and 'high importance on rational', the system needs emotion: 1, rational: 5; hence, exact answers. For the participants of the research this meant that they had to choose between an 'analogue' slide bar, on which all the values between one and five would be possible, or a discrete input manner where they can only choose one, two, three, four or five.

Next to the two extreme options, an idea was presented in which information on former campaigns was shown as comparison. This idea is connected to the theory about example critiquing presented in the theory chapter. Also some possible extra features were presented, among those: an explanation device, a time line and a to-do list.

With these ideas and their own first design in mind, the participants were asked to reconsider their thoughts and come up with a final design which combined the best ideas. The

[2]This figure also shows that the Communication Development Model [30] was under development during this project, as the determinant 'Norm' has been split up in 'Descriptive norm' and 'Injunctive norm' in later versions.

two groups presented their work to each other and the workshop ended with a discussion about the designs and the importance of certain elements.

Four people participated in this first design workshop. Three of them were senior campaign managers, the other one was a campaign researcher. The group of four people was divided in two groups of two people. The design flow and the discussion which arises from the design was recorded. So the paper work on the table and the voices were recorded, not the people themselves.

The first half, in which the participants were asked to think freely, took about one hour. After this hour the groups presented their results to each other. The presentations are included on the videos. During the second half of the workshop, the participants were asked to combine their ideas with the ideas that were provided by the designer.

The two groups worked as independent as possible on their assignments, but they were allowed to ask questions. Also the researcher asked some questions and provided some hints to get the groups started. During the presentations and discussions after the two parts clarification on the ideas was given.

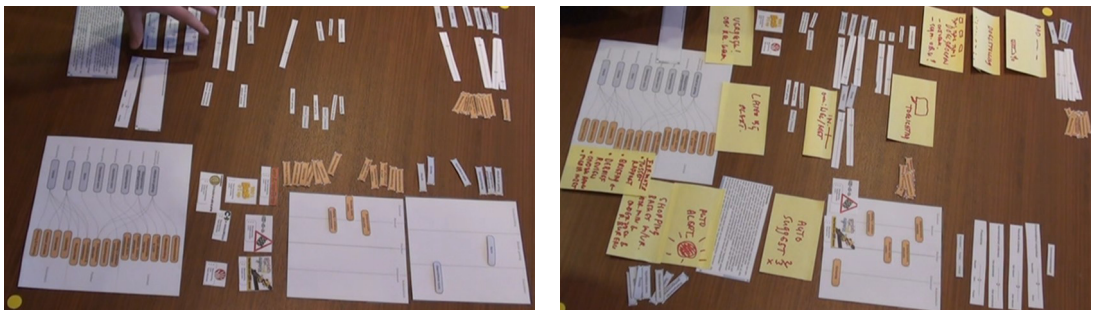


Figure 4.5: Screen shots from the second part of the first workshop, the designer's ideas and the combination with the first part.

4.2.3 Reconsideration workshop

After a couple of weeks the results from the open minded workshop were presented to the campaign managers in the reconsideration workshop. The ideas from the participants were combined in a paper prototype of the system. In this workshop the work area was narrowed down to the size of a normal 17 inch computer screen. The researcher presented several concepts, how they could work and where they could be placed on the screen. Each element was separately printed and cut out such that it was easy to move or replace elements.

In this workshop the prototype was presented to the participants element by element. The participants were allowed to interrupt the presentation to ask questions and state their opinions. Intentionally the group of four people was kept together such that it was possible to discuss opinions.

The prototype presentation started with the surrounding elements of the system. Those which are needed in a system but do not necessarily relate to the Communication Development Model [30]. Among those elements were: the campaign goal which always must be

visible, an indicator for the correctness of the strategy, buttons for saving and erasing. Figure 4.6 explains all parts.

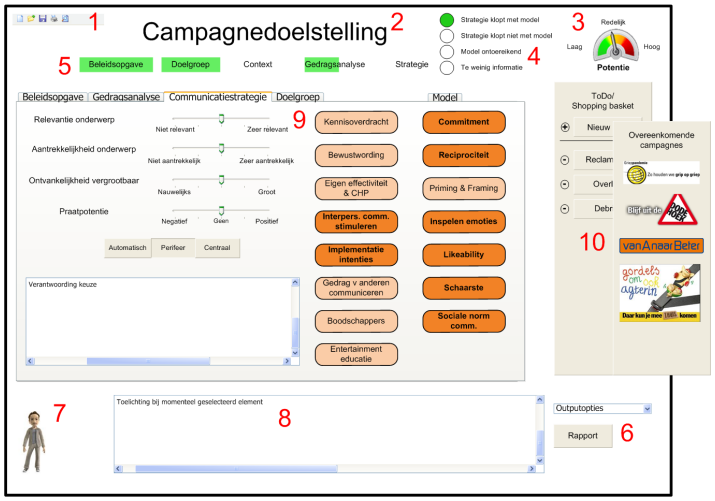


Figure 4.6: The 'screen' as presented in the reconsideration workshop: 1 buttons: save, new, delete, etc.; 2. the goal of the campaign is always clear and visible ; 3. a valve which indicates the likelihood of success of this campaign; 4. a 'traffic light' which indicates how sure the system is of its suggestion; 5. a progress bar, separated for the several tasks; 6. several options for creating documents; 7. an avatar, 'Henk', who can answer questions and gives suggestions; 8. a text field in which the system or 'Henk' can display text; 9. tab panes for separate tasks; 10. a to-do list which can be switched to a suggestion list for old campaigns which are similar to the current campaign.

Secondly, the main elements of the system were presented. This was a screen with several parts for the several steps in the model. Tabs were provided for the policy goal, the analysis of behaviour, the strategy and overview of the model. Additionally this paper prototype had features for comparison with former campaigns, a to-do list, an explanation device, an avatar and an output device.

Again four people participated in this workshop. Three of those were the campaign researcher and two of the campaign managers of the open minded workshop. The other one was also a campaign manager, but he did not take part in the open minded workshop. Logically, one of the participants of the open minded workshop did not take part in the reconsideration workshop.

The presentation of the prototype was recorded on video. Likewise the open minded workshop, only the design itself and the discussion were recorded. So the people participating in the study are not on the video. The presentation and the resulting discussion took about one and a half hour.

4.2.4 Software workshop: Java prototype testing

For the last workshop, the ideas and requirements which were found in the two foregoing workshops were implemented as a software prototype[3]. For this the Java programming language version 1.6 and the JSwing packages for applet design were used.

[3]DaDmain Protoype 1.0

The goal of this workshop was to present the final design to the users and have them test it. As this was a programmed version it was not possible to easily add or remove features from the prototype, which was one of the core goals of the other two workshops. Furthermore, not all the features were fully implemented. The prototype did have save, erase and output buttons, but those buttons were not functional. This is because more effort has been put in the design of the interaction with the model than in the additional features. The full design of the prototype will be discussed in the design chapter.

Since the goal of this workshop was to test the interaction with the Communication Development Model [30]. It was necessary to put the information of the model in a digital format. It was chosen to build an Excel-file which contained the several determinants and mechanism and their relations to the questions in numbers (see chapter 6 on the reasoning engine for more details). Most of the actual values given to those several attributes were an educated guess from the researcher. It was ensured that the prototype gave varying answers to various input. It turned out from a discussion with the authors of Communication Development Model [30], that it might not be that easy to transfer social science knowledge to numbers. This problem will be considered in the discussion chapter of this thesis.

The workshop took place in two separated sessions with two participants each. These participants were asked to take a current policy goal in mind and use the prototype to design a communication strategy. There was chosen to make groups of two people because this forces the users to discuss their thoughts but it is still possible to work together on one computer.

Camtasia studio 4 was used to record the prototype workshop. This program captures all movements on an indicated area of the computer screen. Next to this, Camtasia recorded the discussion between the two participants.

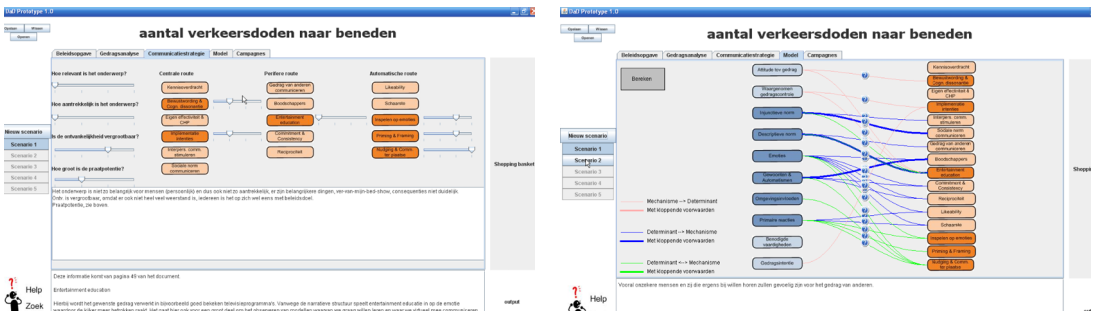


Figure 4.7: Screen shots from the prototype workshop. The strategy design screen and the model with the results of the chosen attributes.

4.3 Research rigour

All three design workshops were recorded into a .avi-video format. This resulted in two times two hours of video for the open minded workshop, one and a half hour for the reconsideration workshop and two times one hour for the prototype workshop. The 7.5 hours of video were transcribed by the researcher immediately after each workshop; unfortunately not every discussion was clear enough to describe, so some parts were left out.

The transcriptions were tagged according to the topics from the literature study (see section 2.4). The resulting topics were checked for how much they reoccurred in the workshop, whether there was agreement or not and how long discussions took. The results were then used for the design of each next workshop and after the last workshop for the design of prototype 1.1.

In total five professionals from the Public and Communication Department participated in this research. Yet, it turned out that every workshop there was an other participant who could not be present; two of the five participated in all workshops. So each workshop was attended by four participants, the researcher and Van Essen; who did not have an active role but used the discussions for her own work.

The four participating campaign managers were medior or senior managers and volunteered for this project - the fifth participant was a campaign researcher -. Two of the campaign managers and the researcher were actively involved in writing the Communication Development Model [30]. Therefore, they already had a positive attitude towards the model. As they volunteered for the project, it can be expected that all participants also have a somewhat positive attitude towards computer programs. Although reluctance was expressed during the prototype workshop: one of the participants showed reluctance towards the use of such a decision support system, but he added that he also had reluctance towards the whole model.

4.4 Discussion on the method

In this section, only a discussion about the method is given. For a discussion about the results and the whole project, see chapter 9.

Participatory design was chosen as the research and design method in this thesis. As shown above, many software development projects fail, because of a lack of connection to the end users and therefore to work practice. This research was planned to end without a final product and without thorough usability tests in real life situations. Since enduring use of a product can only be evaluated after a year, it is not possible to test whether above problem has been solved or not.

Luckily, some other problems which occur in 'traditional' software design have been solved. During the several workshops, the researcher has been sent back to reconsider the design ideas. Decisions were cancelled which otherwise would have become a major part of the system. One example of this is how the system guides the users trough the design process. The end conclusion was that there should be as less guidance as possible, typically something that was indicated by the users.

One of the issues mentioned by Pommeranz and colleagues [27] was that the participants had difficulties with creating their own ideas. They stuck to variants on the presented concepts. Therefore, the first part of the first workshop started with a complete blank 'screen'. The participants were asked to design the system from scratch. Only later, in the second part of the fist workshop, some ideas of the researcher were added. At this moment, it turned out that the researcher took a completely different approach in the preliminary design. Therefore, the participants had some difficulties with combining their own elements with those of the designer. This shows again were the problem in software design lies, the builder of the system has a completely different view than the user.

Overall, the participants in the research liked the way in which the workshops were organised. They showed to be very conscious about what a computer system can and cannot do. The participants showed that they were very conscious about what they did and did not want. E.g.: "The subject is really difficult but please put the problem in this small box." was said during the analysis of the policy goal. The system only provided a small box to enter the problem. Therefore the participants felt that the interface did not reflect reality.

Although the process was rather labour-intensive, the participants liked the way in which the design was established. They thought that their way of handling the prototype was representative for the whole group of campaigns managers. Altogether, their opinion about the usefulness of the Communication Development Model [30] and the way it was implemented has improved during the workshops. Even though work needs to be done, "I can imagine that [such a system] has a long term perspective".

In conclusion, participatory design has proven its merits as a design and research method. It increased the bond of the users to the system and found design issues - like the guidance example above - which otherwise would have stayed unnoticed. Although the method needs more iterations and therefore is labour intensive, it does result in a better end product which means less repair work and more usage in the future.

Results and Design 5

Presented in this thesis is the research done in the past half year, but also a prototype; the decision support system designed during the several workshops. Therefore, this chapter presents the results from the research and the design decisions together.

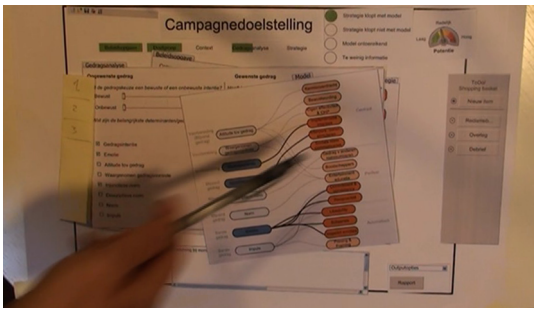


Figure 5.1: Screen shot from the reconsideration workshop

In this chapter, the results of the three research workshops are described in a meaningful matter. The first section describes how the ideas from the literature study and the preliminary analysis were taken along to the open minded workshop. Then for each workshop is described: which assumptions the workshop started with, the results of that workshop and how these results were translated to design decisions. The last section describes the final prototype.

5.1 Preliminary analysis

The preliminary analysis by Van Essen was meant for her to find out 'how' the campaign managers think about their work. As this analysis partly answers the first three sub questions, the analysis was incorporated in this research. This analysis was conducted among a larger group of campaign managers, about ten, than participated in this research. Also, some other employees of the Public and Communication Department of the government attended the analysis.

5.1.1 Results

- All results in this section come from the report of the meeting by Van Essen, this report is not publicly available. - The first two propositions were about to which extent the campaign manager is a sparring partner for the client, the ministry, and the marketing agency. During the discussion it was agreed that the - senior - campaign managers would like to be a good sparring partner, but they lacked the actual knowledge. Especially people from marketing

agencies usually work according to some theory, it is only possible to discuss the strategy with them when the campaign managers has arguments to bring to the discussion. Also, it was agreed that the campaign manager takes the lead in facilitating the process of the design of a strategy; however, there was discussion about whether the campaign manager should have a part in the design decision taken for a strategy.

Next, the question: "What makes a strategy a good strategy?" was addressed. Ideas from all participants were gathered and clustered, this resulted in the following set of answers:

Problem analysis a good analysis of the problem is the foundation of a good strategy.

Focus on target group the strategy must connect to the target group, not to the perception of the commissioner of the strategy.

Based on goals the strategy must contribute to measurable goals.

Well-founded choices which are made should be thoroughly founded by arguments. There must be a focus on making choices, as often commissioners want more than possible in a campaign.

Focus of the campaign a choice must be made for the use of specific mechanisms.

Supported by all participants all participants must agree on the chosen strategy.

The second main question was: "Which role does the campaign manager have in designing the strategy?". Answer to this question was that the campaign manager is not seen as the decider in the strategy design, but he does have a role in the process. This role depends on the extent to which the client already has an idea about the strategy and the extent to which the campaign manager has the knowledge and the passion to be involved in the design process. Overall, three situations can be discerned: one, the ministry - client - already has an idea of the strategy and decides which route to take; two, the campaign manager decides on the strategy to take; and three, the marketing agency defines the strategy to follow. Currently, the second option occurs more than the first and the third occurs most often. In the current role of the campaign manager the following aspects can be distinguished: facilitating the process, advising, expectations management, providing direction and steering on decision making and as last, writing a good brief/debrief (report of the campaign).

5.1.2 Design decisions

From the preliminary analysis, above results and the findings from the literature study, the following design decisions were made:

(P1) *Enable broad problem analysis*: The campaign managers indicated that a good problem analysis is important, the literature study refers to this as exploring the problem space.

(P2) *Make clear choices*: The campaign managers found that the design of the campaign must result in concrete choices. So there should be a clear solution as outcome of the process. This can be the choice for some specific mechanisms to address in this campaign.

(P3) *Enable broad thinking*: Although decisions must be made, the literature study does address the problem of making a decision to early; before the analysis is completed. So reconsidering the analysis and the decisions must stay possible. This is also seen as moving back-and-forth through the problem and solution space.

(P4) *Make the campaign manager sparring partner*: The Communication Development Model [30] is meant to provide knowledge and arguments to the campaign manager to enable him to be a valuable discussion partner in the design process.

(P5) *Enable weighted adding*: In the literature study it was concluded that weighted adding is one of the best decision making strategies, but the strategy is often too effort demanding. Therefore a way must be found to enable weighted adding without putting a higher cognitive demand on the campaign manager.

(P6) *Keep the campaign manager in the lead*: From the literature study and the results presented above it can be seen that the campaign manager has the lead in - facilitating - the design process. It must be ensured that this lead is not taken away from him.

(P7) *Reduce the effort*: The decision support system should at least make the strategy design process easier. So whatever the system does, designing a strategy with the system should not be more difficult than designing a good strategy without the system.

(P8) *Provide overview*: The campaign manager should always have the overview over decisions and consequences of these decisions. Partly because the overview makes sure that the campaign manager keeps track of the process, but also because a wide approach to the problem should be kept.

To emphasise, these are design decisions which were made by the researcher based on the preliminary analysis and literature study before the open minded workshop took place. How these decisions have been used in the open minded workshop will be presented in the next section.

5.2 Open minded workshop

In the first part of the open minded workshop the participants were asked to think complete freely about which components a decision support system should have and how the system should look. For this first part no extra ideas were given other than: the system should help you working with the Communication Development Model [30]. In the second part of this first workshop, the design ideas of the researcher, which result from the literature study and the first preliminary analysis by Van Essen (phase *I*), were presented as suggestions to the participants of the research.

5.2.1 Design suggestions from the researcher

At the start of the second part of this workshop the ideas of the researcher were introduced. All ideas were based on the document describing the model at that moment, the preliminary analysis and the literature study. Those ideas were tightly connected to the kind of knowledge represented by the model and how to interact with this specific kind of knowledge -

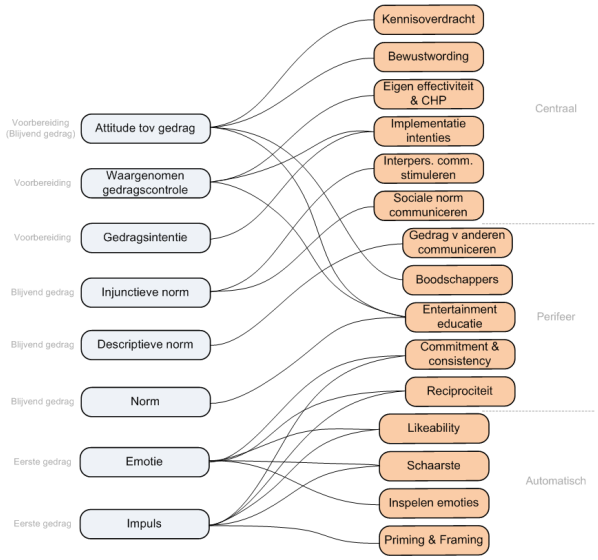


Figure 5.2: A system representation of one of the earlier versions of the model. The participants referred to this as the 'spaghetti model'. The latest version is shown in appendix B.

design decision (P4) -. As will be shown in this section, the campaign managers think more about the form of the system than its contents; but that is what they were asked to do.

There were four main design suggestions from the researcher. The first part was designed to be very close to the original list of questions. Only that answers to the questions were given in a digitalised form, this addresses only design decision (P7). For example, one of the questions was: "Is the undesired behaviour conscious or unconscious?", with this question came a switch button where either conscious or unconscious must be selected. The question list for the analysis of the behaviour and the composition of the strategy were presented. The questions considering the policy goal were omitted, as it mostly consisted of the question: what is the policy goal? Added to those lists were a box for justification of the choices made. With the idea that choices must be archived and should be accessible for future reference. Also, there was a text box which provided explanations of the several elements. With such an explanation the manager always knows what the system is doing and why certain suggestions are given (P6).

The second part consisted of a visual representation of the model used for overview (P8), using what was later indicated as a 'spaghetti-scheme' (see figure 5.2). In this model the user could see for each determinant how it links to the mechanisms. In this way, made choices are immediately connected to a certain outcome (P2). The participants were asked not to discuss the links themselves, only their possible usefulness; this because the workshop was about the employability of a decision support system and not on its contents.

The third part was more like a black box model and made use of direct interaction. The screen consists of two spaces, a problem and a solution space. The selected determinants could be dragged in the problem space, the system would than put the linked mechanisms in the solution space. When a determinant was moved up, the linked mechanisms would move along and vice versa. Also it was possible to select and move mechanisms, the system would then show how the determinants reacted. As basis for the reasoning the model as described above was used. The strength of this method was intended to be the direct inter-

Figure 5.3: Logos of old campaigns; attached, the mechanisms which were assigned to those campaigns.

action. For each choice in the problem space it would be immediately clear how this affected the solution. The used method intended to facilitate a kind of weighted adding strategy (presented in the literature study chapter 2), but without having to assign values directly (P5). Placing one object above another makes it more important, cognitively this is easier than assigning numeric values to the same objects.

In the last part using old campaigns as an example was introduced, they wear meant to broaden the thought process (P3). The old campaigns were presented together with the mechanisms which were connected to them. Also presented as last was the possibility of using slide bars, this meant that you not had to make a binary choice between the determinants, but the slide bars gave the possibility of indicating importance. Additionally, the whole system has as goal to keep the analysis of the problem broad (P1).

The designs were explained as described above and the participants were asked to combine them with their ideas from the first part of the workshop. It was allowed to combine all elements from all screens and even to give new meaning to elements; otherwise stated, there were no restrictions.

5.2.2 Results

From the discussion in the open minded workshop, the next topics were found to be important by the researcher. They are presented in the order of topics as they appear in the theory chapter. Some topics are grouped to form a consistent story.

Design stance, problem paradigm and recognition of information

The Communication Development Model [30] will be the central part of this decision support system, therefore, it can be said that the model is the design stance of the system. This was told the participants before starting the workshop, in fact it was told them at the beginning of the whole design project. For this reason they started with the model as the core of the system.

The Communication Development Model [30] is first used for the policy analysis of a particular problem. So in this first part one could say that the problem paradigm for the strategy is being set. Notwithstanding the fact that the problem and its paradigm can be altered at a later moment. The list of questions which accompanies the model starts with an analysis of the undesired and desired behaviour. The participants indicated that they do understand the need for this analysis, but that they have problems with the translation towards

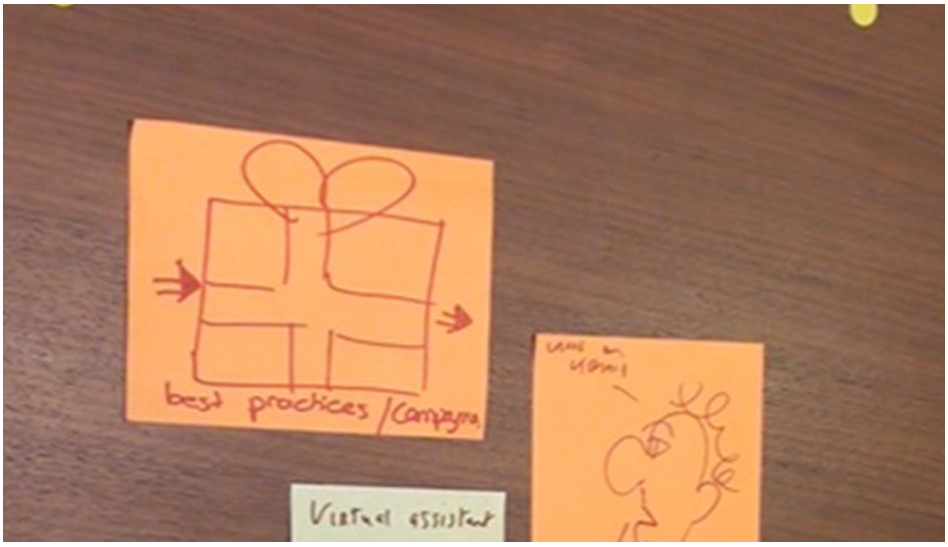


Figure 5.4: The drawn gift indicates that former campaign with good results serve as a 'present' for each next campaign to be designed.

the model. Indicated is that they expect the model to help them denoting the concepts.

Already at this point the need for example campaigns seems useful, as they can help with defining similar problems, the participants indicated this as a 'present' (figure 5.4). So the knowledge stored in the model can form the basis for an advice, a decision. By giving examples it is shown how difficult it can be to use the mechanisms in practice.

Breadth-first, switching and overview

During the analysis of the problem and the formulation of the strategy, the campaign managers would like to be able to choose from several options, several scenarios. The scenarios should show the relevant paths through the model and can therefore be used to start the briefing process. Several scenarios can divert on several target groups, but it should be possible to address several scenarios for the same target group as well.

Switching between the several scenarios can also help translating the policy analysis and the problem, towards a solution. As you will always consider the policy task in parallel with the analysis of the problem, there will be a lot of switching between the several screens: "Check this, check that, read a little bit.", is how campaign managers see that they will use the system. This shows the need of tracking whether every aspect of the problem has been considered or not, and shows that a good presentation of the overview is of utmost importance.

This overview can be provided by building the model visually on the screen. Or at least show which links exist, which are being used and which other ones could be of use in the problem under consideration. Also, the model could show why a solution is certainly not a good idea, give some additional questions to consider but also the model should provide the reason why this is the case (as shown by the explaining text balloon in figure 4.1).

Weighted-adding with slide bars

In the second part of the first workshop, the participants were given, among other things, a couple of concepts and slide bars. One of the ideas behind the slide bars was the decision strategy weighted adding, addressed in the literature study and chapter 2: theory as the normative decision method. From the workshop arose the question whether conscious and unconscious behaviour can both be an aspect of a certain situation. For weighted adding to be useful, these questions must be answered.

From the discussion also appeared that each concept can be looked at differently. For the importance they would like a switch, so something is either important or not, but there is nothing in between. For other concepts it seemed necessary to provide an amount to which the concept should be considered.

This resulted in a discussion about whether slide bars should be discrete or not. With in the back of the mind that software system will always make some kind of discrete decision, whether you see it on the screen or not. The participants did agree on the fact that discrete slide bars did not really feel right, this problem will be considered later on in this chapter. All in all, the result should always be a concrete decision, so the system has to lead to something.

Reducing of cognitive effort

When speaking about reduction of effort, there must be a current level of effort which becomes lighter through the use of a decision support system. As current level, the paper question lists which arise from the Communication Development Model [30] were used.

From this starting point, effort reduction could be met by only asking the, at that moment, relevant questions. So the logical order in which the questions are stated changes with the preference of the user. Also, it is possible that questions become irrelevant because of the answer to a previous question. Questions could further be categorised in themes, with respect to the themes that are being used in the department (see figure 5.5).

On the other hand, the risk of missing certain questions is recognised by the participants. A system which is too easy to handle could lead to a misinformed decision. This means that the system should make sure all questions and topics are considered. Another suggestion made was copying the answers provided for the undesired behaviour to the desired behaviour, but is this copying actually possible? With this possibility it looks like the two are the same and so the system gives the idea that it is a correct action; but from the discussions between the campaign managers can be read that desired and undesired behaviour always should be considered separately.

Another way to reduce the effort of the decision is providing meaning to the elements considered. 'Meaning of concepts' is a separate topic to be considered, but here is meant the actual presentation of the meaning. Providing an explanation of each concept the moment the concept is used helps the designer in making his decision. The participants asked for explanation devices on several moments in this workshop. This due to the still rather difficult topic that is considered.

Next to this, there should be an easy possibility to outsource difficult decisions to people who might know the answer. Or another possibility is that the user can ask the system for a suggestion. Based on the given answers and data, the system can give a hint for the route to take. Furthermore, the presentation of the information can also give a hint here. The way

Figure 5.5: This drawing asks for the questions of the model to be stated in a logical order, this order can change with the answers given and choices made earlier in the design process. At the bottom of the picture, some campaign themes are shown.

of presenting used in the second part of the open minded workshop (figure 5.2) was not entirely clear from the beginning; but the moment it was explained, the users appreciated it and found it a useful way of looking at the subject matter.

A lot of the effort reduction is reached when the system has to give an end solution to the user. Again, the overview is of high importance. The participants indicated that it would be really useful to have a kind of fact sheet during and at the end of the design process. This fact sheet, or report, could serve as a basis for the briefing sent to the client and the marketing agency.

Human-in-the-lead

In a human-computer team the human should always be in the lead. Maybe only because of the fact that the computer is not bothered by being commanded all day, but there are some other aspects, especially when supporting design. As it are the difficult, non-linear, parts of the design that have to be considered by humans, they are the ones who can recognise best when such thing arises.

In the open minded workshop, there is some evidence that the participants want to be steered through the model. As mentioned above, the system should make sure that everything is considered, but that is something else than being in charge over the actual decision. One of the participants literally mentions: “I am not such a fan of black-boxes.”. So she really wants to understand what is going on; this might be an open box, which sets the directions to follow, as long as it also explains why those directions are set. Otherwise stated: “You need to keep track of what you are doing, this does not mean that you know everything yourself.”.

So the moment you discover that you do not know the answer to a question, you want to be able to access the theory, or ask for external help. Additionally, entering the briefing with more than one scenario can help the designer to keep broad thoughts. The several scenarios

Figure 5.6: An avatar can serve as guide through the system and as a connection to external help.

should then contain the information on which they are based.

Also stated on this subject is that the participants would like to be warned after having made a wrong decision, instead of being steered in the right direction. Having some kind of automatic suggestion screen is not the signal that should be given by the system.

In the end, making the right decision and interpreting the information correctly is what should be the expertise of the campaign manager.

Example critiquing

During the first part of the open minded workshop, in which the participants were asked to think completely free about the components they would like a decision support system to contain, the campaign managers came up with a 'best practices feature' (figure 5.4). Such feature should contain relevant campaigns which serve as example for the current strategy. "That you have the possibility to go back for a moment, which policy goal resembles the current one?" and "You need examples, which concepts were addressed by other campaigns on alcohol and drugs?", were questions stated in the discussion. Also examples from commercial campaigns could be included.

Another form of example critiquing can be enabled by giving suggestions of scenarios, so critiquing possible solutions. Critiquing given options is easier than coming up with new ideas. Based on the values provided for the determinants and the mechanisms, the system can come up with several options to address the problem.

Constructive preferences

The theory about constructive preferences states that it is rather easy to affect the preference of the user (for references see the theory in chapter 2). So when a system is designed with the goal to elicit the true preference and not a momentary preference, consideration should be taken for the way a question is asked. Therefore, the participants were not forced to start at a certain point in the system. It was asked how they would start the design of a strategy

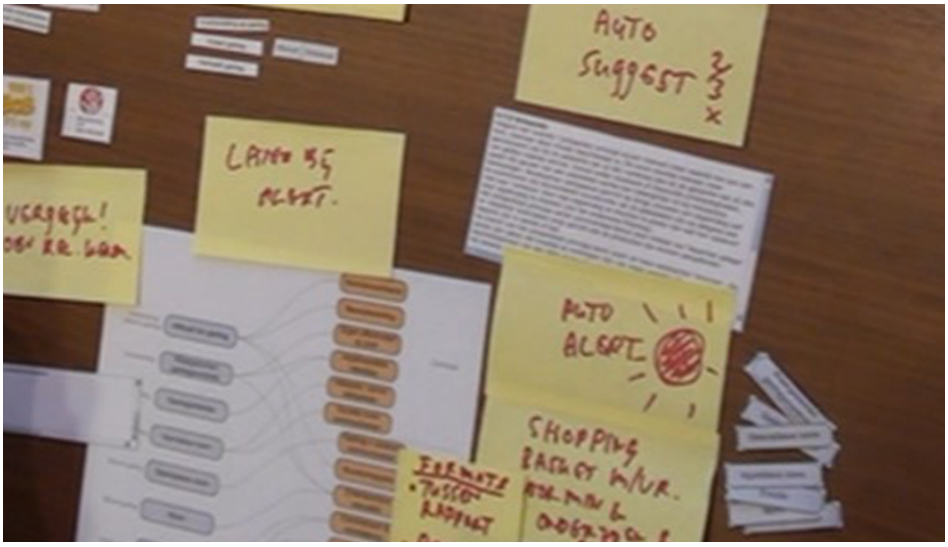


Figure 5.7: The 'autosuggest'-button and warning light indicate that the system gives suggestions when asked for but does not force the user to look at the suggestions.

themselves. The participants liked this freedom but they did ask for some kind of basic routine, a place to start designing and a route to follow through the program.

The system should then interfere with the decision at the moment the user asks for it. So based on the given preferences the system could give a suggestion, in the form of a blinking button, or something similar. The campaign managers designed a system which does show the connection between the several elements, but it does not have direct interaction. The system should make its calculations on the background and only interfere when boundaries are being crossed or when asked for a suggestion (figure 5.7).

Again, the importance of an explanation device is apparent in this topic. As a good explanation can serve as the basis for a preference, this also shows that the explanation should be neutral; otherwise the explanation itself will steer the preference.

Also found were two positive aspects of steering preferences. Rather early in the free design workshop the participants indicated they would like a nudge, which remembers them of the policy goal all the time. Like a blinking and repeating news trailer: "Less traffic casualties. Less traffic casualties.". Next to this, the system could provide the themes in which strategies are designed within the communication department. In this way each strategy is connected to several others, because of the topic they have in common.

Explanation of concepts by individual participants

When designing together, in human-human teams as well as in human-computer teams, discussion is a key element of the design process. In such a discussion it is necessary that participants have similar explanations to the several concepts. This explanation is part of the before mentioned design stance each designer has. In this particular case, the design stance of the system is based on the theory from the Communication Development Model [30], theory which is accepted by the users.

This problem was also recognised by the participants of the several workshops. There is a lot of discussion about the concepts addressed in the model, but also about the elements

of the system under design. Therefore the participants asked for an explanation device (see figure 4.1). This helps them getting their mind on track: "Are we still in line with the theory?".

Making the model easier to access is one of the most important reasons for designing a decision support system. Because it is assumed that the model is correct, simplifying the usage is partly put in providing explanations of elements which are necessary at that moment. So when you click an element, an explanation should pop-up. This is more convenient than referring to the printed document for the same explanation.

Usability

Pleasurable to interact with and easy to interact with are some of the terms that can define usability of a system. In the open minded workshop it was mostly about how the participants expect a system to interact.

Both the groups came up with a person to 'talk' with as part of their system. When asking for help or addressing the information contained in the model, they liked to do this via an avatar. In one of the cases this avatar was called 'Henk', but it was added that it should be possible to name your avatar whatever you like. The need for such an avatar was rather surprising as in earlier research was found that such avatars are not appreciated by users [27], this issue will be considered in the discussion (chapter 9).

In the second part of the open minded workshop, some slide bars were presented as a way to provide information to the system. This method is linked to the concept of *weighted adding* mentioned above. One of the participants mentioned that this feels a little bit "thick-witted"[1]. A mentioned solution was to define some discrete levels on the slide bar, but immediately added was that this might not reflect the real world. Another concern was mentioned on direct interaction of the system. So when the value of a slide bar is changed, some graph somewhere changes along with it. The participants perceived this as a nudge towards giving a more preferable answer as the graph would then look better.

Other usability aspects asked for were: the possibility to hide screens that you have no need for at the moment and some kind of clickable model. So a visual representation of the Communication Development Model [30], in such a way that you can interact with the graphic. This in combination with a hand-held device like a tablet computer would make it easy to use the system wherever you like. The question where and with whom to use the system is also one to be considered, as each strategy has to be designed in cooperation with the client and one or more marketing agencies.

Usefulness

Output was considered as one of the main elements on which the system usefulness can be defined. The output should be visual, with room for interpretation, but it should be accompanied by a print in text. Likewise was stated with the use of slide bars, their values could be clear in numbers but an explaining text should also be provided.

Furthermore the output should be clear enough to be taken along in a discussion with the client. Most preferably the whole system should be taken to each meeting. "Like you are carrying around the whole file."

[1] 'suffig' in Dutch

Figure 5.8: The users wanted to use augmented reality to be able to test the strategy on a specific target group.

Apparent benefits

During the workshop the participants found out that some parts of their work could be integrated with the usage of a decision support system. First of course, the knowledge embedded in the system which is now easier to access, but also having a clear overview of what you know and do not know. To this should be added a possibility to outsource certain questions from with an integrated e-mail function.

Stable reasoning basis

As said before, the Communication Development Model [30] is central in the reasoning engine of the decision support system. Therefore the model is the part that gives the system its stable reasoning ability. So the model is the point of return when you alter the targets of the communication strategy. The model provides the reasons for certain questions to your clients and marketing agencies and provides the scaffold of the decision. Therefore the system could be equipped with a warning system that puts you back on track once you got of.

A nice addition to this would be to know how certain target groups will react to specific communication concepts. The moment this knowledge is embedded in the system, a good suggestion can be given about the plausibility of a chosen strategy. Figure 5.8 shows that his could be done with augmented reality. Whether testing on target groups is really possible with augmented reality will not be discussed here, although it is interesting to see that concepts from other disciplines are used to explain ideas. And of course, testing strategies on target groups would actually be a useful feature.

5.2.3 Design decisions

The design decisions can be seen as a summary of the results presented above. The decisions were written by the researcher but they are based on the opinions of all participants in the

open minded workshop. The following design decisions were made:

(O1) *Old-campaigns are useful*: The open minded workshop confirms that old-campaigns can serve as good examples for the campaign being designed.

(O2) *Several scenarios*: Using several scenarios helps in keeping a broad view on the design. A visual overview of these scenarios is important to enable comparison.

(O3) *Weighted adding*: This does seem a useful decision strategy for considering all elements, although it is recognised that the unit of measurement for components needs to be calibrated thoroughly.

(O4) *Not too much effort reduction*: Only asking relevant questions is already a method to reduce the cognitive effort of designing. On the other hand, making the process too simple can result in misinformed decisions. Providing explanations to elements and clear suggestions as outcomes are other ways of reducing cognitive effort.

(O5) *Guidance in an open fashion*: The campaign managers would like to be guided through the design process by the system, however, the human must stay in the lead. Suggestions and links must be presented in an open fashion. Making the actual decision is the task of the campaign manager.

(O6) *User controls the system*: And not the other way around. A pleasurable system does not interfere with the process all the time. The campaign managers indicated that they would not like direct interaction, the system should give suggestions or warnings when asked for. On the other hand, a request was made for a continuous nudge for the policy goal.

(O7) *Complete information*: The information from the Communication Development Model [30] given by the system should be enough to actually use the model. So no paper reference should be necessary anymore.

(O8) *Visual interaction*: To enable the usability of the system, the campaign managers introduced an avatar to interact with. Also, emphasis was put on visual interaction and explanation.

(O9) *The output is important*: The usefulness of the system is to a great extent determined by its actual output. It must be possible to use the output to make concrete and justifiable decisions.

(O10) *Integration in work process*: The system should not only support usage of the Communication Development Model [30], but also should incorporate other tasks of the campaign manager.

(O11) *Predict chance of success*: The model is the stable point of reference of the system and the campaign manager. A nice feature would be when the system could predict the plausibility of a strategy based on information of the selected target groups.

5.3 Reconsideration workshop

The data presented above were used to create a paper prototype. This prototype was the basis for the reconsideration workshop.

5.3.1 Description of the paper prototype

Presented first was the policy objective which has a central position at the top of the screen. From the previous workshop was found that a continuous reminder of the goal would be preferable (second part of (O6)). Next to this some standard buttons, like saving, deleting, and opening, were situated. On the other side of the screen, a knowledge indicator is placed. This device shows what the model can say about the current answers by one of the following options: the system is sure of its advice, there is not enough information or the model is insufficient to give an advice. Also it has a success indicator, which gives a hint of the plausibility of success for this combination of determinants and mechanisms (O11). As last in the top row, there is a progress indicator, which shows where in the model the user currently is and which parts have been skipped for the moment.

In the bottom row on the right, there are the several options for output. The user can select his preferred lay-out and then gets e.g. a pdf-file. So there is a device for output, in compliance with (O9). However, this paper version does of course not say anything about how good that output is. On the other side of the bottom row, so on the left, there is the avatar: 'Henk'. In this design, this avatar is more a kind of a point of reference. The avatar includes the search function, a help-wizard and a warning device like: "The combinations you have currently selected are not a good idea, because...". The avatar is meant to make interacting with the system more pleasurable (O8). The last part in the bottom row is the explanation box. When a certain element is clicked, the explaining text for the element will appear in this box. The content for the texts comes from the Communication Development Model [30] and is meant to give a full explanation (O7).

The centre part of the system consists of the content of the model, the translation of the question lists in such a way that the answers are usable for the system. The centre is designed with the use of five tab panels. The first tab consists of the policy objectives, the second asks questions about the analysis of the behaviour, the third defines the strategy and the fourth shows the model in the scheme described earlier. Also there is a tab panel for the analysis of the target group, however, during the reconsideration workshop it had no content as no useful information could be found.

The tab for the policy analysis has not entirely been worked out yet, since there are not much questions to ask here. Although the system and the strategy do need such an analysis. The analysis of the behaviour gives the opportunity to select determinants for both the desired and undesired behaviour. Also, there are for each kind of behaviour two slide bars to set the amount of unconsciousness and consciousness. In this tab, the choices are literally presented as check boxes.

The next tab contains the communication strategy in which the mechanisms must be selected. These mechanisms are also selected in an on/off fashion, but they do not look like check boxes. This with the aim to make the system more visually attractive (O8). Next to selecting mechanisms, some questions must be answered through slide bars and there is a text box for justification of the chosen strategy. When asked for, the system can give a

suggestion of the mechanisms to use based on the determinants from the previous tab panel. So the system only provides a suggestion the moment it is asked for one (O5).

The fourth tab shows the model with the selected determinants, mechanisms and the links. Links which have a high likelihood of success are thicker, explanations are provided when an element or a link is clicked. Also it is possible to change the choices in this screen, then the effect is shown directly (O3).

On the right side of the screen the 'shopping-basket' from the previous workshop was put. This gives the possibility to put tasks on a to-do-list for future reference and might make it possible to act on those tasks within the system (O10). The list can be shown when necessary. In the same way the user can ask for a sample from the old campaigns embedded in the system (O1). Again, shown when asked for.

Another problem was that the system could cause too much effort reduction (O4), in this paper version it was not explicitly attempted to make the process more difficult. This will be considered in the prototype workshop. Also the system did not have an option for explicitly designing several scenarios (O2), this was one of the options added during the reconsideration workshop.

5.3.2 Results

From the reconsideration workshop, the following topics were considered to be important by the researcher.

Strategy is design and therefore liable to a design stance

With a decision support system, practice is ultimately connected to science; "We will be influencing literature." one of the participants stated. Nonetheless, campaign managers will never become redundant as there is too much left for interpretation and choices. For example, connections between all elements should be present, but they are not completely clear and worked out yet. Like, conscious and unconscious behaviour, can they both be of influence at the same moment? Only human campaign managers can interpret this question as it depends on many factors. Therefore, it could also be advantageous to provide the input from the marketing agencies to the system, as they will have their own design stance with which the discussion can be broadened.

A lot of discussion takes part in forming an idea of the problem. One of the participants mentioned that it could be possible that the campaign objectives are set only after the problem and solution analyses have been made. Again, marketing agencies can then have a part in the discussion.

Switching, recognition of information, breadth-first, weighted adding and overview

"Are you thinking about the solution strategy while making an analysis of the behaviour?" That questions arose during the reconsideration workshop. Because one of the risks is that you will find a satisfying conclusion and end at that point. Too much short cuts in the decision process can lead to such an early solution.

The participants described as their ideal: "It should be the case that the campaign manager checks several options, which then can be compared to each other." (see also figure 5.9). In this line of thinking it is possible to see several scenarios of the system as several

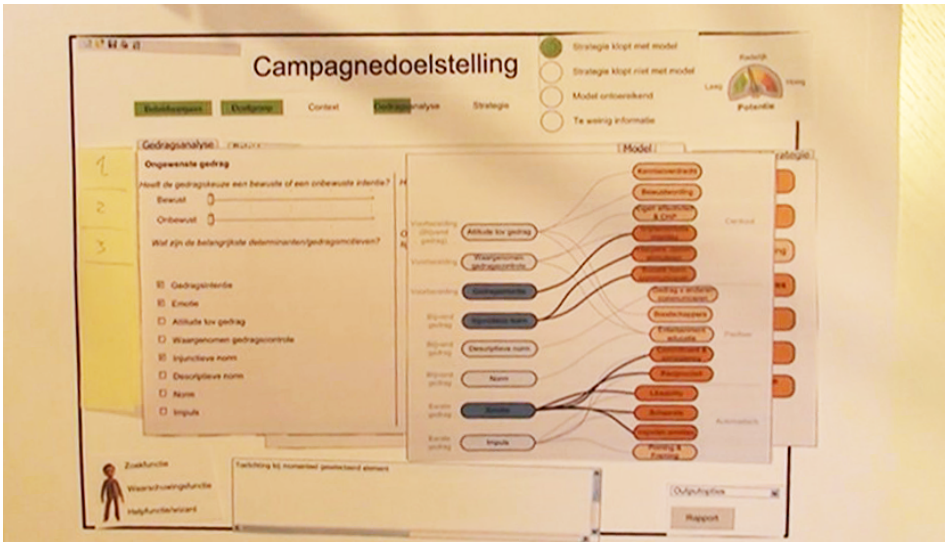


Figure 5.9: It should be possible to design several scenarios for the same campaign with the system, the block on the left containing 1, 2, 3 shows a way in which these scenarios could be managed.

solutions. The scenarios can differ on the analysis of the behaviour, but also on the chosen target group. Although there is a little anxiety towards following the whole system twice or more, this does seem a good solution. The process could even be improved by already implementing several characteristics for the several target groups.

Subsequently, the overview has to be kept in mind. Currently there might be several scenarios, based on different target groups or different analyses of behaviour. To enable best comparison, the scenarios should be shown together; "Why do I not choose that one?" should be clear from comparing strategies.

Also it is suggested that some kind of chance of success meter would help in making the decision. The rate of success could be given by the system, but it is also possible that the campaign manager gives an indication. In this way the strategy can be used for future reference and analysis.

Analysing several scenarios in such a way that the system can deal with the choices can only be done on the basis of slide bars and check boxes - or other input methods, but at least not on plain text -. So there will always be a certain discrete scale in each answer, you have to make a decision. Yet, the decision might not reflect the real world outcome perfectly, this has to be shown in the overview.

Reducing effort, but with the human in the lead

The goal of the decision support system is to help the campaign managers making a better decision. Partly this means, making it easier for them to make a decision. However, during the reconsideration workshop was recognised that it is not possible to evade answering difficult questions. It is possible to make them look more convenient but the content will stay the same.

Reduction of - cognitive - effort can be reached by monitoring the process, giving sugges-

tions at proper moments. The extent to which you want the system to follow and interfere is one of the discussion points from the reconsideration workshop. The model can indicate which research has to be done to get further information. On the other hand, when the system does this, it should be able to explain what it needs the information for. It is not important to see this explanation all the time, but it must be there when necessary. Additionally: "The information will only give the right feeling when you know where it came from, only then the information will make a lasting impression."

For example the 'mediatool' - a tool which helps in choosing between a television campaign or newspaper advertising by asking some questions - is mentioned several times by the participants. Apparently this tool is useful as it gives concrete answers, but it does not say anything about where its suggestions come from, therefore the tool is perceived as annoying.

Furthermore, you will have to accept that the model cannot help you in some situations. The embedded information is then just not complete enough. Still, it would be good to feed the system with all information you have. Then the system can check what it does and does not know, and in this way give suggestions for further research. "Of course it is not: you put something in, and something comes out."

Also stated in the reconsideration workshop was that the system has as major drawback that it breaks the bond the campaign manager has with a campaign. When he would make a strategy from scratch, he would build the whole campaign and therefore know exactly which decisions he made where and why. Just because the campaign manager has done it himself. The system may guide this process but also take out the conscious 'why' of decisions, in this way the connection between the human and his designed strategy is lost.

Example critiquing

Using the old campaigns as an example for the design is also in the reconsideration workshop perceived as a good addition. The participants do think that the old campaigns can mostly be of use when the actual strategy is chosen, so after the analysis of the behaviour. Also, care has to be taken to which campaign is taken as an example. For instance: the 'Gordeldiercampagne', which had as aim to increase seatbelt usage, was very effective; however, this was a very specific case with a lot of ideal nudging possibilities. It can hardly serve as an example for other strategies.

Moreover, currently there is only information about which campaigns used which mechanisms; and this information was added afterwards. There is hardly any information about how successful specific campaigns were and to which mechanism the success might be attributed. So old campaigns can help as an example in the discussion, but they do not provide firm solutions yet.

Constructive preferences and steps of decision

The participants like the way by which the campaign objective is put central at the top of the screen. On the other hand, they are still somewhat anxious towards direct interaction. When the model changes directly with your input, you get too much tendency to provide a profitable answer.

Also, the model as it is currently provided looks very complex, "like spaghetti", but the participants do believe that making it simpler would result in omitting too much informa-

tion. Together with this goes the nudge that every component has some importance, so every element can be selected. This behaviour should not be motivated as it does not result in clear strategies. Specific choices must be made in strategy design.

Actually it would be good if the model helped in making the decision between the several options. And if the decision is too hard, because there is a lack of information, then more research should be done.

Meaning of concepts

During the reconsideration workshop the participants find out that their knowledge of the several elements is not sharp enough to provide proper examples. Also, effort must be put in validating elements as their meaning is not entirely agreed on yet.

Usability

For the usability of the system some minor details are mentioned. Like the system would need some kind of help-wizard. Especially for first time users, some of the elements are too difficult to understand at once. Next to this the participants show reactance to some negative formulations as: 'the model has insufficient knowledge to provide an answer'. So care should be taken to details.

Also, the difference between a warning given by the system and the likelihood of success meter is not understood completely. In the design showed to them during the reconsideration workshop there are about three warning systems. In this way it does seem as if the system only contains exact knowledge and always has an answer, at that is precisely not the case.

The knowledge embedded in the system has a rather high level of difficulty, it is good when the the system shows this complexity. Do not make the theory look easier than it is.

Usefulness

The usefulness of the system relies heavily on the measurability of concepts. The reasoning engine can only calculate with numbers, not with plain text. This problem is realised by the participants, although they show some reactance towards giving input through slide bars and check boxes. "Are we asking the right questions and can we put those into numbers?" Next to this comes the fact that without any measuring of results the whole project is rather useless, as the effectiveness of a campaign is what should be improved by the model.

It would be preferable to have a system which gives as many answers as possible without steering the user into a direction. So will the system always give an answer? Also if there is a lack of information? That is when the human has to take care in decision making. He has to criticise everything the system does. Therefore it would be good when the system can give some kind of success rate for each scenario. The outcomes for the several scenarios together can then be the basis for the solution.

All in all, the perceived usefulness of such a system is rather high. Although some of the subsystems are not deemed necessary. Especially as an internal tool, the system can have a good job in working with the model.

Apparent benefits

The system presented in the reconsideration workshop does have a high amount of warning facilities. One of the participants mentioned that this does give the idea that the system and its embedded knowledge is perfect. So where the system does seem very beneficiary, it really is not, since it gives a bad suggestion with high confidence. Therefore the system should mostly provide information on which the discussion can be based. The only thing the system would be doing then, is giving some suggestions which force you to think about the decision. And the system shows what you have not considered yet. The campaign manager might choose to start the campaign anyway, but at least knows where his decision is based on.

Although it would be good to have a system which says: "you need 2 million to start this campaign to make sure it is successful"; it is acknowledged that this is not possible in the near future.

5.3.3 Design decisions

The design decisions can be seen as a summary of the results in this section. The decisions were written by the researcher but they are based on the opinions of all participants in the reconsideration workshop. The following design decisions were made:

(R1) *No predefined route*: The system should not have a predefined route to follow. Recognised was that policy goals can be set after having analysed the problem.

(R2) *Practice has influence on science*: With experience from the work field, science can be influenced. This is one of the reasons why campaign managers will never become redundant. But also, when the model cannot give an answer to a certain situation, this is a situation which must be inquired by social sciences.

(R3) *Take care of short-cuts in the process*: The campaign managers asked themselves whether they were thinking about the solution whilst analysing the problem or not. This behaviour could lead to short-cuts in the design resulting in misinformed decisions.

(R4) *Several scenarios*: Considering several scenarios for each case does result in more work for the campaign manager, but comparing scenarios does lead to better solutions.

(R5) *Difficult questions will exist*: It must be recognised that even with a system it will always be necessary to answer difficult questions. The system can monitor the process and give suggestions at proper moments and information when asked for.

(R6) *Overview is important*: The campaign managers feel that using the system diminishes their connection to the designed strategy. The campaign will not 'grow' for them. Providing overview can solve this problem.

(R7) *No direct interaction*: Old-campaigns can be used as best practices but only when asked for. The nudge for the policy goal is found to be useful but the participants are still anxious towards direct interaction.

(R8) *Complexity should be visible*: The model looks complex, even with the system. Yet, the model also is complex, therefore the system should not make it look simple.

(R9) *No false certainty*: A system which gives a high amount of warnings looks very confident. But it is acknowledged that the system is certainly not confident. Therefore, warnings should only be used when certain.

(R10) *Stick to core business*: The system should stick to its core business and therefore not contain too much additional tools.

(R11) *A system is discrete*: The system is only useful when the several concepts can be measured, put into numbers. Making the answers discrete does result in a loss of information but the system would be useless otherwise. The users have to realise this.

5.4 Prototype workshop

With the results from the reconsideration workshop, the software prototype was designed.

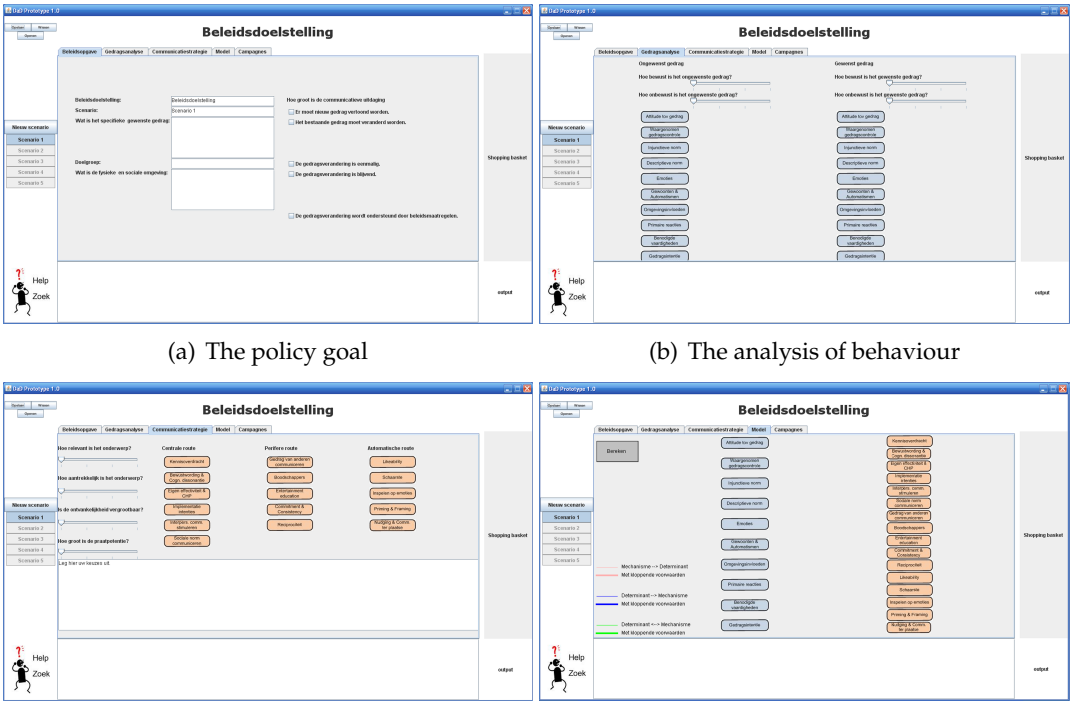
5.4.1 Description of the design

The third and last workshop is meant to put the designed ideas into practice. How does the interaction actually feel? is one of the most important questions. Not all elements have been fully implemented in the prototype, there was chosen to give a preference to the elements that actually can be tested in a useful way. Also, it was found before that the system should stay easy to handle (R10). Therefore, the prototype did have an avatar for searching and as a help function. Also, there were save and delete buttons, and an output option just beneath the to-do-list. Only none of those options actually worked. They were just bogus buttons or pictures. What did work from the surrounding elements was the policy objective at the top and the explanation field at the bottom. Especially the last one is of high importance for the system and therefore for the research.

While building this prototype it was deliberately chosen to leave out the warning options and the progress indicator. The warning options because it would be too tedious in this phase to give meaningful content to them. Also, from the reconsideration workshop it was found that there were too many of them, that gave the idea that the knowledge embedded in the system is exact, which of course it is not (R9). The progress indicator was left out because there is no such thing as progress. You have to consider all the elements, three tab screens, but there is no such thing as a path to follow through those screens (R1). This because the model, and consequently the system, is not meant to guide the designer, it is meant to give suggestions for decisions. The user may choose for himself where to begin and which order to follow. This also means that it is up to the campaign manager to not take any short-cuts (R3), however the model overview will also present this (R6).

As in the reconsideration workshop, the centre part of the system is most important. The first tab still consisted of the policy objectives and only involved answering some static questions. The system did not use the answers for reasoning, although there are some possibilities to do so. The policy objective was directly connected to the shown objective in the top part of the screen (R7). This software prototype also had a way to consider several designs in parallel (R4), although it was not possible yet to - partly copy scenarios.

The second tab was the analysis of the behaviour. This tab consisted of two equal halves, one for the undesired behaviour on the left and the one for desired behaviour on the right.



(a) The policy goal

(b) The analysis of behaviour

(c) The communication strategy

(d) The model overview

Figure 5.10: Screen shots of empty panels of Prototype 1.0

For each behaviour the amount of consciousness and unconsciousness could be set separately with as options $0, 1, 2$ or 3 (R11). Also it was possible to select a determinant and when selected, the importance of the determinant could be indicated on the same discrete scale. This meant that not selecting a determinant results in not considering it at all.

The third tab showed the communication strategy. First four, rather difficult (R5), questions were shown with a possibility to answer them via slide bars. Next to this were the mechanisms divided in three groups according to central, peripheral and automatic behaviour (see Communication Development Model [30] for an explanation of the difference). It was deliberately chosen not to present the mechanisms in two rows as they then would become too similar to the analysis of the behaviour, whereas they are something completely different. Again, mechanisms could be chosen and when chosen their importance could be set. As last on this tab was a justification box, in which the user had to justify his choices.

In the fourth tab the model was shown. After clicking a 'calculate'-button the system would show how the determinants linked to the mechanisms based on the knowledge it has (R6). Here it was chosen not to show all the links, but only the links that had a meaning for this case. There were three different types of links. In blue, the links were indicated form a determinant to a mechanism. This link was shown when the determinant was selected but the mechanism was not. In pink, the system showed the link from a chosen mechanism to an unselected determinant. And as last, in green, the links were shown which were a 'match'; so the determinant and the mechanism were both chosen. Additionally, the indicated values for consciousness and unconsciousness of the behaviour and the answers to the questions on the strategy tab were included in the calculation. When those values were found to be correct for a certain link, then the line would become bold. This shows how complex it is to

provide a clear overview of the model (R8). For ease of implementation it was chosen only to consider the undesired behaviour in the calculation, not taking into account the importance of the elements selected.

The last tab showed the old campaigns that had a connection with the chosen mechanisms. A maximum of ten campaigns were showed together with the mechanisms that they were selected on. The connection of the mechanisms and campaigns was taken from a campaign analysis of the communication department.

5.4.2 Results

From the data the following topics were found to be important by the researcher.

Strategy is design

The participants describe the system as a very linear representation of the model, whereas strategy design is something that works from talking, discussions and going back and forth. The system enables back-and-forth movement but the users have to learn to work with the system.

Design stance

During the prototype workshop there was a discussion about the necessity of analysing both the desired and undesired behaviour. As the focus could be on implementing new behaviour, one could argue that there is no undesired behaviour. On the other hand, not doing something already is undesired behaviour. This example illustrates how there can be thought differently about analysing behaviour.

Problem paradigm, breadth-first, switching and weighted adding

"Is this the policy objective or do we need to add 'alcohol' to it?" The campaign that this quote is about aims to lower traffic casualties and therefore shows rather nicely how the problem can be changed by adding one or two words. As a campaign about lowering drunk-driving is something else than a campaign that wants the target group to adhere to speed limits. The participants decided to leave alcohol from the policy objective but then asked each other whether adhering to the speed limit is 'new behaviour' or 'changing existing behaviour'. Both points of view have their arguments, but they will result in a different suggestion from the system[2].

The question about the physical and social environment arouses discussion, it is clear that these also can be a reason to assess several scenarios. Already mentioned before are the several target groups which lead to different scenarios. In the prototype workshop it becomes clear that differentiating on all these aspects must be a possibility in the system.

During the workshop the campaign managers felt that it is more important to first analyse the undesired behaviour and do research on that, and only thereafter consider the desired behaviour. Also shown is some back and forth movement. The participants start trying some variables and then see what happens. They acknowledge that they also try this with

[2]Or at least they would have when the system had taken the difference between new and existing behaviour into consideration. This is not the case for the prototype used in the workshop.

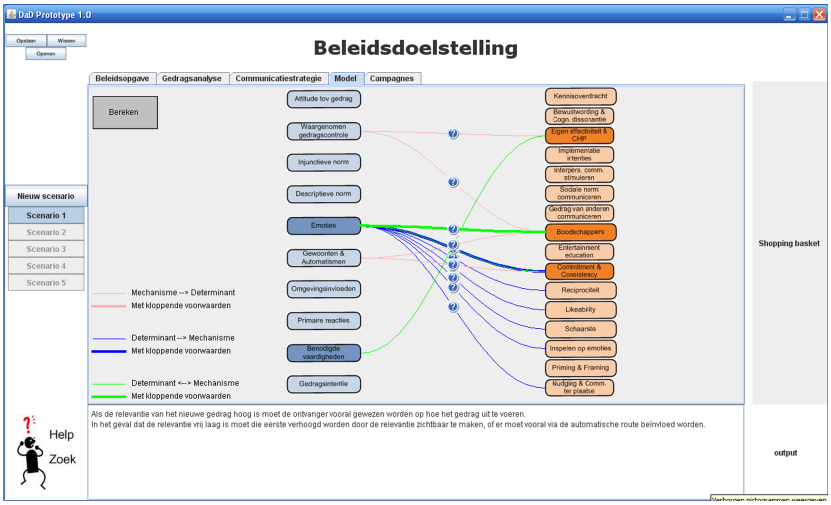


Figure 5.11: The overview of the model with some thick green lines, which indicate that the chosen combination of determinant and mechanism is a good solution for the problem considered. (This is no real case.)

the 'mediatool' mentioned before, but the prototype gives more explanation of what the reason for the change actually is.

Nevertheless, some reluctance is shown towards the way the several concepts are compared to each other. The different unconscious and conscious behaviour slide bars still give the idea that they should add up. Furthermore for a determinant it is possible that it causes undesired behaviour which is something else than the determinant being important for changing the undesired behaviour.

On the other hand, the weighted adding method is appreciated for the fact that it forces you to consider all the elements. And it shows the campaign managers that they have to make a choices. Just selecting everything does not result in clear answers. Even though it are a lot of answers to give. So on the one hand it should be easy to work with the system and enter your preferences, but it should not feel like a blanks exercise.

Overview

The prototype 1.0 does not give clear conclusions, written in words. The users would like the possibility to give their own comments to elements, in this way creating some kind of overview for themselves.

The overview of the model provided by the system causes a lot of discussion. Especially the thin lines in the system are referred to as a "missed chance". Where after the users return to the strategy design tab to check what possibility they missed (see figure 5.11).

Human in the lead

The system does not lead the users through the model. The several tabs do have their own meaning, but their is no guide like: first the analysis and then the strategy. The participants recognise this from a discussion about how the model should work kept before. This comes back at several decision points. One of the participants finds it odd that she can choose her

own route through the mechanisms; the link with the determinants is stated in the model, but the system does not give a preliminary suggestion. Again, the same users do indicate that this system already gives a better overview than the 'mediatool'.

Constructive preferences

"Can this determinant cause the desired behaviour? Is an other question than: How important is this determinant for this behaviour?" Those questions illustrate how subtle explanations of determinants are. Also, they show that the users think about how to interpret the components.

Some of the explanations confuse the campaign managers. Partly because they are different from what is in their mind, but also because some determinant overlap each other. The determinants and mechanisms are not mutually exclusive. Some of them act on each other and with each other on the same components of behaviour.

Usability

Concern is expressed that the system makes the design process look like a game too much: "Are my choices exactly in line with the model?". This is not the way you want users to feel when using the decision support system. Like said above, the users are confused by some of the explanations, therefore being triggered to just give some answer and look what the result is. Although next to this is mentioned that each explanation is better than no explanation at all.

In the prototype workshop, where the actual interaction can be tested, becomes immediately clear that the system does have some interaction errors. The slide bars do not show which end indicates a high value, they do not have a middle option and they contain not enough steps. And the text fields, in which the campaign managers can justify their decisions, do not trigger to give a complete explanation. Providing answering topics could solve this last problem.

Also, it is not possible to compare the scenarios with each other without clicking. Due to the small screen it is only possible to show one scenario at a time. Comparison must occur through switching.

Usefulness and apparent benefits

On the other hand, the system does feel useful. For instance, the campaign managers appreciate that the system helps separating the strategy from the concept. Also, by using the system, working with the model feels completely different than by answering a list of questions on paper. Therefore the overall resulting feeling is that the system has its possibilities; however, there is also indicated that system does not give full solutions. It will mostly be used as a start up of the design process, getting the ideas for the design and being able to take part in the discussion are the most useful benefits. "It really helps to make sharper decisions."

When asked how he would rate this system on a scale from one to ten, the campaign manager answered eight[3].

[3]The question was asked by an other participant, not by the researcher.

So the apparent benefits of the system are: provoking a clear discussion, being useful to work with and helping in making better decisions. The campaign manager feels that he would choose the intervention that is favourable according to the system.

5.4.3 Design conclusions

From this last workshop, the design decisions are more presented as conclusions, as they will not be taken further to a next workshop. They are still listed to be referred to later. From the prototype workshop the following design decisions were made:

(S1) *Design process seems too linear*: The system makes it look as the design process is straightforward and linear. This should certainly not be the case.

(S2) *Arousal of discussion*: The system clearly arouses discussion about the concepts and elements but also about the design process of the strategy.

(S3) *Back-and-forth movement*: The moment the users understood the system, they started to move back-and-forth trough the several panes.

(S4) *Weighted adding*: The weighted adding method is not always found pleasurable to work with because it looks rather tedious, but it is appreciated because it forces the user to make a decision.

(S5) *Overview motivates reconsideration of choices*: The campaign managers refer to the thick lines in the model ass 'missed chances' and start to reconsider them. On the other hand, written output is still considered to be a useful addition.

(S6) *Human in the lead*: The users are somewhat confused at the start of the workshop because the system does not guide them. After getting known of the system they appreciate how it works.

(S7) *Comparison of scenarios*: The usability still has some small issues, like several scenarios cannot be compared in one screen.

(S8) *Separation of tasks*: The system is valued because it separates the strategy and the concept. The campaign managers think that it will be used to generate ideas as a start up for the strategy.

5.5 Prototype 1.1

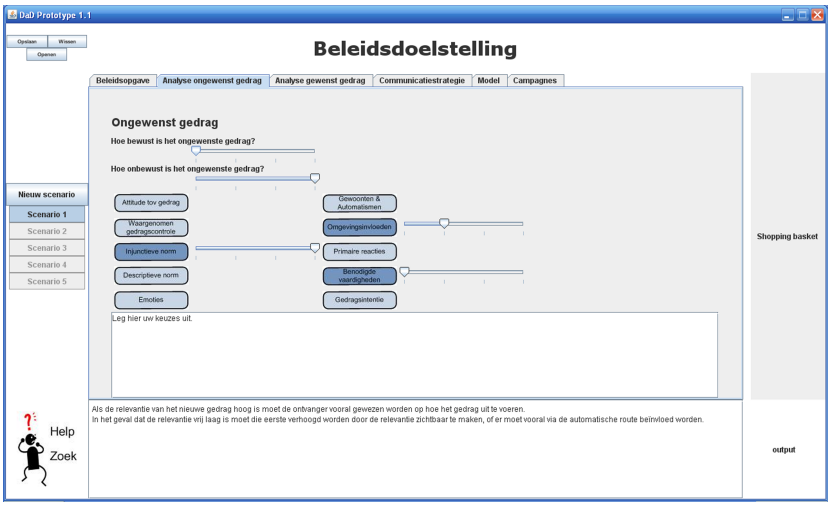
As can be seen from the previous section, the prototype still has some minor usability issues. Not all of them are fixed in the final prototype because this would result in too much work. Especially because the final prototype will only be used for presentation purposes and not for further research.

One important aspect was redesigned for the final prototype. In the analysis phase, the undesired and desired behaviour are disconnected from each other. This separation is also shown in the overview on the model screen. This separation occurs because the designer of the system saw the analysis of the behaviour as the problem, and the strategy as the solution; however, the writers of the Communication Development Model [30] saw the undesired

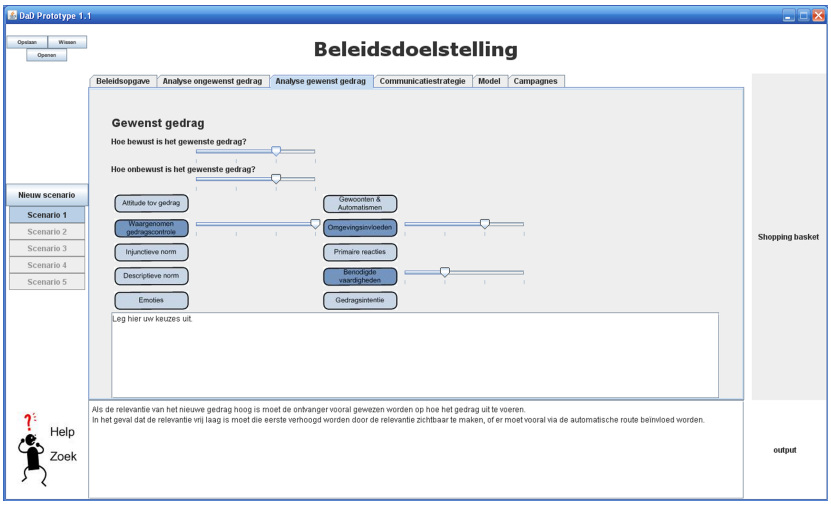
behaviour as the problem and the desired behaviour as the solution, the strategy is then the path towards the solution. Which of those views is correct will not be discussed, but separating the desired and undesired behaviour means that the user can choose for himself how he wishes to look at it.

Furthermore, creating a separation makes it possible to put both kinds of behaviour in the model overview. This again enables the possibility to consider only one of them. Which was the stance of one of the campaign managers.

While building Prototype 1.1, also care was taken for a full working algorithm. So this version also takes the importance factors of determinants and mechanisms in consideration. This is shown by the thickness of each line and will be fully explained in chapter 6.



(a) Analysis of undesired behaviour



(b) Analysis of desired behaviour

Figure 5.11: Screen shots of Prototype 1.1. The analysis of the undesired and desired behaviour have been separated. Figure 5.12 shows the new model overview.

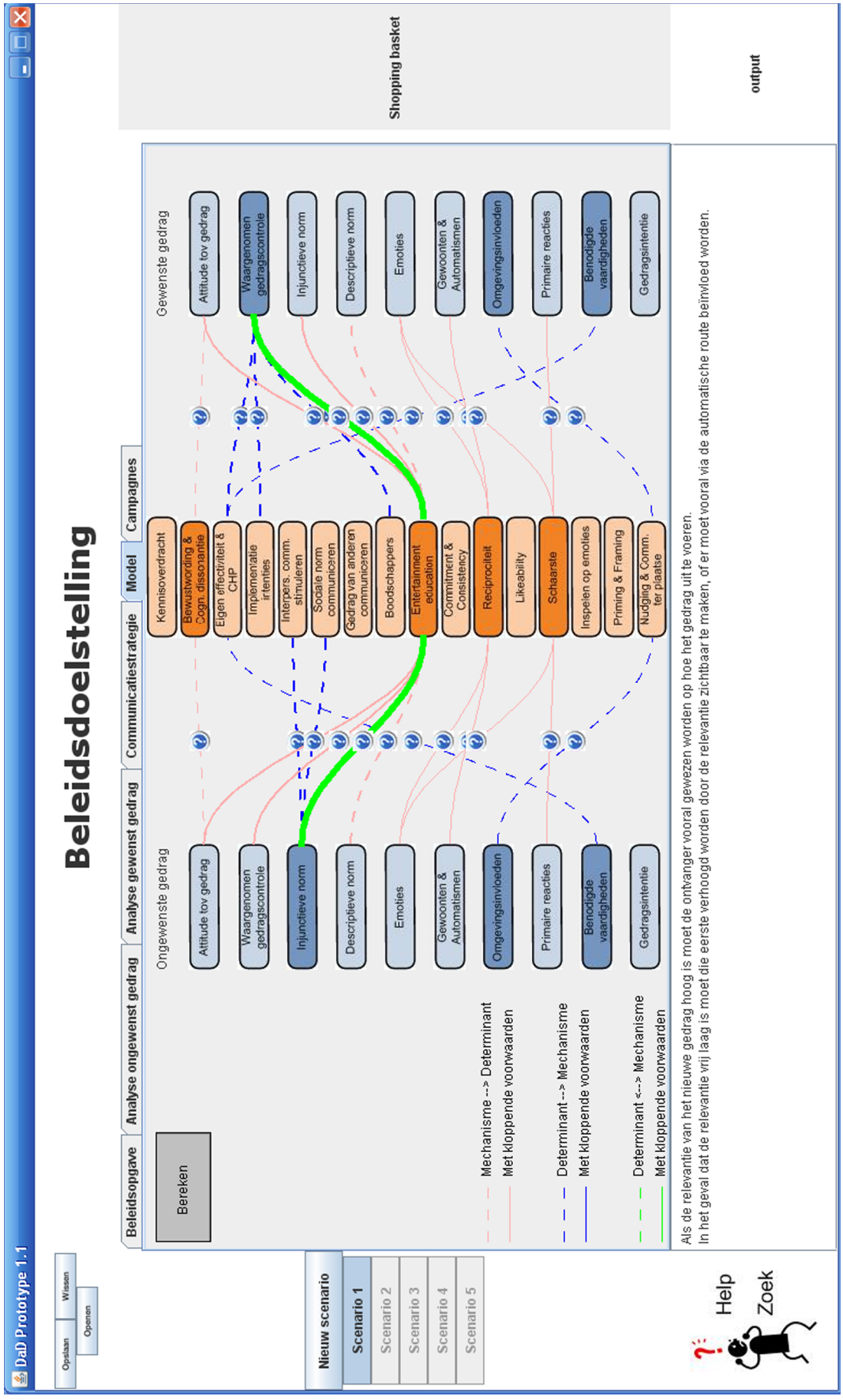


Figure 5.12: The model view shows that it is possible to address an issue on the *injunctive norm* by using *entertainment education* to change the *perceived control of behaviour*.

Reasoning engine 6

A decision support system can be divided into four main elements. The two elements of research in this thesis together form the interface, the part of the decision support system which is seen by the user, the part that asks for input and shows the output. Of equal importance is the reasoning engine, the part that takes the input, matches it against knowledge and provides the output which is shown by the interface. This chapter will deal with the architecture and algorithms of the reasoning engine.

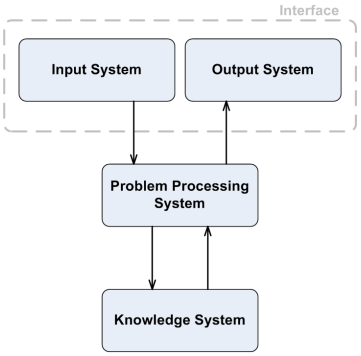


Figure 6.1: Basic architecture of a decision support system [5] - *interface block added by the author* -. (For a full description see section A.4.1.)

In short, this thesis considers a decision support system as consisting of four elements, shown in figure 6.1. - This is a rather unspecific view taken from [5]. Other, more detailed, architectures do exist, but the view used is detailed enough for the point of this thesis. - Input from the user is managed by the *language system* and output to the user is managed by the *presentation system*. Together, they form the interface of the decision support system. This research focuses on the design of this interface. So where in this thesis is spoken of the design of a decision support system, the elements inside the dashed box are meant.

Nevertheless, a useful decision support system also needs a well designed reasoning engine. Therefore, the fifth sub question of this research states: *"Which knowledge, from the communication development model, can be made accessible by the decision support system?"*. The Communication Development Model [30] describes knowledge which is useful for campaign managers, but a computer cannot read a document; at least not one of this complexity. Therefore, the knowledge must be transferred to some format comprehensible for the system. How can this be done? First the decision strategy that is implemented in the problem processing system.

Back to the architecture. The reasoning engine consists of the bottom two parts of figure 6.1: the *problem processing system* and the *knowledge system*.

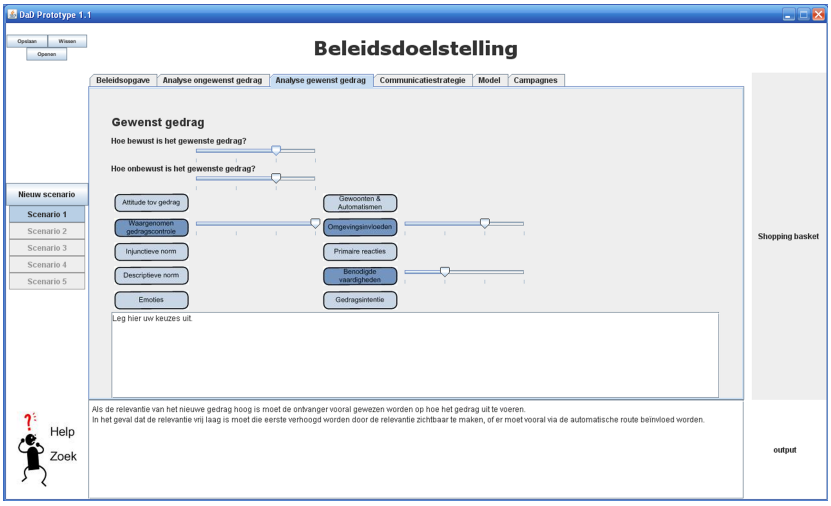


Figure 6.2: The analysis of behaviour tab with checked and unchecked determinants. Separate .jpg icons are used to display checked and unchecked elements.

6.1 Knowledge system

The knowledge system is a database which contains all static information the system has, in this case the information from the Communication Development Model [30]. Ideally, the knowledge system can be changed without having to rewrite the parts above. So for this research, the information from the Communication Development Model [30] was reduced to a basic set of elements, presented in appendix C, which are stored in an Excel-file. Theoretically new determinants, mechanisms and links can be added to the Excel-file without having to rewrite the problem processing system or the interface.[1]

6.1.1 How knowledge is stored

In the Excel-file, the following useful information is stored. The first sheet contains determinants of behaviour for the analysis of undesired behaviour, the second sheet contains the determinants for desired behaviour. In the current knowledge engine both sheets are the same, but theoretically it is possible that other determinants are needed for the two separate kinds of behaviour.

Each determinant has its own line and each column represents a variable of the determinant, there are nine columns. The first column is the name of the determinant, the second a code which is used by the problem processing system to refer to this determinant. The third and fourth column give the name of the icon for this determinant in respectively the unchecked and checked state - as can be seen in figure 6.2 determinants turn dark blue when selected, for this separate icons were used -. The fifth column gives a page of the original document [30] on which information on this determinant can be found, the sixth column gives a short explanation. The last three columns contain respectively values for the consciousness, unconsciousness and changeability of the specified determinant.

[1] In practice determinants and mechanisms are shown on the screen by drawn icons, so for new concepts new icons would have to be created.

The mechanisms are stored in the same manner. Only they have six columns, respectively for: the name, a code, the unchecked icon, the checked icon, a page number and a short explaining text for this mechanism. The Excel-file furthermore has a sheet for old-campaigns which can be used as comparison. Those campaigns are stored with their name followed by two or three mechanisms which were used in this campaign. Mechanisms have been added afterwards by the Public and Communication Department. In future, this part of the database will grow when new campaigns are designed.

The most interesting part of the knowledge engine is stored in the links between the determinants and the mechanisms. It are those links which are supposed to raise discussion, but it cannot be said that all of them are exactly set and agreed on. Fortunately, it is possible to change the links without any restrictions when the program is not being used. The links are stored on a separate sheet in the Excel-file. Each link has nine columns. The first two contain the codes of the link and the mechanism which are connected by this link. The third column gives a textual explanation of 'why' this link exists and 'how' it can be used. The other six columns contain the variables for each link in the following order: consciousness, unconsciousness, relevance, attractiveness, susceptibility and possibility of speech. Actually, it are those values which are used by the problem processing system to calculate the given suggestions. This will be discussed in next section, now first there will shortly be explained how the knowledge engine is read.

6.1.2 How knowledge is read

At the moment the decision support system is started, it will first read the Excel-file and store all the knowledge in scenario's; because of this it is not possible to change the Excel-file while the program is running, as the program will only read the Excel-file when it is started. It was chosen to make the *Scenario* the basic class[2] of the problem processing system. A scenario contains: two lists of determinants, one for desired and one for undesired behaviour; a list of mechanisms and a list of old campaigns. So, the program starts with reading the Excel-file and stores the separate sheets in their corresponding lists in the scenario.

The close reader will have noticed that the links do not have their own list in the scenario. That is because links are stored inside the determinants and mechanisms. So each determinant 'knows' to which mechanisms it is linked, and the other way around, each mechanism also 'knows' which determinants it is connected to. Actually, the program considers a link from a determinant to a mechanism as something else than the link from a mechanism to a determinant. However, the two are read from the same sheet in the Excel-file, and therefore one cannot exist without a counterpart of the other one; the two links can be considered as a binovular twin.

The scenario also stores all answers to questions and text entered in text boxes. The exact manner in which this is done will not be discussed here, it is enough to know that the scenario is the base point of the system. So the interface part checks the scenario class to find out which determinants and mechanisms must be shown and in what order. When a determinant is selected on the screen - input -, the interface will push this information to the scenario which in its turn, will tell the interface that an other icon must be shown - output -. - Selecting a determinant means that the determinant becomes darker. -

[2] 'Class' is a term from (Java-)programming, it can contain other classes (knowledge) and perform certain tasks. Check (Java-)programming guides for a full reference.

When the decision support system is asked to give a suggestion it will start the calculations. The next section will describe how this algorithm works.

6.2 Problem processing system

This section will only explain how the problem processing systems reads the input received from the interface and how it calculates an answer. First the algorithm as used in Prototype 1.1 will be described in text. After that, the code is provided. The numbers provided refer to the lines of code in section 6.2.2, the numbers written between parenthesis refer to figure 6.4.

6.2.1 Algorithm in text

The goal of the 'bereken' - 'calculation' - method is to find the links which have to be displayed by the model overview. These links are either perfect or not perfect and their thickness indicates how important they are. The calculation of what is perfect and not perfect and the calculation of the importance is the part that will be described below.

The algorithm starts with creating lists in which the results from the calculations are stored. This is done in two sets of six lists, the first set is for the desired behaviour, the second for the undesired behaviour. As they are similar, only the desired behaviour will be explained. The interface reads these lists to know which lines should be displayed in which manner and colour, see also figure 6.3.

The system knows three kinds of links: links from a selected determinant to an unselected mechanism, lines 7 and 8 shown in blue in figure 6.3; links from a selected mechanism to an unselected determinant, lines 9 and 10 shown in pink in figure 6.3; and links from a selected determinant to a selected mechanism, lines 11 and 12 shown in green in figure 6.3. The last set of links are called 'hits', because those indicate that a correct choice has been made. Also, a link is either strong - perfect - lines 7, 9 and 11 or weak - not perfect - lines 8, 10 and 12. In the model overview, weak links are showed as dashed lines and strong links are shown as full lines.

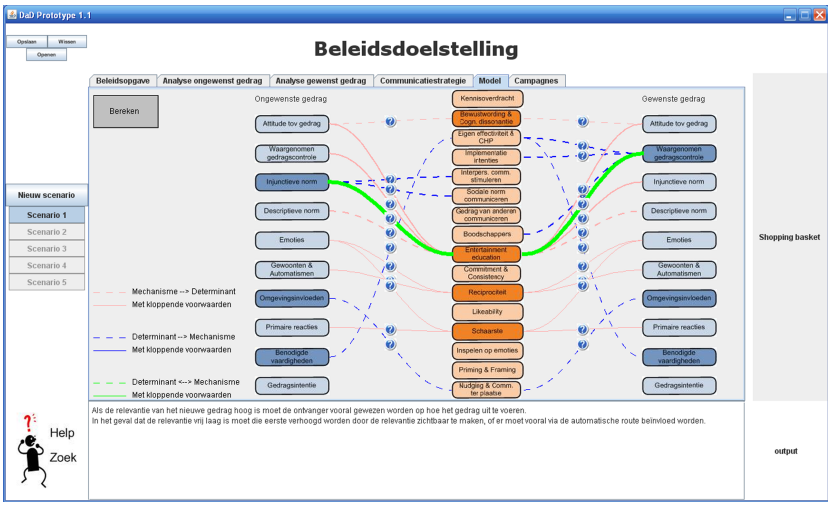


Figure 6.3: Model overview from prototype 1.1

Next, how are those lists filled? This process roughly contains four steps. First, the problem processing system stores the selected determinants and mechanism temporarily, lines $26-39$. Second step, line $40-57$, the algorithm checks which hits are found. Of each hit it is checked whether it is a strong link or not, line 48, and the value of the link is set, lines 49 and 52. In lines 50 and 53 the result is added to the corresponding list. Third step, the links from a selected determinant to unselected mechanisms are found, lines $58-76$. This process is the same as above, only line 64 is added, this makes sure that the link is not already stored in another list. The fourth step, lines $77-95$ is the same as the third step, but then for the selected mechanisms to unselected determinants.

Also the algorithm makes use of some assisting methods, the most important ones will be explained now. Lines $102-127$ show one of the methods for calculating the importance of a link, the importance indicates how thick the link is displayed. The method gets the determinant and mechanism which are connected by this link, lines 116 and 117. Then, from this determinant and mechanism the importance is read from the interface (shown by the numbers (3) and (8) in figure 6.4), lines 120 and 122. These values are added to each other, line 124, and stored in the link, line 125. The interface reads from this value how thick the link has to be drawn.

The method which checks whether a link matches perfectly with the analysis or not is shown in lines $129-140$. This method reads the values indicated by (1) and (2) in figure 6.4 and matches this with the corresponding values in the link. If they match, then the link is perfect and drawn as a full line, otherwise it is drawn as a dashed line. The next method, lines $141-152$, does a similar thing but then for the values indicated as $(4-7)$ in figure 6.4. For a 'hit' to be perfect, both methods must return true as indicated by line 48.

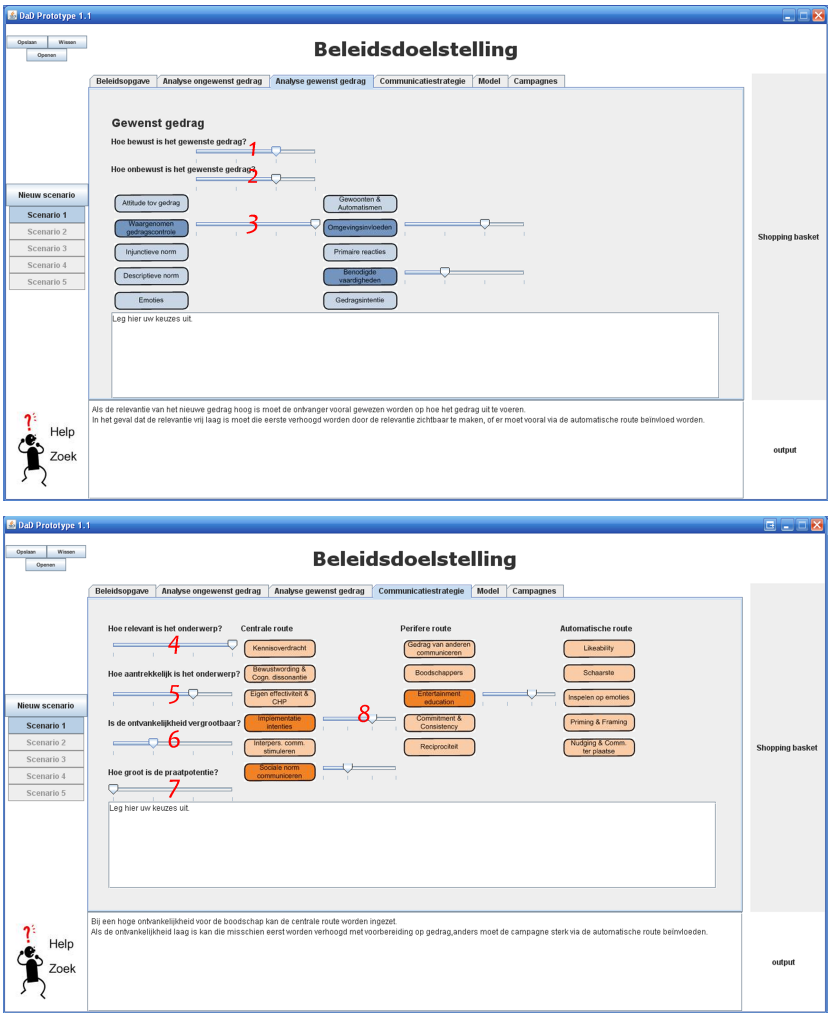


Figure 6.4: Numbered screen shots from Prototype 1.1

6.2.2 Algorithm in Java-code

```
1   /**
2    * Calculation algorithm of the problem processing system.
3    * For each determinant the links with the mechanisms are found and vice versa.
4    */
5   public void bereken(){
6     //Storage lists for links for the desired behaviour
7     strongDMLGew = new Vector<DetMechLink>();
8     weakDMLGew = new Vector<DetMechLink>();
9     strongMDLGew = new Vector<MechDetLink>();
10    weakMDLGew = new Vector<MechDetLink>();
11    strongHitGew = new Vector<DetMechLink>();
12    weakHitGew = new Vector<DetMechLink>();
13
14    //Storage lists for links for the undesired behaviour
15    strongDMLOng = new Vector<DetMechLink>();
16    weakDMLOng = new Vector<DetMechLink>();
17    strongMDLOng = new Vector<MechDetLink>();
18    weakMDLOng = new Vector<MechDetLink>();
19    strongHitOng = new Vector<DetMechLink>();
20    weakHitOng = new Vector<DetMechLink>();
21
22
23    /**
24     * Desired behaviour
25     */
26    //Selected determinants and mechanisms are temporarily stored
27    Vector<Determinant> tijdelijkd = new Vector<Determinant>();
28    Vector<Mechanisme> tijdelijkm = new Vector<Mechanisme>();
29
30    //Find the selected determinants
31    for (int i = 0; i < getGewenstDet().TOTAL; i++) {
32      Determinant td = getGewenstDet().getDeterminant(i);
33      if(td.isSelected()) tijdelijkd.add(td);
34    }
35    //Find the selected mechanisms
36    for (int i = 0; i < getMechanismen().TOTAL; i++) {
37      Mechanisme tm = getMechanismen().getMechanisme(i);
38      if(tm.isSelected()) tijdelijkm.add(tm);
39    }
40    //Check whether hits are found in the temporarily stored determinants and
        mechanisms
41    for (int i = 0; i < tijdelijkd.size(); i++) {
42      Vector<DetMechLink> dmls = tijdelijkd.get(i).getDetMechLinks();
43      for (int j = 0; j < dmls.size(); j++) {
44        DetMechLink dml = dmls.get(j);
45        Mechanisme m  = dml.getMechanisme();
46        if(m.isSelected()) {
47          //If all demands are met, this link is a strong link
48          if(perfectDeterminantLinkGew(dml) && perfectMechanismeLink(m.getLink(
              dml.getDeterminant()))){
49            setTValueGew(dml); //New in Prototype 1.1
50            strongHitGew.add(dml);
51          }else{
52            setTValueGew(dml); //New in Prototype 1.1
53            weakHitGew.add(dml);
```

```
54            }
55          }
56        }
57      }
58      //Find the links from the determinants (so no connection to selected
            mechanisms)
59      for (int i = 0; i < tijdelijkd.size(); i++) {
60        Vector<DetMechLink> td = tijdelijkd.get(i).getDetMechLinks();
61        for (int j = 0; j < td.size(); j++) {
62          DetMechLink cur = td.get(j);
63          //If it is not already contained in another list, put it here
64          if(!hitGewContains(cur) && !mechGewContains(cur)){
65            //If all demands are met, this link is a strong link
66            if(perfectDeterminantLinkGew(cur)){
67              setTValueGew(cur); //New in Prototype 1.1
68              strongDMLGew.add(cur);
69            }
70            else {
71              setTValueGew(cur); //New in Prototype 1.1
72              weakDMLGew.add(cur);
73            }
74          }
75        }
76      }
77      //Find the links from the mechanisms (so no connection to selected
            determinants)
78      for (int i = 0; i < tijdelijkm.size(); i++) {
79        Vector<MechDetLink> tm = tijdelijkm.get(i).getMechDetLinks();
80        for (int j = 0; j < tm.size(); j++) {
81          MechDetLink cur = tm.get(j);
82          //If it is not already contained in another list, put it here
83          if(!hitGewContains(cur) && !detGewContains(cur)){
84            //If all demands are met, this link is a strong link
85            if(perfectMechanismeLink(cur)){
86              setTValueGew(cur); //New in Prototype 1.1
87              strongMDLGew.add(cur);
88            }
89            else {
90              setTValueGew(cur); //New in Prototype 1.1
91              weakMDLGew.add(cur);
92            }
93          }
94        }
95      }
96      /**
97       * Undesired behaviour
98       */
99      //Algorithm is similar to desired behaviour, only the results are stored in
            the second set of six lists.
100   }
101
102   /**
103    * The links from a mechanism to a determinant.
104    * Takes the determinant from desired behaviour
105    * and the mechanism which are connected by link 'mdl'.
106    * Calculates the importance value of this link by
107    * adding the indicated importance values from the
```

```
108     * selected determinant and mechanism.
109     * Stores this value in the link itself.
110     *
111     * @version Prototype 1.1
112     * @param mdl the link for which a value is calculated
113     */
114    private void setTValueGew(MechDetLink mdl){
115      mdl.resetTValueG();
116      int index = parentWindow.getCurrentScenario().getGewenstDeterminanten().
             getNoDeterminant(mdl.getDeterminant());
117      Determinant det = parentWindow.getCurrentScenario().getGewenstDeterminanten()
             .getDeterminant(index);
118      Mechanisme mech = mdl.getMechanisme();
119
120      int dval = 0;
121      if(det.isSelected()) dval = det.getBelang().getValue();
122      int mval = 0;
123      if(mech.isSelected()) mval = mech.getBelang().getValue();
124
125      int calc = dval+mval;
126      mdl.setTValueG(calc);
127    }
128    //The link from the determinant to the mechanism has a similar method
129
130    /**
131     * Checks whether the link matches perfectly
132     * with the answers given to conscious and unconscious
133     * in the analysis of the undesired behaviour.
134     *
135     * @param cur: the link from determinant to mechanism to be checked
136     * @return true if the link matches completely, false otherwise.
137     */
138    private boolean perfectDeterminantLink(DetMechLink cur){
139      return cur.getBewustInvloed() == parentWindow.getCurrentScenario().
             getOngBewustInvloed() &&
140      cur.getOnbewustInvloed() == parentWindow.getCurrentScenario().
             getOngOnbewustInvloed();
141    }
142    /**
143     * Checks whether the link matches perfectly
144     * with the answers given to relevance, attractiveness, etc.
145     *
146     * @param cur: the link form mechanism to determinant to be checked
147     * @return true if the link matches completely, false otherwise.
148     */
149    private boolean perfectMechanismeLink(MechDetLink cur){
150      return cur.getRelevantie() <= parentWindow.getCurrentScenario().getRelevantie
             () &&
151      cur.getOntvankelijkheid() <= parentWindow.getCurrentScenario().
             getOntvankelijkheid() &&
152      cur.getAantrekkelijkheid() <=  parentWindow.getCurrentScenario().
             getAantrekkelijkheid();
153    }
```

Listing 6.1: Part of the Java-code of the algorithm, class ModelManager.java

An example strategy design 7

The communication strategy designed below serves as an example of how the decision support system could be used, a first iteration of the design process is shown. The strategy is written by the author of the thesis and uses DaD Prototype 1.1 as decision support system. Aim of the example campaign is to increase the usage of bicycle lights.

Figure 7.1: Poster of the 'Val op!' - *Catch the eye!* - campaign of the government.

This chapter will follow the flow in which this strategy is designed. So first the policy goal, then the analysis of the undesired and desired behaviour after which the strategy is chosen. The model view helps with the discussion and the actual choice of the strategy. Please note that this is not the 'only right' sequence of using the decision support system as there is no such thing as a right sequence, everything is possible.

7.1 Policy goal

To start, the policy goal for the communication strategy is formulated: "Cyclist should always have working bicycle lights.". The first target group considered is the part of the general public that cycles, so cyclists. (The screen for the policy goal is showed figure 7.2(a).) And as a first formulation of the specific desired behaviour is stated: "Cyclist should repair their lights, or buy new light when they currently do not have them. The behaviour should be repeated when the light breaks." So, the desired behaviour is continuous and should be enduring.

Now it can be discussed whether the desired behaviour is 'new behaviour' or a 'change of existing behaviour'. Arguments can be made for both propositions. Here it is assumed that everybody knows what bicycle lights are and how to use them, only in the current behaviour there is some reason not to use lights. Therefore desired behaviour is indicated as a 'change of existing behaviour'.

For the physical and social environment is written: "The street, with other traffic. Being visible is in everybody's concern.". Furthermore, the desired behaviour is supported by

policy measures because driving without lights at night is prohibited by law; which again is enforced by fines.

(a) General public

(b) Students

Figure 7.2: Analysis of the policy goal.

During the analysis of the policy goal a second, more specific, target group is thought of. A new scenario is made with the target group of 'students' as specific subject (see figure 7.2(b)). This second target group is chosen because students more often have bicycles without light.

The specific desired behaviour is kept the same, but for the physical and social environment it is written: "Student bicycles are more often parked outside and often in areas crowded with other bicycles. Because of this, the bicycle and its lights will break more often. Also the social environment has an effect, as students more often use their bicycle at night and it is common among students not to have bicycle lights.".

With this in mind, the undesired behaviour is analysed.

7.2 Undesired behaviour

(a) General public

(b) Students

Figure 7.3: Analysis of the undesired behaviour.

First the 'general public' is considered, see figure 7.3(a). The undesired behaviour is perceived as highly 'unconscious' behaviour although there also is a 'conscious' part in it. This because people often know that cycling without light is not a smart thing to do, but they end up doing it anyway; without being able to explain why this behaviour occurs.

As first important determinant 'Perceived behavioural control' is selected: having to repair your light all the time is a tedious task; detachable lights are always in your other coat, lost or the batteries have gone dead.

The next important determinant is 'Habits': when driving without light is your habit, you do not think about it any more and there are lampposts on each street anyway.

Also of influence are 'Primary reactions': often the cyclist is only remembered of his malfunctioning light when he needs it at night, at that moment it is still more beneficiary to cycle than to go by food.

To a lesser extent the 'Necessary skills' have influence on the undesired behaviour: on the one hand this is the ability to repair your own light, but also the nearness of the bicycle repair shop or the department store is of influence.

For the students two determinants are added to the list above, see figure 7.3(b). The first being the 'Descriptive norm': students do cycle without light in the same way as they scream at night, are drunk all the time and hardly ever can be seen studying. So for them the undesired behaviour is normal and, amongst the group, accepted.

Also, 'Outside influences' are more important for students. Student bicycles are often maltreated. They are mostly parked outdoors between lots of other bicycles which results in damaged cables and lights. Furthermore, students more often cycle at night, but almost always in the bigger cities were there are less cars, at least in the narrow streets of the city centre, and more light.

Next, the desired behaviour will be analysed.

7.3 Desired behaviour

Figure 7.4: Analysis of the desired behaviour for both the 'general public' and 'students'.

The analysis of the desired behaviour is the same for the 'general public' and the 'students', therefore only one picture is presented in figure 7.4. The new behaviour should be entirely 'conscious', although there is some extent of habit in using your lights; usage must always be in front of the mind. As usage also means checking the batteries and replacing when necessary.

As important is found the 'Attitude towards behaviour': using lights on his bicycle is

mostly beneficiary for the user himself, therefore it should be rather easy to create a positive attitude towards this behaviour.

'Emotions' can be used to trigger fear of the danger of driving without lights. However, fear only works when there is a reasonable and concrete solution for that fear. Luckily, this case is such a solution.

Using you light should become a 'Habit'; yet, checking the light and repairing when necessary must be a conscious act. Therefore this determinant has only a minor influence.

As last, the 'Intention of behaviour' is present for most people. Everybody knows the importance and necessity of being seen in traffic at night. Still, there are people who do not transform this intention into actual behaviour.

Now the undesired and desired behaviour have been analysed, the communication strategy will be considered.

7.4 Communication strategy

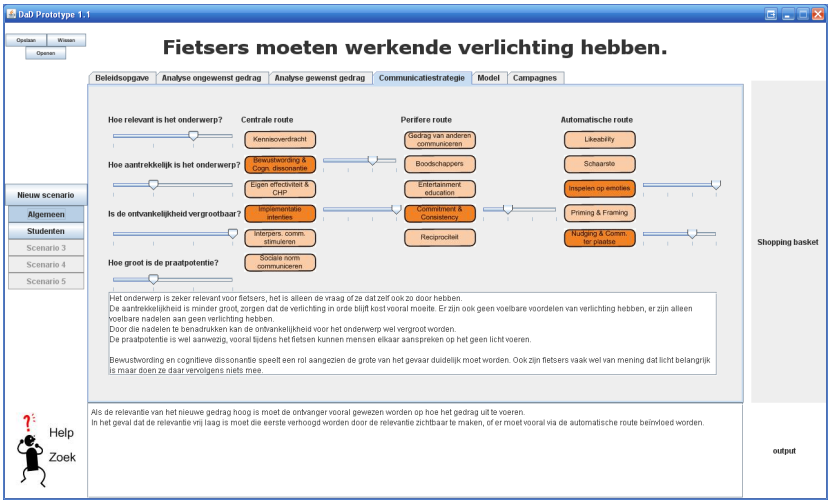


Figure 7.5: Communication strategy for both the 'general public' and 'students'.

Again the strategy is found to be the same for the 'students' and the 'general public'. First, the four questions on the left of the screen in figure 7.5 are considered. The subject is found to be 'relevant' to the target group; they may not perceive it as such yet, but it is. Because of the current undesired behaviour it can be assumed that the behaviour is not 'attractive'. There are no apparent benefits of showing the desired behaviour, there is only a possibility of harm when the behaviour is not shown. By stressing the likely harm it is possible to enlarge the 'susceptibility' to the behaviour. As last the 'possibility of speech' is seen as not very high, as the subject is not very interesting.

'Becoming aware & Cognitive dissonance' is seen as a possibility in this strategy because the magnitude of the danger has to become apparent. And as said, most cyclists know that light is important but they do not act on this knowledge.

For this, also 'Implementation of intentions' is used. The intention must get a more important place in daily life. In some way people must remember to repair their lights by day

when they do not need the lights.

The behaviour could also be made more important by 'Commitment & Consistency'. The cyclist makes a deal with himself that he has to make sure that his light works for his own safety.

By 'Playing on emotions' fear of not being seen can be used to have the cyclist use lights. As said before, a concrete suggestion must be given for the possibility of how the danger can be avoided.

By 'Nudging & Communication on location' the cyclist can be shown how dangerous cycling without light is the moment he is actually doing it. Also, fines or the possibility to buy detachable lights can help in increasing usage of lights on bicycles.

7.5 Model view

The overview of the model is used to reconsider the choices made in this first iteration of strategy design. This is first done for the 'general public' (figure 7.6(a)).

The attention is drawn by the bottom part of the model. It seems that 'Nudging & Communication on location' is the ideal solution for this problem. This mechanism can change the 'Primary reactions' and it can use 'Emotions' - danger and fear -. Also, this mechanism breaks the 'Habit' of cycling without light.

On the other hand, 'Nudging & Communication on location' does seem rather difficult to use in this situation. Controlling people at night is not only expensive but also very labour intensive. On the other hand it is already done by standard police controls; so increasing those controls should result in the desired behaviour.

Next to this, 'Implementation of intentions' must certainly not be forgotten. The solution does not seem entirely ideal because of the high amount of 'unconsciousness' and the lack of 'attractiveness' of the behaviour, but the mechanism could work for a large part of the target group. Additionally, e.g. radio commercials can reach the audience at the right moment, at daylight, to remember them to repair their lights.

Furthermore, the overview of the model does not seem to suggest that we have missed important elements (no thick lines to unselected components).

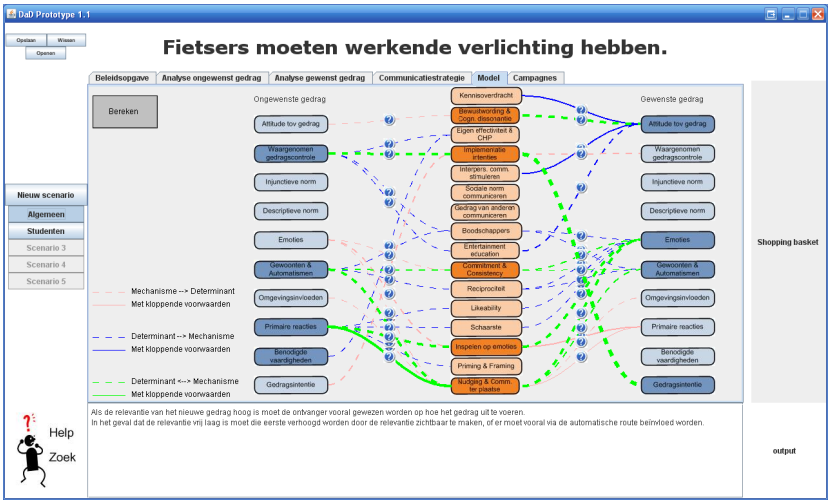
For the 'Students' (figure 7.6(b)) it seems that the 'Descriptive norm' of the undesired behaviour can be changed accordingly with an increase of 'Attitude towards behaviour' of the desired behaviour. Therefore, the usage of 'Entertainment education' should be reconsidered.

Moreover, the 'Outside influences' confirm the usage of 'Nudging & Communication on location'. It is more easy to have police control inside city centres, also other specific locations like university campuses and train stations can be chosen to start a campaign from.

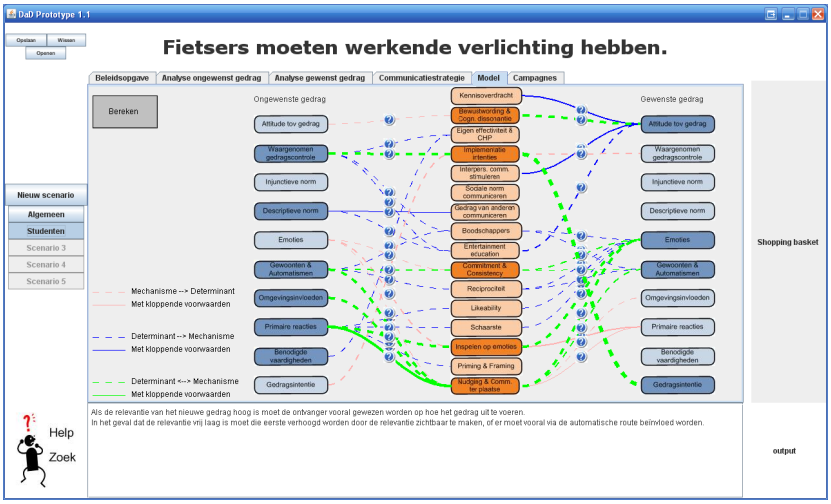
7.6 Chosen strategy

In the above scenario, two main triggers for the desired behaviour are mentioned. The first is fining the undesired behaviour, the second is creating fear of the undesired behaviour. The first can be done by police controls only and connects with 'Nudging & Communication on location'. The second is more usable in a multimedia campaign. Of course fear of getting a fine can also be used in a campaign.

Question is: which of the two works better? Or is it somehow possible to embed both arguments for using lights in the same campaign. In this case it looks beneficiary to use both. As police controls at night can enforce usage of bicycle lights but the risk of being caught is not very high. A media campaign can remember - nudge - the cyclist of repairing/buying light by day. So an at first unexpected outcome is that there are reasons to have a campaign by daylight, whereas it is a problem which only occurs at night.



(a) General public



(b) Students

Figure 7.6: Overview of the model.

Conclusion 8

The conclusion will first address the sub questions in order as stated in the introduction. Then a set of guidelines will be given as answer to the main question.

> DSSs imply the use of computers to assist managers in their decision processes in semi- and ill-structured tasks, to support rather than replace managerial judgment, and to improve the effectiveness of decision making rather than its efficiency (Keen and Scott Morton 1978).

Figure 8.1: Citation from [22].

When and in which setting will the communication professional use the decision support system?
Due to the narrow task of the system, it will only by used by the campaign manager alone to form his ideas, so mostly not while talking to the client or the marketing agency. However, in a futuristic view, working in a larger context seems favourable, but for a start the system is too cumbersome to be of direct use in a group discussion because its suggestions need to be thought over and therefore cannot be used instantaneously.

What does the communication professional expect from the decision support system?
During the open minded workshop, the participants designed a system which helped them using the Communication Development Model [30], but they also came up with several additional features which supported their overall job. There was discussion about what the system should actually be able to do. A device which made it possible to mail to clients and marketing agencies directly seemed useful at first and the system should be able to provide a complete briefing as output, but in the later design workshops these kind of features were removed again. One of the participants stated that he would use the system at the start of the strategy design process to get some ideas; find which concepts are useful and which are not. The system might be taken up again when necessary during the design process, but the system should certainly not be necessary all the time. So the campaign managers expect the decision support system to make the knowledge from social sciences comprehensible and to help with making concrete choices.

Which part of the strategy design process can be supported by the decision support system?
With the Communication Development Model [30] it is clear which knowledge from social sciences can be applicable in certain situations. Considering and choosing from all possible combinations is still a tedious task. This task can be supported by a decision support system. Especially in the first design of such a system, it is good to narrow the system down to only this task. When the system has proven to be useful, other aspects of the strategy design process might be added in later designs. So making a briefing, mailing clients and calculating costs are all tasks which a campaign manager would like to do outside the system.

Which tacit knowledge, work bias and implicit practices can be made explicit by the decision support system?
Amongst the several campaign managers who participated in this research, different explanations of the concepts of the model were available; even though they all worked according to the same document. These differences are mostly not made explicit and even when they are they cannot be erased completely. They might even become bigger when the model becomes a habit and denotations of concepts evolve. So a stable factor in the design team is needed to keep the denotations of the concepts on the same line. A decision support system can provide this stable denotation.

Which knowledge, from the communication development model, can be made accessible by the decision support system?
A decision support system is particularly good at showing connections within information. For the Communication Development Model [30] this means the links between the determinants and the mechanisms. But also how those links react on the questions stated in the model, like: "How relevant is the information?". Also, the decision support system can give short explanations of concepts in a useful manner. Still, the user has to understand the model and know it rather well, as the system can only provide reminders and not whole explanations.

How do scientists from the social sciences see the suggestions of the decision support system?
The scientists who wrote the Communication Development Model [30] did not have the intention to use it as the basis of a decision support system. So from the beginning, they were rather sceptical about the possibilities such a system has. Especially reasoning with exact numbers was found to be not representative for the nature of the model and social sciences. During the discussions, interest in the line of thinking arose and some said that this 'technical' way of approaching social sciences might have its benefits.

8.1 Guidelines

What are guidelines for the design of a decision support system which improves the use of the 'Communication Development Model' by communication professionals while designing government communication strategies that aim to influence people's behaviour?

So the outcome of this research is a set of guidelines for designing a decision support system. This is certainly not a complete set, but the guidelines contribute to the work on designing decision support systems. The guidelines address the most apparent issues which were found during the several design workshops.

Involve the user in the design. Developed was a decision support system meant to work in a professional context. The system should therefore fit in the context. The best way to achieve this is involving the end user in the development process. In this way a system is created which adheres to the needs of the user and because of the - early - involvement, the users understand what the system can and cannot do. Especially the last, what the system cannot do, is often a source of irritation which grows if the user does not understand why the system cannot perform a seemingly easy task. Furthermore software design for work processes means a change in that process. The software

is designed to fit in the process; but also, the process and therefore the professionals acting in the process change towards the software.

Show the complexity of the task. Again because of the professional work context, problems of a certain complexity are addressed by the decision support system. Complexity which arises from the ill-definedness of the problems and the vast amount of solutions. The decision support system is meant to assist in solving complex problems, it certainly is not meant to make the problem easier. Therefore, the system should not make the problem, and solving the problem, look easier than it is. Showing complexity does mean the users have to learn to work with the system, as the system will also look complex (like the model view in e.g. figure 5.11). The complexity will become comprehensible when the user gets accustomed to the system. So building a system which is to be understood at once is not beneficiary to the work context, as it will become too easy to handle when the user gets used to it when he uses the system more often.

This is contradictory to decision support systems meant for customer environments, as they for example use a system once for making the decision about which car to buy. They will use the system now and maybe again in about ten years but not more often. In this case the user has no time to become accustomed to the system and therefore such a system should be easy to understand from start.

Give support not answers. The decision support system designed in this situation works on qualitative knowledge. Because of this, the system cannot give facts as answers. Of course, it would be possible to design the system in such way that it gives confident answers, but then the system would not reflect the complexity of the problem. So the system should give suggestions, things to consider; it should arouse discussion among the designers of the strategy or at least in the head of a designer who works alone. In this way the system supports the process and not actually leads the process.

Enforce justification of decisions. However, the discussion mentioned in previous guideline does mean that separate designers can give separate explanations to problems and therefore solutions. So when a decision is made, the designer should be enforced to explain this decision to the system. Not that it soon will become possible for a system to reason with this justification. But with a justification it becomes possible to reconsider the made decision, other designers will understand why a decision was made and strategies and made choices can be used as historic example in future cases. All this only works when a complete database with explanations and justifications of the design stance is included.

Keep the work area small. The decision support system should support the design of a communication strategy. This is a part of the whole job of a communication professional. It would be possible to design a system which is able to support all tasks a professional has to do. Like including an e-mail system, cost calculation sheets or list of contact persons for this specific case. But that would make the system overly complex and the user cannot choose to use the system anymore. The decision support system designed in this thesis is meant to support a part of the process and can be used when perceived necessary by the communication professional.

Discussion 9

The decision support system designed in this research is meant to arouse discussion. The discussion in this thesis is caused by the system, but not in the way the system is meant to cause discussions.

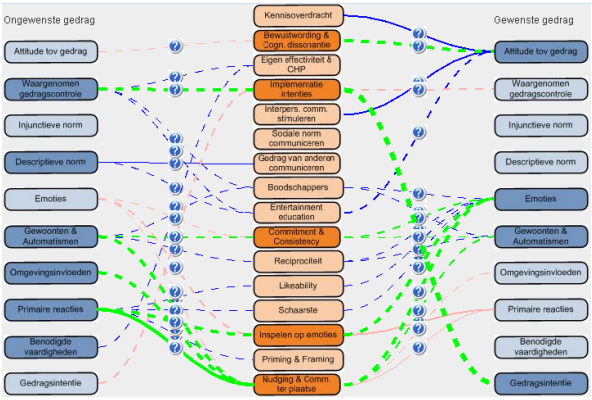


Figure 9.1: The model view arouses discussion

The discussion will address the research done, results which were not expected and which part could have been done better. Also some suggestions for further research will be given.

A system influences the work situation

Designing a communication strategy is a complex task; it is even so complex, that it is very hard to assess the effectiveness of a strategy. Therefore, improving effectiveness of communication strategies is the main goal of the Communication Development Model [30]. This starts at defining concepts which can be measured, choices must be made about which of those concepts to apply in a specific case to design a good strategy for that case. The prototype designed during this project made it possible to select concepts and assign importance values to them. To make the decision easier, the prototype gave explanations to each concept.

However, it turned out that the communication professionals assigned some importance to all of the used concepts for each case, whereas they had the opinion that concrete choices should be made. Their selection of all concepts resulted in a very crowded model overview from which almost no information could be read. So from the overview, the professionals went back to the concepts and made their choice more specific. This is exactly the behaviour that was meant to be provoked by the system. Making choices, considering the outcomes, refining the choices, repeating this process some times and then end with a good communication strategy. Up to this point, the designed artefact does exactly what it is meant to do.

On the other hand, the professionals did need some time to understand the system as it was designed. Even though they all took part in the design process, system complexity is still rather high. However, making the system easier to handle does not reflect the complexity

of the professional work situation. A system which is easy to handle also results in easy solutions, solutions which do not improve the effectiveness of the strategy. Therefore a rather complex system is needed to cope with rather complex problems. The users of the system will have to understand this and they will have to put some effort in learning to work with the system. So although this project was meant to design a system which is attuned to the work situation of the communication professional, it is not possible to introduce the system without changing that work situation.

Luckily, the research method chosen helped in changing the work situation as the users understood the above mentioned problem. At some points they realised that a system exactly suited to their needs could not be designed, so their needs would have to be changed somewhat. Additionally, it is believed that the system is able to get junior professionals to a higher level. As they would need the level of a medior to handle the system, they feel what is needed to reach this level by using it.

Stated otherwise, the system captures the experience a senior communication professional has and employs this experience to create more effective communication strategies. The experience is supported where necessary, so at different concepts for different users and at more concepts for junior users.

Research rigour

As said, the research method was chosen to be participatory design because with this method the end-users are integrated in the design process and their experience is implicitly and explicitly used. As a consequence, the designed system is based on the specific experience of the communication professionals who participated in this research. All participants volunteered, so it can be expected that they have a positive opinion towards computer systems. Therefore it was not inquired whether communication professionals with reluctance towards systems would also be convinced by the usefulness of the designed artefact. This makes that this research is a first step towards designing decision support systems for communication professionals. A lot of steps can still be taken as more participants means more and different experiences. Most preferable would be when the research and design method can turn system pessimists in system optimists, as this would mean that the system cannot be ignored as a useful artefact in the professional work situation.

Next to including more participants and especially a more diverse group of participants, the research can be improved by more iterations in the design process. From the design theory addressed a result was that design is a process of back-and-forth movement. In this project, there was some recapturing of ideas, but ideally more could have been done. Like during this project, the analysis of the results was done by the researcher alone. So all design decisions were made by one member of the design team. The other members did get the chance to reflect on those decisions and alter them, but it did not really feel as one team which made the whole design together.

A nice example of different design stances which had to be brought together can be found in how the model was read. Consider for instance the representation of the model in appendix B. The researcher had at some moment the idea that a professional could select important determinants for a certain case and answer some questions which then result in variables. From the combination of those two, one or more links are 'triggered' and accordingly, mechanisms are found as solutions. But, during a discussion, one of the writers of the Communication Development Model [30] considered the model from the mechanisms

towards the determinants. These are two completely different views on the same model. As a result, the model was represented as having no direction at all. This can be seen in figure 9.1. From left to right, the determinants result in mechanisms, but thereafter, mechanisms also result in determinants. As it is not obliged to consider the first column of determinants, it is possible to only address the mechanisms and how they act on determinants.

Rather unique for this research among professionals was that a group of actual professionals participated in the project. In the literature study can be read that research among designers is often done with junior and senior design students. Where the senior students are considered as experienced designers. This research was conducted among senior communication strategy designers, so participants with a lot of experience in the actual field.

The system is not exact

The decision support system designed in this project made knowledge from social sciences more accessible and applicable for communication professionals. The knowledge used during the research was already selected for behavioural change strategies of the government. Because of a restricted time period, the knowledge from the Communication Development Model [30] was somewhat flattened in the decision support system. For instance, all determinants are represented as acting on an equal level, but this is not always the case. Some of the determinants have more layers of complexity, so after having chosen a determinant, within that determinant further choices could be made. All those choices are written in the Communication Development Model [30], but they have been left out in the prototypes of the decision support system. Including them would not only have put a higher demand on the implementation of the system but also would have resulted in more discussion about the concepts; especially the latter was not meant to be a part of the research.

As a consequence, the system is less confident and exact than it could have been. It should be emphasised that a decision support system for designing communication strategies will never be exact, because of the nature of the knowledge used; however, with more time and effort a better product could have been designed. Therefore, the resulting artefact is only called a prototype of which the most recent has version 1.1. Again, this is a first step in the research on this specific subject, next steps can be made with a prototype 2.0 and maybe even a final product.

A decision support system is an improvement

Next question to consider is: is a decision support system an improvement with respect to the current situation? The Communication Development Model [30] was meant to result in a list of questions which guide the campaign managers while designing a communication strategy. So asking the right questions is not something the system does better than a paper version. Improvements can be found in asking the right question at the right moment, storing the answers in a standard fashion, using the answers to give additional thoughts and giving explanations on the concepts. With a paper list of questions, the campaign manager would have to know the Communication Development Model [30] by heart, whereas the system can give explanations of concepts. With the paper list, the campaign manager would have to create his own overview, the system already does this in a standard way for all the campaign managers. In this way it becomes easier to compare and therefore evaluate strategies.

Although, one of the participants did express that he was afraid to lose the bond with the designed strategy by using the system. When the campaign manager designs the strategy all by himself, it will become his child. By using the system, the manager may not be that proud of his own design. This is of course a major drawback, but also a problem which is addressed by including the end user in the design of the system and making sure that he always makes the actual choices. The system only supports the process.

Transferring conclusions to other fields

This research was conducted at the Public and Communication Department of the government. A department which mostly design campaigns which aim to enforce a change of behaviour among target groups. This is a specific kind of communication, many other kinds exist as will be shown in a minute. The only reason to chose this specific one is that they already had a body of knowledge and the campaign managers were willing to participate in the research. So, is the decision support system designed in this research transferable to other communication disciplines?

Ideally, it is. Recall that the system is designed with several components. Transferring it to an other discipline within communication would mostly mean attaching another body of knowledge, so another knowledge system. Of course, a body of knowledge must be found which is suitable to embed in a system. Even more important is that a health communication professional might be a complete different kind of professional than a government communication professional who might be different again to a science communication professional.

They not only address different problems with different needs, but also different kinds of people act as those professionals. Health communication professionals more often studied medicines, science communication professionals might be engineers. So it still has to be found out whether it is possible to design one system which can support the work of several kinds of communication professionals; as the results only say something about government communication professionals. Furthermore, the system is specifically designed in a case in which the professionals were already convinced of the usefulness of academic knowledge. Communication professionals who do not consider academic knowledge as useful must be addressed in a different manner than was researched in this project.

Further research

Next to the topics above, further research can be spread over several academic fields. A vast amount of research is already ongoing in the field of interface design. Since this particular field is also of high interest for commercial purposes, new ideas are continuously found. Take for instance the design of interaction methods for mobile phones or tablet computers. For decision support systems, it is important to find ways to elicit the true preferences of the user of the system; but also to keep interaction pleasurable. Especially interaction systems for professional use should get attention, as professionals have other demands for systems than consumers.

In this thesis, several theories from social sciences were used to design a communication strategy. Communication science was considered to be applied social science. As can be read, there were some problems in using academic knowledge in a practical situation. A translation was made in the Communication Development Model [30], but it is also possible to do research on the specific knowledge needed. For this, it must become possible to

make effectiveness of communication strategies measurable; which is of course not a new thought. The moment a sound and standard way of measuring effectiveness is found, it becomes possible to improve effectiveness, and at that moment it also becomes easier to predict effectiveness with the use of a decision support system.

Furthermore, it was believed in this thesis that knowledge from social sciences could be embedded in a reasoning engine in such a way that a computer system can use the knowledge in calculations. For this, it was necessary to translate the knowledge to attributes, variables and numbers. The values used in the reasoning engine of the prototypes have not been tested in a quantitative manner. For the reasoning engine to become actually useful, these tests must be conducted. Luckily, if quantitative ways can be found to describe social science it becomes also easier to assess the effectiveness of a campaign.

Following the idea that social science can be used as basis for a computer system, the question can be asked in which manner this could be done. As can be read from the prologue of this thesis, the idea for this research partly arose from a course on agent-based modelling. Even though this method has not been used in this research, the author does believe that agent-based modelling could be a very good way to digitalise the knowledge from social sciences. As agent-based modelling has possibilities of reasoning with uncertainty and several groups of people - agents - which react differently on given nudges. But, next to agent-based modelling, other techniques might exist which are very well able to cope with the peculiarities of social sciences. A subject very well suitable for deeper inquiry.

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Literature study A

A literature study on the employability of decision support systems while designing communication strategies.

Roland Heinrichs - 18 April 2011

Abstract

In this literature study we provide a theoretical basis for research on decision support systems for designing communication strategies. By investigating designing and decision making, and the several concepts of decision support systems, we theorise on the basic requirements of such a system.
The background of this study is research which aims to improve the effectiveness of communication strategies by making the design process more explicit and by improving use of knowledge from social sciences in the design of the strategy.
Concluded is that a decision support system could be a good assistant in designing communication strategies. A software system performs specifically well on tasks which are cognitive effort demanding for humans. For such a system to work and to be used, some guidelines have to be kept in mind. Like the system has to provide the information in one overview. Most important is that the human designer always has the lead, as he must provide the new creative ideas.

A.1 Introduction

The design of communication strategies is subjected to scientific inquiry, the aim is to improve the effectiveness of the strategies. Most of the strategies considered here, intent to change the behaviour of the lay public, e.g. use more public transport. In current practice the communication strategies are largely designed with tacit knowledge of the communication professional (further addressed to as the designer in this paper). Often, this tacit knowledge does not include the insights from social sciences. Research has shown [33] that the designers would like to be able to use theories from social sciences and that the theories could improve the effectiveness of the strategies. Furthermore, communication strategies could be improved by better monitoring of the design process. For example: explicit storage of the choices, makes it possible to compare the several strategies and evaluate them with respect to their differences in angles and results.

For the first problem, the usage of social theories, a solution could be to educate all the designers on psychological and social theories. Another solution is to only hire academics to design the strategies. Actually, the designers do not need to know exactly how theories are developed or proven, they only need to know how to use them. Therefore we only have to open up knowledge from the academic arena to practice. In figure A.1 this idea is illustrated.

We believe that a decision support system could improve the design of communication strategies. E.g. a software system has the tendency to be consistent, and therefore make

comparison and evaluation of strategies easier. In addition, the theories from social sciences could be embedded in the system and in this way would be easier to access. These are two assumptions which have to be investigated. In this literature study a theoretical basis for the research on the employability of decision support systems while designing communication strategies is provided.

A.1.1 Research question

This literature study examines whether a decision support system could improve the design process of communication strategies. Designing means making decisions: where to put the borders on the problems and the solutions, how to choose target groups and how to address them? It are those choices to which a decision support system can be of help. The systems supports the decision making which is inextricable from design. To research the possibilities the following research question has been phrased:

How can the design of communication strategies be guided by a decision support system?

This question consists of two main parts:

'the design of communication strategies' As not much research has been done on the design of communication strategies, analogies will be searched in other design fields as creative design and engineering. Attention will be paid to design inconsistencies, lack of knowledge, methodological gaps and how they can be recovered. Additionally, improvement of current practice will be considered.

'guided by a decision support system' This is a software system which guides the user in making design decisions. The system provides guidelines, 'heuristics', for the design and points out gaps in the communication strategy; and in this way makes sure that the designer considered all possible solutions.

The decision support system supports the design process and therefore not only repairs gaps in the design process but also improves the existing techniques which have proven to be useful. Furthermore, care must be taken for the drawbacks, like the procedures of the system which might obstruct the thinking of the designer, of the usage of an automated decision support system. The following sub questions guide the literature study:

1. Which design deficiencies are apparent in current methodologies?
2. How can those deficiencies be recognised by the designer?
3. Which kinds of decision support systems exist?
   (a) Which techniques can be applied to solve the found deficiencies?
   (b) Which techniques can be applied to improve the existing design process?
4. What are the drawbacks of the usage of decision support systems?

A.1.2 Organisation of the paper

As said before, the field of communication is still under development. So in the second chapter of this paper, we will consider similar characteristics from other fields and investigate whether the solutions from those other fields can be applied in communication strategy design. Therefore it should be mentioned that we see the design of communication strategies as a creative act. Typical for creative fields is that there is not one best solution, there are several, so a good solution for each problem must be found. The starting point of the second chapter is Cross [13].

Our goal is to support the decision making in communication strategy design. The decisions are often based on tacit knowledge and preferences of the designer. Those preferences are considered not to be stable and finding the actual preferences is considered to be difficult [4, 11, 21]. Therefore the third chapter considers preference elicitation methods for decision makers.

Since we try to find out whether a decision support system is a solution, we also have to take a look at the possibilities and usages of decision support systems. These will be presented in the fourth chapter. Most of the information comes from papers in *The handbook of Decision Support Systems* [5, 6, 7, 8, 9, 10] which thus is used as the guideline for the fourth chapter.

In the fifth chapter a discussion will be presented on the concepts found. As last a conclusion will be given on the employability of decision support systems while designing communication strategies.

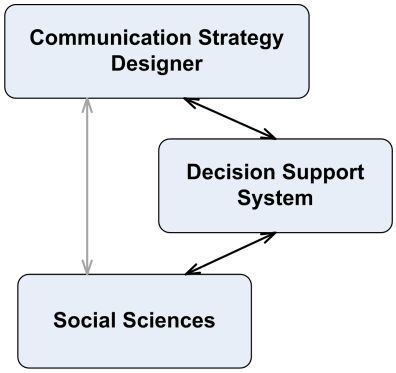


Figure A.1: With the decision support system knowledge from social sciences is made easier to access.

A.2 Communication strategy design is creative design

The development of communication strategies is seen as a design process in our view. While designing strategies, choices must be made. This means that a decision support system could help in the design process. Before we get to the actual process of making choices and how a decision support system might help with this, we first examine what the skill of designing actually means. As scholars only recently started to think about designing communication strategies, the merits of design are taken from analogies with creative design fields as architecture and more procedural restricted design fields as engineering.

As Simon states: "Schools of engineering, as well as schools of architecture, business education, law and medicine, are all centrally concerned with designing." [31]. Simon gives the example of the engineer and the composer, where they are not likely to have a mutually rewarding conversation about each other's work. They can have an interesting discussion about designing. As this is the process in which they are both engaged.

A.2.1 Why design?

First we will discuss the structure of the problems that designers typically address. From this, the similarity with designing communication strategies will become clear. As the problem structures are similar, the designer's process to get to a solution might be beneficial for communication professionals as well.

Ill-defined design problems

To start, a distinction must be made between ill-defined and well-structured design problems. The latter occur mostly in engineering sciences where specific problems can be solved with a technical artefact. The requirements of the artefact are well defined. For example, the engineering of a watch is a rather well-structured design process. The problem is clear and one already has an idea of how to solve it. Some creative thinking might be necessary to get to solutions of sub problems, but the goal is clear. On the other hand, ill-defined problems require additional information to be discovered, created and invented. The requirements and the goal alone are not enough [19]. E.g.: because we see that people do not take enough exercise, we want to start a campaign for them to take at least 30 minutes of exercise a day. This is a clear problem and even the solution is already given. Now the question is: how to get them exercising? It is possible to trigger people's knowledge about good health and with this trigger their intrinsic motivation. Another approach is to create more parks which make running more pleasant. Both will increase people's intention to take exercise, but they are based on a completely different problem configuration. As with the first the problem is the lack of knowledge where the second solution takes as problem the lack of a pleasant exercising environment. In this case, the initial problem is too ill-defined and more completely different solutions could be possible.

From this could be readed that design is a goal oriented process, which aims to change existing situations into preferred ones [15, 31]. As we will see soon, the process is not always that linear. Designers switch a lot between the problem and the solution, and in this way, cover the gap between the existing and the preferred situation. Especially in design, a good solution alone is not enough. We expect designers to not only solve problems well, but to surprise us and add something new [24]. For instance: if all the houses were the same, then the problem for a place to live would be solved, but the neighbourhood would become very boring. For the sake of integrating practical usage with good looks, new solutions to new problems must be found. Designers are the ones to make the connections between those several independent fields [15]. As last remark in this subsection: designers do not aim to come up with the best solution, as this depends on the problem which is set. Designers satisfise [31], they come up with a good solution, where good also means original and beautiful.

Design stances and ideas

Janssen [19] distinguishes between *design stances* and *design ideas*. Both definitions give a rather clear distinction in some important aspects of designing and the designer. In this case, the field under consideration is architecture.

Design stances are seen as the guiding principles used by the designer and can, explicitly or implicitly, be embedded in a design project. This answers the question of what the designer sees as proper architecture. The design ideas emerge from outside the problem context. Not created by a process of reasoning but more by gut feeling, they provide a framework that defines and directs the overall design approach. Mostly, they are not discarded at the end of a project, but they become long-lasting themes which even live on after the death of the architect.

To jump for a moment to the subject of decision support systems for designing, one should recognise that a computer system also has a design stance [19]. This can either explicitly be built in by the programmer or implicitly emerge from the choices made while developing the system.

Another important distinction made by Janssen is the difference in the *design configuration* and the *design character*. The character is the subjective part of the design, whereas the configuration of the design describes the technical details. For instance, a house is defined by its walls, the roof, the size, the amount of windows etc. From this an objective assessment can be made about the soundness of the house. Whether a house is beautiful or not, or whether it fits in its surroundings or not is a subject of discussion. There are guidelines for those discussions, but there is not a single good answer.

A.2.2 Creating the problem paradigm

In the previous paragraphs we have seen that designers have their own design stances and ideas. Cross [13] refers to this as the 'problem paradigm' of the designer and Janssen [19] states that designers are influenced by this paradigm, consciously or unconsciously. To express their paradigm, designers use naming and framing [13] of the problem. Friedman [15] states that good design solutions are always embedded in specific problems. The problem sets the premise by establishing the boundary conditions of a solution, and the problem helps with creating the information and matching it to the solution [31]. Especially for experts in ill-defined design situations such as creative domains, explicit problem decomposition is used during the whole project [19]. Those problem structuring activities keep reoccurring during design [13].

To conceptualise this problem structuring, Janssen [19] links it to schemata-theory. Designers use overall known concepts to link new design problems to possible solutions. An example of this given by Lawson [24] is the concept of 'belvedere'[1] in architecture. These concepts can be stored in external resources. No one expects the architect to know all of the concepts; we expect him to be able to look them up and apply them [31]. Lawson also found out that designers use these concepts in their narratives. They do not talk about geometries, but about known concepts. In this way a lot can be said by just linking the problem to an existing idea. The design schema defines its own value system as well. This fits with the idea that, to a large extent, designers define the problems that they aim to solve [19]; resulting in

[1] Belvedere is the concept which describes a beautiful view. Often the upper floors of a high building can have a belvedere.

different designers who represent ill-defined problems differently and use different problem solving strategies [18]. One can imagine that these kinds of narratives are very hard to grasp for a computer system.

How to become an expert designer

Expert designers have more experience than novices because they have more example cases to relate to. Logically, they perform better in naming and framing, and therefore also see the problems and the solutions quicker [13]. Cross adds to this that experts see the overall picture of their experience. Whereas often it is considered that design preconceptions should be avoided at all costs, design cannot exist without them [19].

Furthermore, for a novice to become an expert, training and dedication are indispensable [13]. Of course this holds for everyone, sportsmen need to train and mathematicians have to practise. For design it is even more difficult, because of the ill-defined problems, it is rather unclear what exactly to train. Above we roughly described how (expert) designers think, how to get to this thinking is even more difficult to grasp. The difficulty of becoming an expert is shown by a peak of excellence in design which usually occurs after the age of 40 [24].

While inquiring the implicit constraints in design, Dabbeeru and Mukerjee [14] found, in engineering science, that experienced designers often immediately come up with designs that are superior to those of novice designers. We have already seen that this has to do with experience, but how is this experience used? Lawson [24] states that experts recognise situations rather than analyse them. He makes the analogy with chess. It is impossible to consider all the possible moves from a given position, but using previous encountered situations to solve problems does the job. Engineers solve problems in the same manner, they recognise information when they come across it, rather than being aware of what they are looking for at the beginning of their search [1]. For instance, Ahmed [1] found out that experts like to flick through printed literature, rather than use keyword search in a digital version.

On the other hand, the novices are the ones who usually get stuck in information gathering. Cross found that senior design students were able to gather more information, consider more alternative solutions and transitioned more between types of design activities [13]. This is because novices employ a trial-and-error strategy whereas experts use more integrated design strategies. Cross even states that the expert seems to have more control of his cognitive activity. The highest experts are able to keep parallel lines of thought longer than other designers [13].

The expert's problem solving strategies could be used to make designing more efficient [18]. According to Friedman [15], the most common reasons for failure include 'lack of method' and 'absence of systematic and comprehensive understanding'. These involve gaps in knowledge and preparation. A good strategy or system could enable the switching between design and implementation which is typically expert behaviour [13].

A simple example of a method often used by experts is that they make rather small drawings. The motto is: "Make the drawing as small as possible while still showing the point you want to make." [24]. When looking at a drawing made on A4 paper one does not have to move his head and is still able to see the whole picture. In this way the whole problem space can be considered at once. Together with reading more out of the sketch than was invested in its making [14], the importance of comprehensive overview is proved.

Lawson [24] also showed that designers frequently refer to documentation and that drawn and written documentation are considered equivalent.

Now the question arises which basic strategies could be used. Cross found that in the most creative periods in which *novel design decisions* occur, the switching between design modes, e.g. from depth-first to breadth-first and vice versa, is very high [13]. Dabbeeru and Mukerjee state that the human designer discovers patterns of functional effectiveness while exploring different parts of the design space [14]. This supposes that switching mode and focus often does result in creative design. The question is whether this works or not when novices are forced to do this.

Exploring the problem space

We have already seen that the problem space is defined by the designer and that the problem definition is important for the process of solution finding. Now we consider how this problem space is explored.

Ho [18] states that the breadth-first approach is the best way of problem construction as it first broadens the problem space. So first come up with several problems and then consider them in depth to look for gaps and find the best representation of the problem at hand. This is complied by Cross [13] who found that novices use mostly depth-first search; but experts start at breadth-first. The last one provides a better overview of the problem which enables them to come up with better solutions. Recall that the experts were better at recognising situations.

Cross immediately adds that design is not that distinctive in breadth- versus depth-first or a backward versus forward approach. The problem and the solution have to be seen together, they co-evolve. This means back-and-forth movement between the solution and the problem space [13]. Or as Friedman calls it: "The continual interaction of design problems and design solutions generates the problematics and knowledge stock of the field in tandem." [15] This is a search that does not depend on the size of the set, but on the constraints that are given to the problem [31].

A.2.3 Design deficiencies

Above we considered some methods used by designers and we saw the difference between experts and novice designers. We also need to look at overall design deficiencies which keep occurring in all kinds of situations and on all levels. In other words, although designers might be experts in their field, that does not mean that nothing can be improved. First the fact that designers have the tendency to stick to the original idea [13]. Designers do create a problem and a solution space to find the best solution, but when it turns out that extraordinary problems arise at the moment a solution has been chosen, designers will try to patch their design instead of starting from scratch. This behaviour is seen as normal expert behaviour [13], but it is also is a typical lack that can be prevented by exploring the problem and solution space more thoroughly.

Additionally, the cognitive costs, the amount of (thinking) effort, of an activity is often leading in making design decisions. This means that the easier solutions, which are thought of earlier, are mostly taken as the correct ones. Although expert designers do consider the problem and solution space more thoroughly than novice designers, they also show this limiting behaviour [13]. Janssen [19] sees computer aided design as a solution for this problem,

because computers are able to evaluate more options in a shorter period and in this way reduce the cognitive effort of an activity.

Furthermore, when a designer does not have a clear initial plan, he will muddle along until a solution has been found [15]. Muddling along is not necessarily bad as muddling results in proposals that fail in an early stage of concept development. This contributes to the exploration of the solution space [15]. On the other hand, completed attempts of design are made in which designers believe they have solved the problem. Often, the contract of the designer is ended before this failure is discovered. Clients hardly ever return to the original designer for repair work [15].

A.3 Decision making and preference elicitation

As we have seen, the process of design basically consists of expanding the problem and solution space and then working towards a solution by choosing elements within the found spaces. This choice is made by the human designer based on his preferences. Therefore this chapter addresses how choices could be made and how human behaviour influences choice making. Also we presented that preferences are constructed when needed and not stable, this is of influence on the decision. In the last part is investigated how decision making could be supported, regarding human behaviour and the constructive nature of preferences.

A.3.1 Rational decision strategies

When making a decision or a choice, especially in consumer decision making, one has several alternatives. Each alternative has some attributes which depict its unique characteristics. Several alternatives might have the same attributes, others might be only present in one alternative. Take for example the comparison of houses: two alternatives might have a garage, the second being somewhat smaller than the first. A third alternative might not have a garage at all. Now the attribute 'garage' is considered. The first house would be the preferred one as its garage is bigger than the one of the second alternative, the third option needs another outstanding attribute to stay in the race.

To get a grasp of how decisions should and could be made, we will consider the *Weighted Adding Strategy*; a normative system which always results in the most optimal decision [4]. In this strategy, an importance weight is assigned to each attribute and the decision maker gives a subjective value to that attribute for the considered alternative. Now the sum of the products of all attribute's weights and their subjective values, gives an overall value for each alternative. The alternative with the highest value is the preferred one. One can see that there are some assumptions in this strategy as you need to know all the attributes and corresponding relative importance weights. Furthermore, this strategy assumes people are rational and willing to take the time to consider all options. Mostly, this will not be the case. Therefore, Bettman [4] discusses some other decision strategies. We will not discuss them here, but overall the other strategies reduce the cognitive effort of the decision compared to the weighted adding strategy. Which means that in theory the decision is less optimal.

Bettman assumes that individuals have their own repertoire of strategies gained by experience or training. The advantages and disadvantages for each strategy might differ from one situation to another as different strategies will be more or less accurate, effort demanding, emotional or easy to justify. This means that for the choice process to make sense, the

goal of the consumer on the specific task must be known [4]. Here the dangers of using incorrect strategies arise. Bettman states that in general the more selective consumers are in processing information, the more susceptible they are to salience of particular attributes which might not be the most important ones.

A.3.2 Human behaviour

When talking about decision making, we consider a human who has to make the decision. This decision will not be as rational as presented above. Therefore we will take a more close look at human behaviour, how information is processed and what this means for decision making. Again this information is mostly taken from consumer decision making as this is the field on which research has been done.

Cognitive processing

The way in which people make a decision is largely based on how they think. Not always completely rational. This can be explained by the effort reduction most people implicitly try to achieve. Bettman found that consumers must be motivated somehow to use a list with information and they will use the information in the form it is presented without transforming it [4]. Especially for a professional situation, as a work-environment, the motivation of users is important. Although it is his job, the expert has to be implicitly motivated. For instance the willpower of a person is weakened when put under huge cognitive loads and when someone is inexperienced in a choice domain [25]. Additional methods must be used to make sure the designer uses the provided information.

Differences can be found in expert and novice behaviour. Knijnenburg and Willemsen depict that attribute-based preference elicitation works the best for domain experts. This is because they are more familiar with the attributes, have better understanding of the value of each of them and they are more capable of making trade-offs between them [23]. Those characteristics support the use of weighted adding for domain experts. Another aspect of knowledge of the field in preference elicitation is that one who does not understand completely how his preferences are constructed, e.g. on which aspects, will be reluctant to use the suggestions from a decision support system based on this preference [11]. For this, the user must understand the field he is working in, but the cognitive load must stay small as we will soon see.

In problem solving and solution finding, users are mostly not able to come up with preferences beyond their basic ones. But they are able to critique given suggestions and solutions [29]. Bettman [4] states that the perceptions of the user are attuned to noticing changes, rather than absolute magnitudes of stimuli and outcomes. So a loss relative to some preference creates the awareness of the preference. To enable critiquing Pu stated the following principles [29]:

1. React to examples: especially hidden preferences are most effectively solicited via example solutions.

2. Show decision context: the use of example solutions in which attributes can be directly manipulated.

3. Show minimal context: reduce cognitive load and display complexities.

4. Show feature attributes in critiquing context: all the attributes a preference is based on should be shown.

In the behaviour of people, often a value bias occurs which is not recognised by the decision maker himself [16]. The above critiquing principles help finding those biases, but the long-term mental model of people will evolve with new experiences. The mental model must be updated continuously with changing preferences [16, 12]. One goal for researchers, especially described by Milkman [25], is to improve the conscious thinking in problem solving. They make the distinction between unconscious decision making (system 1 thinking) and conscious decision making (system 2 thinking) and try to improve system 2 thinking. Some strategies suggested by Milkman to improve system 2 thinking are: enabling the use of formal analytical processes, taking an outsiders perspective, consider the opposite and making sure that the decision is discussed and made in a group instead of by individuals.

Cognitive load

In the previous chapter about design we have seen that cognitive effort is a limiter on the amount of options considered. A trade-off between accuracy and effort is found in preference construction [11]. The same holds for decision making, the desire to minimise cognitive effort is compromised with the desire to make an accurate decision [4]. This behaviour is shown on several levels. It is possible that several alternatives or attributes of alternatives do not get the same attention. The amount of information processed on each attribute can vary, resulting in a bias. Furthermore, other decision strategies than the normative one can be chosen. An example is the *Equal Weights Strategy* which works the same as weighted adding, only with equal weights on the attributes [4].

To get back to the mental models discussed earlier, Bettman found that individuals made as little decision-attributes explicit as possible. In this way reducing the cognitive load of the decision [4]. Again, the use of user involved preference elicitation is likely to be more effective than standardised models if the user understands and accepts the solutions outcomes [29].

A.3.3 Constructive preferences

In contrast to what one might assume, people do not have stable, existing preferences. Finding ones preference, e.g. for the purpose of making a good decision, does not mean uncovering what one wants, but forming what one wants considering all the possibilities. Preferences are constructive and adaptive [4, 11, 21] by nature. Bettman [4] provides two reasons for this constructive nature. First, people lack the cognitive resources to generate well defined preferences for many different situations; secondly, consumers bring multiple goals to a given problem.

For consumers, the problem of decision making still becomes larger with the rising complexity and amount of products to choose from. The research of Bettman is based on consumer decision making, from which the next major conclusions are presented [4]:

1. choice among options depends critically on the goals of the decision maker;
2. choice among options depends on the complexity of the decision task;
3. choice among options is context dependent;

4. choice among options depends on how the question is phrased;

5. choice among options depends on how the choice set is represented (framed) or displayed.

Bettman [4] also found that behaviour is shaped by the interaction between the properties of the human information-processing system and the properties of task environments. In decision support systems, the system may influence the constructed preference of the user. Such influences should therefore be considered in the design of the system until the last detail. According to Pu [29], even the underlying database of a system can influence the user, as the order in which the information is presented relies on the order in which it is stored.

The above nature of preference construction is taken from consumer decision behaviour. The difficulties mostly arise when the consumer is not experienced in the field he has to make a decision in. Typically, designers and thus also communication strategy designers, are professionals in their field. This means that the lack of experience should not arise here. Still we believe that the constructive nature occurs, because of the overall lack of knowledge of what exactly is a well-founded communication strategy. In the strategy design process the construction of stable preferences and similar decisions in similar situations is crucial, because strategies can only be evaluated if it is clear how they were designed. Additionally for the comparison of several strategies we need to know exactly on which variables they differ.

A.3.4 Support of decision making

The design methods used by experts must be supported, this means that deficiencies which occur in those methods should be removed. How the decision making actually takes place defines largely how it can be supported. So this will be inquired next.

Approach

Carenini divides the overall approach of decision making into three steps: identify alternatives, specify values for evaluation and apply the values in choosing [11]. Courtney exchanges the second phase for a design phase in which alternative ways of solving problems are found, the first phase he sees as information gathering [12]. Hall and Davis suggest that exposing the decision maker to additional perspectives will broaden the information-gathering and decision making scope [16]. However if too many goals are considered, the framework is compromised [4]. From the design chapter we can recall the balanced methods of Cross [13]. He states that a thorough investigation of the problem and solution space is necessary, but too much information can cause an overload. Overall it can be said that there is no stopping rule in designing. Designers stop because they are out of time, money, patience or because the solution is good enough [12].

To enable making the most optimal choice, Courtney [12] further suggests showing the solutions in all kinds of different display methods to uncover the connectedness of elements and with implicit assumptions of the viewer. Courtney sees that the decision process begins with the recognition that a problem exists; a decision needs to be made. However, before jumping into analysis, several perspectives should be developed. Perspective development is an iterative process, especially in group work . Hall and Davis [16] distinct two aspects in

perspective synthesis as they call it: the problem space in which the problem is structured and potential alternative solutions are discussed and the solution space where approved alternative solutions are placed. We recognise the formalisation of the back-and-forth movement in design studies [13].

Framing

As we have seen before, several ways of framing a problem may lead to different choices [4]. In design, the problem paradigm of the designer is formed by his design stances and ideas [19]. Framing to steer preference elicitation can be useful. Bettman [4] has found for instance that the minimisation of the experienced negative emotion influences the decision. With the correct frame, in this case no negative trade-offs, the negative emotions can be avoided. Bettman also found that it is critical to understand the determinants of the focus of attention, because saliency of attributes can have an impact on the choice. A salient but unimportant aspect can attract the involuntary attention, in this way unconsciously steering the decision process [4].

Already described before is the idea that the solution must always be as complete as possible to the user. Pu [29] found two situations in which this is not the case: when a solution contains too much detail to show and when attributes influencing the decision are not explicit in the example solution. Still, Pu emphasises, that displaying the solution space effectively is crucial. The same authors also suggest that trade-offs should be made at the structural level and not at the attribute level. When comparing houses as in the start of this chapter: one should always look at the whole house, a garage could also be traded-off against the backyard. This makes the effect of the trade-off explicitly visible, these findings are supported by Johnson [21].

On the other hand, one could think of a situation in which the concept is not easy to visualise. Like, people often have problems with understanding probability outcomes. In this case Johnson suggests to use an analogical visual experience to make the probability readable to the user [21].

Pu has identified and tested the following design principles for improving preference elicitation [29]:

1. Any preference, any order: the process should not depend on the architecture of the system.

2. Immediate feedback: because of non-obvious relations (trade-offs), users should immediately see the effects of their choices.

3. Visual feedback: enable quick and easy processing of the provided information.

Faults

As we saw in the design chapter, the key component of problem solving is to expand the problem set with as many facts and assumptions as is reasonable. Difficulties arise immediately. For instance, the meaning attained to concepts can vary across the different designers who might be working on the same subject. The assumptions of the designers with different backgrounds must all be made explicit [12, 16]. Not only the assumptions of the several users can be different. With the wrong elicitation tools, thinking about alternatives can easily be

circumvented [29]. For instance: uncovering a bias does not work by offering warnings, describing the directions or providing feedback [25]. One should recognise, there is no formula or pat procedure to assure or guarantee that all interactions are taken into account [12].

Furthermore, we have seen that there should be a balanced search between problems and alternatives [13]. What is a good number? Pu [29] suggests that five solutions is not enough to guarantee the inclusion of the most optimal solution. Especially when the current design problem is not an easy one, a provided anchor even when arbitrary, can already influence the choice process [21]. Johnson also found that default options do matter. When presented with a choice, people will be reluctant to deviate from the given option. He provides four reasons of why this occurs [21]:

- people may interpret them as suggestions or recommendations;
- people may wish to avoid the effort and cost of changing from a default;
- people prefer not to act than to make a decision which is possibly harmful, even if acting could be less harmful;
- loss aversion: losses are experienced more intensely than equivalent gains.

This is also supported by the findings of Carenini and Poole who state that decision makers avoid trade-offs [11].

A.4 Decision support systems

The area of decision support systems is the discipline which focuses on supporting and improving (managerial) decision making [6]. The systems do this by connecting the intellectual resources of the individual with the capabilities of the computer. Typically, semi-structured problems can be solved with such an approach [8]. The basic assumption then is: help where necessary [9]. The combination of the user and the system must be better than one of them alone [10].

Power [28], who refers to the pioneering work of Alter [3], defines three major characteristics of decision support systems. Decision support systems:

- are designed specifically to facilitate decision processes;
- should support rather than automate decision making; and
- should be able to respond quickly to the changing needs of decision makers.

One of the fields in which decision support systems were early adopted is marketing science. Here the systems are also addressed to as marketing decision support systems. The first models for marketing appeared in the 1960's. Since then, the interest in marketing systems has increased in academic literature and marketing practice [8]. Nowadays, no one approach has been adopted yet, the current literature reveals wide variations in how marketers and developers perceive systems and their place in the process [8].

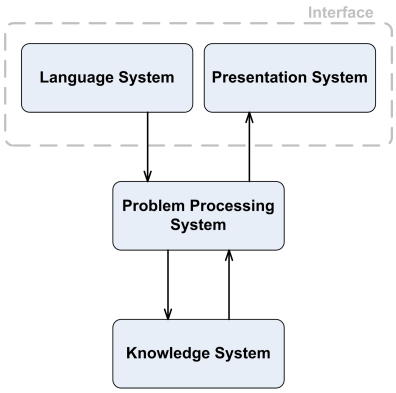


Figure A.2: A schematic overview of the architecture presented in [5]. The language and presentation system together form the interface.

A.4.1 Architecture

In short we will present the architecture of common decision support systems as discussed in [5] (see figure A.2). This does not define the entire system, it is only a diagram to explain the most basic parts. These authors distinguish four essential components in a decision support system: the language system (LS) for the input, the presentation system (PS) for the output, the knowledge system (KS) for the storage of knowledge and the problem processing system (PPS) for reasoning. The first three components are used by the last one to get to a decision. One could say that the user interface is defined by the language and the presentation system. The problem processing abilities are used to support the interface with knowledge acquisition and emission which in turn is used by the knowledge system to interpret the input and present the output in a meaningful way. In this architecture, the knowledge system is the part in which the stance of the decision support system is defined. One can imagine that it is rather difficult to grasp the concepts of social sciences in the knowledge system. The solutions to this difficulty are not a subject of this review, but they will have to be a major topic in the further development of such decision support systems.

A.4.2 Failure factors

Decision support systems are software systems. Likewise the development of software systems, the design of decision support systems is error prone and high-risk business. Failure rates of 80% are reported [6]. For instance, failures can occur in the incompatibility between decision styles of the user and the system [6], the system can be to cumbersome or confining [7] or the decision support system could (negatively) affect the process it is involved in [5].

The usability of the system is a key-attribute which defines whether the system is actually used or not. The knowledge and reasoning of a system can be very good, but if the user does not understand how the system works or too much mouse-clicks are needed to control the system; then it will not be used. This means that the design of a good user interface is of utmost importance.

Aloysius [2] states that the preference elicitation technique is a key-element of the system. He theorises that preference elicitation techniques differ in the amount to which they require explicit trade-offs. Although trade-offs are seen as the normative method of prefer-

ence elicitation, they are also a major source of decisional stress [2]. With trade-offs the effort of the decision task is enlarged, which results in lower perceived accuracy of the system [2]. Generally, a decision support system is perceived as more accurate when it is easier to handle [2]. Aloysius concludes that, given a choice, decision makers prefer unsophisticated decision support systems.

Next to system usability, also the nature of the system should be considered in its design. We have seen before that a decision support system is based on human-computer interaction. Therefore, both of the parties should have influence on the decision. Acknowledged is that the decision support system should not take control over the decision or process [8]. Especially when regarding decision support systems in creative fields, the system should not be too restrictive [7]. Telling of what is or what might be can be beneficial for establishing control or coordination in local decisions, but this also locks other ways of thinking [9].

A.4.3 Success factors

Use of the decision support system is typically optional, so the benefits must be apparent to the user of the system [10]. For a decision support system to be successful, Arnott and Dodson [6] discern six categories: the system quality, which means the usability of the system itself; the information quality, which is the usefulness of the knowledge stored in the system; the system use, whether the system is used by the target group or not; user satisfaction, whether the users find the system usable or not; and the impact of the system on the individual and the organisational level.

Next to the technical demands there are the organisational demands. For example: if the managers do not really support the idea, then not enough time or money (resources) will be allocated which likely results in the failure of the project. The same occurs when no appropriate knowledge or skills are available or when this knowledge is not stored properly (data management). This means that the organisational and technical demands of the system must be feasible [7].

On the other hand, there also are less-defined demands. Especially when developing decision support systems for ill-defined problems, the business objectives or the system requirements might not be clear yet. One does not know what to expect from such a system. Therefore, system developers must adhere to changing requirements of the users [6]. We have seen this problem before in the design chapter; the contract with the developers is often ended before design flaws are discovered [15]. For the system to be used, it must be under continuous development and the users must be satisfied. The design of the system will also influence business objectives.

Above findings on system usability do not mean that the system should always behave exactly suited towards the user. Developing a system for each specific user would be too tedious. There are even benefits of unsuited systems, the decision maker could be inspired by the system to think in new ways [6]. Especially in creative fields this is an important aspect of decision support systems. A specific kind of decision support systems is the creativity support system [7]. Such a system brings together external stimuli that are normally not brought together.

For a workplace, i.e. the system and its environment, to be encouraging creativity it should [7]: give employees a high degree of autonomy, allocate resources in terms of equipment, facilities and time to the projects of interest, provide sufficiently challenging work and be free from organisational strife or other impediments to the creative output from the em-

ployees. As we have seen, exploring the problem and solution space is typical for design, the user could examine the problem and solution space more thoroughly by automating some tasks in the exploration phase [10]. Still, the choice of the problem-solving mode must be consistent with the problem for the decision support system to be used [8]; the meta-decision of choosing how to choose is proven to be important [2].

A.4.4 Design support

Garfield speaks of a creativity support system in [7]. Such a system helps the designer by increasing his individual creativity and domain-relevant skills and by triggering intrinsic motivation. In this way the individual increases his ability to be creative. Intrinsic motivation is important as we have seen in the design chapter, because motivation is one of the necessary elements for becoming a good designer. In relation to a support system this means that the designer should be in control of the process, because the intrinsic task motivation occurs mostly when one thinks he is in control of the task being at hand [7]. Among others a creativity support system can break cognitive inertia and guide the designer towards other pathways [7]. These again are exactly some of the problems that designers cope with. Therefore some design suggestions for marketing decision support systems are also useful for decision support systems for designing communication strategies. Such are: design systems to encourage discussions, reduce problem complexity and encourage consideration of alternatives [8].

Pick [10] discusses a more complete list of processes in the design phase which can be supported by a system. These are: model selection, model formulation, gathering diverse viewpoints, setting criteria, handling multiple criteria, searching for alternatives and predicting outcomes from tentative solutions. One of the most promising but also most difficult ones is the prediction of outcomes. Pick states that a decision support system is able to allow the decision maker to examine different scenarios in a short time to get near optimal results. From the former chapter we have learned that in preference elicitation it is important to directly see what happens if a variable is changed. Now we have seen that with the right user interface, the decision support system can enable this behaviour. Furthermore, the decision support system could embed expert models in its knowledge system [10]. In this way inexperienced users are enabled to use more difficult processes.

A.4.5 Usefulness in communication

In marketing science was shown that communication and coordination between marketing and production is improved by decision support systems [10]. This is similar to our goal, which is connecting the design of communication strategies to academic fields of communication. The similarity is not surprising since we see that marketing copes with the same problems as communication. Marketing managers did not use (academic) knowledge because [8]: good models were hard to find, good empirical estimation of parameters was even harder, managers did not understand the models and most models were incomplete on critical issues. A decision support system can help with all those problems. Mainly because a decision support system, just like other software systems, is very consistent. It will always give the same suggestions in similar situations. This enables designers who use a decision support system to behave less arbitrarily [10, 5].

To conclude, decision support systems developed for marketing can also be useful for communication because of the similar ill-defined structure of problems in consideration. Marketing problems are often not well defined in terms of goals, means, mechanisms and constraints and often do not lend themselves to the procedural or logical reasoning used in conventional computer programs [8]. By using the system's stable reasoning together with the creative abilities of human decision makers (the designers) the quality of the design will be enlarged. Even if the decision itself is not improved, at least the process is less effort demanding and the product is documented in a consistent manner [10].

A.5 Discussion

In the previous three chapters we have shown the merits of design, decision making and decision support systems. It was argued that the development of communication strategies is a form of design. Then we saw that design means decision making based on implicit and explicit preferences. It was shown that decision support systems can guide this process. This is because decision support systems developed for marketing problems solve the same problems as arise in the design of communication strategies.

To discuss how a decision support system should be developed to improve the design process and product of communication strategies we will first recall the system architecture discussed before (see figure A.2 on page 118). Basically, a decision support system consists of four elements: input, output, reasoning and knowledge; respectively called the language system, presentation system, problem processing system and the knowledge system. From the design field we saw that problems and solutions are created in their own space, but both are considered in parallel. Continuously back-and-forth movement between problem and solution is necessary to come to the best solution. For the decision support system this means that influence of input on the communication strategy must be clear. So when a parameter in the problem space is changed, the influence on the results in the solution must be shown directly. Furthermore in design, overview was shown to be of high importance, recall the small sketches on which all information is present for the eye. The first suggestion is to integrate the language and presentation system in one interface, by this enabling the switching between design tasks.

At the same time, professionals not familiar with the scientific models in the knowledge system can use the decision support system to create a better understanding of these models. By playing with the input, one learns form the resulting output described by the model. In this way knowledge present in social theories is unfolded by the decision support system.

Not only the use of theories in design of communication strategies is improved, but also the whole process of design can be monitored and thus improved. For the main benefit of this first stage of the development of decision support systems for communication is the consistency of the system. A software system will always react the same on similar input. This enables the simulation, comparison and evaluation of strategies. Furthermore, when all strategies are developed with the same system, or at least with a similar architecture and language, old strategies can be recalled and altered. Proper storage and easy access is already a benefit.

Additionally we saw that reduction of cognitive effort is one of the main reasons why less-thorough decision strategies are chosen and thus unfounded design choices are made. A decision support system can implement the normative weighted adding strategy and ensure

that it is easy to use and understand. Therefore the interface must be constructed in such a way, that the negative influences we have discussed, like negative emotions in making trade-offs, are reduced. With the reduction of negative influences the system grasps the real preference of the designer. Furthermore, methods of expert designers, like keeping parallel lines of thought as long as possible, can be encouraged with a decision support system.

For the decision support system to actually be used, care must be taken on its usability. Too many software systems are not used because of an improperly designed interface. Especially in our case, where we want people to use difficult theories, the access to these theories must be easy and understandable. Next to this, the value of the improvement must be clear. A system can have huge benefits, but if the user does not perceive the benefits they are useless.

To end this discussion we want to emphasise that a system which supports designing has a design stance. Just like the designer himself. This design stance occurs because the system is developed by a person, this is not necessarily bad but it must be explicit. Like our stance in this paper is that the use of social theories improves the design of communication strategies and that a decision support system can support this. The paper shows that the stance is founded on theories but it still needs to be proven to be correct.

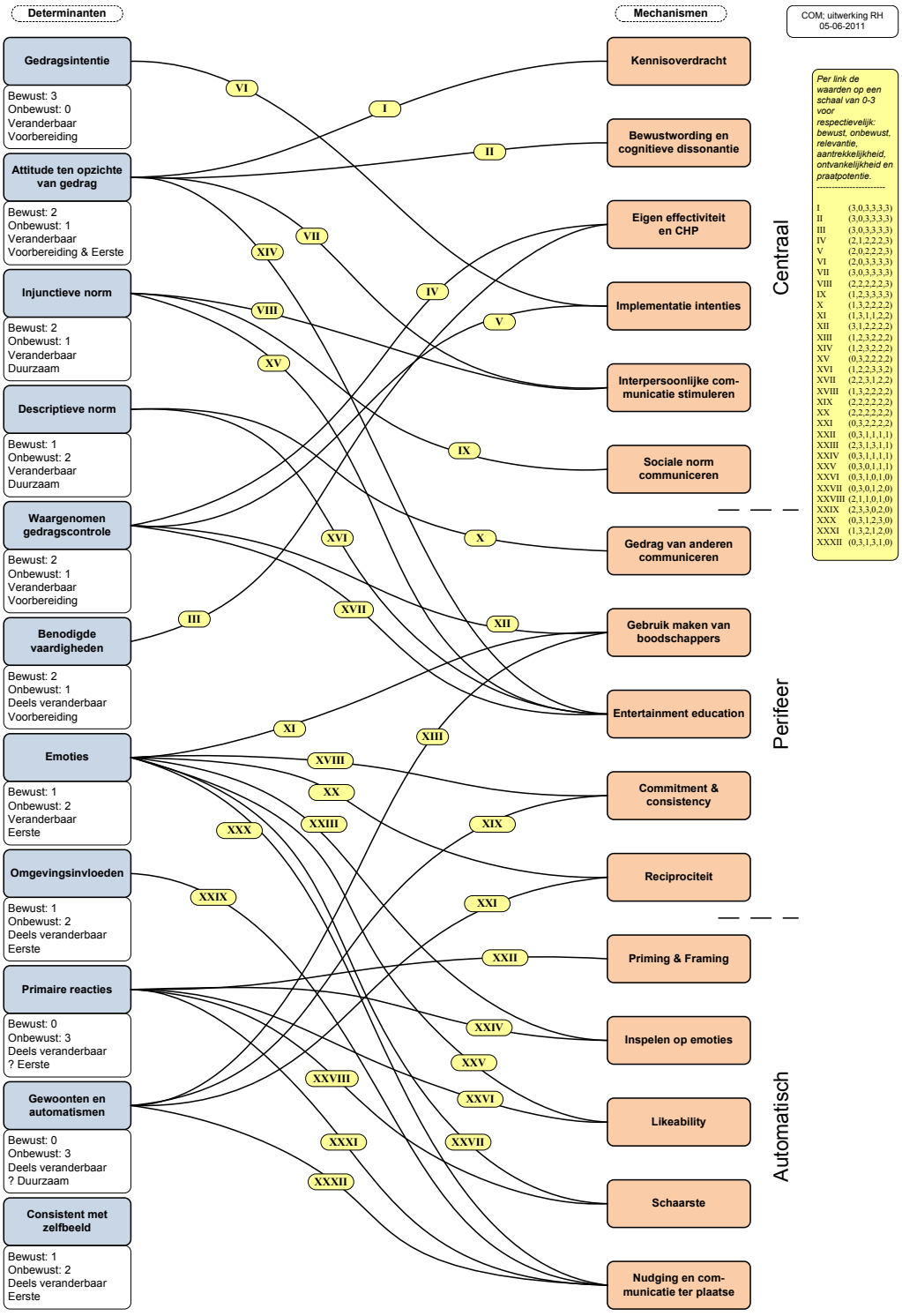
A.6 Conclusion

The first sub question we asked ourselves is: which design deficiencies are apparent in current methodologies? This study shows that designers are humans, and thus are coping with humanoid problems. Reducing cognitive effort by not considering all the information or not going back to the beginning when the design turns out to have flaws are typical human behaviour. Especially when the designer cannot be an expert on all the information he has to take into account, like communication professionals who are not experts on social science, the design effort is higher than the human can cope with. The designer will sometimes recognise this but more often he will not. As the problem is typically ill-defined, it is often not apparent which information is missing. The designer cannot recognise something he does not see.

For this, a decision support system could be a proper solution. As for the system it is much easier to have all the information and reason with all the possible combinations of variables. This will only work if the system is able to provide its suggestions in a proper way. Otherwise the designer will not be able to comprehend the information and nothing will have improved. For this we think that the same heuristics as in design can be used. Show all the information in one overview, so the problem next to the solution. By also providing the influences of changes of the one on the other, the designer can understand the problem and the solution more thoroughly and therefore make a better design.

Then again, the system also has its drawbacks. Most important being that it is not able to think among its own knowledge. This means that the designer has the task of being creative. The effort demanding tasks can be made more convenient by the system, interpreting information and being original must come from the designer. Therefore, the system and the designer as a team will design better communication strategies then one of them alone, but the designer still has to make the decisions.

Knowledge system B



Description of concepts C

C.1 Determinants

Attitude towards behaviour - *Attitude ten op zichte van gedrag* -
The attitude is a personal evaluation of the pro's and con's of behaviour.
Conscious: 2 Unconscious: 1

Perceived behavioural control - *Waargenomen gedragscontrole* -
A personal assessment of someone's own abilities and limitations for successful performance of the behaviour.
Conscious: 2 Unconscious: 1

Injunctive norm - *Injunctieve norm* -
Refers to the image a person has of the behaviour that important persons around him favour and the motivation the person has to conform with this behaviour; often, the important persons have some way of punishing or rewarding behaviour.
Conscious: 2 Unconscious: 1

Descriptive norm - *Descriptieve norm* -
How people behave in a certain situation is often an example for individuals how to behave. Especially when one wants to associate himself with the others.
Conscious: 1 Unconscious: 2

Emotions - *Emoties* -
Emotions associated with behaviour have high influence on the performance of that behaviour. Negative emotions prevent behaviour whilst positive emotions enforce behaviour.
Conscious: 1 Unconscious: 2

Habits - *Gewoonten en automatismen* -
Behaviour can become a habit, the performer is then not aware of the behaviour. In this way, humans do not have to think about each decision; decisions are made completely automatic.
Conscious: 0 Unconscious: 3

Outside influences - *Omgevingsinvloeden* -
The chance of performance of the desired behaviour increases when the environment has a positive influence on the behaviour. Like a sleeping policeman on the street.
Conscious: 1 Unconscious: 2

Primary reactions - *Primaire reacties* -
Especially in unmotivated and unconscious behaviour, primary reactions have high influence.

People often now that some behaviour is not favourable, but in the situation at this moment they just lack the willpower to adhere to this knowledge.
Conscious: 0 Unconscious: 3

Necessary skills - *Benodigde vaardigheden* -
Behaviour can only be performed if one has the necessary skills to do so. Save browsing is only possible if one knows how to install a firewall.
Conscious: 2 Unconscious: 1

Intention of behaviour - *Gedragsintentie* -
The intention to show behaviour is not necessarily compliant with the actual shown behaviour. Especially habitual or normative behaviour are hard to change.
Conscious: 3 Unconscious: 0

Consistent with self-image - *Consistent met zelfbeeld* -
Not used in the prototype because it has no links attached.
Conscious: 1 Unconscious: 2

C.2 Mechanisms

Knowledge transfer - *Kennisoverdracht* -
If the target group is involved in the subject, strong arguments can change the behaviour.

Becoming aware and cognitive dissonance - *Bewustwording en cognitieve dissonantie* -
Creating awareness can get the target group involved. Cognitive dissonance refers to a lack in the knowledge about the behaviour.

Self-efficacy - *Eigen effectiviteit en CHP* -
The target group can be influenced by showing how easy the desired behaviour is.

Implementation of intentions - *Implementatie intenties* -
Making the future behaviour concrete can make that an intention actually leads to behaviour.

Stimulation of interpersonal communication - *Interpersoonlijke communicatie stimuleren* -
The accent is not on what people do, but how and when they talk about it.

Communication of the social norm - *Sociale norm communiceren* -
People intent to copy behaviour from others. Because either they do not know what to do in a situation or they want to be a part of the group.

Communication of behaviour of others - *Gedrag van anderen communiceren* -
Especially in situations where the majority of a group shows the undesired behaviour, the desired behaviour should be made explicit.

Messengers - *Boodschappers* -
Information can be transferred by using celebrities as messengers.

Entertainment education - *Entertainment education* -
The desired behaviour is covered in e.g. a well known television show.

Commitment and consistency - *Commitment en consistency* -
Consistency is usually appreciated by our society. Commitment makes use of the fact that people will adhere to an agreement they have made with themselves or others.

Reciprocity - *Reciprociteit* -
When someone gives something to us, we feel that we have to give something back.

Likeability - *Likeability* -
People will show more positive behaviour towards people they like. This can be physical attractiveness or sympathy with the other person.

Scarcity - *Schaarste* -
A product is considered more valuable when it is scarce. Scarcity is a measure for quality but also limits our freedom of choice. People are more triggered by fear to lose something than be the chance to win something.

Playing on emotions - *Inspelen op emoties* -
Emotions are not only able to increase or decrease the intention to a subject. They can also support or limit a change of behaviour.

Priming and framing - *Priming en framing* -
Priming aims to make people sensible to future communication. This can be done by influencing unconsciously. Framing information can cause more conscious or unconscious processing of the information.

Nudging and communication on location - *Nudging en Communicatie ter plaatse* -
Nudges in the physical environment can trigger desired behaviour or undesired behaviour.

C.3 Links

The Roman numerals refer to the links in appendix B.

I *Knowledge transfer works especially well at a conscious change of behaviour.*
Conscious: 3 Unconscious 0 Relevance: 3 Attractiveness: 3 Susceptibility: 3 Possibility of speech: 3

II *This is behaviour that people already would like to show, they only need to become aware of this.*
Conscious: 3 Unconscious 0 Relevance: 3 Attractiveness: 3 Susceptibility: 3 Possibility of speech: 3

III *People will sooner think they can perform behaviour when it is shown how easy the behaviour is.*
Conscious: 3 Unconscious 0 Relevance: 3 Attractiveness: 3 Susceptibility: 3 Possibility of speech: 3

IV *This shows how much effort people put in performing behaviour and how long the behaviour will endure in spite of difficulties.*
Conscious: 2 Unconscious 1 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 3

V *The behaviour is made concrete by showing how and when the behaviour can be performed.*
Conscious: 2 Unconscious 0 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 3

VI *The intention of showing behaviour has to be turned into actual behaviour.*
Conscious: 2 Unconscious 0 Relevance: 3 Attractiveness: 3 Susceptibility: 3 Possibility of speech: 3

VII *People can have influence on each other's behaviour by talking about it.*
Conscious: 3 Unconscious 0 Relevance: 3 Attractiveness: 3 Susceptibility: 3 Possibility of speech: 3

VIII *People affect each other consciously and unconsciously by talking about behaviour.*
Conscious: 2 Unconscious 2 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 3

IX *Especially uncertain people are susceptible to behaviour of others.*
Conscious: 1 Unconscious 2 Relevance: 3 Attractiveness: 3 Susceptibility: 3 Possibility of speech: 3

X *By talking about how others should perform behaviour the target group will also change their behaviour.*
Conscious: 1 Unconscious 3 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XI *The desired behaviour can be spread out by connecting it to role models.*
Conscious: 1 Unconscious 3 Relevance: 1 Attractiveness: 1 Susceptibility: 2 Possibility of speech: 2

XII *The target group can be convinced of their abilities if others show the behaviour.*
Conscious: 3 Unconscious 1 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XIII *Behaviour can be internalised by showing concrete examples in concrete situations.*
Conscious: 1 Unconscious 2 Relevance: 3 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XIV *Attitude towards behaviour becomes more positive if role models show the behaviour.*
Conscious: 1 Unconscious 2 Relevance: 3 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XV *Entertainment education can show which behaviour others perform.*
Conscious: 0 Unconscious 3 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XVI *Entertainment education can show which behaviour others should perform.*
Conscious: 1 Unconscious 2 Relevance: 2 Attractiveness: 3 Susceptibility: 3 Possibility of speech: 2

XVII *Entertainment education can show how easy the behaviour is.*
Conscious: 2 Unconscious 2 Relevance: 3 Attractiveness: 1 Susceptibility: 2 Possibility of speech: 2

XVIII *Behaviour is experiences as more important and therefore more performed when there is a strong emotional bond.*
Conscious: 1 Unconscious 3 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XIX *By bonding to a subject behaviour becomes more consistent and can become a habit.*
Conscious: 2 Unconscious 2 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XX *By providing (the pretence of) something in return one feels obliged to give something.*
Conscious: 2 Unconscious 2 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XXI *It is a custom to return something when a favour is provided.*
Conscious: 0 Unconscious 3 Relevance: 2 Attractiveness: 2 Susceptibility: 2 Possibility of speech: 2

XXII *Desired behaviour can be enforced by good preparation.*
Conscious: 0 Unconscious 3 Relevance: 1 Attractiveness: 1 Susceptibility: 1 Possibility of speech: 1

XXIII *Behaviour can be started by triggering fear or humour.*
Conscious: 2 Unconscious 3 Relevance: 1 Attractiveness: 3 Susceptibility: 1 Possibility of speech: 1

XXIV *Especially unexpected emotional incentives can cause primary reactions.*
Conscious: 0 Unconscious 3 Relevance: 1 Attractiveness: 1 Susceptibility: 1 Possibility of speech: 1

XXV *The behaviour will be shown earlier because the messenger is valued or associated with.*
Conscious: 0 Unconscious 3 Relevance: 0 Attractiveness: 1 Susceptibility: 1 Possibility of speech: 1

XXVI *A positive impulse can trigger first behaviour.*
Conscious: 0 Unconscious 3 Relevance: 1 Attractiveness: 0 Susceptibility: 1 Possibility of speech: 0

XXVII *Scarce products are higher valued.*
Conscious: 0 Unconscious 3 Relevance: 0 Attractiveness: 1 Susceptibility: 2 Possibility of speech: 0

XXVIII *The feeling not to get something can trigger behaviour.*
Conscious: 2 Unconscious 1 Relevance: 1 Attractiveness: 0 Susceptibility: 1 Possibility of speech: 0

XXIX *Behaviour can be started by giving incentives in the physical environment.*
Conscious: 2 Unconscious 3 Relevance: 3 Attractiveness: 0 Susceptibility: 2 Possibility of speech: 0

XXX *Emotions can be aroused by specific influences.*
Conscious: 0 Unconscious 3 Relevance: 1 Attractiveness: 2 Susceptibility: 3 Possibility of speech: 0

XXXI *Connecting behaviour to specific situations makes that the behaviour is shown earlier in that situation.*

Conscious: 1 Unconscious 3 Relevance: 2 Attractiveness: 1 Susceptibility: 2 Possibility of speech: 0

XXXII *A nudge can trigger a habit which leads to desired behaviour.*

Conscious: 0 Unconscious 3 Relevance: 1 Attractiveness: 3 Susceptibility: 1 Possibility of speech: 0