

Artificial Intelligence for Music Composing: Future Scenario Analysis

Nikita Karpov

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| <p>Abstract</p> <p>Emerging technologies have multiple times reshaped the field of music, challenging our perception of creativity and questioning the established values. Today, Artificial Intelligence (AI) is recognized to be one of the most potential and influential technology areas for musical solutions, particularly – for composing. As a novel way to augment human creativity, the so-called AI-composers attract massive attention of professionals and enthusiasts, raise concerns and present a subject to a vivid discussion. This study aims to identify how AI-composers might be integrated into the process of music creation in the future and what impact they may have on various stakeholders within the industry.</p> <p>To accomplish the research goal, the study used the Scenario Analysis Method and relied on inductive reasoning. Qualitative primary data was collected via 5 in-depth semi-structured interviews conducted with professionals of diverse profiles. Combined with secondary data from academic literature, the collected data was used to evaluate the current situation and make future projections.</p> <p>The results of the study are reflected in 4 scenarios, which illustrate how the integration of AI-composers might proceed over a 10-year timeline and explain what conditions may influence the integration. The study identified AI-composers to carry a multitude of functions: it is a new way of expression for musicians and composers, an advancing soundtrack tool for content producers and a phenomenon that makes us reconsider our take on creativity. The range of implementation of AI-composers is expected to experience significant growth in the future, as more additional functions will appear and the capacity of the tool will grow. Special attention should be paid on the legal conditions: still finding themselves in an unstable legal context, AI-composers may soon receive the required legislative aid, which would noticeably incentivize their development.</p> | | |
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1 Introduction

1.1 Context of the research

Throughout history, music has been an outstanding reflection of human culture. Reaching one's ear, a composition delivers a range of societal and technological benchmarks of the era, which the piece of music derives from. Technologies, in turn, are directly related to the way that music is produced, played and distributed. Such inventions as radio and sound synthesis among many other ones have been the core driving force of the music industry. As they became deeply ingrained in the industry, new ones appeared on the horizon. Artificial Intelligence (AI) is seen to have the potential to once again reshape the industry in many ways. AI – is a universal term for adaptive algorithms, which are assigned to intellectually challenging tasks.

Already now, development in Artificial Intelligence found various applications in the music industry: from algorithms used for music recommendations on streaming platforms to the ones capable of editing recordings. This research is particularly focusing on AI-composers – a tool used to assist composing on various levels, e.g. by generating chord progression and melodies or by providing a ready-made composition within a chosen style. Two projects dedicated to developing such AI-composers attract special attention among others: these are AIVA and Flow Machines. Having participated in recording a gaming soundtrack and music albums, they represent the cutting edge of the research in AI-composers.

Working mechanisms, as well as implementation of virtual composers are explained by the developers, however, the potential impact of AI-composers on the music industry and composing profession remains nebulous. Whilst some projects, like Flow Machines, aspire to provide musicians and composers with an assistive tool at the first place, AIVA is on the contrary investing in the autonomy of the AI-composer. Being able to generate music by style and reference material, AIVA is claimed to not only benefit composers and musicians of various kinds, but also other users, who at times might have no musical education or experience at all – like game developers, who can utilize AIVA's creation for gaming scores with insignificant adjustments. Flow Machines and AIVA, hence, represent two opposite approaches of using AI-

composers: the first sees it merely as augmentation of human creativity, the latter – as a competitive alternative to it. The potential influence of either hasn't yet been analysed, which leaves unclear, how the figure of an AI-composer may impact the music industry and what advantages and threats it bares for composers, users of the algorithms and their developers.

1.2 Motivation for the research

The motivation for the research comes from the author's personal interest in the relation between music and technology, computerization and development in AI in particular. Novelty and ambiguity of the issue are driving the research, as the author strives to contribute to making the role of AI-composers more transparent.

Comparative to the state of development in AI, there is an insignificant amount of published academic literature, which would explain and project consequences of adopting this technology in the music field. Based on the literature available, it's still impossible to draw a comprehensive conclusion on how the technology might influence the profession of individual musicians and media-composers employed for game, film and other productions.

Outcomes of this research can be further considered by the leads of AI-composer projects, musicians, composers and other stakeholders in need of musical content: game developers, filmmakers, theatre directors, etc. As for the developers of AI-composers, the paper may benefit them by representing how the product is perceived by the users. For musicians, and media composers, the paper brings more clarity about the benefits and threats of the newly appeared solution. Others gain more awareness of the cutting-edge methods in soundtrack production for various industries.

1.3 Research objectives & questions

The research sets a goal of modelling how the integration of AI-composers may proceed in the future, including the analysis of impactful factors and describing how working methods of various stakeholders may change in light of AI-composers' emergence. To meet the research objectives, the following research questions are to be answered with this research:

Where does the edge of AI's ability lie in music composing? Through answering this question, the research strives to identify features and characteristics, which define the distinction between human and virtual composers and argues, which circumstances, if any, could minimize such difference.

How might AI change the process of composing? Questioned are the changes that AI-composers may introduce to the process of composing when used by various professionals.

What is the potential impact AI-composers might have on employment of composers? The research question discusses how the emergence of the tool may impact the employment of composers and demand for their work in various industries.

What are the conditions influencing the integration of AI-composers? The answer to this research question is meant to name the factors, which would encourage the integration of the tool into the process of composing and music-making or otherwise.

1.4 Research design & structure

The paper presents inductive research, for which it utilizes the future scenarios framework. Compiled of four phases, the framework not only provides an essential structure for the scenario-building process but is used to organize various stages of data collection and analysis. In this way, Phase 1 contains the Literature Review and only secondary sources are used at this stage. Then, phase 2 mainly incorporates primary data collection and analysis but also refers to some secondary data to support the findings. Phase 3 is dedicated to making projections based on the received data and doesn't introduce any new secondary or primary data. Phase 4 is the final step of the analysis. Its role is to interpret the received data and projections and model complete futures models from it. A more detailed look on the framework is provided further in the paper (see 2.4).

In the context of the whole paper, Phases 1-4 represent the *research implementation* part. Prior to it are *introduction*, where the context of the research is

given and research questions are formulated, and *methodology*, which introduces the theoretical basement of the research. The *discussion* part concludes the research, answering research questions and providing it with consideration for further studies.

2 Research approach & methodology

2.1 Research approach

As a futures research, the paper sticks to inductive reasoning. Approached in this way, data is first collected utilizing academic literature and surveying the appropriate population, then analysed and used to build theories from. Such an approach is reasoned with numerous factors. Firstly, aspiring to provide a multi-angle overlook of the issue, the research refers to qualitative data of “feel” – driven interviews of people of various professions – such detailed manner is commonly associated with inductive approach (Saunders, Lewis, Thornhill 2007). Secondly, inductivity is more preferred concerning to the chosen research method – future scenarios. Generally, scenario analysis can be carried both inductively and deductively but the used trend-extrapolation technique, that builds future predictions from the data of past and current development, inclines the research towards the inductive approach.

2.2 Research method: Scenario Analysis

The future of AI in composing can be influenced by a combination of various factors – not merely technological, but also the ones deriving from the neighbouring dimensions of culture and law. Understanding and analysing the complete picture demands to keep track of every identified factor and its potential impact. Scenario Analysis is a method that binds those factors in comprehensive models of futures, alternatively called scenarios, and offers techniques to estimate the impact that these factors have on each other and on one scenario as a whole. Importantly, scenarios are distinctive from what is normally understood by prognosis, though the latter has become a partial aspect of the method. The main difference is that whilst prognosis predicts what is most likely to happen, scenarios are not restricted to just

one vision of the future, but include alternative futures, each of which might (or might not) become actual (Steinmüller 2002).

In this way, scenario analysis presents a tool to construct “...different possible models of the future; ... which can serve as a compass for lines of action in the present” (Kosow, Gaßner 2008, 13). Scenarios in their nature may vary by how practically-oriented they are. Mainly, scenarios are classified to be whether exploratory or normative. The first visualize the possible future from the perspective of the current point in time, “...lay bare the unpredictabilities, the paths of development, and the key factors involved”, generally – carry an explorative, “knowledge” function. The second, as opposed, look backwards from a desirable point in future and build strategies on how to reach that point; such scenarios are “normative” and have a goal-setting and strategy-developing function (ibid, 30). This research falls in the first category. Sure, it might be used as a strategical aid for various people of the field, but the main purpose of it is to bring clarity and diversely review the issue. In other words, the paper does not recommend any concrete actions but illuminates the current state and suggests which direction it might take in the future.

2.3 Technique used: trend extrapolation

Trend extrapolation technique is used to predict the behaviour of a trend basing on the current and past events. In this context, a trend is defined distinctively from its everyday use. As defined by Pfadenhauer (2006), “A “trend” in this causal relationship is to be understood as a development over a period of time, that is, a long-term vector of development in which the waxing or waning of an interesting factor takes place”. By the technique, the long-term data of past and future developments is collected in order to depict the behaviour of a trend over a period of time and the trend is further projected into the future. Trend analysis can be carried both using qualitative and quantitative data. Qualitative trend analysis is known for studying “softer” factors, such as social, institutional, commercial and political ones. Besides, the technique is implemented in light of the absence of numerical data, which is also the case of the current research (Svendsen, Strategic Futures Team

2001). Since the research conceptually reviews a technological phenomenon and does not operate with numerical data, it sticks to the qualitative trend analysis.

In this way, qualitative trend analysis first observes the most impactful trends and describes, how they might develop in the future. For that, a trend curve is extrapolated in accordance with the received data. The mere extrapolation of a trend, however, can't present a reliable basis for scenarios for it too heavily assuming future to be a totally calculable prolongation of past (Kosow, Gaßner 2008, 47). Often the extrapolated trend results in one scenario, which turns out to be trivial and represents the future in a predictable way. Suggesting little deviation and representing the "business as usual" development, the trend can be used as a reference, that others are compared against, but the predictions made from it are often more of an "outlook" or a "forecast", rather than a "scenario". In order to reach variations necessary for multiple alternative scenarios, trend extrapolation should take the unexpected into account. Trend Impact Analysis is a tool that is often used bundled with trend extrapolation in order to alternate the development of a trend. It includes figuring out a set of impactful events – often, via interviewing experts of the field or through literature studies – which are expected to influence the course of a specific trend in the future. (ibid, 49).

2.4 Framework overview – research structure

Having explained the fundamentals of the technique, the next step is to put it into the complete picture to better illustrate at which point certain steps take place. The scenario building process is broken down differently by various academics. The most abstract divisions number from three to four phases, whilst the more detailed ones go up to eight. The one proposed by IZT (2007), which the current paper sticks to, divides scenario building into five concrete phases (Kosow, Gaßner 2008, 25). The fifth one, however, concerns strategical planning on basis of the outlined scenarios and thus won't be included in this research, since there is no aim of formulating strategical guidance (See 2.2). The suggested sequence then looks as following (the upper line has been added to represent how the framework is adjusted to the specific research):

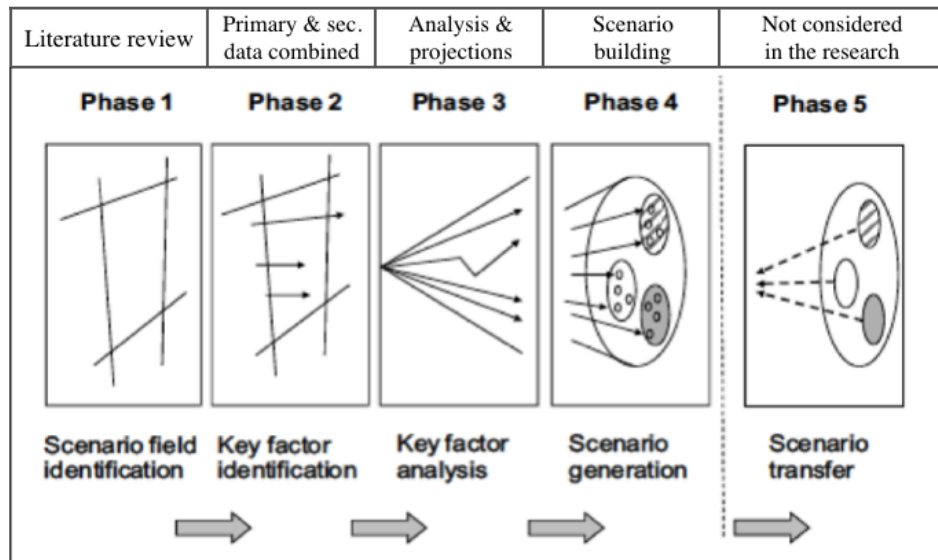


Figure 1. The general scenario process in five phases (adapted from Kosow, Gaßner 2008, 25)

Phase 1, *Scenario field identification*, draws boundaries of the studied field, defines the issue and explains the purpose for which scenarios are built. Adjusted to this research, phase 1 is presented in the form of a literature review: utilizing secondary academic sources, the aim at this stage is to illustrate the context of AI-composers and determine the nature of trends, which should be kept track of further in the paper, e.g. “internal” trends, studying the internal factors of the field, or “external” trends of neighbouring dimensions, as environmental, economic, political, cultural, etc. (ibid, 26).

Phase 2, *Key factor identification*, shifts focus from the generic field description to its key factors, in this case - trends, which are further observed and serve as a basis for the scenarios. Successful trend identification requires a profound understanding of the field so that the researcher is able to break it down to more specific areas, noting the on-going trends for each. The phase also includes estimating timelines for the trends and scenarios. Primary data is collected at this stage through qualitative interviews with experts of the field. Secondary data is used additionally to support the findings and outline trends together with relevant events, which might impact their development in the future.

Phase 3, *Key factor analysis*, is dedicated to making future projections for the trends, considering the impact of the figured events. Since this part involves directly

visualizing the future development of trends, it requires intuitive and creative work (ibid, 27).

Phase 4, *Scenario generation*, is the final step that is meant to structure the gained data and group scenarios from the specified trends. As mentioned earlier in the paper, the attempt is not to provide the “most likely” outcome, but to identify “the range of feasible outcomes” (Glenn, The Futures Group International, 2007). It is recommended (Eurofound, 2003) that the number of developed scenarios is kept between 4 and 5 so that they are distinguishable from one another and cognitively processable. Each scenario does not only reveal the proposed end-state but also explains, which exact trend combination leads to it. Scenarios are then assigned intelligible names and given short text descriptions, which sum up the core aspects of each model. By that, the scenario analysis itself comes to the end. The research questions are answered in the concluding part of the research – *discussion*.

2.5 Data collection and analysis

As mentioned in the previous section, data collection and analysis is carried during Phase 2. The intention of primary data collection is to compile a set of trends and events within each dimension. The aim is to not only suggest different happenings but also understand their cause. For these matters, semi-structured interviews are chosen as a primary data collection method. This kind of interviews, also referred to as qualitative interviews, allows varying the list questions as they are answered in order to get more details on the desired aspect. Unlike structured interviews that use questionnaires and emphasize the scale of the received data, semi-structured interviews engage fewer interviewees but are able to provide the research with detailed answers, which can be elaborated with follow-up questions as the interview proceeds. (Saunders et al. 2007, 312.)

The data collected in the form of recorded interviews is then transcribed into the text form. Text is edited and scanned for relevant pieces of information.

2.6 Research ethics

For the research receives primary data from actual specialists of the field, it is important to make sure that the paper complies with the standardized research

ethics. For this matter, the primary data is gathered only with the prior consent of respondents. Confidentiality of their private information is guaranteed, and only such characteristics as one's area of expertise and prior professional background are revealed. In order for the reader to easily distinguish one interviewee from another, the characteristics are summed in to profiles assigned to each respondent. Digital recording of interviews is carried with permission of interviewees.

3 Research implementation

3.1 Phase 1. Scenario field identification – Literature Review

In its broadest sense, the studied scenario field is restricted to the relation between music and technologies. By studying the integration process of the other two inventions in the first part of this phase, the research receives an overall understanding of how the adoption of an invention might proceed in the music industry. It helps to analyse the concerns, which may be associated with a musical solution and see how they reflected on the actual turn of events.

The second part of the phase studies the research in AI and composing, which on its own has a long history behind. Description of it is concluded with introducing some of the current AI composing solutions.

3.1.1 Technologies & music

“The introduction of new technologies and instruments provides a way of probing and breaching the often taken for granted norms, values, and conventions of musical culture (Pinch & Bijsterveld, 2003). Issues such as virtuosity and creativity become contested: is it the performer or is it ‘merely’ the instrument that makes the innovation?” (Pinch & Bijsterveld, 2004, 640)

The adoption of technologies and innovations in the music industry has never proceeded without disputes and ever-growing concerns: whether a novel tool presents new ways of production, recording or distribution of music, it may often change beneficiaries of the industry and cause people to step off the beaten track. The concerns that arise along with the new solution often refer to the change in revenue models and employment of people. AI-composers are, remarkably, associated with both. Before analysing which changes may follow as AI-composers become commonplace, the research investigates the adoption of two inventions,

which have already established their names in the industry. Same as AI-composers, the two inventions have risen both legal and ethical concerns at various stages of adoption, with that presenting a valuable example of how such concerns may evoke an attempt to govern the process of integration and what the outcome of it may be like.

Each case of the adoption of a technology is individual, for it carries its unique historical traits and nuances, which doesn't give much space for generalization. However, one might learn a lot from past experience and adjust it to the context of the current research. This part of the research is dedicated to extracting some guidelines for reviewing the adoption of AI-composers, based on the history of inventions prior to it.

The sound synthesizer case

Generally defined, "the sound synthesizer is the ultimate electronic instrument. Traditionally in the form of a keyboard, synthesizers generate electronic signals which are converted to sound through a medium such as speakers or headphones. With its invention, the possibility of creating virtually any sound was achieved." (Green 2013, 3). First constructed in 1955 by Harry Olsen and Herbert Belar (ibid, 3), the synthesizer was becoming truly revolutionary a decade later, as the first Moog Synthesizers were introduced to the market. First presented in 1964, the Moog Synthesizer was a set of modules, which were interconnected with wires, and controlled with a keyboard and knobs. The exact set of modules could be tailored for individual needs of customers - the first of them were avant-garde composers, who sought for a sound never heard before. As the extra modules would be added, the synthesizer could grow infinitely. Its bulkiness, novelty, as well as the price prevented its spread to a broader audience: the three models were in the price range of \$2,800 to \$6,200. (McNamee 2010; Pinch, Trocco 2002, 68). In 1970, the mini-Moog was released - a synthesizer in a much more compact cabinet, tailored especially for live performances. Uniting multiple modules under a single deck and having some novel features added, it influenced pop culture like none of its predecessors did (McNamee, 2010).

The mere idea of being able to reproduce any sound was found as astonishing as it was frightening. Before establishing itself as an independent instrument, the synthesizer

was seen to endanger the livelihood of musicians. In 1969, it resulted in a ban released by the American Federation of Musicians (AFM) against the commercial use of the Moog synthesizer. (Pinch et al. 2002, 148). In the eyes of the Union, as Robert Moog put it: “All the sounds that musicians could make somehow existed in the Moog—all you had to do was push a button that said ‘Jascha Heifetz’ and out would come the most fantastic violin player!” (ibid, 148). It took a while before the union affirmed the instruments’ own complexity, which demanded skills and practice, and accepted the category of a “synthesizer player”.

The instrument was never initially planned to precisely emulate the sounds of other instruments: the electronic sounds on their own attracted massive attention of users. However, some intersection between the synthesizer and orchestral instruments did happen: strings and organs appeared to be among the most popular sounds produced by the synthesizer. “Almost a whole generation of session musicians were put out of work by the synthesizer. On the other hand, there is no doubt that the growth of the synthesizer industry and the new sorts of musician it encouraged led to plenty of new work” (ibid, 149).

In this way, the influence of this instrument seems ambivalent. It served as a tool to alternate some orchestral sounds, but the use of the instrument is not restricted to just that. The film industry is often seen to have fully realized the potential of the synthesizer. With the infinite arrays of timbres, film composers received means of expression, that the orchestra wouldn’t be able to provide. The instrument has consequently given a signature sound to such movies as *Bladerunner* and *The Shining*. (Green 2013, 6, 16).

When it comes to popular music, the influence of the synthesizer is truly hard to overestimate. Apart from contributing to the already existing rock music, the instrument paved a way to the completely novel genres of music, as are house, techno and IDM. Along with drum-machines, it became the cornerstone of what is referred to as “electronic music”. Conceptually, it supported the shift from the conventional music concepts, as melody, harmony and rhythm to the sound itself (ibid, 6). In a way, it democratized music-making, allowing even more people to produce music leaving the conventional musical training aside. The “quality” of such

sound-centric music has always been a subject to the aesthetical debate, which this research deliberately avoids. No matter the quality of music introduced by the synthesizer, the invention presents an extremely high interest for the research.

Newly appeared, the synthesizer was expected to negatively impact the employability of session musicians. As an attempt to take control over the situation, AFM released a ban against the commercial use of the instrument. Through the diplomatic work of Moog's representatives, the ban was soon cancelled without causing any serious harm to the company. It would be pointless to negate the fact that the fears of AFM were somewhat confirmed, and the replacement did follow for some session musicians. However, other changes and improvements that the instrument brought along to the music and film industries speak for themselves – the synthesizer has not just taken the job of certain people but has granted the possibilities for discovery and experiment, attracting loads of others to the field.

The digital sampler case

One might think of sampling as of a way to create digital copies of a musical piece. Would it be a single drum sound, a melody or the sound of a whole orchestra playing, sampling allows capturing parts of a recording so that they can be further played and manipulated separately. That might include changing them by tempo, pitch or length, looping and layering them, adding effects, removing or adding background noise. (Katz 2004, 138-139). The instrument to carry such a task is called a sampler – traditionally a machine with pads, buttons and knobs, commonly used in music production from late 80's to this day.

Sampling is an extremely powerful technique in popular music. It can make recorded guitar leads, drum rolls or any other fragments of a recording travel over years and across genres to later appear in the production of a person, who sampled them. Whilst some producers use samples additionally, some build the whole composition as a collage of such, utilizing the whole range of samples, from basslines to voice samples and sound effects.

It's important to mention that despite the continuous development of the technology, one's ability to use a distinctive sample of a recording has been

significantly restricted by the updated legal circuits. In the USA and worldwide alike, the overt, distinct use of samples reached its highest point in the '80s, as hip-hop producers openly referred to funk, soul and rock records to use their fragments for one's own production. However, as more copyright infringement cases with subsequent monetary penalties appeared, forthcoming producers were left with fewer options to sample one's work (Harrington 2018).

As for now, there are in fact two options for using a music sample: to whether pay all the related royalties to the author and the publisher of the original material or to cardinaly transform samples in a way that makes their origin untraceable (Hussain 2019). Though the first option hasn't lost its relevance completely, the second one is preferred far more often. In this case, samples still possess their practical value, presenting a diverse material to work with, but the idea of visibly adopting one's work, which has been the core value of sampling to some, is given up on (ibid, 2019).

Katz (2004, 151-157) argues that the cultural value of sampling lies in overtaking the original embodiment of a musical idea in the first place. On the example of Public Enemy's "Fight the Power" he underlines the potency behind preserving the character of a sample that links its sound to the original author. Released in 1988, as sampling still was unregulated, the song interweaves unambiguous political lyrics with sampled motives of such key African American pop figures as the Jacksons, James Brown and many others. For such song, which articulates problems of poverty, crime, oppression of the black community and separatism within it, "it is performative quotation – made available by digital sampling – that allows Public Enemy to call forth a pantheon of black figure with such vividness" (ibid, 155). The author, therefore, claims sampling to not only be an outstanding musical tool but a cultural continuation of the signifying practice, which had for long existed in the African American culture.

The lawsuits followed in early '90s took their part in the later development of rap as the genre, to a great extent influenced by sampling. From the time on, the use of traceable samples was transforming into a way of showing one's wealth, rather than cultural belonging: an approximate price of legally clearing out one sample is estimated as 10,000\$. (Nielson 2013). The fall of sampling has uncoincidentally

matched with lyrics becoming less political within the genre. Sampling one's work, the artist referred to his social and historical context that in a way shaped one's own lyrics. With sampling left aside, "artists' lyrical point of reference only lies within themselves" (Shocklee cited in Nielson 2013).

As a way of direct musical reference, sampling provided artists with not just an interpretable musical material, but with a cultural standpoint, which inherently shaped their own style. As opposed to the synthesizer case, the lawsuits on the matter happened and finally had an impact on how sampling was used over time. The use of distinctive samples became too expansive to remain commonplace, which made artists process them more heavily, leaving the listener with no clue of samples' origins. An alternative of legally clearing the sample by paying the related royalties to the original author is used less frequently and is only considered by more prominent artists. The history of sampling is a demonstrable example of how legal regulations might impact the adoption of a technique, the musical instrument behind it and even genres, most dependent on how accessible the technique is.

Directions for the further analysis

As mature inventions with established applications for composers, the synthesizer and the digital sampler provide the research with some valuable guidelines. First of all, it is found that a multi-perspective approach is to be used when studying a musical invention. The adoption path synthesizer has proven that reviewing an invention from the cultural perspective in the musical context means pointing both at the positive changes that the invention brings, e.g. new ways of expression and bringing more diversity into the profession of composers, as well as at the negative ones, as partial replacement of employed people, who have to requalify due to particular features of the invention. The case of the digital sampler, in turn, has shown that legality of an invention should be well-considered since the adoption path can experience significant changes in light of new legislation. That is especially relevant for AI-composers, which refer to other copyright-protected compositions in order to produce new material. Taking these facts into account, it is found necessary to include the cultural and legal perspectives while investigating the integration of

AI-composers, as well as to consider internal factors as the ways that AI-composers benefit their users.

3.1.2 Artificial Intelligence for music making

Human and Artificial Intelligence: the interplay

The research in Music-AI started long before computers gained their familiar shape. Since 1950's the field has been attracting specialists, who programmed algorithms to perform various musical tasks as composition, improvisation, musical recognition and notation and many other ones. The history of this on-going research presents a certain interest for the current paper in terms of relative philosophical issues, as defining creativity of Artificial Intelligence, however, the literature review is not attentive to concrete practical programming methods used now and in the past. Scoping out the intention behind them, but not their technical part, the paper seeks to understand *what* has been driving the research rather than *how*.

Studying Music-AI means permanently redefining the fundamental concepts of *Music, Artificiality and Intelligence*. Widely open to interpretation, the definition of each is always context-dependent and versatile, which makes it hard to bring them down to just one common interpretation. However, same as the research impacts our perception of such concepts, our up-to-date vision of them is fundamental for the course of the research.

There has for long been no better benchmark for Artificial Intelligence than our own, Human Intelligence. This approach in measuring AI underlies one the most renowned tests, called Turing Test, which suggests that a system is an intelligent one in case of its indistinguishability from a human being (McGuire 2006, 5). The test was proposed along with an article by Alan Turing released in 1950 and assumed having an interrogator, a machine and a person. Through asking a question and receiving textual responses, the first makes judgements on the belonging of the respondent who is whether a machine or an actual person, and in case of no apparent difference between the two, the test is considered as passed (ibid, 6).

The musical version of the test is arranged by substituting text messages with musical pieces fed to and received from the respondents. One of the major teams of

AI-composer developers – AIVA, claims the musical Turing Test to have been already passed by the composer programmed by them (Kalegasi 2017). Undoubtedly being a valuable accomplishment for the research in Music-AI, this shouldn't, however, let one mistakenly think of AI-composers to be a full-fledged alternative to the human ones. The Turing Test on its own, as well as the underlying assumption of AI's validity in case of its full similarity to human, have been subject to profound critique, which points out a range of ontological issues.

The main standpoint of the addressed critique, as well contributed by Alan Turing himself as he proposed the test, questions the logical conclusions that are made once the test is passed: "would it therefore be true to say that the machine is intelligent or would it just affirm its capability of passing this exact test?". After all, "... passing the Turing test is only a subset of the situation that humans have to contend with on a day to day basis." (McGuire 2006, 7). The list of characteristics that actually make us intelligent is so vast that an attempt of coding it would be at least a demanding, lasting, meticulous task; what's more, from the further explained perspective, a beneficial use of AI may not come from making it operating completely indistinguishable from a human being.

Though being adaptable, AI algorithms are still restricted to a certain domain – in this case, the domain of music. The quality of AI's output within the domain is always *predefined* by the input, which equals the data that the algorithm is fed. Being indistinguishable from a human within a certain domain, what the Turing Test is meant to proclaim, nonetheless won't mean generating a complete original work, due to the limited and known input channels. Consequently, in some sense the algorithm won't ever be truly original. Then, in order to come up with an AI algorithm potentially as intelligent (e.g. as original) as a human being, it will require it to access the same input channels of all domains that we access, including memories of past events and "means of acting upon the environment" (Marsden 2000, 20-21). The branch of AI studies, which looks specifically into the cross-domain operating AI is called Artificial General Intelligence (AGI). Predicted to be developed as early as 2060, AGI will be able to adopt the knowledge of one domain to other ones, with that developing a knowledge base comparable to a human one (Joshi 2019). This

then might set a precedent for hypothetically passing the Turing Test, which isn't possible in principle with the domain-restricted or narrow AI.

In contrast to what the Turing Test suggests, it can be therefore argued that the value of AI lies in its "other-than-human" behaviour, which stands for AI's increased information processing capacity, significantly surpassing the human one (Marsden 2000, 22). At the same time, what is expected from AI-based musical algorithms is an aesthetically pleasing result, still categorized as human in its nature. It is hence fair to say that Music-AI should include both human and "other-than-human" features, be artificial in the "human-made" sense as it is "human-like" to the desired extent, whilst the complete resemblance of a human being is meaningless and impossible to achieve unless AGI is reached. Elaborating on the "human-like" character of Music-AI leads us to the discussion on its aesthetics.

The aesthetical value of AI-produced music

Projects like AIVA present an option of automotive track generation, however, we still haven't reached the moment when a hit song could be composed solely by an algorithm (Avdeeff 2019, 5). There are quite a few aspects that require human input before such song is released – in fact, though to a great extent contributed by the AI, all the "AI-composed" pop songs, like "Daddy's car" by Flow Machines are interpreted and arranged by human professionals before the final version is ready (Goldhill 2016). When it comes to the AI-composed tracks that are less human modified or not so at all, such often miss the expression, which could make them compete with the human-made ones.

The production process of AI-Music is built upon huge datasets of music scripts that an algorithm learns from. Even though any artistic activity includes advanced knowledge of the domain that one operates in, it also carries extensive knowledge and experience of the human culture in general, which is interpreted through an artwork. The creative capacity of substantive AI-based artworks is well-explained by Manovich (2018): "Creating aesthetically-satisfying and semantically-plausible media artefacts about human beings and their world may only become possible after sufficient progress in AGI is made. In other words, a computer would need to have approximately the same knowledge of the world as an adult human". As we can't

now fully rely on AI to express our vision of the world, we can beneficially utilize it to come up with unexpected solutions to extend our own creativity. Benoît Carré, who's collaboration with Flow Machines, Sony's AI-based music software, resulted in a full-length music album released under the name of SKYGGE emphasizes both the value that AI brought to the production through instant idea generation as well the importance of the human input to "stitch songs together, give them structure and emotion" (Marshall 2018). Other people who worked on the album as well mention the necessity in human presence, since an interesting melody or a chord progression is to be normally long waited for and still demands interpretation once received in order for the whole composition to be cohesive (ibid 2018).

Remarkably, some mistakes that musical gear produces can be purposefully turned into a virtue. Its' aberrations and cases of misusing of musical equipment might later become standardized and become a genre cornerstone on their own as it happened with Roland TB-303 bass synthesizer, which completely failed by its initial implication of accompanying single guitarists, but became iconic for the rising house scene (Vine 2011). In a somewhat similar way, flaws of AI-composers can gain musical meaning when reasoned by a human composer. "Mistakes" then can lead to novel musical ideas even if the initial result was "musically incorrect" (Dickson 2017). Because of that, AI-generated artefacts, for now, best simulate "avant-garde" or "experimental" artistic styles, whereas artworks are less constrained with genre conventions and therefore can be less stylistically accurate (Manovich 2018).

Considering the aforementioned facts, the "quality" of AI-generated music is always liable to individual evaluation, whilst the music itself is to be interpreted to match one's existing musical ideas or grant completely new ones. Whether the AI-presented results are musically appropriate or not may vary from case to case, and their resemblance of the human-composed music may be desired as well as it may be not. Importantly, even illogical musical results can be beneficially used, which makes AI-composers a great collaboration tool for composers. When it comes down to the independent work of AI-composers with minimized human input, it will naturally advance over time as algorithms learn and the volumes of datasets increase; besides, reaching AGI is expected to move creative-AI one step closer to the sophistication of human creators through being able to learn from multiple domains at once.

The edge of the research: AIVA and Flow Machines

Out of the vast range of AI applications in the music industry, the research exclusively focuses on those, that assist composing. The number of companies offering products of such application is increasing continuously, however, there is no necessity in covering most of them – though having some individual features, the projects mainly fall into one of the two categories, that will be described below. In order to have some concrete samples for observation, the author chose 2 projects, which are AIVA (Aiva Technologies) and Flow Machines (Sony). These projects were chosen due to their wide public recognition (such is considered featuring in various reviews and articles), which is thought to signify a compelling product.

The product is normally whether an online or a downloadable editor, that allows the user to generate musical patterns using different sets of instruments and stylistic modifications. Flow Machines position its product as an extension to composers' creativity in the first place, which is both reflected in the product design and companies' philosophy: the platform provides various composition building tools, such is, for instance, chord progression generator, but none of the two assumes completing the whole music-writing process for the composer. What's more, from the perspective of these projects, the composer is still to be the centric figure, whilst AI algorithms are there to contribute to the process by providing new musical ideas. Sony (2019) has particularly clarified it on the website: "Flow Machines cannot create a song automatically by themselves. It is a tool for a creator to get inspiration and ideas to have their creativity greatly augmented. [...] Although it is often said that AI might replace human, we believe that technology should be human centered designed."

AIVA works a bit differently. As well as carrying the functions of the projects of the first category, AIVA is capable of generating complete soundtracks on its own, which significantly broadens the project's target audience. As identified on the company's website (Aiva technologies 2019), the product can be both used by composers, who might use it as a creative tool and by game developers, who need a lasting soundtrack created with no prior musical knowledge. The settings are then brought down to style and mood to make them match the experience. Remarkably, AIVA also

allows generating a soundtrack based on influence – a musical piece, that is uploaded, analysed by the algorithms and further serve as a base for the newly generated track. The two tracks are sure distinguishable from one another but have some common stylistic traits.

The AI-generated pieces that involve insignificant human input are normally positioned as soundtracks - supplementary audio to games or videos, where they can be adopted. As discussed above, those pieces might be not as compelling and catchy as the human-composed ones, but in case of a game soundtrack, it's their duration and adaptivity that make them noteworthy. As Pierre Barreau, the leader behind AIVA explained (2018), with hundreds of hours of gameplay, games might only have two hours of music on average, which ruins the gaming experience with noticeable repetitions. AIVA, in contrast, presents a lasting adaptive soundtrack that matches the visuals and provides a more immersive experience. Such quality of the produced music might be favourable for small game studios that would otherwise need to roam through gigabytes of stock music. For bigger studios, it is always considerable to hire a composer or a band to create an exclusive soundtrack or to license existing music, however, it's mostly not the case for indie studios with tighter budgets (Lopez 2018).

Like many other kinds of medium, games are unimaginable without sound, and quite often it's due to its soundtrack that a game manages to make a unique and lasting impression on the player. Importantly, the game soundtrack has to be adaptive, meaning it has to match the game surroundings and correspond to the player's choices, changing as the game narrative develops. Unlike linear audio, an adaptive soundtrack provides an instant reaction to the events in the game – this explains the main challenge associated with adaptive audio, as a huge number of potential player choices has to be considered and coherently reflected in the soundtrack (Gasca 2013). One obvious benefit of AI-composer is the unlimited generation of music, which allows to create a longer soundtrack with more diversification, based on the selected inputs. With or without an employed human composer, it can significantly simplify the composing process, yet enriching the game soundscape at the same time.

AI's legal status in music

The illegality of AI-composers evokes especially vigorous discussion: the whole working process, from “training” on datasets of songs to generating a new piece on their basis falls into the grey area of the copyright law. The datasets are essential for an algorithm to be able to produce new material in the first place. At times, projects like AIVA allow to not only generate music on the basis of already analysed scores but to manually choose and upload songs that the newly generated piece is to be reminiscent of. As mentioned above, AIVA calls the function “compose with influences”. To begin with, copying one’s style won’t cause the problem – the general style of an artist doesn’t fall under such protection and, thus, can be mimicked both by AI-composers and human artists. Unless the new composition sounds exactly like the copyright-protected recording, or uses a recognizable audio sample from it, no violation occurs. AI-composers are safe from such duplication of existing works due to their preinstalled anti-plagiarism checkers; however, building a composition on thousands of other copyright-protected songs can still cause some legal issues. It is mainly due to the fact that the up-to-date copyright law still leaves uncovered whether purchasing a song grants its buyer the rights to use it as a raw material for an AI software. (Deahl 2019). Matter the fact that the processed songs are just “a combination of 1s and 0s”, even directly examining the algorithm won’t help to tell which songs were used for its training (ibid 2019). For now, artists wouldn’t need to give their consent for their songs to be studied by an AI-composer, but neither would they receive any royalties for that. The current status basically means an AI-Composer could generate revenues by means of copying an artist’s full discography, not presenting any interest for the mastermind, who’s work is core to the AI-Composer’s results.

The operations of AIVA are legally safe even in case the training of AI is regulated in future. The 30000 scores-database consists of classical pieces, which are copyright-expired since more than 70 years passed after authors’ death. The focus on classical music as well serves another purpose: the style is predominantly used for cinema and games, where AIVA is planned to be widely used in the future. (Kaleagasi 2017). In contrast, one can’t tell if only copyright-expired scores are uploaded privately with

the “compose with influences” function – in fact, it can be any song as long as it is presented in the midi format.

With the emergence of AI-composers, the discussion on the copyright protection of machine-generated pieces has become utmost of relevance. For now, the copyright law of most countries demands human origins of the work, in order for it to enjoy the copyright protection, but the need for lawful extensions and clarifications is obvious, as the labour of the developers behind AI-composers has to be fairly acknowledged and monetized. The copyright law of some countries, like the one of the United Kingdom, already provides recognition for the cases, where an artistic work is generated by a computer: “the author then shall be taken to the person, by whom the arrangements necessary for the creation of the work are undertaken” (Yamamoto 2018). In other words, the author of a computer-generated piece is then whether a developer of the algorithm or a licensed user of such. This model could be a solution for the countries, where AI-generated works are not yet legally recognized. After Guadamuz (2017), there are just a few ways legal systems can deal with works, where human interaction is minimal or non-existent: either by denying the copyright protection, or by attributing “authorship of such works to the creator of the program”.

There are already multiple existent cases with programmers and developers owning the copyright for the works their algorithm produced. Recently, a court in China has ruled an article generated by AI to be copyright protected, whilst the authorship was assigned to Tencent – the company behind the algorithm (Sawers 2020). In a similar way, all the 6 employees of the Endel company – and AI soundtrack generator, have been listed as authors of the tracks produced by the algorithm (Deahl 2019). AIVA’s case is just as noteworthy since all the material that the algorithm produces is protected by copyright, whilst AIVA, as claimed by the CEO, is a registered composer, recognized by SACEM – the France and Luxembourg authors rights society (Kalegasi 2017). Yet, it might seem to make AIVA even more comparable to a human composer, however, there is still a significant difference in the legal status of the two: according to the explanation given above, the only way for a generated work to be copyright-protected is by giving the author to the developer behind it. Most certainly, that is how it functions in the case of AIVA, who’s CEO Pierre Barreau

“remains the tutor of the algorithm until she (AIVA) gets more rights in the eyes of law” (Nvidia 2017).

The necessity in extending the US Copyright Law is also expressed by the local legal authorities, as the U.S. Patent and Trademark Office (USPTO) called for experts' opinion on the new forms of intellectual property protection (Sawers 2020). The need of such arises from the fact that, like most legal systems, the Compendium of US Copyright Office Practices doesn't yet assume “a machine or mere mechanical process that operates randomly or automatically without any creative input or intervention from a human author” to be a creator on its own, which concerns both patentable and copyrightable material (Deahl 2019). For the cases of automotive work of an AI-composer, which does not include any significant human input, this, in fact, means failing to legally recognize the result. Attempting to reflect on the situation, the authorities in the US are estimating the conditions, on which the AI-generated works can enjoy the copyright. Here are some of the questions taken from the agenda, which are the most relevant for the research (USPTO, 2019). Firstly, UPSTO discusses, if the copyright protection of AI-generated works should or should not be possible without the contribution of a natural person. Secondly, if such a contribution is needed, the extent of it should be regulated; the authorship could then be assigned to the programmer, the one who generates the piece, the one who chose the material for the dataset, and so on. Thirdly, it is being discussed, if the authors, who's works are used for the training of algorithms should be recognized for that.

As demonstrated, the dominating legal standpoint that requires the human origins of a copyrightable work doesn't suffice the existing advancements in automotive composing, when pieces are written without any human input. At the same time, we might already now notice the possible resolution for this issue, as we look at the model suggested in the U.K., where the copyright for computer-generated works is held by the person, who made the necessary arrangements, as programming of the algorithm or initiation of the generative process. Besides, the legislation suggested by USPTO in the future can be overtaken as a template for the EU legal system.

3.2 Phase 2. Key factor (trend) identification.

The identified field illustrates AI-composers in a malleable state, which can very likely undergo changes due to how the new solution is perceived by professionals and legal experts. This part of the research is aimed at shaping the data received from the field identification into smaller and more concrete areas with relevant trends. For a detailed analysis of each area, experts have been interviewed to support the identification of specific trends and events, which can impact the development of the first in the future. The chosen timeline covers the span of 10 years, meaning the mentioned events are assumed to happen from 2020 to 2030, and the modelled scenarios represent possible states, which the integration of AI might reach by 2030 latest.

Respondent profiles

The emergence of AI-composers, as well as their development in the future should be evaluated from the practical, cultural and legal perspectives. Five in-depth interviews gather opinions of four experts of these areas, and in order to provide even more diversity, experts are not only addressed question relative to their prime qualification, but to other areas as well: in this way, the interview conducted with a legal expert also included the discussion of the cultural perspective of AI-music, as the interviewee was musically trained and was seen to be able to contribute. In order to conveniently refer to each interviewee in the following part of the research and not disclose personal information at the same time, portfolios for each interviewee are assembled:

Theatre Composer (TC) – with more than 30 years of experience in composing, the respondent has managed to work with major theatres of Finland and Germany, besides composing for films, games and other productions. Close partnership with the clients has always been the centric feature of the profession for this respondent.

Game Composer (GC) and an audio engineer, now owning an audio production studio, which provides filmmakers and game developers with complete soundtracks. A trained musician, the respondent is familiar with the whole process of soundtrack

creation, both from the creative and technical perspective. The respondent has kept track of the most recent solutions for music production, including AI-composers.

Teaching Game Designer (GD), priority involved in sound design and sound engineering, ex-DJ and a producer, trained pianist. A diverse portfolio of this respondent appeared to be extremely valuable since it presents the perspectives of multiple professions at the same time.

Legal Expert (LE) – a teaching specialist in the field of Intellectual Property, presented an insight into multiple legal issues related to the integration of AI-composers. As a trained musician, the interviewee presented a perspective, influenced both by the knowledge in the sphere of law and composing at the same time.

It was initially planned for more interviews to be conducted, but after the fifth interview the collection of primary data was stopped due to data saturation. Since the exploratory study is not aiming for a consensus but strives to illustrate the options for futures, the five conducted interviews have sufficed the needs of the stage.

3.2.1 The operational dimension

What should be primarily considered when discussing the integration of AI-composers, is their operational value. The mentioned projects, where AI was implemented to compose along with other musicians and artists already tell of a very perspective musical solution, which is seen to become more accurate, independent and advanced in the future. There are multiple factors, which might make the human-AI shared composing process more sophisticated. Apart from extensive datasets, which mainly determine the output of the algorithms now, numerous other techniques are planned to be implemented in the future. As commented by Pierre Barreau (Nvidia 2017), there are three developments, which the AIVA team plans to implement:

- a) It's planned to develop a "musical ear" – the ability of AI to independently evaluate the quality of the produced material and tell whether it fits the client's criteria or not;
- b) Enhancing the competence of AI in making orchestral arrangements;

- c) Training AIVA's ability to read through scripts of films, games or any other given material to identify the general stylistics of it and produce in accordance with that (ibid 2017).

All these features are at the moment backed by a human specialist: people tell if the material produced by AIVA meets the requirements of the customer, the composed score is manually arranged for the orchestra, as well as the main themes and twists of the provided material, are studied by people for an appropriate accompaniment to be made. Shall AIVA become capable of all these things, its comparison with an actual human composer will have more ground to take place. Assuming these additional features become commonplace and will be overtaken by other developers in the future, the whole niche of AI-media composers, which are used for films, games, and other media will gain more demand respective to the growing precision in the work of these composers.

The ability of AI-composers to analyse scripts of the provided material and evaluate the result, as well as make arrangements for the whole orchestra, would significantly increase their value both at independent and assistive work. The discussion with two media composers – TC and GC, who have for long worked for various productions, has proven this point. As mentioned by both of the respondents, the early stages of any production, when the idea is crystallized and discussed between the directors, sound and visual designers, often require the fast provision of mock-ups and samples, which are used to illustrate ideas and explain the general stylistics of the material. As TC has commented, *“it's impossible to explain music. That's why it's best to provide the clients with ready musical samples to see if the vision of both sides matches”*. The ability of AI to accelerate the process of conceptualization is appreciated by both specialists, as in some cases, especially with theatre productions, the main music themes have to be provided relatively quick in order for other acts to be coordinated with them (TC). Through adding the aforementioned features, the users of AI-composers would be able to not only benefit from the high number of pieces produced at a high pace, but also from their quality and improved relevance.

As for gaming music, GC has pointed out on the fact that AI-composers could easily alternate another means, which is currently used to quickly provide a musical reference. The so-called music “loops” – pre-recorded repetitive pieces of music, prepared and sold or leased by other musicians, are actively used by media composers. *“That's practically what's already being done, except that these loops are made by real people and not by artificial intelligence. Removing the middle man and having the artificial intelligence making pieces based on the chosen criteria would be quite useful”* (GC). In this way, AI-composers can already be used in the production of gaming music at least in the early stages – as a better, more tailor-made alternative to loop-banks – and successfully compose whole pieces, shall the improvements be implemented.

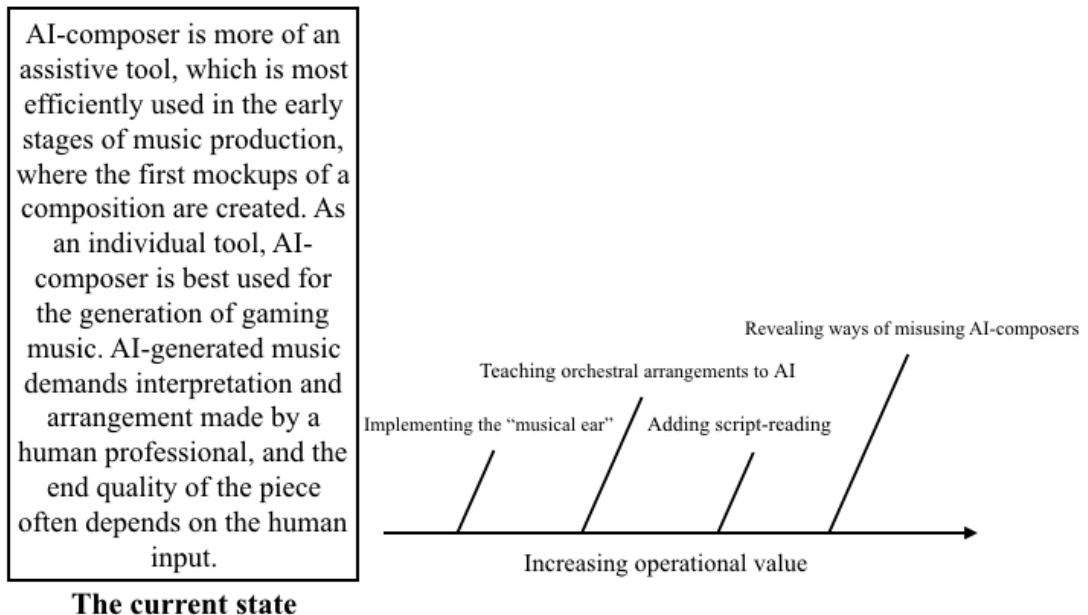
Among other media, gaming is now seen to be the field, where AI-composers used most appropriately, especially in case of minimized human input. When asked to mention any other practical difference in producing a soundtrack for games and making a one for films, TC mentioned the fact that, from one’s own experience, the AI-composed music might be a better fit for games rather than films, since the music is found “generic” and “missing the drama curve”, and might be fine for the game background music, but isn’t emotional enough for films or theatre productions (TC). However, GC stressed the fact that the composing part accounts to just some 10% of the workload when it comes game audio: *“the bulk of what our clients pay us to do is the technical work, as making note transitions smoother, removing harsh resonances and generally making the instruments sound more realistic. Composing as such is never the main challenge.”* In this way, though not being fully able to overtake tasks of a gaming composer due to many technical specialities, the quality of the produced audio is, for now, most fitting the gaming environment in comparison to other media. Assuming AI-composers’ production will become more sophisticated in the future, the range of their implementation might then spread to other media, whilst the necessity in the human presence might potentially decrease.

At the same time, precision is not always what is expected from an AI-composer. As mentioned in the literature review some producers aspire to utilize them in order to be presented with extraordinary musical ideas – often, something they wouldn’t come to themselves, since the result might be deviating from their personal way of

working or musical grammar in general. “*Using things in the wrong way as a part of artistic expression*” has been stressed by TC and GD, and AI-composers, non-exceptionally, can be approached in this way. The AI-composers like Flow Machines, which are positioned as a tool for cooperation in the first place, might, therefore, benefit from making more loose suggestions, allowing deviations from what is musically correct. Utilizing this characteristic of AI-composers might help human creatives to step aside from various constraints and extend their creativity. Turning such mistakes into something original is a matter of purpose, which, for now, only human possess, so considering this composer as an independent alternative to a human composer is out of question.

The two kinds of AI-composers, which are in this paper represented by Flow Machines and AIVA seemingly demonstrate the two categories of AI-composers: assistive and independent ones respectively. There’s a clear distinction in how both projects are positioned: Flow Machines’ team emphasizes the match of human skills with what Flow Machines Composer can complement them with, whilst AIVA is, on the contrary, aspires to grant the software with features of a human composer and train it to independently accomplish AIVA’s clients’ requirements. Both of these categories are expected to both develop independently and intersect in the future, since the composers of each can serve multiple goals at ones. Though the expected upcoming functions of AIVA can as well benefit assistive composing, there’s a definite aspiration of the company to introduce a full-fledged composer with a range of musical abilities comparable to human ones. This direction in the development of AI-composers will be especially emphasized in further analysis.

With that said, the first major trend of the field shall be ‘growing practical value of AI-composers’. The set of aforementioned events, as adding script-readers, ‘musical ear’ and teaching orchestral arrangements to AI would make AI-composers work more precise, requiring less human input. Besides, revealing a way of misusing AI-composers could contribute to the growth of their practical value for the composers used as an augmentation of human composers’ work.



The current state

Figure 2. The operational perspective on current state of AI-composers, the according trend and events

3.2.2 The cultural dimension

This sphere covers the emotional perception of AI-composers by the professionals. As demonstrated with the case studies, technologies have at all time contributed to how the music was produced, however, their appearance can be both embraced and resisted. AI-composers, non-exceptionally, bear a twofold image. From one side, one notices a source of inspiration, something novel to be discovered and reflected on, an augmentation of one’s creativity. From another one, people inevitably recognize some detriment that the solution brings along. In this regard, it’s important to separate the media buzz, which is often supported in favour of higher publicity, with actual changes that the solution brings to the multiple related professions - interviews held within the research has identified numerous ones, which are likely to be reshaped after the adoption of the solution is complete. Taking the two extremes of this field, the trends can be formulated as “adoption-readiness” and “resistance”.

The first one is contributed by the perception of AI-composers as a tool for composing and a novel means of expression. Projects like SKYGEE and Taryn Southern's "I AM AI" represent the interest of artists in discovering what the end product of the human-AI cooperation could sound like. This standpoint was acknowledged by the experts: *"I see using AI-composers like playing any other instrument, like a violin, sore or drums"* (LE). Apart from being a noteworthy tool, AI-composers represent a phenomenon, which has to be inevitably reflected by artists. *"The essence of art is in representing societal and human problems, as well as the individual experience of artists, so I can't see how any art school could actually forget about computers and AI in particular. It's not only a wonderful tool, but also something that can't be ignored, because in case it is, contemporary artists are not making contemporary art"* – LE noted unambiguously. The position demonstrates not only an open attitude to the specific solution, but to the progress in general: *"transformation is natural, we can't and shouldn't fight against it. It does bring challenges and maybe even disruption, but trying to keep what we've had won't ever make any innovation"* (LE). A similar perspective has been demonstrated by GD: *"Any kind of progress, whether it's positive or negative, augments things in a way that moves us in a different direction. You've got to have some constant upgrading, constant creation, constant movement - left, right, up or down – it doesn't matter... otherwise, we can't develop as a society, so I'm excited to see what happens."*

Though stressing the necessity of innovations, both experts have as well pointed at the fact that such changes might not be favourable for everyone at once. LE has underlined that each innovation might directly impact the revenue models and, consequently, *"the winners and losers of the music industry."* GD has as well mentioned that whether AI-composers can be considered a detriment or a virtue is always a matter of perspective. Obviously beneficial for people developing the algorithms and for the users of such, AI-composers will also provoke adaptation and requalification of others. As an example of the niche, which could be easily altered by AI-composers, GD refers to the production of loops of pre-recorded music, which is often purchased by commercial producers, video-makers and media composers. As affirmed by another expert of the field in the previous part, the product provided by loop-makers might indeed lose its relevance in case AI-composers become capable of

delivering a more tailor-made reference material, being otherwise comparable to what loop-makers provide (GC). As AI-composers will develop further, both as a cooperative tool and as individual producers, more sophisticated compositions will be provided and the range of such niches grow eventually. *“It's a new piece of technology, it is revolutionary, there are trade-offs with that revolution, but there will be an adaptation”* – GD comments.

As the paper demonstrates with case studies, such “trade-offs” are easily initiated by those, who incur losses due to a newly appeared solution. AFM, representing session musicians – in case of Moog synthesizers, and right holders, who’s songs have been sampled – in case of the digital sampler – have attempted resisting the solutions, which challenged the usual ways money was earned in the industry. The latter case received arguably more resonance, matter the fact it included the violation of intellectual property rights and therefore had a base for a legal dispute. In these terms, the context of AI-composers is more comparable to the adoption of the digital sampler.

It can be assumed, that such “opposition” won’t be represented just by loop-makers, who might already be competed with, considering the present capacity of AI-composers. In case some AI-composers become more independent, which such projects as AIVA aspire to reach, some tasks of media composers might be taken over by them. The possible resistance of actually employed media-composers, therefore, shouldn’t be left out of consideration.

AI-composers, synthesizers and samplers are just a few selected examples out of the range of solutions that reshaped the music industry. At all times, they were feared to bring irrevocable changes. *“Music business was expected to die first at the time when the radio was created. And what actually happened with the invention of the radio – is the era of mass hits and popular music. Thereafter, when the tape recording system was created, which allowed making recordings from the radio, every expert would say no one will sell an album again. Again, the completely opposite thing happened because the old platform remained a promotional tool... Years later, we were told that with the era of Spotify, mass hits will extinct, but then we look at Adele, and she manages to prove the complete opposite: mass hits are now bigger than ever before”*

(LE). As learned from the history of other innovations, whatever the new solution brings, its emergence makes the music industry flourish in the new, unexpected colours. Experts agree upon the fact that it's up for the people within the industry to adapt and reap the advantages of the innovation. However, as well there always are people who adapt their craft to innovations, there are ones whose interests are conflicted with it, which sets them to undertake actions. Representing extremes lies in the core of the chosen research method, which demands considering both cases: "adoption-readiness" and "resistance".

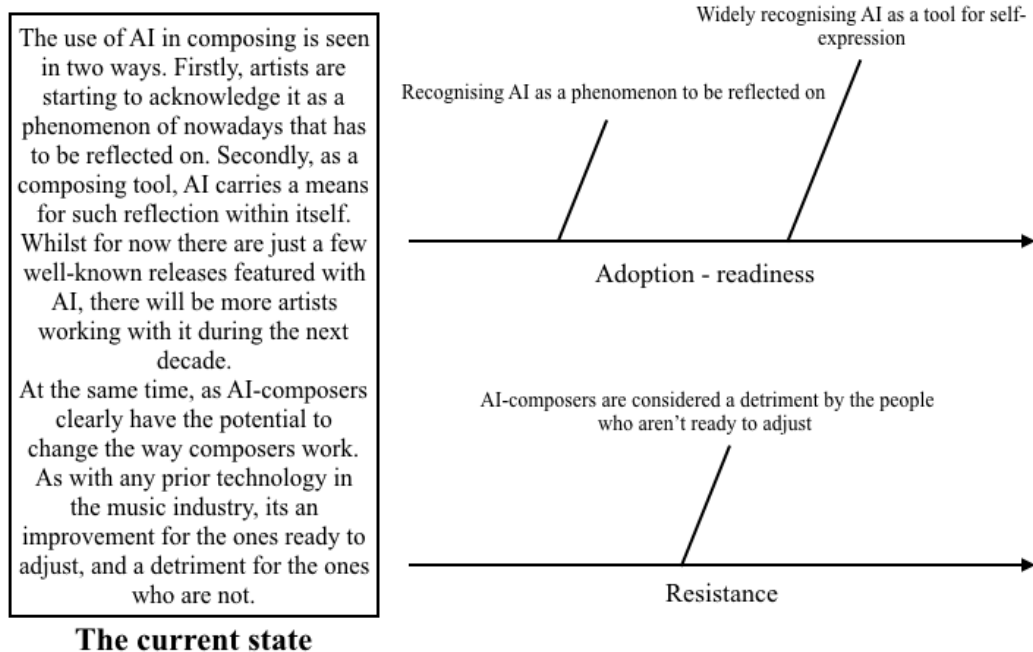


Figure 3. The cultural perspective on the current state of AI-composers, the according trends and events

3.2.3 The legal dimension

The literature review has shown that the legal issues associated with AI-composers either concern the training of algorithms or the material that they generate. For now, most legislative systems, as the one of the US, rather discourage the research in creative AI by both failing to recognize the produced works and leaving a potential precedent in training algorithms on copyright-protected works. Further legislation might improve the situation by regulating these questions, as well as hinder the research in case no regulations are introduced, and the conditions of authorship remain the same. The two trends of the legal sphere are formulated accordingly: "recognition" and "denial".

So, what are the legal conditions, which can incentivize the research in creative AI and the development of AI-composers in particular? The creative process for AI always starts with analysing datasets, and therefore the training material for algorithms has to be licensed. Whilst there's no issue with analysing datasets of copyright-expired music, as most developers claim to be doing at the moment, analysing copyright-protected material might cause several legal conflicts. As LE has clarified, *"there are several things that we might be colliding with. Firstly, is the violation of existing copyrights of right owners and authors. Secondly, using somebody's material for your own commercial benefit is illegal without appropriate permission – a license"*. At the same time, LE points at the fact that, if done in accordance with law, the idea of analysing a song with the purpose of generating a new one of an alike motive carries nothing wrong or immoral. *"Constantly overtaking influences is something that artist do all the time. Human beings are just like algorithms in this regard: they look, listen and absorb before they come up with their own things"* (LE). An established form of song licensing, LE claims, would help the developers and users of AI algorithms to safely train AI on the copyright-protected material, encouraging authors and right holders to provide the developer companies with it.

Making computer-generated works enjoy copyright protection is, on the other hand, a more complicated issue, which allows multiple solutions depending on the case. As argued in the literature review, assigning authorship to a natural person behind the generated piece – whether to a programmer or a licensed user of an algorithm – is one of the possible ways to deem copyright for such works. This could suffice such cases, where human arrangements are required before the composition is ready and AI is positioned as an augmentation to human creativity. However, as algorithms become more sophisticated, the necessity of human input might decrease, which should be reflected with the copyright law. In order for such works to then enjoy the copyright protection, after Pearlman (2018, 36), there should be conditions of assigning authorship to the AI-creator. In order to avoid the subsequent dilemma of copyright ownership, suggested is a model, where AI would be affirmed as a creator, while the copyright for the generated products would be immediately assigned to a natural or legal person, as are government entities or business corporations. Multiple

experts agree upon the fact, that AI is highly unlikely to gain intellectual property (IP) rights comparable to the ones possessed by humans: deriving from constitutional rights, IP law explicitly covers the interest of human beings, requiring the copyrightable work to originate from a “human agent” (LE; *ibid* 2018, 12). Detaching authorship from owning the copyright in a way suggested by Pearlman can help to bypass this quandary, making AI-creators a hireable entity, which provides the programmer or the licensee with copyrightable IP.

In this way, there are ways for legal authorities, and particularly for the US Copyright Office and UPSTO to deal with both possible cases, no matter if some extent of human input is present with the work or the result originates from the sole, unexpected work of an algorithm. Combined with a safe and rewarding way of training algorithms, the legislation could justly recognize all the stakeholders of creative AI, from authors of the works used in training datasets, to programmers and developers of the algorithm and companies or private users it is leased to. With public opinion already gathered by UPSTO by the time this paper is written and an active discussion set running, one can assume that the required legislation will be released and arranged as an established model within the mentioned timeline.

There sure might as well be a less incentivizing turn of events for the research in creative AI. Whilst the research has identified no distinct anti-AI movements, hurdles of the research wouldn't come from the intention of keeping AI away from the creative sphere, but would be rather caused by the heavy reliance on the outdated laws and legal requirements, which for now determine the inability to protect a machine-generated work with copyright in most of the countries. For the U.S, it's the Copyright Act of 1976 to still set norms for the origins of a copyrightable work (Pearlman 2018, 12). Still guided by this act, courts and other legal authorities discourage the further development in creative AI, with that making the dominance of outdated acts and laws the biggest obstacle for the research. In this way, denying the author in AI doesn't come from counteractions, but from the mere absence of any revisions.

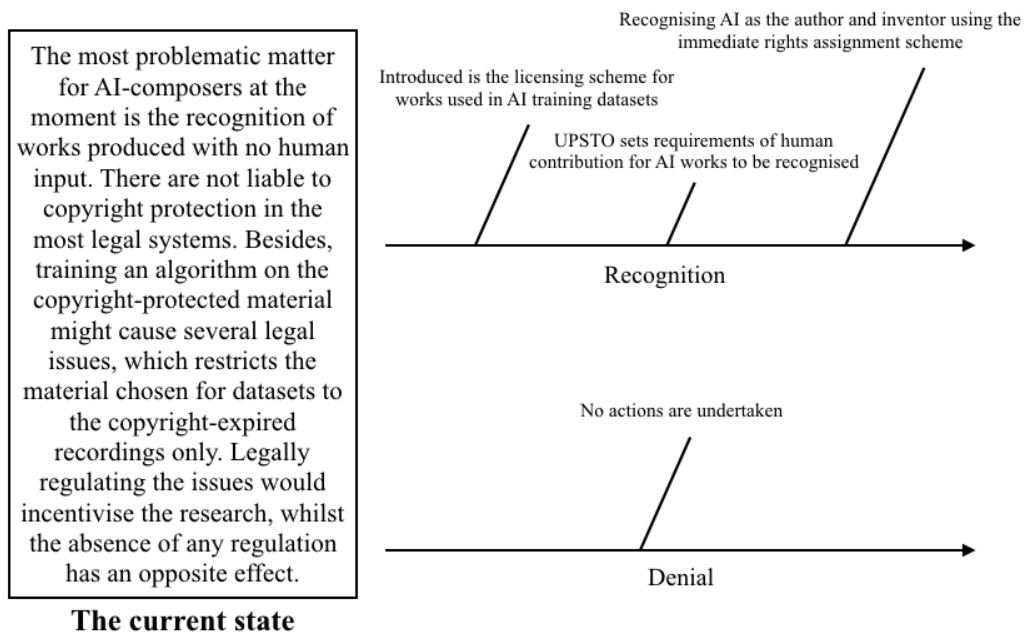


Figure 4. The legal perspective on current state of AI-composers, the according trends and events

3.3 Phase 3. Key factor (trend) analysis.

At this point of the research the projections first take place. For that, each model of the 3 perspectives – operational, cultural and legal – is extrapolated in accordance with influences of the trend-relevant events. The result of this stage is a future model of each perspective, which might be realized by 2030.

3.3.1 A potential projection within the operational dimension

The described set of features is aimed at making AIVA a more independent, critical and accurate composer, which can on its own understand the requirements of a customer through analysing scripts, evaluate the end result and minimize human involvement at various production stages. With that the creations of the virtual composer will not only be musically compelling but also context-relevant, i.e. supporting the style and progression of a provided material, would that be a game, a film or a script of a theatre production. At the same time, when used to augment the creativity of a human composer, accuracy may be given up on in sake of more unexpected suggestions, which are then interpreted by a musician.

Shall the mentioned events take place, by 2030 AI-composers will embody a tool capable of diverse and case-specific assistive and independent work, whilst the produced music will not only be good enough for a background soundtrack, as

commonly required in games but also be expressive enough to suffice the requirements of other types of media, as films and theatre productions. Used as a tool in the hands of a curious and open mind, they might as well be used in a way opposite to the one initially intended, like with unconventional musical suggestions, which are further purposefully arranged in to original composition decisions. It may be hard and unfruitful to try making any estimations on how the tool can be misused otherwise, but the preceding solutions of the music industry has shown that actual use of an instrument at times has little in common what was initially suggested by the developers.

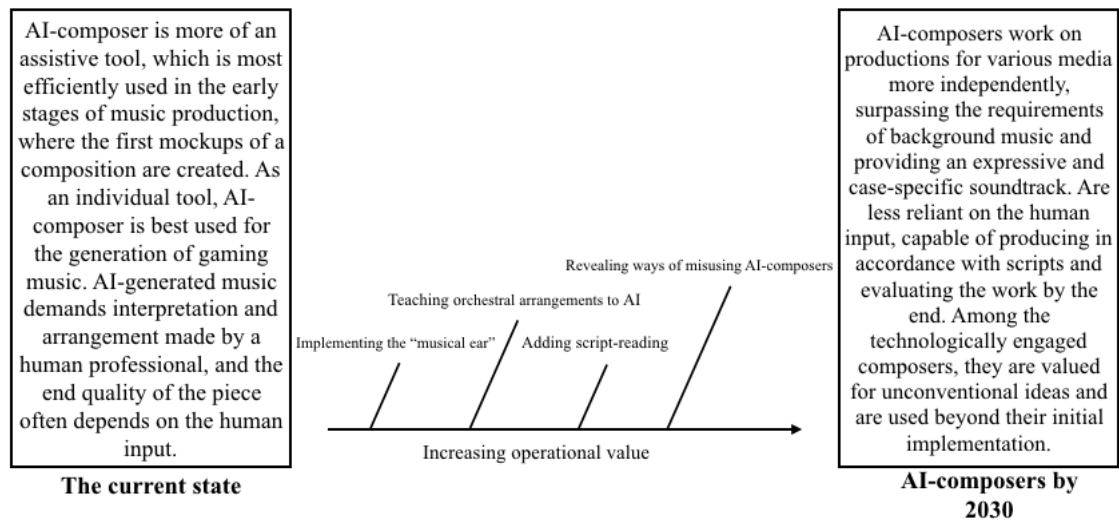


Figure 5. Future projections within the operational dimension

3.3.2 Potential projections within the cultural dimension

Over the span of the next ten years, AI and AI-composers particularly will attract more attention in the creative sphere, mostly so due to the ever-growing involvement of the technology on other fronts of our life. As AI continues to make a noticeable change in a vast range of applications, from transportation to medicine, AI's portrait will further morph from being fictional and futuristic to practical and common. The close engagement of AI with our own culture will be inevitably reflected in the sphere of arts – naturally, through using the creative capacity of AI itself. Due to a deeper rooting of the technology in our lives, the artefacts produced by or with the use of AI-composers will be of higher cultural relevance, whilst their artistic value will increase through the advancements mentioned in the previous chapter. In this way, following the *adoption-readiness* trend and the related events,

AI-composers are expected to draw the attention of a higher number of artist by 2030, and take an established stand in the artistic world.

On the flip side, as professionals will be confronted with the growing capacity of AI-composers, there might appear an urge for adaptation and requalification. It is expected to be first felt within the least demanding areas, as by loop-producers and some of the game composers. Smaller gaming studios may switch to AI-composers as to their prime source of soundtrack, leaving the mere technical part for human professional. It's not predicted that AI-composers will become a full-fledged alternative to composers of a bigger scale, who work for bigger gaming studios, or to cinema and theatre composers, but possibly, the difference between using and not using an AI-composer for assistance will become crucial. These conditions will provoke requalification, which may not be carried successfully by each one. The experience of people, for whom the emergence of AI-composers will turn out to be disadvantageous may undermine the image of AI-composers.

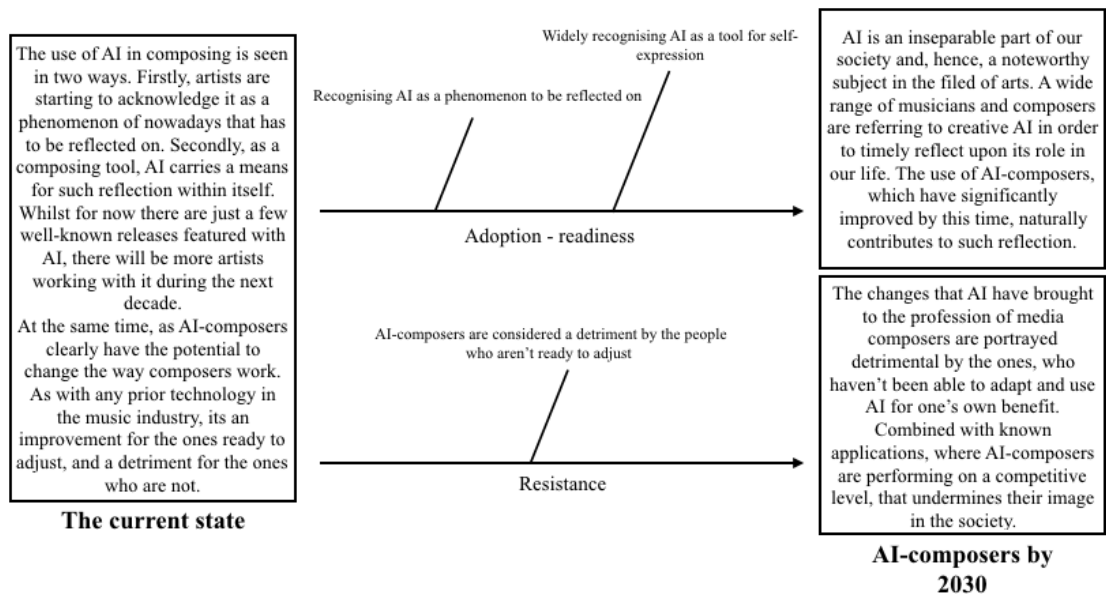


Figure 6. Future projections within the cultural dimension

3.3.3 Potential projections within the legal dimension

To date, there is no global agreement between the world's legislative systems on registering the IP produced by AI. It is besides very unlikely that any global actions are about to follow in the next 10 years considering the differences in these systems and acts they operate upon. However, being exposed to the same challenge, governments might individually undertake alike actions in order to correspond to the

modern situation. For this research, the specific projection is made on the example of the US legal system, since the research has identified its authorities to most recently arrange gatherings dedicated to these issues. Assuming the mentioned changes take place in the US, it is expected that alike shifts are made in other world's legal systems.

In case the debate progresses as outlined by the *recognition* trend, developers and users of AI-composers may receive the essential legislative aid, which would incentivize the research in creative AI and secure the use of AI-composers at all production stages. By 2030 the US legislation would at least include the extensions listed below:

- a) Licensing of songs and any other forms of copyright-protected material before such are included in datasets. The measure provides a broader selection of material for developers and rewards the authors and rights-holders, also eliminating the potential precedent from the process.
- b) AI-generated works enjoy copyright protection through the human contribution requirement, feasible for the developer of an algorithm, e.g. a contribution in form designing the algorithm and/or choosing data for its dataset, as well as for the licensed user, e.g. in form of directly initiating the generative process.
- c) For the cases, where the human contribution is non-present or can't be easily evaluated, the works are still deemed copyrightable, whilst the IP rights are immediately assigned to the creator of the program, to its user or as a joint work.

Through the set of events, the US Copyright Law will gain more transparency in regard to creative AI, encourage further development provide a stable system to control the interests.

In the opposite case, the inability of the US legal system to provide the needed extensions in accordance with the essential requirements of the modern creative AI would hurdle the development of the technology. Same as today, the precedent of the copyright law violation will remain in the process of AI training. Besides, the only possibility of registering an AI-generated work with insignificant or non-present

human input is by claiming it to have human origins. Leasing an AI-composer for private use with the aim of generating IP would therefore be much more complex.

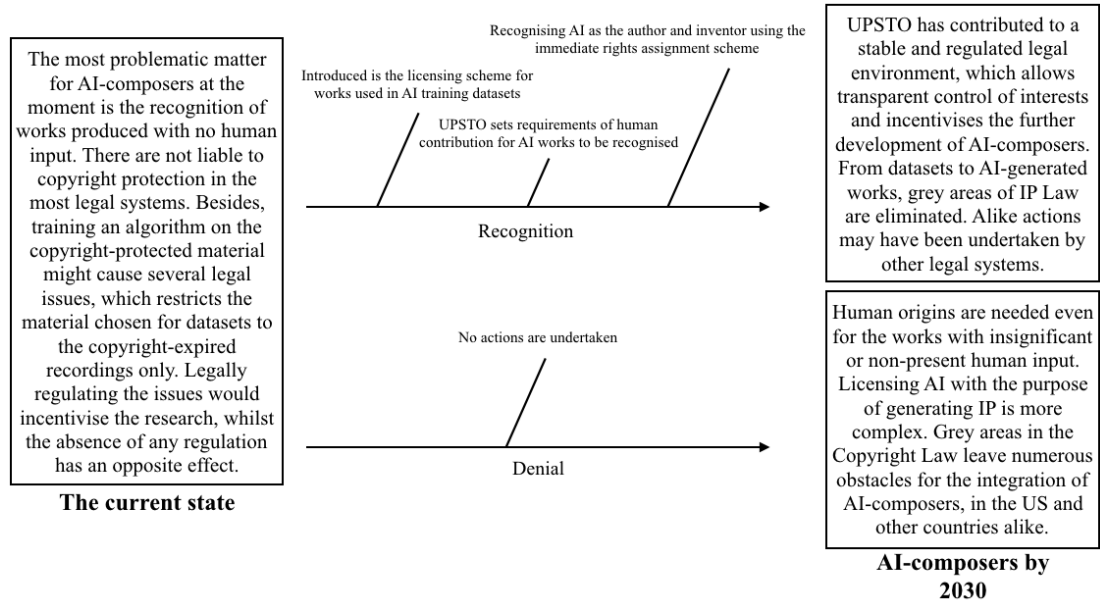


Figure 7. Future projections within the legal perspective

3.4 Phase 4. Scenario building

This part of the paper groups previously made projections into demonstrative scenarios. Each scenario layers all three perspectives – an operational, cultural and legal one – by taking one projection from each. Scenarios are to represent the full spectrum of possible outcomes, from most favourable or utopian ones, to least or dystopian, besides taking into consideration the ones in-between, which contain a combination of both desirable and undesirable outcomes. Given projections made in the previous chapter, combining them in all possible ways provides the total of 4 scenarios (figure 8). Scenarios are colour-coded on order to conveniently refer to each while describing:

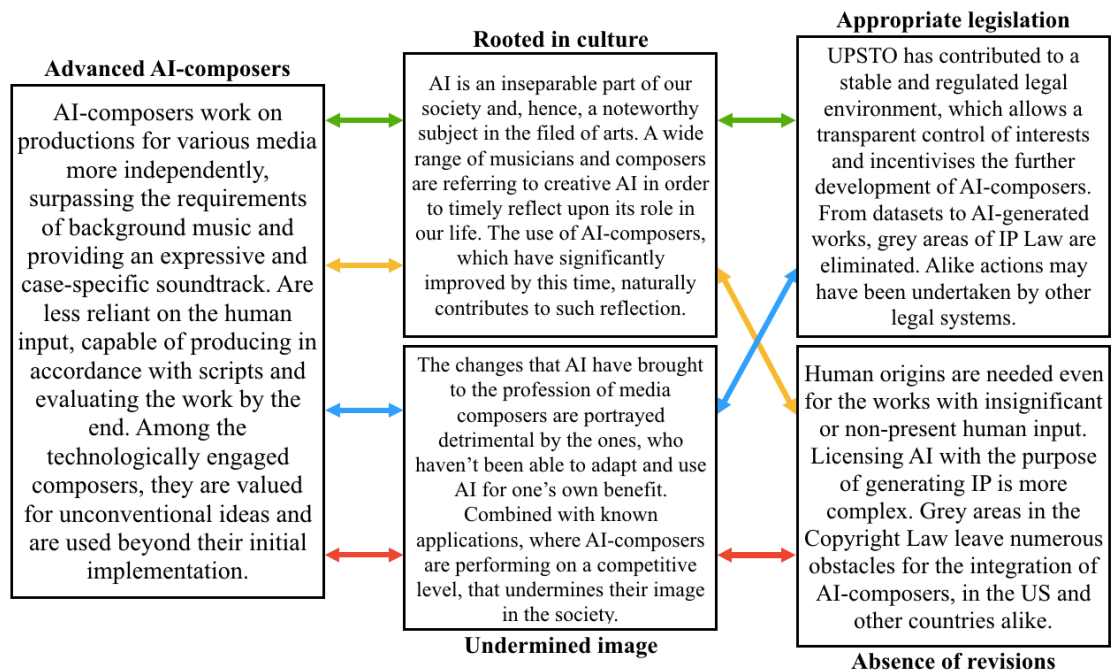


Figure 8. Possible projection combinations. Scenarios

Scenarios are referred to from the viewpoint of developing companies, which are at the first place interested in the integration of AI-composers. Therefore, in case any subjective evaluation occurs in the description of scenarios, i.e. claiming something to be beneficial, it's meant to be the case for these companies at the first place, but may be the opposite for other parties.

Scenario 1, Green: "The progressive scenario"

The scenario is most favourable for the efficient integration of AI-composers on all fronts. In this case, the integration of AI-composers proceeds rewardingly and flawless due to highly responsive cultural and legal environment. AI-composers are positively and justly perceived in society and legislation-wise and well fit into the pro-technological paradigm.

Scenario 2, Yellow: "The socio-legal conflict"

Within this scenario, achievements reached with AI-composers have received positive cultural recognition, but their operational capacity and cultural value are not adequately reflected on the legal level. In this case, most legislative systems discourage the creative applications of AI, making AI-friendly artists conceal the actual origins of the work and hindering the commercial use of AI-composer and other virtual creators. Despite the deep rooting of AI-composers in our culture, their

use is kept associated with the potential cases of copyright-infringement deriving from the inappropriate legislation. For these matters, the development of AI-composers is not progressing at the highest pace until the legislation is extended appropriately.

Scenario 3, Blue: “Disruptive but legal AI”

Depicted is a state, whereas the technological advancement of AI combined with legislative support has an effect opposite from the first scenario. Though being technologically efficient and legally stable, AI-composers are portrayed in the bad light by the composers, who haven’t been able to adjust to the new solution, and this representation outweighs the benefits that AI-composers bring to the tech-savvy composers and other users. The growth of developer companies isn’t generally restricted with that but the perception of the product is negative within certain circles.

Scenario 4, Red: “Wrong place, wrong time”

A dystopian scenario, which identifies a negative response to the solution, both on the cultural and legal levels. The image of AI-composers is undermined by the associated urge of requalification as well as by their insecure legal position. For the projects engaged with the development of AI-composers, that is the least beneficial scenario.

For a convenient overlook, scenarios are presented in the table below:

Table 1. Scenarios

| | Projection within the operational dimension | Projection within the cultural dimension | Projection within the legal dimension |
|--|---|--|---------------------------------------|
| Scenario 1: “The progressive scenario” | Advanced AI-composers | Rooted in culture | Appropriate legislation |

| | | | |
|--|-----------------------|-------------------|-------------------------|
| Scenario 2: “The socio-legal conflict” | Advanced AI-composers | Rooted in culture | Absence of revisions |
| Scenario 3: “Disruptive but legal AI” | Advanced AI-composers | Undermined image | Appropriate legislation |
| Scenario 4: “Wrong place, wrong time” | Advanced AI-composers | Undermined image | Absence of revisions |

4 Discussion

4.1 Answering the research questions

After collecting, analysing and projecting the data using scenario analysis, it is possible to exhaustively answer the formulated research questions. As described in the first chapter of the paper, the objective of the research was to demonstrate how the adoption of AI-composers will proceed in the future, as well as to estimate the engagement of various stakeholders, as AI-composer developers, musicians, media composers and people involved in various productions. The carried scenario analysis met the initial goals of the research by providing a detailed and multi-perspective overlook of the matter.

Where does the edge of AI’s ability lie in music composing?

AI’s capacity is to a great extent dependent on the volume of datasets that the algorithms are trained on, however, the investigation has revealed other aspects that are expected to significantly contribute to the performance of AI-composers: such are the external analytical functions that were announced to be installed by AIVA, and which, in case their efficiency is proven, might be overtaken by other developers. Through analysing its own work and being able to compose in accordance with different clues and motives extracted from scripts, AI might potentially narrow the

gap that so far defines its difference compared to a human composer - the ability of the latter to produce the soundtrack, which is not only emotional but also responsive to scripted changes and twists. Till the point that these features are implemented, it would be, hence, fair to claim that, for now, the edge of AI's ability in composing is defined by providing compelling musical pieces, whilst such functions as interpretation and evaluation are beyond it. Consequently, being able to compose and interpret – something that AI misses so far – can be seen as the benchmark of AI's ability in composing, which will inevitably demand to revise the answer to this question.

Interpreting the question in a more general way, one may at the same time stick to the argumentation provided in the literature review (see 3.1.2, Human and Artificial Intelligence). It could be then argued that the edge of abilities of AI-composers, and of any other virtual creators, lies in reaching Artificial General Intelligence, since AI could then generate artefacts that derive from knowledge and operation in multiple domains, with that being more comparable to the creative process of a human being. In this sense, reaching AGI could be seen as the peak of AI's abilities.

How might AI change the process of composing?

The research shows that AI is already bringing changes into the process on multiple levels: from suggesting musical ideas to a human creator, who closely cooperates with AI, to being able to produce pieces on its own, accomplishing the whole composing process (not to confuse with the production process, whereas multiple stages as mixing and mastering are predominantly occupied by human professionals). The already present functions will further develop in the future: suggestions will become even more precise and tailor-made, and so will the compositions independently made by AI-composers. Answering the question, AI-composers are already becoming a valid part of the toolset for musicians and media composers – yet, for most technologically involved ones, but the use among composers may be becoming more common as the tool advances. Not only the increasing precision of AI-composers would make them a valuable asset for the composing process, but also a trait opposite from it – their ability to contribute to the process with “out-of-the-box” suggestions, which couldn't be reached otherwise

due to various constraints that constantly arise in the human creative process. This could set the path for further ways of “misusing” AI-composers, as it commonly happens with other musical tools.

As mentioned, the other side of potential changes means much greater involvement of AI-composers that just making primary suggestions – there is a clear intention of some projects like AIVA to introduce a full-fledged composer capable of making a soundtrack with least human involvement possible. The produced material is so far considered to best fit in the field of gaming, both after how the developers and composers evaluate it, however, considering the implementation of aforementioned features and extensions, overtime the produced soundtrack’s quality will suffice other media as well. There sure might already be cases when the soundtrack of AIVA and alike is used beyond games, and there are no criteria, which would tell for what media the soundtrack fits – the decisive process is dependent on the individual opinion of a producer. Mentioned is the rather a dominant image, which derives from the tool’s public appearance. So far, its inclined towards the gaming field. The growing capacity of the tool and emergence of the first critical and evaluative skills of AI-composer may easily spread the implementation to other media as well.

What is the potential impact AI-composers might have on employment of composers?

This question logically arises from the described possibility of AI-composers to independently provide a soundtrack for a range of productions in the future. As it can be seen from the examples received from case studies and interviews, technologies and new solutions do have and noticeable impact of how people work within the music industry and what they work on. Technologies often bring changes that provoke people to rethink their approaches and adapt, possibly change the area of their qualification, but barely does it happen so that a new solution contains a detriment for everyone at once. New avenues of implementation are appearing as fast as some are partially taken by the technology, but the range of possibilities is never still and is never completely restrained by a technology. It has always been up for professionals to recognize new possibilities as some become less relevant in light of the newly appeared solution and the integration of AI-composers makes no exception in this regard.

As shown with the research, it's already possible to identify professionals who are easily competed with as AI-composers gain popularity. At the first place, mentioned are people who provide composers and musicians with musical references in the form of pre-recorded music. Being capable of the same but with more adjustability and accuracy, AI-composers may be presenting a better alternative for the users. Furthermore, the number of such areas may grow, soon making AI-composers a considerable option for game productions and beyond. At least two conclusions are essential to be made when discussing employment and overall significance of human composers in this context:

- a) Firstly, what prior technological solutions demonstrate in the music industry, is that technologies and inventions rarely replace one another – instead, they are becoming more or less centric. Streaming hasn't eliminated radio; synthesizers haven't taken the charm away from acoustic instruments. In the same way, presenting an alternative way of making a soundtrack, AI-composers won't become an exclusive option, which suits everyone's needs at once.
- b) Secondly, since every solution comes with a change, the flexibility of people within the domain has remained utmost importance. Ability to spot advantages of a solution and make personal use of them is what has kept various professionals of the music industry afloat at all times. For musicians and composers, this skill besides closely intersects with a natural curiosity that they have been expressing towards new solutions.

What are the conditions influencing the integration of AI-composers?

Case studies made in the first part of the literature review have investigated the adoption of other two inventions in the music field in order to better navigate the course of this research. It has been revealed that apart from operational and cultural dimensions, which should be considered studying the most phenomenon of technological nature, its highly important to take the related legal conditions into account since such has proven to determine the path of numerous musical solutions.

This research question is extensively answered with scenarios presented at the end of the third chapter. Apart from operational factors, the integration of AI-composers

heavily depends on the way it is perceived by professionals – the two extremes of this matter are noted as whether recognizing AI-composers as a valid part of contemporary culture and using them for artistic reflection or merely seeing them as a source of detriment. As for the legal factors, legislation may significantly support the adoption of AI-composer – mainly, by recognizing the end result of their work, or otherwise, present a hurdle for the research. The latter is closer to the reality of today and may even worsen, as the imbalance between (the absence of) legislative aids and actual abilities of AI-composers grow.

4.2 Conclusions & implications

Through case studies, academic literature and in-depth discussions with 4 professionals of the field, the research presents a comprehensive overlook of the integration of AI-composers and its potential path for the 10 next years. Sticking to qualitative reasoning, the research first received guidance from the 2 cases of mature and well-established inventions, then identified the operational, cultural and legal contexts of AI-composers and revealed impactful events from each of the three dimensions. Then, future projections were made with the consideration that these events take place; the results from each dimension were, finally, combined in a total of 4 scenarios.

The research has proven the integration of AI-composers to be dependent on multiple factors of operational, cultural and legal nature. In the world of advanced, practical and creative AI, it is crucial for every party to stay in the course of the most recent advancements and timely adjust to the situation. The research assumes the progress of creative AI to be inevitable – something that can be sure contributed to or discouraged, but never – fully prevented or banned. According to this perception of the phenomena, its best for each stakeholder of the process to thoroughly analyse the integration of AI-composers, recognize new opportunities that derive from it and find ways to engage with them personally. Same as with prior technologies of the music field, the spectrum of novel opportunities brought along by AI-composers is vast and may be definitely used for one's virtue if approached appropriately.

4.3 Reliability of the research & limitations

The goal was not to provide detailed forecasts and calculated probabilities and their effect, but rather offer foresight of the potential yet uncertain futures. Scenario Analysis enables tracking the influence of multiple factors, which results in multifaceted models of futures. Explorative scenarios suffice the intention of showing what the future *may* be like and what influential factors it *may* constitute, but they do not, and most importantly, are not meant to precisely predict future. However, even disclaiming the accuracy of the results per se, there are still multiple reliability issues that should be mentioned.

One issue concerns events, which were outlined by collecting primary and secondary data and were considered to have an impact on the development of trends. Within the operational dimension, such events were overtaken from the example of one specific company and used to represent the general operational potential. As for the legal dimension, extrapolations were made on the basis of the US legal systems. Even being directly extracted from the collected data, they are restricted to illustrating just some bit of development within each dimension and, thus, can only partially define it. The occurrence of these events is not only uncertain but furthermore can't fully represent the development within dimensions. Inevitably, by extrapolating qualitative data in such a way, there are always factors left out of consideration, whilst the selective method of the researcher lets one argue the reliability of the research. Another issue refers to parts inherently built upon the researcher's creative and imaginative abilities – like 3.3, which contains making futures projections. The involved subjectivity of the researcher also reflects on the reliability of findings.

When it comes to the limitations experienced during the research process, such mostly concern the accessibility of data. The first-hand information regarding companies' future plans and estimations would have been best collected from them directly, but such is rarely revealed to the public, so the research had to operate with rather limited comments of companies' representatives given via press releases.

4.4 Recommendations for further research

The paper sets a path for multiple possible further kinds of research. Firstly, the present paper avoided giving any kind of recommendations or suggesting any strategical planning to the engaged parties. However, referring to this research as to a starting point, a normative deductive scenario analysis could be carried in the future: picking the desired futures model, the analysis could study and describe the means of reaching this state and present a developer company a concrete set of actions.

Though having presented a multi-perspective overlook of various contexts, the research merely scratches the surface of each dimension. It could be therefore recommended for in-depth researches to be carried within each dimension individually: in the operational one - to better understand the nature of purely technological challenges that may arise as further progress in AI-composers is made; in the cultural dimension – to gain more awareness of how AI and AI-composers will develop as a part of our culture and of the symbolic meaning they bring along; in the legal dimension – to clarify on specifics and (un)readiness of each individual legal system in regard to creative AI, to foresee or even stimulate changes.

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