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# Broadcast Automation System

Newsroom Production

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<p>Broadcast automation is not new technology. It has been developing for years and has only recently evolved fast due to its importance in today's economy. This thesis is designed to be a stepping stone for different aspects of news automation systems. The process starts from the journalist's newsroom computer system (NRCS) and ends with the final production of transmitting the program. It is a study of how the system is now rather than a statement of what it should be in the future. However, future technological advances are already in development.</p> <p>This thesis does not go through the technology behind the automations system, because the technology contains a great deal of classified information due to growth in field of broadcast automation and the fierce competition between the industries. These methods that are demonstrated in this thesis are already in use. They are produced by major news programs on a daily basis. These broadcasting companies include Finnish and many other international broadcasting companies such as YLE, BBC, Aljazeera and many more.</p>	
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## 1 Introduction

Automation technology has been a part of broadcast production for a long time. A newsroom automation system depends highly on how well it integrates with the newsroom computer system of the news station. The fundamental outcome of any new idea on a product or technology is how it integrates into the operational work flow. It should accommodate the very requirements of the directors, journalists, engineers and other staff members who are using the product every day.

This thesis is designed to be a study of different aspects of news automation systems. The analysis starts from the journalist's newsroom computer system (NRCS) and ends with the final on air transmission. The thesis is a study of how the system is now rather than a statement of what it should be in the future. However, future technological improvements are already under constant development. The technology behind the automation systems is not discussed in detail, because the technology contains a great deal of classified information due to growth in the field of broadcast automation and the fierce competition between the industries. These methods that will be described are already in use. They are produced by major news programs on an everyday basis. These broadcasters are for example a Finnish broadcasting company called YLE, a British broadcast company called BBC, a Qatari broadcast company called Aljazeera and many other companies.

The goal of the thesis is to give general information regarding television production and proceed to the workflow. The reason why this topic was chosen is because it is essential in broadcast engineering. A media engineering student who would like to work in multi-camera production should have knowledge of automation systems and their functions. Overall, the broadcast production provides a wide range of information, but in this case the focus is on operating methods using automation technology that are used in studios and defining some of the priorities and systems that operators would like work with in years to come.

## 2 Broadcast Automation System

### 2.1 History

The evolution of television was contributed by many inventors over the years. In the beginning, there were different types of television systems, mechanical and electronic, that came into existence. The first practical demonstrations were developed by using electromechanical methods. The electromechanical television gave way to all electronic systems in almost all requests, which means that the early television systems were all black and white, until colour television was invented later. YLE decided to move to colour television in January 1968.

In 1955 a pilot was aired on Finland Television broadcasting by the television club of the radio engineer's society. Finnish broadcasting company also known as YLE started daily television broadcasts at the beginning of 1958 [1]. The Finnish television system has been expanded and been added on over the years. Commercial television has been part of the Finnish television system from very beginning. In mid 1980s MTV3 was introduced as the third TV channel. It was previously broadcasted as part of YLE, but was later separated to another channel [2]. In 2002 YLE used Omnibus studio automation for the news broadcasts. The broadcast production process began transitioning from analogue to digital or, on the other hand, from tape to disk. The staff members and management started to realize that their methods must adapt as well. However, the television companies had to go through co-operative negotiations wherein they discuss their future goals, before they can make any major changes. [3]

Broadcasts can be categorized as live or recorded. In the recorded version there is the possibility to correct errors and use other ways to improve the show. Broadcast network identification is frequently used to differentiate networks that transmit an above the air signal that is from networks that are transmitted only through satellite or cable TV. However television is undergoing a transformation stage which is supposedly like a quantum leap compared to the digital transition. Analog technologies were replaced by digital copies, so the system design and functionality were primarily similar. This means the broadcast television can indicate the programming aspect of the broadcast. The broadcast television systems are the standard layouts for the broadcast transmission of analog signals. These analog components include different technical parameters for the broadcast signals. [4]

## 2.2 Broadcast Automation

Broadcast automation is not a new technology. It has been exciting for years and has only recently evolved faster due to its importance in today's economy. Economy has affected the broadcast industry tremendously. As the broadcast facilities move forward towards the future, there are plenty of challenges to which the industry must develop solutions and some of the changes will be gone through in this chapter. The biggest fear in the automation industry is not knowing what the future might look like. According to research that has been done, there will be speculations on what the industry will look like in the future. [5]

The biggest factor in broadcast automation development is costs. The economic issue is the main reason why automated broadcasters are used. Many companies are doubting the reliability of these systems. They are saying that it is risky to allow one system to have so much master control. It is a risk, but not inevitable. The smart solution is to have integrated redundancy inside the system and external redundancy in all systems. That will ensure that the program will air and that secure measures have been taken into account. That level of security will come with a higher price. The biggest industries have this kind of a system. Master control automation integrates animations, audio, graphics, live video, playout servers, real-time, external data feed and other functionalities into one system. This integration workflow is essential to the automation process. It is also controlled by a third-party system.

In today's economy the broadcasters focus has turned into a pure survival strategy. The survival strategies are not only used because of the economy but also because of the fierce competition between the industries. The economy is going through its worst time in centuries and it is not only leaving trace in production companies but also in program quality. Automation systems have been critical in the broadcasting industry during these rough times. An automation system is a smart investment considering long time possibilities. Many of the broadcasting companies have taken automation into account when considering return on investment (ROI). The whole point is to gain profit and reduce the risks. Industry leaders have said that by automating the production process, lowering staff, smartening efficiencies and by doing plenty more with less is crucial for the future of the broadcast television, which is the sad truth in modern day facilities. [6]

However, when the number of the studio staff is reduced the amount of resources can be diverted elsewhere. The question is not about the savings but rather how the savings are utilized. For example, a broadcast company had automated the control room and acquired robot cameras. The saving the automation made, the company were able to acquire a Steady Camera operator in the news studio and three lightweight satellite cars. These savings improved the quality of the program. For asset managements to be effective a solid system should include some transcoding features which are done by redistributing rich media asset. The integration between a device and the system is the main focus. For automation companies it is important that they are extending their products to participate on both sides, the engineering and the production, even though the technology is always developing new ways of making itself more usable. As can be seen in figure 1 the automation system is integrating the whole process where there use to be a production personnel operating in each system. The goal is to straighten companies increasing workflow efficiency and accuracy. [9]

There are three different types of news production automation systems and they are called the standard, combo and hybrid system. A standard system is a PC- and software-based unit that controls a variety of third-party equipment and video servers. A combo automation system consists of an internal rich media video server, and automation control software systems are combined. The hybrid system is a channel in a box solution, where the automation application, video server, switchers, routers, graphics and others are included within a one box system. The hybrid systems is also automation software with internal third-party production devices. The combo and hybrid systems are growing in the broadcast industry. They are the two most popular systems used in the industry nowadays. The hybrid system is predicted to be more common in the future. Some of the main reasons are lower costs and simpler integration. [11]

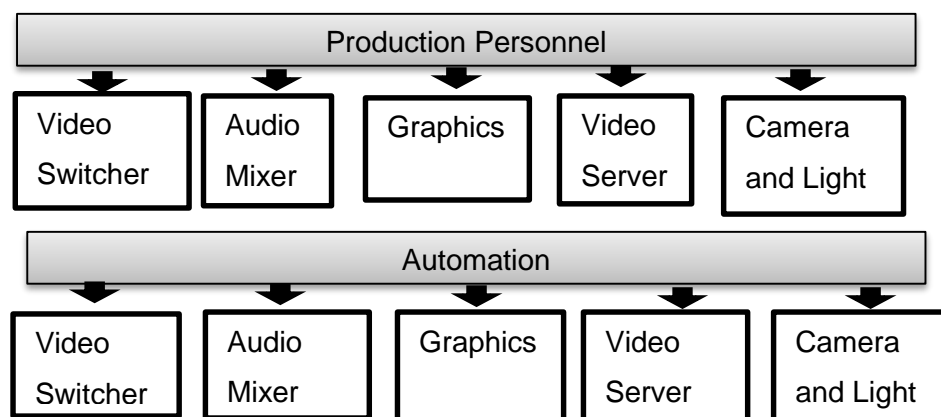


Figure 1. Production crew. Modified from Mosart [15].



## 2.3 News Automation

### 2.3.1 Newsroom Production

News automation is made of several different systems bound together. These systems are used in different parts in practise. The news automation systems consist of three primary levels. A newsroom computer operating system includes automated news gathering systems. It is designed to assist the journalist with media management, including rundown preparations and scripting. Journalists write their stories and the director codes the rundown. An automated central storage system centralizes and manages the content, metadata and graphic elements. The final aspect of a news production chain is the production itself and playout automation. Studio automation does not in itself renew the image, but the way how the studio equipment is used. [9]

Considering the technology, there are two general categories of news production automation systems, software based and hardware based. Hardware-based systems have a limited number of external devices that can be controlled. It is suitable for live news where the format is unscripted. Third-party devices can be operated by using software based systems. Software based systems are more popular in Europe [9]. Currently, the automation industries are including hardware possibility into their previous software systems [10]. However, the software has some issues with handling unexpected events for example when the tape does not cue or there is a last minute change. In this case the automation system could have possible solutions for failure conditions but for many other conditions there will be a need for a personal intuition which is beyond an automated process. [14]

Broadcasters are over thinking their workflows. There have been a lot of changes made in the history of broadcasting. Tapes are no longer used. Many new channels have been started throughout the country and all of them are competing to be the best. Every program wants futuristic technology that will draw them to stand out from the competitors and the growing market share. For futuristic appearance, most of the channels are influenced by new technology. The newsroom computer system (NRCS) has been developed from a clear text based, cable browsing, rundown and script refining structure to a multimedia workflow engine that extends outside the news production room.

Newsroom systems are some of the new big players in the field of new technology. The main purpose is to automate the processes, cut staff members, enhance efficiencies and implement much more with less resource as figure 1 illustrates. Upgrading the video servers, switches and graphic applications from standard definition (SD) to high definition (HD) grants the programs the ability to upgrade and transfer more inclusive newscasts. A variety of news organization sources have pointed out the reason for the change in automation to be expanding reliability, better quality, accessibility and efficient workflow, which is partially true, but the economy seems to be the main reason. It is also a fact that before the automation there was some sort of mistakes weekly, such as wrong audio channel was opened or the wrong video source has been mixed. The number of human errors has decreased dramatically due to the automation.

Live links are emphasized in news. Journalists carry massive responsibility for news stories, because the journalist have to conduct a precise background information search on the stories quickly before airing them. Due to the newsroom automation system the journalism itself is evolving with the technology. The central definition of the newsroom systems consist of three major factors. Firstly, there is the advanced technology that makes the newsroom systems more dynamic than before. Secondly, there is the evolution of working habits that people in the newsroom are able to ensure. Finally, there are modifications in broadcast system drivers resulting in enormously extended output on a station by station basis in terms of diversity of the programs and production methods that have to be provided.

### 2.3.2 Production Purpose

The digital technology has transformed the news from the beginning of the creation. In the same way the audience is changing the way they access the news. Newsrooms have had to make adjustments to the way they make news. The raising request in multiplatform has become popular alongside social media networks. The multiplatform means the software is platform independent, the content can be viewed in various devices such as smart phones and laptops. Thus, this expanding growth does not extend to the broadcasters financial plan and that is where the biggest trial comes. The best way is to work harder and professionally by using the newest technology.

The main reason that automation is becoming fundamental in broadcasting is because of the global economy crisis. The consequences that have affected broadcasters have been demanding and now broadcasters are looking for more cost effective ways. Broadcasters are always looking for something new and better. Automation systems are now more important than ever before. The crisis has developed opportunity for a newer technology and the money made in television industry has been used for web and mobile content production.

Before broadcasters used to purchase products for proficient workflow, but nowadays they must have ROI. By that I imply how the product is going to save money for the company and improve the production quality at the same time. Not only are the costs and risks the determining factors, but also the operating and maintenance costs of the product. In Europe almost every news organization has had automation for the past ten to 15 years. [9]

The reason why automation has been taken into use is because of it is freeing resources and lowering competence requirements. The automation to execute different commands in the content is a good example, and it also reduces human errors. One standard software product is enhanced according to a client broadcaster's requirements regarding the selection of equipment and adoption of newscast format, effects and content by user configuration. Open systems are not designed to accommodate for special equipment but can develop news interfaces according to standard agreements. Due to increase in costs, newsrooms are no longer used as before. Currently, news production is adopting new workflows and technological improvements that are dominating the industry. Some broadcasters at times like this are unwilling to install new hardware and software, reforming production workflows, retraining their whole staff members or swap out their entire NRCS systems, but then again in times like this change has to be made in order to save money which inevitably leads to reducing staffing levels rather than improving overall output as seen in table 1. The images and figures in this study are general representation of the automation. They do not represent any individual company. The idea is to illustrate the purpose. [18]

### 3 Production Methods

In studio production, the first step of seeing how the studio productions are done is by taking a closer look at the role and responsibilities of the main character in the whole process. The director has the main role when executing a program. This chapter goes through the equipment used in studios and facilities, such as studio sets. The news production studio and control crew are traditionally skilled professionals and technicians and usually fully occupied.

The production process can be organized into three consecutive stages: preproduction, production and post-production. All television productions have a number of common features. The specific skills required from the director and crew can vary considerably with the type of program that is being produced.

The program substance itself can determine how the program should be presented. Some types of productions follow a prepared plan and others have to rely on heavily on spontaneous decisions, for example interviews and talk shows, newscasts and sports programs. The way to develop a production depends on a number of factors, such as the show is live or recording the action for subsequent editing and post production treatment. It also depends on whether it is chosen to be record continuously or selectively and whether it is able to control and direct the action that is shooting or if it is obliged to grab shots between.

Table 1. Studio crew with and without automation. Adapted from Mosart [15].

<b>Manual</b>	<b>Automation</b>
Director	Director
Technical director	Audio/Camera
Audio	
Camera	
Graphics	
<b>= 5 crew members</b>	<b>= 2 crew members</b>

### 3.1 The Control Rooms

In television production the production control room (PCR) and studio control room (SCR) are similar control rooms. PCR is the area in a television studio in where the distribution of the outgoing transmission takes hold. The studio floor is the stage where the news reader performs the broadcast. The master control room (MCR) is the technical hub of transmission operations. This is mutual amongst most television stations over the air and networks. A transmission control room (TCR) is typically a scaled down version of central casting.

The main equipment in the control room is a video monitor wall. Newer facilities have a virtual monitor wall that displays many screens. Each screen is capable of showing multiple sources simultaneously on a monitor wall. The monitors show the program, preview, VTRs, cameras, graphics and other video sources. An audio mixing console consists of audio equipment, and the control panel of the vision mixer is used to choose between multiple cameras and numerous other sources.

A character generator (CG) means the text or the title of the program is implanted into the lower third of the television screen. It creates the names and titles as on-screen graphics on the broadcast. The camera control unit (CCU) in other terms technical director's station is where the waveform monitors and vector scopes are controlled along with intercoms for communication with crew.

### 3.2 Multi-camera Production

Multi-camera production is used in most television programs. There are different points of view throughout the show. When multiple cameras are placed in different angles and different shots are provided, this will create a better overall look for the viewer's multi-camera production offers more versatile information than a single-camera. On the other hand, a single camera has the attendance of looking the production through certain direction. To change the viewpoint in a single camera production means stopping and starting recording while the position of the camera place is changed. This might cause losing some detail [4]. Using multiple cameras and a video switcher or computer software to edit the show on the air was originally invented in the movie industry when TV came along as a cheaper and faster way to produce shows.

### 3.3 Broadcast Directing Methods

The directing method depends on the production. However, the directing process has changed throughout the years. The methods mentioned in this chapter are fundamental methods for directing and generally implemented in directing processes. In pre-production the director will start with analyzing and visualizing the script. Visualization signifies seeing the script in pictures and hearing with sounds. Visualization is essential for the strong translation of the script to screen. The director has to co-ordinate with confidence and authority.

Pre-production is more demanding than directing the shows. Being cautious minimizes and more likely reduces the chance of failure. Depending on the show, as I mentioned previously pre-production activities also differ enormously. Careful script analysis will lead to a good start, especially if the director has a vivid visual image that could help determine the subsequent visualization of the process as well as sequencing.

In news it is not necessary to go through a daily analysis. News segments are part of a routine. Routine studio production, such as news, occurs on the same set with the same format. In news broadcast automation the director is a general term, because of the automation system the more suitable term would be an operator since director operates the system not using his or her artistic directing methods on a formatted production. In addition, the news has always been a strict format. The idea behind the news is that the transmissions has to appear the same way in every program. The news has been a format even before the automation. The producer and the director will discuss specific communication goals and production type. This communication in the beginning can prevent many misconceptions and expensive mistakes. The producer is always the head of the process.

The director's support staff depends on the size of the production in the television station. The invaluable and important support staff is the assistant director (AD). An assistant director helps the director in the production phase. He or she is there to assist in rehearsals and on air performance. Most importantly the assistant director is responsible for the timing of the show from rehearsals to an actual production. The director is responsible for getting the program done in scheduled time. In a news program the directors are responsible for delivering the news on and off air on time.

A director must have multitasking skills and should also be able to pay full attention to every element. The director has to be able to direct various elements during the production process. There are a few important skills directors should have, and one of them is for the director to have artistic skills, because the director is expected to translate ideas into effective pictures and sound. The director should be a psychologist that can encourage staff members to do their best. The director should also be a technical advisor who has problem solving skills and a coordinator with an excellent eye for details and he or she should not leave anything out before double checking everything.

Additionally, the terminology that directors use must be understood by all the team members. The reason why director's terminology exists is because it is essential for well-organized communication between the director and the team. There is no time to explain details during the show. This could lead to other staff members replying back to the director, which could distract the director. Better communication is the outcome of short signals. The pressure on the director is very demanding, because the director is expected to make the correct decisions the first time around.

In live telecasts there is no time to make any changes like in post-production. Once a telecast has aired that is the outcome the audience will receive. Multi-camera directing is not only about co-ordination of technical operations but also about actions of the staff. Managing complex machinery does not come nearly close as what it would be like dealing with the crew. Once the director has mastered the camera, audio, video recording, graphics, remote feeding and the timing, the challenge will be the communication between the staff members.

A control room is designed specifically for multi-camera production. The concern with multi-camera directing is not only the visualization of the shots but also instantaneous sequencing of various shots beforehand by forming a continuous and logical pattern. The intercom system in the control room provides communication among the production team. Rehearsals are very important. They do not only give a routine for the whole team but also show errors in the production preparation. [15]

### 3.4 News

The role for the TV director (news director in this case) is only to be in charge of the broadcast. The news show is a format, which means the director is not making any artistic decisions to the program in terms of visualization. The director is an individual at a broadcast station who communicates with the news department at all times. In the local news, the news director is characteristically in charge of the broadcast and responsible for collaboration with entire news staff, including journalists, news presenters, photographers, editors, producers, and other technical staff, for example if a news insert is missing from the newscast. The director is in charge of how smoothly the show proceeds, as well as communicating with the producer if there are any problems. A news studio typically has multiple cameras, but not many camera movements. Usually, the only other person at a news station who wields more authority than the director is a general manager or company president.

Producing a news program means defining and predicting the news. The news workflow starts with planning and preparations. This process will repeat frequently along the day. It consists of editorial meetings and planning a rough running order template. The conference is about current news agendas. The news stories are assigned to journalists and researchers. A crew is sent out to start a news gathering. By that time graphic and studio work is organized. Video editors and producers prepare short pieces. Journalists write up stories. Researchers get back to the journalist with the footage. Journalists take the story to video editors to produce news packages. News presenters prepare and rehearse scripts. Journalists finish the scripts. Then the program is rehearsed and the final story selected.



In the old fashioned way of news production, the autocue scripts were typed and video tape recorder (VTR) inserts were cued up, but now the automation is used in most news productions this process is no longer necessary. The editor or the director can change the agenda, for example for breaking news. Finally the director goes through the process in the control room with the rest of the crew.

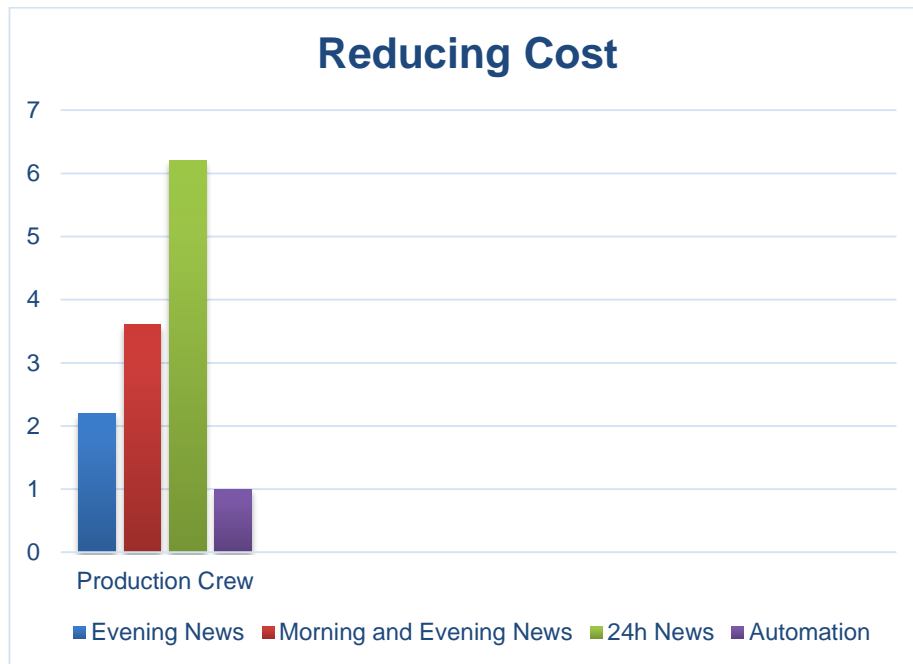


Figure 2. Reducing Cost. Modified from Mosart [15].

### 3.5 Automation Systems

Automation systems are estimated 50 broadcast automation companies across the world. The industry is announced to be worth 11 billion dollars and it continues growing 11 percent annually. Dominant automation players propose video server and combo automation system. Automation is a software running on video servers with highly advanced interfaces and device control for third-party equipment. Other outstanding automation systems are for example the Ross Overdrive automation system and Ignite News Workflow. [14]

### 3.5.1 Ross Overdrive Automation System

The Ross Overdrive automation system is a highly flexible and advanced production control system, but the difference between it and Mosart is that it uses a touch screen GUI interface control system over the devices that are used in a production environment. The automation system integrates with many series of production switches, audio mixers, robotic cameras and more. A Finnish commercial television company called MTV3 utilizes Ross Overdrive. With Overdrive the level of automation can be narrowed down from fully automated to manual or anything between. This allows the control room staff size and level of the device control to be optimized, which most likely means reducing manpower and replacing people with automation. Thus, this is the way most of the automation systems have adopted.

Overdrive provides recognizable image shots with user defined picture icons. Screenshots or graphics created in the newsroom can be used to personalize each overdrive template. This is an excellent way to preview if the correct story is listed in the rundown. Ross overdrive newsroom workflow consists of four steps. The first is preparing the show templates and inserting a story. The second is going on air when the rundown is ready and implemented in the newsroom system. The third is making changes on the fly, when all the changes made in rundown are automatically synchronized in overdrive. The fourth is handling unscripted events allowing last second changes, for example breaking news.

### 3.5.2 Ignite News Workflow

Ignite automation is a Dutch commercial TV broadcaster. The Grass Valley Ignite integrated production system delivers flexibility and efficiency. It gives the operator the control over audio mixing, video switching, digital video effect, video and audio servers, robot cameras and other devices. When a newscast is going according to a plan, the operator can rely on pre programmed timeline to execute events in order. The ignite system also gives the operator a number of options to manually direct the broadcast through unscripted and breaking news events, and then join the time when ready.

The ignite system can speed stations transmission to digital and HD productions because of the scalable and modular system. The ability to execute complicated, multi-source audio and video events identically improves the look and feel of a newscast on air. The Ignite system virtually eliminates technical errors while utilizing personnel to their fullest. The Grass Valley Ignite line is an integrated system that provides both software and hardware platform and has the ability to deliver greater production efficiencies, less equipment maintenance and depreciation, thereby lowering operating expenses while also increasing the station's programming capabilities, resulting in a strong ROI.

## 4 Viz Mosart Automation System

### 4.1 Viz Mosart

The Vizrt product provides real-time 3D graphics, maps, visualized sport analyses, asset management tools and workflow solutions for the digital broadcast industry. The reason the Vizrt Mosart automation system is the main topic in this study is because of the personal experience with the device. I was provided a rare opportunity operating the software by directing a newscast. The company Visualization (Vizrt) creates content production, management and distribution tools. The product is integrated into the editorial workflow with templates that can be entered by newsroom control systems [13]. The clients of the company are world leading broadcasters and the Finnish broadcast company YLE is applying this system as well. YLE took the Mosart into their system in January 2010. All the news were later aired using the Mosart in March 2012. A look reform was applied to the news format and the robotic cameras were added to the main newscast in February 2013.

The non-conventional workflow permits the journalist or the director to modify graphic content up until the minute the modified graphics are played on a newscast. This might seem a great idea, but it comes with a huge risk. The content that is returned late is a problem. The director has to go through all the content to make sure everything works correctly and has correct media IDs. If there are last minute changes on the elements and they are not functioning correctly, the whole rundown will be affected.

The Vizrt purchased all the supplied share of Mosart Medialab AS (Mosart). The transition of both Vizrt and Mosart working together is strategically wise and financially beneficial. However, their co-operation seems to be essential in the line of broadcast companies. [12]

The idea of Mosart newscast was to find solutions to integrate almost all the studio devices without a network being tied to any system hardware. Mosart is a studio automation that supports many manufacturing systems from production switches to robotic camera systems. Scripts and stories written in the computer system will immediately appear in the graphic user interface (GUI). The device operators depending on the production company can store many video clips and graphic elements in the GUI where it can be executed later on air. This system can be adjusted for any television production company.

Viz Mosart is not only two major broadcast industries combining their technology together but also a possibility for future development with all its recourses. The automation system is used by the Finnish broadcasting company called YLE. Viz Mosart is software used for automation. YLE took the automation system into its facilities in January 2013. The newscast automation can work with any manufacturers' equipment and integrates with Vizrt broadcast graphics and video products. The software can control a variety of devices for instance, lighting, camera, video, audio mixers, graphics and video servers.

Broadcasting live newscast is a complicated process that requires a massive amount of resources from news gathering and production, providing reliably high quality of content. A normal live broadcast would take five people in the control room to produce, for example three of the staff members could move to create more and better news content. Companies might take this solution into consideration instead of dismissing responsibility, but then the companies would have to train themselves to be all-around. After all, this solution will cost the company. The focus would be creating more and better content. This automation software provides the director with a control room system that is capable of driving live production from a single graphic interface. It also integrates with devices such as video cameras, graphics, audio and lights by using native application programming interfaces (APIs) all working in together. Broadcasters can distribute workflow between multiple control rooms. This possibility will allow staff members to produce greater efficiency of technical properties.

Well organized GUI provides all the information needed for each program and activating both scripts and elements is accomplished with a one executing button. Additionally, the software uses integration with news room systems allowing the journalist to edit show content, and any changes made in the run down are immediately reflected in the software interface and can be generated live to air. This software was designed by professionals with the idea of simple usability and efficiency for highly difficult operations in news run-down. This is why it is common between the leading broadcasters worldwide.

#### 4.1.1 Architecture and Design

The architecture of Mosart was originally intended to be able to work with different types of systems and devices. The software was built on open system IT standards and interfaces. It has a template base architecture which grants the users the possibility to change broadcast hardware devices without modifying or changing the structure of the rundown. Figure 3 illustrates the Mosart system architecture workflow. [13]

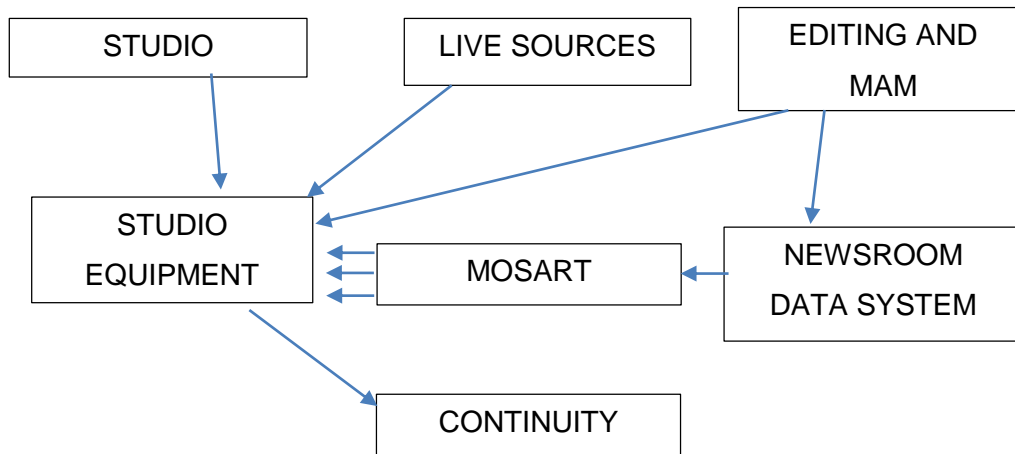


Figure 3. Architectural system workflow. Adapted from Mosart [13].

#### 4.1.2 User interface

The software interface is designed to be a clear, smooth and logical user interface. This will give the operator an actual overview of the whole rundown, and also showing enough detailed information about the program. Figure 4 illustrates the image of the Viz Mosart graphic user interface. The user interface works with colour codes, which immediately instruct the operator if the program is airing and playing or cued. The user interface also instructs the future events and separates studio, clips and graphic.



Figure 4. Viz Mosart automation system GUI. Reprinted from Vizrt [14].

A newscast automation system works with multiple GUIs. For example the director which in this case is the operator and assistant operator can access the GUI in the master control room when airing the program, and the journalists within the newsroom can access the GUI according to authorization of the person. [13]

#### 4.1.3 Rundown and Templates

Mosart has a story based architectural design that manages the rundowns. A rundown controls new stories, events and elements in addition to other commands. Automation provides context delicate templates. This means that the running order depends on the context in the template rundown sequence, for example if the running order begins video on the first headline of the template and fades out after the last headline. This will allow the editor to change the order of the headlines up to the final moment.

Instead of writing device commands straight in the rundown, Mosart has a wide range of pre-programmed templates containing device commands for a vision mixer, a playout server, a full screen graphics system, overlay graphics, an audio mixer, a sound file player, camera robotics, routers, a weather system and other attached devices. The templates are parameterized and may take arguments as part of newsroom computer system commands.

#### 4.1.4 Workflow

A newsroom is where the work begins. All the journalists, editors, producers and directors beside other staff members work together to gather the latest news to the broadcast. Newsrooms are more often found next to the studio where the news content will be later aired. The news that have been developed in the newsroom will be generated to all studio automation templates as seen in figure 5. From the newsroom the system sends all the commands written in the newsroom computer system (NRCS) to control studio components which are for example lights, robotic cameras, video and graphics. After the commands have been given in the system, the operator, producer and other members of the staff will locate the control room to execute a complex live broadcast. The production control room serves as a large physical facility that can be monitored and also controlled. [14]

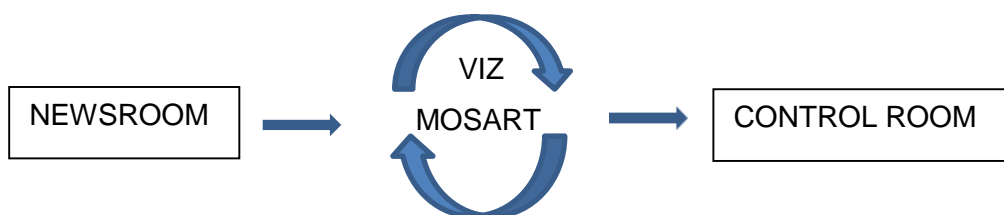


Figure 5. Viz Mosart workflow. Modified from Viz Mosart [14].

#### 4.2 Equipment and Integration

The system integration that is utilized in the Mosart news automation consists of newsroom computer systems, media asset management, vision mixers, audio mixers and levellers, graphics, fader and control panels, servers, camera robotics, routers, video wall mixers, weather and triggering. There are a variety of players in the news automation and they all have brand names. The usual tools needed for a television studio are multiple cameras, tripods with dollies for each camera, multiple microphones, a video switcher, an audio switcher, a graphics generator, lights, a head set communication system, monitors for each video source and more.



#### 4.2.1 Newsroom Computer System

The NRCS is where the newscast production begins with. It is the foundation of a newsroom whether the facility is based on nonlinear production or operates with tape-based workflow. The concepts are created with wires, established with scripting capabilities and ordered for payout with the rundown inside the NRCS. The people that utilize the NRCS are typically news directors, producers, managers, journalists, reporters, editors, operation users and IT staff. They operate the system in different ways. For example a news director manages the on air content whereas journalists execute story ideas by reporting them in the NRCS. Table 2 indicates a list of function expected form newsroom systems [16]. The scope of well-known newsroom computer systems such as Avid's iNEWS and the Associated Press' (AP) ENPS are based on core technology. They are originally conceived from a time where it was only text based and are still being operational. Their success has made the competitors find it difficult to breach the market. There are some broadcasters who have developed their own systems, but these systems are not many and has not been placed outside its own company. [18]

Table 2. The newsroom system functions. Adapted from Mosart [16].

Encoding, trans-coding	Running order creation
Cataloguing and metadata creation	Script and show timing
search engine, low-resolution proxy browsing, shot-listing and editing	Graphics creation
Prompting	Captioning
Subtitling	On air play out automation
WEB and DVD authoring and publishing, archiving (short-, medium- and long-term) of media and text	Digital asset management.
Planning/diary/assignments	Voice-over recording

Communications (messaging, mail), web browsing and research	High-resolution conforming and finishing
News agency reception, sorting and alerts	Video server management
Ingest scheduling and management	Scriptwriting

#### 4.2.2 Multiplatform

A multiplatform integrates with the Media Asset Management (MAM) systems. They are both moving forward content flow and reusing directions. In forward content flow direction the Mosart multiplatform questions the MAM system for additional asset information such as full clip name and metadata. It saves all the metadata received from the NRCS as well as from the MAM system in an as-run rundown. The as-run rundown has an XML format and the multiplatform may be configured to filter and transform the data into the news format desired by the broadcasters. For re-use purpose the multiplatform needs a clean feed recording with as-run rundown data information and has to also contain a completely updated image of the newscast. [13]

#### 4.2.3 Vision

The vision mixer is the person behind the video switches and cuts between video sources, such as camera shots and video inserts. The video switcher is sometimes also called the person who drives the system. The device is also used to select between several different video sources. The CCU is responsible for colour and contrast balance between the studio cameras, but the vision mixer can also inform if there is a colour correction problem.

A large control panel is also used to choose between the multiple-camera setups and other various sources. The production is either recorded or seen on air, but the video sources are all viewed in video monitors in the control room. The term cutting between the sources means switching directly between two input signals. As an additional effect, the mixers can choose between diversity of transitions from a simple wipe to patterns. The other feature mixers can perform using the table is a keying operation. Mixers can also generate colour signals that are called mattes.

Therefore, Mosart supports all major video switchers and will go through a thorough implementation as part of a standard delivery program. Video sources can be template pre-specified or specified in a newsroom computer system and optionally overridden by the director in the user interface. Also, the transition type and duration can be template pre-specified, but can be changed in the newsroom computer system.

#### 4.2.4 Audio

The sound mixer is considered a department head for the sound system, and is thus absolutely responsible for all aspects of broadcasts related to sound. The process of audio mixing is combining multiple sounds into different channels. Many effects may be applied by manipulating dynamics, signal levels, the panoramic position and frequency content.

In a broadcast, the sound editor operates the audio mixing device by adjusting and fixing the sounds. Sound mixers usually have a creative and important role when making decisions based on the quality of the sound when it comes to audio, but they have to consult the director. A sound editor can decide what sound effects to use. A sound editor can edit and make new sounds using different filters and combining sounds, equalizing and correcting sounds with volume curves.

Usually, the sound mixer will arrive at his or her own location such as the audio control room with ready set equipment, which typically contains microphones, radio systems, booms, a mixing console or table, cables, audio storage, headphones and other tools. When the sound mixer is capturing a wide variety of sound, the important task is to examine the format of the finished product whether it is mono, stereo or surround sound.

Therefore, Mosart supports a numerous sets of audio mixers and will do a detailed implementation as part of the product. Basic audio fader levels are set in the automation templates, which are also linked to visual events. During production faders can be adjusted on the audio mixer, in the user interface or on a separate fader panel. The system has developed functional logic for the audio when it comes to interview situations whereas the audio is able to change between multiple cameras.

#### 4.2.5 Video Server

A server is a device where the quality images are stored concerning the broadcast production. The video server permits numerous users to refine stories using the stored images which can accommodate the server by using the images simultaneously. Video servers can be used in different contexts, such as in news. The short news video clips are part of a news broadcast and these clips are stored in the server as perceived on networks. Therefore, Mosart approves a set of video servers. Several server manufacturers can be controlled by automation simultaneously. The graphical user interface visibly specifies lost clips, empty placeholders or wrong filenames. The software provides self-assurance to the director to view the graphical rundown and by that allowing him or her to specifically view the first frame of any clip in the rundown to see if it contains the right story. Television channels are using storage servers to archive all their materials and reuse the content through the same servers instead of using an old fashioned tape system. The modern workflow has to have a better network that contains very strong servers including storage space, graphics and video. [13]

#### 4.2.6 Digital Technology

In television the digital technology was initially design to create special effects that could not be achieved by using analog technology. The analog images were later digitized which resulted in the calculation of mathematical algorithms to process the new information. The process allows the images to be manipulated. They can for example be shrunk or twisted. The creation of digital video recorders were the second new innovation. This technology stored signals as a sequence of computer binary numbers. The television production process is gradually changing from a system that communicates between multiple digital sources with analog gear to the use of a fully digitalized environment. [18]

The introduction of high definition television (HDTV) offers significant enhancements for user experience. The main improvement is the quality of the image as well as the realistic impression of the scenery. However, not all broadcasts are transmitting in HD format. There is going to be a transition period. For other countries to approach the new technology, it might take several years before the three current digital TV formats known as standard definition (SD), HD720 and HD1080 could exists together. [15]

## 5 Director

### 5.1 Introducing Director in News

The latest version of Mosart (3.6) was released in 2014. Viz Mosart is constantly trying to develop new and better products for their customers. The application runs on a stand-alone server with main server and backup server. There are native protocol controls for multiple devices throughout the control room. Because the actual process is very complicated, I will go through the idea of how to direct automation by using the Viz Mosart system. The directing methods that are used differ between each broadcasting company, but this chapter will introduce the role of the director in the news and how it is generally proceed. What is presented below are notes based on practical experience while shadowing a news director at YLE.

#### Learning Diary

A meeting was held in the beginning of the day. Before the day starts, a news group which includes directors, producers, managers, journalists, reporters and editors from different news departments such as economy and foreign affairs will come together to plan and prepare the news. From the start the news group discuss the schedule for today focusing on delivering many updated news during the day and proceeding to give most reliable information at all times. The group are informing their team members all day keeping each other updated. The reason is that if there is a late important breaking news story it can mean that all the previous planning is forgotten and everything has to be changed because of new developments. Later that day the head of the news group gathers the group around again to discuss another timetable and the head editor of each newsgroup chooses the main topics, which are included in the later newscast.

The director is responsible for the planning of the rundown and technical execution of the news show. The producer is responsible for the content of the show. The director starts to code the rundown, based on the ready inserts and the worksheet that is given. The director makes the codes ready so that the editors can add their work into the NRCS. While coding the rundown, the director has to communicate with the journalists and editors. The director is responsible for the elements written in the rundown and that it is correctly filled. Thus, the director has an assistant director who is in as another pair of eyes.

Additionally every news broadcast has an assistant director. His or her task is to go through the rundown and see if the title of the program and the codes for the automation are written correctly. In the live news, the AD is responsible for time, informing the director and live reports about the duration of the clips and broadcast limit. There are two types of news broadcasts: there are long broadcast and short from broadcasts. Short news are produced in smaller studio as seen in picture 3. In the long newscast there is another person alongside the director called the Mosart driver. The Mosart driver is presumably a second director that controls the automation, but only by the director's commands. The position might somehow perceived similar to the video mixer's task, but it is not. Video mixers only controls the video source, whereas the Mosart driver controls the whole system.

The director and the producer communicate about the rundown. They for example discuss the amount of live feeds that are planned and in which newscasts. In some cases if there is not enough time left, the producer decides what to leave out and informs the director. There is a lot of preparation before the live newscast and everything goes strictly by time. The main responsibility is with the producer to rate a logical proceeding rundown. The idea is that the new and important news are in the beginning of the list.

If problems occur for example a live feed that was planned does not happen, there has to be a fallback. To give another example, if the satellite time for the live feed is either early or late, the newscast is up to the producer. The decisions that the producer makes are really tough ones considering the overall broadcast.

After the rundown is done everything is updated to the automation system. The rundown is displayed on a video server in order to show the contents status to the whole newsroom and all the reports. There are many people working on the same rundown simultaneously. Before the live newscast, the director prepares some time to go through the rundown to see if everything is working correctly. Before the rehearsal, the director enters the studio to see if all the setups for the news are active and if the Mosart automation and its equipment control is active. The director hands paper prints of the rundown to the studio team. After the rehearsal, the director will be waiting for the permission to start the news. That communication happens through a talkback system.



Figure 6. Small control room operation of YLE.

## 5.2 Demonstrating GUI

The Mosart graphic user interface is divided into three important sections. On the left side of the interface there is the current and the next script. This way the director can follow the content. The scripts contain all the elements that include the script, for example the title of the presenter in both the previous and the next story. The interface has to contain as much information as possible without distracting the director. It should be simple, clearly presented and easy to illustrate without going through the newsroom computer system all the time for detailed information.

The main part of the GUI is the central part. The graphical representation is shown to the operator and everything in the script is presented as a timeline. The timeline shows specific times from the second the story is airing until it comes to its end. Timing has to be very precise. The whole news is based on providing updated news on time. Mosart uses a systematic color coding system, where each color represents an element or device. The first time the user sees the GUI can be completely confusing, because the technology is so advanced, especially for someone who has been used to a conventional way of directing. The system is without a doubt non-traditional.

The graphical representation allows the operator to visualize the entire rundown as a snapshot, which provides graphical information of the entire program. On the right side of the GUI there is a graphical representation of current transmitting program output and a preview of what is next in line. This helps the operator to stay always one step ahead of the program. Mosart does not define key commands. Its configuration totally depends on the client's needs, like most of the automation systems. The automation industry configures the systems according to their customer's preferences.

Another useful feature is the flexibility of moving around the rundown. This feature is important in news, because there could be breaking news and the system must adapt effectively to any last minute changes. Breaking out of the running order is the most unique advantage that Mosart has. If the journalist is not able to write breaking news quickly enough, the operator can simply remove the headline and the running order will continue to the next in line.

#### 5.2.1 Failure

In the context of the previous discussions, the broadcasters are questioning the automation system. They think it is too much control for one machine to have. The automation system has its own risks, no questions about it. Any kind of system failure is inevitable. It can either be a technical or a human mistake. Some of the system problems that can occur in news programs can be the prompter not responding, this means that the text for the news reader does not appear. Furthermore, the stories do not play video or play it incorrectly, video stuck in one frame, no audio in the video or a robot camera wondering around the studio. Some of these errors are considered as technical errors. Of course an error could also be a user error. The totally automated newsroom must have complete duplication and considerable redundancy in key areas to accommodate the inevitable equipment or partial system failure. This means that there is a secure backup system which is ready to overtake the previous system. Partial breakdown is to be expected and in that case the best solution is to allow for manual override in the same way. Some of the error cases are explained briefly below.



## Case 1

When a technical error occurs, the news operator is in a tough position, but sometimes the best solution is to wait and see since there is a running order that the automation is waiting to play out. On the other hand in manual way of directing. The director could have straight gone through another camera where the news reader could apologize for the technical problem and go to the next topic. That kind of effective reaction, flexibility and problem solving technique could have worked in a conventional way of directing the news. Instead in automation the AD and the staff have to do a lot of work in a few seconds for a new sequence for the camera or just simply wait for the automation system to finish if the program is an on air event. Thus, during the news the content could be added to the rundown again. Luckily bigger news productions are operated in a control room with the team of the staff. This of course depends on the news broadcast and if it is short news or long news. Although, the automation does provide the ability to cut through cameras as well as a video mixer, but the structure of the rundown is pre-programmed compared to conservative way of directing. The director, assistant director and producer is each monitoring the process while the news broadcast is airing. There is a backup system running simultaneously regardless of the news in the background for any inconvenient problems, if error messages are displayed or if the broadcast just freezes.

## Case 2

The second problem is a last minute or vital second change without any formal deadline, even though it is logical to hand everything in before the newscast. These operations are designed for breaking new news items, but since there is no specific description for the limitation journalists or editors can return stories during the live cast or just before airing time and a back-up plan is needed. This operation is risky and not in any circumstance preferable. The problem in this context is the fact that the directors must go through the rundown to make sure everything is working correctly and has right content. It is impossible to go through all the items of the broadcast and see if there is something missing, especially if the stories are handed in late. By the time the program is on air it is no longer on the director's responsibility, even though the director is responsible for executing the show.

Some of the problems that occurred when material was submitted late:

- Wrong ID (e.g. the same insert twice during a newscast)
- Missing text (e.g. the Finnish translation missing)
- Wrong location on the rundown
- Wrong code or no code at all

These problems are just a fraction of what other technical problems there might be. The director's efficient work routine during the broadcast is the key of preventing or fix many of these errors on time. This shows that problem solving skills are needed for professional and efficient workflow with the co-operation of the supporting staff. The director has to manage to find the problem and correct it on time.

### Case 3

Another common problem case is with the camera codes. The robot camera can be slow and if a wrong code is transcribed, it does not know what action to take and this process could lead to capturing the wrong frame. In that case, the robot camera driver has to fix the camera despite the codes. The codes could be corrected in seconds. If the next frame is not repaired on time the camera takes random shot, but later goes back to the codes that were in the manuscript.

### 5.2.2 Future

If the future is realistically predicted the future then the newsroom system will integrate far more automation in both processes and systems in the future. The journalist will be able to prepare stories that can deliver multiple news versions automatically. This amount of automation will help broadcasters to achieve future goals as well as stay in their budget. However, this sadly results in fewer staff members, but the remaining staff will be working harder than before and creating multiple news on televisions, the internet or any other smart device platform.

Thus, it is not easy to predict the future, but by studying the changes made throughout the years of broadcast automation, it become easier to make observations. Automation is heading in fact towards reducing man power and to automating the whole process. In the near future a control room would no longer be staffed, but it would be monitored by a fully automated system with only one system operator. For example, programming will arrive from media delivery services and auto populate the playout servers. This would mean the computer system will give commands to the user or even repair itself. Built-in intelligence is added to monitor the system and will decide the right course of action.

### 5.2.3 Interviews

This section discusses the interviews that I had with operators and experts that work with automation on a daily basis. The operators have been working on programs with Mosart, and the experts are professionally trained users that have more knowledge of the engineering side of the system.

#### 1. What does automation mean in your line of work?

Operator:

- Automation means the direct transmission of events is programmed and timed to the rundown prior to shipment and these operations are no longer necessarily carried out by separate people. The most prominent example of this is the lack of camera operators in the new production system – robotic cameras operate self-rundown depending on the type of programming.

Experts:

- Automation has changed the news broadcast control, as it performs almost all the work. Furthermore, the shifts have changed to cater a smaller number of people. The control room staff has partially changed, and the more important part of the news production is the news desk before the public broadcasts. Today, the

directors are completely dependent on the codes in which transmissions are made.

The possibility of improvisation is diminished, the news is more out of control than the traditional driving guidance.

- The working environment has changed. New commands and codes have been added. The coding has become crucial and demands more accuracy. Even the possibilities have been minimized, which means everything has to be decided early. However, last second changes are possible but then it is necessary to find out the items that have to be corrected or coded again.

## **2. How did your work image change with the transition to automation?**

Operator:

- The pilot's point of view is that the automation stress transmission in preparation and all the circumstances must be programmed so that they are driven out as desired. Responding to unexpected situations, in some cases the unexpected situations are much slower than in a fully manual production. Thus the situation must also anticipate more and possibly preprogrammed alternative solutions, one of which is selected from a live situation.

Experts:

- Automation affects the transmission planning. At times the wishes of news producers are ignored in such situations which would benefit the broadcast. However all new situations are regulated by superusers which make templates in order to keep the situations functioning. As a result the news broadcast is even more formatted and transmissions appear to be the same from day to day. The second shift control of the Mosart has replaced the video mixer news. The Mosart shift is pretty close to even video mixer's job description, but the mixing table has changed into a keyboard and a monitor which looks like Mosart's rundown.

- Matters have to be agreed on in the early production. Especially in the beginning of new appearances, the more the system becomes familiar to the user, the easier or faster it is to fix on air.

Directing is no longer free, which means the user is given a certain work limit within a certain time frame. On the contrary, news has been formatted long before automation. It might not seem such a change on the viewer.

### **3. What are your thoughts about the automation system and the usability of the Mosart?**

Operator:

- The user interface is very wide, it requires deep expertise and continuous use in order to master it fully.

Experts:

- "Once you are used to something it becomes a habit". The interface is constantly improved for the better. Since Mosart is also used in the BBC's main evening and other large companies, the pressure has come all the time to get a better user interface and it is updated all the time.
- The more the user work with Mosart, the more familiar it becomes. There is much to learn before the user completely understand Mosart and its capabilities.

### **4. Compare directing before automation and after, which one serves directing better?**

Operator:

- The use of automation change the focus of the work of the director clearly expresses the technical side of the edit. A rundown is used to program the time which is used, for example the title of the images, photo mats in the design and editing. The amount of the expressive control has decreased with the introduction of automation.

Experts:

- Basic consignment is an ideal tool for power, but Mosart feels unwieldy in a crisis where the broadcast rundown changes a lot during transmission. A certain change in all of this is also due to the fact that the company send only one person to operate the robot cameras, whereas before the company had a studio on the floor with 2-3 cameramen.
- It would be good to have cameramen and mixers, like in other productions, but before automation, the image sizes were the same. It is understandable why automation is used in news, but it has set some restrictions on directing in a different way. Without a mixer present, different options are demanding to build like they used to be, not everything was successful.

**5. How could automation be improved (something that could be added or left out)?**

Operator:

- In automation, the robot cameras biggest weakness is pre-recorded image composition, which is not optimal for different lengths and features of people. This is reflected in the quality of the shots and could be noticeable. Robotic cameras should have facial recognition software which would prevent needless erroneous image composition. Automation in this respect should be brought to completion.

Experts:

- More memory locations are needed to store graphics and photo mats before the transmission.
- Broadcasts can always be improved with new image sizes and ideas. Mosart is also developing all the time and updates changes. Improvements are being done continuously.

**Mention a few of the good and bad features of an automation system?****Positive**

- Cost-effective
- Complex sequences can be materialized accurately
- Camera, timed rotations run exactly as planned
- Basic shipments will be more successful
- There will not be so many human errors in transmission
- Making up the transmission easily without the need to alert a large number of staff to work
- Fast transportation
- Suitable for short production
- Makes broadcasting easier in long production
- Learn to operate an automation system that is also being used in other news broadcast companies

**Negative**

- The rate of response is delayed due to unexpected circumstances on live TV
- Pre-recorded image composition is often poor, it requires constant manual correction of which is remotely slow
- Rundown programming takes a lot of time
- Specific rigidity transmission changes that come during the transmission
- Improvisation in designing transmission is gone, because the directors are totally dependent on the pre-programmed templates.
- It is heavy on the long productions
- Staff reduction
- Stiffness
- Not flexible enough
- Less spontaneous

## 6 Discussion

The two types of production personnel consist of technical and non-technical. The non-technical production personnel include a variety of people who design the program, for example writers, and people who execute the program, for example the director. The technical personnel include the engineers who maintain the equipment and the non-engineering technical personnel who operate the equipment. The automaton will be replacing the non-engineering technical personnel. The news department has its own personnel which consist of journalists and the rest of the production team.

Analyzing the feedback from the production personnel in a news department shows that there are controversies with the previous thoughts about the result. In the beginning of the project, it is useful to start the research with a certain direction, and think of how the system and its functionalities are operating. After all the discussion gone through in this thesis, the results can prove to be the exact opposite. These interviews enlighten the facts and provide good arguments with any thoughts. However, it is necessary to understand the fundamental reason behind the existence of the system and how far it has developed. It becomes understandable why automation has been taken into use in the modern day. Automation systems have their benefits, but what gives one a peace of mind is the continuing developments to make the automation system more flexible, for example by implementing similar workflows as in conventional way of directing.



## 7 Conclusion

The goal of this final year project was to analyze the importance of automation in the newsroom production. This thesis gives a summary of the quality of automation systems because it is essential to understand what is required to produce good content for the news. It may not be required to know all of the features of every piece of equipment and integration that is written, but one needs to understand enough about them. The user of an automation system should know the practises in production and creatively comprehend the technology behind it. The principle point of this study was to become familiar with the automation process, usability, production purpose, technology and equipment behind the system. The technology is moving forward which means the industry has to change with the process. The automation systems are saving money for companies, but at the same time they will bring something to the production. The idea in this thesis is that it all comes down to becoming familiar with the production methods and then to starting by visualizing the content program and developing an effective routine for the workflow. In conclusion, the future will bring more complex technology. Thus what the media industry can do is to adapt the new technology and make use of the simplified workflow.

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