Towards Music Industry 5.0: Perspectives on Artificial Intelligence

Alexander Williams, Mathieu Barthet

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Alexander Williams[1], **Mathieu Barthet**[1,2]

[1]Centre for Digital Music, Queen Mary University of London
[2]Aix-Marseille Univ CNRS PRISM
alexander.j.williams@qmul.ac.uk, m.barthet@qmul.ac.uk

Abstract

Artificial Intelligence (AI) is a disruptive technology that is transforming many industries including the music industry. Recently, the concept of Industry 5.0. has been proposed emphasising principles of sustainability, resilience, and human-centricity to address current shortcomings in Industry 4.0. and its associated technologies, including AI. In line with these principles, this paper puts forward a position for ethical AI practices in the music industry. We outline the current state of AI in the music industry and its wider ethical and legal issues through an analysis and discussion of contemporary case studies. We list current commercial applications of AI in music, collect a range of perspectives on AI in the industry from diverse stakeholders, and comment on existing and forthcoming regulatory frameworks and industry initiatives. Resultingly, we provide several timely research directions, practical recommendations, and commercial opportunities to aid the transition to a human-centric, resilient, and sustainable music industry 5.0. This work particularly focuses on western music industry case studies in the European Union (EU), United States of America (US), and United Kingdom (UK), but many of the issues raised are universal. While this work is not exhaustive, we nevertheless hope it guides researchers, businesses, and policy makers to develop responsible frameworks for deploying and regulating AI in the music industry.

Introduction

Cultural and creative industries produce and disseminate cultural products influenced by people's lifestyles, beliefs, attitudes, and insights (Jahromi and Ghazinoory 2023). They provide economic value and contribute to innovation, employment, and national competitiveness (Mbamba 2024). Music is one such industry, and generally refers to individuals and organisations that earn money by creating and selling various forms of music, performing, and organisations and professionals that aid, train, assist, represent and supply music creators (UK Music 2024).

The makeup of the music industry is not static and has developed closely in relation to technological innovation and the creation of new music technology (music tech) (Lerch 2018). Some may consider music tech companies a segment of the overall music industry, but tensions have always existed in their complex relationship with the wider industry. The music tech sector typically seeks to develop disruptive or value-adding technologies that challenge the industry status quo in areas such as music production, publishing, consumption, or distribution, while music rights-holders seek to protect the value of their intellectual property (IP) - primarily music recordings and artist brands. In many cases, the success and survival of an emerging music tech company depends upon securing licencing arrangements for copyrighted material from asset holders or obtaining support through partnerships. This power dynamic means many emerging music tech companies will be resisted if they are seen not to align with the corporate strategic goals of the incumbent oligopoly (Watson and Leyshon 2022).

Current music tech innovation is rooted in the maturity of Industry 4.0 technologies such as AI, big data, cloud computing, virtual / augmented reality (VR / AR), the Internet of Things, and blockchain. Such technologies are (socially) disruptive (Hopster 2021) and are currently transforming the music industry by introducing new business models, revenue streams, and methods of music distribution and engagement (Jahromi and Ghazinoory 2023; Mbamba 2024; Clancy 2021). In 2021, the European Commission proposed the concept of Industry 5.0. Where Industry 4.0 focused on increasing production efficiency, flexibility and worker upskilling through technical innovation, Industry 5.0 focuses on using the encompassed technologies to achieve societal goals beyond jobs and growth, such as social fairness, sustainability, and worker wellbeing (Xu et al. 2021).

Recent reports suggest that, without intervention, music sector workers stand to lose nearly a quarter of their income to AI in the next four years (Cisac and PMP Strategy 2024) and up to 30% of (UK) jobs are automatable with AI with "crafts, creative arts and design" roles amongst those currently most at risk (Department for Education 2023). Given the fundamental human connection in music (Malloch and Trevarthen 2018), it is essential that the music industry transitions to an Industry 5.0. model and adopts its three core principles of human-centricity, sustainability, and resilience to ameliorate the existential challenges posed by AI.

Related Work

In recent years, there has been an increasing number of works discussing ethical issues of AI in music applications generally and in specific commercial case studies, partic-

ularly generative music. (Mbamba 2024) reviews the impact of Industry 4.0 technologies on global creative industries, particularly focusing on AI for music creation and recommendation, VR / AR, and blockchain for digital rights management. (Oğul 2024) contrasted ethical guidelines published by various AI researchers, music industry organisations, and campaign groups. (Barnett 2023) conducted a systematic literature review on ethical implications of generative audio models while (Jabour 2024) focused on the perceptions, ethical concerns, and business opportunities of AI-generated vocals. (Holzapfel, Sturm, and Coeckelbergh 2018; Huang et al. 2023) present ethical considerations relating to music information retrieval technology (MIR), while (Peeters 2021) looks more closely at the impact of AI on MIR in general. (All-Party Parliamentary Group on Music and UK Music 2024) presents a report on AI in relation to the UK music industry. (Huang, Sturm, and Holzapfel 2021) presents an East-Asian ethical perspective on applying AI to music applications. (Ma et al. 2024) present a survey of AI models for music applications with discussion of ethical and social issues. (Sturm et al. 2024) and (Boon 2023) critique the models of specific music generation platforms, Boomy and AIVA. (Pasti Da Porto 2023) studies how the music industry can meet UN Sustainable Development Goals.

Commercial Applications of AI in the Music Industry

AI systems are already being used commercially for recommending music (Born et al. 2021), DJing (Clancy 2021), separating songs into their separate instrument parts such as vocals, drums, guitar etc. (Hennequin et al. 2019; Sun 2023; Clancy 2021), mastering music (Birtchnell 2018; Robinson 2024; Welsh 2022), imitating a singer's voice (Monroe 2023; Minsker 2021; Coscarelli 2023; Hawthorne 2024), writing lyrics (Simpson 2022; Taylor 2024) sound design / foley (noa 2021), music transcription (Bittner 2022), creating concert visuals and VR performances (Google Arts & Culture 2019; Rufo 2024), sample identification (Cetin 2023), generating music artwork (Jones 2024a), generating dancer choreography (Studio Wayne McGregor 2019; Myers 2023), music venue security and management (Henkin 2023; Anderson 2024; noa 2019), and music marketing and public relations (Adgcraft Communications 2024). In the last two years, there has been a notable rise in the number and quality of music generation models and services including Suno, Udio, Boomy, AIVA, SOUNDRAW, Tad AI, Google's MusicLM (Agostinelli et al. 2023), Meta's AudioCraft, Stability AI's Stable Audio / Open (Evans et al. 2024a,b) and others.

Such use cases indicate that AI is already affecting professions in the creative industries including artists, musicians, composers, DJs, visual artists / graphic designers, mixing engineers, marketing, public relations, journalists, sound designers, song writers, publishers, producers, choreographers, and performers. AI systems also influence culture and consumer habits (Born et al. 2021; Holzapfel, Sturm, and Coeckelbergh 2018) and exploit general consumers for unpaid labour (Morreale et al. 2023). We can expect that new applications of AI in the music industry will emerge with maturity in their technology readiness level (TRL).

Public and Professional Attitudes to AI in the Music Industry

AI has been described as a floating signifier in that it can mean different things to different people (Suchman 2023). It has also been suggested that those with familiarity and expertise with AI are more likely to support its general application (Horowitz et al. 2024) and that there are numerous factors that can lead to incorrectly assessing AI's capabilities (Crompton 2021). Therefore, any general opinions on AI should be taken cautiously, particularly as it has captured mainstream public attention in recent years. Nevertheless, while opinions on AI in the music industry vary even amongst similar stakeholders, common themes emerge.

Artists and Music Industry Professionals

Over 35,000 professionals working in creative industries including literature, music, film, theatre and television have backed a statement against using unlicensed training data for AI (Milmo 2024). An open letter from the Artist Rights Alliance advocacy group seeking protections against predatory use of AI has also been signed by 200 well-known music acts (Artist Rights Alliance 2024).

Meanwhile, a recent survey (Tencer 2024a) of mostly western music producers suggests that 25% are now using AI in the creation of music. Of those that do: 74% use it for stem separation; 46% for mastering and EQ plugins; 21% for generating song elements; and 3% to create entire songs. Of the 75% not using AI: 82% cite artistic and creative reasons; 35% quality reasons; 14% costs; and 10% copyright concerns as reasons. Assistive AI was seen more positively than generative AI but both had less than 50% approval. Willingness to pay for AI tools was also low. Another survey of 1,600 self-releasing artists (Dalugdug 2023) from DIY distributor TuneCore found that 27% of indie music artists had used AI in some capacity. Of those artists who had used AI tools: 57% had used it to create artwork; 37% had used it to create promotional assets; and 20% had used it to engage with fans. About half of respondents expressed willingness to license their music for training AI, while a third expressed willingness to grant consent for their music, voice or artwork to be used in generative AI.

Many music industry groups including professional associations, music tech companies, music publishers, and academic and educational institutions have backed initiatives including aiformusic and the Human Artistry Campaign that contain principles for AI music creation emphasising responsible development and human involvement (Universal Music Group 2024; Tencer 2024c). Sony, one of the largest music publishers in the world with a significant music tech division, has also published a statement declaring its support for human artistry and clear intention to opt out of any unlicensed AI training or data mining carried out by external actors on its content (Aswad 2024). While such organisations are undoubtedly protecting their own commercial interests, they are nevertheless protecting artists' rights in the process.

General Public / Music Consumers

Two surveys on the general public's attitudes to various applications of AI in the music industry were conducted by music industry organisations. The first is in the 2023 report by (International Federation of the Phonographic Industry 2023) representing the views of over 8000 record companies worldwide. It surveys 43,000 people from 26 countries accounting for 91% of global recorded music market revenues on their musical habits and opinions including AI. Results suggest: 79% feel human creativity essential to the creation of music; 76% think an artist's music or vocals should not be used or ingested by AI without permission; 74% agree AI should not be used to clone or impersonate artists without authorisation; 73% agree AI systems should clearly list any music used for training; 70% think there should be restrictions on what AI can do; and 64% say governments should play a role in setting restrictions in what AI can do.

The second is a 2024 UK-specific report on AI and the Music Industry compiled by UK Music (All-Party Parliamentary Group on Music and UK Music 2024), which included a poll on the UK general public's attitudes to music applications of AI (Whitestone Insight 2024). In it, 83% agree AI-generated songs should be clearly labelled; 80% agree that the law should prevent an artist's music from being used to train an AI application without consent; 77% agree that AI-generated music that does not acknowledge the original music's creators amounts to theft; 68% are concerned about music artists losing out financially by having their work used by AI to generate new music; 66% are concerned about AI generation eventually replacing human creativity; 62% are concerned about the rise of deep fakes of their favourite artist; and 55% are concerned about listening to AI generated music without realising it.

Issues Raised by AI in Music

Experts have argued that AI models will carry benefits such as increasing reach and accessibility of the arts (Jahromi and Ghazinoory 2023), providing creative opportunities, new mediums for expression, saving time on routine procedures, offering inspiration (Deruty et al. 2022; Birtchnell 2018), being a tool for financial benefit, and a way for music fandoms to engage with artists (Shroff 2024). Conversely, issues have been raised relating to ownership and distribution rights, royalty sharing, fair use of training data, job displacement / automation of traditional creative and knowledge work, competition, deskilling, model bias, cultural appropriation, creativity stifling and climate impact (Sturm et al. 2019; Shroff 2024; Rezwana and Maher 2023; Barnett 2023; Henderson et al. 2020; Boon 2023; Sturm et al. 2024). Exploitative working practices and inequality are already common in the music industry (Arditi and Nolan 2024). Like digitalisation (Pusztahelyi and Stefán 2024), AI has the potential to both improve existing conditions and pose new issues.

Environmental Impact

The music industry's environmental impact is significant owing to the energy and resource utilisation associated with live music, physical and digital music distribution, and manufacturing and distributing music equipment (Brennan 2020). Some initiatives, guidelines and businesses have emerged to reduce music's environmental impact (Nolan 2024; Pasti Da Porto 2023), but widespread industrial adoption of AI poses challenges to sustainability goals as model energy requirements become non-trivial (Peeters 2021).

Automation and Deskilling

Given its significant economic potential, automation in creative industries is likely to continue expanding to high-value work previously done only by humans. AI systems will not necessarily need to perform better than humans for such substitution to take place, instead it is likely that quality-cost considerations will inform business adoption (Melville, Robert, and Xiao 2023). While workers with unique career histories, contextual music industry knowledge and developed 'people skills' *should* have the privilege to charge for premium services (Birtchnell 2018), certain applications of AI risk displacing and devaluing early career opportunities that are crucial for industry workers to develop confidence, experience and portfolio for operating at and obtaining work at a higher level.

Intellectual Property Issues

Creative and cultural industries are more than just the generation of IP but IP is of significant interest to various stakeholders due to its economic value (Lee 2022). There are three primary aspects of generative AI applications that intersect with IP protection (Wengen and Ribbert 2024): (i) learning with protected works as input; (ii) copyright protection of AI generated works; and (iii) potential infringement by the output of pre-existing works. These intersections and their current legal ambiguities are the subject of legal cases in various countries. For example, major music publishers UMG, Sony Music, and Warner Records are suing generative AI music companies Suno and Udio in the US for copyright infringement (Brittain 2024), while in the UK a court case between stock photo provider Getty Images and British AI company Stability AI is pending trial at the High Court over the use of copyrighted images for training their Stable Diffusion image generation model (Davies 2024; Brittain 2023). Current uncertainty and emerging legislation has led AI companies to seek pre-emptive deals to secure usage of copyrighted materials for training (noa 2024), and major music publishers such as UMG to seek deals licensing artists' music and voices with various AI companies including Google (Ingham 2023), Endel (Olson 2023) and TikTok (Gerken 2024; Casey 2024). However, the details of these deals mostly remain private.

Licensing and Remuneration Models Discussions on fair exposure and remuneration structures for music creators who license their data for training AI models have yet to generate consensus (Henry et al. 2024). Licensing deals are often bespoke. For example, Holly Herndon and Grimes are two independent artists who have both created and freely distributed their own AI voice models for public use but with different forms of remuneration. Grimes proposed splitting 50% royalties on any successful song that uses her AI voice

- an identical deal to any human artist she would collaborate with (Monroe 2023) - while income generated from commercial licensing of Holly Herndon's AI voice would go directly to her IP-owning cooperative to fund new tool development (Minsker 2021). Furthermore, there are active debates over opt-in versus opt-out licensing models (Pasquale and Sun 2024; Gahnberg 2024) - whether data can be used for AI training by default before user intervention. Critics of opt-out schemes say it is unfair to put the burden of opting out of AI training on the creator whose work is being trained on when many will be unaware of such schemes (Milmo 2024), particularly when a significant proportion of the music industry are under-resourced freelancers (Rutter 2016).

Dynamic opt-in licensing and attribution-based models - where revenue is paid out proportionally to the use of data - have gained traction in industry. For example, music tech company LANDR's 'Fair Trade AI' program lets musicians using its platform earn money by opting their music in to internal AI training (subject to curation) (Robinson 2024). Participating users will receive an attribution-based share of 20% of the revenue generated by any of LANDR's tools trained on this dataset. Similarly, Sureel is a dynamic licensing management platform that tracks data usage for attribution payments and integrates with the Do Not Train registry hosted by Spawning AI, which is respected by Hugging Face and Stability AI amongst others (Pelczynski 2024). Major music publishers seem to favour the attribution model, suggested by the partnership between UMG and the company ProRata (Stassen 2024; Knibbs 2024a).

Academics have also proposed alternative models for royalty distribution of music created using AI such as (national) levy-based trust funds and ownership funds (Drott 2021; Jacques and Flynn 2024), and attribution-based on algorithmic evaluation (Deng, Zhang, and Ma 2024).

Data Poisoning In some cases, bad actors may choose to avoid licensing content or to ignore opt-out directives from creators to train on their data. In response to this, services have been introduced offering so-called "data poisoning" - imperceptibly altering the pixel composition of images to perturb AI models being trained on that data and degrade model performance (Heikkilä 2023; Chen et al. 2023).

Data poisoning can be likened to an adversarial attack that causes future harm by incorrectly calibrating AI models. It is challenging to mitigate for (Chen et al. 2023). Though not yet mature, there is research in applying this to musical audio contexts (Meerza, Sun, and Liu 2024). Without condoning the practice, it is plain that some of its application stems from creators' loss of agency over how their work is used. It highlights the need for informed consent, fair licensing deals over user data, and ethical dataset creation.

Music Identification and IP Enforcement The Google Assistant software can identify very short music excerpts and unearth previously undiscovered samples (Cetin 2023) using an approach likely employing neural audio fingerprinting (Arcas et al. 2017). While sample identification can be informative for music listeners, such technology also allows for easier detection of copyright infringement, especially when deployed on digital music distribution platforms hosting user-generated content such as YouTube, Spotify, or SoundCloud. Content moderation systems on these platforms rely on algorithms that scan millions of content uploads automatically each day, and can produce outcomes that include blocking and taking down material. However, such rigid and widespread enforcement of copyright discourages the distribution of infringing works produced through specific creative practices that involve sampling, such as hip hop music, mash-ups, and bootleg remixes (Watson 2024; Brøvig-Hanssen and Jones 2023).

Copyright laws that protect owners' interests in IP are balanced by limitations and exceptions intended to prevent copyright from excessively impinging on freedom of expression. These are country-specific, for example 'fair use' in the US and 'parody' in the EU / UK, but rarely specify precisely what kind of appropriation of copyrighted material is permitted. Many uses of copyrighted material are untested in court and their legal status remains unclear. Consequently, platforms mostly ignore limitations and exceptions to enact blanket decisions in the interests of operational efficiency, significantly reducing the efficacy of copyright law's exceptions to the detriment of cultural expression (Brøvig-Hanssen and Jones 2023). Thus, enforcing copyright in these contexts is a nuanced issue, that requires balancing creative liberties with the economic incentives provided by IP rights.

Reproducibility in Music AI Research

Advances in music AI research, and AI more generally (Henderson et al. 2018), are currently stifled by reproducibility issues. New issues have emerged due to the current trend of requiring larger models to achieve current state-of-the-art quality and subsequent protection of their commercial value. Producing large commercially-ready (Lavin et al. 2022) models is only possible with intense resources. With rare exception, only a few large tech corporations can create and deploy large AI systems at scale, from start to finish (Widder, West, and Whittaker 2023). Many companies will also choose to limit access to models or not divulge proprietary algorithms or model training processes, mostly for commercial reasons but occasionally for AI safety reasons. For example, the original paper for Google's MusicLM (Agostinelli et al. 2023) stated that they had "no plans" to release the tool to the public due to concerns that a significantly large proportion of its generated output could be traced to copyrighted sources. But Google has also recently made it available for beta testing following licensing agreements with UMG (Jabour 2024). Safety and commercial value are both valid reasons not to share work, but this restricts research progress and conflicts with optimistic hopes for decentralisation as a benefit of AI (Birtchnell 2018).

The State of AI Regulation in the West

Optimistic predictions of AI's economic potential has led policy makers around the world to back the technology with various initiatives (Uren and Edwards 2023). At the same time, there is caution. G7 Nations have signed the Hiroshima AI Process which contains high-level guiding principles for developing advanced AI systems (Wintour 2024) and AI legislation is starting to emerge in many polities including the

EU, US, and UK. While the extent of regulation varies, western polities appear motivated in finding a balance between supporting their creative / cultural and technology sectors.

European Union

The EU has recently approved its AI Act, which will be fully applicable in law by 2026 with some aspects already in effect (Official Journal of the European Union 2024). General purpose AI models will have to comply with transparency requirements and EU copyright law by labelling AI-generated content, designing models to prevent generating illegal content, publishing summaries of copyrighted training data, and obtaining the authorisation of the rights holder concerned for any use of copyright protected content, unless relevant exceptions and limitations apply (Tencer 2024b).

The act was cautiously welcomed by trade organisations for IP rights holders, including a number of music industry groups (International Federation of the Phonographic Industry 2024), but measures were also criticised as "watered down" by consumer watchdogs (Corporate Europe Observatory 2024). The nature of risk self-assessment and disparity in risk-level regulation suggests that many music industry applications could potentially be assessed as low-risk despite the numerous impacts identified here and consequently subjected to looser regulation (Nature Editorials 2024). Additionally, while the act encourages sustainability through standardisation, codes of practice and information disclosure, it does not respond effectively to the AI industry's significant environmental impacts (Pereira 2024).

United States of America

AI regulation in the US is currently a patchwork of guidelines proposed by state and local governments. In terms of IP, the US Copyright Office released recently updated guidelines rejecting the notion of considering AI as a contributor, stating that they do not register works created by machines and creative works still need a human author to qualify for copyright protections (Rockwell 2024; Berkowitz 2024).

Publicity laws, rather than copyright, protect an individual's name, image, and likeness from being exploited for commercial purposes (Rockwell 2024). In 2023 / 2024, the NO AI FRAUD and NO FAKES Acts were introduced in the US House and Senate respectively seeking to establish a "right of publicity" at the federal level and hold individuals and companies liable for producing or hosting deepfakes. While these bills have not passed yet, in July 2024 Tennessee's ELVIS Act was the first state-level legislation to come into effect with the intention to protect musicians having their vocal likeness generated by AI for commercial purposes. The bill makes it illegal to replicate an artist's voice without their consent (All-Party Parliamentary Group on Music and UK Music 2024).

Elsewhere, the AI Environmental Impacts Act has been introduced to direct the National Institute for Standards and Technology to collaborate with academia, industry and civil society to establish standards for assessing AI's environmental impact, and to create a voluntary reporting framework for AI developers and operators. However, this legislation has not yet passed. In any case, voluntary measures rarely produce a lasting culture of accountability and consistent adoption because of reliance on goodwill (Crawford 2024).

The United Kingdom

The UK has no specific AI legislation and AI is currently governed by limited pre-existing laws. For example, the IP aspect of AI generated works is currently covered by the Copyright, Designs and Patents Act 1988. Unlike the US, the UK's act explicitly allows for computer-generated work to be copyrighted. Section 9(3) of the act stipulates that when a work has 'no human author' and is 'computer-generated', the 'author' is defined as the person who makes 'arrangements necessary for the creation of the work' and is granted copyright. The law currently empowers UK courts to decide appropriate authorship of AI-generated music works depending on the facts of each case. Ambiguities mean this becomes complex when many different stakeholders could be involved in the creation of AI-generated music such as the user, programmer, data controller, training data creator, model trainer, model owner, investors, or any combination of these (Sturm et al. 2019; Koempel 2020; Majumdar 2023).

British lawmakers appear to have recognised that the current law is inadequate in the context of AI-generated works. In 2023, a debate was held in the UK parliament on IP Rights in relation to AI (HC Deb 2023). One of the key outcomes was a successful argument against a so-called text and data mining (TDM) exemption on copyrighted works to allow AI developers free use of existing music, literature and works of art for the purposes of training AI (Culture, Media and Sport Committee 2023). However since then the UK Government has changed following a democratic election in 2024 and it now appears that the TDM exemption and opt-out system are being reconsidered by the new government following lobbying from AI companies (Thomas and Gross 2024).

A report by UK music industry representatives and UK parliamentarians (All-Party Parliamentary Group on Music and UK Music 2024) makes eight recommendations for the UK Government informed by testimony from legal experts on UK, EU, and US IP law, authors associations, and the British music tech company DAACI. The recommendations centre around the introduction of a pro-creative industries AI Bill that protects copyright, introduces new rights and obligations around labelling and record keeping, and enhances personality rights. Other recommendations include transparent labelling requirements for AI-generated content, an obligation for AI developers and those using models to keep a record of training data, compliance with UK copyright law, addressing the copyright status of AI-generated works, and specific personality rights to protect individual's voice, image, name, and likeness from misappropriation.

Conclusions and Recommendations

AI is affecting the music industries in a myriad of ways still being borne out. This paper has outlined many areas of the western music industry that are currently affected by AI and detailed some of the associated issues, taking into account current general public and music industry perceptions on

AI and current / proposed legal frameworks in the EU, US and UK. To conclude this paper, we make recommendations consistent with the principles of Industry 5.0. on topics of advocacy, working practices, commercial opportunities, and research directions to support the transition to a sustainable, resilient and human-centric music industry.

Sustainability and Ethical Practice

Disclosure of potential impacts and ethical implications of AI in music is currently lacking. Findings in (Barnett 2023) suggest that less than 10% of generative audio research papers discuss any negative broader impact in their work, even though 65% consider potential positive broader impacts. (Henderson et al. 2020) meanwhile found substantial underreporting of information to calculate energy and resource use. (Reje 2022) suggests that many emerging music tech start-ups developing AI do not prioritise the adoption of formal ethical guidelines and (Oğul 2024) notes that environmental impact and sustainability are frequently missing even from published ethical guidelines on AI in the music industry. Largely, AI developers are not prioritising energy reduction, energy-efficient models, or disclosing relevant data. As such it is hard to get accurate and complete data on AI's environmental impact (Crawford 2024).

Organisations developing AI music systems should be transparent and share relevant information and resources where possible, disclosing potential impacts in appropriate language (Haueis 2024). They should create or adopt ethical guidelines (e.g. aiformusic) to guide development and follow the machine learning technology readiness level (ML-TRL) assessment framework proposed by (Lavin et al. 2022) which prioritises ethics and fairness to develop principled, safe, and trusted AI technology. Model developers should take steps to report the energy required for the training and inference of their AI models and make efforts to minimise energy use through adoption of efficient model architectures and data pipelines (Chen et al. 2023; Douwes et al. 2023), following examples such as (Douwes et al. 2023; Douwes and Serizel 2024; Tabata and Wang 2021; Utz and DiPaola 2023) which demonstrate methods for computing and optimising energy use and emissions in the training and inference of AI audio models and other digital audio applications. Developers should also consider using smaller training datasets which require less energy to train on and enable additional benefits in certain use-cases (Vigliensoni, Perry, and Fiebrink 2022). These measures will enable adopters to, in turn, make an informed decision about specific model use.

We agree with (Brennan 2020) and (Crawford 2024) that addressing the environmental impact of AI is a collective effort from industry, researchers, legislators, and the public. Audiences must consider their consumption choices. Likewise musicians, manufacturers, promoters, labels, and technology companies that rely on AI or musical content for their business model should consider the sustainability of their working practices and shift towards more sustainable ones where practicable. For this, we recommend leveraging resources from organisations such as Music Declares Emergency (Nolan 2024) and elsewhere (Jones, McLachlan, and Mander 2021) to inspire mitigation efforts. However, we recognise that without strong legislation or sufficient incentives many companies and industry workers may prioritise profit acquisition, career opportunities, or user needs over sustainability goals (Sturm et al. 2024), even when environmentally conscious values are held (Røyseng, Vinge, and Stavrum 2024). Thus, most importantly, lawmakers should develop targeted incentives in relation to AI and the music industry to address the climate crisis (Crawford 2024).

Investment in Human Creativity and Industry Grassroots

Large, data-intensive AI models have shifted the value of music towards its profitability as data, rather than intrinsic artistic worth. But it is crucial to acknowledge that the efficacy of these AI systems is contingent upon the high-quality materials from which they learn that predominantly stem from human creativity (Jacques and Flynn 2024). Therefore, we recommend that individuals and organisations that feel strongly about work quality and Industry 5.0. principles should strive to commission human creatives where practicable. Similarly, we would like to see more initiatives from industry and governments investing in the music industry grassroots to maintain a creative talent pipeline. For example, Spotify's investment in UK youth clubs (Collins 2024) and the UK Government's backing of a voluntary levy on tickets at large venues to support grassroots venues and workers (Reilly 2024). Such initiatives will not only maintain fulfilling employment opportunities, facilitate worker upskilling, and build music industry resilience, but also contribute to the resilience of AI models in general. New, high quality dataset creation will help to maintain model performance and contemporaneity while web-scraped data becomes increasingly unreliable and ineffective due to AI-generated content (Alemohammad et al. 2024; Jones 2024b).

Intellectual Property Licensing and Compliance

Shifting legal situations in the UK, EU, and US in favour of the entrenched music industries demonstrate the importance for individuals and organisations to organise, advocate, and lobby for their position. However, developments of both the technology and the legal frameworks governing it should be closely watched to ensure they are fair to creators and other key industry workers. Standard licensing practices are yet to emerge so it is important to set fair precedents within the industry in terms of remuneration, transparency, and consent.

A global music industry with divergent legislation makes international data sharing and standards adherence complex. There are opportunities in IP licensing and environmental standards compliance certification and enforcement as demonstrated by the Fairly Trained Initiative (Knibbs 2024b). Several ongoing research directions could be valuable to various aspects of compliance from detecting deep fakes and AI-generated music (Vaglio et al. 2021; Khanjani, Watson, and Janeja 2023; Desblancs et al. 2024), to assessing generative music output similarity for attribution-based models (Flexer 2023; Batlle-Roca et al. 2024; Deng, Zhang, and Ma 2024), the placement and detection of watermarks in AI-generated content (Porter 2023), and data poisoning for music (Meerza, Sun, and Liu 2024).

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