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Investigation of methods for user adapted visualisation of information in a hypermedia generation system

J. Werner

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Investigation of methods for user adapted visualisation of information in a hypermedia generation system

ABSTRACT

A literature review of user interaction to support creative processes is given. A design for an authoring system for semi-automatically generated hypermedia presentations is developed. The system designed is called SampLe (a Semi-Automatic Multimedia Presentation generation Environment).

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Investigation of methods for user adapted visualisation of information in a hypermedia generation system

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23. January 2004

Statement

Hiermit erkläre ich, Jana Werner, dass ich die vorliegende Diplomarbeit selbständig und nur unter Verwendung der angegebenen Hilfsmittel und Literatur erstellt habe.

Amsterdam, 23. Januar 2004

Jana Werner

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Chapter 1

Introduction

The production of multimedia presentations is a complex, resource demanding, and distributed process with the aim of providing interesting and relevant information for the user at the right time. The activities associated with the various phases in this process may vary according to the type of production but each of them requires a tremendous amount of skill. The production is, therefore, in most cases organised around teams that provide the required knowledge on such tasks as plot generation, content selection, graphic design, programming, etc. to facilitate a well-tailored end-product that suits the need of the identified user group.

Manual production is, however, just one end of the production spectrum. At the other end we find fully automated systems. These are usually employed in dynamic environments, such as the World Wide Web, where neither the individual user requirements nor the requested material can be predicted in advance and "... that do not allow the intervention of a human during presentation generation at any time after the initial request" [11]. Such a system is designed along the phases of the presentation production process and the relevant skills to address the circumstances and presuppositions of the user at the time of accessing the information.

In the Multimedia and Human-Computer Interaction Theme (INS-2) at the Centrum voor Wiskunde en Informatica (CWI), the Dutch National Research Institute for Mathematics and Computer Science, a Semi-Automatic Multimedia Presentation generation Environment (SampLe) is under development that pursues an approach in-between these two extremes, by supporting users on various levels of expertise with respect to domain knowledge and task skill, in building multimedia presentations. This approach of intelligent support is novel, as it steps beyond the traditional type of tools, such as Microsoft Power Point, that only provide an editorial template-based environment (one to serve all) without any personalised conceptual support. The integrated approach, pursued within SampLe, tries to combine the technical support with structural and content issues of presentation building in a system that leaves control to the human.

The work described in this Media System Design (MSD) thesis is part of the research for the SampLe environment. The goal of this thesis is to describe

an effective and, moreover, attractive intuitive front-end for a semi-automatic multimedia presentation authoring environment. The interface, which facilitates the access to the underlying system representations and the use of system process described elsewhere [11], is not restrictive or confining but rather opens up new grounds for designing a presentation by supporting the creative aspects of the process, as inspired by [4]. This does not necessarily mean developing a system that is itself creative but rather should give inspiration by providing functions, tools and work-styles reflecting thought-patterns that foster creativity.

1.1 Structure of the Thesis

In chapter 2 we give an overview of the SampLe system architecture as it defines the five stages in which the presentation building process is subdivided.

In chapter 3 we outline relevant aspects of human creativity and suggest how it can be fostered in a semi-automated presentation generation environment. We then apply the insights gained to our approach on Interaction Design.

In chapter 4 we provide fundamentals about Interaction Design and User-Centred Design (UCD). We discuss theories, models and heuristics that can help to develop an optimal Interaction Design. We then provide a brief introduction to the theory of mental models as this forms the basis for our definition for the target group being addressed in our interface approach.

In chapter 5 we describe our design in detail. We introduce the workspaces, discuss different functionalities and their possible ways of visualisation and use, and go step by step through the SampLe Interaction Design. Finally we present the SampLe HTML mock-up.

In chapter 6 we conclude with a summary of the results of this work and compare it with an alternative approach for presentation building. The alternative is not implemented or backed up by a mock-up, as it would require a truly creative system, but allows a better discussion of the advantages and disadvantages of our design. Based on this discussion we briefly describe a vision about integrated browsing and presentation building combined in one work-step.

Chapter 2

SampLe structures

As our work on the creativity-supportive front-end for a semi-automatic multimedia presentation authoring environment is closely related to the developments in the SampLe project we now briefly introduce the system.

The overall idea of the SampLe project is to facilitate a user to make a presentation about a topic within the domain of visual arts. A presentation is understood here as a discourse structure that describes a path through an associated semantic network which represents the domain knowledge to be explored. In order to accomplish this task of presentation making, material needs to be collected from the semantic network, evaluated and assigned to the logical structure of the presentation.

The SampLe system, once finalised, covers three functionalities. First it assists the user on various levels of expertise to access, interpret, evaluate and manipulate the complex representation structures of the domain (closed but vast repository). Secondly it enables the creation of a presentation (a path through the knowledge space) by establishing a discourse structure that utilizes the relevant data of all available media data. Finally, the system facilitates the extension of the knowledge space as part of the working process of presentation authoring.

The underlying structures of the knowledge space used by SampLe are grouped around the following concepts:

Goal: The goal, which, in the context of SampLe, is the aim of the user to build a presentation in the domain of the visual arts, forms the basis for the whole organisation of the system. This means that the system architecture, including the graphical interface, reflects this goal both implicitly and explicitly. Thus every task to be achieved, every action to be performed and every role to be assigned within the authoring process is driven by the domain requirements and the knowledge and skills of the user.

The most relevant structures influenced by the goal, namely role, task, and action, need further explanation.

Role: Roles in SampLe can cover two conceptual structures. On the one hand they describe the level of domain knowledge and rhetoric skills of the user, namely on a scale from novice to expert. On the other hand a role is assigned to an abstract concept like a paragraph in a text (introduction, summary, etc.), and is understood here as a function or part performed especially in a particular operation or process.

Task: The goal is reached through performing a set of tasks, each of them achieving a piece of work to be finished within a certain time. A task can be, for example, the collection of material, which requires a certain number of actions.

Action: An action is a set of atomic functions to accomplish a task usually over a period of time, in stages, with the possibility of repetition. In the context of material collection, an action would be to form a search query and submit it.

The conceptual structures described in the previous discussion are reflected in the SampLe system architecture, which implements the presentation building process in five stages [11]:

Theme identification facilitates the identification of the presentation theme in terms of content and presentation settings. Content specifications comprise the topic, possible related topics and the presentation genre, which is a kind of narrative structure, derived from literature genres. Presentation settings concern selecting media types (e.g. audio, video, text, etc.) and the desired flow of the presentation whether it be an interactive or continuous mode.

Specification of presentation structure consists of choosing and altering genre templates. These are specific presentation structures, that resemble different narrative compositions. These presentation structures (essay, biography, etc.) consist of conceptual parts (introduction, description, conclusion, etc.) that are arranged within a top-level structure. The system-proposed conceptual parts depend on the user's choice of topic and related topics or can even be freely chosen by the user him-/herself. The latter facilitates the user not to be limited in his/her creativity by too much automation. Furthermore, structures and conceptual parts can be edited by the user, which could mean extension or reduction as well as changing number, size or order of conceptual parts.

Collection of material allows the retrieval of information in which media items are assigned to the conceptual parts in the structure according to their content and with respect to their role within the narrative structure. Moreover, new documents can be imported or generated and links between documents can be altered. For assuring the retrieval of adequate documents, data has to be annotated with the concepts from the domain ontology, allowing the system to identify its content and with the contents from the narrative structure ontology. In addition, items are annotated

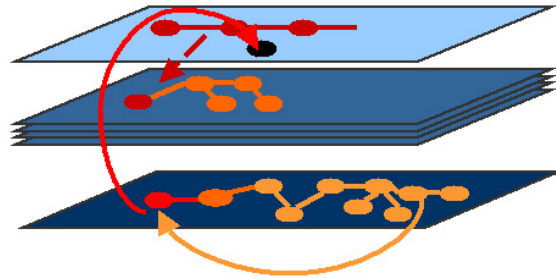


Figure 2.1: Iterative process of presentation building, taken from [40]

with concepts from the media ontology to assure the use of the appropriate media representation.

Arrangement of material supports the specification of a coherent ordering based on rules concerning the content, narrative structure and the presentation structure the media items need to fit in. Spatial and temporal order has to be taken into account.

Presentation creation allows the definition of visual elements and effects. The input from the preceding steps is then conveyed into a multimedia presentation. For details see [33]. In this thesis, the step of presentation generation is not further investigated.

These five steps are iterative and can be interrelating. In stage 2 the user might have chosen, for example, a genre for the presentation (e.g. a biography) and realises later, after having inspected the retrieved material and collected information units that a different genre (e.g. an essay) would fit the content better. Therefore s/he might go back and change the genre. Figure 2.1 on page 5 shows the interactivity on and between the various production stages in SampLe graphically. The dark red arrow in combination with the black dot represents the iterative element between the stages represented as layers.

The 5 stages of the presentation building process and the structures for goals, roles, tasks and actions culminate in the SampLe system architecture as described in figure 2.2 on page 6.

This architecture consists of four components:

Application Model handles the actual presentation building process and the interaction with the user.

User Model represents the user who is currently working with the application. It contains all of the user’s characteristics that are relevant for the application and functions that can be applied to him/her.

Adaptation Model handles the “communication” between the Application Model and User Model.

Domain Model manages the underlying Data.

2. SampLe structures

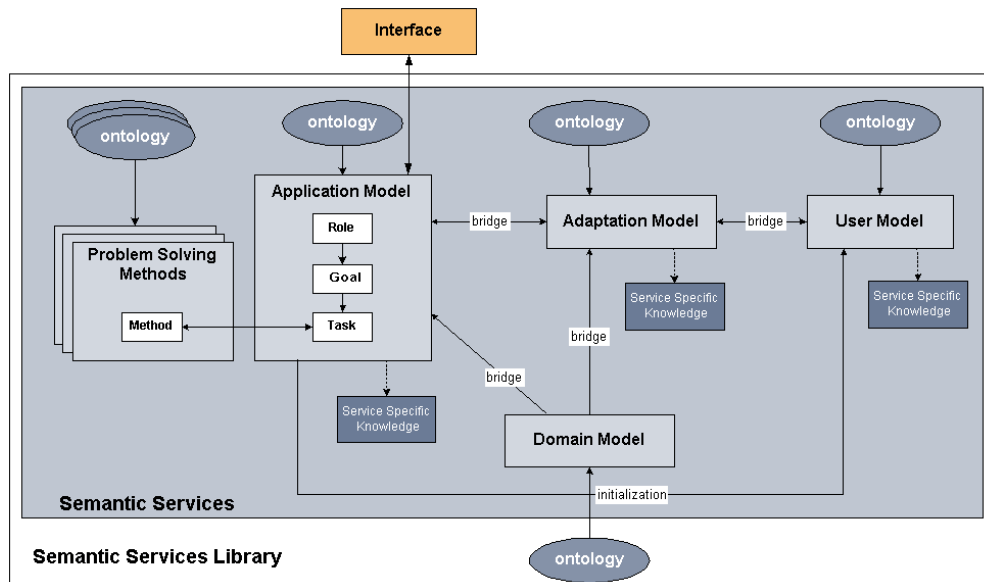


Figure 2.2: SampLe architecture

The work described in this thesis concentrates on the Application Model. We are interested in two aspects in particular:

- a) visualising the underlying complex processes and data structures in a front-end
- b) supporting creativity in the presentation building process.

Having introduced the environment our work is embedded in, we proceed with a description of our view on the concept of creativity in the context of SampLe.

Chapter 3

Creativity support in human computer interfaces

In the previous chapter, we showed that the process of presentation building is based on the performance of various tasks with respect to a particular goal, such as collecting, choosing and using material, contextualising and re-contextualising information. All these tasks are necessarily creative, as they

”...include the ability to take existing objects and combine them in different ways for new purposes. For example, Gutenberg took the wine press and produced a printing press. Thus, a simple definition of creativity is the action of combining previously uncombined elements. From art, music and invention to household chores, this is part of the nature of being creative. Another way of looking at creativity is as playing with the way things are interrelated. Creativity is the ability to generate novel and useful ideas and solutions to everyday problems and challenges.” [1].

The restrictive use of creativity as described in the above citation, namely the mere combination of existing elements, is just one facet of the phenomenon. A more elaborate form of creativity goes beyond the combination and achieves the creation of new, not known ideas. Creativity understood in this way means

”...seeing the same thing as everybody else but thinking of something different” [1]

As the interface to be designed in this thesis is also a reflection on creative tasks, it is important to have an understanding of the creative process. Moreover, it is necessary to look at approaches in IT that have already tried to support such a process. The results of both two investigations provide the basis for the creativity support aspects in our Interaction Design, described in chapter 5.

3.1 The creativity process

About 2500 years ago, the Greeks believed that the inspiration for originality came from a great number of gods that were delivered by heavenly creatures, the 9 Muses. The daughters of Mnemosyne, the goddess of memory, and Zeus, the Muses were believed to be guides and sources of inspiration of human creativity, each of them presiding over a different art or science. This is a beautiful enchanting and poetic view on the process of creativity. With respect to the above citations, however, it is more appropriate to understand creativity as an intrinsically human process. From the vast literature, we have chosen to follow the process description by Graham Wallas.

In the beginning of the 20th century Graham Wallas (1858-1932, English political scientist and psychologist) described the creative process as four stages of creation (as cited in [1]):

Preparation. The person must know the subject (on which to be creative) very well. S/he also must define the topic on which s/he wants to work and collect as much information about it as possible. For example, inventing a technical apparatus requires, that s/he has to have technical background. It was found, that the people who invented something creative only did so in their area of expertise. Creativity does not come over us out of the blue. A big part of it is based on knowledge and preparation.

Incubation. Wallas found that many creative ideas only emerged after a period of time was spent away from the problem, with usually a precedent phase of active engagement, like with Archimedes having his idea in a public bath or Isaac Newton being inspired in his Lincolnshire orchard when an apple fell down from a tree. During this time of doing nothing, the subconscious connects the available information and the task to find new ideas. In some creativity-techniques it has been tried to artificially generate this phase by applying techniques of relaxation.

Illumination. The flash of an idea that has grown during the incubation comes usually very unexpectedly. It's a mysterious phase and Wallas could only propose to rest the mind and wait for it. It is important to be open to the new ideas or dreams, no matter if they might seem strange at first sight.

Verification. In this last step, it has to be reviewed whether this first idea is actually useful and can be realised. Since such a flash-idea is not always realisable in reality, this last step is of vital importance. If the result of this evaluation is negative, the process has to be repeated.

At the end of the 20th century, the subject of creativity and cognition in IT became an area of interest for research. It is still in its infancy and hardly investigated. In the beginning, the aim was to understand and model creativity as an autonomous process within a computational system. Today the emphasis has shifted to trying to support human creativity with the help of computers. Building on Wallas' four-step-structure of the creative process, many models

have been developed in the last few years, trying to map this work-style to computerised creativity support [27].

3.2 Creativity support in computer systems

A question that arose in the research of creativity in IT is whether technology can aid human creativity since creativity is an inherently human attribute and computers themselves are unable to be creative.

One of the major hypotheses for the work described in this thesis is that IT can support human creativity just like other technologies have done in the past (Leonardo da Vinci painting on canvas or Pasteur using microscopes for his discoveries). Computer tools can facilitate creativity in two ways - first of all they can support knowledge gathering, integration and out of this, idea generation. Secondly, they can support the generation of creative artefacts by providing the necessary work environment and functionality. According to [13], “the optimal computer tool will provide support on both of these levels”. The research in computer support of creativity, however, merely focuses on the aspect of functionality as exemplified in ([8],[9],[23],[24], [31]).

In these approaches creativity is mainly researched by means of experimentation, the exploration of alternatives, continual evaluation of one’s progress, iteration and undos. These non-linear techniques, essential for working creatively, are used to break up the production process of Single State Documents. The model of this process allows a document to be in only one state at a time which forces a linear work-style. Thereby it hinders any experimental processes that characterise creative endeavours according to Schön’s theory of reflection-in-action [31]. His theory states that creative workers approach a task by firstly trying to understand the problem, secondly “making a move” [31], meaning they act on it and then reflect on their move. This process is repeated over and over again. Thereby, designers do not take any standard approach to solve the problem but rather choose from a repertoire of knowledge and experience to make up a first idea of solving the problem which is then tested in those moves. While trying out variations, the work is step by step brought into the desired direction while the designer gains more and more understanding of the problem by observing how the design alters according to his/her decisions. Schön calls that “entering into a conversation with the problem, making a move, analysing how it ‘talks back’ to him, and responding accordingly” [31]. The investigated projects ([31],[24],[23], [8],[9]) always tackle this problem by providing different kinds of histories and undo mechanisms, comparison tools, versioning, etc. to facilitate the user to “talk” to his/her problem which needs to be solved.

Though these approaches cover the restrictive use of creativity, described in the beginning of this chapter, and also combine the incubation, illumination and verification phases of the Wallas’ model in an iterative loop, they merely facilitate the generation of creative artefacts by providing functional support rather than pursuing the integrated approach of supporting knowledge gathering, integration and out of this, idea generation.

The interaction processes in SampLe tries to address the complete integrated

approach for creativity support. For the development of the SampLe front-end, this means that a design and functionality has to be developed along the four phases of the Wallas creativity model. The previously described functionality, found in existing research, is integrated in the front-end design. Moreover, additional functionality is provided to support the missing Wallas stages.

The preparation stage in which the user becomes familiar with the domain and/or tasks, which is not recognised by the presented research, is supported by providing a tutorial on how to use SampLe and the content-based learning is supported by providing abstracts and summaries.

For the remaining three stages we provide functionality that supports the creative process in the moment-to-moment interactions, such as smooth co-ordination across windows, e.g. when a user reads an unfamiliar term, an explanation is usually only one click away (such as our browsing through genres and names and images, see chapter 5). We enable synchronized scrolling of related documents to facilitate comparisons and hierarchical browsing. We provide adjustable visualization features (and add colour, text, resize and so forth). Thesauri and other textual exploration tools (e.g. a text comparison tool) help associating by finding synonyms, antonyms, homonyms, rhymes or even anagrams. A preview function is provided as “reflecting a work is a central notion in quality improvement, creativity and education methods” ([27] p.20). Depending on the user’s topic and settings SampLe offers an appropriate repository of documents and artefacts (and even finished presentations for comparison and inspiration) for the user to browse through, as inspiration often is triggered through existing work. Making available a wide range of containers which can be resized, reordered and changed around and then actually be filled with provided or new content, is another way of leading people carefully into the subject. We do so by providing e.g. parts of presentation genres to be filled with information/documents.

For the illumination phase, a potential option is to enable the system to detect when the user is stuck in his/her work to propose relaxation techniques or ask the user to leave the work-place for a certain time to get a mental distance to the problem. We provide export and save-status functionality to allow the user to take his/her work out of the work-environment as different surroundings might incite new ideas. Since SampLe is a semi-automatic authoring environment, the verification phase can be supported on a formal level but the semantic validation will mainly be left to the user.

The availability of all these functionalities is achieved by the Interaction Design that provides them right at the point where needed in a non obtrusive way and reduces the restraints and mental load that stop people from being creative. In this way we attempt to help users to shift from acquiring and studying knowledge to create new knowledge and rearrange or extend the existing or place it in new contexts. A detailed description of the various adapted functionality and their integration is described in chapter 5.

Having introduced the essential aspects of creativity and creativity support in IT for this work, we are now in the position to outline the theoretical basis for the approach taken towards the design of the Interaction Design for the SampLe system.

Chapter 4

Human computer interfaces and interaction theory

In the previous chapters we introduced the framework for our presentation generation environment and outlined our understanding of creativity and creativity support in such a system. This chapter introduces the design fundamentals for the interface. The emphasis in our description of design methods focusses on Interaction Design in particular for 2D+ interfaces for human computer interaction (HCI). We first discuss Interaction Design in general and, in the second part of this chapter, we focus on specific design aspects related to UCD.

4.1 Interaction and dialogue styles

The view of "interaction" taken in this thesis is based on the following definition:

"Interaction can be defined as a balanced exchange of input and output symbols or tokens that are based on a common, agreed language of the interchange. In the computer domain, input means the submission of interaction symbols by the user to the system, and output means the computer's display of interaction symbols to the user. The application (that is software providing the functionality of the application) is accessible to the user through the user interface."
([32] pp. 18-19.)

Understanding interaction in this sense allows us to distinguish between tools that enable a user to perform the interaction and the cognitive processes that lead to the use of such tools. Here we understand tools as hardware, such as keyboard or mouse, or software, such as an icon-based desktop, which combines *interaction methods* that are "high-level software components that allow users to interact with the system in specified ways", [32] p.19.

The cognitive models that form the basis for interaction are mainly *discourse strategies*. Discourse strategies are models of the communication process happening between the system and the user, where the emphasis is laid on the representation of the user's point of view. Depending on the type of dialogue these styles are organised in groups, such as

Conversational dialogue styles are based on the exchange of symbols and/or tokens of sequentially structured information. This is done in accordance to predefined lexical and syntactic rules of conversation that users need to follow in order to be able to use the system. Examples are command languages, query languages, and question answer dialogues.

Model world interaction styles allow the user to interact with the application system within a spatially and visually presented world consisting of a user-interface and application objects. Instead of following language rules, the user performs action methods: the system displays objects of the model world that the user can directly manipulate, sequentially or non-sequentially, in order to fulfill a task.

Advanced dialogue styles are more user-centred than those based on technical concepts, allowing interaction to be based on the users' tasks and concepts. A common interaction style is WIMP (Windows, Icons, Menus and Pointer), a combination of window-based, graphical and menu-driven dialogues, and direct manipulation.

Natural language dialogues associate an anthropomorphic personality with the computer (social interaction).

Multimodal interaction combines natural language with other input modes such as gestures.

Virtual environments include both multimodal interaction and three-dimensional graphic models and user interfaces, allowing the user to act directly on application objects in an immersive or non-immersive manner.

Of the wide range of dialogue styles, we describe in more detail only those that are relevant for our system. The interested reader can find more detail in ([32] pp.29-31).

Model world interaction styles:

Windows and multithreaded dialogue. Windows divide both the screen space and multiple dialogue threads into clearly divided areas. The user can move between these clearly marked dialogue threads to work on parallel tasks.

Graphical dialogue. Graphical user interfaces with icons allow the user to see possible dialogue choices, and furthermore allow direct action on graphical objects on the screen.

Menu-driven dialogue. Menus show the user all the options available at one task level at any moment during the dialogue. The user browses through the menu hierarchy to find the right methods for the task at hand.

Form and mask filling. The user fills in application-specific "forms" with values that are then used in the application. The user sees at all times what information has been entered and which information is still required.

Traditional dialogue style:

Question-answer dialogue. The system poses a question and the user has to answer by choosing one of the options, or by giving a value, [32] p.30.

Advanced dialogue style:

Direct manipulation. The user directly works on an object and the system shows the changes made in real time. "This paradigm is especially useful for novice users, since it does not require any learning of syntax. At most it requires mapping of simple actions on their effect, e.g. 'double clicking means opening'. The most common environment where direct manipulation has been used successfully is the desktop user interface. The WIMP (Windows, Icons, Menus and Pointing) dialogue style often associated with the desktop user interface is a combination of menu-driven, graphical and window-based dialog. Perhaps the most important principle of direct manipulation is the WYSIWYG (what you see is what you get, [32] p.31).

Document-based interaction The user works directly on a document.

While these interaction theories describe communication mechanisms on a theoretical basis, we still need to provide an audiovisual means of representing them. This is the aim of Interaction Design, which we discuss in the following sections.

4.2 Interaction Design

As the aim of this thesis is to develop an interface for a dynamic and interactive authoring environment, it is appropriate to quickly outline what Interaction Design means in the context of this thesis:

"...designing interactive products to support people in their everyday and working lives. In particular, it is about creating user experiences that enhance and extend the way people work, communicate and interact." ([21] p.6).

This definition describes Interaction Design as a general approach that deals with all kinds of interactive products from a coffee machine to a mobile phone. We want to look at Interaction Design, however, from a particular angle, namely in the context of complex multimedia information spaces. The information space is accessed through a graphical interface that facilitates the user in generating an interactive multimedia application, that itself becomes part of the information space. Our goal hereby is to optimise the user's interactions with the system so s/he is optimally supported throughout his/her work and has enough space and freedom to develop his/her ideas without being distracted from the actual goal.

In this undertaking we draw on the already established results within the long history of interface-design. Experts from many different fields, such as

graphic and media design, informatics, psychology, sociology and anthropology have contributed to establish a technology now only too familiar to computer users. Mouse and keyboard, windows, menus or scroll-bars appear in many Interaction Designs and are absolutely natural and functional to people that have used them many times before and need little thought and attention when using them. Further improvements in technology, such as speech control, new ways of visualization such as virtual reality, or tools such as mobile phones add to the richness of human interaction and forced the development of novel forms of Interaction Design to address the growing and changing needs in human information handling and communication.

In the context of SampLe we address the particular problem of supporting the authoring of presentations in educational environments. The aim is to provide an interactive interface that can be used through a computer with mouse and keyboard. It could well be possible that such a system could be extended to Computer Supported Cooperative Working / Learning (CSCW/L) or use new technology by working on electronic blackboards or handheld devices when developing multimedia presentations.

In the rest of the chapter we outline the ideas and theories within Interaction Design that influenced our final design approach, as described in chapter 5, that aims to provide a coherent and consistent interface as the basis for supporting creative work.

4.3 Interaction Design and SampLe

The primary objective in designing any application interface is to evaluate the user needs with respect to the system demands. Where some systems' primary aim is to keep users absorbed and entertained, other systems are designed to support highly productive work.

The goals of Interaction Design can be classified into two categories: usability goals and user experience goals. The following usability goals can be distinguished:

Effectiveness is defined as "productive or capable of producing a result" [17]. In other words, how well does the system perform in what it is supposed to do.

Efficiency refers to the competence, performance and productivity of the application and how adequately it facilitates the user with the support s/he needs to reach his/her goals.

Safety refers to protecting the user from dangerous situations by making the user aware of his/her actions, warning him/her when carrying out irreversible decisions and protecting him/her from making mistakes by minimizing the risk of wrong actions.

Utility refers to whether the system functions adequately support the user in carrying out his/her task.

Learnability relates to how easy it is to learn to use the system. It is, therefore, important to find out about the expertise of the user and how much time they are willing to spend on learning a system. The goal of learnability needs special attention in a complex system where the target group is very diverse and no manuals exist. Offering several help systems and providing various design approaches and complexity levels for different working-styles can accomplish the goal.

Memorability refers to how easy the user remembers how to use the system once s/he has learned it. Logical structuring, explicit naming, menu options, categorizing of e.g. tools, and the use of signs can help the user to quickly get back into the system even if s/he has not used it for a while.

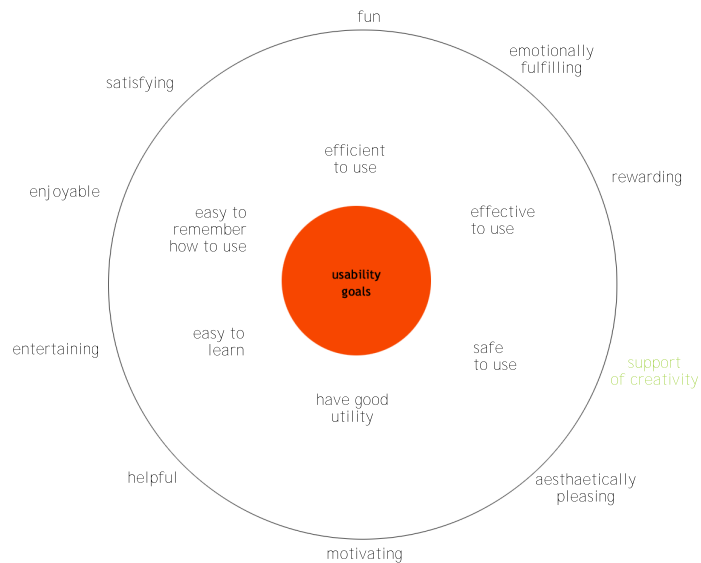
Beyond trying to meet the basic goals of usability it is of importance within Interaction Design to evaluate the relevance of those goals for the application that are concerned with user experience. The main factors, stated in [21], are:

- Satisfaction
- Joy
- Fun
- Entertainment
- Helpfulness
- Motivation
- Pleasing aesthetics
- Creativity support
- Reward
- Emotional fulfilment

As most of these factors are highly subjective it is necessary to evaluate them in user tests, which also requires that an analysis of the potential user group is performed in combination with the development of the Interaction Design. The relevant issues for our approach with respect to UCD are discussed later in more detail in section 4.5.

The relationship between usability and user experience goals is described in figure 4.1 on page 16.

With the front-end for the SampLe application, we try to address the usability goals. Yet, as outlined in chapter 1, we focus in our design on the user experience goal support of creativity, hence this will be the only user experience goal our front-end is trying to meet.



"Usability and user experience goals. Usability goals are central to interaction design and are operationalized through specific criteria. User experience goals are shown in the outer circle and are less clearly defined." taken from [27 p.19]

Figure 4.1: Usability and user experience goals, [21], p.19

In order to understand and apply Interaction Design and UCD in an optimal way, many aspects of these usability and user experience goals have been investigated from the different disciplines involved, such as psychology, cognitive ergonomics, industrial design, informatics and many more. Various theories, heuristics and models have evolved, covering most facets of the topic. In the following sections we want to take a closer look at those being of particular interest for designing the SampLe interface.

4.4 Theoretical aspects for Interaction Design

The various approaches to meet usability and user experience goals described in section 4.3 in a user interface, such as introducing virtual reality [18] or digital black boards [8], all have one elemental aspect in common, the application of intuition in their Interaction Design. In the following section we describe the fundamentals of intuition theory and its importance for effective Interaction Design.

4.4.1 Intuition

According to dictionary.com [2], intuition is

"The act or faculty of knowing or sensing without the use of rational processes; immediate cognition."

In [7] it is stated that

”In a psychological encyclopaedia intuition is described as being . . . essentially arriving at decisions or conclusions without explicit or conscious processes of reasoned thinking. It is sometimes thought that intuitions are reliable; and indeed we do act most of the time without knowing why or what our reasons may be. It is certainly rare to set out an argument in formal terms, and go through the steps as prescribed by logicians. In this sense, almost all judgements and behaviour are ‘intuitive’ (Gregory 1989 p. 389)”.

Combining these ideas we define intuition for the Interaction Design of SampLe as

”the availability of functions supporting learning of unknown functions and their operation, but in a way that is not perceived as ‘teaching’ or ‘education’. Learning must be a spontaneous product of the activity of use.” [[7], p. 32].

To understand how we can put this definition into practice, we want to take a further look into how to apply intuition in computer applications.

In mechanical devices, such as a typewriter or a coffee machine, the function and therefore how to use the device can to a great degree be intuitively gathered from the construction of the mechanics and their perceivable surface. Computers, however, do not have such an innate design but can be used for many different tasks. Yet, if we analyse the large number of available applications and their interfaces, we see that again the interfaces represent the particular functionality with respect to content and processing. Thus, an interface should in its particular domain be similarly intuitive and explicit in its construction of mechanisms and their tangible surface as a mechanical device. In other words, an essential element of intuition is that it relies on a defined context in a domain. For design, this means that a clear analysis of the needs of the domain (tasks, processes, etc.) and related needs of the user is required.

The domain and task analysis for the SampLe project resulted in the five-stage model of the presentation building process, as described in chapter 2, of which the first four stages are realised in this thesis. The interface-design, as described in chapter 5, only uses these four steps as the start pointing of the Interaction Design development. During the design process it turned out, for example, that the logical distinction between collection of material and arrangement of material (see chapter 2) does not make sense for the interface as the overlap of sub-tasks in both tasks is too substantial to argue for two different workspaces. Hence, the interface combines both, resulting in three instead of four work-spaces as suggested by the SampLe process model.

On the task level, there are two problems to tackle an intuitive user interface. Firstly, the interface must convey the content for a task and imply how to use the interface for solving it. Secondly it has to make the transitions between tasks understandable for the user by providing intuitive navigation.

In order to solve the first problem, we have to develop intuitive access to the interface, by analysing what tools are needed for solving a particular task and offer them to the user at the right points within the process and in the right places of the work-space. Therefore, we build on the insight that existing knowledge or skills that were acquired when using advanced audio-visual technology, may be relevant when trying to operate new or unknown systems. Some of these background capabilities are individual as they come from individual or cultural experiences, such as reading from left to right in the European culture. Others are characteristic for all human beings, such as processing images faster and more direct than symbols, such as written words. Some of them are not even typical for humans only but have an evolutionary background. In the SampLe interface, we provide functions and symbolic language, such as the play and pause button, which appears on any CD player. We assume that the user has learned those from using other applications or from experience from the analogue world. These functions do not need any explanation as we expect that the user can detect their purpose, even though they were put into the new context of our interface (for example a play button that does not start a CD but some other function).

The second problem, namely that of transitions between stages in the work process, is important as the user performs sudden jumps and thereby changes the workspace. This makes it hard for users to keep oriented and hence it is necessary to provide a substantial and continuous navigation as we know it from the real world. Instantaneous jumps and sudden changes of environment are just not possible in the real world where the slow shifting of our surroundings informs us about the kind of changes we go through, allowing us to interpolate where we are and where we might end up if we continue the chosen path. One way of tackling the transition problem in SampLe is to merge two process-steps into one so that this problem disappears.

For the remaining three work-steps that cannot be combined, as their functionality is too different, we introduce a navigation that consists of known elements from the World Wide Web and experiences from the real world, such as applying reading-direction alignment of the work-step representations in the navigation. Some navigation aspects are even "... delegated to the level of non-symbolic processes of direct perception-action control drawing on evolutionary old 'hard-wired' systems in the brain since these systems are much better distinct and possess much more processing power as they are made for automatic control, compared to symbolic information processing that always requires conscious efforts of the users." [[7] , p. 46]. An example of perception-action control is for example colour-coding (for details see section 5.1.3).

Though intuition in user interfaces is very complex, intangible and powerful, it might in itself not be able to cover all of the demands we have on an effective user interface. In the following section we, therefore, take a look at the conceptual model of metaphors as a concrete realisation of intuition theory and investigate if and how metaphors are able to contribute to the development of intuitive interface-design.

4.4.2 Metaphors

In literature, a metaphor is understood as:

”1 A figure of speech in which a word or phrase that ordinarily designates one thing is used to designate another, thus making an implicit comparison, as in ‘a sea of troubles’ or ‘All the world’s a stage’(Shakespeare).

2 One thing conceived as representing another; a symbol: ‘Hollywood has always been an irresistible, prefabricated metaphor for the crass, the materialistic, the shallow, and the craven’ (Neal Gabler)”
[2]

A simple form of metaphor describes something new by comparing it with something that is already known. This concept is closely related to that of analogy, which is a comparison based on similarity to an object or circumstance in another domain, allowing the mapping of these aspects and thereby understanding the original object or circumstance better.

Metaphors can be used to support intuition, whether it be in computer systems or in other areas, such as architecture, psychology, pedagogy, film, etc., since they also support the learning of unknown functions and their operation, but in a way that is not perceived as ‘teaching’ or ‘education’ as mentioned in the definition of intuitive design in section 4.4.1. For example, explaining the rules of electricity by making pupils think of the behaviour of water in a hose would be such a familiar metaphor.

In computer interfaces metaphors are mainly used for spatial and functional representations in a visual form to explain objects and/or interaction methods. Probably some of the most famous metaphors are those of the “desktop”, describing the functionality of virtual information management or the trash can for deleting items, like in the Mac OS and Microsoft Windows Graphical User Interfaces (GUIs).

Interface metaphors have so far been very successful. They help in particular novice users to orient themselves in an unfamiliar environment, explain the use of functions in a simple way and reduce the fear of the unknown. It is also found that people find it easier to learn (reduce learning time) and talk about what they are doing (since similar practices can be applied). They encourage interaction and increase motivation by conveying a feeling of instant familiarity and thus ease dialogue processes and recognition [example [18]].

Although the use of metaphors might have advantages, it is not unproblematic. One of the greatest difficulties is to choose an appropriate metaphor for the object or circumstance that is to be represented. Mismatches and short-falls are likely to exacerbate and impair understanding, learning and working. An example is the metaphor of a typewriter for word processors, where central functions, such as the use of the return key causes not only line shift but can also delete text ([32], p. 111). Users might not be able to grasp the functionality beyond the metaphor.

Metaphors might lack flexibility by being insufficient or too constraining, restricting tasks that would actually be useful but cannot be mapped to the

metaphor(s). Thus, a metaphor might be over promising which results in users possibly becoming upset when they discover the limits of the metaphor. Different user groups with different cultural backgrounds and technical knowledge might have different understanding and demands on metaphors. For users with high declarative knowledge, a metaphor might be a too naive approach to interface-design.

Finally, designers might be trapped by taking over an object for a metaphor that was designed badly in the first place. Trying to think of metaphors also runs the risk of narrowing the designer's horizon and instead of developing new and forward thinking concepts, they resort to old, hackneyed and limited ideas.

Taking all these pros and cons into account, we choose metaphors in the SampLe environment carefully and use them economically. Their detailed application will be described at the appropriate points in the SampLe interface description in chapter 5.

4.4.3 Usability heuristics

For developing a concrete Interaction Design, it is not enough to simply base our work on the broad insights of intuition theory and metaphors. Rather, these wide and theoretical fundamentals, applicable to all areas of life, need to be concretised in a set of heuristics that refer to the kind of interface-design that is aimed at in this thesis (specified in 4.2 and 4.3).

For the development of the SampLe Interaction Design, we work along heuristics for usability in user interface-design that were developed by Jakob Nielsen [19]. Those heuristics concretise the insights of our intuition and metaphor sections above as Nielsen manifests the fundamentals for intuitive use of an application in order to optimise its usability.

In this section we introduce each of the 10 usability heuristics by Nielsen and see how they can be applied to SampLe.

1 Visibility of system status - The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

This heuristic actually addresses the problem of discontinuity when moving between the different work-steps, as was discussed in section 4.4.1. Some of the most important facts for users to know within an application are where they are, what they can do there, where they can go, how they get back and how they can leave the system. We provide that information through a consistent and expedient navigation on several layers, branding of the sections and windows through naming and colour coding and clearly marked linking. We also support this information-policy by providing special boxes with information about functions, content and system status information as well as providing a background space which can, among other things, be used to provide secondary information. Separate windows are employed for clarifying decisions and problems and offering alternatives from which the user can choose. A detailed explanation of the extensive navigation and information system will be given in section 5.1.3.

2 Match between system and the real world - The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

Since our user-group is assumed to be inhomogeneous and coming from diverse backgrounds, finding the right way of addressing them is quite a challenge. We use, therefore, known functionalities from the analogue and digital world that fit western European standards.

On the design level, we resort to familiar concepts, such as text links, scroll-bars, trees, list views, information maps and metaphors, as discussed in section 4.4.2, such as the window-metaphor.

For easier orientation and understanding the system follows the 5 step model for putting together a presentation, as described in chapter 2, that can, however, be slightly adapted to special demands of users. The steps are lined up (next to each other) in the navigation in reading direction from left to right, ending with an image metaphor for the final presentation. This visual representation shows the user clearly which steps she has to take for reaching the goal of building a presentation. This line-up integrates orientation and navigation.

3 User control and freedom - Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

SampLe is a complex application in terms of functionality and the complexity of content that has to be handled (complex information units and the relation between them). The design provides, therefore, histories and undo functions to make sure that the user can return to earlier states, following Schön's theory of reflection-in-action, as described in section 3.2. This also reduces the mental load resulting in a focus on the actual content instead of having to keep an action-history and their effects in mind.

We support different working modes (structural and content-emphasized work mode) and varied ways of using a function wherever it is possible. Furthermore, there are several points, where decisions that the user made in his/her work process are summarized and can be reconsidered.

4 Consistency and standards - Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Consistency is one of the main criteria for intuitive interface-design so that users recognise functionality and content to speed up the learn- and work-process.

In the interface-design we place similar functionality in similar places, grouped together throughout the 3 main work stages. We keep the use of symbols and wording clear and consistent in links, names, page titles, headers, etc. Tool-tips give additional explanation support. The design follows web- and desktop

standards, which are assumed to be known by the user if s/he managed to enter our system.

Import/export interfaces handle the communication with other programmes and versioning of the edited documents. They must be worked out carefully since various media types exist in the system that can be edited and exchanged with a number of applications.

5 Help users recognize, diagnose, and recover from errors - Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

Errors are frustrating and the resulting feeling of helplessness and anger is counter productive for creativity-based authoring. For that reason we thought carefully about error handling in crucial points within the application, such as the search. If a user's search yields no hits we guide him/her to use different search methods (text field, alphabetical, directories, etc.) and give possible reasons why the search was not successful as well as advice on how to search. If a user is not content with the retrieved information, we try to tell him/her the reasons why the system chose that content and lead him/her back to a new search where s/he can adapt the crucial criteria. A detailed description about the search can be read in section 5.3.1.

For system-errors, we only can generally say that we offer links to the help system since those have not been investigated in this research setting.

6 Error prevention - Even better than good error messages is a careful design that prevents a problem from occurring in the first place.

Again, this aspect was only investigated in terms of usability and interface-design. We give support during the search in the form of asking for specification if a user has entered an ambiguous term. ("Did you mean x or y?"). On a more general level, we try to prevent errors by continuously leading the user through the system, so s/he does not get lost and always knows what to do and where and how to do it. With a user model that decides what degree of complexity in terms of information presentation techniques to offer to the user, we facilitate a level of complexity the user can grasp.

7 Recognition rather than recall - Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

In ([32], p. 28) it is stated that "Recognition of objects that have been seen before is a very powerful skill, although the level of detail that is remembered is limited." We support recognition by continuously making the user aware of where s/he is located within the system through colour coding, clear indications within the navigation and paths, naming on the windows and the headlines within the content. We provide understandable labels and descriptive links, based on domain and application terminology, as they are also crucial

for recognition. Options and functions are made visible through tool palettes that are attached to the objects they can be used on. Additional options and context sensitive information are given in boxes attached to the relevant windows, asking questions and thereby offering different links to different content and different levels of complexity.

The system always keeps entered information on the workspace and links back to the points where they were entered so they can be altered if required. Also on that background instructions and help can be found.

8 Flexibility and efficiency of use - Accelerators – unseen by the novice user – may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

Since the application is personalised through the application of user modelling, it becomes increasingly efficient in providing the right level of complexity and content the more it knows about the user. Additionally, the user is able to customise his/her workspace to his/her needs and habits to allow more efficient working. S/he can open and close additional windows as s/he wishes and move and resize them as well as making use of a full screen mode so as not to be distracted by other functionalities.

The freedom of a linear or a non-linear mode of operation allows to adapt the work-process to the users' demands. Within the work process, the user has to take rough decisions and is then offered refining steps that s/he can take but that are not obligatory. In some areas, different views of the same information are available. The user can switch between them or use them in parallel. Bookmarks, notepads, digital post-its and recording functions support a flexible, creative work mode. The user can interrupt his/her work, save his/her status and print or export the current work status. Furthermore it is possible to import and export files to edit them in more efficient tools.

9 Aesthetic and minimalist design (also referred to as simplicity) - Dialogues should not contain information that is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

This rule facilitates the intuitive aspects of authoring since distraction by irrelevant content is counter productive for intuitive modes of operation.

For graphic design, we do without filling decor that does not have any function. The overall impression is that of a straight, clear, well-proportioned and prorated space where each element has a particular use and any useless elements are omitted. To support this impression we use clear colours and sans serif fonts. A wide workspace is left open with a discrete font not to evoke the feeling of being run over by design and information. Progressive levels of detail avoid too much information to be crammed into one page. More general information is put higher up in the hierarchy and let users drill down deeper if

they want the details. In terms of linguistics we try to use economic and clear and short wording (no essays) so that if a user has to read something, it can be done quickly without forgetting his/her current task.

10 Help and documentation. Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focus on the user's task, list concrete steps to be carried out, and not be too large.

A complex help system is implemented on different levels, at different points and with varying goals, which gives the user the feeling that assistance is never too far away, easy to understand and which will lead him/her quickly back to his/her main task by being direct and supportive. It is introduced in detail in chapter 5.

The first part of this chapter gives a detailed insight into interaction and Interaction Design, what they are good for and how we apply them to SampLe, namely by referring to intuition theory as it is the common basis for any non-training system. This foundation is realised in the application of metaphors and, moreover, in Nielsen's usability heuristics along which we develop the SampLe Interaction Design. In the remaining part of this chapter we take a look at the protagonists upon which Interaction Design centres, namely the users. We will, therefore, define UCD, comprehend how users take up and process an application through Interaction Design and finally outline the SampLe target group and how we intend to meet their diverse expectations.

4.5 User-Centred Design (UCD)

Whereas Interaction Design has its emphasis on designing a front-end for a (technical) application, UCD as a sub-category puts the people, their way of communication with a system and the cognitive processes within their mind in the centre of attention. When trying to develop a satisfactory system, it is important to take into account who is going to use it. We might have to deal with a homogenous or diverse target group and therefore need to investigate different approaches on the technological layer and the front-end modelling. We have to facilitate a capable Interaction Design that is easy to learn, effective to use and provides an enjoyable user experience for all the different user groups. As our application is web-based we first illustrate with a short overview of the development of user-centred technology on the WWW, what UCD is about and what needs to be taken into account when developing UCD.

4.5.1 UCD and the web

About 10 years ago, the Internet started with bare and static HTML web pages that provided structured content (mainly scientific texts). In the second phase, actual web design, derived from graphic design, added higher-level aesthetics

and first attempts of Interaction Design and UCD to the presentation. Information was, for example, grouped through means of typography, form and colour. The third generation of web applications reached a level of technological progress through which sites cannot only be structured and made user friendly by static one-fits-all design but moreover, use “intelligent” dynamic methods that support dynamic processes to personalise content and even design by applying such technologies as user modelling.

With the help of these technologies, users can now be provided with a level of design sophistication to exactly match their personal needs and optimally support their goals in terms of providing adequate content as well as an optimal work-environment to maintain or alter it. Thus, we are only now in the position to offer UCD that never requires readers to conform to an interface or application that places unnecessary obstacles in their paths of task solving or limits their space of thinking and creativity.

In the SampLe system the whole system architecture is oriented to the user’s goal (as described in chapter 2) and is designed around that process and the tasks and actions which have to be completed to meet that goal, taking into account the user’s constraints and how s/he can be optimally supported. On a more detailed level, new options and technologies that help put the user at the centre of attention are applied in SampLe through the User Model and Adaptation Model influencing the front-end as well as actively leaving it to the user to model the workspace to his/her needs.

We now proceed in explaining what makes an Interaction Design user-centred, how and when it is perceived as user-centred and what makes our approach user-centred for our target group.

4.5.2 Ergonomy

Ergonomy (the word’s Greek origin means “the study of work”), originally called Human Factors (HF), finds its roots in the following fields, where the first three have provided the biggest influence: Computer Science, Cognitive Psychology, Ergonomics and Human Factors, Engineering and Industrial Design, Anthropology, Sociology, Philosophy and Artificial Intelligence. Within Computer Science, Human Factors usually falls into the category of UCD since it is ultimately concerned with the user, enhancing the users’ experience be it in productivity, understanding or capability. In this section we take a look at the theory of ergonomy and how it can be applied to SampLe to boost our UCD and thereby support the intuition approach, as described in section 4.4.1.

The formal field of ergonomy dates back to World War II where it became evident that human safety was an issue when pilots became too challenged by the design of their cockpits. This work was primarily concerned with avoiding certain accidents related to cockpit design and aircrew performance. Even though the improper use of our application does not set lives at risk, we have, in general, to cope with similar problems. Ergonomy helps us to reduce the challenge and distraction in the work with our Interaction Design to a minimum to avoid unproductive work, errors and resulting anger and frustration. In applying ergonomy, we meet our goals of developing an intuitive interface and



Figure 4.2: The ergonomic gap between Task Inception and Task Completion, to be minimized by ergonomics

provide the medium for creativity.

Ergonomics is best seen as a human jumping from one side of a cliff to the other, as shown in figure 4.2 on page 26. The challenge is proportional to the size of the gap between the two cliffs. The person is a user of a computer system, in our case a person who wishes to build a multimedia presentation with the Sample system. The user begins with the task inception. At this point, the user has decided to accomplish a task by using a computer system. S/he faces the challenge of the computer system in order to reach task completion, in our case the goal of having to build a presentation. In an ideal system there would be no challenge, and hence no gap. The user could accomplish the task because no user limitations, such as restricted patience or memory, would interfere. In an ideal system there would be no challenge to these factors, and thus no gap between task inception and task completion resulting in a 100 % UCD as well as intuitively usable front-end. This Holy Grail is not achievable because we have to deal with many of the following human factors, taken from [28], each adding to the gap:

1. Impatience
2. Limited memory
3. Need analogies
4. Limited concentration
5. Changes in mood
6. Prejudices
7. Fears
8. Make errors

9. Misjudgment
10. Process information non-linearly
11. Distraction
12. Can only perform a limited number of concurrent tasks
13. Users are all different
14. Think in terms of ideas composed of words, numbers, multimedia, and intuitions
15. Fatigue
16. Need complex information presented hierarchically
17. Require practice to become good at doing things
18. Tend to do things the easy way
19. Resistance to change
20. Prefer to learn by doing than by explanation
21. Act irrationally
22. Sometimes affected adversely by stimuli such as color and patterns
23. Become nervous
24. Prefer standard ways of doing things
25. Constrained by time
26. Work better in groups than individually ($1+1=3$)
27. Use intuitions to construe information that is sometimes wrong
28. Rely on tools to complete tasks (like spell checking) thus causing dependency
29. Associate unrelated things
30. Sometimes do not trust what is not understood

In chapter 5, we point out how some of the most relevant or specific ergonomics are taken into account for the SampLe front-end design, such as 1,2,3,8,11,13,15 and 16 by working along the usability heuristics, described in 4.4.3. In the remainder of this chapter we now introduce the user group for the SampLe application in more detail and show how this user group influences the UCD of the SampLe front-end.

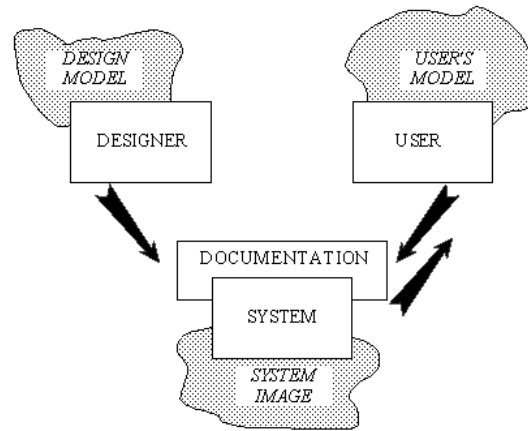


Figure 4.3: Correlation of design model, system image and user's mental model

4.6 Understanding users

In this section, we take a closer look at the protagonists of this work, our users. We briefly introduce a theory about how they grasp and process a system design with the theory of mental models and then introduce our target group. Based on this discussion, we describe the technical approach to model their needs in terms of UCD.

4.6.1 Mental models

Based on cognitive processes for processing information in the human mind ([32] p. 28), a number of conceptual models have been developed to better comprehend problems and difficulties in human-computer interaction ([32] p. 20).

One method of developing a system that will be understood by users the way it is intended to be, is by applying the framework of mental models. Mental modelling is a theoretic approach to understanding how the human mind works when learning and working with a system of any kind.

When designing an application, the designer builds up a mental model in his/her mind of how the application and Interaction Design should work. This model is then transferred into a system image, which represents the actual system and how it works. When interacting with the system, the end-user forms a mental model of the system that is continuously modified during learning. Figure 4.3 describes the relation between the three models graphically.

The better these three models map to each other, the easier it will be for the user to handle the system. The user's mental model does not have to be correct in all detail. It is sufficient that a user can apply his/her mental model to form action sequences, predict system actions, learn readily and use the system effectively. Applying these models in user interface-design is of central importance when trying to promote intuitive human-computer interaction and user-centred system development. In SampLe these three models are represented through the application, user and adaptation model. The design of the front-end re-

flects the relations between the three models in so far, as it incorporates the potential changes in the interface suggested by the adaptation model, which again are based on the negotiation between user and adaptation model. Yet, the interaction between the three models is based on a specific target group, which is described in the following section.

4.6.2 SampLe target group

A target group can be defined by different classifications, such as demographical, cultural, behaviouristic (in terms of lifestyle, values, philosophy of life, social status, work,) etc. Different psychographic models, such as the “Sinus-Milieu-Modell” [3] or the “Erlebnismilieu by Schulze” [25] segment people depending on their social environment, their values and other social factors. From the interpretation of such studies, an appropriate system architecture, user modelling, system design, graphic design, addressing/wording, etc. can be derived to adapt the interface to the user’s knowledge, experience and needs and thereby to minimise the ergonomic gap and optimise the UCD and intuitive use.

As our work is placed in the early stages of a research project, we are not in the position to collect empirical data to develop such detailed classifications. We are only able to divide our target group roughly on the basis of general attributes, such as high and low declarative and procedural knowledge. On the basis of this classification, four stereotypic example-profiles of potential user types are created. We assume there are the following four constellations:

1. High procedural and high declarative knowledge (student)
2. High procedural and low declarative knowledge (pupil)
3. Low procedural and high declarative knowledge (lecturer at art college)
4. Low procedural and low declarative knowledge (museum guide, primary school teacher, evening class attendee)

The declarative knowledge can refer to the content itself or to the degree to which a person has knowledge and experience in building and giving a presentation. Either one of them or both can be high or low.

There are two ways to bridge the ergonomic gap, described in section 4.5.2, between the SampLe user and the system:

- bring the user closer to the system, which requires that the user adapts to the system or
- adapt the system to the user, which means that the system needs to be made user-centred.

We aim for the second approach, as we wish not to bother our user with an unnecessary learning curve that hinders the creative work of authoring. The problem is, however, that once a user starts working with the system for the first time, we have to manage with very little information about the user. In the final section we therefore show how our UCD in SampLe tackles this problem.

4.6.3 User-centred design in SampLe

There is a long history in trying to increase user support and many approaches exist to personalise applications for end users (a good example is described in [26]) by applying various technologies. User modelling is often seen as the ultimate solution for providing tailored systems, interfaces and content. A user profile is usually determined by:

Motivation is the user's desire to complete their plan or attain their goal.

The ideal state is to maintain a high level of personal relevance and consistency with values/cultural beliefs and keep perceived user risks and inconsistency with user attitudes low.

Ability is the extent to which the user has available resources with which to complete their plan. Keeping a satisfactory ability level includes factors such as knowledge, skill level, money and physical abilities.

Opportunity rates the elements that could hinder the user from completing their plan such as time available and distractions (both within the presentation or site and externally). Optimal interaction occurs when there are limited distractions and therefore a high opportunity.

One of the great problems that we face in designing SampLe, is trying to provide a strongly personalised system with respect to content (declarative knowledge) and functionality (procedural knowledge) although we face a diverse target group and do not have any information about the specific user at the moment she first starts using the system. One way of solving that problem is to let users go through endless questionnaires before they actually start to use the application in order to categorise them and then offer an appropriate system through user modelling. This is a time-consuming and cumbersome procedure, in addition to the fact that many users feel uncomfortable about divulging personal information. Probably not many users are willing to accept this practice.

The other extreme is to provide one system that always appears in the same configuration and leaves it to the user to adapt it to his/her needs, for example, by eliminating complex functions or rearranging menus in a way they feel comfortable with and that support their particular working style. But this approach significantly increases the complexity of a work environment, is time consuming and very difficult for users with low procedural knowledge. In the literature ([16], p.6) it is also argued that customising a workspace is bad for UCD as consistency is one of the most important principles, where constant changes necessarily create inconsistency. But again as these changes are made by the user him-/herself this is no serious problem as long as the system shows how the changes can be redone.

For the design of SampLe we extracted the best out of both approaches, user modelling (see chapter 2) and customizing workspaces, and combined them. Figure 4.4 on page 31 describes our approach graphically.

The presentation building process in SampLe is designed in such a form that the complexity of content and functionality to be used starts on a low



Figure 4.4: Correlation between customisable workspace and user modelling

level and increases strongly towards the end. When the user first enters the system and the user model is still rudimentary and therefore cannot provide useful information for adapting the system, we fully concentrate on providing a customisable workspace. Since the tasks that have to be fulfilled in the first steps of the process are not too complicated, we can easily leave it to the user to sort out his/her workspace, giving greatest possible freedom to customising the workspace, proposed structures, offered content etc. and thereby allowing the user to get familiar with the application. By monitoring how s/he adapts his/her environment and what data s/he enters into the system, the user model is elaborated over time. By the time the user reaches the more complicated work steps, the user model should be able to take over and optimally support the user in reaching his/her goals by proposing adequate content and functionality and make useful restrictions. In this way we make use of the advantages of both approaches and can compensate their disadvantages.

By applying pure user modelling, we could, e.g., run the risk of limiting the user because the application might cut down functionality and content so that there is no more space for creativity. While user-modelling is passive and the user cannot change the things that result from applying it, the concept of customisable workspace allows users to actively adapt their environment and use them in new ways and thereby do the opposite of limiting but rather expand his/her horizon.

In the last chapters we have introduced the SampLe architecture, the concept of creativity and its possible support in computer systems, provided a theory about Interaction Design and the sub-topic UCD and how to put it into practice with the help of dialogue styles and intuition theory, being implemented through metaphors, usability heuristics, ergonomics and technical system-architecture. We now have laid the fundamentals for the applied part of this work, the actual SampLe Interaction Design. In the following chapter, we introduce the structure, graphics and content for the front-end design and show how the preceding theory was put into practice to obtain an effective, intuitive and human-centred Interaction Design which fosters creativity.

Chapter 5

SampLe front-end

In this chapter, we present the SampLe front-end that was developed, based on the fundamental design concepts for the interfaces and the description of the Interaction Design. Sections 5.1 to 5.3 introduce the basic elements the front-end consists of, namely the structure of the workspace, graphic design and navigation and core functionality that appears in several places within the Interaction Design, such as the help system and information retrieval in detail. Section 5.4 then explains the actual Interaction Design, naming the previously described elements at the appropriate places. Section 5.5 describes additional functionality for supporting creativity.

5.1 The SampLe interface

It is a great challenge to develop an interface that is based on all the theories, ideas and experiences that meet the usability and user experience goals, described in section 4.3. Moreover, the premise was to provide an environment for creativity for a great variety of users. The following sections describe the assembly of the SampLe work space, the graphic design and the navigation that leads through the three stages of the presentation building process.

5.1.1 Structure of workspace

For the layout and structure of the SampLe interface-design, the requisites to meet were the implementation of the intuition principles, as described in section 4.4.1. Moreover, we have to convey an adequate model of the system to meet our usability and creativity goals. Furthermore, the design has to be adaptable for customisation and for supporting different work styles and knowledge levels.

To meet all these requirements, we decided to opt for a mix of traditional window workspaces, a web environment and a 2D+ information space as outlined in figure 5.1 on page 33.

The main structure is a 2.5D navigation space, content windows that are arranged within the space, tools, functions and secondary information.

The navigation occupies the top (1/5) part of the screen. The rest of the

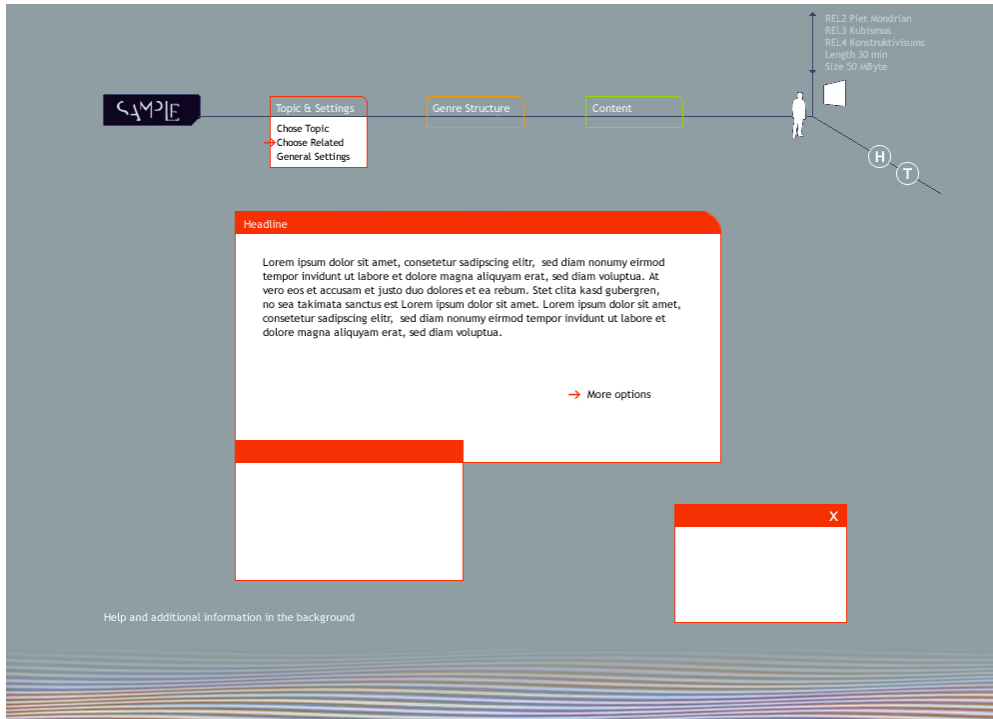


Figure 5.1: Structure and graphic design of the SampLe workspace

space is devoted to provide room for windows and functions. The windows are displayed in reasonable contrast with the background (not too strong or too weak, as proposed in [10]). In this way they appear to be in front of the other elements and therefore are perceived as being more important. For the user the screen is now divided into areas of high importance and areas of secondary information, which will be found if specifically looked for. Thus, distraction from the main tasks is kept to a minimum. The windows can be moved and resized, attached to each other for building work-units, for example to enable parallel scrolling. Some major windows, described in 5.4, can be resized to full-screen mode to avoid distraction further. With an alpha-channel variation, windows that are temporarily not used, can be faded to allow the user to keep such information in the background that s/he considers important but does not want to work on it that moment or to organise the importance of tasks for him-/herself. If in the future more workspace is needed, a work-switcher as used in Linux Red Hat, could be introduced.

This design and arrangement covers most of the described usability heuristics, in particular “Match between system and real world”, “Consistency and standards” and “Flexibility and efficiency of use” (described in 4.4.3). It also forms the basis for realising the ergonomic requirements for a UCD such as “Distraction” by dividing the screen in areas of high and low importance. Moreover, as our design introduces already known communication methods such as windows and web-like navigation it overcomes the problem of fear of engaging with an unknown environment. This also adheres to our findings from intu-

ition theory stating that known or experienced components and functionality from other spheres increases intuitive learning and working (see section 4.4.1). Although our target group is diverse and possibly not very skilled in terms of using authoring applications, which makes it difficult to assess the elements and processes we can assume as known, we assume that the users will be able to easily handle the SampLe environment because the window metaphor is the most common for accessing an operating system. In other words, if the users can start SampLe they are familiar with the basic technology.

Most of the interaction is handled through model world interaction styles, as outlined in section 4.1:

- Windows and multi-threaded dialogues, where the content and tools are kept in a number of windows that can be used in parallel
- Graphical dialogues with icons within these windows, that allow direct interaction, permitting intuitive use,
- menu-driven dialogs on the top- level navigation, and form and mask filling within the windows to work on the content.

As stated in section 4.6.3, the user is welcome to alter the environment but does not have to if s/he is not able to do so.

5.1.2 Graphic design

The graphic design, as shown in figure 5.1 on page 33 of the environment is kept simple with clear colours and colour planes and sans serif type for better legibility [10]. Graphical elements such as lines, boxes, fonts of different shades of white and the blue-grey background are used to group or separate information.

A colour coding, specified in the following section, is applied to work with direct perception-action control for intuitive orientation (see intuition section 4.4.1), following the “Recognition rather than recall” heuristic, as well as for making clear which steps in the process belong together.

Generally the concrete graphic design can be subject to change and varied in many ways, but the general idea behind it has to stay the same and must be in itself consistent and intuitively usable and moreover adhere to the “Aesthetic and minimalist design” heuristic.

5.1.3 Navigation

Navigation is a vital function within screen-based information systems and developing an appropriate design for this is a major task to be tackled in Interaction Design. By appropriate we mean a concept that is

- consistent,
- supports effectiveness and memorability (see section 4.3),

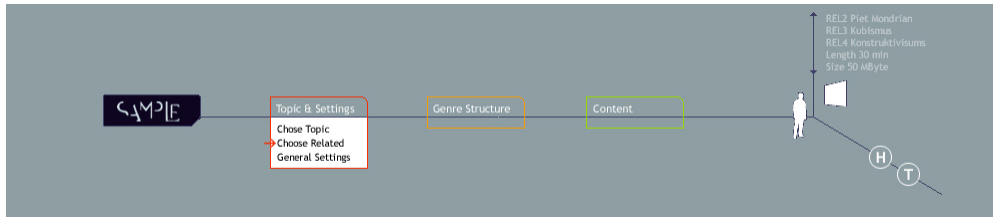


Figure 5.2: Primary navigation

- facilitates intuitive use (see section 4.4.1),
- overturns the discontinuity problem (see section 4.4.1) and
- helps the user to build a closely matching mental model of the system.

Our navigation meets these broad requirements with a top-level navigation and two levels of contextual navigation.

The primary navigation, as shown in figure 5.2, is located on top of the screen, directly on the background. It is always positioned there, to keep the interface consistent and thus avoid confusion.

The navigation area is composed of three axes that span a 2.5D-space. Each of the three axes takes up a different “dimension” of information. The horizontal axis starts with the SampLe logo and shows the three stages in which we have divided the process that has to be traversed for building a presentation:

Topic & Settings where the presentation topic and related topics can be chosen and general settings such as media, size, etc. can be selected;

Genre Structure where the narrative structure of the presentation is chosen and can be edited;

Content where the multimedia content for the presentation can be edited and assembled.

As seen in figure 5.2, the three stages are colour coded with red, orange and green. As shown in 5.4, these colors are likewise applied to the windows within the workspace and to all attached elements to communicate, which workspaces belong to which stage and to quickly and intuitively convey in which stage the user is currently working, addressing the subconscious.

The symbol of the person looking at a screen, located in the point of origin of the three axes, symbolises the goal which is reached when these steps are followed from left to right in reading direction, namely having built a presentation. Novice users can simply follow this work order. If they do so they get information about what steps have to be taken in order to build a presentation, where they are and how much and what work is already completed and what still needs to be done. Advanced users can work in a non-linear fashion by clicking on the headline that belongs to the part of the work process they want to address. The three main steps of the process are colour-coded for better orientation and memorability, where each group contains the sub-tasks of the

main authoring step. If a user enters the system for the first time, s/he is lead to the first step of the work process. If a user has been in the system before and logs in again, s/he will see the screen s/he last worked on.

For better orientation, the work process is subdivided only in two levels, not to confuse users by having to “burrow deep into the menu structure” [Nielsen navigation guidelines, taken from [21], p. 415]. Empirically gained evidence has proven that shallow menu structures are better in terms of usability than deep ones [Larson and Czerwinski, 1998, Shneiderman, 1998, taken from [21], p. 415].

The wording of the navigational links is kept simple, short and unambiguous, as proposed by Nielsen. Beyond its functionality for navigating, however, the navigation area also supplies the user with brief information about the content of the three steps that have to be taken for building the presentation. The navigation area remains persistent through sub categories as well as windows and links in the content navigation.

The lateral axis takes up general functionality that should be reachable throughout the whole system, such as the help-reference, the tutorial, and the save work status.

The vertical axis carries keywords about all the decisions the user has taken within the presentation-building process, such as the name of the chosen topic, genre or presentation settings such as duration or size of the presentation. This summarised information provides a quick overview and can also be used to jump between decisions, for example to change one by clicking on the corresponding text-links (see heuristics 1, 3, 8 in section 4.4.3).

All three navigation-axes literally lead to the point of origin, where the symbol of the final presentation is positioned, which graphically implies that using the functions and links from all axes leads the user to his/her goal of having built a presentation. The primary navigation meets the navigation heuristic of being – to a certain degree – extendable by changing the length of the axes for adding or cutting functions and links. (For example, help, worksteps/order, content information).

The heuristic of “user control and freedom” is met in the navigation by providing different ways to get to a certain point, not to constrain the user to one path through the system, enjoining one work pattern. We support that heuristic not only by giving two ways of navigation in the top level but also by providing several ways of context navigation, as described in figure 5.3 on page 37.

Every main working window supplies an arrow, that directly points the way to the next work step. At some stages, two arrows will indicate that the user can either dig deeper into the current matter or move on to the next stage. This wizard-like arrow-navigation within the content is very useful for novice users that are taken by the hand and lead through the process step by step.

The second form of content navigation consists of different textual and symbolic links within the content or attached to the content windows, leading to additional functions, to the help or to other steps in the presentation building process.

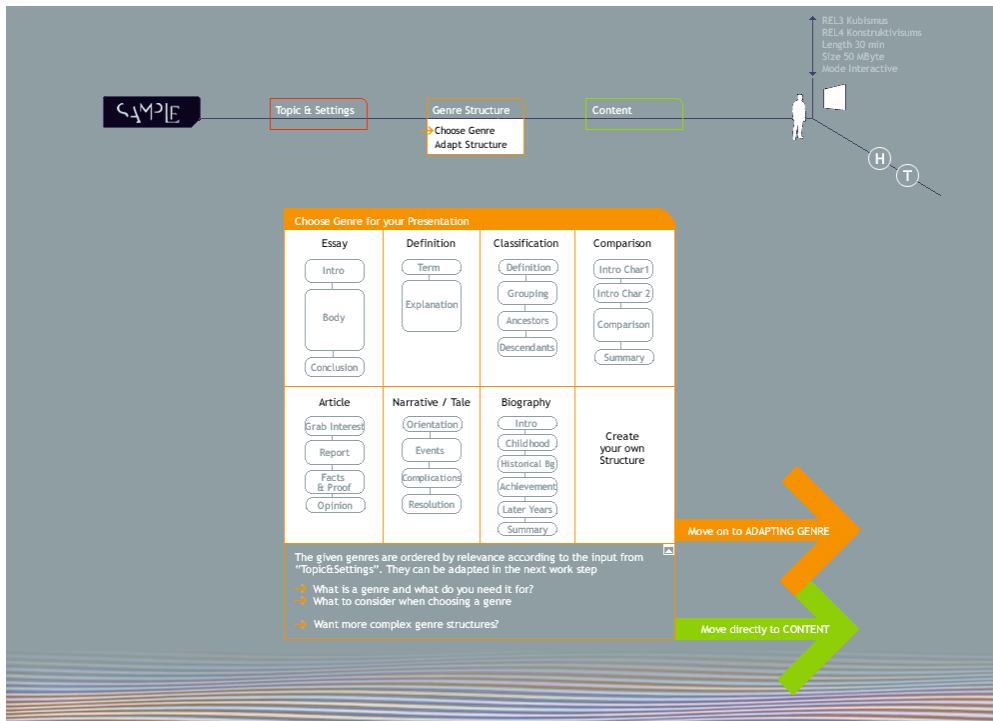


Figure 5.3: Example for context navigation

Because of the discontinuity of the environment (as described in section 4.4.1), the SampLe-navigation has to answer the four navigation-related questions that have to be covered in order to make up for the discontinuity:

'Where am I?' by pointing out the current work-step with an arrow, and moreover supported by the previously described colour coding of the three work stages.

'How did I get there?' and **'Where can I go from here?'** by showing the steps of work in a linear order, allowing the user to see the preceding and the (number and content of) successors.

'What can I do here?' by appropriate naming of the work-step.

On the content-level, context-sensitive creativity support navigation is offered in certain sectors in the form of text-links or windows that offer creativity-support functions. These are meant as proposals, in case the user is “stuck” or needs new inspiration, as found in the incubation phase of the Wallas model (see 3.1). Those links then lead to functions that were created out of techniques that inspire or enhance creativity or try to relax and charm away the user as proposed by Wallas for creativity development. In future developments, intelligent navigation can support the second Wallas stage by proposing that the user leave the system for a while when it has detected that the user is “stuck” in his/her thoughts, since creative insights cannot be forced and sometimes need distance to the problem and relaxation.

Having introduced the basic design and navigation concepts within the SampLe interface, we now introduce the help and search functions as both are omnipresent in our Interaction Design. After that, the reader has all foundations to be lead through the Interaction Design for the SampLe interface itself.

5.2 Help system

The functions “help” and “tutorial” can be reached through the first level navigation but will also be provided at complex points within the content through links that point directly to certain topics. The difference between the two is that the help is understood as a concise manual or reference for quick consultation, whereas the tutorial gives guidance and instructions and allows the user to practice on examples, since people “prefer to learn by doing than by explanation” (see Ergonomy 4.5.2). For users with low procedural knowledge, the tutorial would be a vital part of the preparation-stage for creativity development. It is linked directly from the start-page of the application. That way, users that prefer to learn something about the system they are going to use in advance can be met here.

Both help and tutorial will open in a separate window and are adapted to the stage of the work-process the user is in when opening them. In this way, the provided information will fit the part of the system the user is working in and we avoid long searching and frustration, that can easily arise if a user is at the point where s/he calls up the help system. It also might be a faster way to find a solution to his/her question or problem. The user will also find links to the start and index of the help and tutorial as well as FAQ’s and a search. Our aim is never to let the user feel like s/he is left alone or even despairs when a problem or question arises and thereby meet the user experience goal of “helpfulness” and the heuristic “help and documentation”.

5.3 Information retrieval

Retrieving information and documents or searching for them, is one of the core functions in SampLe, in particular as it is an excellent feature for providing creativity support. Section 5.3 first explains the different ways of information retrieval within SampLe and secondly discusses different approaches of presenting result-sets, their advantages and disadvantages and their use and adaptation for SampLe.

5.3.1 Search

The search had to be implemented in several locations and is the first function the user has to deal with when using SampLe. It appears on the second screen, as shown in figure 5.4 on page 39, where the user can choose a presentation topic and again for defining related topics. In a later stage it is used for retrieving multimedia content with which to fill the presentation.

Figure 5.4: SampLe search options for presentation topic

When designing the visualization of the search process we had to take into account that SampLe users have different technical backgrounds and as a result different mental models on how to search. Furthermore, the knowledge about the presentation topic is crucial for the provision of an adequate search. We provide, therefore, a variety of search functions with different levels of complexity and different ways of approaching the desired information. Different kinds of searches help to gather information which supports Wallas' Preparation stage, facilitate associations (Incubation stage) that might spark off new ideas, give inspiration through entering information and evaluating the system response or through browsing.

For users that know exactly what information they are looking for and how to form search requests (even using operators like +, “”, etc.), we provide a common text field where the search query is entered. If the user does not know his/her topic exactly (e.g. name of a painting from a certain artist), this search can be limited to categories, such as, artist, artefact, genre, medium, movement, style, technique and time period, for a more focused approach. If a user wishes to make a presentation about a painting by the artist Theo van Doesburg, s/he enters his name into the query field and limits the search to “artefacts”.

Another form of retrieval is by directories, as outlined in figure 5.5 on page 40. Here the user clicks on one of the umbrella terms, such as artist, artefact, genre, medium, movement, style, technique, or time period, and will then get a list of the available sub-terms that s/he can choose from. In this way, the user makes his/her way through a classification of terms and relations provided by the system, and hopefully finds the desired information. This search helps users, whose declarative knowledge is relatively low, to get an overview of the contents and interrelations within the domain of interest. This mechanism also stimulates new ideas, supporting the Wallas Preparation stage. Furthermore it follows the ergonomics rule which states that complex information needs to be presented hierarchically (see section 4.5.2).

An extended form of search that is connected with both previously described

5. SampLe front-end

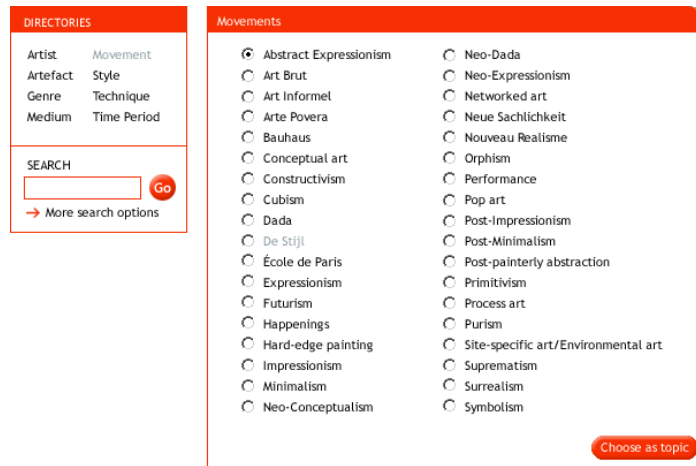


Figure 5.5: Search by directories

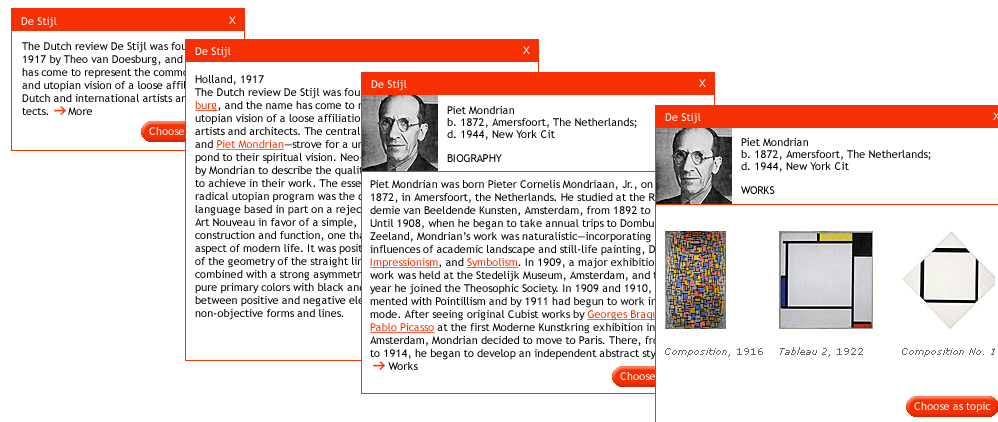


Figure 5.6: Extended search - browsing in SampLe, texts taken from [14]

techniques, is browsing. This extension is useful with respect to creative processes such as authoring, because simple “Search interfaces lack the ability to support information exploration, making it increasingly difficult for scientists and practitioners to gain a “big picture” view of DLs, to locate germane resources...” [15]. An example is provided in figure 5.6.

If a user is not familiar with the subject or wants to know more about a retrieved term or document, the search results can be clicked on and the system will provide a short explanatory text as well as a list of directly linked artefacts and documents. The same browsing technique is offered within the directory search. Those summaries might include links to connected topics, for example links to influential painters when reading an abstract about a genre. In the abstract about a painter, there could be a reference to his/her artwork, and in there again a link to an interpretation about an artefact etc. In such a way, the user can browse and drift through the available information. S/he might find new insights or at least get to know the subject better by following well proportioned information chunks, which is supportive for creativity development.

Another type of search, in a broader sense, is available in the content area. In a symbolic 2D presentation of documents (in the form of a map-view, introduced in section 5.3.2), the user can select one of these documents. The system then retrieves documents that are directly related to the document that was clicked on and displays them within the 2D presentation. In doing so, the user can obtain new information without losing the context of the former search by iteratively adding documents and thereby exploring new relations, taking an interesting document as starting point and then crawling through the information woods.

5.3.2 Presentation of result sets

The presentation of search results for topic and related topics will appear in the form of a list view that the user can choose from by clicking a check-box, and thereby accepting the proposed term as topic or related topic. If no results are returned, the user can perform a new search or refine his/her query. If the user is not content with the results, feedback is given as to why these results were obtained and how the query string can be adapted to improve the results. Help on “how to search” is made available through a link to the help menu.

The presentation of the retrieved documents in the last of the three presentation building stages is a central usability design feature in SampLe. It goes one step further by not only presenting one match after the other but also presenting interrelations and thus allowing the user to edit the whole structure. On the basis of the users’ input about topic, related topics, genre and presentation settings, the system presents a set of documents that the user can extend, edit, rearrange, compare and assess. The presented documents are often related to each other and these links can be edited (established, deleted or changed in direction or value).

To find an optimal representation and work space for such complex document-structures and tasks, different visualisation techniques were compared in terms of usability, ergonomics and representation of necessary information (names, links, etc.). These are presented in the following sub-sections, where we introduce presentation techniques, namely list-view, 2D-map-view, 3D modelling, and creative search.

List-view

Documents retrieved using this technique are presented similarly to web-search-engines such as google (<http://www.google.com>) in a ranked list, where the user chooses the ranking criteria, such as relevance, size, name, etc. This technique works well if the user is searching for one particular document and the search query was specified so clearly that only a very small set of documents need to be displayed. If the user is confronted with a large set of results, s/he is most likely to get lost and the work with the results is rather inconvenient and ineffective, thus it is time-consuming to identify the documents of relevance. According to [[29], cited in [20]] “the average user looks only at the first 10-20 items in the search results list.”. These organisational problems intensify if the user has a

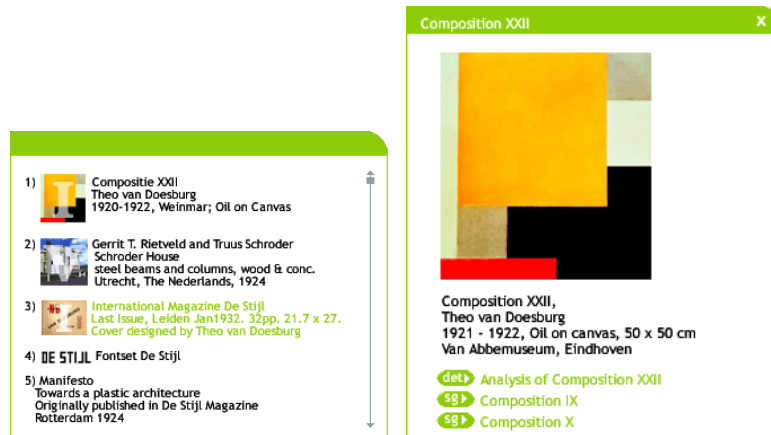


Figure 5.7: List-view and detailed view

low declarative knowledge level or when the domain is very large.

A small amount of support in identifying relevant documents is to give additional information, such as size, dates, or the first words of the document, additional to the headline. For images and videos, this textual abstract is replaced with a thumbnail of the images or with the first frame of the videos, as shown in figure 5.7.

The advantage of a list-view for presenting search results is that a great number of users is accustomed to this type of visualisation and knows how to handle and interpret the retrieved data, which facilitates our intuition goal. A disadvantage in the SampLe context is that this visualisation technique is not optimal for pointing out relations to other documents. They could be presented as text links but these have to be read and cannot be recognised visually in patterns, which means a slower and less intuitive evaluation and comparison process. We alleviate this disadvantage by introducing icons representing relations in a detailed view, as shown in figure 5.7. The conscious efforts of information processing are thus reduced to the faster way of direct perception (4.4.1). The user can see the related documents by clicking on the icons.

2D Map-view

A second possible approach for presenting a data-set in the content-section is in the form of a map-view, as displayed in figure 5.8 on page 43. This approach exists in different variations e.g. presenting the results of a web-search by topics, as in kartoo.com (<http://www.kartoo.com>) or presenting large datasets of digital libraries, also grouped into classes, as in [12]. The map-view design resembles an association technique, also used in creativity support, called mind-mapping. It builds on the associative way of thinking, called radial thinking and the technique of brainstorming, where memories or thought-patterns are visualised and at the same time invoke new associations, laying the basis for creativity. These maps have the advantage of

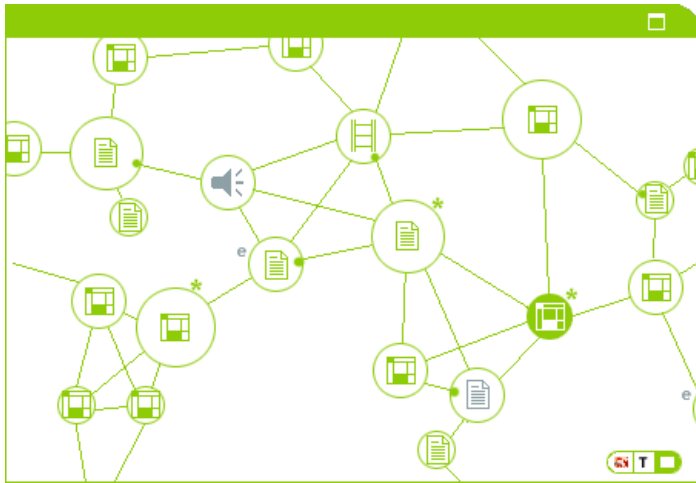


Figure 5.8: Map-view

- giving an overview of large subjects/areas,
- can hold large amounts of data,
- encourage problem solving by showing new creative pathways,
- are efficient to read and remember,
- attract and hold the eye/brain and
- give the whole picture and the details at the same time.

For a system that aims to support creativity, this approach seemed ideal. We incorporated it, therefore, in an adapted form by presenting the system-retrieved documents as icons in an information map as shown in figure 5.8.

The difference in size of the icons expresses the relevance of the documents. Existing relations between them are visualised with lines. Relationships can be labeled “opposites”, “same group”, “example”, etc. This visualisation can be varied in degrees of complexity, showing, for example, more information, such as names, document sizes, thumbnails. This abstract visualisation of the available information and their relations among them, that can be experimented with by moving and editing, gives the user a new point of view on the subject of interest, which again promotes creativity through several factors, such as:

- information exploration
- exploiting human vision by shifting “users mental load from slow reading to faster perceptual processes such as visual pattern recognition” [15]
- reducing visual search time
- providing a better understanding of complex data sets

- revealing relationships that might otherwise stay unnoticed
- invoke new relationships and constellations by seeing content in physical structures
- Manage large complex information spaces

However, a great disadvantage of such information maps may be that they are hard to understand for novice users and have a high learning curve.

3D Model

Another method would be to present the data in a 3-dimensional model and innumerable structures and designs have been developed for this approach (such as ebiz-live [15]; cybergeography [6]; LyberWorld [Hemmje et. al., 94] taken from [34]). In theory, the added dimension should convey more information, but “there is little empirical evidence to support this.” [Swan & Allan, 98, taken from [34]]. Furthermore, the visualisation of a 3-dimensional space on a 2-dimensional screen is not appropriate and it was shown that “users’ performance with 3-D visualizations is greatly influenced by previous experience with other 3-D systems” (such as 3-D games) [34]. Considering these experiences and findings, we decided not to implement a 3D visualisation in SampLe.

Creative search

This approach to information retrieval was inspired by [5]. The described system, as shown in figure 5.9, shifts web browsing to a more “ambient visualisation” [5] where media elements are taken from the documents that are browsed and shown over time in an information stream that can be manipulated by the user.

We incorporated this new way of browsing into SampLe to provide yet another feature of creativity support as this, what we term ‘creative browsing’ “extends experience beyond routine, to support creative experience” [5]. It is offered in several locations in SampLe for giving inspiration, as an environment for creativity and a passive relaxing way of “travelling” through information. It shows documents in a directly perceptible way and associates them randomly so that the mode of work changes to a passive one, whereas all other work in SampLe requires the user to be active. Thereby it is breaking the work- and thought-pattern of the users and thus supports creativity.

In SampLe, the creative search helps the finding of related presentation topics and documents in the content section. As a starting point the system takes the decisions that the user has already made (e.g. having chosen a presentation topic) and presents possible related information (related presentation topics) by showing images or headlines of documents, videos or even audio files.

The actual viewing process can be imagined as flying through an “information-channel”. The images, videos and headlines are faded into one another and move towards the user. At the same time, the opacity increases. The items become bigger and are perceived as moving towards the user until they fade out. Controls like play, pause, a timeline to rewind and fast forward as well as a control



Figure 5.9: Creative browsing

for the speed of the animation are provided at the bottom of the screen. The whole function can be switched to full-screen mode so as not to be distracted by other elements on the screen and to be able to intensively concentrate and switch off all other thoughts.

While the user is watching this information-stream s/he can grab the items that appeal to him/her and drag them into a kind of clipboard. Items that do not appeal at all can be pulled into a rubbish bin. In the next step, the user can then inspect the collected items in the clipboard and either use them for his/her further work or discard them. During the presentation-process, the system records the grabbed and deleted items and deduces what other information to present or to hide.

Conclusion

Many approaches exist to design search and, in particular, visualisation of retrieved data. For SampLe, we decided to use the representation of a list-view, which has an advantage when it comes to scanning a small set of single documents, combined with a map-view which is preferred for supporting the recognition of patterns, constellations, connections, etc., as it is a more overall structural approach, whereas the list-view is more content-oriented. We leave it to the user to choose the preferred one or combine the advantages of both. The concrete graphic design of the map-view is only one proposal and can be altered for future versions of SampLe.

The spectrum of search utilities is supplemented by two more passive relaxation inspiring techniques, namely the creative browsing and the exploring of information chunks, as described in 5.3.1. They give a creative and informative view on the available information. The combination of these techniques should be sufficient to support this vital task in the presentation building process of

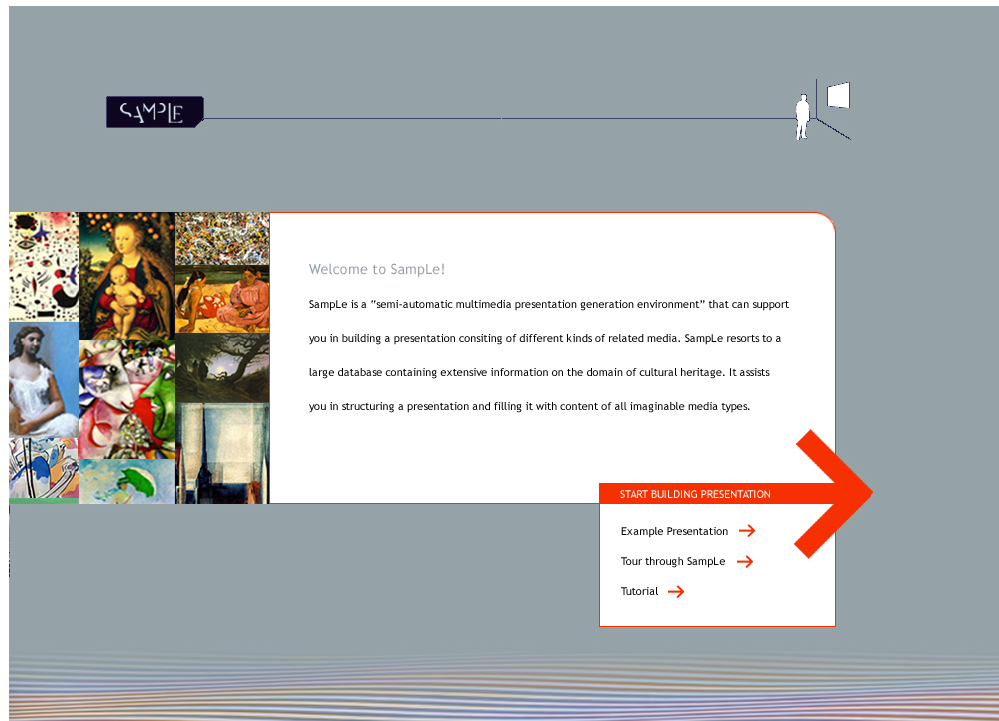


Figure 5.10: SampLe Introduction Screen

finding and arranging adequate content.

5.4 SampLe Interaction Design

In the following sections we present the core part of this thesis, namely the process guidance of the SampLe front-end. The description incorporates the previously introduced interface design and search and help functionality, as well as the theoretical findings from chapters 2 to 4.

5.4.1 Introduction

The first entity the user views when entering SampLe is the introduction screen, as shown in figure 5.10 on page 46. It gives a short textual introduction to the system, what it is about and what it can do for the user or cannot deliver to avoid disappointment and frustration. Additionally, example-presentations can be viewed, as building one is a complex and time consuming process, so that the user should not go through it if his/her expectations do not fit the possible output.

Four links give entry points to the system, each addressing different target groups (see section 4.6.2). Novice users might enter the guided tour to get to know the system and work in the Wallas' preparation stage. Users with low procedural knowledge might choose the tutorial. Users with high procedural knowledge or a great affinity for playing and trying out new tools, might enter

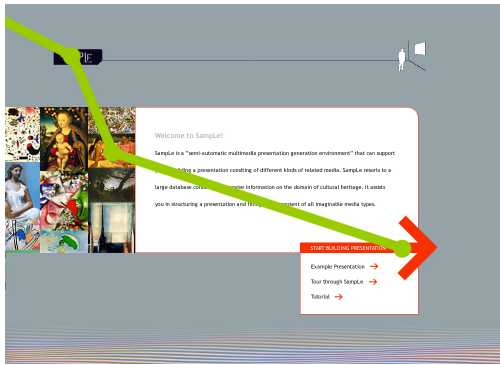


Figure 5.11: Introduction Screen with expected viewing path

the system straight away and start working. As stated above, users of all four target groups might take a look at example presentations for adjusting their expectations.

The graphic design follows west European principles (commonly applied in advertising) of arranging visual information that can be traced with the method of gaze detection. When viewing an image, the human eye moves in saccades and stops only at certain points for less than a second. Only at these points of "fixation" can information be perceived.

In figure 5.11 on page 47, we apply the method of gaze detection to explain how a user accesses the first screen of the SampLe application. According to this method, the eyes of the viewer enter the display from the left (reading direction from left to right), they will pause at the first salient element, which is in our case the black SampLe logo, conveying the name of the application. The next stop is the colourful collage of artefacts. This gives a first hint about the content and goal of the application, namely providing information about art. From there the users' eyes move to the white area with the text and are lead to the second salient element - the large red arrow, which is the link that leads the user directly into the application. By the time the user has arrived there, we have reached our goal of providing a simple and moreover intuitive first page, that does not distract or make the user feel lost but rather leads straight into the subject on a subconscious level.

Only when taking a second look, the information around these main points will be perceived, such as reading the text in detail or reading the smaller links under the red arrow. This second look will be taken by novice or new users and they will find appropriate information such as an introduction and different links that get them started with SampLe. In this way we hope to have created a starting page that addresses all users of our wide target group.

5.4.2 Topic

After having clicked on the red arrow with the inscription "START BUILDING PRESENTATION" (see figure 5.12) in the introduction screen, the user reaches the first of the three authoring stages, "Topic & Settings". Here s/he first views the topic-page where a user has to choose a presentations topic. Whereas some



Figure 5.12: Choice of presentation topic

information requested by the system in later steps can be left out, this one is obviously essential for further work. SampLe supports three scenarios for topic search:

Scenario 1: The user knows exactly what the presentation is about and just wants to enter it into the system

For this scenario, SampLe provides an input field, where the user can enter his/her presentation topic (for a detailed description - see section 5.3). When the entered information is unambiguous, SampLe will accept it and move on to the next step. Otherwise, it will give the user options that fit his/her search request. For example, if the user entered an ambiguous term “De Stijl”, the system asks: do you mean “De Stijl art movement” or “De Stijl magazine”? Additionally, this search can be limited to certain categories, also described in detail in section 5.3 above.

Another approach the user can take is to find the desired topic in the provided directories. Here the user can choose a term by going through categories, as explained in 5.3. This is an effective way to explore the range of content the system provides for users with high declarative knowledge and a way of classifying their own knowledge, updating relations and, for users with lower declarative knowledge, understanding how the desired topic fits into the classification. This technique also provides ideas for new relations to investigate and connect in a presentation, where ”This choosing is the act of collecting, reusing, and recontextualising . . . ’choosing’ that is, collecting, is a creative act.” [5] p.49.

Scenario 2: The user knows roughly what topic the presentation is about (e.g. the presentation should be about some topic within the “De Stijl” art movement) but needs the system to help with finalising the details of the topic

For this approach, we provide a text field in which the user can enter an umbrella term. The system then proposes possible topics. Those topics could also be ordered by artist, artefact, genre, etc. or the search in the first place could be limited to such a category. Another approach would be to make use of the directories to find a possible presentation subject. Since, as described in 5.3, all headlines in the directory are linked to short descriptions with links to related topics, the user with low declarative knowledge can browse through this information, get to know the whole category better and be in a better position to decide on an interesting subject.

The user does not know at all what topic to present

This case seems unlikely, but is still possible. One scenario could be a pupil who has to give a presentation for his/her art class, where the teacher has not specified a concrete topic but rather wants the pupils to choose one for themselves. In this case we want to provide the users with sources of inspiration to be creative and find their own topic by:

- Taking a look at the most favoured topics that users made presentations about
- Exploring a multimedia time-bar (similar to MS Encarta’s time-bar) with dates, events, names, movements and artefacts attached to them, presenting different periods the user can choose to establish a topic for the presentation.
- Completing a questionnaire, asking about e.g. the users favourite colours, country, etc. to derive possible presentation topics that can then be presented in a list-view or explored through creative browsing
- Offering a top-ten list of already made and downloadable presentations

A user who is unfamiliar with a subject might also use the umbrella-term field to enter the name of something that comes into his/her mind or just browse through the offered directories and read about their content and through that find a topic of interest. In the same manner, an experienced user who knows his/her topic already might still take a look at the multimedia time-line for new ideas. There are always several ways of approaching a solution in SampLe for giving users as much freedom as possible to solve a task by applying a work-style that fits their habits and makes them feel comfortable and inspired.

When a topic is found, the system should show how much and what material is available on the chosen topic. In this way, the user can estimate whether it is going to fulfil his/her demands in available variety and depth of material and therefore whether it makes sense to work with SampLe or not, how much

material can be re-used and what has to be produced by the user him-/herself. For users with low declarative knowledge, there is an option to request a short summary on the topic. If the user is not happy with the system proposed topic(s), a refined or new search must be offered. The user-model should track the search requests to be able to extract a search pattern and optimise the results. Once a topic is chosen, it is written in the list on the vertical navigation axis (see section 5.1.3) and the user is lead to the next step.

Related topics search and handling

Related topics can be chosen to be discussed in addition to the main topic of the presentation. Related topics can take the form of a:

- counter-example,
- detail (to add to e.g. a movement certain famous artists who should be discussed in detail within the presentation),
- enhancement or
- origin

of a subject. Such related topics are optional. Choosing one or more makes it easier for the system to provide adequate content if required.

Novice users receive an introduction into “related topics”, which are optional and of which as many as desired can be chosen.

The related topic interface, as shown in figure 5.13 on page 51, uses a similar technique as the one described in the topic-page. The aim is, again, to support the different user types adequately.

The advanced user who knows his/her related topics can enter them into a search field. The search works similarly to the one in the topic section, described earlier, including the limitation to categories.

Both expert and novice user, can also look through the directories to find related topics and might be inspired while browsing through them and their summaries.

Novice users with low declarative knowledge or users that are looking for new inspiration, might let the system propose possibly related topics. These proposals can be limited to categories (artist, artefact, etc.), to a certain order in the timeline (e.g. a user chose a technique as topic and a related topic might be a technique that came before or was developed out of the chosen technique) or similar or contrasting topics (e.g. Expressionism vs. Impressionism). They can then be accepted or used as a basis to develop further ideas for related topics.

Another inspiring way of finding related topics is by using the creative search (described in 5.3). Taking the established topic, the system proposes related topics that can be chosen by dragging them onto the clipboard. After the creative browsing, those topics can be ordered, browsed and accepted or discarded by the user.

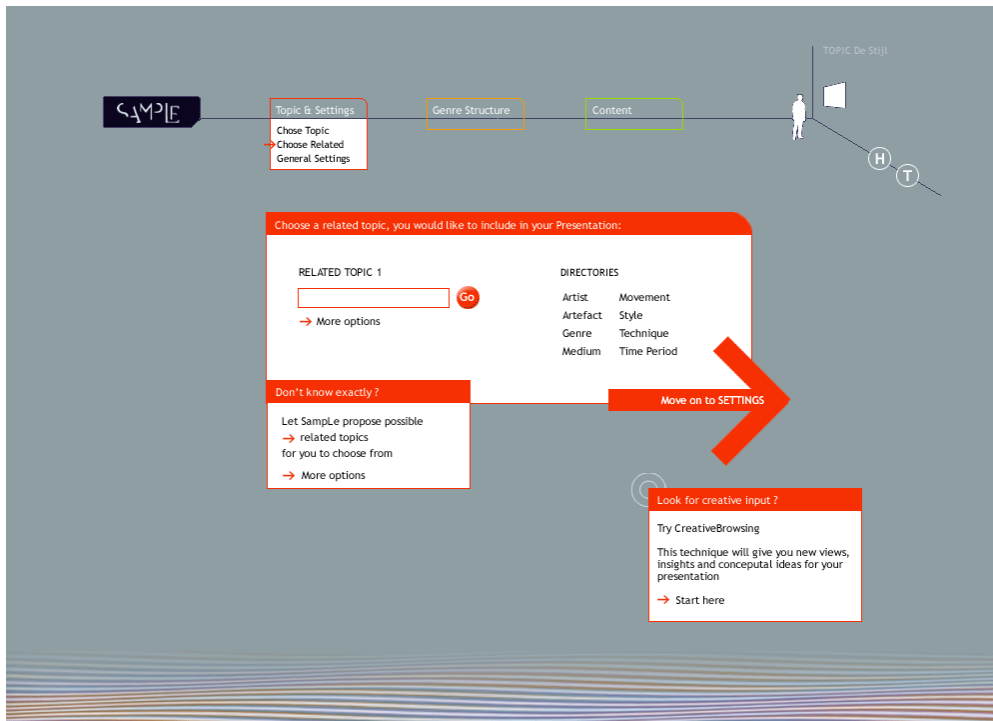


Figure 5.13: Choice of related topic

The user can then pick one or more of the suggested topics, see how much material is available and finally select them as related topic(s) or refine the search. Furthermore, an intelligent search support is offered by allowing the user to limit the search to only retrieving semantically related topics, e.g. if the user chose a painting technique as a topic, only “contradictory techniques” or “acorresponding artefacts” are proposed as related topics. If the user chose one “contradictory technique” as a related topic, the system can propose more, if required.

Proposed topics are displayed in a list-view with a short description and/or a map-view (see section 5.3.2) to see the relations, exchange relations and accept or deny the proposals. The user always has the choice between choosing a(nother) related topic or moving on to the next step of the presentation building process. Once a topic is chosen, it is added to the list containing the main topic in the navigation area. This list can be manipulated by the user at any time.

After having chosen the topic and related topics, the system will detect whether presentations in this constellation already exist and, if so, show their names to the user. At this point in the authoring process, the user should have completed the Wallas preparation stage in terms of declarative knowledge about the content of the presentation and thus possibly have had the first creative insights by combining topics and related topics in a novel manner. The various search and browse functions have supported that development. Furthermore, the basis has been laid for incubating creative ideas about how to form an

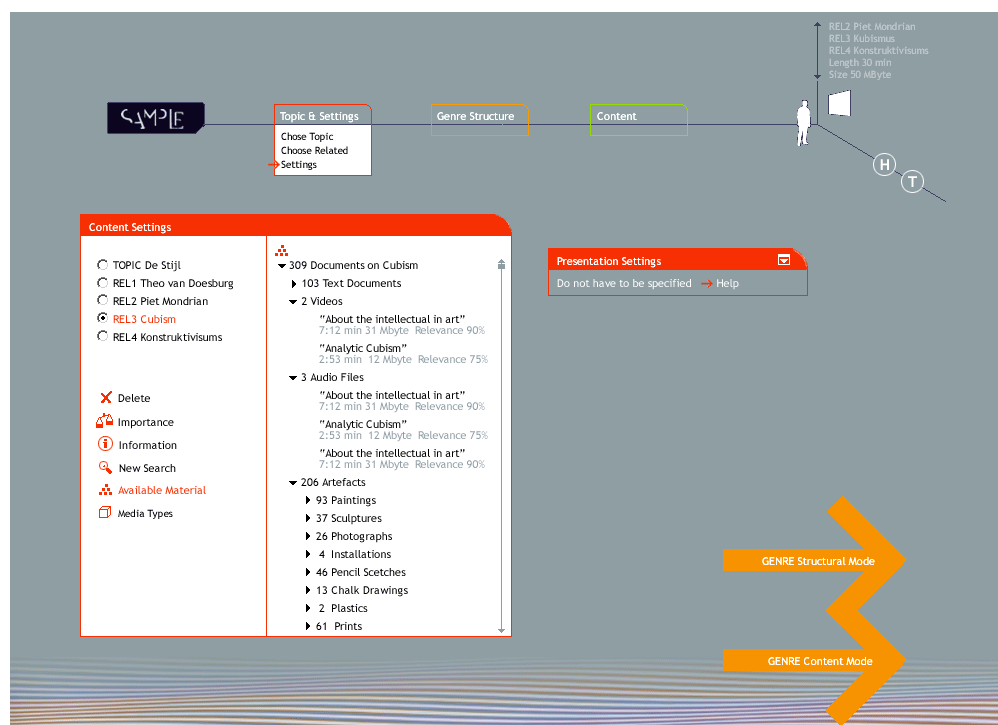


Figure 5.14: Settings Screen

appealing presentation.

5.4.3 Settings

After having worked through the topic and related topic pages, the user gets an overview of his/her previous decisions in the settings-page and can edit them in the "Content Settings" window, as shown in figure 5.14. Furthermore, general parameters for the presentation can be set in the "Presentation Settings" window, as displayed in figure 5.15 on page 53.

The content settings include ordering and deleting related topics. They can be given different weights of importance, short summaries can be viewed again, a new search can be started and the available material on each topic or related topic can be viewed again.

The user can define preferences for media types s/he wishes to use for the potential content during the presentation, as shown in figure 5.15 on the right window side. The user can follow the hierarchical order down to the document-level and get the names and sizes of available documents. In the "Media Types"-section, the user can cut down each topic to certain media types.

As seen in figure 5.14, the "Presentation Settings" window is by default collapsed, which indicates that the information to be given in this window is optional. The user can specify some or all of the given options, shown in figure 5.15 but does not have to. The more settings are given, the more adequate content the system can offer.

"Presentation media" allows the user to choose which media should or



Figure 5.15: Settings screen with expanded presentation settings window

should not be included by setting the corresponding check-boxes. Based on the SMIL standard, an approximate temporal length, bandwidth and size in terms of amount of data and resolution can be given. A medium for which the presentation should be optimised can be chosen, such as paper, a handheld-screen, an mp3-player, etc. The mode of presentation can be set to interactive or automatic, where the presentation runs through without the user intervening. The interactive mode lets the user choose items, click links, play animations, etc. to actively influence the course of the presentation.

Once the user has finished the definition of settings, s/he can enter the next phase of the authoring process, namely the definition of the presentation genre.

5.4.4 Genre

Two approaches were developed to define and work with a presentation genre. The first had already been established in the SampLe project, tackling the task on the *content* level. Since this concept seemed biased, an alternative that approaches the requirements on a *structural* level has been developed from scratch. Both concepts are included in the SampLe Interaction Design. We first introduce the “*Structural approach*” and then describe the “*Content approach*”. The User Model and Adaptation Model will at this point of the process decide on the basis of the collected information about the current user, which one to provide.

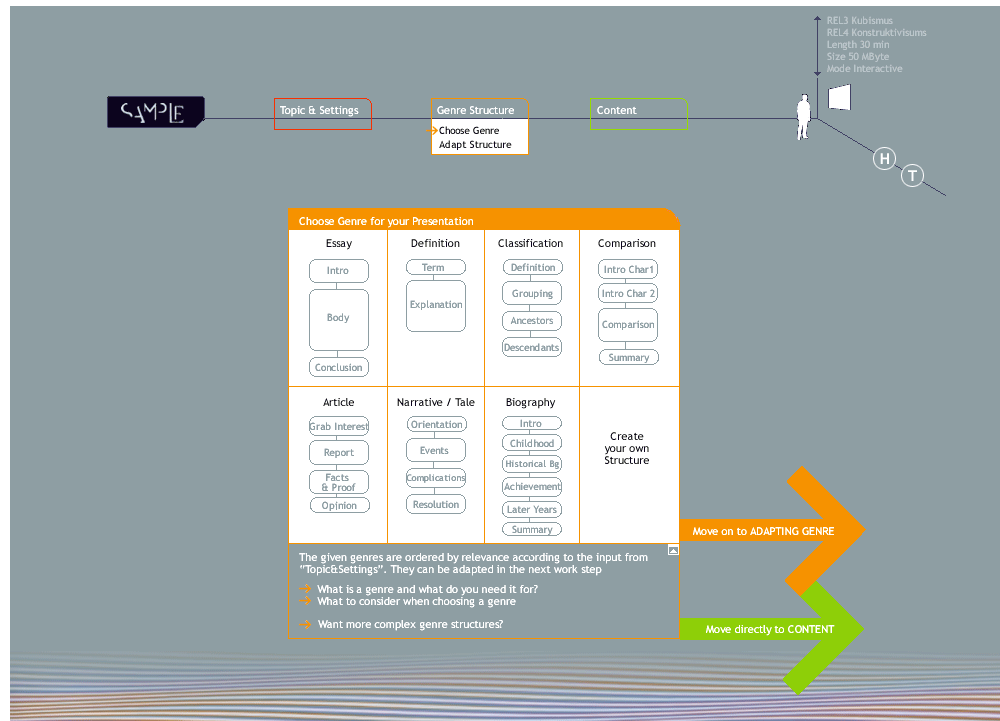


Figure 5.16: Selecting presentation genre

Genre definition - Structural approach

In the structural approach, the user is led to a choice of literature genres such as essay, description, narrative, etc. These are presented in a visual way (see figure 5.16 on page 54), with containers representing the structural parts of the genre, such as introduction, conclusion, etc. The order in which these genres are presented is ranked in relevance, depending on the topic, related topic and settings choices the user has made. If, for example, the user chose an artist as the presentation topic, the genre “biography” will most likely be the first to be presented to him/her.

Understanding and choosing a genre are very complex but also crucial processes. Extensive help is offered, therefore, attached to the main window. Here the user is provided with structural and procedural information about every available genre. Additionally, the user is also supplied with consequences of the use of a genre with respect to time, content reasoning, etc.

The offered genres can be clicked on and a detailed description of the structural parts appears (figure 5.17 on page 55), outlining the content of the structural parts in terms of literature theory. By providing this sort of information, SampLe addresses Wallas’ preparation phase in terms of declarative knowledge of presentation building, laying the foundation for experimental compositions.

The user can choose one of the proposed genres and move on to the next phase. If advanced users are not pleased with the range of proposals, they can either build their own genre (figure 5.17 on page 55, see bottom right field) or choose to see more complex system-proposed genres.

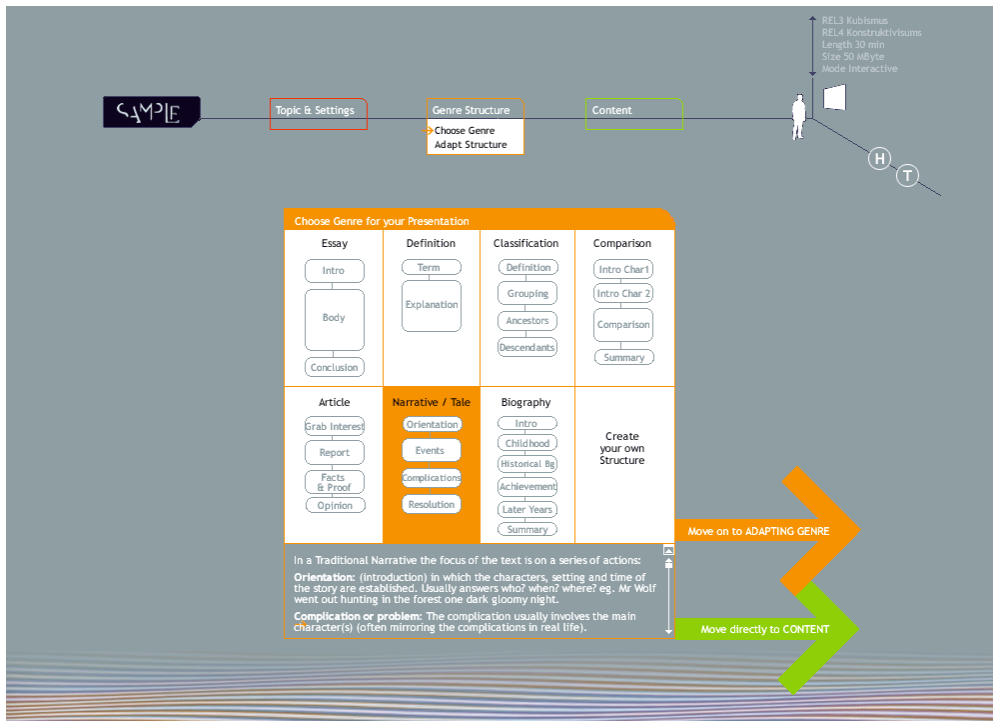


Figure 5.17: Selecting presentation genre with active Narrative/Tale-genre and corresponding explanatory text

In the first case, a workspace opens in which all available structural containers are listed, ordered by the genres they usually belong to. From this list, the user can choose the ones that appeal and put them into an order s/he chooses. Moreover, s/he can introduce new structural containers. These containers need to be labeled so that the system is able to apply them in order to present appropriate content in the content authoring stage.

In the case that the user chooses one of the proposed genres, for example “essay”, then the system offers a variety of structures of essays, not only consisting of introduction, body and conclusion but with a great variety of very complex structures. The user can then choose one of these or add and delete parts or exchange parts, where containers can be included that are not directly related to the particular structure the user is currently working on. This freedom of not constraining the user to one genre but rather encouraging experimentation with the combination of different narrative structures could produce entirely new narration structures and thus facilitate the highest degree of free creative work.

In the next step of the process, the user is offered to refine his/her chosen genre (figure 5.18 on page 56). Detailed sections can be added to structural parts and both sections and structural parts can be deleted or edited in length, determining how much, and to what depth, material should fill that section. The user can do this “fine tuning”, but it is not mandatory. For the advanced user, there is an option that offers more, not directly related sections from other genre types to put into the genre containers of his/her chosen genre.

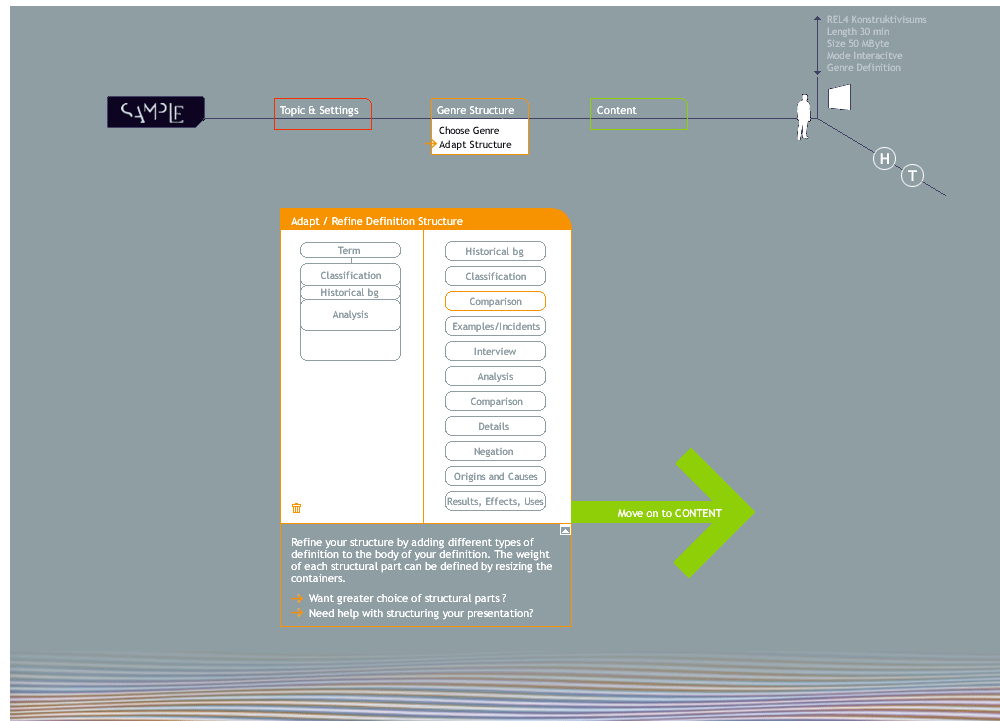


Figure 5.18: Screen for adapting chosen presentation genre

For the novice user, a wizard is provided, that leads step by step through the adaptation process by asking questions and explaining the process and then editing the structure according to the answers the user supplies. After having finished with editing and refining the structure, the user can move on to the content phase in the presentation building process.

Genre definition - Content approach

A quite different approach to define the genre involves the content already available at this stage of the process. After having finished the “Topic & Settings” stage, the user selects a genre from a list ordered by relevance (figure 5.19).

The user chooses one of these rhetorical structures, e.g. “essay” (figure 5.20) and is then presented with suggestions for possible essays, already arranged in structural parts, each providing concrete headlines which hint at the contents that will be treated. When clicking on these headlines, a short summary appears, explaining which content is proposed for that headline.

These structures can be edited. Structural parts and/or headlines can be moved, deleted or changed and also be exchanged, between structures. The tool palette, attached to the window, shows the user that these structures can be edited. The “wand” tool in the tool palette allows the user to extend the structural parts by clicking on them. This functionality is similar to the wand tool described in 5.3, only that here more possible headlines within a structural part are presented. The thesaurus is a general tool that is always helpful for looking up words, finding new connections and inspiration. In the structural

5. SampLe front-end

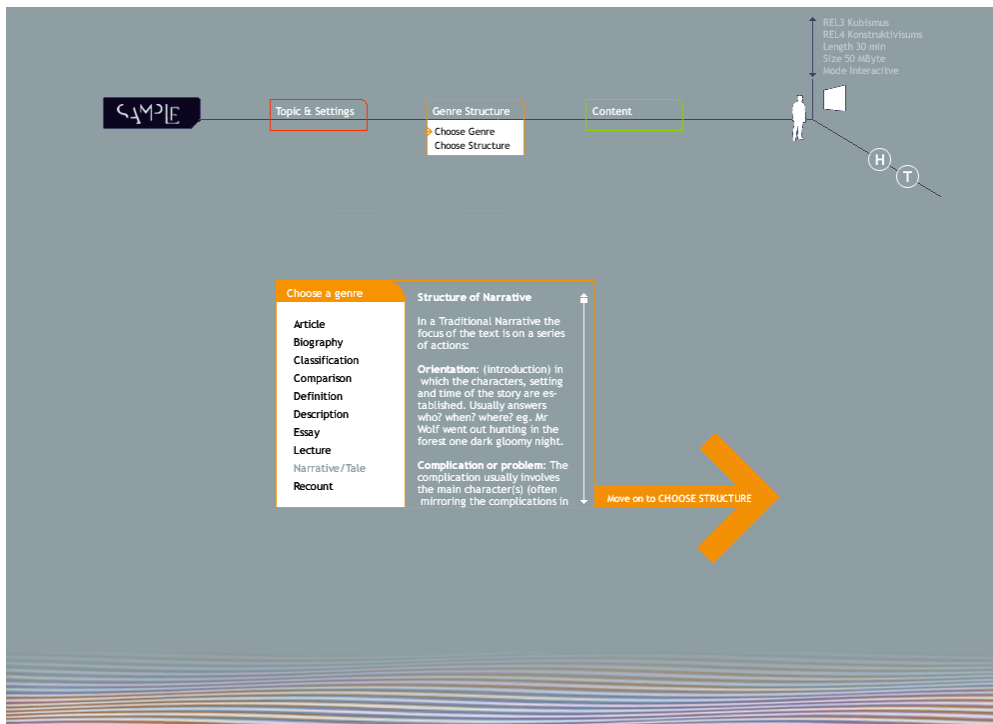


Figure 5.19: Screen to choose presentation genre

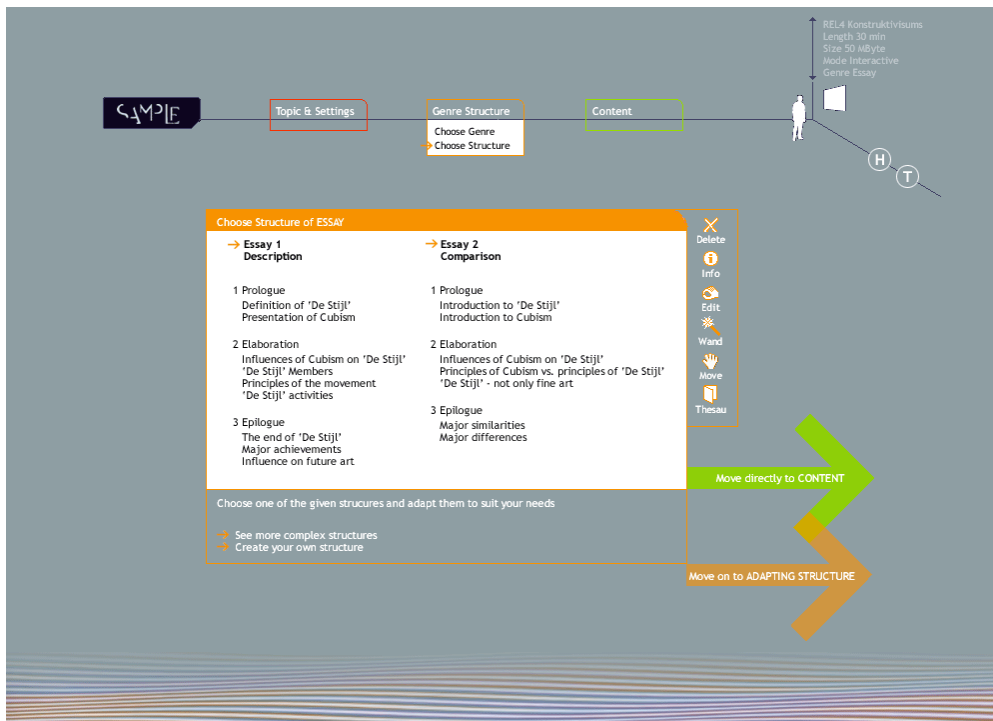


Figure 5.20: Screen to choose presentation structure

approach, more complex structures can be viewed by clicking on the text-link in the help window and the user can also build his/her own genre which leads him/her to the structural approach, described above.

Conclusion

In both cases of genre composition, the user can in a later stage of his/her work always go back and adapt the chosen genre after investigating the available content in more detail. In case the system “realises” during the content-building process that the currently processed content fits better into a different genre, it will propose an alteration (e.g. if the first choice is an essay but the content fits better to biography, the system would propose that).

Though both approaches work in a top-down fashion, they vary in their way of representing the authoring process. The structural approach is directed towards working out a project structure before dealing with the content to fill it. The content oriented approach already takes the content into account while developing the presentation structure. Thus, the content oriented approach might be more applicable for novice users. As a result, the presentation structure might be simpler.

The two approaches vary in the way that the first concentrates on working out a perfect structure before selecting content, whereas the second selects content before finding a structure.

5.4.5 Content

After the user has finished working on the structure of his/her presentation, s/he is lead into the content section. For the structural approach, there are two steps of content selection, a more general and a section specific one. As described earlier (in section 4.6.3), at this point of the process, the user model should contain enough information for the system to decide whether to offer or skip the first of the two steps for the structural genre approach, which is more complex and should only be provided to an advanced user in terms of declarative as well as procedural knowledge. In the course of a section, the section-specific content selection, being relevant for content and structural genre approaches, will be described first and the more complex intermediate step for the structural genre approach is then described.

Simple mode

Having finalised the presentation genre, the novice user is lead to a page where the chosen genre containers (such as introduction, conclusion, etc.) are shown as tabs in a window with sub-tabs, representing the sections, if there were any created by the user (see figure 5.21 on page 59). These contain documents in the form of a list and a map view that were retrieved by the system on the basis of all settings that have been made in the course of the process to this point. As described above in section 4.6.1, the user can either use both or just one of the views, depending on his/her needs with respect to the mental model, work style and habits and information requirements. The maps in the tabs for each

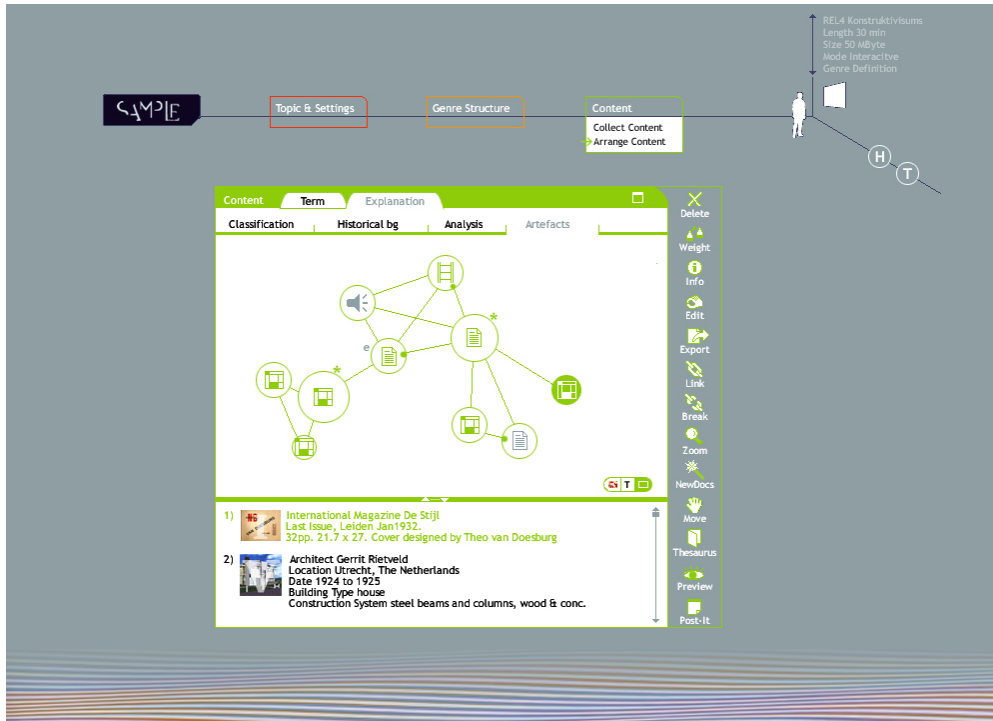


Figure 5.21: Content screen with map- and list-view on presentation documents

section can be viewed in parallel by dragging the tabs out of the window and thereby separating them into new windows.

The given documents and their relations are just a first proposal by the system and can be altered, rearranged, modified, complemented etc. by the user. They can also be moved to another section by dragging them onto the corresponding tab.

The map-view comprises the information about relevant documents and their relations, which is divided into different (levels of) views. In the first view (see figure 5.21 on page 59), the document types are represented by icons for text, audio, video and images. The size of the circles around them reflects their importance. The star on some of them tells the user that a document is often cited, and thus trustworthy (which might be helpful for e.g. making a presentation about an artist, to start with an image that many people know and can associate with the possibly less well known artist). The blue “e” on some of the documents informs the user that these are edited versions of an original document. When clicking on the “e”, the user is lead to the original version and gets more information about the editing process (how and when) and the editor (level of domain expertise). The blue icons indicate that the documents were edited by the user him-/herself. Relations between the documents are represented as lines. A dot at the end of a line within a circle means, that the document on the other side only refers to a certain part of that document. In the detailed view, that is opened when clicking on a document icon, the referred part will be marked. The detailed map view (see figure 5.22 on page 60),

5. SampLe front-end



Figure 5.22: Content screen with map-view showing link-values and brief descriptions

which is selected with the view switcher on the bottom right of the map area, provides the names and short information about the documents. Furthermore, the relations between documents are now labeled, where the various values mean:

”**opp**” gives the user the information that those two documents have opposing content,

”**sg**” means that documents belong to the same group, such as the composition paintings by Theo van Doesburg,

”**eg**” shows that a document is an example of the content in the other document.

On an even more detailed level, shown in figure 5.23 on page 61, more information is given by replacing the document icons with the actual artefacts, either the images or the headlines of the text documents or the first frame of a video or even the video playing in the thumbnail. Additional personalised views, in terms of semantics or structure can be offered, such as viewing only edited documents certain media types or documents.

In the list-view, the documents are always shown as thumbnail images, videos or as headlines for text documents. Additionally, relevant information about the author, creation date, first words of the text, etc. are provided.

This first set of documents and its constellation is, as stated before, only a first proposal from SampLe. This set can be edited and complemented by the



Figure 5.23: Content screen with map-view showing brief descriptions and images

user. A tool palette is, therefore, provided at the right side of the window that contains basic editing tools as well as functionality that supports the creative work process.

The user can get a detailed view of the documents presented in the map or list by clicking on them (see figure 5.25 on page 62). The documents will open in a separate window, so that several can be worked on at the same time, e.g. to compare or establish links between them or between sections of their content. Existing links will be shown as icons similar to the ones in the map-view and text links to the corresponding documents. A text function is also provided to change or add text; for images and videos, a highlight function can highlight parts of an image if a user wants to put emphasis on only a detail.

All these tools are there to help the user to easily play and experiment with the content, form new relations and coherences. Thus, the tool palette opens the space to free reign of creativity in terms of building highly informative, maybe even surprising or entertaining, enthralling presentations, supporting the second and third Wallas stage.

In case the user is not happy at all with the provided content, s/he can either jump back to the settings page and delete or exchange or re-evaluate the weight of the related topics or do a new search for related topics or the general presentation topic.

Another way of finding more content, either because the user is not happy with the provided items or just for broadening his/her horizon, is the application of creative search. In this stage of the process, the system will take the topic,

5. SampLe front-end














 Delete  Weight  Info  Edit  Export  Link  Break  Zoom  New Docs  Move  Thesau  Preview  Post-It	<p>delete items, of which a "blacklist" is kept not to offer them again when the user makes a new search</p> <p>weight their importance,</p> <p>get short information</p> <p>edit a document</p> <p>export it for editing in specialised tools</p> <p>make links between documents</p> <p>break existing links</p> <p>zoom into parts of the map</p> <p>add new docs with the wand by clicking on a highly interesting doc to see more related documents</p> <p>move documents in new positions</p> <p>find new words, and through that possibly new ideas, in the thesaurus</p> <p>preview part of the presentation (see 3.2, reflection-in-action)</p> <p>add post-it notes to remember important information and shift the mental weight</p>
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Figure 5.24: Tool palette



Figure 5.25: Content Screen with two detail-view document windows

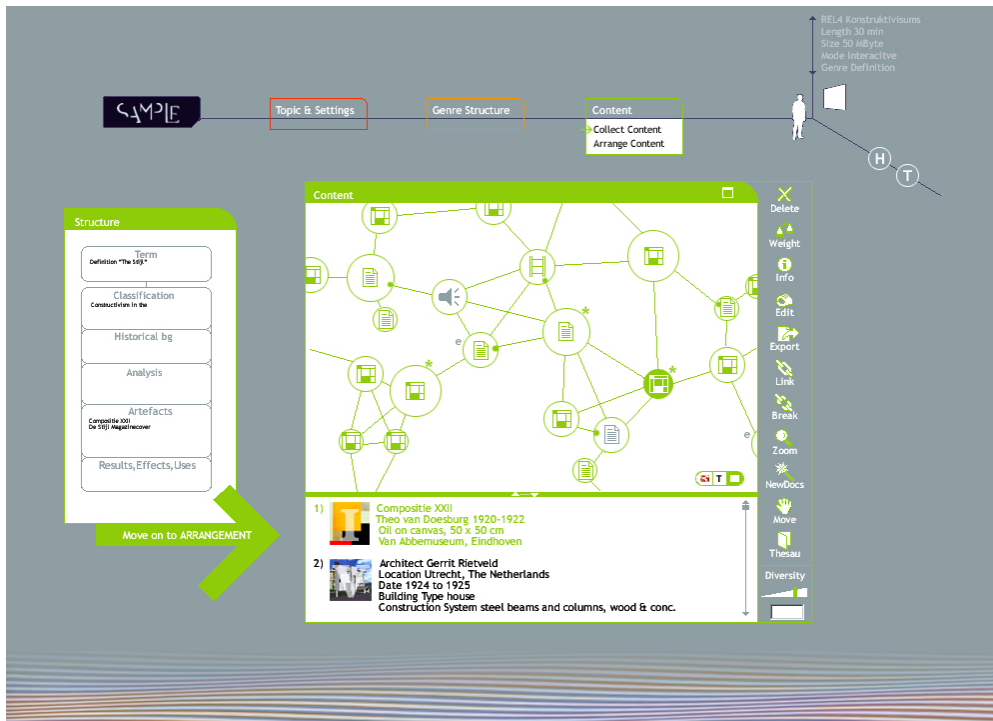


Figure 5.26: Content Screen with two detail-view document windows

related topics and genre decisions as starting points for proposing adequate documents. The user can drag those s/he is interested in into the clipboard and the appropriate documents can then be added to the map or list.

Advanced mode

As stated above, advanced users will not directly be lead into the specific content selection section but take an intermediate step. After having chosen and adapted the genre structure, the expert is lead to a screen that contains one window with his/her genre and sub-section containers and a separate window containing an information map- and list-view, as shown in figure 5.26 on page 63.

The difference to the approach described previously is that the user does not find him/herself directly in the structural containers with the system offering him/her the appropriate content for each section, but rather “outside” in a “rough information gathering space”. Here the system displays all the information, relevant for the specified topics, settings and genre structure. Another window displays the content structure that was built in the previous steps. The user can crawl through the developing information space and take out the documents or document groups s/he likes and drag them into the relevant containers or sub-sections that are displayed in the left window. Only in the next step, detailed work is performed within those containers, such as arranging and editing the selected documents as described in the previous section. This intermediate work step gives the user a greater view on available material, lets him/her explore a wider range and maybe find more adequate or interesting documents.

The map-view shown in this section shows a clipping of all available information and their relations, and thus differs from the static map-view used in the simple content selection mode. The user can move in different directions with the ‘move tool’ and follow interesting paths. In such a way, a higher quality of content can be collected for a presentation as the system only gives an entry point but the content itself is selected by the human user and not, as in the simple mode, by the system itself.

5.5 Additional functions with emphasis on creativity support

The SampLe front-end holds a great number of functions that facilitate the often iterative work style of presentation building. The work process seldom follows a straight order but usually involves going back and forth between steps, running into dead ends, having to go back to earlier phases and head into new directions many times. Furthermore, varying content and constellations and going back to old versions, thereby thinking in new directions and at the same time keeping in mind ideas or documents, is a very complex demand on the human mind which uses up its capacity to the maximum so that there is not much room left for being creative and inventive. The SampLe tools and functions try to take that mental load off the user, by offering functions that support going back and forward, that save ideas and thoughts and constellations and inspire, thereby adhering to the principles of Ergonomy, that state that humans “can only perform a limited number of concurrent tasks” and have a “limited memory” and applying Schöns theory of reflection-in-action, described in section 3.2.

A *notepad* is a simple but effective tool for shifting the user’s mental load. Going one step further, an *audio notebook* does not even have to distract the user from his/her ideas by having him/her open a screen and concentrate on writing and formulating useful sentences. Recording speech is much faster, more direct, since it refers to much older areas of the human brain, and less attention has to be given to it. Those two tools are particularly useful if they are also used beyond the actual system. Users that are deeply involved in a matter and want to be creative, have to leave their workspace for getting new ideas (see section 3). Therefore it would be helpful if they always had a notepad or audio notebook near by (e.g. in an organiser) for quickly taking down new glimpses of ideas that usually spark off very spontaneously and in the most unlikely situations, far away from the workspace. These notes can then be imported to SampLe for further processing. Those two tools are very helpful in the second and third Wallas stage.

Digital post-it notes serve the same purpose within the system. The user can attach such annotations to details of his/her work to remember little things that might not fit in the contemporary content but should be kept in mind to work them out later. A similar tool, but in a more concrete sense works like a *clipboard*. It allows the user to save e.g. pieces of text, whole documents or even constellations of documents, that might not fit in the particular context but still

are interesting enough to be possibly used in other parts of the presentation. It works like a *snippet-library* where users can put their clipped information, order it and reuse it. Tackling the problem from the opposite site - not saving the documents themselves but rather remember their location to get back to them - is the function of the *bookmark tool*. With it, the user can mark retrieved documents or parts of documents that s/he finds interesting as well as work-steps that should be reviewed again, such as the presentation settings, where the length of the presentation might be altered after having gained an overview of the available content.

A *dictionary and thesaurus* are available mainly in the topic search and content sections. As stated above (see section 3), those tools are effective for developing new ideas and relations through the creativity technique of association. An *import-export folder* keeps track of editing documents and having a well organised interface to adjacent specialised tools as well as applying *versioning*. Changes within documents or changes in structures and editing topics etc. always have an undo or history function. Versioning within the content section of SampLe, when working with the map-view, adding, deleting and changing documents and their place within the structure, is managed by a tool, similar to the one described in [23] as "*visual design timeline*", where all changes within the map view of the content section are kept in thumbnail images, like a comic strip, that show the changes made by the user. S/he can go back and forward between the changed constellations (multiple undos/history), try new constellations and does not have to be afraid to lose ideas by trying a different way that might not lead anywhere, as s/he can always go back to the older versions. This freedom of varying and playing and thereby exploring the content without having to worry about losing things, is very important for working creatively and supports the incubation phase.

During the content arrangement, the user can check his/her work constantly by getting a *preview* of his/her presentation. This function is very important so as not to work "blind" but rather being able to check over and over until the desired result is reached, as described by Schöns theory of reflection-in-action. The user can *save the work status* at any time and leave the system to have a creative break, think everything over and let ideas settle. As described in section 3.1, this incubation phase is a key point to creativity. Furthermore, the user can *export or print his/her work status* to be able to take it outside the usual work environment and maybe work in different environments with different media, such as real paintings or books, rather than sitting in front of a computer that can only be operated through a screen, keyboard and mouse and always looks, feels and smells the same.

On the document level, "Souvenir", an *indexing system for video and audio files* is helpful to think about and arrange content or to record and index interesting parts of videos or audio files for plaiting into the content structure, described in detail in [30]. For working on textual documents, a tool that compares *text-variances* between similar documents, as described in [9] can accelerate work.

5.6 Conclusion

The goal of this thesis was to develop a user interface that leads users with various levels of knowledge through the process of multimedia presentation authoring and thereby supports the creative task of that work. In this chapter we introduced one possible solution to achieve this goal. The following chapter outlines possible improvements to that system and positions its concept within the wide spectrum of possible approaches, thereby discussing the advantages and shortcomings of our solution.

Chapter 6

Evaluation and future work

The evaluation and discussion regarding the work presented in this thesis is conducted on two levels. First, we briefly outline issues on the micro level, concerning design improvements in the current system and its technological basis. Secondly, we evaluate our structural approach to the presentation authoring process on the macro level, considering alternative concepts. Thereby we outline the advantages and disadvantages of the approach taken in this thesis, and point out potential issues for improvement and further development.

6.1 Evaluation on the micro level

One major functionality in SampLe that needs further thought is the information retrieval. In chapter 5.3, we briefly discussed several alternatives for that complex subject. On the basis of gained insights, concrete designs were developed, as described in sections 5.3.1 and 5.3.2. We believe that those implementations serve their purpose in a sufficient way. Still, it would be desirable to add functionality, such as showing the user how retrieved documents are related to the search query in order to allow the user to efficiently refine the search. If, for example, the choice of a related topic produced results in a document that is related to the secondary topic but does not suit the needs for the presentation, the user should be made aware why the document was chosen and then have the option to specify why the document does not fit the presentation needs. Furthermore, the concrete visualisation, for example, of the map-view could be critically revised, based on usability tests, in order to be improved. A colour coding or even a very different visualisation, as for example designed in [26] might improve our approach. A lot of research exists on the topic of information retrieval and the time for a thorough analysis was not sufficient for this work. Therefore a further investigation is advised.

Our approach on the use of intuition for the development of applications with no previous learning-time, as discussed in section 4.4.1, could be developed one step further, as advised in [7]. The described discontinuity problem in the navigation can be solved by introducing transitions between the four work-stages as well as between each work-step. One way of realising that is by placing the workspaces into a 3D environment, such as an office, in which

the different authoring phases are presented as desks which the user can virtually walk to and work on, where the walking resembles the transitions. A more reasonable approach might be to animate the existing environment by introducing movement and transitions, for example, by giving the impression that the work-steps are arranged on a roll which can be turned forward and backward where windows can be dragged into another area, providing a more free way of working. This model implies the recommended linear work-style, as well as iteration. That technique clearly emphasizes the connections between the work-steps and avoids sudden jumps from one environment to the next, implying that all the steps in the authoring process belong together and lead to one whole. A simpler approach can be found in the authoring environment of Macromedia Director or Flash.

From an Interaction Design point of view, it might be interesting to investigate how a system such as SampLe could work on a digital blackboard, similar to the one described in [24]. The working practice is assumed to be rather different, possibly influencing the results, too. The sheer fact of having the user standing up, working on a much bigger space to move and arrange elements, would probably affect the work strongly. Moreover, it would enable people to work together, allowing the application of more creativity techniques, such as brainstorming. Taking the cooperative aspect one step further, a Computer Supported Cooperative Working/Learning (CSCW/L) approach would be worth investigating, allowing people in different locations to build a presentation together via a network.

6.2 Evaluation on the macro level

In the course of this thesis, we described a structural top-down approach for guiding a user through the process of multimedia-based presentation building, including the authoring phases:

- defining topic and related topics,
- building a structure and then
- arranging content within this structure.

This approach resembles the SampLe architecture (see chapter 2) and seems plausible and feasible. We also showed that we can support human creativity during authoring by providing an environment and functionality that incites creativity.

A more challenging approach in terms of creativity support is, however, to go a step further and let the system itself become more creative. This can be achieved by following a bottom-up concept in the presentation building process. In this section we will briefly introduce this approach and compare it to the one worked-out in this thesis, thereby pointing out the advantages and disadvantages of our work and possible improvements.

In the bottom-up design, the user would - similarly to the top-down approach - start with the definition of the presentation topic. The difference here

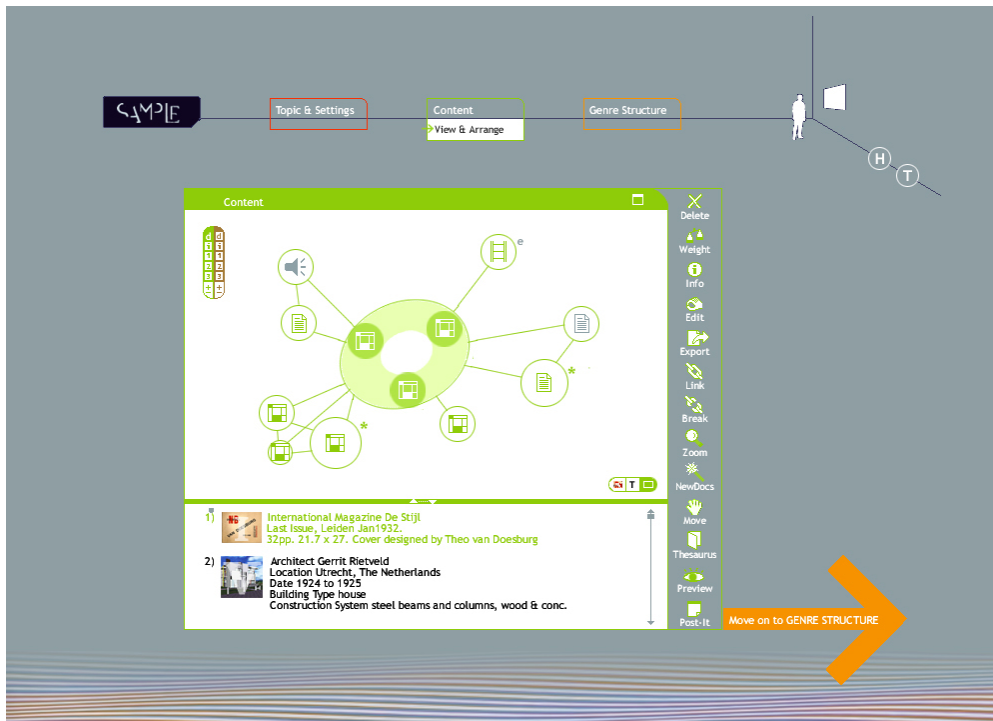


Figure 6.1: List and map views of content in bottom-up presentation building approach

is that the user can enter as many topics as s/he likes, whether it be 1 or 20. A topic can be very specific, such as a painting or it can be generic, such as a painting technique. In the next step, s/he can make formal presentation settings, concerning media, presentation size, etc. The system then tries to find similarities and differences between the given topics and displays documents that describe those. To illustrate the differences in both approaches, consider the example of a user who is interested in three images as topics, namely “Carafe, Jug, and Fruit Bowl” by Pablo Picasso, Paul Klee’s “Red Balloon” and Roy Lichtenstein’s “grrrrrrrrrr!!”.

In our map view visualisation for the bottom-up design, shown in figure 6.1 on page 69, the topics are shown in the middle of the screen, connected through a light-green band and the related documents are arranged around them.

In another view, the user can additionally investigate documents, that show the differences between all chosen documents, where differences are assigned a brown colour. This information might be just as interesting as finding out about their similarities. Furthermore, one more level of document detail can be faded in for related and diacritical documents, that are indirectly related to the three paintings (see figure 6.2 on page 70).

For seeing documents that are related to two or only one of these paintings, the three images would move apart and the green band between them expands to take up the documents that belong to each pair (see figure 6.3 on page 70). The documents that are only related to one artefact, will be shown in the centre.

6. Evaluation and future work

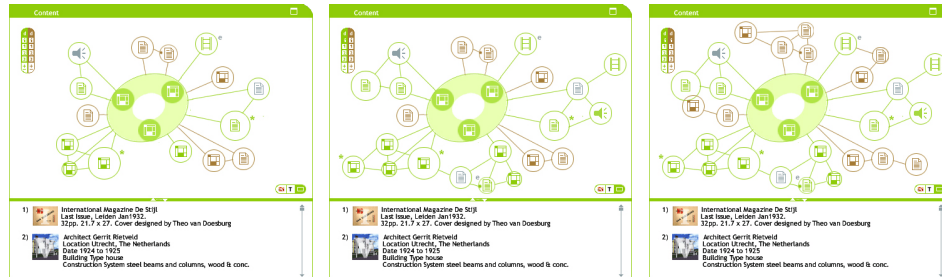


Figure 6.2: Related and diacritic direct and indirect documents in a map view



Figure 6.3: Documents related to one and two artefacts

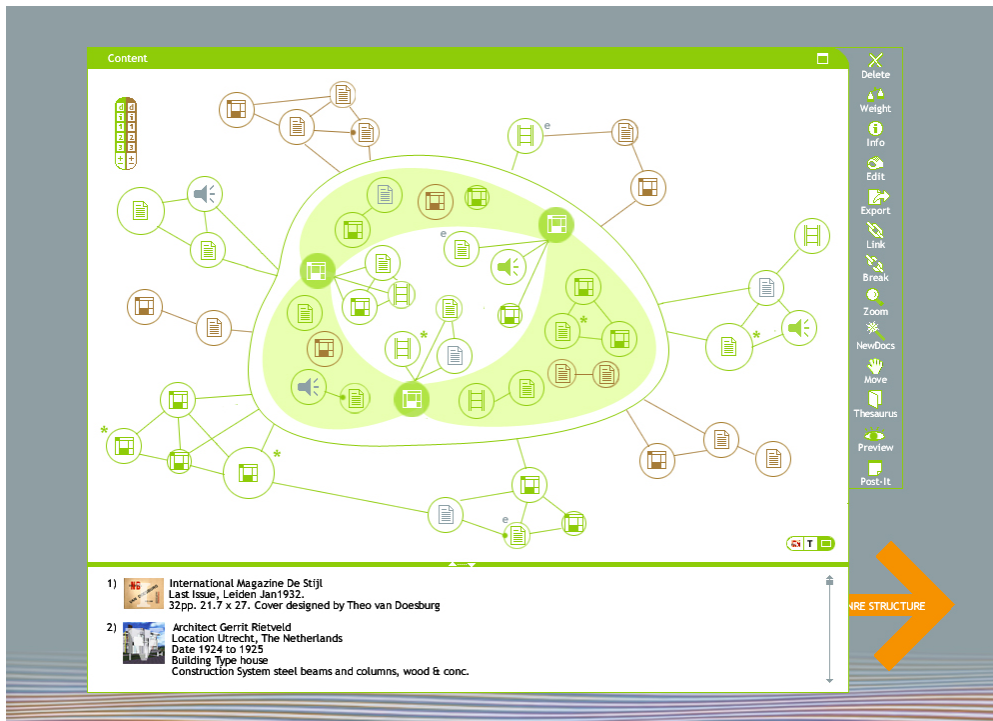


Figure 6.4: Combined map-view

In the different views, the user can again arrange and edit the provided content, just like in the approaches described in section 5.4. The corresponding list-view would also work similarly to the list-view described in section 5.3.2, with the only difference that here the documents are ordered in groups according to which document or document constellation they belong to.

All map views can be combined in one big information map, shown in figure 6.4, which is the basis for the next step in the authoring process, the presentation structuring.

When the user has finished arranging the documents, s/he moves on to mapping a structure on that content. The system will propose different genres and displays which documents can be used in the suggested genre and which will be missed. The former will be coloured orange whereas the latter will keep their original green or brown tone, as shown in figure 6.5.

The user can switch between different genres to compare which structure covers the most relevant information and then decide which s/he likes best. In the next step, the presentation of information will be similar to the content section in our top-down approach. The structural parts of the presentation are represented in the form of tabs on top of the content-window and the information is grouped within these structural parts. The user can again edit and rearrange the content. The documents that did not fit into the structure are presented in a separate window in a list-view. The user can still add those documents s/he thinks are vital though omitted by the system (see figure 6.6.

6. Evaluation and future work

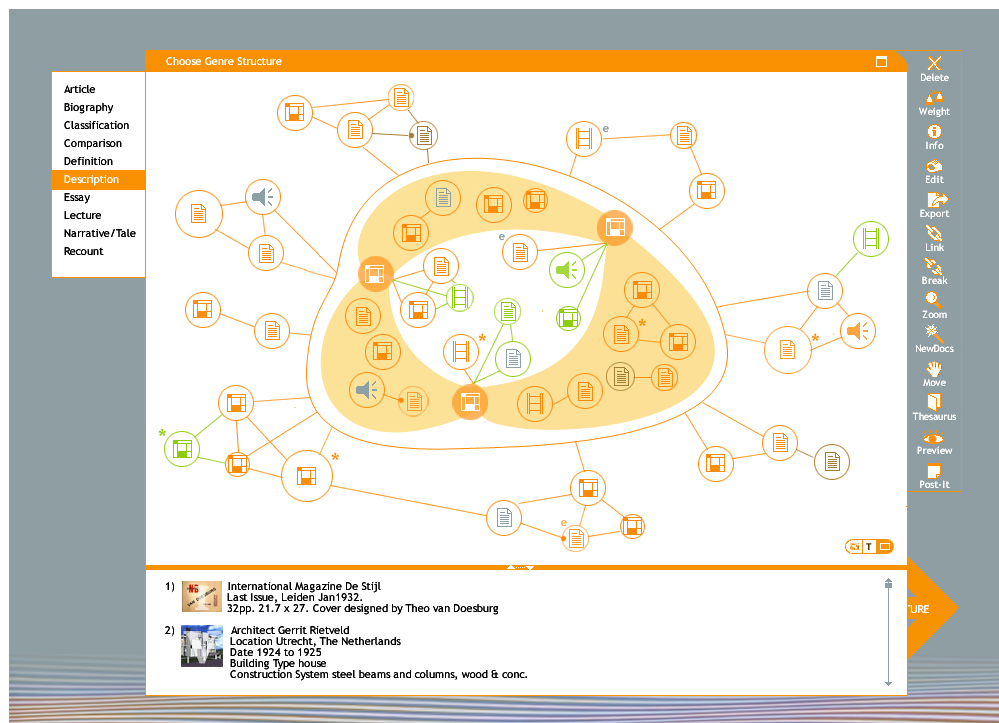


Figure 6.5: Structure mapping on content

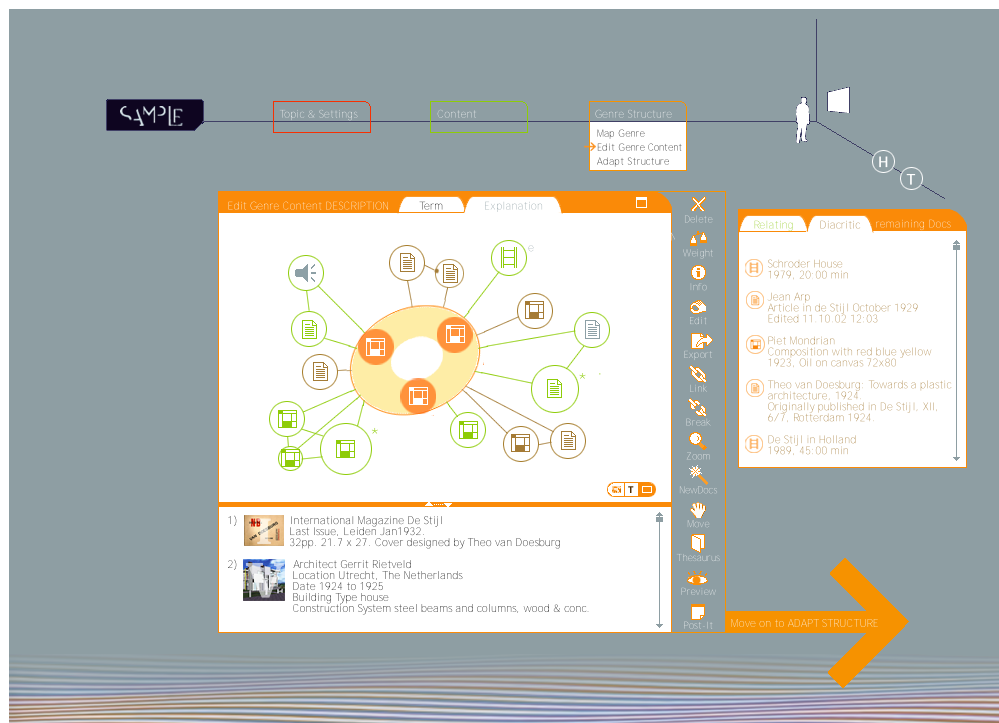


Figure 6.6: Structural work-window

From now, all creativity and working techniques, described in chapter 5, apply again and all sorts of document refinements are also applicable. When returning to the content, after having added subsections, the system will split the documents into those subsections, again trying to add those that did not fit the first time.

Creativity is handed over in the bottom-up approach to the system in two ways:

- in finding relevant documents to the entered topic(s) and
- when mapping the content to a structure.

In this way, many constellations proposed to the user may not make sense, but if only one of them approaches the matter in a completely new and innovative way or sparks off a novel idea, it has already paid off.

The bottom-up approach is very flexible and not structurally constricted. The final information target, which the process is heading towards (in terms of content and story), might not be quite clear from the start but that again leaves a lot of space for spontaneity and creativity, trying out options and finding the best possible content. Decisions are made during investigating content and are not constricted in advance by structural decisions. This work style is, therefore, likely to produce higher qualitative content. A disadvantage of this approach is, though, that the mapped structure is by nature simpler. One can overcome this shortcoming by allowing the user to also adapt the structure in a later part of the process, similar to the top-down approach.

Many questions and problems arise out of the bottom-up idea. A lot of work would have to be put into the visualisation of the map-view. Currently, only a 3-topic approach has been exemplified but it would be rather difficult to visualise, for example, 20 topics. The SampLe architecture, in its present form, is not designed for such an approach. The underlying system architecture would have to be adapted for supporting this design, making SampLe itself creative. The Topia project, however, deals with presentation generation in a bottom-up manner and detailed research about that can be read in [22].

In general it is unclear as to whether such an approach makes sense at all. It can be argued that since the eventual outcome of this approach to presentation authoring is not clear from the start, but rather arises during the process, is certainly not suitable for authoring a presentation with a clear topic that has to be produced under time pressure. On the other hand, this bottom-up concept appropriately supports an explorative work-style that aims more at self-learning rather than pursuing the goal of building a presentation for an audience. It is, therefore, imaginable to implement this concept in a web-environment that supports the creative exploration of large domains, assuming a curious and creative target group with time to spend.

The actual presentation generation phase, shortly described in chapter 2, is not part of the visualisation outlined in this thesis. Once the system has collected all structural information the relevant documents are arranged on that basis into a multimedia presentation. Our user can review his/her presentation, edit it visually and revise the whole presentation, making sure that the ideas

s/he wants to convey are presented to meet his/her own and the audiences' expectations. If, however, after experiencing the content as a whole, s/he finds inconsistencies, s/he would have to return to the content or structural section to remodel his/her ideas. This is a rather cumbersome practice and a more integrated approach might be worth considering, such as browsing combined with presentation building.

In a browsing-oriented way of presentation authoring, the user enters the presentation topic and is then "situated" directly in the presentation mode, browsing system-proposed headlines and documents through links. The user could for example enter "Theo van Doesburg" as a topic. The system then proposes different headlines to start with, such as "Inferred Artists", "His Life", etc. From these headlines the user can choose those s/he wants the presentation to start with. The system then proposes documents in that category the user can work on. Within those documents, more links could exist that can be followed and added to the presentation or not. All these structures, links and documents the user sees are already ordered in the form of a presentation and the user only determines which of the proposed parts to show and which to leave out. In this way, a presentation is built which simultaneously facilitates the user to learn more about the content. The structure, which would have to be interactive, arises at the same time the user browses and chooses the relevant documents. The final presentation generation step in this design is obsolete as the user is already in presentation mode. This integrated approach is not yet fully worked out and many questions remain.

The bottom-up approach has the advantage that its integrated nature most likely produces predictable results as the user always directly gets feedback about the result of his/her action and does not have to wait until the end to see the final result. However, the disadvantages are that in browsing:

- only a very limited number of documents could be proposed,
- relations between many documents cannot be made clear to the user and
- structuring of the chosen information for the system would be a difficult task for the system.

Having taken the structural approach as a starting point for semi-automated multimedia presentation generation, it has become clear that there are many more forms to investigate. The approach investigated in detail in this thesis seems to be the obvious and most reasonable, but might be, as has been shown in our final discussion, not the most open and creative, as well as not the most economic and integrated one. On the other hand, the two new ideas are rather vague at this stage and thus open up a great number of new problems, as discussed above. Both would have to be tested on feasibility and sense, to make sure that they are really superior to the approach described in this thesis.

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