



LECTURE CONTENT: CONTROL ROOM DESIGN

- Signal path – from production to consumer
 - Production operators team
 - The editorial staff
- Newsroom computer system
 - Automation software
- Media asset management



3 Theory

This chapter describes the general factors within control room designs and how the ergonomics and/or staff within the control room could affect the results.

There will also be an explanation of all the different staff needed to create a newscast. A technical description of different system and protocols needed to create a television production, and how they are used will also be executed.

3.1 Control room design

Design and the structural layouts of control rooms have lots of peer-reviewed reviews and investigations, especially within the nuclear power plant control rooms and army-based control rooms. The actual design of television control rooms hasn't got as much attention. This section will therefore describe the overall concerns and benefits of using different control room designs, mainly from the human factor but also some technical aspects will be taken into consideration.

3.1.1 Control room ergonomics

A control room is a physical location where a physical facility or physically distributed service can be monitored and controlled (Bennett 1955). In the television industry, there are different types of control rooms, serving different purposes with the aim of transmitting a video signal to the distributor and viewer.

When designing a Control room from scratch, a method called Top Down approach could be used (Figure 3.1). The top down approach describes the different phases a control room goes through when developed, constructed and evaluated. The first phase "A" is the planning stage where the purpose and goal of the control room is decided. The second "B" phase is a little more specific. This is where the overall technology that isn't visible in the actual control room comes in to the planning process. The phase "C + D" stage is where the actual layout and arrangement of the control room is planned. The final "E" phase is the evaluation phase where everything is tested and where errors are fixed.

The author of the control room design chapter (Noyes & Bransby 2001) proclaims the downside of planning the ergonomics in the control room on a late phase in the planning process. The effects of this could be that the operators in the control room don't feel comfortable and confused when operating.

The author also addresses control rooms with automated divisions. The author states the fact that if an operator's service work is automated, but still supervised by the operator, there is a high risk for the operator to get bored or even falling asleep (Hunt & Ivergård 2008).

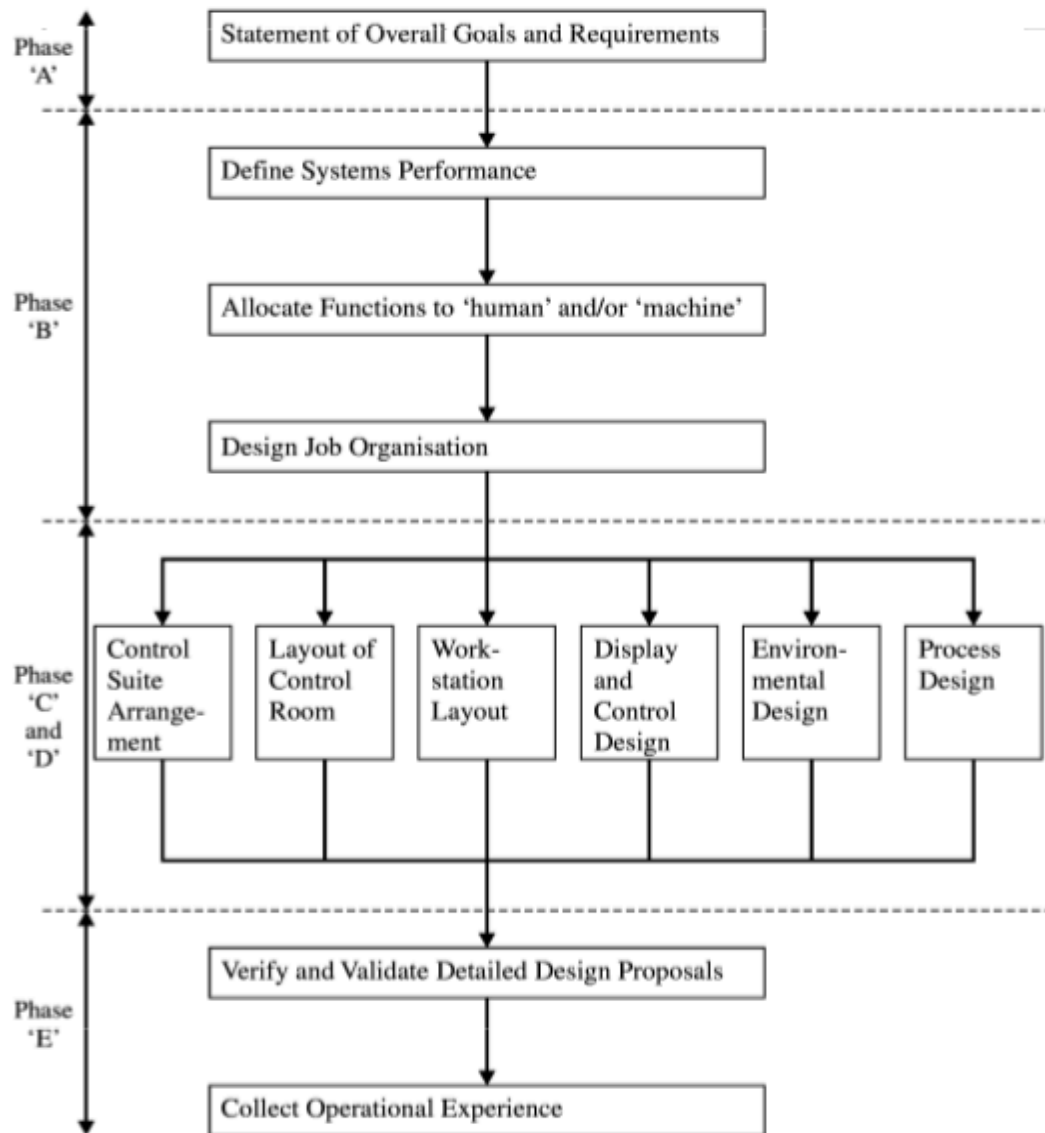


Figure 3.1 - Top Down approach³

3.1.2 People in control

People working together trying to achieve a common goal are often bound to work in team. Teamwork in a control room is essential for the different operators to be able to conduct a newscast. Since traditional television control room uses different professions to operate different equipment, an understanding on how a good team is working is necessary.

One measurable way of measuring how a team operates and evolves can be measured using the TEAM(Team evolution and maturation) model. It describes how task-oriented teams mature over a number of developing stages. These stages are, for examples forming, norming, performing. On these different stages, two main types of skills are measured, Teamwork- and Taskwork skills.

Another measurable model that measures the underlying potentials and efficiency for a team is the Team process model. This model takes three basic factors into

³ Image retrieved from "Noyes & Bransby 2001"

consideration, input factors, process factors and output factors (Ivergård & Hunt 2008c). The input factor includes certain external environmental factors. It could be team compositions or team experience.

The process factor measures how the team works during the actual work. It measures aspects such as planning, communication and motivations.

The output factor measures the actual finished effort conducted by the team, such as error rate or team satisfaction (Noyes & Bransby 2001; Caldwell & Viraldo 2014).

*“Teamworking is a set of two or more people who interact dynamically, interdependently and adaptively towards a common and valued goal”
- (Rentsch et al. 2010)*

3.1.3 Human errors when in control

To be able to discuss and make conclusion about the human error, we need to understand what a human error is. How do we quantify and measure an error caused by humans?

Early studies tried classifying human errors into different segments, and have during time come to be differentiated into two major quantities. The first is slips and lapses and the second is mistakes.

Slips and lapses are unintentional errors. The intention was correct for the situation, but it was carried out the wrong way.

The author of the human error chapter takes a teapot as an example. *“Forgetting to boil a kettle and making a cup of tea with cold water”* (Noyes & Bransby 2001). The slips and lapses however differ in the way they can be observed. A slip is an error that normally can be observed by someone else. Laps however is an unobservable error, it may only be obvious for the person who executed the error.

Mistake errors are those that arise from failures created during the planning stage. It may be correctly executed, but the original goals for achieving the goals are incorrect. Again, an example from the author is *“driving the wrong way on a one-way street”* (Noyes & Bransby 2001; McRuer 1980).

3.1.4 Human in combination with technology

People working in control rooms are referred to as control room operators, or just operators. The operators could have the same task, but they may also have different responsibilities in the control room.

Modern control room works like a command center. The operators are supervising or controlling one or more computers via a certain user interface (UI). The computer then regulates certain properties of a systems. It could be a motor, fuel injection or even other computers. The interaction between the operator and the visible parts of the UI is called human computer interaction (HCI)

A common HCI is to use desktop application as a UI for a “common” user. However in control rooms, other uncommon UI are used. It could be anything from joysticks, physical keypads (not to be confused whit the common keyboard used on the majority of personal computers) and other types of physical UIs (Hughes et al. 1994; Ivergård & Hunt 2008d).

3.2 Signal path – from production to consumer

To be able to understand how the final video signal is distributed to the viewers all around the country, a business intelligence is done to see which stakeholders that are responsible for broadcasting the final news production.

This is done to later be able to compare if, and how this has changed due to the fact of more centralized control rooms.

3.2.1 Production control room

A production company is a company that produces a certain show (in the case Nyhetsbolaget Sverige AB, the news), which is broadcasted on a specific television channel live or post (for example “TV4” and “TV4 HD”). Educated staff operates the studios and the control rooms that are used to make the news production. The control rooms that in general produces the actual content and composition is known as a Production Control room (PCR) or a Studio Control room (SCR).

The final production, which consists of a final video- and audio signal, is then sent to the Master control room (3.2.2) (Lind 2012; Tozer 2012).

3.2.2 Master control room

MCR (Master Control room) has unlike PCR the task of taking care of all input and output fiber- and satellite signals. The incoming signals could be feeds from foreign news agencies, such as Reuters, APTN and sometimes from outside broadcast cameras or trucks that should be used in a production in the house or broadcasted directly to a television channel owned by television channel.

The MCR doesn't have any visual responsibility of the production, rather to make sure that all signals from relevant PCRs are converted to right broadcasting formats and routed to make sure that the Transmission control room (TCR) is able to broadcast the final material (Weise & Weynand 2007; Tozer 2012).



Figure 3.2 - Master control room at TV4, operated by Ericsson Broadcast Service

3.2.3 Transmission control room

TCR (Transmission control room) also known as playout or program control, has the responsibility of delivering the final product to different transmission service companies who then delivers the video signal to the viewers all over the country. It could be either pre-recorded programs or live content material produced by a PCR in the same building, or produced elsewhere, known as outside broadcast (OB).

If the television channel has prescheduled programs, the playout operators have the responsibility that these planed timeslots are kept.

If the channel is a commercial financed television channel, the TCR also has to make sure that the pre-recorder commercial content is broadcasted at the right time and at the right length (Tozer 2012).



Figure 3.3 Transmission control room at TV4 operated by Ericsson broadcast service

3.2.4 Media hub

The Media hub division has similar duties as MCR, however the media hub doesn't have any responsibilities for all signals relevant for television channel, rather signals needed in the productions by the production company that's producing the news. Media hub has lots of responsibilities that aren't directly linked to the live news production, such as capture the recorded material from the cameras to the editing room, record relevant material from different productions etc.

In terms of the live News production, the media hub has the duty to make sure that the video signal from a field reporter's camera is connected to the relevant PCR. This is so that the production company can be able to conduct its directly report on the news show from a reporter on the scene of the news event. MCR is as described above responsible for the incoming satellite and fiber video signals. The Media hub however manages video signals retrieved from the Web, Ethernet, or 3G/4G LTE.

During this live-report, it is important that the field reporter hears the entire news production to be able to answer the news anchors (3.4.2) questions. If, however, the field reporter hears him- or herself a few milliseconds later, it will be a disturbance factor for the reporter. To avoid this, an audio signal called mix-minus is created. This signal contains all audio from the production except the audio from the field reporter. The mix-minus audio signal is produced by the PCR and sent to an interruptible foldback (IFB). The Media hub then connects this IFB to the telephone used by the field reporter on sight (Lind 2012; Tozer 2012).



Figure 3.4 Media hub

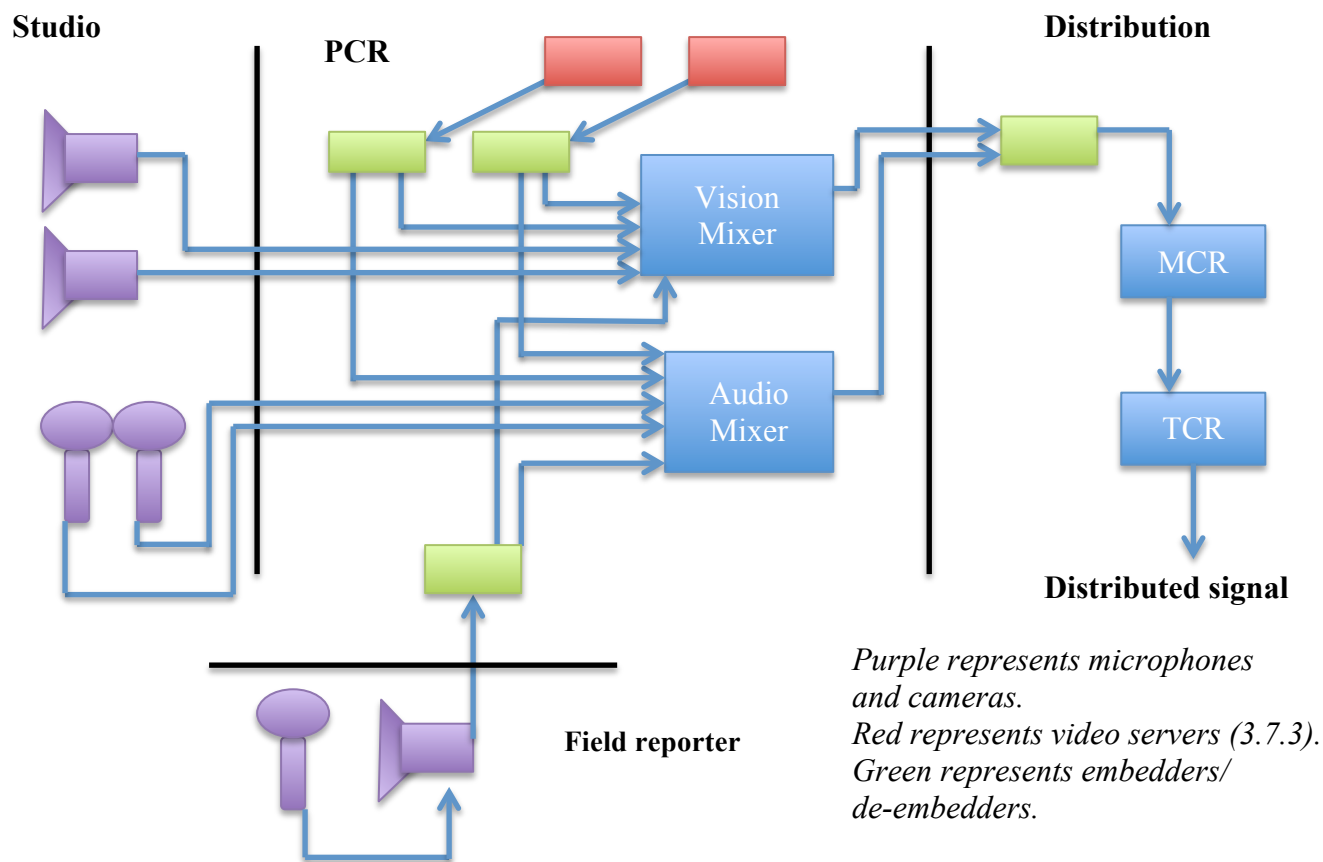


Figure 3.5 Overview signal path

3.3 Production operators team

In a traditional PCR, there are different responsibilities for each operator. The most common job roles of the different production staff will here be presented based on literature studies and observations from Nyhetsbolaget Sverige AB and SVT

3.3.1 Television director

The television director has the overall responsibility for the creative look of the television production. That includes the camera positions, in some extent lightning design of the venue and digital video effects (DVE) such as splits and wipes. During the actual broadcast, the television director decides which source (camera, video from a video server, graphics, DVE etc.) that should be outputted. The television director works closely to the production assistant (3.3.2) getting support with timeslots and getting countdowns when the packages are coming to an end. The amount of work done by the television director is dependent on the size of the production, on a big concert; up to 20 different cameras could be used. However in a news show, around three cameras are used and the broadcast is often executed with very similar routines and layouts, decided by an executive producer (Millerson & Jim 2012; Lind 2012).

3.3.2 Production assistant

The production assistant (PA) has a different function depending on if the PA is working on a film production or television production. In the PCR the PA takes on a prompting role. On a live news production, the PA's working close to the Television director by assisting him- or her on countdowns on packages. They also have the basic responsibility of planning the news show together with the producer. During the news show, they make sure that the different contents in the news show are within their planned timeslots. The PA also has the overall communication with the TCR, giving each other countdowns and preparing timeslots for the commercials and at what time to start and end the news show (Millerson & Jim 2012).

3.3.3 Television producer

A television producer is a person who has responsibility over all parts of a television production. In the case of centralized control, it's the television producer who's responsible for the broadcast together with the producer. Unlike the television director, who focuses solely on the appearance of the broadcast, the television producer is responsible that all parts of the production look good and sound good etc. The television producer doesn't have any excellence within a specific area of the broadcast but is instead oriented to have a wider knowledge to be able to conduct a broadcast by him- or herself.

3.3.4 Technical director

The basic role for the technical director (TD) is to make sure that all the cameras used in the production have the right format and have the same visual appearance. The camera formats need to be adapted to be able to connect the vision mixer (3.3.5). This is done by connecting the camera to one specified camera control unit (CCU) where all the camera functions are controlled, such as format, RGB-variety, exposure etc. There are reasons why the TD needs to adjust color settings during the broadcast, for example camera manufacture, camera position, lightning etc. The most important task for the TD is to make sure that the different cameras have the same visual appearances, so when the television director cuts between different cameras, the different images shouldn't look different. The TD controls the CCUs from a Remote Control Panel (RCP) located in the PCR (Weise & Weynand 2007).

3.3.5 Vision engineer

The vision engineer operates the vision mixer. The vision mixer is the console from where the operator selects the different video sources, such as cameras, graphics and video servers. They're also responsible for programming certain DVEs wanted by the television director, such as different types of splits. The vision engineer works directly under the television director during the broadcast by outputting certain video sources that's required by the television director (Weise & Weynand 2007).

3.3.6 Audio engineer

The audio engineer has the single purpose of being in charge of the entire audio of the broadcast. That also requires sending the right mix-minus audio signal to the relevant IFB.

The audio engineer has the task of making fine adjustments on different audio levels from different inputs, such as microphones from different news anchors, audio from the video servers and the microphone from the field reporter.

It's also up to the audio engineer to equalize the different audio signal. This is done to correct the response of microphones and equalization may also be used to eliminate unwanted sounds (Weise & Weynand 2007).

3.3.7 Camera operator

The camera operator is the person responsible using the cameras as instructed by the television director. The camera operator operates the camera position/height, pan/tilt and zoom/focus. On a multiple camera production, produced from a PCR, the camera operator doesn't adjust the color settings and exposure, the TD does this. The camera operator can either control the camera manually from the studio or remotely from the PCR via a joystick (Broth 2009; Millerson & Jim 2012).

3.3.8 Character generator operator

The character generator (CG) operator is in charge of all on display and preparing graphic used on the television show. The graphics can vary from picture graphics to upper/lower thirds or informative headers.

The picture graphics (not to be confused with CG-graphics) are sometimes used as "over the shoulder" beside the News anchor to get a visual enhancement of topic.

The CG operator needs to make sure that the right nametag is presented also that the right header is presented (Millerson & Jim 2012).

3.4 The editorial staff

The editorial staff is those responsible for the content of a news show. They have the task of making sure that updated news are broadcasted when the news show is taking place.

3.4.1 Producer

The producer has the overall responsibility of the news show. The producer chooses the news content, and structures how the broadcast should be executed. The producer searches for news at different sources and works with the editorial staff to create the content. They also work closely with the television director/producer and the PA to plan the broadcast. In the PCR, the producer is in charge on what will happen during a news show. He or she might change the order of the rundown during the broadcast or change the manuscript read by the news anchor if necessary. One example of when changes could be made would be if, during a broadcast, it occurs a breaking news that the producer wants to be announced (Anastassiou 1994; Millerson & Jim 2012).

3.4.2 News anchor

The News anchor, also known as the lead anchor, is the person who reads the news and introduces the different packages shown on the broadcast. The news anchor is often supported by a teleprompter to get better eye contact with the viewer (see figure 3.5)

The anchor is often referred as the lead anchor if he or she “*leads*” the news show, handing over to other news anchors in the broadcast, such as sport anchor, economic anchor or the weather presenter. The anchor works directly under the producer, reading the desired text to present the package.

During the actual broadcast, the anchor has several different factors to consider, reading the right script, staying on time and looking in the right camera. To achieve this, the anchor gets support from different professions working in the PCR. The news anchor is during the broadcast constantly in contact with relevant staff in the control room, via an in-ear (Langer 1997).



Figure 3.6 Teleprompter

3.4.3 Reporter

The reporter, or sometimes referred to as a journalist, is the person making a news story assigned by the producer. Making a news story requires lots of research and source criticism on the researched material. The reporter is also responsible of gathering material for the package; most of this material consists of images and video materials. It can be gathered by the reporter and their own cameras or by using video feeds from other news agencies all around the world. The reporter also conducts interviews with people relevant to the package, for examples politicians, victims etc. (Bolin 2014).

3.4.4 Editor

The editor is in charge of the editing process; editing different packages done by the reporter and creating voiceover images that will be used on the broadcast. Editors on modern news stations use non-linear devices to edit their material. The editor works directly under the Reporter by compiling all the material gathered by the reporter. The editor has some technical responsibility, making color correction of the final edited material and setting proper audio levels between the interviews and the voiceover audio recorded by the reporter (Millerson & Jim 2012).

⁴ Image retrieved from <http://static.bhphoto.com/images/images500x500/908154.jpg>,

3.5 Newsroom computer System

A Newsroom computer system (NRCS) is a software program used by the majority of the production staff. This is the software where the producer creates the rundown for the newscast. The NRCS is built as a synchronized multiple client software, meaning that different users are able to work with different chores simultaneously.

There are different manufactures to the different NRCS on the market, but most of their UI is built on the same basic structure. A girder builds up the program, where rows host the different events in the rundown, and where the columns are different instances for the staff, such as, notes for the PA, teleprompter-text, graphics information etc. (see figure 3.7). The column host the different subjects (Owens & Millerson 2011).

11		--LSPIK	KAM	2		beskriver situatio
12	22-FLYKTINGBÄTAR	EL-06	LSPEAK			SB: strandbild >
13	22-KISTABRAND	--TGM	KAM	2		sig såväl inne i r
14		--PÅA	KAM	2		- kräv din rätt" öv
15	22-MEDBORGARTJÄNS T	07-NY	INSLAG			SO:GÖRAS >
16		--LSPIK				kräv din rätt" över
17		EL-0630	LSPEAK			SB: >
18		--LSPIK	KAM	2		för sju bedrägerie
19	22-PANTBEDRÄGERI	EL-0700	LSPEAK			SB: PANTBURK AR >
20	--ÖVERLÄMNING KAM	--NYH TILL SPORT KAM 4	DVE	FJKAM4	MIX-10	handlar det om s
21	--SPORT	--SPORT 3'30				
22	SPORT	--START KAM4	KAM	4		SJÖGREN MAXI MILIAN ARTELL MARIKA ERIKS
23		LSPIK-SEDIN				Bennett. Calgary
24	22-NHL3	EL-SEDIN	LSPEAK			SB: >

Figure 3.7 UI of the NRCS "ENPS" used at Nyhetsbolaget Sverige AB

3.6 Automation software

To be able to understand how centralized system within the news production work, the underlying technical infrastructure and protocols need to be explained to understand how the different equipment in the PCRs are connected.

3.6.1 MOS

The media objective server (MOS) is a protocol, based on the XML language. Media objects are defined as CG, video, audio and still-store graphics and they are often stored on a non-linear device.

A MOS protocol is essential for a centralized newscaster to work. The MOS protocol uses XML-tags to be able to store and easily retrieve and find data within a media asset management system (3.7) (Tozer 2012).

3.6.2 Communication between different equipment

The automation software can if required, control the different equipment in the PCR. Those systems that don't use MOS-control are audio-mixer, visual-mixer, lightning-mixer CCU and the robot camera-control.

The lightning-mixer, CCU and the robot camera-control use pre-recorded fixtures, settings and positions within their own software. These different parameters are then called by the automation system to either cut to these parameters, meaning that an instant modification will happen, or to fade to that parameter for a smooth transition. This could for example be used in an opening sequence when the camera moves slowly and the lightning in the studio gradually increases.

The vision-mixer and the audio-mixer could also have pre-recorded venues within their own software. This is common to the visual-mixer, when certain pre-programmed splits or other DVEs are called by the automation system. Since the different mixers have lots of different inputs, it would be unwise to pre-program all different possible existing combinations. The automation can therefore control single inputs on the different mixer, for example to output a specific camera and at the same time turning on a microphone in the studio.

3.7 Media Asset Management

A media asset management (MAM) is a procedure to manage tasks and decisions surrounding all the cataloguing and storing of mediated assets.

These assets refer to all different technical systems and equipment needed to store and playout different media files and media types. It is essential for the PCRs to have connection to certain MAMs to be able to playout various media files (Zilinski & Lorenz 2012). Some of the necessary MAMs will be described below.

3.7.1 Video storage system

A video storage system is a database where video files are stored. The video storage system is not to be confused with a video server with high resolute playout functions. The video storage has the purpose of archiving videos that have been recorded. The videos can be received from editors via their program to make packages.

Low-resolution previews can also be accessed directly from the storage system. In- and out marks on different video clips can be set and posted to the NRCS.

Every time a new material is posted to the video storage system, it immediately gets a MOS ID-tag (Tozer 2012; Millerson & Jim 2012; Zilinski & Lorenz 2012).

3.7.2 Graphic

Graphics are practically always used at a news-show. It can be either images to enhance the subject of the news, lower thirds or headers to give out information or certain full-frame graphics, such as soccer score or results from a certain league etc.

Different computers often generate these different types of graphics.

The informative graphics and the full frame informative graphics are generated by CG-computers. These graphics will have different information and content on each broadcast, but also have the same visual appearance. Instead of creating new graphics for each broadcast, different templates can be filled in the NRCS that creates a MOS-tagged CG.

The graphics are played out manually or automatically. The graphics that's played out manually is done by a keystroke to the certain CG-computer, located in the PCR. The PA often plays out the informative graphics. The television director plays out the picture graphics; which can be manipulated by the vision engineer to appear on just a part of the program image. The MOS-tagged CG can be timed with in- and length time in the NRCS. This is common on packages, making the CG play out automatically (Owens & Millerson 2011; Tozer 2012; Zilinski & Lorenz 2012).

3.7.3 Video servers

The video server is the technical system where the high resolute video is played out from. The server may have different outputs and the television director in the PCR chooses which of the outputs the video file should be played from.

When a MOS tag appears at a rundown in the NRCS, a high resolute video file is rendered from the storage system and uploaded to the video server. If an automation system is used, the program sends a command, using MOS, to preview and play out the relevant video from the desired video output at the server (Tozer 2012; Millerson & Jim 2012).