

Phuong Ha Thu Nguyen

# Multi-camera video production for medium-sized concert.

Case: October #Beatz concert at Gloria stage - Helsinki.

---

Helsinki Metropolia University of Applied Sciences

Bachelor of Engineering

Media Engineering

22 Novemeber 2017

Thesis

Author(s)	Phuong, Nguyen Thu Ha
Title	Multi-camera video production for medium-sized concert. Case: October #Beatz concert at Gloria stage – Helsinki.
Number of Pages	54 pages + 6 appendices
Date	Last updated 27 March 2018
Degree	Bachelor of Media Engineering
Degree Programme	International Degree Programmes in Technology
Specialisation option	Audio Visual Technology
Instructor(s)	Jonna Erisksson, Senior Lecturer
<p><b>ABSTRACT</b></p> <p>This thesis illustrates the workflows of producing a live concert video using multi-camera technique, as well as providing practical solutions to tackle problems and possible risks of production.</p> <p>The thesis project is based on theoretical researches on technical information, collecting empirical data, and practical experience from case productions of filming musical concerts. Based on this study, the budget, crewmembers' skills and technical issues in general could be identified as the biggest problems when filming concerts. The goal of this project was to produce a guideline for videographers in producing live music video using multi-camera technique, which could be also utilized in different video productions.</p>	
Keywords	Concert video, Multi-camera, Recording, Risk assessment, Video Mixer, Visualization, Teamwork, Video Production, Live venue.

## Contents

1	Introduction	1
1.1	Project backgrounds	2
1.2	Production challenges and the goal of the project	4
1.3	Structure of the report	5
2	Project flow and methods	6
2.1	Stages of the project	6
2.2	Data gathering process	7
3	Best practices	8
3.1	Overview of multi-camera production	8
3.2	Job roles of a multi-camera production	10
3.3	Production Equipment	13
3.4	Production work station	15
3.5	Benefits of multi-camera production	16
3.6	Leadership and Project Management	17
3.7	Visual Story Telling	18
3.8	Conceptual framework	19
4	Preproduction	20
4.1	Meeting with the concert organizers	21
4.2	Filming location	22
4.3	Establishment of Production Crew	23
4.4	Learn the performance	25
4.5	Production equipment	26
4.5.1	Equipment sources	26
4.5.2	Equipment preparation	27
4.5.3	Estimation of hard drive space	29
4.6	Operation plan on concert day	30
4.7	Final Filming Script	31
4.8	Risk Assessment	33
5	Production - Recording on D-Day	36
5.1	Arriving and setting up	36
5.2	Final rehearsal	38



5.3	Video recording	39
5.4	Audio recording	40
5.5	Collecting files and cleaning up	41
6	Postproduction	42
6.1	Video editing workflow	43
6.2	Audio editing	45
6.3	Publishing	47
7	Multi-camera post-editing versus live switching techniques	48
7.1	Production comparision	49
7.2	Final Product Comparision	50
8	Future development – Live streaming a concert	51
9	Project evaluation and conclusion	52
	References	54
	Appendices	
	Appendix 1. Stage plan	55
	Appendix 2. Instrument layout	56
	Appendix 3. Gloria master floor plan (1 <sup>st</sup> and 2 <sup>nd</sup> floor)	57
	Appendix 4. Standard video production contract	58
	Appendix 5. Filming risk assessment form	59
	Appendix 6. October #Beatz 2014 performance list	60



## List of Tables and Figures

Figure 1. Project flow and project stages	6
Figure 2. Example of camera positioning in a concert	12
Figure 3. Video crew schedule October #Beatz 2014	23
Figure 4. Video equipment list October #Beatz 2014	26
Figure 5. Multi-camera editing mode with Sony Vegas Pro	44
Figure 6. Audio editing with Adobe Audition CC	46
Table 1. Video crew's "Operation plan on D-Day" October #Beatz 2014	30
Table 2. Filming script October #Beatz 2014	31
Table 3. Risk assessment	34
Table 4. Equipment distribution list	37



### List of abbreviations

Abbreviation	Explanation	Abbreviation	Explanation
D-Day	Designated day	O#B	October #Beatz
Cam(s)	Camera(s)	MFF	Music for friends
DVD	Digital video disc	UAS	University of applied sciences
HD	High definition	DVE	Digital video effects
Gig	Equipment package	CG	Character generator
FOH	Front of house	ESU	Equipment setup
WS	Wide shot	FAX	Facilities
MS	Medium shot	Mac OS	Macintosh operating systems
CU	Close-up shot	Amp	Amplifier
ECU	Extreme close-up shot	Mic	Microphone
SFX	Sound effect	FPS	Frames per second
VFX	Visual effect	BPC	Bits per channel
DSLR	Digital single-lens reflex	DOF	Depth of field
VT	Video Tape	HDD	Hard disk drive
SCR	Studio control room	APS-C	Advanced photo system type-C
PCR	Production control room	CF	Compact flash
TB	Terabyte	SD	Secure digital
EF	Electro-focus	ISO	International standard organization
EOS	Electro optical systems	ENG	Electronic News gathering
		EFP	Electronic field production



## Glossary

Term	Definition
<b>Extreme closeup Shot</b>	A shot that show extreme details of the object, usually reveals hidden characteristic and emotion of the characters.
<b>Close-up shot</b>	Shot cuts out unnecessary images, shows object in details.
<b>Medium Shot</b>	Shot shows more images, less detail, good for a variety of shots, does not have as much impact as a close-up.
<b>Wide shot</b>	Shot establishes scenery and orients the viewers.
<b>Establishing Shot</b>	Acquaints the viewer with a subject or scene, usually a wide shot.
<b>Crane shot</b>	Shots that are taken by a camera placed on a moving crane or jib to capture the whole scenery.
<b>Cut</b>	Instantaneous change from one image to another one.
<b>Fade</b>	A gradual mix to/ from black to an image.
<b>Dissolve</b>	A gradual mix from one image to another.
<b>Super/ Key</b>	Super-imposing one image over another, usually with text and graphic.
<b>Pan</b>	Moving the camera horizontally.
<b>Tilt</b>	Moving the camera vertically.
<b>Dolly</b>	Moving the camera pedestal toward or away from the subject.
<b>Truck</b>	Moving the camera pedestal laterally across the set.
<b>Zoom</b>	Changing the focal length of the shot.
<b>A-roll</b>	Primary footage.
<b>B-roll</b>	Supplementary or secondary footage.
<b>Sequence/ Timeline</b>	Where all the cuts take place, a place to lay out clips.
<b>Levels</b>	The amount of loudness the audio of a clip or sequence will have this ranged from -infinity dB to 0 dB.
<b>Peaking</b>	A level of audio that reaches over 0 dB, which tops out and distorts.
<b>Edit</b>	To make a cut in a clip making it a separate clip.
<b>Transition</b>	An effect, which visually moves your video from one clip to another. There are many types of transitions.
<b>Key frame</b>	A marker that locks in a parameter for a specific property.
<b>Frame rate</b>	Number of frame in one second of the clip.
<b>Slow/ fast motion</b>	An effect to make the scene looks like time being slow down/



	faster than normal, which made by changing frame rate.
<b>Mark in/ Mark out</b>	Placing a marker at the start/ end position of chosen clip.
<b>Overwrite</b>	Editing mode that replaces old clips with new clips at the same place in the sequence.
<b>Tracks</b>	Where files are stored in the timeline.
<b>ENG</b>	Shooting specifically for use in news report.
<b>EFP</b>	Video production which takes place in the filming field.
<b>NewTek Tricaster</b>	A portable product that allow integration of live mixing, graphic broadcasting, web streaming together; often called as “studio in a box”.
<b>Fly-pack system</b>	Portable control system for multi-camera production at any location using available power.
<b>Remotes (Truck shoots)</b>	Portable studio control system build in a truck for mobility and bigger production where there is no studio available.
<b>Digital single-lens reflex camera (DSLR)</b>	Digital camera that combines the optics and mechanisms of single-lens reflex camera with a digital image sensor.
<b>Video camera</b>	Camera produced to capture motion picture.
<b>Camcorder</b>	Combine a video camera and a video recorder for easier portability.
<b>Full-frame sensor</b>	Image sensor format of which size is similar to 35 mm small film format.
<b>APS-C sensor</b>	Image sensor format of which size is similar to the classic advanced photo system, aspect ratio 3:2.
<b>Film production</b>	Video production that are used in producing films.
<b>Cutting A-B cameras</b>	Combining two or more raw footages with transition effects.
<b>The two-sided single</b>	A-B cameras shot the same object from the same angle.



## 1 Introduction

Due to the fast growth of music industry, the number of live music shows has increased significantly. Live music industry is estimated to be worth more than 25 million euros annually according to IFPI (International Federation of the Phonographic Industry). As a result, millions of live concert video productions are produced every year. They are distributed with various type of recoding products, for examples, DVDs, live-stream program, or videos uploaded on the Internet.

The development of current technology in audio and video display is another contribution of the extension of live-music production. The audience desires high-end audio and image resolution. As a result, there is a need for more information about production process and the way music concert videos are produced. However, very few books and articles related to this subject have been published up to now. Therefore, it is difficult for videographers to understand key concepts, and to know fundamental steps of concert production without proper guidelines or experience.



## 1.1 Project backgrounds

Music For Friends Helsinki (MFF) is a music club organized by international students with 5-10 active members and many volunteers. The club focuses on organizing musical activities and events for Helsinki citizens. In autumn 2014, MFF organized their first mid-professional concert. The group was in need of videos and media production for their performances throughout three hours of show time, together with other marketing materials.

Live-switching technique and post-editing were utilized in the projects to experiment and to get deeper understanding of concert video workflows. Production requirements and recording equipment vary in different productions even when location is the same. The purpose of this study is to find out the most efficient technique for concert filming under different scenarios.

This thesis studies three different productions: the October #Beatz 2014 concert video project and two other projects in 2015 and 2016 that were somewhat similar but added more insight into different aspects during video production. The aim was to find the best practices for live concert video production.

The location of the three concerts was "Gloria Cultural Arena", Pieni Roobertinkatu 12-14, Helsinki, Finland. Gloria Cultural Arena has been operating regularly since 1999 focusing on music events. Gloria aims at creating new cultural productions by youth groups and cultural groups and focuses also in theatre, dance, art and film exhibitions. Over 15 years, there have been over 700 000 visitors during over 3000 events in Gloria. Since 2014, Gloria became the main partner with MFF in organizing October #Beatz concert. Gloria not only provides a venue and musical instruments, but also sponsors O#B video projects especially with audio tech, stage lighting, and other effects. In 2016, Gloria sponsored all video equipment as well as recording system for MFF.

Case studies were carried out in Helsinki, Finland in 2014, 2015 and 2016. First project was in 2014 used five camera angles. In 2015, a bigger scale concert had



utilized six cameras and two goPros. Post-editing method was used in both years. In 2016, live-mixing method was used to conduct a comparison between post-editing techniques and live switching technique, as to figure out the most suitable methods for the concerts organization.

Case October #Beatz 2014: Multi-camera, post-editing production. Final product: concert video clips (post-editing).

Case October #Beatz 2015: Multi-camera production. Final product: full concert clips (sequences).

Case October #Beatz Concert 2016: Multi-camera live switching Production. Final product: Full concert video clips (multi scenes mixed).



## 1.2 Production challenges and the goal of the project

The host organization had little knowledge in video production and it was the first time they organized a mid-professional concert. As a result, there were some limitations in conducting video projects. First, the lack of budget led to limitation in human resources and equipment. Second, the stage dimension affected to the scale of the video production. Third, time management crisis occurred, due to the failure in project time estimation of the concert organizers. Finally, because sound system was built prior to the show by Gloria staff, it will not be explained in this project.

The goal of the project is to produce the best workflows for video maker in making of live concert video at a medium-sized venue, by researching the best practices. Moreover, it also aims at creating the internal instruction for media production plan of O#B as an annual event of MFF.



### 1.3 Structure of the report

In the previous section, project background and the goal of the project was explained. Next, the methods and workflow of the project will be discussed in more detail. In the following chapter, researches about background theories and best practices of multi-camera techniques will be covered. The following chapter collects information from different sources and synthesizes it into one final concert video production plan in the preproduction phase.

Next, production and postproduction processes, together with the usage results are covered. After that, a conclusion of two editing methods and their functionalities regarding the concert organization will be discussed. Finally, there is a summary of the whole project and how it succeeded.



## 2 Project flow and methods

### 2.1 Stages of the project

The initial step of the thesis is to decide the goal and outcome of the project. They were introduced in the previous chapter. The following picture (Figure 1) illustrates the whole project flow and its stages. It tells the inputs and outputs of different stages in a convenient graphical form. Next, the whole project flow in figure 1 will be explained in more detail.

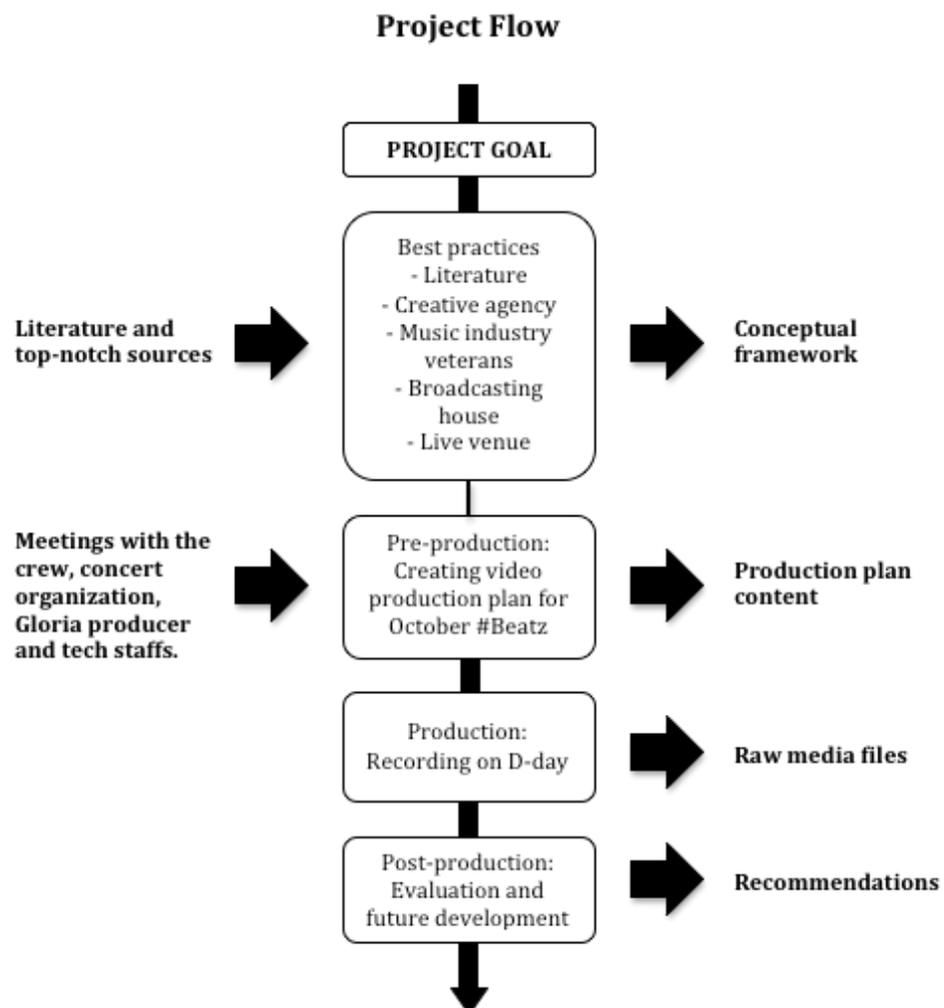


Figure 1. Project flow and project stages

## 2.2 Data gathering process

The project begins with general searching for best practices, process and workflow, and problem analysis from academic sources. Information was collected from books and publications of creative enterprises, broadcasting stations, live venues, entertainment organization, as well as from companies and people from music industry. The outcome of this method is a conceptual production framework.

Second, data from production-related sources was gathered. Information about venue, stage dimension, lighting condition, stage effects, sound system, and available video equipment was collected from Gloria's main producer and staff responsible for the concert. Data such as budget, quality requirements, duration of the show, number of performers, outfits, and the songs' structure were discussed during meetings with the concert organizers.

Next, it was important to find the best approach for the production within the team. This created the actual content for the production plan and pointed out the possible risks and improvement points for the conceptual framework.

During the D-day, the stage rehearsal testing was done within three hours before show time. Recording of video and audio were done according to plan without any major issues. After show time, recorded files were collected from Gloria's recording room to be ready for postproduction. These files are valuable material for internal and external use of the organization.

Finally, video editing and publishing were done with high quality audio and visuals. Final videos were uploaded on different social media channels. Practical experience of video production, building a plan processes, problem identification, and product reviews were also conducted during postproduction and recommendations for future development were given.



### 3 Best practices

Although multi-camera production is a highly practical task, it is crucial to understand the best practises that are widely used in entertainment industry. This chapter will take a deep look into the best practises of multi-camera production and will form a coherent picture on theoretical level, how multi-camera productions should be executed.

#### 3.1 Overview of multi-camera production

A multi-camera program is a program where multiple camera are used to record the action simultaneously from different angles. According to Churchman (2014) there are two main types of productions that are filmed using the multi-camera format: Live broadcasting and Studio programs [1]. Live broadcasting appears daily for example musical concerts, public events, or sports that are held live at big venues stadiums, stages, wedding halls, and so on. Studio programs are for example game shows, chat shows, studio comedy, and studio drama.

There are different types of multi-camera productions: studio systems, mobile television systems, film production, cutting A-B cameras and the two-sided single production (Jacobson 2010). [2]

Studio systems are built within a studio by wiring components of the gig like cameras, audio mixer, video mixer and lighting controller which together use various transmission signal cables. Most are recorded live to tape and require little editing, for example small fixes, and censoring of obscenity. Studio systems are commonly used in live streaming productions and broadcasted without further editing.

Mobile television systems are easily transported to a filming field where there is no studio available and which are often used for small productions. For the mobility and less expensive, this system is being used in a variety of scenarios and divided in four basic categorizes: NewTek Tricaster, ENG-style shoot, Fly-pack system, and Remotes. [3]



Post editing methods are commonly used in the making of live concert video. Post-editing means the recorded footages will be synced together with video editing software after the concert. Meanwhile, live switching technique utilizes a video mixer system to control and mix received sequences from cameras into one sequence during recording time. The thesis will discuss the differences in technical aspects, difficulty and efficiency between these two methods in section 7 of this thesis.



### 3.2 Job roles of a multi-camera production

There are many roles in a multi-camera production and different tasks must be achieved by many people simultaneously. In this section, I will introduce these different roles, their tasks, and the importance to the production.

**Video director:** a person who controls the video mixer during live switching. He or she communicates with the camera operators during filming to direct the cut and produce aesthetic footages. Video director has an important role in planning and postproduction.

**Audio technician** controls the audio desk. The main responsibility of the audio technician is to maintain a suitable audio peak at a balanced level that improves the harmony of the whole set. He or she could use headset and display monitors to check sound peak and level during the show time or listen to the sounds from the front.

**Set designer:** The set designer takes care of the look and positioning of objects on stage, includes decoration, background graphic, lighting, instrument, props, and so on. Set designer aims at creating the best ideas to support the content of the show with visual design.

**Producer:** he or she is the main contact person when decisions must be made. The producer has all essential information related to the production like budget, timing, etc. Producer's task is to make sure that the crew members know their responsibilities and that the production runs smoothly within the given schedule and budget.

**Lighting technician:** he or she creates aesthetic visual and lighting effect for the performance together with the set designer.



Floor manager or assistant director handles script and takes care of rundown lists. The assistant also supports the director in looking over the whole set to spot issues that need attention.

Graphic generator: different from graphic designer; a graphic generator utilizes the graphical system to run pre-made graphic. These graphics are, for example: information about speakers on the screen, special announcements, tables or lists to update the current situation of the show, intro, outro, advertisements, and so on.

VT Operator or technical runner works in control room to manage the recording equipment. VT operator makes sure video and audio are constantly recorded with good quality and in the right format. He or she often checks up the equipment settings, connections of camera and microphones, and the drive space of the recorder.

Camera operator controls the camera settings and films the set. Camera operators work often in accordance with video directors via a communication system. The number of camera operators depends on the scale of the concert. For a medium-sized venue, three to five skilled operators could be enough. In many cases, a camera operator could also cover two cameras. Figure 2 is a sample of video production of a bigger-scale concert. In this picture, the crew used nine cameras, the positions of which are shown below:



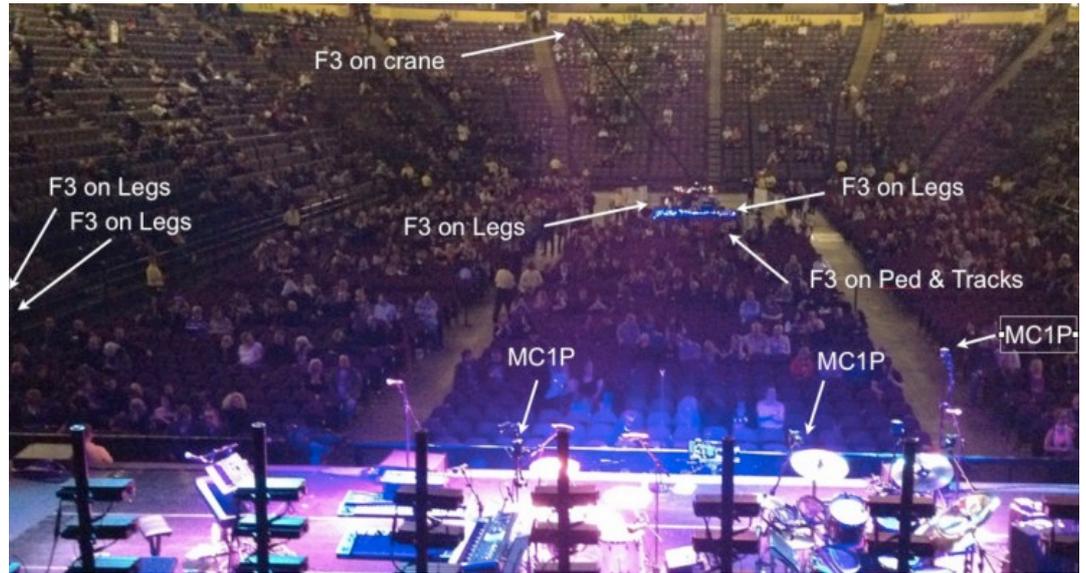


Figure 2. Example of camera positioning in a concert (Marine 2012) (4)

Gigs: 6 cameras F3-Sony and 3 mini cameras Sony HD MC1P

### 3.3 Production Equipment

The choice of most suitable equipment needs consideration regarding finance and efficiency in filming location. Production crews can either buy new equipment for long-term use or rent from equipment agencies in the case of short-term use. Basic video equipment that could be used in multi-camera video production are introduced below.

Camera: digital single-lens reflex camera (DSLR), video camera, and camcorders. Popular camera brands: Arri, Red, Sony, Canon, Blackmagic, Panasonic, and so on. Cameras and accessories should be compatible with each other. Besides, cameras should share the same make and model, although model can be slightly different in serial number due to differences in built-in settings of origin manufacturers.

There are different types of lenses: standard, macro, telephoto, wide angle, ultra-wide angle (fish eyes), kit, focal, and special lenses like soft-focus, infrared, tilt and shift lenses (Photography Mad) (5). Lenses are differing in focal point, aperture, focusing, image stability, mount, size, and weight, which accordingly used to produce different visual styles.

Other accessories include memory cards, battery, charger, card reader, aux cable, vid cable, lens control, filters, close-up/diopter, matte box, and lens adapter.

A cameraman needs supporting tools in order to film footages with both stabilized image and aesthetic movement, for example: Tripod, fluid heads, ball heads, monopods, tilt plate, adapters, cinesaddle, easy rig, flowcine, support systems, shoulder sets, handgrips, and sounter mounting accessories.

Crane is a popular equipment used in live filming. Cranes are varied in size and depend on the load capacity and length of loading arm. Dolly, JIB and Stabilizer: dolly, skateboard/ track dolly, dolly and jib accessories, track, heavy duty mini



dolly, mini dolly, slider, table dolly, JIB, JIB tripod, mini JIB, gimbal stabilizer, gimbal stabilizer accessories, steadicam, and car rig.

Video switcher/ vision mixer: a system that connects all cameras and mixes all video feeds into one single video sequence.

Audio desk/ audio mixing console/ Audio mixer: system used for adjusting volume and mixing audio feeds from microphones.

Rake receiver: signal antenna for better receiving and transmission to FOH.

Video cable: connect cameras to video mixer to transmit video feed.

Audio cable: connect all microphones to audio mixer to transmit audio feed.



### 3.4 Production work station

Front of house (FOH) position is an area set up in front of the stage, normally behind audience area. This is because FOH technicians keep tracks of the performance flow to make adjustment for sound level, lighting effect, graphic movement, and additional special effect like 'smoke'. FOH often includes sound desk and lighting desk, together with graphical computer and special effect or props controller. From here, sound technician listens to the performance during the show to identify problematic sound issues and balance the loudness and harmony of vocal and instrument. Sound technicians make sure the audience has the best audio quality during the concert. Besides, lighting technician observes the performance to adjust lighting system accordingly. Lighting technician takes a significant role in creating atmosphere for the performance through lighting effects. Similarly, graphic generator follows the performance to control graphic flow, smoke machine, as well as closing and opening the curtain using a controller.

Production control room (PCR) or studio control room is where composition of the program takes place in a television broadcasting firm. It is where audio and video recording systems are installed. PRC operators control the system and check continuous recording signals. Video feeds from cameras are being mixed in the PCR into one sequence. There is a communication system between PCR and FOH area, so that crew operation is smooth during show time.

Studio or post house is where post-production tasks like audio editing, sound re-recording, image editing, final fixes, credits, and subtitle adding take place. The post house has computers and needed tools for reviewing, editing, and supports publishing of final videos.



### 3.5 Benefits of multi-camera production

Multi-camera format is developed and used mostly for the benefit it provides to entertainment industry. This technique enables programs to be viewed in variable angles instead of only one, which is more visually interesting as well as create the pace, intrigue, and bring emotion to keep viewers engaged. Besides, shooting with many cameras at the same time means greater coverage of the action since there is only one chance to capture the moment during live events. Each of the cameras follow a different part of the action forms a coherent narrative of events without missing anything. Therefore, flow of different subjects' actions and reactions drives the emotional connection with the viewer; together they create the meaning of the story in the minds of the audience.

The multi-camera format helps to reduce production time. Firstly, reshooting the same action at different angles will be unnecessary in this case. Second, it produces less starting and stopping points during filming. Third, there is no need to relight the sets from different angles. In a nutshell, using multi-camera format minimizes production time and editing time and eliminates postproduction work.

Multi-camera products are useful in various occasions as well as for different purposes. One of the most popular usages of a live concert video is to publish it on the Internet for marketing purposes as to highlight the performance of the musicians. Therefore, quality requirements are high in both image and sound to provide the most aesthetic and vibrant experience for audience. Another product of the production is DVD, which will be put on sale to bring financial benefit for the music producers. Moreover, a booming aspect of the current music industry is live streaming concert via broadcasting channels, which requires professional multi-camera production crews.



### 3.6 Leadership and Project Management in Voluntary-based projects

The difficulties in leadership and voluntary-based projects are often related with lack of money, and the fact that people involved in the production as volunteers. When working in a non-profit environment, leadership and management skills are vital to make sure the project achieves the best results within its limited resources. Communication is the key of any project to ensure everybody knows what they should do and especially when to do their work. Therefore, meetings and pre-planning are important for the success of the project. Delivering products within given deadline depends on the availability of team members, which requires prior arrangements with post production. After making an initial conceptual framework, adjustments to the plan should be known by all parties to avoid miscommunication, over-expectation and unnecessary work stress on the team.



### 3.7 Visual Story Telling

In a concert, there are a lot of different visual factors to consider to deliver the message to audience such as lighting, video background, sound, graphic, stage decoration, performer's act, atmosphere and outfit.

During preplanning phase, filming crew should attend rehearsals, where they can watch and remember the movement of performers and eventually practice with cameras. Filming script notes the camera angles, type of shots, and moment to be highlighted for example instrument solo. Script ensures that the production achieves good visual level and avoids missing important details. Camera crews use filming script to practice operation and are ready for taking good shots of the objects while the camera director can take action in time. In postproduction, script helps to fasten the editing process since it marks out nice shots to be chosen.



### 3.8 Conceptual framework

After considering all the information necessary for the video production for O#B concert, it seemed logical to divide it in three phases: pre-production, D-day, and post-production.

Preproduction is the time used for preparing for a project. This includes getting involved with the concert organizers and building a good partnership with Gloria's main producer to learn about the scope of the concert, expectation of concert organizers, and availability of the venue. Based on this, I planned the number of crewmembers, sources of equipment, production costs, and my own timeline for leading the production. After working with concert organizers and contacting possible technical partners, I found the team and equipment that met up production requirements. Section 4 of this thesis will give more details on the preproduction phase.

Section five of this study discusses activities of video crew on D-day. The production crew will work according to an operation plan and filming script that have been made during preproduction. My tasks on this day were ensuring the timeline of the concert with the organizers and communicating with venue staffs. I also needed to prepare for making quick decisions in case of unexpected changes occurs, as well as give general directions and support team members.

Finally, post-production involves editing and publishing of final videos. Editing tasks are divided between volunteers. I gave the editors instructions on how to edit video and audio. This part will be described in detail in section six of the thesis.



## 4 Preproduction

Preproduction concentrated on collecting all necessary information and factors of the projects from MFF and Gloria to produce a suitable production plan for October #Beatz project indicating timing, objects, tasks, and operation. Timing attributes are the length and the order of performance. Objects mean the 'objects' being put in the scene, which mostly are performers, instruments, special details. Operation means the overall actions, and movement of each cameraman during the scene-in-action. A clear and specific plan helps the overall process run smoothly and helps creating a high-quality outcome product. During the D-Day, the planning sheet was printed out to hand over to crewmembers.



#### 4.1 Meeting with the concert organizers

In order to understand the need of multi-camera production and communicating the project, a meeting was held at the beginning of O#B project between video producer and concert organizers. In the meeting, it was agreed between the two sides that video producer has the responsibility on all matters that are related to media. In this case, the expected outcomes in exchange for MFF are media materials, and O#B videos.

We agreed that the organization has a very tight budget organizing the concert and creating media products. I needed to seek for crewmembers that would be willing to work as volunteers and get in touch with possible sponsors.

An agreement was reached covering things such as the goal of the project, estimated budget, project brief, tasks of producer and delivery. Appendix 4 (page 58) is a standard video production contract that was used as a reference during October #Beatz video production. In general, a production contract should include following information: Date and place of the contract establishment, names and titles of participants, contract's name and purpose, length of the project, brief job description, working schedule, payment method and extra payment, product delivery, terms and conditions, and signatures of both sides.



## 4.2 Filming location

Getting camera crew acquainted with the stage map certainly brings advantage to generate a quicker and smoother process. Therefore, a meeting with main producer of Gloria was held two months prior to the D-day, for me to discuss the venue and for crewmembers to get to know filming location. During the meeting, information obtained covered overall venue plan, production control room, technical staffs on D-day, and Gloria's available video equipment. Meanwhile, crewmembers took notes of whereabouts and numbers of electric sockets, stage dimension, and information related to their camera positions.

Besides information from Gloria, an "Instrument layout" document showing position of instrument was provided by MFF. This layout helped us to spot out free space for movement of crewmembers to avoid blocking audience view or accidentally unplugging cables.

Appendix 1 (page 55) – "Stage plan" illustrates design of the stage, its dimension of 4\*7 meters.

Appendix 2 (page 56) - "Instrument layout", demonstrates position of instrument: drum set, keyboards, amplifiers, cables, micros, stands, guitars, and so on.

Appendix 3 (page 57) – "Gloria master floor plan (1<sup>st</sup> and 2<sup>nd</sup> floor)" shows different sections of the venue.



### 4.3 Establishment of Production Crew

All crewmembers were volunteers from MFF and from my own network of professionals. Each of them had different skill levels and backgrounds. Selecting crewmembers and assigning tasks were based on their skill set. To find a suitable position with each person, I discussed with each individual prior to the first team meeting. During these conversations, we discussed about requirements and the current situation of the project. I also asked them about their availability during the whole project. Together we planned a crew schedule that would catch up with the concert's timeline. Figure 3 is the crew schedule conducted in the first team meeting. There are three production phases explained later in the study.

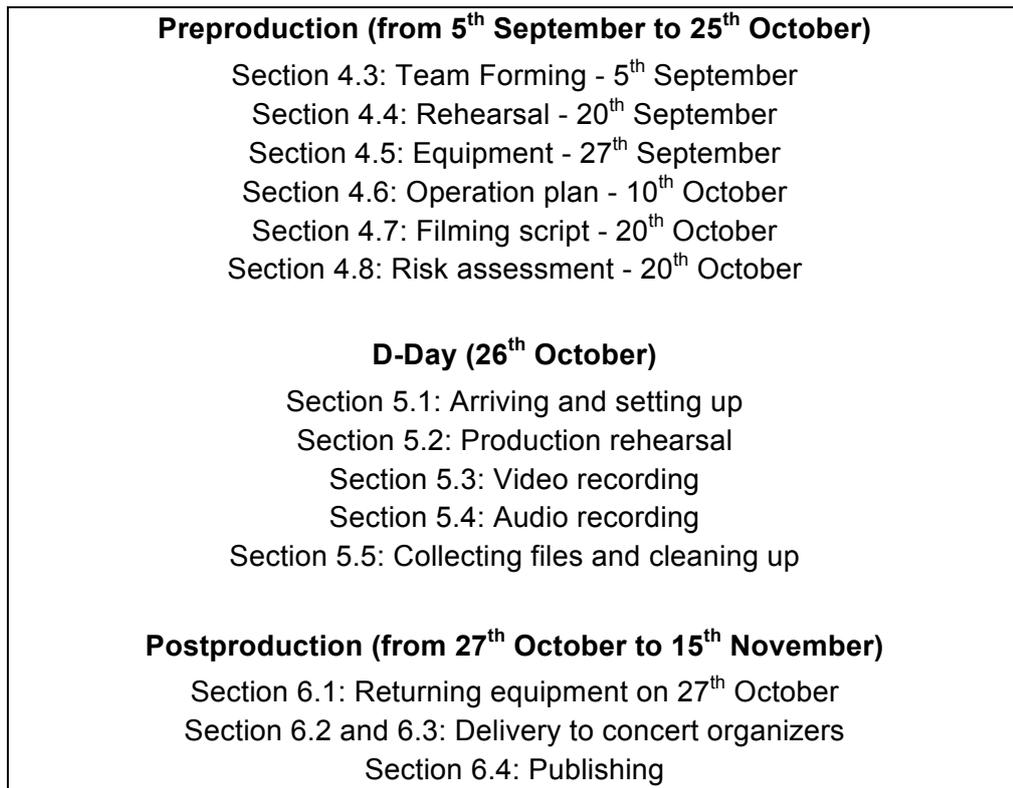


Figure 3. Video crew schedule (October #Beatz 2014)



**October #Beatz 2014 video crew members:**

Phuong Nguyen: producer, editor.  
Julien Masha: Camera operator (master).  
Hai Phan: Camera operator (close-up), editor.  
Dao Cong Thanh: Camera operator (on-stage).  
Chuong Truong: Camera operator (master 2).  
Thien Nguyen: Editor.  
Dang Vu Tung: Editor.  
Nguyen Pham Quang Huy: FOH assistant.  
Nguyen Dinh Hieu: PCR operator.  
Nguyen Tien Duc: Filming advisor.

**October #Beatz 2015 video crew members:**

Phuong Nguyen: Producer, editor.  
Thu Vu: Assistant director.  
Chuong Truong: Camera operator (master)  
Phuong Tho Doan: Camera operator, editor (onstage).  
Linh Tran: Camera operator (dolly).  
Nguyen Hoang Phuong: Camera operator (running).  
Lacey Nguyen: Camera operator, editor (close-up).  
Phuong Anh: Camera operator (Master 2).  
Nguyen Dinh Hieu: stage designer, FOH assistant.  
James Nguyen: PCR operator.

**October #Beatz 2016 video crew members:**

Phuong Nguyen: Producer, editor.  
Huong Thu Nguyen: Camera operator (close-up).  
Nguyen Hoang Phuong: Camera operator (onstage).  
Thien Nguyen: Editor.  
Joachim Luttinen: Video director.

**FOH audio and lighting controller, stage effects by Gloria's staffs.**



#### 4.4 Learn the performance - Rehearsal

A good understanding of the performances leads to visualization of filming techniques to use. Camera crew was asked to take notes on highlights of the performances, movement of performers, and details like facial expression or outfit during rehearsals. These affect the camera positioning as they convey critical details for filming with emotion.

The concert was being studied thoroughly, in terms of timing, number of performers, and song layout. These factors are indicated in final filming script. The object in focus will be chosen according to song layout. For example, the main vocal appears most often on the screen, while the guitarist should be the focus during guitar solo.

Appendix 6 (page 60) is the “October #Beatz 2014 performance list” that illustrates the details of performance conducted after rehearsals. One person was in charge of checking the length and timing of the performance. We also recorded the rehearsal for reviewing and later discussions.



## 4.5 Production equipment

### 4.5.1 Equipment sources

During the meeting with the concert organizers, we agreed that their budget was rather small for this production. Therefore, I needed to seek for video equipment; meanwhile concert organizers were looking for more financial support. After a lot of emails and phone calls, I got a list of equipment that are affordable and suitable for the project. My university - Helsinki Metropolia UAS campus in Leppävaara, supported most of the equipment. Besides, some of the crewmembers also brought their own equipment. A goPro camera was rented from Kinos Rental Oy with decent price. In order to keep track of all equipment, I made a list so that the crewmembers could check them easily (figure 4).

<b>Metropolia</b>		<b>Kinos Rental Oy</b>		<b>Chuong</b>	
Canon 5D Mark III	1	GoPro Hero 3	1	Canon 550D	1
Canon 5D Mark II	2	Batteries	3	Canon 700D	1
Canon EF 24-105	3			8GB SD	1
Canon EF 24-70	1			Tripod	1
Canon EF 24-35	1			<b>Thanh</b>	
Batteries	5			Canon 60D	1
Charges	3			16 GB SD	1
Bags	3			Tripod	1
GoPro Hero 3	1			<b>Julien</b>	
GlideCam	1			Tripod	1
32GB CF card	2			Laptop	1
16GB CF card	2			<b>Hai</b>	
32GB SD card	1			Laptop	1
Slider	1			Hard drive 2 Tb	1
				GoPro Hero 2	1

Figure 4. Video equipment list October #Beatz 2014



#### 4.5.2 Equipment preparation

In a multi-camera production, the ideal setup is to use camera of the same make and model to achieve the most similar image quality. Besides, camera profile, frame rate, white balance, and so on should be set alike in all the cameras. This will help the editors a lot in their work, as well as reduce production time and budget. Section 5.1 – “Arriving and Setting up” gives details of camera settings on concert day.

Filming a concert usually means capturing fast moving objects in low-light condition. We considered using color-flat mode, either with built-in settings of camera or installing “Technicolor” software. The colour-flat mode means low contrast and high dynamic range. This setup will create a base for syncing image quality-wise in post-production because it gives more flexibility on colour correction and colour grading.

The lens used for each camera depends on its position. Depending on distance to the stage and object in focus, each camera position chooses proper lens kits for accomplishing their tasks. One lens was given to a photographer, while camera operators used other lenses. Both close up and running positions were using Canon EF 24-105 mm f/4L lens so that they were able to zoom into the object. The onstage position was using EF 20-35 mm f2.8 wide-angle lens and master camera with Canon EF 24-70 mm ft.

Most importantly, battery and memory card provided for each camera unit must be enough to run through the whole concert. Each camera operator had at least two batteries and two memory cards, enclosed with one battery charger. Memory card compatibility had to be from 8GB and above, and 10-bpc as to better storing information on color depth. New card must be changed when the indicator that there are five minutes left shows up on the screen, and during song breaks. Besides, CF cards are faster than SD card and perform better for video, so they were used as primary cards.



Some cameras have dual memory card slots, for example Canon Mark III, which means the camera will automatically switch to another card when one is full. Since this feature is very useful for a camera that films continuously throughout the show without breaks, we chose this camera for master position.



### 4.5.3 Estimation of hard drive space

Below is an estimation of file size, both video and audio, to prepare enough capacity in hard drive.

$$(1) \text{ Image file size} = (\text{Bit depth} * \text{resolution} * \text{frame rate} * \text{duration}) / (8 * 1024 * 1024 * 1024) = (\text{TB})$$

Duration of the concert = 2 hours 22 minutes 18 seconds =  $2*60*60 + 22*60 + 18 = 8538$  seconds.

Resolution =  $1920 * 1080$  (pixel)

Frame rate = 29,97 fps (NTSC; high definition video)

Bit depth (number of color tones) = 24 bit

Image file size =  $(24 * 1920 * 1080 * 29,97 * 8538) / (8 * 1024 * 1024 * 1024 * 1024) = 1,4477$  (TB)

$$(2) \text{ Audio file size} = (\text{sample rate} * \text{bit depth} * \text{duration} * \text{channel}) / (8 * 1024 * 1024 * 1024 * 1024) = (\text{TB})$$

Duration of the concert = 2 hours 22 minutes 18 seconds =  $2*60*60 + 22*60 + 18 = 8538$  seconds.

Bit depth (number of sound levels)= 24 bit (DVD-audio quality)

Sample rate = 44100 Hz

Channel = 2 (stereo type)

Audio file size =  $(44100 * 24 * 2 * 8538) / (8 * 1024 * 1024 * 1024 * 1024) = 0,0021$  (TB)

$$(3) \text{ Video file size} = (1) \text{ audio file size} + (2) \text{ images file}$$

Video file size =  $1,4477 + 0,0021 = 1,4498$  (TB)

To conclude, an external hard drive of 1,5 TB or higher would be enough to store all data. We bought a 2 Tb hard drive since there is not much difference in price. We also had another hard drive to store backup files.



#### 4.6 Operation plan on concert day

An operation plan was made and handed over for crew members to make sure everything would run smoothly within the concert's schedule and also reduce risks.

<b>Time</b>	<b>Video crew</b>
11:30-12:00	Arriving
12:00-13:00	Set-up cameras
13:00-14:00	PCR test
14:00-14:30	Final check lighting, graphic, effects
14:30-16:30	Production rehearsal
16:30-17:00	Dinner
17:00-17:30	Announcement – group photo
17:30-18:00	Filming backstage
18:00-18:30	Final check equipment
18:30-19:30	OCTOBER #BEATZ - Part 1
19:30-20:00-Break	Check equipment
20:00-21:15	OCTOBER #BEATZ - Part 2
21:15-21:30	Closing and Cleaning up
21:30-22:00	

Table 1. Video crew's "Operation plan on D-day" October #Beatz 2014



#### 4.7 Final Filming Script

There were four camera positions in O#B 2014: master, on-stage, close-up, and running. Master camera was placed in front of the stage for a full shot, or close-up shot of object in focus. Running camera was in charge of establishing shot, or wide shot of the audience from above. On-stage camera focused on instrumentalists and shot from right side of the stage. Close-up camera covered objects from the left side of the stage. Besides, two goPro Hero cameras were attached to the drum, which required a person to turn on recording before rock performance. "Filming script" below illustrates the position and tasks of each camera operators according to the concert's timeline.

No	Type	Name	Time	Master (1 <sup>st</sup> floor)	Close-up	Onstage (Stage + backstage)	Running (2 <sup>nd</sup> floor + Running)
1	Musical Introduction*	All about you	4	WS	CU to performers	MS performers.	CU performers
2	Acoustic Band	Mưa hồng	4	MS	CU guitarist (film right hand at guitar solo 2'25").	CU vocalist	WS
3	Beginner Band (Acoustic)	The Show	4	WS	Audience, performers	CU guitarist vocalists	WS audience
4	Acoustic Band	Ba kẻ con nghe	4	WS	CU vocalist	CU bassist	MS
5	Beginner Band (Acoustic)	Riptide*	4	WS	CU vocalist	1. CU guitarist 2. Chorus (1'20"): CU drummer	1. MS 2. WS audience
6	Acoustic Band	9 Crimes*	4	MS	Flowerpot at beginning. CU guitarist (left)	CU vocalist (right)	WS
7	Dance*	When you look at me + My goodies*	3	WS	CU dancer	CU dancer. Note: She lies on the floor at 2'30".	WS audience from behind
8	Band - Jazz*	Don't	5		*Vocalists	Vocalists, solo	WS



		know why*			solo bass after chorus 2	instrumental	
9	Acoustic band	4 Chữ lăm*	4		Vocalists	*Drummer, keyboard, guitarist	WS
BREAK				Change new memory card and new battery, charge used battery, transferring files into hard drives.			
10	Band - Indie	Little Talk*	4	1. MS 2. CU vocalists 3. Ending (3'50''): WS	CU female vocalist (left), guitarist	CU male vocalist (right), band	1. WS 2. Ending (3'50''): MS
11	Acoustic Band (Korean)	Aloha	4	WS	CU guitarist, vocalists	CU band	MS
12	Acoustic Band	Chuyến Xe	5	WS	CU vocalist	1. CU band. 2. CU guitars solo 3'40''.	MS
13	Band - Alternative	Counting Stars*	4	WS	CU vocalists	CU band	MS
14	Dance*	Never Ever	5	WS	CU dancers	MS	1. MS 2. WS audience
15	Acoustic	Blower's Daughter	4	WS	MS vocalist	CU vocalist	CU vocalist
16	Band - Rock *	Sắc Màu + Đám Cưới Chuột + Seize the day + Nói vòng tay lớn	25	Phuong: start recording two goPro cameras.			
				WS	1. CU vocalist, guitarist 2. MS band	1. CU band 2. MS from behind vocalist	CU band MS

Table 2. Filming script October #Beatz 2014



#### 4.8 Risk Assessment

There is always a possibility for many unexpected changes on the D-Day, which requires crewmembers to quickly adapt. The production often depends a lot on the venue situation, logistic, timing, etc. However, a well-prepared crew will be more confident to solve the problems.

Camera operators should avoid blocking audience by keeping moving while doing handheld work and not block one's view for too long. It is recommended that staffs wears black not disturb performers. A perfect movement shot would be smooth if the tripod was put onto balance areas.

Risk assessment had been carried out during a crew meeting. Figure below is a table of risks that might occur, their probabilities and impacts, as well as the solution to adapt in each situation.



<b>Event</b>	October #Beatz	<b>Date</b>	26th October 2014	<b>Venue</b>	Gloria stage Helsinki
--------------	----------------	-------------	-------------------	--------------	--------------------------

<b>(1) Activity/ Area of concern:</b> What is taking place as part of the event?	<b>(2) Hazards identified</b> What can cause harm?	<b>(3) Person at risk</b> Who could be harmed by the hazard?	<b>(4) Current risk factor</b> (high, medium, or low) Evaluate the level of risk	<b>(5) Action to be taken to minimize each risk</b> What action can you take to lower the level of risk	<b>(6) New risk factor</b> (High, medium, or low) appears after action taken
Miscommunication among crewmembers	Team member does not work in harmony with the team.	The crew	Medium	Discussion and handout script and operation plan.	Low
Recording system stop during show time	Files broken or missing	Producer Editor	Medium	Always have one technician present to check and solve the issues.	Low
Camera stop working	Run out of battery or memory spaces, or suddenly stop.	Camera operator	Medium	Prepare at least two batteries and two memory cards for each camera.	Low

People on stage accidentally pull out a signal cable.	Transmission signal from one camera or microphone is lost.	Video director, Producer	Medium	Fix the cable by taping it with the floor and around the jack.	Low
Equipment broken or lost	The person in charge and producer need to take full responsibility.	Producer and the person in charge.	Low	- Have backup equipment. - Buy equipment insurance.	Low
Concert starts later than the schedule.	The timing of filming script will be change and may cause difficulty during operation.	The crew	Medium	Producer works with concert organizers to minimize all factors that would delay concert time.	Low
One or more crew member misses the operation plan.	The production operation will be delayed and hard to control.	The crew	Medium	Assistant director follow the tasks and support members when needed.	Low

Date: 23th September 2014

Table 3. Risk assessment



## 5 Production - Recording on D-Day

### 5.1 Arriving and setting up

It is essential that the camera crew arrives in time. Normally, it takes about one hour for setting up equipment. In case of live switching it takes more time to connect cameras with output video mixer and test if the video signal system works. The crew needs to arrive to the filming location at the same time with logistic team to load down video equipment and bring them inside the PCR.

Master camera gig was put on a camera riser of 0.5 meter high. The tripod was adjusted so that the lens of the camera is at eye level with the performers on stage. The camera was tilted down to reserve space for headroom.

It is essential to match different camera angles qualitywise. The first step is to choose the camera of similar make and model (see table Equipment distribution list below). The next step is adjusting camera settings, so that each angle will produce image as similar as possible with other angles. To make sure there are no mistakes, we double-checked these settings before show time.

We agreed prior to the event to go with frame size 1920\*1080 pixels, and set the frame rate to 29.97 progressive fps. Since stage lighting was built in the same day right before rehearsal, shutter speed was set afterward based on testing lighting condition. Shutter speed was adjusted slightly up or down around double the frame rate of the camera in accordance with lens type and camera angle of different camera positions. White balance was set to the same custom, using a white paper held in front of the cameras. All cameras were set to similar ISO at first, as low as possible in given lighting condition. After that, we tested filming during rehearsal and then comparing images to adjust ISO level of each camera slightly so that the images matched closely. The goPro camera footages were synced qualitywise during postproduction.



Equipment should be delivered simultaneously to the venue. Distribution of equipment to the members was in accordance to their tasks and position. A list of cameras, accessories, and people in charge of them had been made so that crewmembers could easily keep track of them (table 4). This list helped avoiding losses, as well as helped the members easily seek for equipment if they need during show time.

	Camera	Lens	Battery	Memory cards	Accessories	Others
(Phuong)	2 goPro Hero 3		2	32Gb Micro SD	goPro mounts, Charger	Watch
Master (Julien)	Canon 5D mark III	24-70	2	32 GB CF	Tripod, Charger	Watch
Close-up (Hai)	Canon 5D mark II	24-105	2	2 * 16 GB CF	Charger	Watch
On-stage (Thanh)	Canon 60D	20-35	1	32 GB SD	Glidecam, Charger	Watch
	Canon 700D (back up)	Same	1	16 GB SD		
Running (Chuong)	Canon 5D mark II	24-105	1	32 GB CF	Tripod, Charger	Watch
	Canon 550D (back up)	Same	1	8 GB SD		

Table 4. Equipment distribution list



## 5.2 Final rehearsal

Facilities check was conducted during final rehearsal, right before the audience arrived to the venue. Gloria staffs did sound check and lighting tests, with the support of MFF's technical assistant to ensure the flow of the concert. In the meantime, a trial rundown was also being performed, to test the communication system between PCR and FOH positions. Camera operators double-checked their own gear. Camera operators also practiced their movement for smooth pan, tilt, zoom, and so on.

Lighting conditions during rehearsal were exact. Camera operators recorded some trial scenes in lowest and strongest lighting states to choose the right setting. Since the spotlight's direction was uncontrollable, we needed to point out the lighting spots for performers. Rehearsal was finished 10 minutes before door opening time, which was just enough for final check of camera settings to ensure similarity and consistency.



### 5.3 Video recording

After the concert, I made interviews with camera crew to ask about issues and difficulties during show. Some issues to master camera and on-stage camera identified were solved and support was given during show time.

The master camera tripod was put onto a camera riser. Master camera operator stood on a chair to control the camera, which is not so stable and caused him difficulties while filming. Unfortunately, it was hard to find a more stable support.

Secondly, the on-stage camera operator had problems with moving around since there were many cables on the stage, and it was very dark during breaks between songs. To solve this, we taped the cables to the floor so that the operator would not accidentally unplug them.

During a short break of 15 minutes, crewmembers gathered in the PCR room to check all their equipment. Recording video files of part 1 of the show was transferred from the memory cards to two laptops, and from computer to external hard drive afterwards. Due to time limit, two laptops were used for transferring files at the same time. In the meantime, used batteries were put in the charger, and a new battery was replaced in part two of the concert.



#### 5.4 Audio recording

Sound is an essential part for any video production. In the case of concert video, audio is even more important and requires special attention during recording as well as post editing. Speaking of audio-related problems that might occur in a real concert, some common ones are for example: too much ambience noise, instrumental mistakes, unbalanced sound, etc.

Audio recording for O#B was done using recording equipment and control room of Gloria. The recording system connects to all instruments setup on the stage and transmits multiple audio signals into its internal drive. Sound check and audio recording test were done right after stage setup. Microphones were also setup by front of house technicians of Gloria in accordance with “Instruments layout” (appendix 2) provided by MFF.

The number of audio output tracks equals to the number of microphones and instruments used for the show. Even though recording is automated, PCR operator was present all the time to ensure recording. Recording started from the beginning till the end of the show for about three hours without any disruption.

## 5.5 Collecting files and cleaning up

At the end of the show, PCR operator stopped the recording and collected the files. There was an issue with HDD format, which took us some extra time to change to compatible one with the recording system. At the same time, crewmembers brought back in-charge equipment and packed them in their original camera bags.

After the show, it took around five hours to transfer all files from memory cards into two hard drives. After that, I could clean up the equipment, format the memory cards, and charge the batteries to full. All equipment was packed in good condition and returned safe and sound in the next morning. To conclude, the production went well according to our operation plan and all members achieved their own tasks.



## 6 Postproduction

Workflow of editing multi-camera sequence:

- Step 1 - Create New Project: Choosing setting either of preference or match with the original sequences' setting.
- Step 2 - Import footage: Add all video clips of the editing performances into the workspace.
- Step 3 - Synchronize footage: Match all video clips by associating audio.
- Step 4 - Enable multi-camera edit: turn on multi-camera mode.
- Step 5 - Editing: Choosing scenes, add effects, adjust color.
- Step 6 - Rendering: Choose preferred output file format depending on the publishing channels.

Section 6.1 and 6.2 below are details of video editing and audio editing, related to software and process used in O#B video project.



## 6.1 Video editing workflow

Editing software such as Adobe Premiere, Sony Vegas, Lightworks, Movie Edit Pro. Multi-camera editing have two parts. The first thing to do is synchronize all the video clips of one performance. It will help to edit, cut, and continue between two cameras at the same moment which is especially useful when music-recording videos go with its own audio track. Computer programs such as Singular Software's "PluralEyes" can be synchronized using an internal feature. "Pluraleyes" (\$149 or free demo at [singularsoftware.com](http://singularsoftware.com)) allow dropping of multiple clips from different cameras into Final Cut Pro for automatically video tracks synchronization based on associated audio [6].

For real time productions like broadcasting music events, live video switchers are ideal to produce multiple camera productions on the fly. Live switching of multiple video sources allows not only shooting but also nearly finished products while the concert is still in process. Signals switch between video inputs choosing one from optional effects like dissolves, fades, and wipes [7].

In postproduction, we combined sequences together in multi-camera editing mode. We slowed down the video playing speed, so that we had enough time to choose the best angle among input sequences. After that, color correction and color grading were made to ensure image consistency, especially with goPro footages. Software used was Sony Vegas Pro 13, for its powerful built-in multi-camera-editing mode. Below is a picture of the editing process.



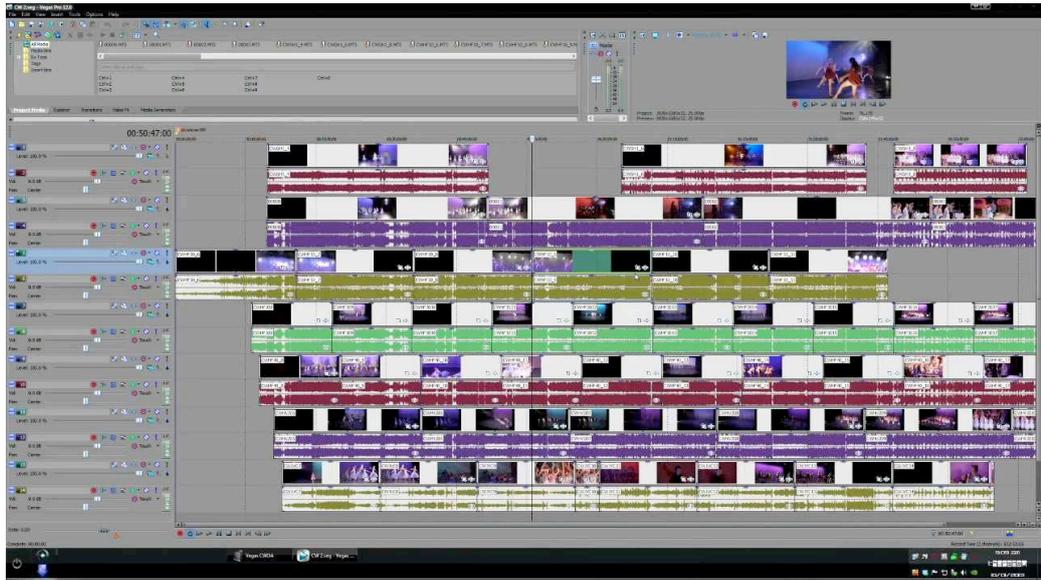


Figure 5. Multi-camera editing mode with Sony Vegas Pro

## 6.2 Audio editing

In fact, most professional live concerts are rerecorded in the studio. Even though O#B is mid-professional and nonprofit, rerecording of vocalists and guitarists was done by concert organizers in home studio to enhance overall audio quality. The option of live audio mixing is possible with Gloria equipment. However, due to limitation in post, we decided to do audio mixing afterwards. Post mixing allows re-recording in the studio or added effect for instrument tracks. Because of the flexibility of postproduction, any mistakes of instrumentalists or singers could be fixed by re-recording in the studio.

For O#B project, audio editing software used were Adobe Audition CC, and Logic Pro X on Mac OS. Logic Pro X was used for synchronizing vocal and instrument tracks. To add effect for audio tracks, we also used EZ Mix which is a sound effect plugin. After the concert, all singers had been invited to a home studio to re-record their singing. For this job, Adobe Audition was used for recording and editing. Re-recording was also done for several instrument parts that had issues during show time. This process was very time consuming but made a significant enhancement on sound quality for the final products.

The audio editing process started with mixing raw audio tracks into one workspace. For O#B 2014, there were 20 tracks of vocals, guitars, bass, drums, keyboards. All tracks have same length, so we did not need to worry about time mismatching. Then we balanced their volumes, set master volume to peak of 0 db. We also compare the master volume with volume of a random official music video on YouTube to ensure that sound level will be reasonable for audience. Next, we added effects for different tracks to produce a better harmony for the song. Finally, we rendered final files into mp3 format at sample rate 44.1 Hz, two channels (stereo type), and bit depth 24 bits for DVD-audio quality.



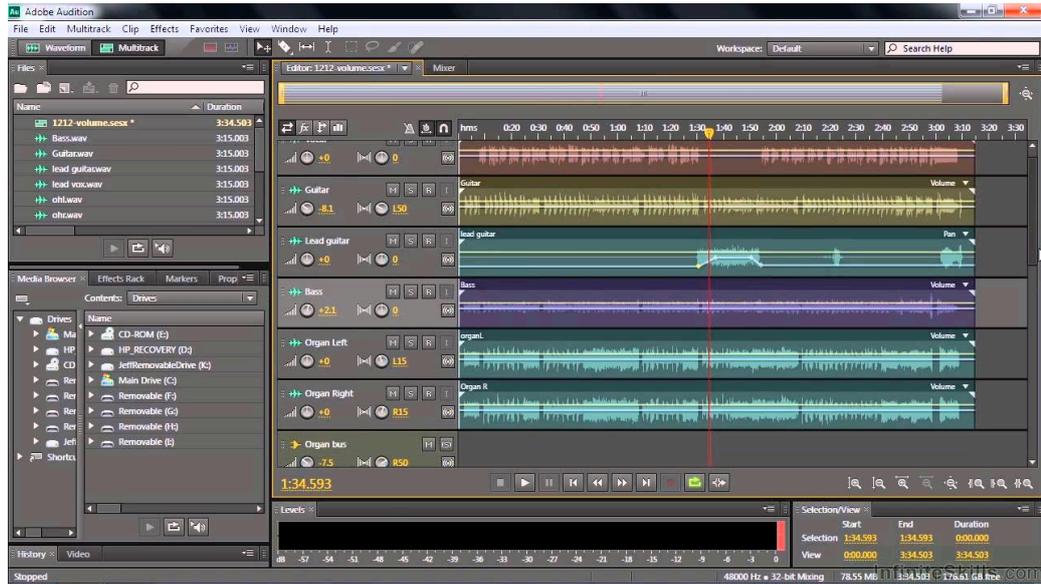


Figure 6. Audio re-recording and editing with Adobe Audition CC



### 6.3 Publishing

Before publishing the final products, copyrights must be considered. Unauthorized use and/or duplication of copyrighted material is considered violation of copyright law in many countries. For example, a piece of video publishing on free video-sharing platform like YouTube cannot be viewed in country if it is identified to have copyright issues. Copyrighted material includes software, documents, graphics, lyrics, photographs, clipart, animations, movie, and video clips, as well as sound and music. Because the concert played covers of famous songs, we met a series of issues with licenses when publishing on YouTube. This problem could not be prevented since video crew had no control over the content. However, I suggested the concert organizers to email the license owners about the permission to cover the songs.

To make a DVD, a DVD burner connected to or installed in a computer is required. DVD authoring program is used to burn video files into DVD so that final product can be play in a standard DVD player. Most popular programs are WinX DVD, Window Media Maker for Windows OS, Burn for Mac OS, DeVeDe for Linux OS. Burning a DVD processing time depends on three factors: the length of the added video files, computer system resources, and speed of the DVD burner. Even though this was not done, the edited video files are being stored in MFF's hard drive so that they can put them into DVD whenever their budget allows. [9]

The main concert organizers gave credits for people involved in the concert. A list of credits with name and title was checked carefully and delivered to the editors. This list mentions all participants of the concert, as well as its sponsors, partners and special thanks to people who supported the concert, including the audience.



## 7 Multi-camera post-editing versus live switching techniques

Decision making in video production usually depends on budget, timeline, and quality requirements. Video production of a concert is based on these aspects to adjust the production plan to fit well for different project sizes and purposes. Postproduction is usually the most time-consuming process, which requires visual skills on colour correction and video transition, creativity, and eventually critical thinking.

This section discusses the advantages and disadvantages of post-editing versus live switching. The purpose of comparison is to provide a practical base factor for decision makers while choosing a suitable technique for their project.

With a voluntary-based project like October #Beatz, the decision depends only on the availability of editors. For its limitation on budget, the concert organizations had trouble with completing post-editing process even though original footages and audio tracks are ready.

In 2016, because of resource constrains, the concert organizers had considered a no-video option, which apparently affected to the morale of performers and other volunteers. So, I suggested that they cut off major post-editing work by utilizing live-switching video system of Gloria. I contacted Gloria's main producer to ask for permission to use their in-house equipment. This resulted in reduction of crewmembers, production time, equipment costs, and the elimination of post video editing.



## 7.1 Production comparison

The need to use the filming script differs from production to production. In case of using video mixer, filming script takes a more important role than in post-editing. This is because post-editing gives more flexibility in editing time, while live-mixing often skips post-editing because of time limits.

Secondly, live switching is considered as a higher professional level production in terms of timing and requirements of final products. Usage of live switching is most often seen in live streaming shows, while post-editing is being used for film or marketing video production. Hence, live switching requires the production planner, the director, and crew to remember script well in advance. The crew also needs to have an ability to respond quickly to unpredicted changes during show time. A live-stream show is often appearing on audience's screen some minutes later than the real time. This is not only because of the speed of signal transmission, but also to have extra time for fixing technical problems that occur in filming occasionally. This method is preferred for being convenient and neat, as well as delivering aesthetic footage to audience during the event.

Third, total production time is shorter in the case of live switching compared to post-editing. Live switching means that the footages are mixed at the same time as they are being recorded using video mixer system. It eliminates the time of importing footages, synchronizing timeline to the right moment, choosing the best angle in multi-camera editing mode, colour balancing, post cutting, inserting graphic or music.

Lastly, production equipment is different. Post-editing does not need a video mixer system. On the other hand, live switching requires video and audio system, and a graphic generator, which is hard to set up and much more expensive to rent. As a result, live-switching production requires more crewmembers on board than post-editing techniques.



## 7.2 Final Product Comparison

Total production time of live switching is shorter than post-editing since it eliminates post-time. However, final products differ in quality including the aesthetic level of shots, lighting, audio quality, as well as compatibility between scenes and music transition.

Colouring and lighting in live switching are achieved through pre-setup of the venue and camera-syncing image qualitywise. They might be affected by the change in lighting condition, especially for outdoor filming. In post-editing, however, the editor can push colour to flatten mode, or using colour-flat mode while filming, so that the footage colours are without gradations, screens, or half-tones. With colour flattening, editors can bring back original and natural colours in postproduction to all sequences, before altering them in grading.

Regarding audio quality, post-editing offers the opportunity for rerecording to replace mistakes during show time, and enhances overall quality through reducing ambience noises, adding effects to instruments, and improving harmony of the song. In case of O#B, we aimed at producing quality contents especially focused on audio, so that audio mixing was done in postproduction and took longer time than video editing.



## 8 Future development – Live streaming a concert

Future partnership had been confirmed among the author, Gloria, MFF's concert organizers. A suggestion for their next concert is live streaming via MFF's social media channel with video system of Gloria. Live streaming and filming equipment are available at Gloria for use. Moreover, a new system of Black Magic cameras had been installed, allows different and flexible filming angles for the videos. Therefore, live streaming option is doable, and also a trend in social media at the moment. Besides, technologies are being developed to bring the authentic and ambient sound for viewers, which lead to the reality of streamed concert in the future. Issues to be considered using this technique might relate to the crewmember's levels, sound quality, music and background graphic creative licensing, and the video's quality in general.

In the future project, if the budget allow, we would be able to utilize more equipment for examples cinema zoom lens, gimbal, track, crane; also additional "audience cameras" and "backstage cameras". Crane shooting allows an overview of the audience and full stage with long shot giving viewers scenery of the concert in a whole. Dolly, track, gimbal, steadycam, etc. are used in shooting of moving objects for visualizing movement. 'Audience camera' focuses on audience's facial expression and reaction. Backstage cameras shoots the activities happened inside the backstage plus scenery from back of stage down to the audience.



## 9 Project evaluation and conclusion

In this study, theories of multi-camera technique were investigated and implemented into reality to create a step-by-step instruction of producing a concert video production. Case studies O#B concert videos were studied to collect experience and examine the way production crew works under certain conditions, and what factors could affect the workflow and quality of final products. The end of this study demonstrated a clear instruction of live music production from initial phase of creating a plan to finalizing the process demonstrated through figures and examples. It is essential to understand the difference in concert scale to draw appropriate adjustments for bigger projects. The final products published on the Internet of the three case studies demonstrate the effectiveness of the outlined instructions. The concert organizers, Gloria staffs, and audience gave the project positive feedback.

Personally, after the thesis project, I was able to use the knowledge and experience learned to participate in a student-run television programme for a Finnish channel and got the role of Technical producer for TEDxOtaniemi. These projects utilize multi-camera knowledge as well as project management skills that I had built through case study projects. Not only me, but also my team members had gained hands-on experience, technical theories, leadership, and management skills to develop their own career path. Therefore, these projects were a very valuable experience for my personal growth and professional development.

To conclude, the thesis had successfully achieved its goal of giving instructions and recommendations for medium-sized live music video production. Future concerts have access to video equipment sources, and hard drives that store all their media materials. The concert videos published as part of this project are of high audiovisual quality. A presentation was given to demonstrate the workflow, briefly report different issues, and introduce the final products.



As a final word I would like to thank the people I have been working with, the concert organizers, and my thesis supervisor. The project has been very interesting and offered a great learning experience for my career.

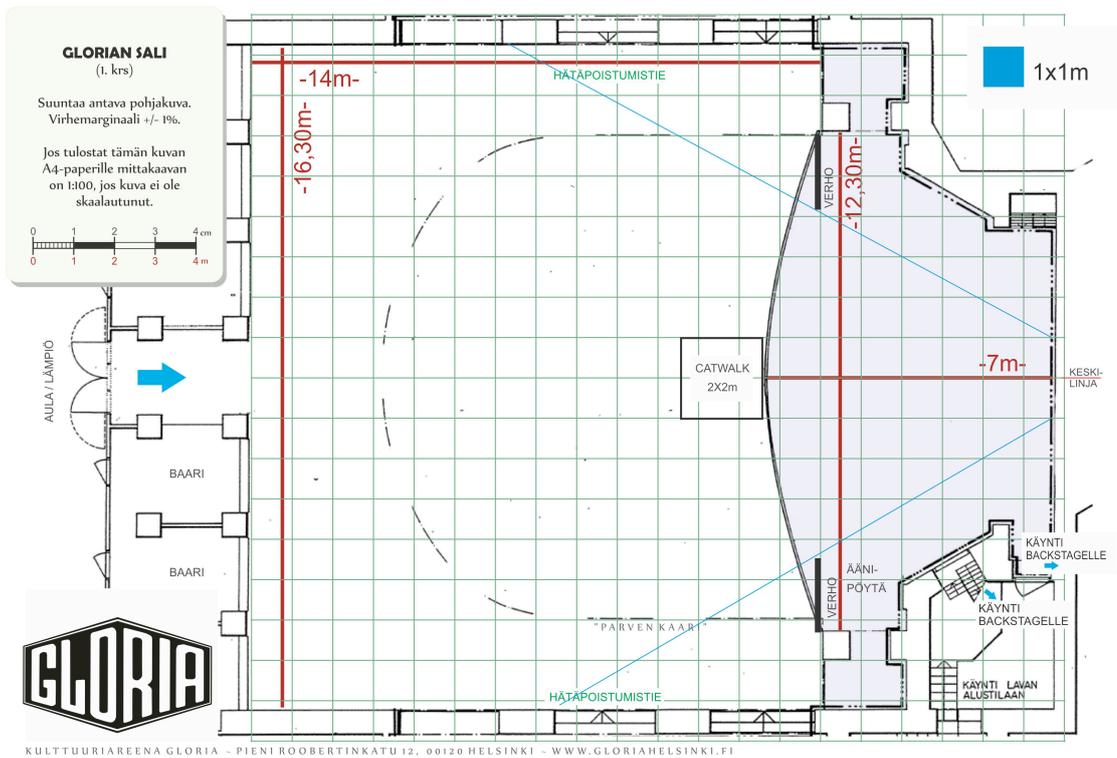
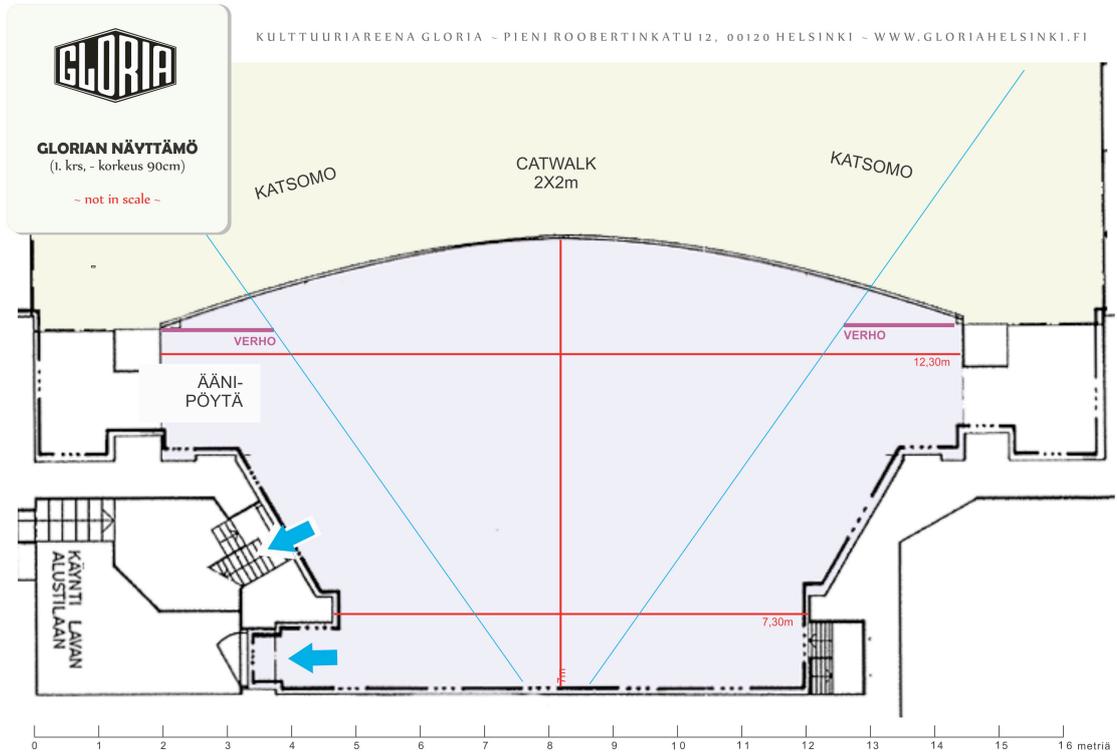


## References

- [1] Churchman, K2014, *Unit 23: Multi-camera production*. Available from: <https://prezi.com/f-5fbphxw1c5/unit-23-multi-camera-production/> Accessed 19 December 2017.
- [2] Jacobson, DH 2010, *Mastering multi-camera techniques from preproduction to editing and deliverables*, Focal Press, Sydney.
- [3] Marine, MG 2012, *How to Shoot a Musical Performance Cinematically: Duran Duran Live with Den Lennie*, image. Available from: <http://nofilmschool.com/2012/07/cinematically-shoot-musical-performance-duran-duran-live-with-den-lennie>. Accessed 24 December 2017.
- [4] Photography Mad, *Camera Lenses*. Available from: <https://www.photographymad.com/pages/view/lenses>. Accessed 29 December 2017.
- [5] Cassidy, K2010, Videomaker, *Multi-camera Shooting*, Available from: <https://www.videomaker.com/article/c10/14563-multi-camera-shooting>. Accessed 1 January 2018.
- [6] Patterson, K 1997, Videomaker, *Choosing the Best Video Mixer*, available from: <https://www.videomaker.com/article/3069-choosing-the-best-video-mixer>. Accessed 15 January 2018.

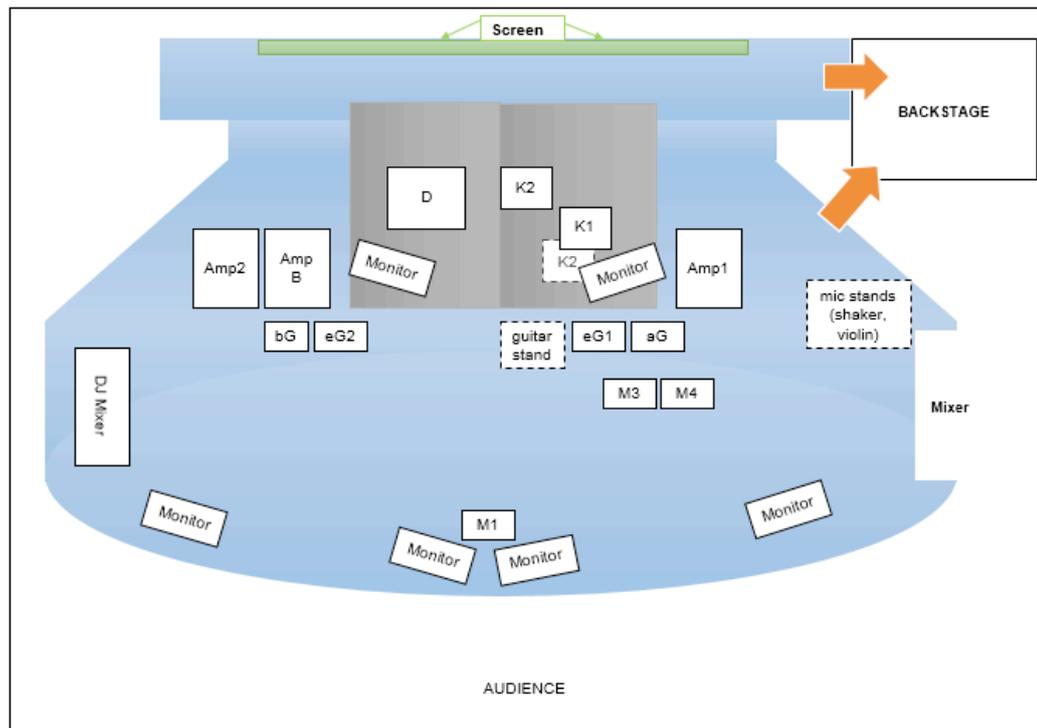


### Appendix 1 Stage plan

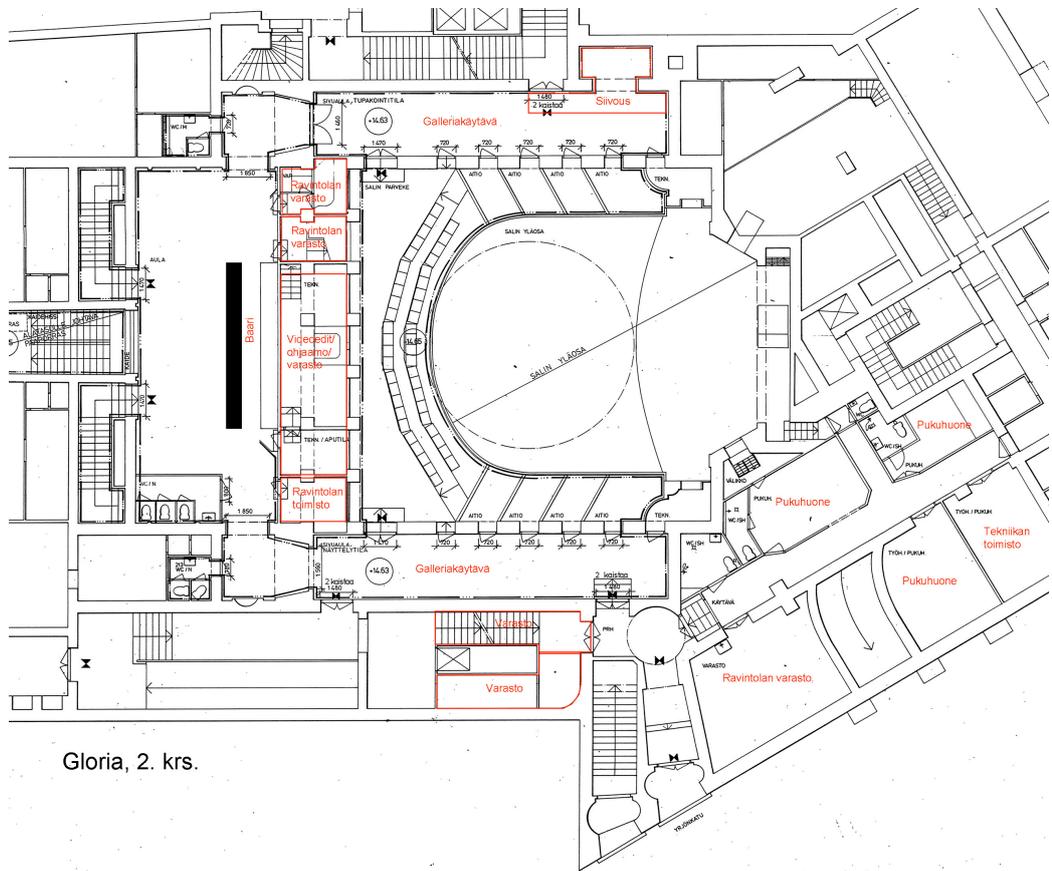
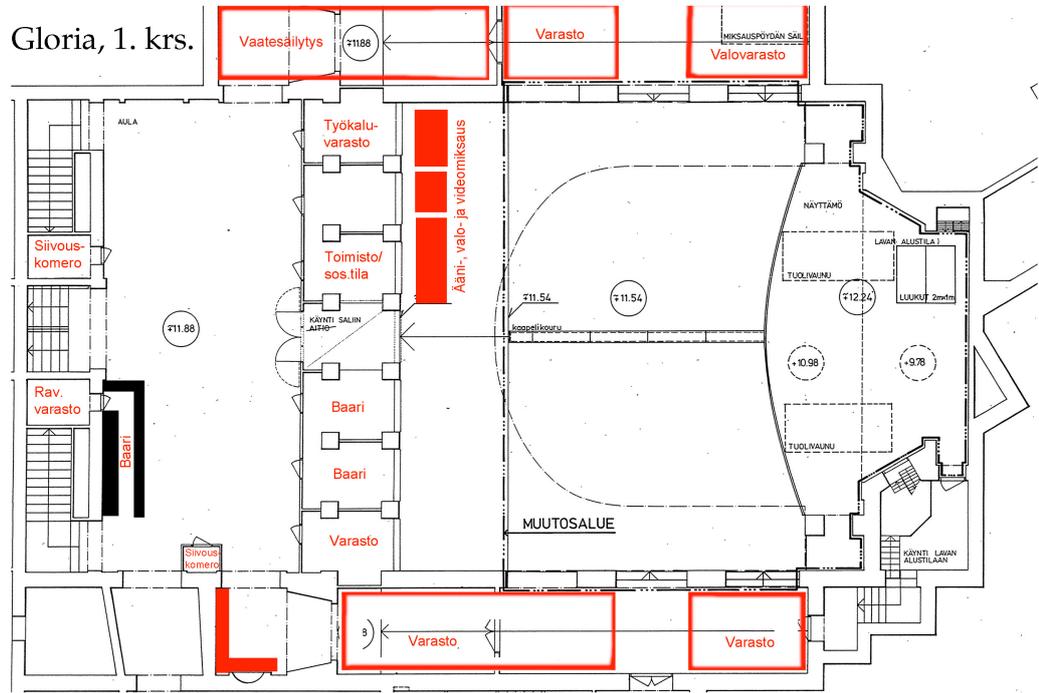


## Appendix 2 Instrument layout

#	Instrument	Code
1	Acoustic guitar	aG
2	Electric guitar 1	eG1
3	Electric guitar 2	eG2
4	Bass	bG
5	Keyboard 1	K1
6	Keyboard 2	K2
7	Drum set	D
8	Ukulele	Uku
9	Shaker	Egg
10	Violin	Vio
11	Microphone 1	M1
12	Microphone 2	M2
13	Microphone 3	M3
14	Microphone 4	M4
15	Microphone 5	M5
16	Microphone 6	M6
17	Guitar Amplifier 1 (head + cab)	Amp1
18	Guitar Amplifier 2 (head + cab)	Amp2
19	Bass Amplifier	AmpB
20	Monitor	Monitor



Appendix 3 Gloria master floor plan (1<sup>st</sup> and 2<sup>nd</sup> floor)



## Appendix 4 Standard video production contract

### PRODUCTION AGREEMENT

Date \_\_\_\_\_ Job # \_\_\_\_\_

This Agreement is made as of this date, \_\_\_\_\_, between \_\_\_\_\_ Contracting Client ("**Client**"), and \_\_\_\_\_ ("**Producer**").

Producer hereby agrees to produce and deliver to Client the production of the below referenced media(s) ("Specified Media(s)"), subject to and in accordance with all terms, conditions, and specifications set forth herein. Producer responsibilities for furnishing media are detailed in attached Addendum A Production Specifications Form.

#### PROJECT

Producer and Client agree to the below project summary, the project contract price and the more detailed production outline of Addendum A Production Specifications Form.

Project Title	Max Length (seconds or minutes)	Media Use (broadcast, web, dvd)	Territory (local, regional, worldwide)	Sound design (yes/no)	Sound clearance (yes/no)
1.					
2.					
3.					

\*Project does not include subcontracting a third party editor or post producer.

**Total Project Cost:** \$ \_\_\_\_\_. **Contingency Day Cost:** \$ \_\_\_\_\_.

Due upon signing of contract: % \_\_\_\_ \$ \_\_\_\_\_.

Due upon approval of storyboard & scripts: % \_\_\_\_ \$ \_\_\_\_\_.

Due upon final completion and delivery of all media: % \_\_\_\_ \$ \_\_\_\_\_.

Client understands final payment for the project is required within 30 days of project completion. For any late payments, Client may be charged at the Producer's discretion, an amount equal to the current prime rate +10% (as charged by Producer's bank from time to time) on unpaid amounts until paid, compounded monthly. If at any time, Client desires to make any changes or variations from the completed project, or the script(s) or storyboard(s) in the Specified Media(s) or from any material or work in progress and such changes result in additional costs to Producer, including person hours, reimbursement for such additional costs shall be payable in accordance with the terms of this Agreement for final payment.

#### QUALITY

It is the essence of this Agreement that all completed media and services supplied by Producer shall be of applicable production standards. Producer agrees that the media shall be of quality, artistically produced with direction, photography, sound, art, animation, synchronization and other physical and aesthetic content as agreed upon in the Agreement.



## Appendix 5 Filming risk assessment form

### Filming Risk Assessment Form

<b>Event:</b>	Filming	<b>Date:</b>	10/12/2015	<b>Venue:</b>	Field
(1) Activity / Area of Concern <small>i.e.: what is taking place as part of the event?</small>	(2) Hazards Identified <small>i.e.: what can cause harm?</small>	(3) Persons at Risk <small>i.e.: who could be harmed by the hazard?</small>	(4) Current Risk Factor (high, medium or low) <small>i.e.: determine the level of risk</small>	(5) Actions to be Taken to Minimize each Risk <small>i.e.: what action can you take to lower the level of risk</small>	(6) New Risk Factor (high, medium or low) <small>i.e.: risk factor after action taken to minimize the risk</small>
An actor is running.	If the actor trips over something they can hurt themselves.	The mselves.	Low	<i>Wear appropriate footwear and remove any obstacles</i>	Low
An actor is laying on the ground.	The actor may get cold and fall ill from laying on the cold and hard ground after a long time.	Themselves.	Low.	<i>Having actor wear warm clothing and placing a blanket on ground for them to lay on and also having a separate blanket for them to get warm after the scene has taking place.</i>	Low

Name of person completing Risk Assessment (printed): .....Celia Peplow.....

Signature: ..... Date: .....



**Appendix 6** October #Beatz 2014 performance list

No	Type of performance	Name of performance	Duration (mins)	Instrument
1	Musical Introduction	All about you	3	Laptop
2	Acoustic Band	Mưa hồng	4	Guitar acoustic
3	Beginner Band (Acoustic)	The Show	4	Guitar
4	Acoustic Band	Ba kẻ con nhe	4	Guitar Acoustic - Bass - Cajon - Keyboard
5	Beginner Band (Acoustic)	Riptide	4	2 x Guitar Acoustic
6	Acoustic Band	9 Crimes	4	Guitar Acoustic - Keyboard
7	Dance	When you look at me + my goodies	3	Laptop
8	Band - Jazz	Don't know why	5	Guitar, piano, drum, bass
9	Acoustic band	4 Chữ lăm	4	Guitar Acoustic, Bass
BREAK (15 mins)				
10	Band - Indie	Little Talk	4	Drum - bass - Acoustic Guitar - Keyboard
11	Acoustic Band (Korean)	Aloha	4	Acoustic Guitar - Bass - keyboard
12	Acoustic Band	Chuyến Xe	5	2 x Guitar
13	Band - Alternative	Counting Stars	4	Guitar - Drum - bass - keyboard
14	Dance	Never Ever	5	Laptop
15	Acoustic	Blower's Daughter	4	Acoustic Guitar - Keyboard
16	Band - Rock	Colors + Đám Cưới Chuột	10	Guitar - Drum - bass - keyboard
	Encore	Seize the day + Nói vòng tay lớn	15	

Performance time	86
Break time	15
Preparation time between songs (~ 2 minutes per change)	30
<b>Total duration (minutes)</b>	<b>131</b>

