Designing the Design

Need-based Storyboard Adaptation for Multimedia Systems Design

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Abstract

The use of Storyboards as an effective design tool is often recommended for Multimedia Systems Design. However, experience has shown us that one cannot just use the tool as it is used in the making of movies. As a design tool Storyboards have to be adapted to the specific multimedia system being developed. A case study in seven multimedia systems development projects revealed that four parameters have to be taken into consideration. The four parameters are: Complexity, size, reality likeliness and degree of reuse. Together these four parameters form a framework in form of a four by four matrix with 16 possible outcomes. Using examples from the cases the paper discusses how to adapt Storyboards in different situations.

Keywords: Multimedia, design, case study

BRT Keywords: CA14, FC, AI0102

Introduction

The term multimedia has over the years been interpreted in very different ways. Some would say like James Hemsley (1997, p.179):

> *"Multimedia is a term used to describe a computer system that is a combination of the following media forms: text, graphics, still-images, audio, animation and motion video."*

In this definition any system using more than one kind of presentation media, is a multimedia system. A more narrow use of the concept can be found in Fred Hofstetter (1997, p.2):

> *"Multimedia is the use of a computer to present and combine text, graphics, audio and video with links and tools that let the user navigate, interact, create, and communicate."*

The essence is the words *communication* and *interaction* as well as *narrative* and *creative* concepts. The objective of multimedia systems development can be seen as achieving a successful transfer of a certain message by use of multimedia elements. Thus, a multimedia system does not only consist of different kinds of media's, which is

“shoveled” into the system (Nielsen 1995, p. 326), but conscious use of these media’s in order to enhance interaction and communication of a message. Therefor the design of multimedia systems is an essential and complicated task.

Because multimedia applications often depicts a situation – a story – and includes audio-visual elements, it has been natural to look for design tools within the movie industry. At least two tools has gained widespread use: (1) Treatments for overall descriptions of the whole system, using narratives to convey, how a subject will be treated and how the multimedia application will look like, when it is completed. And (2) Storyboards to design and document all audio, video, graphic, and logical control elements to take place in (a part of) a multimedia application.

This paper is organized into six sections. In the first section, we describe the research design of an action research based study of seven multimedia applications. In the second section we review existing literature, investigating how the authors' perceive the storyboard tool and how they suggest applying the tool in multimedia system development. The third section argues that four parameters have to be taken into consideration, when designing the kind of storyboards that will work best. In the fourth section the seven cases are shortly introduced and the four parameters, complexity, size, reality likeliness and degree of reuse are applied to explain the seven cases. The fifth section builds a framework out of the four parameters in the form of a four by four matrix with 16 possible outcomes. Finally, in the sixth section, we discuss the potential benefits of this framework and briefly consider directions for future research that are opened by our four by four matrix.

Research Method

To study the use of storyboards we have used action research. The fundamental argument of action research is that a complex social process can be studied best by introducing changes into that process and observing the effects of these changes. We have as researchers not only observed the storyboard phenomena, we have also intervened and participated in the design and use of storyboards.

Action Research – Five Phases

Our action research approach is best described as a cyclical process with five phases (following the advice of Susman & Evered, 1978):

The *client-system infrastructure* or the setting was originally a course in multimedia systems development at the Copenhagen Business School. The course was taught in such a way that groups of students – 10 to 15 students – for half a year developed a multimedia system for a company or an organization. The Fire Chief, First Aid, ASTRA, Danish State Railways and The Business Credit Agency (see detailed descriptions later) are all examples of such systems, where one of the authors have been involved as teacher and advisor. Whereas SMILE and Alka are cases, where one or both of the authors have acted as project manager and/or participated in the project.

Diagnosing how to use storyboards in each of the seven cases has been a collaborative effort, where many different designs have been tested and discussed. The framework presented in this paper is the result of the last diagnosis. The framework is

now applied in a system that is currently being developed.

Action planning and using the storyboards has been the next phase in all seven cases.

After the multimedia applications have been developed, the authors and the project participants have undertaken an *evaluation* of the outcomes of the projects in general. As part of this the use of storyboards was also evaluated.

Last but not least the authors have – after one project and before the next – tried to *specify the learning*. At an early stage, we thought that there was one best way to use storyboards. But as we learned more we realized that different situations, surroundings and circumstances can make different designs of storyboards optimal. Thus in 1998 more informal versions of the framework presented in this paper has been tried.

One key aspect of the research method is the role of theory. At the beginning of the research in 1993-94, the authors were drawing upon existing theory as foundations upon which to plan and take action. E.g. Bergman & Moore (1990) and Alessi & Trollup (1985) were major sources of inspiration to begin with. Following the evaluation of the outcomes of each cycle, our own understanding was reinforced and modified, and the final outcome that we are presenting here is an evolution in comparison to existing theory on storyboards.

Existing Research on Storyboards

When looking to the literature it becomes evident that researchers and practitioners recommend the storyboard approach. For example Faulkner (1998, p.103) determines that:

> *"The initial design for the system can most conveniently be presented in the form of a storyboard"*

However, he gives very little proof for this statement. We found many statements like the above, even though there are different understandings about the naming of the tool. Some choose to call it designing the organizational framework (like Sano (1996)), others scenarios (like Siochi et al (1991), p 163):

> *"One behavioral technique that has long been used both formally and intuitively is scenarios (storyboards) of interface design."*

We reviewed 19 papers and books, which mention storyboards as a tool for designing and visualizing the content, media use, navigational structure and interface of the system (Beccue & Vila (1996), Burger (1993), Cernuzzi, Kreitmayr & Sánchez (1997), Chin, Rosson, & Carrol (1997), Dix et al (1998), Dobsen & Riesbeck (1998), Faulkner (1998), Field (1994), Hix & Hartson (1993), Hofstetter (1997), Koegel Buford (1994), Liu et al. (1997), Nielsen (1995), Preece et al (1994), Sano (1996), Scaife et al. (1997), Siochi et al (1991), Von Wodtke (1993) and Wagner & Capucciati (1996)). From these 19 references only 6 showed real examples of or at least tried to explain suggestions to, how a storyboard could look like (Cernuzzi, Kreitmayr & Sánchez (1997), Chin, Rosson, & Carrol (1997), Dix et al (1998), Hofstetter (1997), Sano (1996), Wagner & Capucciati (1996)).

Almost all of the 19 referrences mentions benefits of the method; like using the storyboard in an evolutionary manor and in iterative cycles (Dobsen & Riesbeck (1998),

Hix & Hartson (1993), Koegel Buford (1994), Wagner & Capucciati (1996)); or the value of the tool, when conveying the design of the system to the users/clients or even in participatory design processes (Burger (1993), Chin, Rosson, & Carrol (1997), Dix et al (1998), Faulkner (1998), Hix & Hartson (1993), Preece et al. (1994), Scaife et al. (1997), Siochi et al. (1991), Von Wodtke (1993)). Though, from these 12 references only 4 describes actual studies of experience with the storyboard approach (Chin, Rosson, & Carrol (1997), Dobsen & Riesbeck (1998), Hix & Hartson (1993), Wagner & Capucciati (1996)).

In conclusion, it seems like very little is said about the actual appearance and use of the storyboard, and even less about the experiences and validation. No one describes whether they use the same standard with success in all types of multimedia systems or whether they change the layout according to the different situation / to the system requirements. Though some researchers do feel that they need more rigorous methods than they believe the storyboard approach can apply and as a consequence they invent new approaches. Examples of this are Siochi et al (1991) and Hix & Hartson (1993), who says storyboards are only useful for the initial design. They promote their own language UAN (User Action Notation), which is almost a pseudo-coding system.

Parameters for Design of Storyboards

When analyzing our learning from each project, we began to see a pattern for when and why the need for adaptation of storyboards arose. Below you will find a description of the four identified parameters and their influence on the functionality of the storyboards:

- **Complexity** – measured as the number of ways through the multimedia system and the degree of user control. These two concepts – no. of ways & user control - are often dependent on each other. For example: If the user has total control of, which directions he/she can “walk-through” the multimedia system, the number of ways through this system will be large. Such a high degree of complexity entails a need for a tool / a storyboard, which can direct attention towards the flow in the system. Precise annotation of which link goes to where and when is necessary. Whereas few ways through a multimedia system and less user control implies that a simple flow diagram may be enough to give a complete overview of the structure.
- **Reuse** – measured as the amount of existing material (text, video etc.) used directly in the multimedia system or slightly adapted to fit the new medium. For example: If an education system is based on material subtracted solely from a video and textbook, then the requirements for a storyboard, which covers content design, learning perspectives etc. are lower than with a system, where all the learning material is designed from scratch.
- **Reality Likeliness** – measured as the importance of a reality feeling – a feeling of being in or learning from a situation portrayed by the system. For example: In order to achieve a high degree of reality likeliness, the systems capability to interact with the user, to display feelings and moods becomes very important. Thus a storyboard, which supports design of the GUI (Graphical User Interface), detailed design of the human-computer interaction, as well as synchronization of the different media used, is highly relevant. While a multimedia system, which do not prioritize reality likeliness, still needs to consider the above issues, but on a less refined level.

- **Size** – measured as the relative sum of different screens and different types of media used. This measure does not contemplate size in the form of bytes. For example: If a system consists of a menu system with lots of screens with text, sound and animations; designs tools, which can be used to form these different kinds of media and to structure the large number of elements are essential. Storyboards that can provide different perspectives or views, since the creation of text and animation are quite different, are then necessary. Whereas with only a few elements of the same character, a top-level design is adequate and each element can then be created according to that general outline.

Applying the Parameters to the Cases

These paragraphs present the storyboards used in each project as well as a discussion of the pros and cons according to our experiences. The value for each of the four parameters is identified – that is high or low reality likeliness, small or large size and so forth.

Danish State Railways Education System

The Danish State Railways (In Danish: de Danske Stats Baner - DSB) wanted an education system on the subject: Readying of freight trains. That is, a system, which could educate station officers in various topics, for example examination of the breaks. In 1995 ten students from the Copenhagen Business School chose to focus on the area “the breaks and the test of breaks”. They designed the learning environment: structure of the course, the content and the evaluation form through strongly use of storyboards, with emphasis on the GUI and interaction strategy. The project group used two different kinds of storyboards and today we realize this need was entailed due to high demands of several parameters.

The group designed only one lecture in the system, but when speaking of size of the system, one should estimate the final system size, in order to assess the correct use of storyboards. This educational system should therefore consider design tools, which can provide different perspectives and structure. Since almost no material has been reused, the storyboard should also support design of content in details.

Reality likeliness was chosen as a primary factor for a successful learning situation. Hence, enabling a vivid design of the different interaction forms and of audio-visual phenomena’s (visualizing the functionality of the break system etc.) was essential.

The structure and details, when designing new material, was provided with a so-called “program-treatment”. However, by referring to our definition of these two concepts in the Introduction to this paper, we would today not choose to call this very detailed level of design for a program-treatment, but maybe structure storyboards (Figure 1). The reality likeliness factor was designed through a precise sketch for each screen. These latter storyboards were used in an early evaluation of the system, in the form of paper prototypes (Figure 2). For the reader’s convenience, the storyboard has been translated into English.

The Railway system has a simple structure, with only a few ways through, and a flow diagram is enough to understand, which buttons leads to where. Since it was difficult to understand and switch between the two formats of storyboards for persons

unfamiliar with the project, and since the system in its final form will end up with a remarkable numbers of storyboards, we learnt, that the two forms had to be integrated in to one.

In summary, when applying the parameters to the Danish State Railways Education System, we can see that the system have Low Complexity and Little Reuse, but High Reality Likeliness and a Large Size. The learning showed that a multimedia system with such a parameter setting should use detailed Storyboards that documents the navigation in detail. Integrate storyboard with other tools, especially tools for documenting the user interface and media synchronization.

Danish State Railways Project Group
Spring 1995

Program-treatment for assignment 5: Control of wagons

Explanation of symbols:
@ : New action begins. Actions beginning simultaneously are listed under the same sign.
$: Told by a narrator/speaker
§ : Sound effect
v : User interaction
V : Video clip
A : Animations
T : Text on Screen
? : Question on Screen
» : Continue icon on the panel
D(xx) : Icon on the panel with the text xx.

If the continuation of the program is dependent on a choice from the user; the possible choices are listed and numbered.

|---|

Screen 3.1.2.0 (static)
@ T: (heading) "Control of wagons".
$: "After you have controlled the train and the pressure tube through the whole train, you now have to control the breaks of the wagons to see if they are working properly. In this lesson you will learn to:
@ $:"Control whether the breaks can break"
@ T: "Control whether the breaks can break"
@ $:"Control whether the breaks can release"
@ T: "Control whether the breaks can release"
@ $:"and like in the previous lesson: Find, report and correct errors"
@ T: "Find, report and correct errors"
@ $:"You can now begin the "control of wagons" by clicking the continue icon"
@ » and D(repeat) becomes active
@ v click on »

|---|

Screen 3.1.2.14 (Static)
@ The third wagon after the locomotive are shown – just like the previos
$: "Has the break been released?
@ D(Yes) and D(No) becomes active
@ v click on 1: D(Yes) or 2: D(No)
1: D(Yes) **Screen 3.1.2.14.1 (popup)**
@ T: "Correct – This break has been released"
$: "Yes, this break is clearly not touching the wheel"

|---|

Figure 1 – Railway structure storyboards (translated in to English)

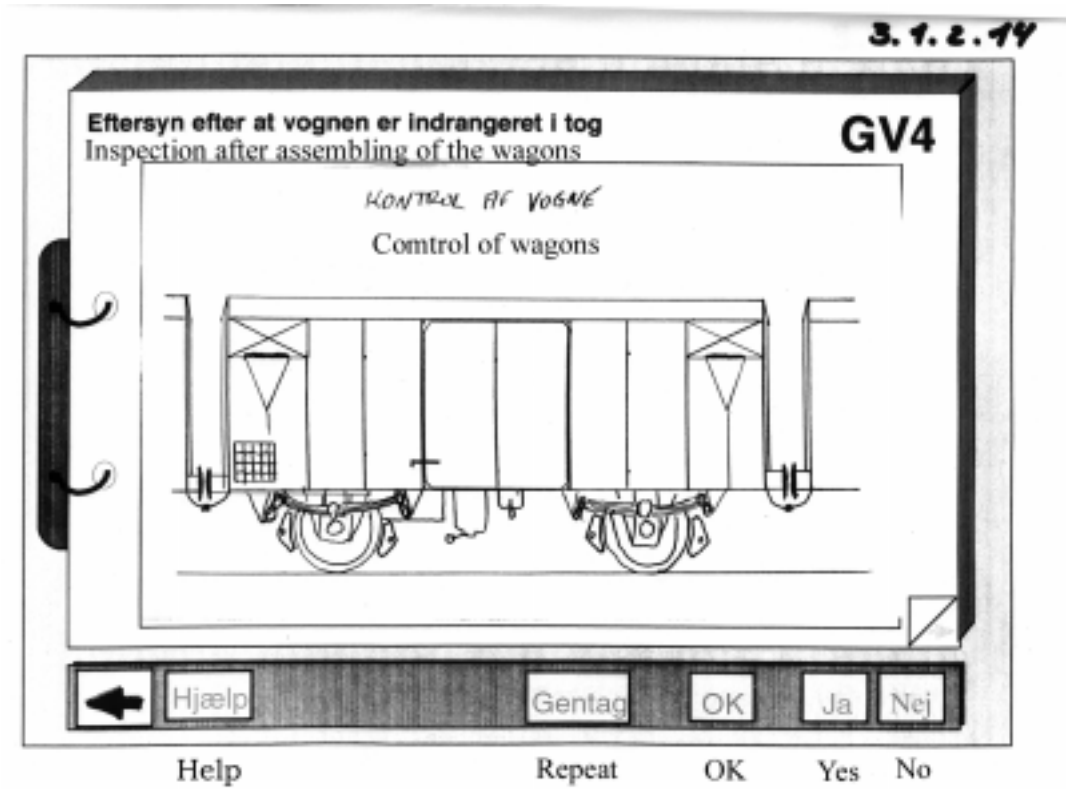

Figure 2 – Railway Storyboard

First Aid Information System

The Danish Civil Defense Association (In Danish: Beredskabs-forbundet) wanted a multimedia information system that could attract people to courses in first aid. Nine students from the Copenhagen Business School developed the first version in 1995-96. A second version was developed in 1997, and approximately 1000 CD-ROMs with the multimedia application were distributed all over Denmark in 1997-98. Storyboards with focus on screen functions and layout were used as the main design tool together with an extensive treatment.

The First Aid Information System has a very low degree of complexity. The project used only one simple flow diagram representing all the choices and ways through the system. The possible choices are also shown under the heading "control" in the storyboard (Figure 3 – the storyboard has been translated into English).

The system is based on existing material for First Aid training. In the training material some First Aid situations were found, and these situations formed the basis for the four stories in the system. For storyboards the template by Bergman & Moore (1990) was used. However, the system was so simple that more than half of the templates was never filled out and later in the development process, updating of storyboards were done purely in a text editor focusing on the overall aspects.

The size of the system was quite small. This was another reason for the very simple storyboards that were needed for the design of the system.

As in the system for Danish State Railways reality likeliness was a primary factor for a successful system. All possible audio and visual effects were used to create the sense of urgency, emergency, danger and speed that characterizes a real First Aid

situation. Because of the many media in use at the same time the synchronization of the media became quite important. This was reflected in the storyboards, especially the ones used later in the design process, which was quite focused on synchronization, and for a small part of the system, it was even necessary to use a state/event-chart.

Again, we have identified a system with Low Complexity with respect to the four parameters. However, there was Much Reuse in the First Aid Information System, and also High Reality Likeliness, but a Small Size. With such values of the four parameters the authors recommend that storyboards are used for providing an overview and to document media synchronization, but they should be kept simple.

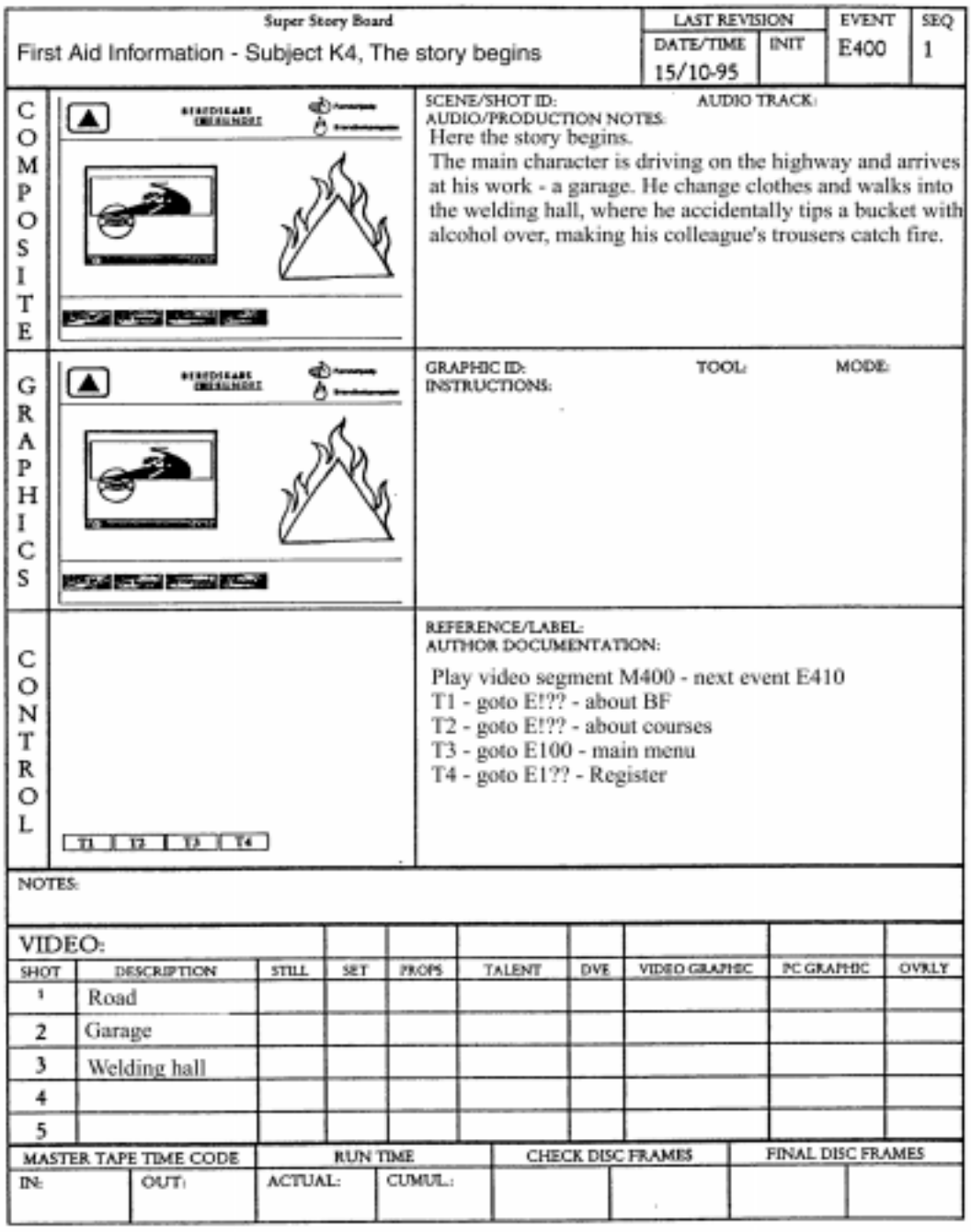

Figure 3 – First Aid Storyboard

Chief Fire Officer Education System

The Danish Government School for Chief Fire Officers (In Danish: Statens Brandskole) wanted a system for further education. The problem was that after a course was passed Chief Fire Officers could go for years without training their ability to behave and react in emergency situations, such as a plane crash or a toxic spill, within their jurisdiction area. A multimedia system to be used locally by Chief Fire Officers on guard was developed by 12 students from the Copenhagen Business School in 1996-97. The system simulates two difficult situations. The Chief Fire Officer can run around, inspect the situation and ask questions as if it were "the real thing". The Fire Officer also has to make decisions and give orders to the fire fighters – exactly as he or she would have to when coping with a real emergency situation. The simulation ends with an evaluation of how good the effort was based on decisions made by the Fire Officer.

When facing an emergency situation a Chief Fire Officer can react in many different ways – all of which *may* be correct (depending on what he or she does later). Thus the Chief Fire Officer Education system has extremely many ways through the system.

In the system a general framework for representing emergency situations was developed and two concrete situations was build; a fire in a three story house, and a hazardous spill from an overturned road tanker. These two concrete situations were re-used from the traditional textbook and scenario training.

The main advantage of the system was meant to be the large degree of reality likeliness. For example a fire in a three-story building will spread upward in minutes and this should be reflected in the situation that the Chief Fire Officer was facing. Because of the many media in use at the same time to create the reality likeliness, plus the difficult issue of timing, synchronization became an important issue.

The storyboard was not detailed on the graphical side, because of the large degree of reuse. A simple hand-drawn picture (Figure 4) was all that was needed of graphics. However, synchronization and timing required several hundred pages of detailed descriptive storyboards (or scripts as the project group chose to call them) and a quite large state/event matrix was used to track and develop emergency situations developing over time. These descriptive storyboards were also necessary, since the resulting system – including the two emergency situations mentioned above – became quite large.

In conclusion, the Chief Fire Officer Education System has a lot of everything: High Complexity, Much Reuse, High Reality Likeliness and a Large Size. The parameters imply that storyboards should also be used to provide an overview and especially for documenting the flow in the system. Integrate the storyboard tool with other tools, so that it contributes to documenting the media synchronization.

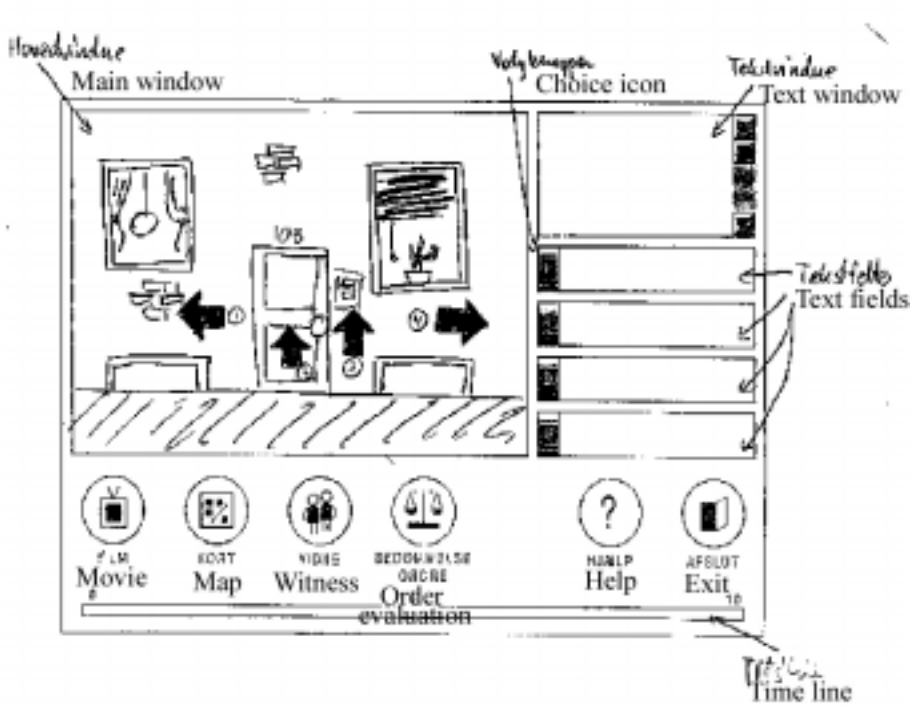

Figure 4 – Chief Fire Officer Storyboard

ASTRALOGI Medical Information System

Astra Denmark A/S wanted an information system, which could be used as a kiosk stand in their lobby and at conferences. Astra offers several courses to people from the medical sector and in coffee breaks the kiosk would be an excellent mean for disseminating the company's mission and research areas to the attendees. 12 students from the Copenhagen Business School developed this interactive multimedia system in 1996-1997. The design uses the terminology and graphics found in space, such as a menu system consisting of planets. The same terminology is used in the building of Astra Denmark. Treatments and prototypes were used for the overall navigational user interface and storyboards were used in details as the main tool for creating and designing the content of the system.

For ASTRALOGI 175 pages of descriptive storyboards were produced. Bergman & Moore (1990) and an electronic storyboard tool to educational systems from a Danish development company called Waves served as main inspiration for this storyboard. Figure 5 shows an example of a storyboard from the ASTRALOGI system (translated into English).

This multimedia application had a large number of screens, but a rather limited number of possible ways through the system, since the user control was limited to navigation in a very hierarchical and sequential menu structure. The project group decided to use two facilities to identify the flow and structure of the system. One was a simple diagram of the flow in the system. The other was an ID system used in the storyboards.

The diagram turned out to be very useful, but the huge effort on naming and keeping track of every button/icon, by means of complicated numbers, turned out to be almost a waste of time. Even though the system was large, it would have been fairly easy

to get an overview of where the different buttons led to, without the strict naming convention.

2. Choice of Quiz or presentation
Objective: In order to get the attention of the user and to raise his curiosity towards the rest of the content of the system, he will be given a choice between different kinds of small appetizers
Means – media's: Speak, background picture, an open book (symbol on knowledge), self-explaining icons to the quiz and presentation.
Requirements: The user-menu (as described in 3x), but here only the start and main-menu buttons are visible, which means the user can also choose to cancel the appetizers and continue to the main menu.

Subject	ID	Parameters
Buttons/Icons:	**KN201**	**Quiz 1** **Description:** **Icon:** Picture of Losec **Text** Quiz about Astra's products **Function:** This button activates 2.1.Quiz about Astra products.
	KN202	**Quiz 2** **Description:** **Icon:** Picture of a research environment: equipment & research, woman, picture 24 **Text** Quiz about Astra's research **Function:** This button activates 2.2. Quiz.about Astra research
	KN203	**Presentation of the program** **Description:** This button starts a small slideshow presenting the content of the CD-ROM, and the possible ways the intended target group can use the system on. **Icon:** Picture of Backo **Text** Presentation of the program **Function:** This button activates 2.3 Presentation
Background:	**BG201**	Picture of an open book (Text and Icons on the left side of the book and answers on the right.)
Illustrations:	**IL201**	The different pictograms.
Pictures:		
Screen text:	**SK201**	**Heading:** "Choose a quiz or get a presentation of the content.' **Description:** The text is light blue. The same color should be used for al the text in the product – unless other colors are mentioned specifically.
Hyperlinks		
Sound/music:		
Animation manu.:		
Speaker manu.:	**SP201**	"Welcome to Astra´s information universe", "You can now choose between a quiz about products or one about research or you can get a presentation of the different possibilities in this system.", "You can also choose to go directly to the main menu by clicking the main-menu-icon on the toolbar
Video manu.:		
Slide manu.:		

Figure 5 - Astra Storyboard

Besides being large in terms of numbers of screens, the system also used many different kinds of media. This implied a need for several design tools together with a storyboard, in order to design, structure and grasp the different perspectives and the large number of media types. In addition to storyboards, treatments, separate video manuscripts and a small navigational prototype was also used as design tools.

Since a lot of the material was designed from scratch (not reused), the project group desired a storyboard, which could leave room for details – each word in a speak sequence had to be specified etc. But since there were no objectives about reality likeliness, the design did not focus on the graphical issues – no space for illustrations, diagrams, or for the general color scheme was made available. We learnt however that this choice was a bit too scarce, had it not been supplemented with standard screen layout suggestions in the treatment and the first prototype.

In the ASTRALOGI Information System we have identified the following parameters: a Low Complexity, Little Reuse and Low Reality Likeliness, but a Large Size. From the above description this involves using detailed storyboards that documents the navigation in detail. Storyboards need not a lot of interface and media features, but should be integrated with other tools, to give the best overview of the large system and to depict all the material, which is being developed

Business Credit Agency Information System

Denmark's largest credit agency company "Købmandsstanden" wanted a system targeted towards their existing customers. The system should provide information about the company's product, organizational structure and company culture. The project group – 11 students from the Copenhagen Business School – developed in 1996-97 a multimedia system, which focused on different economical areas relevant for the target group. Storyboards with a very descriptive (not visual) scope were used in the design process. The final system was printed in 5000 copies and distributed to (potential) customers in Denmark.

The multimedia system has a high degree of complexity and the project used both flow diagrams, but on a rather general level, and descriptions of links in their storyboard (Figure 6 – translated into English)

The system is based on existing material, which have been adapted to the objectives and the new medium, which made a very specified storyboard less relevant. After some considerations the project group decided to use a very descriptive storyboard and instead design the graphical layout concurrently with the actual programming of the system. This decision also matches the fact that the reality likeliness was of little significance and thus also user interaction and graphical elements.

The size of the system was quite considerable, with many different screens and media types, which made it necessary to include a way to structure the storyboards thoroughly and to include other perspectives when designing. As can be seen in the storyboard example (Figure 6) the structure is well provided with a description of links, actions etc.

The parameters identified for the Business Credit Agency Information System were High Complexity, Much Reuse, also a Large Size, but Low Reality Likeliness. The use of overview Storyboards would be sufficient in such systems. They can just be simple

slides – that is no fancy features is needed, but the Storyboard should document the flow in the system and may need integration to other tools, to give the best overview of the large and complex system.

Module 3.5.3 Middle Case

Speak	Text	Video/Graphic	Links	Description
		Background, Headings Icon-panel	2-9	
Bresson Limited has been declared creditworthy and signing of the contract are taking place.		Handshake	10	
The majority of Lysrholt & sons customers are Danish. For example, Lundtex A/S has been a customer from the beginning and the collaboration between the two companies has been working well.			Turn off 10	
Business was thriving for Lysrholt & sons. New contracts, payments on time		Proposition, Material, Contracting Receipts and Money	15 16 17 18 19 Turn of 15- 19	
And time passes by!		Time passes!		

Figure 6 – Storyboard Business Credit Agency

SMILE Information System

SMILE (Spreading Multimedia Information for Learning and Enlightenment) about SPI (Software Process Improvement) is a multimedia CD-ROM. 3000 copies were made and distributed for free all over Europe. It was the result of a cooperation between the Norwegian Computing Center and the Copenhagen Business School and it was funded by ESSI (The European Systems & Software Initiative) in order to promote the adoption of software best practices. Since a need for information about SPI was especially evident in small to medium sized companies, the multimedia system was targeted to this audience. The CD-ROM, which was developed in the period from June 1997 to July 1998, contains three parts: A Case story, an Expert Panel and a Theme part. Even though the parts are seen as separate segments of the CD-ROM, they are integrated with a hyperlink structure and a menu system. The system was designed by comprehensive use of storyboards.

The SMILE system has a high degree of complexity as the user has almost complete control of the systems directions and has the possibility to jump to and from very different areas of the system. The project group realized the need for having detailed knowledge of the flow apparent in the storyboards. A two-page storyboard was used, where the hyperlinks were underscored or marked as buttons on the “screen”-area of the first page, and space was made available for characterizing, which kind of link was necessary on the second page. For example HY(more) indicates that the hyperlink goes deeper in the same area / file of storyboards (Figure 7).

The size of the multimedia system was very large – approximately 450 storyboards (more than half of these with 2 pages each) were designed for the latest version, treatments and manuscripts for video etc. were also developed.

The very detailed level of narration and content matter was necessary since every little bit of material was developed from scratch. Despite the fact that SMILE was dealing

with a quite simple information problem, the need to display the answer to this problem in a very reality like manor was evident for the project group. Two of the three parts of the multimedia application seeks to create an atmosphere of “being there”, whereas the third “theme” part is a non-reality situation.

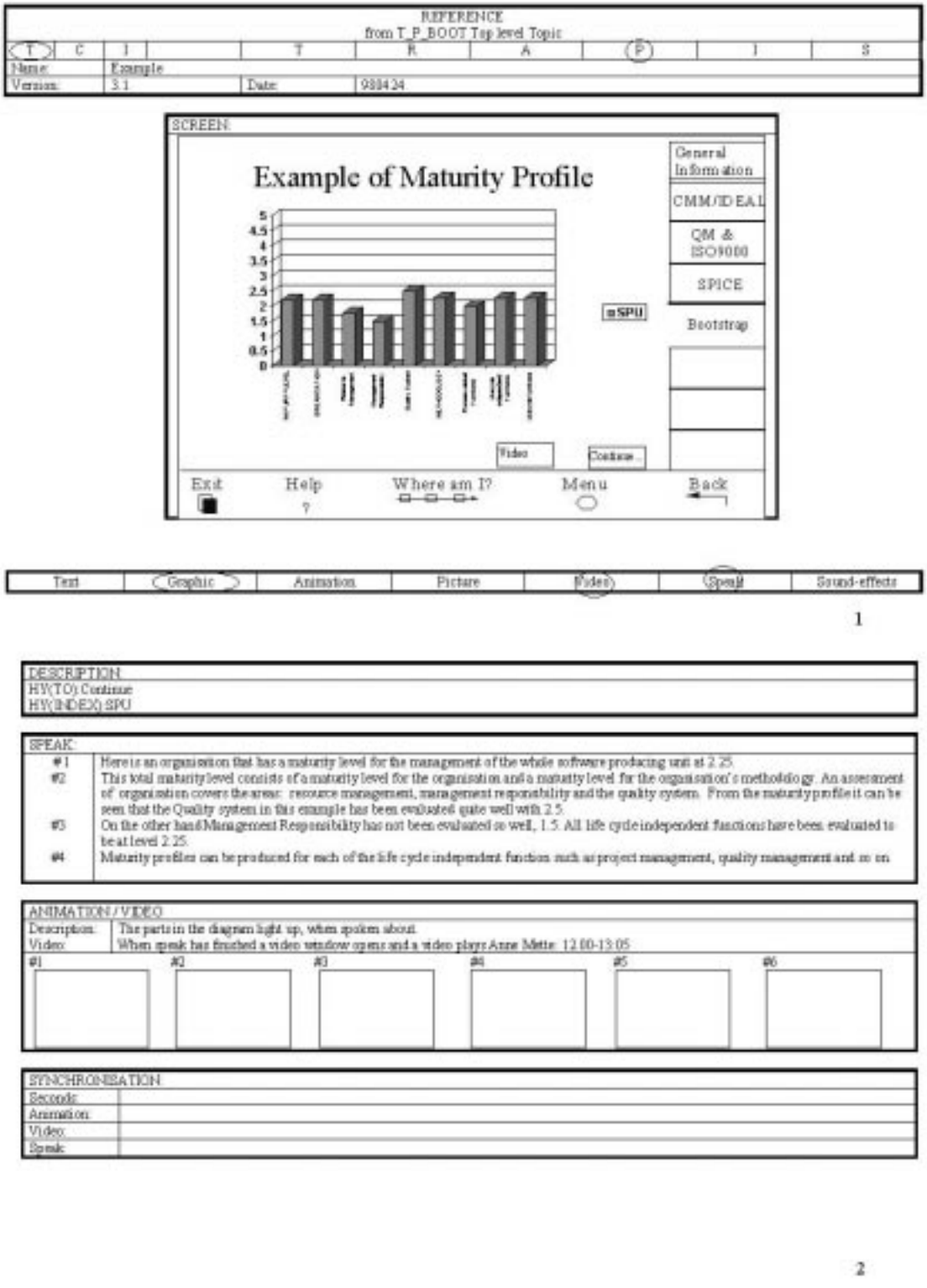

Figure 7– SMILE Storyboard

Even though the storyboard had the capability to operate with different views, to show the flow of the system and to track interaction as well as synchronization issues, the combination of a very large complex system, with no reuse and in a reality like situation, created some complications. The project team was divided in to design and programming people. The people, having to program the system, could not overlook the whole structure by use of the storyboards and in the last weeks before deadline the following additional flow diagram had to be made by one with explicit insight in the design (Figure 8).

The flowcharts are quite similar to what could have been made thoroughly in a CASE tool, but at this point in the process, hand-drawn sketches was all there were time for. The charts are similar to the "screen" area in the storyboard. The charts have all been given numbers – and each link on screen points to another screen/chart. We found that these flow diagrams were very useful for finding and tracking mistakes in the code.

In summary, we have shown that the SMILE Information System have High Complexity, High Reality Likeliness and a Large Size, but Little Reuse. From the SMILE system the following learning can be extracted. The use of detailed Storyboards is necessary. Storyboards that documents flow and navigation in detail and which is integrated with other tools, especially tools for documenting the user interface and media synchronization.

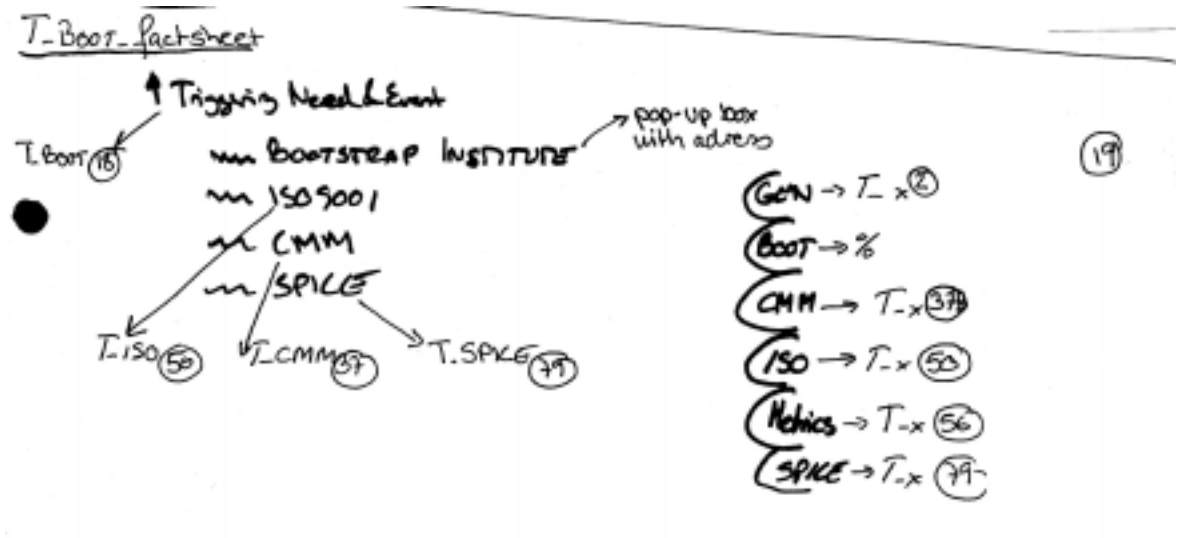

Figure 8 – Flowchart for SMILE

ALKA Educational Business Case

The ALKA Case was a business case developed in an Esprit project named BUSINES-LINC. Six participants from universities and business schools all over cooperate on the development of 18 interactive multimedia business cases for educational purposes. One of the main purposes of BUSINES-LINC is: Development of rich business innovative cases, which could be used in interactive learning processes, with the potential to transfer innovation knowledge and experiences to learners from enterprises and schools. The ALKA case was developed in 1998-99 by the Copenhagen Business School. The case is about a BPR (Business Process Re-Engineering) project in a Danish insurance company

called “ALKA forsikring A/S”. The case was designed through the use of treatments and some very simple standard storyboards.

When the BUSINES-LINC project began in April 1998, the design group from Copenhagen Business School had gathered quite a rich picture of, which factors should at least be considered when designing the storyboard.

The ALKA case belongs to the first group of six interactive business cases developed by the partners, which was developed in a prototype version, in order to establish a mutual framework for all the 18 multimedia cases.

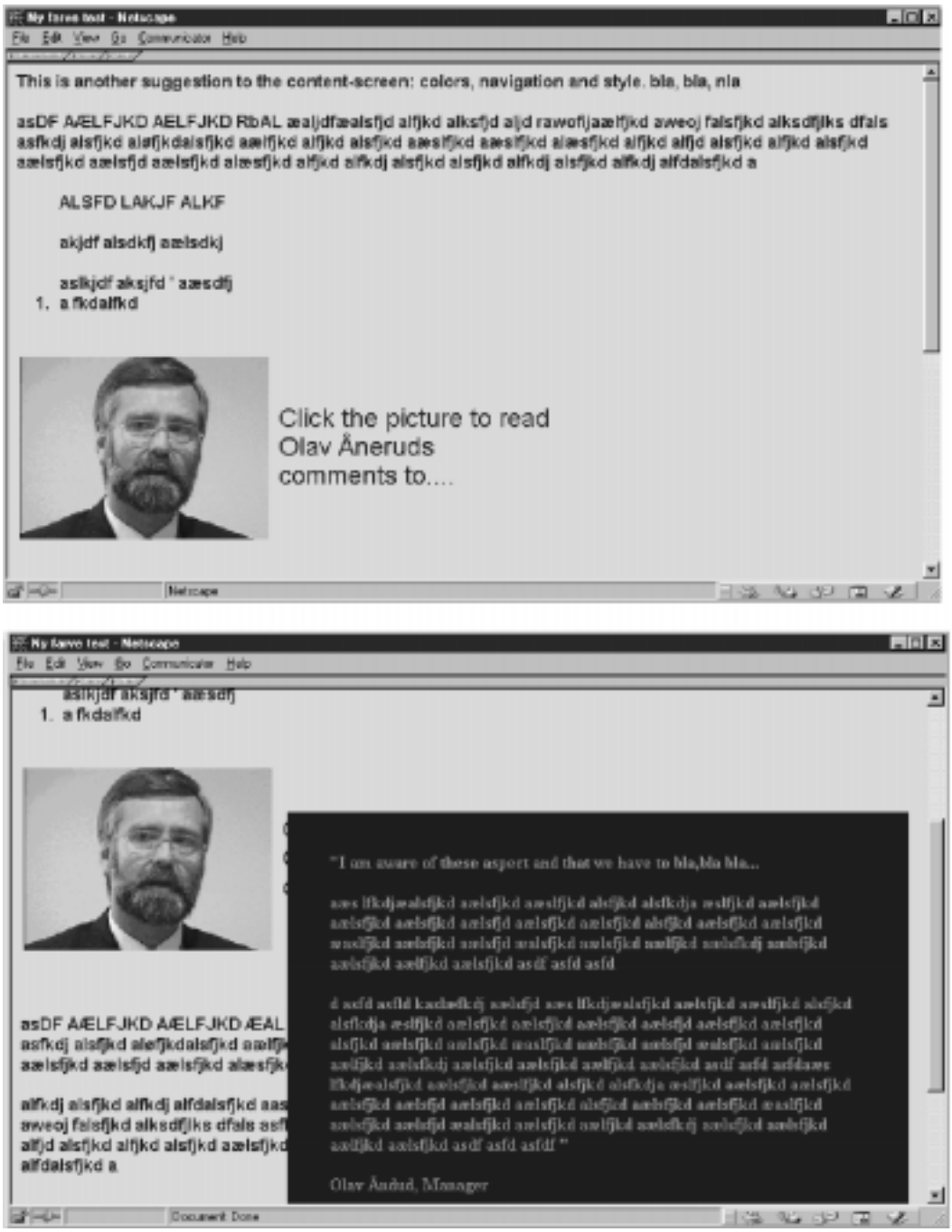

Figure 9 – ALKA Storyboard

Since it was important to find a case, with which a result could be seen fast, the Copenhagen Business School chose a case, which already existed as a written case. Video interviews and some adaptation of the material were performed, but in general there were a lot of reuse in this multimedia system. The nature of the written case meant that the project group knew very early in the development process that this was going to be a small sized system, especially in terms of number of screens. At the same time, the project group decided, in the period between writing the first and the second treatment – primarily for financial reasons – to have a very low degree of complexity and reality likeliness. This meant that a focus on the outline of the narrative issues in combination with some standard suggestions for the GUI were sufficient for the ALKA storyboards.

Since the BUSINES-LINC consortium chose to develop the business cases in HTML, it was favorable, easy and cheap to develop these standard storyboards directly in HTML as well. Figure 9 shows a storyboard, which is an example of the layout of the center of the screen, that is, without menu-bars.

The last of the examples of multimedia systems presented here, the ALKA Educational Business Case has the following parameters: Low Complexity, Low Reality Likeliness, a Small Size and Much Reuse. This features imply that the designers can use the simplest possible kind of Storyboards. There is no need to focus on the flow, the navigation or the synchronization in such a little easy system.

Designing the Design

The four parameters: Complexity, Reuse, Reality Likeliness and Size can be combined into the framework shown in Table 1. By summarizing from the above discussions of each case, we have plotted the seven cases in to the matrix.

		High Reality Likeliness		Low Reality Likeliness	
		Large	Small	Large	Small
High Complexity	Little Reuse	1 SMILE	2	3	4
	Much Reuse	5 Chief Fire Officer	6	7 Business Credit	8
Low Complexity	Little Reuse	9 State Railways	10	11 ASTRALOGI	12
	Much Reuse	13	14 First Aid	15	16 ALKA

Table 1 – “Designing the Design” matrix

The seven cases shows that customizing storyboards according to four parameters and hence building a “storyboard standard” for each specific project is an appropriate way to “design the design” for the situation. We believe that the framework in Table 1 can be used to decide how to use Storyboards in a given project using the list below.

Type

1. Use detailed Storyboards that documents the content, flow and navigation in detail. Integrate storyboard with other tools, especially tools for documenting the user interface and the media synchronization.
2. Use detailed Storyboards that documents the content, flow and navigation in detail. Document user interface and media synchronization – but keep it simple.
3. Use detailed Storyboards that documents the content, flow and navigation in detail. Storyboards can just be simple slides – no fancy features needed – but integrated with other tools to give the best overview of the large system.
4. Use simple Storyboards that especially document flow and navigation.
5. Use overview Storyboards and document the flow and navigation in the system. Integrate the storyboard tool with other tools, so that it contributes to documenting the user interface and media synchronization.
6. Use overview Storyboards that documents the flow in the system. Document media synchronization – but keep it simple.
7. Use overview Storyboards that documents the flow in the system. Storyboards can just be simple slides – no fancy features needed – but integrated with other tools to give the best overview of the large system.
8. Use simple Storyboards to get an overview that documents how you navigate in the system.
9. Use detailed Storyboards that documents the content and the navigation in detail. Integrate storyboard with other tools, especially tools for documenting the user interface and the media synchronization.
10. Use detailed Storyboards that documents the content and the navigation in detail. Document media synchronization – but keep it simple.
11. Use detailed storyboards that document the content and the navigation in detail - no need for interface and media features - but integrate with other tools, to give overview of the large system.
12. Use simple Storyboards that document the content and how you navigate in the system.
13. Use overview Storyboards. Integrate storyboards with other tools, especially tools for documenting the media synchronization.
14. Use overview Storyboards and document media synchronization – but keep it simple.
15. Use overview Storyboards, maybe just simple slides, but integrated with other tools to give the best overview of the large system.
16. Use the simplest possible kind of Storyboards. There is no need to focus on the flow, the navigation or the synchronization in this little easy system.

Discussion

We have now argued that Storyboards have to be adapted to the specific multimedia system being developed. A case study in seven multimedia systems development projects revealed that four parameters have to be taken into consideration. The four parameters are: Complexity, size, reality likeliness and degree of reuse. Together these four parameters form a four by four matrix with 16 possible outcomes. For each outcome we have given advice on how to design Storyboards for that kind of system.

However, in the seven case studies we have carried out, we have found a few observations that would not fit into our framework. These are issues dealing with the organization and structure of a multimedia development project. Let us briefly outline these issues, which we have found had an influence.

The way you organize a multimedia project may influence the needs you have for adapting storyboards. If for example the designers are different from the people producing video, sound, animation and programs, then there is a need for more detailed storyboards to enhance communication between the groups.

In a fixed price and time project you may need to use quite detailed storyboards to enable the precision of the needed estimates. E.g. in the SMILE project our estimates based on quite detailed storyboards were within 10% of the final figure.

If you know that you need to update and maintain a multimedia system several times, then the need for detailed storyboards may increase, since storyboards seems to be a very effective way to document design.

Last but not least, you can choose an environment and/or a program that makes it very easy to make prototypes. And many prototypes can to some degree replace the need for storyboards.

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