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Adaptive Music as a Narrative Device in Video Games

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ABSTRACT

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As technology and game development has progressed, video games have in many ways started to resemble interactive movies. While many of the functions of music in video games are akin to film music and other visual media, video games stand out as being a non-linear medium. As such, composing music for video games requires a fundamentally different approach in design.

Narrative-rich video games often mix cinematic cutscenes and gameplay. While cinematic cutscenes unfold linearly, the player's actions during gameplay are impossible to predict. For the music to fulfil its roles and functions, it will have to adapt to the player's actions and the events of the game.

The purpose of this thesis was to delve deeper into adaptive music in video games and research its possibilities of supporting the narrative. This was partly done through case studies aimed at several story-rich video games. The research focused on analysing the music design and relevant techniques used in these games.

The thesis is a good starting point for those who are interested in writing adaptive music, as it covers the process of design, composition, and production of such material. These processes were tested in the practical part of the thesis which resulted in an adaptive music implementation using Audiokinetic's audio middleware Wwise.

Key words: adaptive music, interactive, narrative, storytelling, game audio

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GLOSSARY

leitmotif	short, recurring musical phrase tied to narrative
one-shot	an audio file that plays once, i.e., does not loop
VST instrument	an additional plugin that generates audio through virtual synthesizers or virtual samplers
DAW	digital audio workstation, a software application for recording, editing and producing audio files
Studio One	a digital audio workstation by Presonus
Wwise	an audio middleware by Audiokinetic
Audio middleware	a 3rd party tool set for audio implementation in game development
Soundcaster	a functionality for testing audio events in Wwise
RPG	role-playing game
MMORPG	massively multiplayer online role-playing game

1 INTRODUCTION

Video games and video game music have always been a big part of my life. So much so, that I even started to write my own video game music not long after I started playing my first instrument. When I composed, I thought of the locations, the characters, and the story but never considered how the player would choose to play the game. Understandable, considering I was writing for fictional games. The games I wrote music for only existed in my mind as I had no knowledge of actual game development, and I knew no-one who took interest in it. Still, writing for these made-up stories of mine was something that captivated me during my early years of composing. The music was able to create strong mental images of how the game would be if it existed.

Even after years of playing video games and being active musically, I didn't think much about the technical aspects of video game music. I focused mostly on how the music made me feel. It was able to transfer me into another world long after I had finished playing the game. Only after starting my studies in Tampere University of Applied Sciences, I began to realize I could utilize my skills in creating game audio and video game music.

After analysing some of my favourite games, it became clear that certain techniques were used to answer the challenges introduced by the interactivity of the medium. Having my background in musicianship and playing in bands, creating music that would adapt to player's actions piqued my interest and I started to research and practice it. As it turns out, adaptive music is widely regarded as being something that enhances the player experience (Velario 2018).

A study by Melodrive suggests that players themselves consider music as a central aspect of their gameplay experience. 179 players filled out surveys regarding video game music and its adaptiveness and 50% of them deemed basic looping music as annoying, stating that "they would rather switch off the music than listen to the same, unchanging loops". Over 80% of the respondents thought that it's important for music to adapt to other aspects of the game, like the narrative and visuals. (Velario 2018.) The importance of adaptive music is

also evident in professional literature. An expert of game audio, Aaron Marks states the following:

> The future has moved more toward interactive and adaptive music - music which follows each twist and turn in the plot, matching your every move. It is possible to create the right atmosphere for what is to come, causing tension or giving a sense that something is about to happen - as is popular in film scores. (Marks 2017, 235.)

The game composer of today will have to utilize a wide array of different skills and practices when answering the high demands of game development. This thesis goes through relevant stages of video game music design, composition, production, and implementation, focusing on adaptive techniques as storytelling devices.

2 THE ROLE AND FUNCTIONS OF MUSIC IN VISUAL MEDIA

It’s easy to see that visual media is accompanied by music regardless of platform. A cooking video on social media is often supported by a laid back and positive, simple tune one could quite quickly catch on and hum along to. Next, one might be looking at a commercial for the next technological advancement in a specified field of some sort. The music in the background speaks of innovation and technology and could be described as “out of this world”. It perfectly matches the fresh way of looking at things or re-organizing your life based on the features the new product is offering. Upon powering up an older PC, one can hear the iconic Windows sound that many find nostalgic. Thus, the role of music in visual media can vary from subtle to extreme depending on the context as well as the desired effect. Music makes you feel. (Phillips 2017, 97.)

2.1 Music as a Language

Very much like spoken language, music is a language that consists of different patterns and components, whose main mission is to communicate abstract ideas to the listener. The range of human emotions and feeling is vast so the music language must tackle this by being versatile as well. The language of music has been in development for centuries and continues to do so in the modern visual media. Its parts can be divided to vocabulary (notes, beats, articulations, and tonal colours), syntax (structures, such as intervals) and grammar (forms of structure, i.e., sonata form) as well as idioms of music scoring (music genres, instrument combinations). (Thomas 2016, 4.)

We have grown to accustom happy music with major tonalities and sad music with minor tonalities. Dissonant intervals communicate a sense of anxiety or fear. Much like spoken language, it is not required to know the theory behind music language in order to be affected by it, but for a composer scoring visual media, understanding and utilizing the language structure helps immensely.

2.2 Music In Films

Compared to shorter forms of media (such as social media and commercials), the role of music takes a new height in film and TV where its functions can be considered nearly limitless. The music can simply evoke a specific feeling in its audience that supports the main narrative, or it might go deeper and communicate an underlying theme of the movie or a subtext of dialog. Using leitmotifs, the music can even tie parts of the plot together. (Temple, 2022.)

The conventional functions of music scoring across visual media can be distributed to six different categories that are as follows: setting the mood, heightening emotion, propelling the action, providing contextual clues, enhancing the aesthetic, and contributing to structural unity (Thomas 2016, 19-28).

It can be an interesting experiment to mute the music of a scene and see what changes. It can also be taken further, by replacing the music with something totally different and thus, enabling the viewer to see how much our emotions are influenced by the music. As the language of music contains various variables, changing an instrument, for example, will influence how the music is perceived, even if the music and its notes would otherwise remain the same.

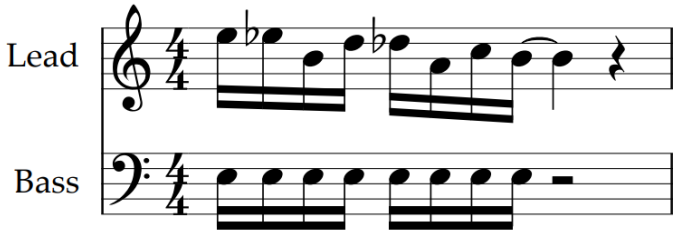
2.3 Music In Video Games

In today's day and age, video games and their genres are varied. As technology has progressed, more options have opened for developers to transfer their creativity into a game. Due to these advancements, it's possible to use music recorded with a live orchestra, which in turn can help emphasize these cinematic qualities further (Marks 2017, 5). Some of the games are simple, based on a few mechanics, some complex and involve cinematic storytelling and extensive worldbuilding. As the game experience can nowadays be very narrative-driven and have an emphasis on cinematic qualities, it's only natural that a lot of the functions of music used in video games are similar to the ones used in films.

Winifred Phillips categorizes functions of music by grouping them together with specific game genres. Real-time strategy, puzzle and survival horror games use

music as a way of accentuating the required state of mind. RPGs, MMORPGs and adventure games are heavily reliant on the immersion created through their world and therefore their music often takes the role of worldbuilding. The music in fighting, racing and action-adventure games takes the role of setting the pace. (Phillips 2017, 97-108.) As an example, thunderous percussion, fast tempo and distorted guitars keep the blood boiling and try to ensure you will defeat your enemy. It is easy to draw similarities to the conventional functions of music scoring mentioned above.

A more video game specific function of music is music as an audience. This can take the form of music seemingly “watching” the gameplay and commenting on the events accordingly. (Phillips 2017, 109.) This function is as old as video games themselves as music is often used to amplify the event when, for example, the player finishes the level or gets defeated. In Castlevania, a platformer released on Nintendo Entertainment System in 1987, upon player getting defeated, the game plays a quick descending pattern of notes on top of a stable root note to communicate defeat. The function of music as an audience is also very evident in adaptive video game music, which is discussed further in Chapter 5.



PICTURE 1. Game over stinger in Castlevania (Konami 1987)

3 LINEAR MEDIA VS NON-LINEAR MEDIA

Films, TV, and commercials can all be considered linear visual media. Watching a movie always has the same opening. It goes through the same story arc and has the same plot twist and ending as the previous time the viewer watched it. A commercial run lasts right up until that specific marketing campaign is over, until starting a new one and sticking to it for the duration it airs. (Marks 2017, 235.) But what happens when we give an outsider the ability to change the course of action?

3.1 Player Participation

Video games are interactive by nature and the basis of video gaming is to give the player something to interact with and control. Depending on the game, the player might decide to spend a long period of time in a specific game area, closely examining and immersing oneself in the intricately designed game world or they might rush through the whole experience. They may choose to run away from a particular enemy or they might take on the challenge. Scoring this kind of events as if they were linear, would result in pieces of music, that would run their course and either end before the player advanced to the next section or cease to reflect what's happening on the screen. (Marks 2017, 44-45.) As Thomas (2016, 45) emphasizes, the timeline of the game "unfolds based on moment-to-moment decisions made by gamers of diverse ages, genders, background, playing styles and even moods".

Some video games are like interactive movies. A 2022 video game The Quarry, by Supermassive Games includes 186 different endings and the outcome is affected by the player's choices. These choices are usually performed during quick-time events, where the player has a limited amount of time to decide on how to proceed. The decisions alter the subsequent events that unfold and often the outcome can be so drastic that the music cue needs to reflect this accordingly. (Supermassive Games 2022.)

3.2 Player Feedback

The music and audio in general give the player important feedback by adapting to the events of gameplay. A sense of urgency is conveyed in Super Mario Bros when time is running out, by modifying the playback speed of the current music track. Similarly, when the player collects a star power-up that renders the player invincible for a limited time, the music switches to a track with faster tempo, urging the player to advance quickly and utilize the invincibility to its maximum potential. When the effect of the star power-up wears off, the music switches back to the normal gameplay track, indicating the player is no longer invincible. (Nintendo, 1985.)

The absence of music itself can be utilized in giving feedback to the player. For example, when the player has explored the game area fully, the absence of music can be used to imply that there is nothing left to achieve in the current location, nudging the player to proceed forward. The absence of music results in a vague feeling of emptiness that drives the player forward and thus can be used as feedback for the player. (Phillips 2017, 41.)

Music can also provide navigational support in the form of hinting. Upon reaching a new area, a motif can be played to imply that the area is of importance and should be explored further. (Phillips 2017, 41.)

3.3 Immersion

Being immersed in something is a phenomenon that happens across all visual media, entertainment and even regular human activities and has similar characteristics as the flow state (Michailidis, Balaguer-Ballester, He 2018). Phillips (2017, 37) states the following: “To define immersion in its most literal sense is to talk about being dunked in water until we are completely below the surface, lost in that muffled world, with little bubbles rising all around us.”

Immersion in linear media, such as films can happen when the viewer is emotionally invested in the experience so much so that they will forget that they are watch-

ing a movie. Similarly, when reading a book, immersion can feel like a vivid journey of imagination; the reader might not register holding and reading a book anymore. (Phillips 2017, 37.)

In video games, immersion resembles other forms of media and activities but with added quality regarding the interactivity of video games. The player eventually forgets that they are using a controller to play and interact with the game. Audiovisual cues and their origins no longer register as coming out of the speakers or the screen. (Phillips 2015, 37.) The player sinks into a fictional world and is taking part in its activities without considering the means to do so.

A 2004 paper by Dr Paul Cairns and Emily Brown introduced three different levels of immersion in video games: engagement, engrossment and total immersion. To reach these higher levels of immersion, in addition to be willing to spend time, effort and engage in the act of playing a video game, the player will have to pay strict attention to all visual and auditory information to fulfil two pre-requisites, which are attention and empathy. The player will have to be emotionally invested in the story, its characters and world in order to achieve a state of total immersion. (Phillips 2017, 37-54.)

As with other mediums, the whole experience of gaming, especially in a narrative focused game, relies heavily on immersion. Anything that disrupts or breaks the immersion can be considered to lessen the quality of the experience. Therefore, as with every other area of game development, music will have to be prepared and executed correctly, to function in an interactive game setting.

4 THE STRUCTURE OF VIDEO GAME MUSIC

As in film, scenes or levels in video games vary (Thomas 2016, 43). Sometimes a scene can start with action, build up to a climax and have a calm ending. Or maybe the protagonist is pictured having a peaceful life in his home village, when suddenly the enemy attacks. After conquering the enemy leader, the protagonist is left with the realization that her loved one has perished during the battle.

In a film scenario, one would score the scene based on the linear progression of the scene. Time codes (or SMPTEs) are provided to the composer to know when exactly a music cue should begin, when the next cue of music is supposed to play and what happens between them. As the film is linear, music can be composed to fit the picture perfectly. (McGregor 2022.)

However, with games, due to their interactivity, we need to consider that often we are unable to anticipate at what point the player will choose to advance or trigger a specific event in the game. Depending on the game, players might have the possibility to do actions that have nothing to do with the current scene playing. They might decide to leave the game area to fulfil side-quests, play mini-games, loot for better equipment or explore some other parts of the game world. (Thomas 2016, 44.) For the music to fulfil its function and role in visual media as was discussed earlier, the music should reflect what happens in the game, adding to the cinematic qualities and immersion of the game experience. In addition to this, music and its transitions should sound musically pleasing and professional so that the music and audio add to the immersivity rather than reduce it. The score will have to be flexible to answer the needs of the interactive nature of video games.

4.1 Music Placement

Most of video game music can be categorized under three distinct types that differ in their placement. These are referred to as, diegetic music, non-diegetic music and music as part of gameplay. (Davis 2021.)

Diegetic music, also known as source music, is music that clearly originates from the scene or game level. If the characters in the story are able to hear the music, then it can be considered diegetic (Thomas 2016, 18). When traversing the post-apocalyptic world of recent Fallout entries, the player has the option to turn on the radio. The player is then accompanied by iconic songs from the 50s and the 60s that are licensed for the game. The music originates from the player's equipment and can thus be regarded as diegetic music. (Bethesda Softworks.) Diegetic music can be very useful in fulfilling a role in worldbuilding.

Non-diegetic music refers to the music that does not originate from the game level itself. This type of music is often labelled as game score and it is also referred to as underscore. Non-diegetic music is the music that plays during gameplay but doesn't have a clear source in the game world. Non-diegetic music cannot be heard by any of the game's characters. (Thomas 2016, 19.)

In some cases, the player can become the source of music itself. Such is the way in numerous games and game series where the gameplay consists of playing an instrument, such as Guitar Hero, Rock Band and Taiko no Tatsujin (Activision; MTV Games; Bandai Namco Entertainment). In a 2019 action role-playing game Code Vein, albeit having a limited set of keys to play, the player is given the possibility to play the piano in a certain location using the game controller (Bandai Namco Entertainment 2019).

4.2 Scoring Components

Given the interactive nature of video games, the music must fulfil specific requirements to work properly in a game setting. Thomas (2016, 83) distinguishes six different basic game scoring components: intros, loops, transitions, tags, stingers, and cinematics. By taking a closer look at these scoring components of video game music, we can examine their specific musical functions as well as how they are used within a game score.

PICTURE 2: Scoring Components as distinguished by Chance Thomas (Photo: Olli Heino 2023)

4.2.1 Intro

An intro serves as a presentation for a new level, gameplay mechanic or other type of beginning inside the video game experience. It is a one-shot piece of music, which means that it will only play once throughout, before continuing to another component of scoring. An intro can fulfil the function of setting a mood, establishing an aesthetic, providing contextual clues, and contributing to structural unity. It has no requirements regarding its durations or complexity. An intro also often establishes the tonic key for the subsequent component as well as the palette. (Thomas 2016, 83.)

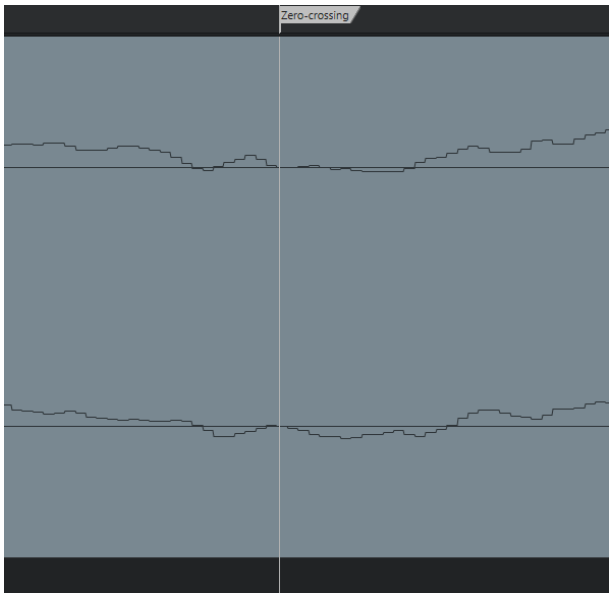
4.2.2 Loop

Loops have been utilized since the dawn of video gaming. The first game to use a looping background music was Space Invaders released in 1978. Its music consisted of a four-note chromatic passage whose pace increased based on the enemies approaching. (Weaver 2019.) Loops enable music to continue infinitely. In a game scenario, where it is impossible to predict how long it will take the player to complete it, these are often the most used types of tracks.

Looping infinite linear music also introduces a risk: getting tired of it. Usually, the solution is to either write music that doesn't stand out and therefore often fails to fulfil its role due to being underwhelming, or writing music that is so well prepared, the player doesn't register it as a loop. (Phillips 2017, 158-159.) Thomas (2017) states, that composers should avoid using themes inside their music loops, as they will quickly wear thin and grow tiresome. Additionally, if the

player notices and pays attention to the looping qualities of the music or if the music pops out needlessly due to dramatic changes in orchestration, sense of immersion is often broken.

It is also important to prepare the musical files in a manner that renders them technically suitable for continuous and infinite playback. Music loops have their tail-end rendered in the beginning of the file to support continuous playback. It's also important to make sure there are no unwanted clicks or pops at loop point. According to Phillips (2017, 176) in order to create a seamless loop "the audio edits should occur when the waveforms are both passing simultaneously over their zero crossing points."



PICTURE 3. Zero-crossing point of a waveform (Photo: Olli Heino 2023)

4.2.3 Transition

Transition components are used when the music needs to change between different components, such as from an intro to a loop, from a loop to a cinematic or between two different loops. The transition will need to consider the characteristics of both components surrounding it in order to create a smooth transition between the two. As an example, if loop A is in the key of E minor and at 130 bpm and Loop B is in the key of C minor at 150 bpm, the transition will have to fulfil it's

role by ramping up the tempo between the two, as well as handling the modulation between the two keys. (Thomas. 2017, 92.)

4.2.4 Tag

Tags provide a sense of finality to a game level, gameplay mechanic or any other gameplay event that has a definite ending. They can provide a climactic ending to a boss battle or communicate loss, which means tags can fulfil the role of winning and losing cues. (Thomas 2017, 95.)

4.2.5 Stingers

Stingers are short musical pieces that can be used for transitions, hints, and feedback in game. They can be synchronized to play on top of other music to provide more variation, tie the gameplay events into music even further or, for example, to mask transitions between different segments of music. Their length can vary and is usually between 2-20 seconds. (Phillips 2017, 177.)

4.2.6 Cinematics

Often referred to as cut-scenes, cinematics are linear game segments where the player is temporarily unable to control their game character. Cinematics' functions are varied, as they can introduce new areas, give new information or work in any way that would be plausible for other forms of visual media as well. Often, they are used as storytelling devices between gameplay segments. (Thomas 2017, 101.)

Games like The Last of Us and Metal Gear Solid series feature lengthy cinematics that can feel like watching a film or a tv series. The Last of Us video game was even adapted into a tv show, in which some of the cutscenes were based and setup exactly like in the game, with same kind of cuts and dialogue. (Naughty Dog 2013; Konami.)

4.3 Game Engine

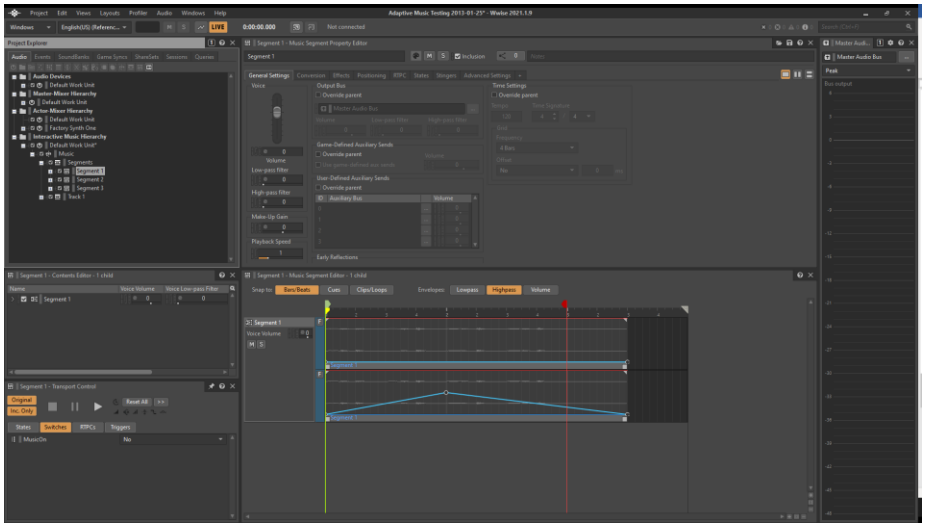
Game engines are software development environments for developing games and nowadays, other forms of media. Some of the core functionalities of a game engine are scripting, animation, artificial intelligence, physics, 2D and 3D graphics as well as sound. By having core functionalities already setup in a game engine, it enables developers to work faster and creating game experiences more easily as opposed to building a project from ground up. (Study Tonight.) Two of the more popular game engines nowadays include the Unity engine and the Unreal engine.

4.4 Audio Middleware

Sometimes, when the project's audio needs get more involved, developers can use a third party tool set that connects the game engine and audio hardware and allows audio to be implemented outside the game engine, which can be helpful for game development in many ways. For one, audio related workload can be more easily shared between the programmers and the audio department, as most of the functions of audio can be set using a graphical interface of the middleware. Even smaller game projects can benefit from using audio middleware in their audio implementation. (Audiokinetic 2019.) Popular choices for audio middleware are Audiokinetic's Wwise and Firelight Technologies' FMOD.

While it is possible to build adaptive music systems into the game engine itself by programming and scripting, the audio middleware makes it possible to implement sounds and music without spending time to build such systems from ground up (Nogueira 2019).

The sounds and music are triggered by game calls sent by the game engine to the audio middleware. The game calls can often deliver information about the current game state. These game states can vary from game to game, but a game could, for example, have a separate game state for exploration, suspense and combat and the audio middleware would play music based on the current state. Upon receiving a game call to switch the state, the music would follow accordingly, based on pre-determined transitional rules.



PICTURE 4. Interactive Music Layout in Wwise (Photo: Olli Heino 2023)

5 TECHNIQUES FOR WRITING ADAPTIVE MUSIC

Adaptive music is music, that adapts to the actions of the player or other events in the game. Any game parameter can be set to control the adaptive music system. The music can be triggered by location, proximity of player in relation to other game objects, game states, health parameters, time of day, etc and by design, its function is to adjust to the current mood of the game, player, and environment. (Marks 2017, 239.) There are two basic techniques utilized in building an adaptive music system for a game: vertical layering and horizontal re-sequencing. As with game development and coding in general, they follow a simple logic of “if-then”, meaning that if certain parameters are fulfilled, the audio middleware will respond accordingly.

5.1 Vertical Layering

In vertical layering, the music consists of separate music tracks that are synced to play along with each other simultaneously. The game engine sends game calls that are then used to control the playback of these tracks. Vertical layering works by adding, subtracting, replacing, or altering the musical material based on the received game calls (Evans 2019, 3.2).

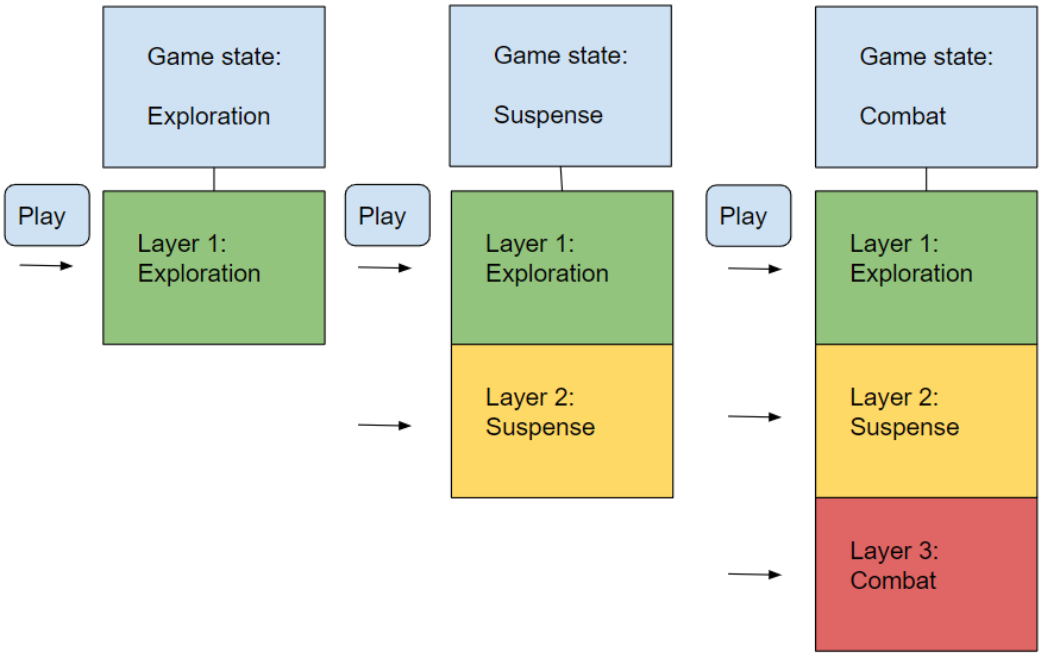
It is important to note, that in vertical layering, all the music layers are playing all the time, but they might be muted and thus inaudible, based on the events of the game. Only when appropriate, the system will raise the volume of a specific layer so that it can be heard. Since the music consists of separate layers, the arrangement has been divided into several music files accordingly.

5.1.1 Additive Vertical Layering

One of the most common ways of using vertical layering, is to compose tracks that build in intensity until all the layers are in use (Phillips 2017, 195). For example, an adaptive music system that utilizes additive vertical layering, could work in a way, that the first layer would support exploration gameplay. When player approaches an enemy, a second layer is then crossfaded into the mix,

providing elements of suspense. Finally, when the player engages in battle, a third layer is introduced for combat elements. After the battle, the third and second layer will fade out, leaving the exploration layer to play by itself once again. (Evans 2019, 3.2.)

These changes in music can be controlled by game states inside the game engine. When the player explores, active game state is set to exploration. When approaching an enemy, the game state switches to suspense. During combat, the game state switches to combat and finally, after the combat, the game state reverts to exploration.



Picture 5: Additive Vertical Layering System (Photo: Olli Heino 2023)

5.1.2 Interchangeable Layers

Interchangeable layers are used, when the aim is to replace layers with one another and thus, provide new harmonic, melodic or rhythmic content or variations in arrangement (Evans 2019, 3.2). As an example, the music could consist of a main layer that always plays and whose function is to provide structural founda-

tion as well as two separate layers each providing their own harmonic and melodic material. The latter layers are interchangeable and unlikely to work when played together as only one of them is intended to play along the main layer. (Phillips 2017, 195-196.)

5.1.3 Vertical Layering Plan and Arrangement

Since the different layers are playing simultaneously in sync, it is important that they have been composed using the same set of rules. They share main characteristics of the composition, such as duration, tempo, and key, in order to work. It is also important to note, that the composition process should take into account how the parts are divided among the layers as each layer should be able to deliver a musical idea of its own, in order to function by itself if needed. Thus, composing music that uses vertical layering is fundamentally very different from the practice of preparing instrument stems for mixing as in such case, the end goal is to listen to the song with all the stems playing (Phillips 2017, 194).

The content of vertical layers can be spread out across layers by a number of different ways. First and foremost, however, it is important to recognize, that the impact of adding a layer is dependent on the contrast it provides against the other layers. If two layers share similar content, such as providing a lead melody, adding the second layer to the mix would not take full advantage of the technique. However, if the second layer would provide a bass line and percussion to the mix instead of consisting of already introduced musical elements, the outcome would be more impactful as the layers' function in music would differ. (Phillips 2015.)

It makes then sense to divide the compositional process and spread musical content across layers to match the main elements of music: melody, harmonic support and counterpoint. Phillips (2015) introduces effective and questionable techniques for each of these elements. For example, to fully utilize the power of vertical layering, melody content should follow proper voice-leading in order to work without harmonic support, if necessary. A dedicated frequency range can help making sure the melody is perceived clearly within the full mix. As discussed before, doubling or harmonizing the melody content is deemed questionable across layers. The same goes for the full homophonic tutti, in which all the layers play

the same material with only different instrumentation. Phillips (2015) continues to write “If the layers sound similar (or the same), they’ll make no impact when they’re activated or deactivated in the game.”.

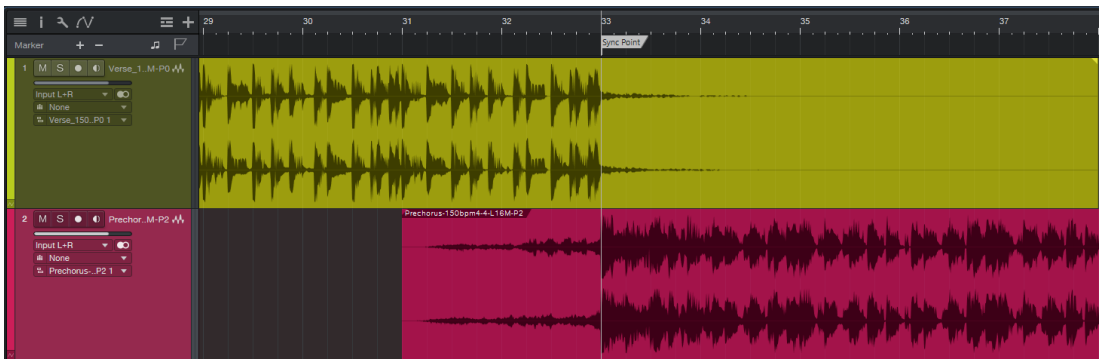
5.1.4 Pros & Cons

Vertical layering system can react fast to game events. Unlike horizontal re-sequencing which we will look at next, the layers don’t have to wait until a designated sync point to switch in intensity, but the change can happen instantaneously, by quickly crossfading a layer in or out of the mix. However, cross-fading music mid-sentence does not always result in the most musical transition.

5.2 Horizontal Resequencing

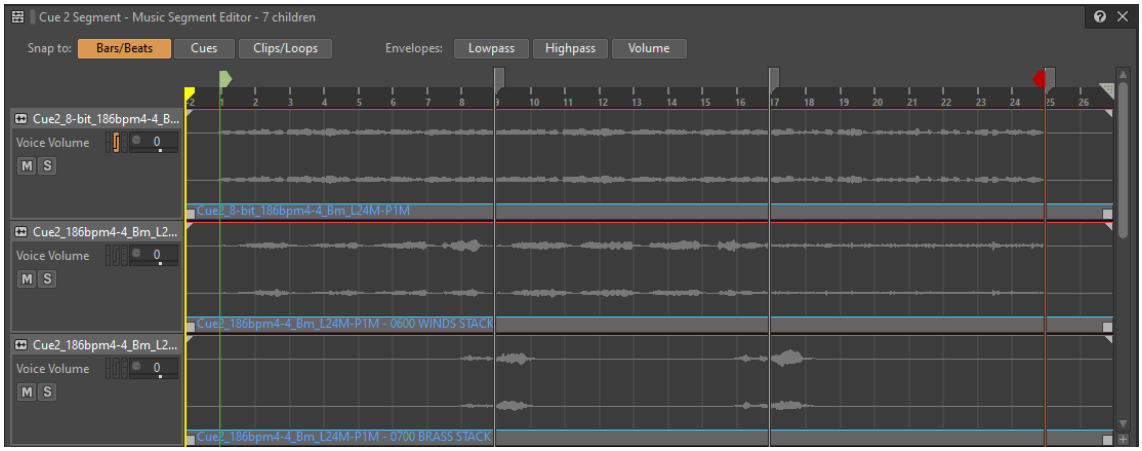
Horizontal re-sequencing is a technique, where in its basic form, music is comprised of different segments. Much like in a vertical layering system, the game events will tell the music when to change but instead of adding or removing layers, the music continues to the next segment of music. The chunks of music can range from short to a large number of measures. (Phillips 2021.)

Using dedicated audio middleware, such as Wwise, a designated sync point can be set to force the transition to happen in a specific moment or specific interval, usually on the first beat of a bar. If the music would transfer to the next segment as soon as the game call from the game engine was sent, the result would often be jarring, as it would not follow basic concepts of playing music in time. Furthermore, the system can be set so, that it is triggering audio files with overlaps to sound more natural. This way the next segment can already introduce itself before the actual sync point, to mask the transition. In Wwise, this additional material is referred to as pre-entry and post-entry material.



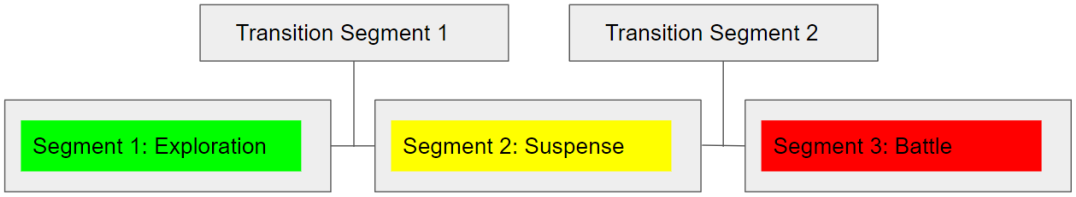
PICTURE 6: Sync point location between two different audio files and pre+post-entry material in Studio One 6. (Photo: Olli Heino 2023)

In Wwise and other audio middleware, it is possible to set transitional rules across the timeline of a music track. Transitions can be set to happen in various ways, for example, when the playhead reaches the exit cue, the start of a beat or a bar, or by reaching a custom cue point.



PICTURE 7: Entry cue (green), exit cue (red) and custom cues (grey) in Music Segment Editor in Wwise. (Photo: Olli Heino 2023)

The music segments can also have transitional segments between them that do not loop. They are used for connecting the main segment ideas fluidly. Transition segments provide the composer the option to modulate key or change tempo during their playback as discussed in chapter 4. Sudden changes to these tempo or key of the song would otherwise be quite jarring, unmusical, and thus, most often, unwanted.



PICTURE 8: Horizontal Re-sequencing System with transitional segments (Photo: Olli Heino 2023)

5.2.1 Horizontal Resequencing Plan

As with vertical layering, the composer will need to know the idea behind the game to properly plan out the music to support the game mechanics. The composer will need to know for example, if the music should be able to transition back to Segment 1, after first transitioning to Segment 2. If this was the case, then it is important to plan out, how the actual transition back to Segment 1 would happen.

It is important to note, that the longer the segment, the longer it can take to switch from a segment to another one, depending on how the transition rules are set. If the music is harmonically rich with developing chord structures, the composer might need to write separate transitions from one segment to another in order to create a smooth transition. Understanding music theory is an invaluable resource when planning out different transitions between segments.

5.2.2 Pros & Cons

Due to having to wait until a designated sync point, changes in music can sometimes take a while when using horizontal re-sequencing. Creating transitions to different segments can be very challenging and requires a certain level of understanding and utilizing of music theory.

6 CASE STUDIES

The following case studies focus on adaptive music techniques and music as storytelling devices. These games have been chosen because they either represent different approaches to adaptive music and its relevant techniques or the music design has a large impact on the narrative of the game itself.

6.1 Dark Souls

In FromSoftware's 2011 action-RPG Dark Souls, the player is navigating a sinister, medieval fantasy world that includes demons, dragons, knights and other creatures. The game take places in the land of Lordran and most of the journey is done in fact, without any music playing. The music is composed by Motoi Sakuraba and is mostly used to highlight a particular safe haven called Firelink Shrine which serves as a central point of the player's adventure, as well as during the notoriously hard boss fights the developer, FromSoftware is known for. (FromSoftware 2011.)

The original version of the game includes 13 bosses, all of which can prove challenging to beat. The music during these battles is orchestral, often dissonant and chaotic supporting the idea that these intimidating, horrific creatures are not easily dealt with. Interestingly, when examining the music from a narrative perspective, one of the boss fights stand out. The final boss, Gwyn, Lord of Cinder, is referenced to many times during the game but he is never shown to the player until the very end. When the player finally starts their battle against him, it is revealed that rather than being an almighty force, Gwyn is a suffering, undead husk of a man. Taking a sudden narrative turn, the music reflects this as well. Instead of a grandiose orchestra and an epic choir the players have gotten used to expect during the boss fights, they are offered one final boss battle track that consists of a solo piano performance full of melancholy and somber qualities. This choice of music supports the narrative in a meaningful way by heightening the emotion and at the same time, makes us reflect on our own long journey through the hardships of Lordran. (FromSoftware 2011.)

6.2 Ori and the Blind Forest

Ori and the Blind Forest is a platform-adventure game by Moon Studios released originally in 2015. It won the best audio award in Golden Joystick Awards 2015 (Gamesradar 2015). The game tells an emotional story with themes of love, sacrifice, and hope as you control Ori, an orphan forest spirit, adopted by Naru, a motherly being of an unknown race. The game's orchestral score is composed by Gareth Cocker. The prologue is a good case study on how to work with segments of music that continuously support the narrative as the player progresses through the prologue.

6.2.1 Prologue

In it's 10-minute prologue, Ori and the Blind Forest introduces the player to it's world. The player learns of how Ori's foster mother, Naru found and adopted him in the forest after following a magical looking leaf during a stormy night in a place called Swallows Nest. Naru and Ori, during their gathering of food from the forest, stumble upon a spot full of apples, and on their way back home, the skies suddenly light ablaze. (Moon Studios 2015.)

The player is shown the world decaying of its colours while Naru looks for last pieces of food. One final apple is given to Ori after which he sets out to look for more food. Succeeding in doing so, the player controls Ori back to their cave only to realize that Naru has died of starvation, through an act of sacrifice by giving the last piece of food to the foster child. Ori, now an orphan again, decides to leave Swallows Nest. Struggling on his way out, he collapses, after which flowers and other flora start to bloom around him. (Moon Studios 2015.)

The prologue already tells a touching story with its vast array of emotions. The life of Ori and Naru is at one point depicted as happy and innocent, yet the very next moment the player is forced to face decay and the death of a loved one.

6.2.2 Music

The prologue progresses through cinematics and gameplay segments taking turns. The music segments trigger when player reaches a certain point in the game area. The music loops often last longer, than what it takes to travel from point A to point B to trigger a new event and music. In most cases, the player can only hear the whole composition when they do not hurry to the next cue, which caters to those who enjoy taking their time and immersing themselves in the game world by not hurrying.

The music consists of linear pieces during cinematics, looping segments and one-shots during the gameplay segments as well as transition stingers between different cues. All in all, based on my research, the prologue has 15 separate music tracks used throughout its course (appendix 1). They are carefully implemented to support the narrative of the prologue. It is also worth mentioning, that by pausing the game during a cutscene, the music will stop and resume after unpausing. When pausing the game during gameplay, however, the music will not stop. This distinguishes the two types of music used: linear compositions during cutscenes and looping music during gameplay. If the music wouldn't stop during the cutscenes when paused, its linear functionality would break as it would no longer follow what happens on the screen. Looping segments have been composed to accompany the gameplay for a longer period of time.

After the death of Ori's foster mother, Naru, Ori decides to leave Swallows Nest. If the player advances through the following gameplay section in a timely manner, the music played sounds like one consistent piece of music that supports the narrative. However, if the player prolongs their stay and does not advance in the scene, the music does not continue beyond a certain point, which reveals to us that the music consists of one-shot music files, that are triggered by reaching the events during the gameplay. First of them triggers when Ori struggles to climb on to a fallen tree, second one when he gets stuck in the bushes and the final one when he is crawling with his last breath of strength forward. These one-shots are only 15-20 seconds long. If the player chooses to wait them out, they are left with nothing but the forest ambience.

The music of Ori & the Blind Forest's prologue shows that game music can be comprised of many smaller musical segments that are then implemented into the game as separate files and smartly placed in the game. The music of the prologue does not feature either vertical or horizontal resequencing, but it uses one-shot cues smartly, to tie the music in to the narrative as player progresses through the scene.

6.3 Nier: Automata

Nier: Automata is an action-rpg released in 2017 and developed by Platinum Games. It takes place in the distant future, where mankind has been driven into exile on the moon by an alien race. The player controls an android called 2B in her endeavours to reclaim the planet.

The music of Nier: Automata contains a lot of vocals and the game's composer Keiichi Okabe wanted to emphasize on that: "A character may feel sad during a battle, and usually a battle sequence would have fierce music, but for NieR, if the character feels sad, I made sure to have that kind of feeling in that fierceness." (Okabe 2016.)

Throughout its story, Nier: Automata uses vertical layering very effectively by tracking where the player is in the story. The first time the player arrives at a new area, he or she might hear only a reduced version of the music. Upon returning to the area after making progress, other layers might be added into the mix, suggesting we are more familiar with the area than before. (Smith 2019.)

Additionally, the game features a gameplay mechanic, where the player can hack hostile enemy machines. Upon doing this, the graphical style morphs into retro style as the player tries to hack the machine in a mini-game of sorts. This is also represented audio-wise by switching the current music track seamlessly to an 8-bit version of the same track. This is done through vertical layering as the technique makes it possible to run two different arrangements in parallel and cross-fade between each other. The transition itself is being masked with an additional effect the audio implementation team refers to as Tone Filter (Ueda 2017).

6.4 The Pathless

The Pathless is an action-adventure game developed by Giant Squid and published by Annapurna Interactive, released in 2020. The player controls a nameless hunter, whose goal is to end a dark curse originating from an ancient island. In order to do this, she must complete puzzles and cleanse corrupted spirits in order to proceed. The game's music was composed by Austin Wintory. (Giant Squid 2020.)

After the prologue chapter, the player's goal is to cleanse the corruption of three different spirits on the island. These spirits are Cernos, the Elk Spirit; Sauro, the Lizard Spirit; and Nimue, the Snake Spirit. The island itself is divided to three different plateaus where each of the spirits reside and the player progresses through the game by confronting them in any order they wish.

The Pathless' adaptive music system tracks player's narrative progress as well as physical location. The main part of the game is divided into three different acts which all have unique music written for them. By defeating any one of the corrupted spirits, the player progresses to the next act. In addition to having separate music based on the narrative progression through different acts, all three of the spirits have a topline instrument assigned to them. If the player is traversing the Forest Plateau, the home of Cernos, they will be able to hear the current act's music with Cernos' lead instrument, Oud. By moving to the Redwood Steppe plateau, an area associated with Sauro, the same music continues to play, but the lead instrument switches seamlessly to double bass, the instrument assigned to Sauro. Finally, by exploring the Great Plains, the player can hear the topline melody being played with a bamboo flute, the instrument of Nimue. When the player defeats a corrupted spirit, their instrument will disappear from the game as well; the player will not be able to hear the topline instrument in any of the areas. (Wintory 2021.)

The Pathless also uses a game mechanic where the player's speed can be increased greatly by shooting talismans scattered around the game world. When

the player has traversed the world in a quick manner for long enough, an additional layer of music is being crossfaded into the mix through use of vertical layering technique.

The adaptive music system of the Pathless allows the player to play for a long period of times without hearing any repetition while traversing the different plateaus (Wintory 2021). It also interestingly blurs the line between diegetic music and source music. The Hunter can’t hear the same music as the player, but eliminating entire instruments from the game score when a boss is defeated suggest that the music is originating from the game world.

7 PRACTICAL PROJECT

The aim of this thesis' practical project was to design an adaptive music system for an imagined brief and reproduce some of the techniques and processes that surfaced during the case studies. I decided that the music would have to include both vertical layering as well as horizontal resequencing techniques and it would be implemented using Wwise to test its functionality properly. The imagined scene was decided to take place in a medieval fantasy world of an action-rpg type of game. I came up with the following brief to support the goals of the project:

A peaceful village receives a message of an impending enemy attack. A hero must quickly gather equipment and the townsfolk together to prepare for the attack before it's too late. When the enemy attacks, the hero will battle through three waves of enemies together with the townsfolk. Upon defeating the enemy leader, the player and the village either triumphs or realizes that the battle has taken the life of a loved one, based on how well the battle was fought.

7.1 Music Design

I first decided to divide the scene to appropriate scoring blocks and decide which segments of the scene would consist of cutscenes and which would contain gameplay as this is a distinguishing factor for the type of music needed. I came up with the following chart:

Cue	Description	Type	Component
Cue 1	Impending attack	Cutscene	Intro
Cue 2	Preparation	Gameplay	Loop
Cue 3	Enemy attacks	Cutscene	Transition
Cue 4	Waves of enemies	Gameplay	Loop
Cue 5	Aftermath	Cutscene	Tag

Figure 1: Cue chart with information on description, type and scoring component (Heino 2023)

Based on this, it was easy to see that the gameplay consisted of only two segments. I named them Gameplay Segment A, in which the player prepares for the battle and Gameplay Segment B, in which the player battles waves of enemies. Since these two segments would include all the actual gameplay, it was evident that most of the adaptivity of the score would fall into these segments.

Gameplay Segment A's purpose is to gradually get ready for the battle by spreading the message to get the elderly and children safe, gather the townsfolk capable of fighting together and collecting equipment from the armoury. To communicate a sense of progression to the player while doing these tasks, I decided to use vertical layering technique and additive layers. The gameplay segment would start with only the main layer playing and additional layers would then be added when player progressed in the completion of these tasks. This would result in a layered loop with 4 layers.

Start of gameplay	Play Layer 1
Complete Task 1	Add Layer 2
Complete Task 2	Add Layer 3
Complete Task 3	Add Layer 4

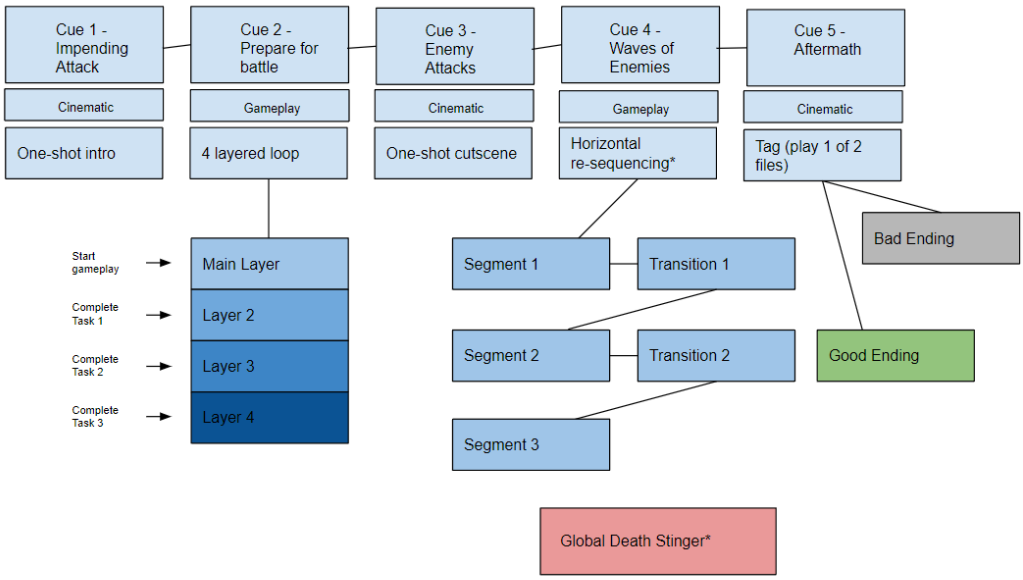
Figure 2: Vertical Layering Chart (Heino 2023)

Gameplay Segment B on the other hand would contain waves of enemies the player would have to defeat in order to progress. For this segment, I wanted to use horizontal re-sequencing to emphasize the added stakes of each wave of enemies and provide emotional aesthetic towards the end, when the battle reaches its climax. To achieve this, I also decided that I would want to change tempo and modulate the key of the music to further emphasize storytelling through music, so transition parts were to be utilized between the looping segments.

Wave 1	Transition	Wave 2	Transition	Wave 3
Loop	One-shot	Loop	One-shot	Loop

Figure 3: Horizontal Re-sequencing Chart (Heino 2023)

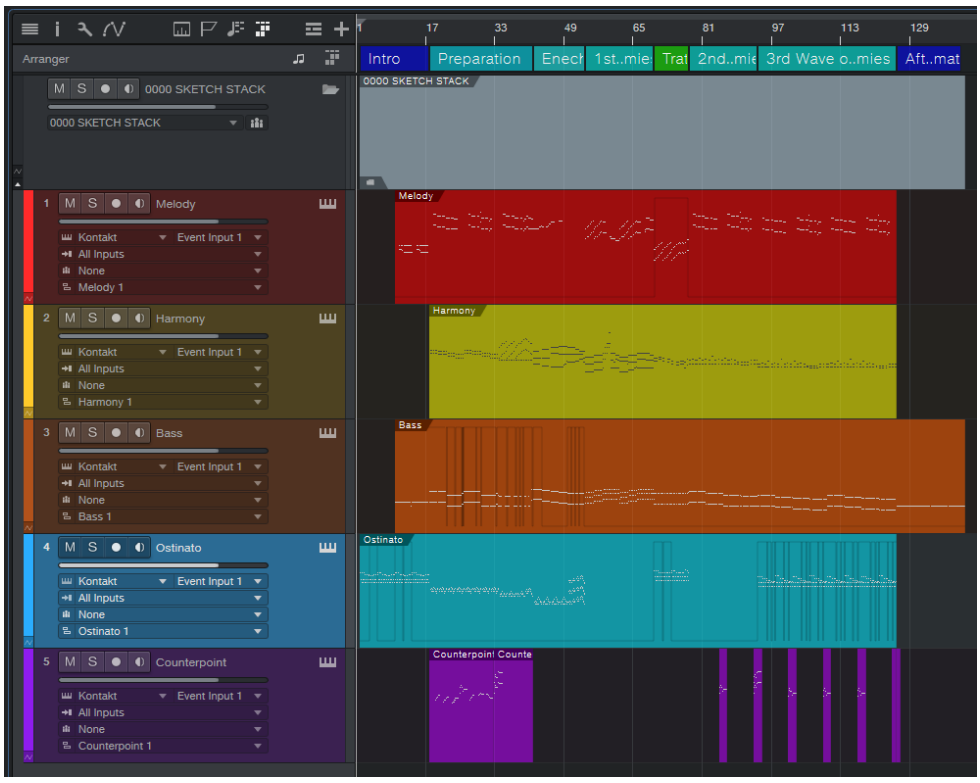
After deciding upon these factors of music design, I built a blueprint for the whole scene. All this was done before writing a single note of music. I also included a global death stinger in the blueprint, which would play at any time the player was defeated. This could only happen during Gameplay Segment B, when player is in battle.



PICTURE 9. Blueprint of the music design (Photo: Olli Heino 2023)

7.2 Music Composition & Arrangements

I started the process of writing music by making a piano sketch that covers all the cues using Presonus Studio One 6 and Noire, a piano VST instrument by Native Instrument. Using only one instance of the VST instrument I separated different compositional elements on different tracks by dividing them according to their fundamental nature: melody, harmony, bass, ostinato and counterpoint. Writing dedicated parts like this makes it easier to arrange the music for a bigger ensemble. For example, a four-part harmony is often extended to include 5, 6, 7 or 8 parts in an orchestra by duplicating upper notes upwards and bass notes downwards (Rimsky-Korsakov, 64). This approach also pushes towards smarter decisions regarding vertical layers as the effectiveness of the layers is dependent on the contrast between them, as discussed in chapter 5. Finally, I decided that an orchestral score would suit the medieval fantasy setting well.



PICTURE 10. Piano Sketch in Studio One 6. (Photo: Olli Heino 2023)

7.2.1 Cue 1: Intro

The intro sets the mood of the track as well as establishes the general aesthetic of the orchestral score and the tonic key for the subsequent segment, which is B minor. I decided to work off on an ostinato figure and assign it to 1st and 2nd violins in the orchestra and provide harmonic support with brass and low male choir, which in combination can sound intimidating. Adding heavy percussion and orchestral snare further communicates the sense of threat. The intro cue mostly builds off on the tonic chord of the key, except for the last two measures which introduce a V chord with the third in the bass. This sets up a nice tension and release when transitioning to the next part.

7.2.2 Cue 2: Preparation for Battle

The next cue is 24 bars in total and as it plays during gameplay segment A, it should loop indefinitely. To avoid monotony that can often be of danger in looping music, I decided to utilize qualities of small ternary form, meaning that the cue would consist of sections A and B, the latter being organized to provide contrast.

Section A would establish the tonic of the key and section B would contrapose another nearby region. (Schoenberg 1967, 119.) As changing keys could unnecessarily complicate the transition to the next segment, I decided to base the section B on the dominant harmony of the home key of B minor, F#, since it provides the most tension and contrast to the tonic while remaining in the same key.

Orchestration-wise, I decided to assign harmonic support to woodwinds, bass lines to cellos, double basses and low male choir and melody line to the piano. Heavy percussion would work as the main layer and other additional percussion layers would be added into the mix as the player completes the required tasks. Additionally, the brass would play a secondary melody that would later resurface as a thematic passage with different instrumentation.

Finally, I made note of possible sync points used for transitioning to the next cue. These were at the end of bars 8 (VI chord), 16 (VI chord) and 24 (V chord, third inversion).

7.2.3 Cue 3: Enemy Attacks

This cue plays during a cinematic, so its structure is linear and non-looping and it needs only one exit cue to the next segment. As such, it works as a good transitional segment for modulation and tempo increase. The previous possible sync points opted for a modulation into the key of D minor. The VI chords of B minor key (bars 8 and 16) in the previous segment work as a IV chord in the new key and the third inversion of V chord (bar 24) resolves nicely to D minor as a chromatic mediant. Combined with a gradual increase of tempo from 186 to 190, this short 12 bar transition packs a nice impact in transitioning to Gameplay Segment B.

7.2.4 Cue 4: Waves of Enemies

Gameplay segment B consists of three waves of enemies. The adaptive music would need to follow the events of the battle by switching into the next segment appropriately, either through separate transition sections or transitioning straight

to the next segment.

The first loop is 16 bars long with a simple chord progression of Bb major, C major and D major (VI, VII, I in the key of D minor). This chord progression plays twice during the 16 bars, so it made sense to set up sync points to bars 8 and 16, where the progression was about to repeat itself.

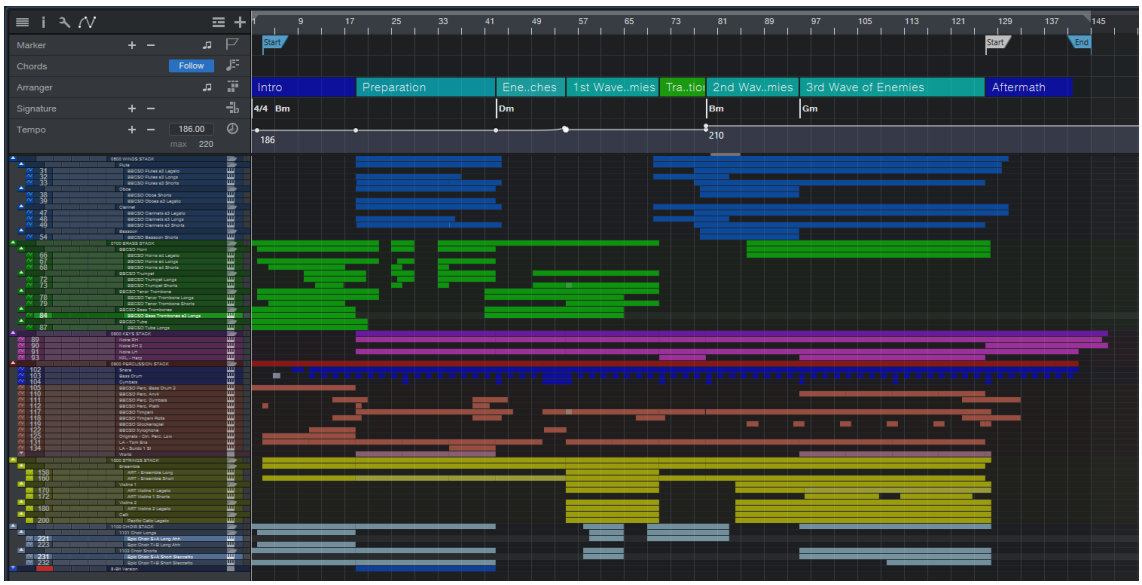
The transitional segment to the next phase builds off on the V chord of the D minor key, which also functions as the VII chord when modulating downwards back to B minor in the next segment. Coupled with a tempo change, this transition feels impactful and emotional and thus, appropriate to the brief.

The music for the 2nd wave of enemies reintroduces the melodic theme from Cue 2. Now with a descending bass line and reworked harmonic support along the change in tempo, the music communicates we are nearing a climax and stakes are getting higher. The counterpoint melody has now been assigned to high strings while piano, together with the woodwinds plays the lead melody.

The transition to the 3rd and final wave of enemies is handled without a separate transition segment. It merely modulates from B minor to G minor through either VII or V chord providing yet another level of increase in emotion through downwards modulation. The final section also introduces high choir parts and new percussion elements to amplify the intensity and reintroduces a variation of the ostinato part in the beginning of the scene.

7.2.5 Cue 5: Aftermath

Cue 5 functions as the outro of the whole scene and includes a piano part with two variations. First variation is an arpeggio outlining Gsus4 that resolves to G. This variation is used when the player has succeeded in battle with no casualties. The second variation is likewise an arpeggio, but this time outlining a Gmadd9b13 chord that does not resolve, communicating a darker outcome.

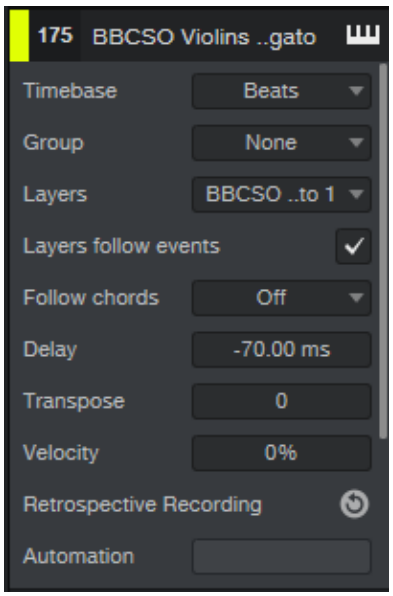


PICTURE 11: An overview of the arrangement in Studio One 6. (Photo: Olli Heino 2023)

7.3 Music Production

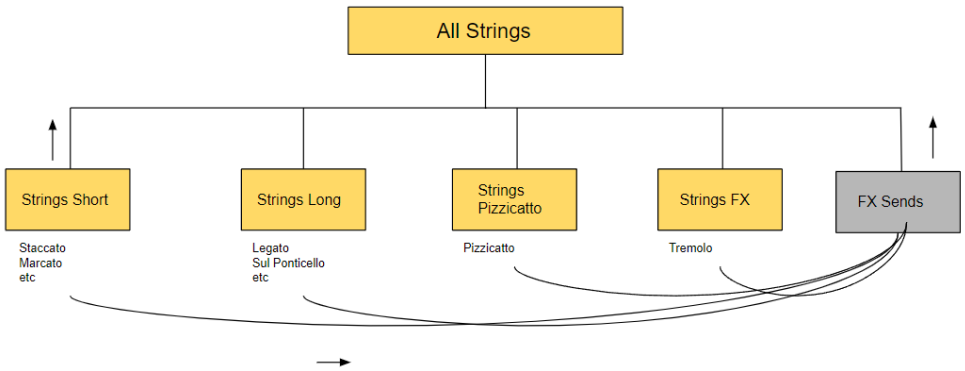
In the production phase, I used sample libraries and VST instruments mostly from Spitfire Audio and Native Instruments. As the primary goal of the thesis was to work with the adaptive techniques, time was not spent recording real instruments. Instead, the available VST instruments and sample libraries were deemed usable for the purpose.

Utilizing a pre-made custom template helped to streamline the production process immensely. When multiple VST instruments and sample libraries are used, it is important to balance them together and make adjustments for any timing differences between the libraries as their sample playback times may vary. In Studio One, there is a separate track parameter for setting a delay in milliseconds. The value can be negative, so it's possible to make the sample play in advance as well. When the track-based delays are set, quantization of MIDI notes results in samples playing properly in time across different libraries.



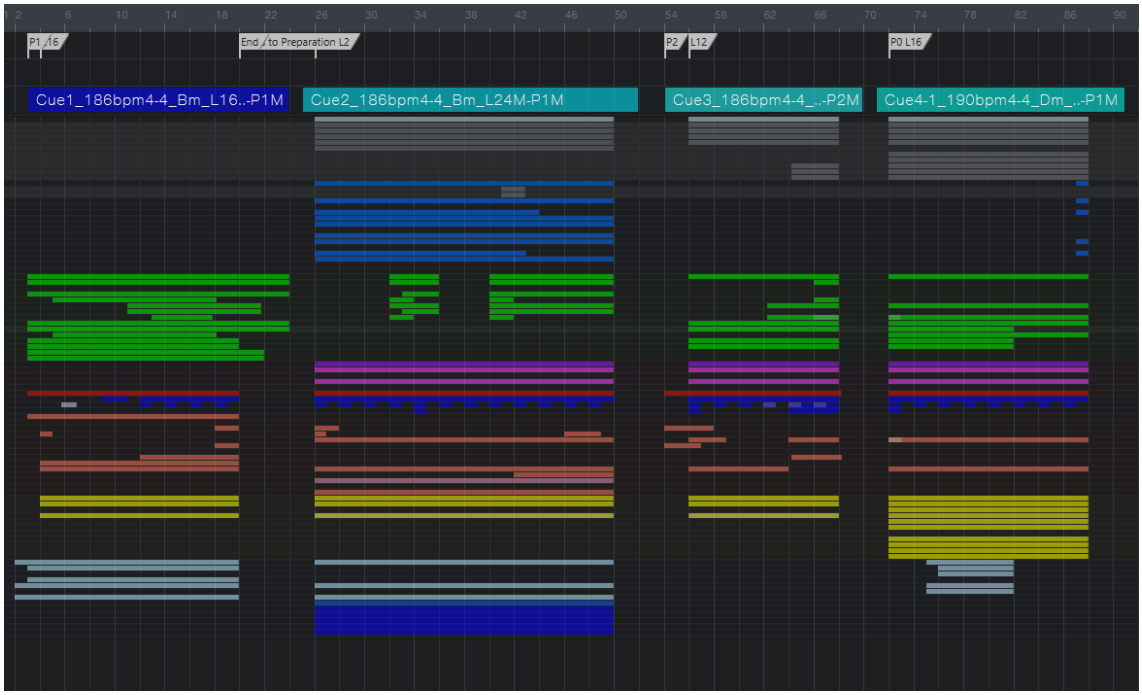
PICTURE 12. Track parameters and delay offset in Studio One 6's Inspector View. (Photo: Olli Heino 2023)

Different sections and articulations tend to need specific treatment in an orchestral setting. I've therefore routed them separately to their own busses. As an example, strings section consists of 1st violins, 2nd violins, violas, celli and double basses. All longer articulations across the section, such as legato and sul ponticello are routed into their respective "Strings Long" bus and the short articulations like staccato and marcato are routed to a "Strings Short" bus. Finally, these articulation specific busses and FX sends are routed to a dedicated bus for all strings, whose output can be used for stem exporting. Since the stems often play by themselves due to use of adaptive techniques, reverbs and effects need to be rendered into the file as well. This same process is used for all sections of the orchestra.



PICTURE 13. Bus-routing for a string section. (Photo: Olli Heino 2023)

Since Wwise is able to play pre-entry and post-entry material of a track and sync it properly with the subsequent tracks during transitions, the DAW arrangement needs to be modified in order to render sections so that they include their respective pre-entry and post-exit material. For example, some cues may be led up to by a 1-2 bar long bass drum roll or a flourish. This pre-entry material should be rendered into the file that contains the material it's leading into. Also, each stem should have their tail-end (post-exit material) intact as well, which means that cues need to be separated from each other for rendering.



PICTURE 14. Cues separated from each other to allow natural decay and effects for rendering purposes. (Photo: Olli Heino 2023)

Even though only cue 2 is utilizing vertical layering, I decided to export the files using the same logic for all sections as this gives more options later on and makes the process more streamlined by following the same steps. As such, the music was exported through the routing described earlier. This resulted in 6 stereo files containing stems for woodwinds, strings, brass, percussion, keys and choir.

Inspired by the 8-bit arrangements of Nier: Automata, I decided to create an alternate 8-bit variation for Cue 2. As the music had already been sketched with its separate parts in mind, all I had to do, was to assign these MIDI parts to 8-bit

style instruments. For this, I used Magical 8-bit Plug, a VST instrument by Yokemura.

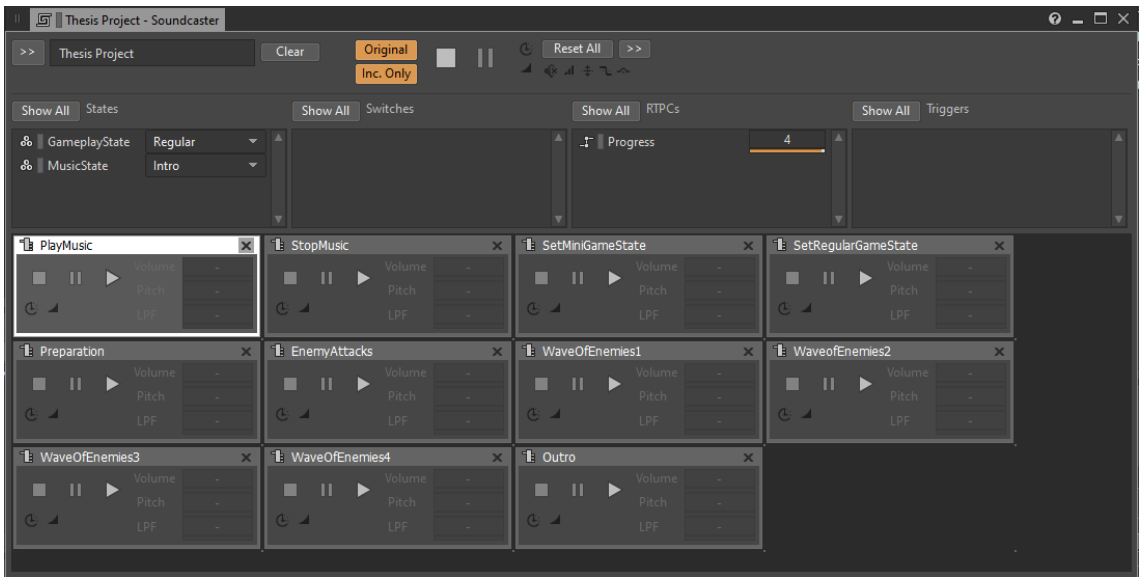
As a game project can include hundreds of audio files, it is a good idea to follow a naming standard (Thomas 2016, 185). I decided to include the following data into the file name: Cue number, tempo, time signature, key, length in measures, length of pre-entry material in measures and finally, the name of the stem. This information will be needed during implementation, so that transitions between different cues will happen correctly.

PICTURE 15. Naming convention for music files. (Photo: Olli Heino 2023)

Using this logic, 52 stereo files were exported for implementation. These included 6 stems per cue, an additional 8-bit arrangement for cue 2, a variation of the keys stem for the final cue and two stingers used for transitions.

7.4 Music Implementation

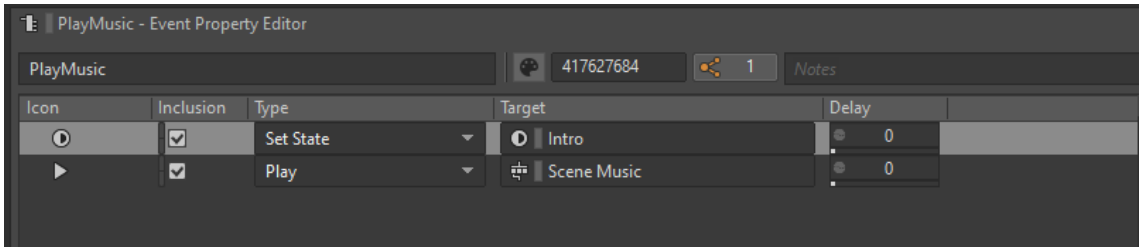
For the music implementation and testing the functionality of the music, I used Audiokinetic's Wwise. As touched upon in chapter 4, the music and its changes are being triggered by game calls sent by the game engine. However, the music implementation can be tested without a game project by manually triggering the events inside a feature called Soundcaster.



PICTURE 16. Soundcaster in Audiokinetic's Wwise. (Photo: Olli Heino 2023)

Wwise can handle anything from small indie games to blockbuster AAA titles and it might seem intimidating at first with its number of different layouts and functions. However, it's important to understand its logic and unit hierarchy to have a better grasp of the adaptive music system and its functionality.

When events are triggered by game calls, they can be set to function in different ways. In this project's case, events are used mainly for playing and stopping the music and changing game states, which results in changes in the music. Separate game states have been created for all the cues of the scene, as well as the smaller horizontal segments inside Gameplay Segment B.

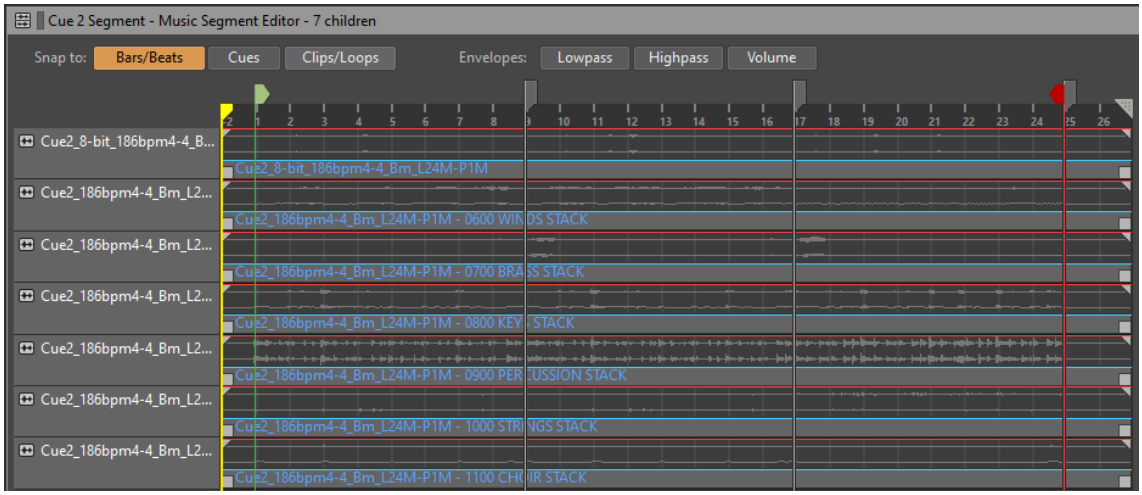


PICTURE 17. Event Property Editor showing that "PlayMusic" event has two tasks: to set the music state to "Intro" and play Scene Music. (Photo: Olli Heino 2023)

In order to switch between the different music segments, the music must be placed under a Music Switch Container. Only then it is possible to set different transitional rules between the music segments. As the imagined scene unfolds in

a linear way, meaning that the player always moves on to the next cue and never backwards, the transition rules are fairly simple, they only advance from one cue to the next one.

The music that plays during the cutscenes was set up so, that it would always exit the source at the exit cue marker. Music that played during the gameplay had to have custom markers, since waiting until the end of the track would simply take too long in most cases. For example, the looping music that plays during cue 2, has custom markers set up so, that it can transition to the next segment when the playhead finishes playing bar 8, 16 or 24.



PICTURE 18. Transition markers for the looping music of cue 2. (Photo: Olli Heino 2023)

The vertical layering technique utilized in Gameplay Segment A was accomplished by using RTPC (real-time parameter control), which makes it possible to tie specific object properties to other parameters (Audiokinetic). As the player had three tasks to complete, the RTPC was allowed a range from 1 to 4. Value 1 stands for the default situation, when no tasks have been completed and the value rises as the player completes the required tasks. When the value rises, different instruments crossfade into the mix, communicating sense of progress. To sum it up, the RTPC value that is based on player's progression, controls the voice volume of the stems.

Finally, a video demonstration of the audio implementation was uploaded to Youtube, to better understand the processes as well as the result (appendix 2).

8 Discussion

The roles and functions of music in visual media differ a lot. While music for video games stands out from the rest of the audio-visual mediums due to its interactivity, at the same time it follows timeless principles that are akin to film music and the language of music in general. The biggest difference between these mediums is the non-linearity of video games and the demands it casts upon the game composer.

Building a flexible game score requires a deep understanding of the game mechanics in addition to skills often associated with media composers. This knowledge goes beyond composing skills, as the structure and design of video games and video game music is unlike anything else. Designing, producing, and implementing music systems may not always be a part of a commissioned composer's workload but an understanding of these integral parts is imperative for providing music that meets today's standards in video games. Furthermore, indie game companies might not always have the luxury of hiring separate people to handle the various parts of game music. Being proficient with the entire pipeline will undoubtedly be valuable for a composer.

Using horizontal sequencing and vertical layering techniques have limitless possibilities as they are, but in a fast-developing industry, using these techniques creatively can add a lot to the originality and immersive qualities of the game. The case studies showed that they all handled music design and adaptive music in a different, yet highly functional way that supported the narrative and added to the game experience.

While the thesis' practical part was based on an imagined brief, following the strict process of music design through composition, all the way to production and implementation is as close to a real project as it can get. Depending on the project, the game composer might not always have much more material to work with than this, so this, too, can be a valuable skill in a game composer's career.

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APPENDICES

Appendix 1. Case Study Chart on Ori & the Blind Forest

A	B	C	D	E	F
	Story	Game State	Trigger	Type	Length
Part 1 - The Storm, Naru finds Ori					
Intro Cinematic	Storm, Ori flies in a form of leaf	Cutscene	Start Game	One-shot	60 seconds
Segment 1	Naru follows leaf	Gameplay	End of cutscene	Loop	40 seconds
Cutscene	Naru find Ori on the branch	Cutscene	Start of cutscene	One-shot	15 seconds
Part 2 -					
Segment 1	Ori wakes up inside a cave	Gameplay	Gameplay Start	Loop	40 seconds
Segment 2	Ori looks for apples with Naru	Gameplay	Exit Cave	Loop	~33 seconds
Cinematic after joining Naru and walking near the water	They find apple stack and build a bridge	Cutscene	Walk near water	One-shot	~30 seconds
Segment 1	Ori takes apples home	Gameplay	Gameplay Start	Loop	50 seconds
Cinematic sequence	Skies light ablaze, world decays	Cutscene	Cutscene start	One-shot	35 seconds
Part 3					
Back at the cave - No music, only ambience	Naru leaves cave	Gameplay	Scene Start	-	-
Back at the cave upon leaving - Eerie chords start a long cinematic	Search for food, failure, sacrifice, Ori finds food	Cutscene	Start of cutscene	One shot	1 minute 40 seconds
Control Ori to the cave - Segment 2 - Loop	Ori goes back to the cave with food	Gameplay	Start Gameplay	Loop	40 seconds
The Death of Naru	Ori finds Naru dead	Cutscene	Start cinematic by approaching Ori	One shot	40 seconds
Part 4					
Alone Again segment 1 - one shot	Ori leaves Swallows Nest	Gameplay	Scene start	one-shot	26 seconds
Alone Again segment 2 - one shot	Ori climbs on top of a branch	Gameplay	Start when climbing over the nyppy	one-shot	27 seconds
Alone Again segment 3 - one shot	Ori gets stuck in the bushes	Gameplay	Get stuck in the bushes	one-shot	40 seconds
Alone Again segment 4 - cinematic	Ori crawls and collapses, flowers and flora bloom, rebirth	Cutscene	Manage to crawl to the end	one-shot	45 seconds

Appendix 2. Video Demonstration of the Music Implementation

A link to the video demonstration of the music and its implementation: https://youtu.be/Aqn0VRiD-cc