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# **Evaluating the Case for a Virtual Research Environment for Researchers of Irish Composition**

Tricia Lyons  
tricia.lyons@gmail.com

Dr Judith Wusteman  
UCD School of Information & Library Studies  
University College Dublin  
Belfield  
Dublin 4  
Ireland  
judith.wusteman@ucd.ie

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Running Head: Virtual Research Environment for Irish Composition

# **Evaluating the Case for a Virtual Research Environment for Researchers of Irish Composition**

## **Abstract**

This article describes a study to determine whether there exists a need for a custom-built Virtual Research Environment (VRE) for academic and independent researchers who study Irish-based music composition. It assesses the potential forms such a VRE could take, based on user requirements and existing VRE models. Challenges and limitations for researchers are identified as possible entry-points for VRE solutions. The feasibility of using components of existing VRE projects for this purpose is considered. Finally, two possible scenarios for the implementation of a VRE are discussed.

## **Note**

The research described in this paper was submitted as a thesis in partial fulfilment for a Masters in Library and Information Studies at UCD Dublin (Lyons, 2010) and was awarded the E.T. Bryant Memorial Prize 2010.

## 1. Introduction

To date, the discipline of music has featured only minimally in the discourse surrounding Virtual Research Environments (VREs), with a mere handful of VRE projects dealing with any aspect of music. The expansion of VRE discourse is the overall premise for this study, with a view to creating a greater presence for the discipline of music. The study explores the concept of the VRE in the context of music research, and evaluates the case for a workable VRE for the community of music researchers in Ireland and elsewhere who concentrate some aspect of their work on Irish-based composition and are affiliated with an Irish third-level institution [1] and/or the Society for Musicology in Ireland [2]. The main research question explored is whether it is possible to devise a useful VRE for such a community. The sub-research questions are as follows:

1. What are the research practices of this community of researchers?
2. What tools and services would a music VRE require?
3. Could a music VRE be modelled on an existing VRE framework?

Challenges and limitations for researchers are identified as possible entry-points for VRE solutions. The feasibility of using components of existing VRE projects for this purpose is considered. Finally, two possible scenarios for the implementation of a VRE are discussed.

## 2. Literature Review

### 2.1. VREs

The definition of the Virtual Research Environment, or VRE, is still evolving. The UK Joint Information Systems Committee (JISC) Virtual Research Environments Programme, widely identified as the leader in the field of VRE development, states that

“The term VRE is now best thought of as shorthand for the tools and technologies needed by researchers to do their research, interact with other researchers (who may come from different disciplines, institutions or even countries) and to make use of resources and technical infrastructures available both locally and nationally.” (JISC, 2010)

The term ‘VRE’ is interchangeable with terms used in other e-research initiatives, such as ‘collaboratory’, ‘cyberenvironment’ and ‘gateway’ (Carusi & Reimer, 2010; Voss & Proctor, 2009). Despite the variation in nomenclature, the motivations behind each of these entities are similar. While Fraser (2005) describes the VRE as “a framework into which tools, services and resources can be plugged”, Carusi and Reimer (2010), define it as an “interface” to infrastructure. Both of these models describe a VRE that is integrated with existing infrastructure or e-infrastructure, drawing tools and processes together, rather than forming the basis of a stand-alone product. Indeed, although the VRE is still a fluid concept, some models for future development and implementation are beginning to gain support (Jeffery and Wusteman, 2011). These include:

- Adoption of lightweight, customisable, modular, often Web 2.0 frameworks.
- Integration of the user’s choice of widely-used collaboration and research tools, rather than creation of tools for each VRE.

The literature repeatedly emphasises the necessity of user-driven VRE development. A VRE has the greatest chance of sustainability and optimal usability when this principle is applied from the point of inception:

“In order to ensure usability, VREs need to be focused on the needs of researchers and specific research communities, putting them in the driving seat of VRE development. This implies a user-driven, bottom-up mode of development” (Carusi and Reimer, 2010).

VREs are, first and foremost, “community building projects” (Knowledge Exchange, 2010) for which “the intention is to improve the research process and not simply to pilot technologies for their own sake” (Fraser, 2005). Research practices are not necessarily altered as a result, although this may be a side-effect of the advantages introduced by the infrastructure of new tools and applications.

## **2.2 Considerations for a Music VRE**

Although several VRE projects include some element of support for music research, a VRE that solely supports such research has not been reported in the literature. Conversely, a growing body of discussion about the needs of music researchers notes the requirement for some type of unified environment where a variety of musical forms may be manipulated through a single platform. Despite the existence of formats for digital distribution of music, widely accepted standard formats have yet to emerge (Grindley, 2007). The array of incompatible file formats, software applications and operating systems has led to concerns about sustainability, accessibility and interoperability of digital music resources (Rebelo, 2010; Wiggins, 2009). Bonardi (2000), proposes a “musicologist’s workstation” that supports

the use of multiple formats in a unified structure and establishes a set of requirements that such a resource should provide.

Bonardi also discusses the potential for facilitation of active listening of music via dynamic scores. A musicologist may typically carry out analysis on a notated score or audio recording and write a document in literary form. This environment should have capabilities to correlate all these activities, allow notations on the musical object and link the source material with the output. The musicologist should have the option to save these processes in a workflow which can be returned to or shared among collaborators.

### **2.2.1 Existing projects**

Although there is not yet a VRE that solely supports music research, there are several existing VRE projects with a dedicated music element. These include AIRS (Advancing Interdisciplinary Research in Singing) [3], a VRE for research into singing; CSAGE (Collaborative Stereoscopic Access Grid Environment) [4] a video-conferencing environment; “Music Beyond Location” (Alan *et al.*, 2008) from the University of Canterbury, New Zealand; NEMA (Networked Environment for Music Analysis) [5] which incorporates the myExperiment VRE (De Roure & Goble, 2007); and DIAMM (Digital Image Archive of Medieval Music) [6], a digital library forming part of the BVREH (Building a Virtual Research Environment for the Humanities) [7] project at Oxford University . These projects are outlined in Table 1.

**TAKE IN TABLE 1**

**CAPTION: Existing VRE projects that include a dedicated music element**

### 3. Methodology

VRE projects should be founded on the user requirements of the research communities they aim to support (Carusi & Reimer, 2010; Knowledge Exchange, 2010; Wusteman, 2009). This is reflected in sub-research questions 1 and 2, namely:

1. What are the research practices of this community of researchers?
2. What tools and services would a music VRE require?

Due to the dearth of data available on the research practices and requirements of music researchers, it was necessary to determine these requirements first-hand. An online questionnaire, incorporating open and closed questions, was used and served a dual purpose:

- It provided qualitative data concerning the research processes and challenges faced by the community of music researchers in question.
- It provided quantitative data relating to the uptake of information and communications technology (ICT) and Web 2.0 tools among this community, and identified important sources, tools and formats for it.

The sample was drawn from the target population of music researchers, in Ireland and elsewhere, who concentrate some aspect of their work on Irish-based composition and are affiliated with an Irish third-level institution and/or the Society for Musicology in Ireland. The target population was deemed compact enough to include all members in the survey sampling.

The questionnaire, available in the Appendix, is divided into four sections. The first section deals with the individual researcher and their personal research practices, tools and sources. The second section focusses on personal experiences of collaboration and interdisciplinary research. It was hoped that these sections would prompt the respondents to think actively about the nature of their work so that they could respond productively to the more general questions of the third and fourth sections that relate to challenges in music research and the desired components for a VRE respectively.

The questionnaire went live on 13 July 2010 and ran for twenty-one days. Questionnaires with a minimum of thirteen complete answers, out of a possible sixteen, were used in the quantitative analysis. Forty-one questionnaires, out of a possible fifty-five, fell into this category. All open questions were analysed, regardless of whether the individual survey was complete, but were confined to the qualitative report so as not to influence statistical information.

## **4. Results and Discussion**

As a picture began to emerge from the findings of the questionnaire, it became apparent that the researchers involved had a low awareness of VREs and a poor understanding and uptake of Web 2.0 tools and services for the purposes of their research. However, the researchers were able to highlight, in great detail, the challenges they encounter in their research and the benefits that ICT brings to that research.

**Q1. Which of these terms do you think best describes your involvement in music composed in Ireland?**

The answers to this question demonstrate the versatility of music research practices around a given topic or research question. The 41 respondents comprised 13 postgraduate researchers (31.7%), 10 lecturers/academic staff (24.4%), 10 composers (24.4%) and 3 performers (7.3%). Five respondents (12.2%) used the “other” category to define their roles. The titles specified were “independent scholar”, “writer”, “author”, “retired academic” and “librarian.”

## **Q2. How did you present your most recent research?**

Figure 1 summarises the responses to this question. “Conference paper” received the most responses with 25 participants choosing this option. Two major conferences happening in the months leading up to the study may have influenced this statistic. The single “other” response was described as “published in an online database”. Perhaps surprisingly, there was no mention of institutional repositories or personal website/blogs as “other” methods of presentation of recent research.

### **TAKE IN FIGURE 1**

**CAPTION: Responses to Question 2: How did you present your most recent research?**

## **Q3. How do you collect data?**

Respondents were asked to select all answers that applied to their data collection practices. Desk research was ranked highest with 39 of 41 (95%) acknowledging it as a means of data collection. This was followed by “listening to recordings”, selected by 33 researchers (80%). “Attending events”, “conducting interviews” and “fieldwork” received 20 (49%), 17 (41%) and 15 (36%) responses respectively. The five “other” responses all

mentioned archival sources, including unpublished manuscripts, music scores and correspondence.

#### **Q4. How important are each of these sources to your research?**

A series of information sources was listed, as illustrated in Figure 2. Researchers were asked to identify the importance, or lack of importance, of each item. Books, library catalogues, print music scores, CDs/tapes/records and electronic journals all accumulated significantly high positive value ratings, each receiving 35+ (85% or over) positive responses. Books outweighed e-books in importance, as did print music scores over the digital alternatives. Journals were the only variable where the digital version had a more positive response than the print alternative. Digital music scores received less positive responses to print music scores but were considered important by nearly three-quarters of respondents nonetheless.

Physical sound items, “CDs/tapes/records”, were identified as significantly more important than audio streaming and music downloading websites. Thirty six respondents (88%) rated these physical sound items “essential” or “fairly important”, with 27 respondents (65%) considering them as “essential”. This compares to only 12 positive responses (29%) for music downloading websites and 17 (41%) for audio streaming, with only 5 respondents (12%) viewing both of the latter sources as “essential”. The causes of this pattern of responses may be a worthwhile topic for further research. It may suggest that researchers have yet to migrate to these platforms or that relevant material is not accessible from these sources.

## **TAKE IN FIGURE 2**

**CAPTION: Responses to Question 4: How important are each of these sources to your research**

### **Q5. How much of your research is conducted online?**

As illustrated in Figure 3, over 70% of researchers in this community conduct less than 50% of their research online. Sixteen researchers (39%) conducted less than 25% of their research online; 13 researchers (31.7%) conducted 26-50% of their research online while 11 (26.8%) respondents placed themselves in the 51-75% category and 1 (less than 3%) selected 76-100%. A follow-up study would be necessary to establish the causes for this.

## **TAKE IN FIGURE 3**

**CAPTION: Responses to Question 4: How much of your research is conducted online?**

### **Questions 6-9**

Questions 6 to 9 explored both discipline-specific and more general sources, tools and standards common to music research.

### **Q6. How often do you use each of these applications?**

Question 6 dealt specifically with applications for generating and/or manipulating data. As illustrated in Figure 4, participants were presented with a list of software programmes used at different stages in the research process, including data collection (field recording software), writing (Office applications) and referencing. Office applications were

the most widely-used with 33 respondents (80.5%) using them on a daily basis. Media players also featured strongly with 19 respondents indicating daily usage and only one individual stating that they never use them. Music notation software was used by 35 respondents (85%) although not as frequently as Office applications or media players. Twenty eight respondents (68%) availed of MIDI and audio tools but frequency of use was low. Reference software and field-recording equipment software were never used by 13 (31.7%) and 15 respondents (36.6%) respectively.

#### **TAKE IN FIGURE 4**

**CAPTION: Responses to Question 6: How often do you use each of these applications?**

#### **Q7. How often do you use each of these online services?**

Question 7 focussed on the uptake of Web 2.0 tools and other online services. Figures 5 and 6 illustrate the responses to this question. The stacked column chart in Figure 5 compares the frequency of use of each tool and service. Figure 6 illustrates a relational comparison of weighted responses.

As these graphs illustrate, email was the most frequently used service, with 38 respondents (92.7%) indicating that they used it every day, only two respondents stating less usage than a few times a month. This is hardly surprising considering that this survey was disseminated via email. Wikis, video-sharing websites, social networking and video conferencing were widely adopted among this group. Twenty-five used social networking and video sharing sites regularly (daily/weekly) while video conferencing was used regularly by 10 (24%). Wikis were used by 40 (97.5%), 21 (51%) of whom claim regular use.

At the lower end of the scale, social bookmarking tools were used by only six respondents (14%) and microblogging sites, such as Twitter, demonstrated a similar minority

uptake. Again, the results highlight a significantly low uptake of audio-based tools: 26 respondents (63%) had never used any audio-sharing services (e.g. SoundCloud), 26 (63%) had never used audio-streaming websites (e.g. Spotify) and 25 (61%) had never used audio-recommendation services (e.g. Last.fm). Of the remainder, only 5 (12%) used audio-sharing on a regular (daily or weekly) basis, 8 (19.5%) used audio-streaming regularly and audio recommendation was used regularly by 1 (2%). These results occurred despite the respondents previously having indicated a high value on recordings and audio-based tools in Question 4.

**TAKE IN FIGURE 5**

**CAPTION: Comparison of frequency of use of each tool/service as elicited in responses to Question 7: How often do you use each of these online services?**

**TAKE IN FIGURE 6**

**CAPTION: Relational comparison of weighted responses for Question 7.**

**Q8. Which of these file extensions do you use when storing and listening to audio?**

Question 8 identified the common file types employed by this group of researchers when listening to audio. Responses are summarised in Figure 7. MP3 was the most common file type, with usage by 35 (85%) of participants. Wav (Waveform Audio File Format) files were second with 30 respondents (73%) followed by WMA (Windows Media Audio), used by 16 (39%). Two respondents (5%) said they did not use any file extensions while 1 (2%) did not know. Three selected the “other” category citing M4A, Ogg and FLAC files.

**TAKE IN FIGURE 7**

**CAPTION: Responses to Question 8: Which of these file extensions do you use when storing and listening to audio?**

**Q9. Which of these file extensions do you use when viewing/notating/composing music?**

The aim of Question 9 was to determine the common standards associated with music notation and composition (both graphical and symbolic representations). Results showed that PDF (Portable Document Format) was the most common format with 31 respondents (76%) choosing this option. PDFs are static read-only documents which cannot be manipulated, so it is safe to assume that PDFs are used only in the viewing of music notation or are converted from other formats, for example, Sibelius files (.sib). The latter were a close second with 29 respondents (70%). MIDI files followed with 13 respondents (32%). Two people (5%) said they do not use any and 1 (2%) did not know. MusicXML files received no acknowledgment. However, Finale, Sibelius and many other music software applications now support MusicXML. In the “other” category, .abc, jpg, btm, Photoshop 7 and .cap (Capella software) were mentioned.

**Q10. Have advances in computers and the World Wide Web influenced your research practices? Please explain.**

A total of 31 responses were collected for this open question which aimed to gather personal opinions on the involvement of ICT in the research practices of this scholarly community. On coding and analysis, results illustrated a general consensus that ICT has had a significant effect on research practices, as detailed below.

Access to resources and information was the chief benefit as stated by the respondents. The advantages of online library catalogues, electronic databases and archival material were commented on by many respondents; these reduced the need to travel to libraries which, in some cases, were outside Ireland, thus saving time and expense. By using these online resources, much preliminary research could be carried out from the desktop, thus

“speeding up traditional research.” The immediacy of access means that researchers could more easily stay up-to-date with the latest research.

Advantages to communication were considered important but the topic of access to resources had precedence. Email has made circulating information faster, easier and less costly. Direct contact with those composers who are the subject of the research is possible through email and social networking. This has led to access to “obscure” scores and recordings and insights into compositions which would not previously have been available.

The availability of scores and audio material online was recognised as a major benefit to music research practices. Researchers frequently acknowledged how the costs of purchasing recordings can now often be avoided through the use of online audio samples and streaming sites such as YouTube. A certain number of scores are freely available to download through resources such as IMSLP (International Music Score Library Project). Previously unattainable versions of works are now accessible and files can be circulated freely among researchers as email attachments. Again this cuts down on costs and increases availability of materials.

Music notation software also featured strongly in the responses to this question. Producing typeset documents of a high quality is now possible through packages like Sibelius and Finale. One researcher pointed out how the production of parts, that is, the sheet-music for the individual instruments extracted from the ensemble score, may be automated. The single negative comment was in relation to time being wasted on internet searches in which “searching for what you are looking for can take hours.” This is a reflection on the haphazard nature of internet searches when compared with regulated catalogue searches. It could be

worth investigating whether this problem could be reduced through the consolidation of resources in a VRE framework.

**Q11. How do you make contacts with individuals for information or participation in your research (e.g. interviewees, other researchers)?**

The focus of Question 11 was on how initial contact is made by the respondents with other researchers, rather than how contact is sustained. As illustrated in Figure 8, all 41 responses indicated that contacts were made through other personal contacts; 30 (73.2%) respondents indicated “meeting at conferences”, 26 (63.4%) used websites, 21 (51.2%) cited “groups and societies” and 14 (34.1%) said they made contacts by “social networking”. Out of the two respondents who specified ‘other’, one mentioned the setting up of a blog to attract contacts and the other noted the use of intermediary sources such as the Contemporary Music Centre.

The high level of personal contact among this group is significant. This could suggest a very tight-knit community, a low degree of social web usage or both. When variables are aggregated into two larger categories, “online networking methods” and “methods that existed pre-internet”, 33.1% of responses fell into the “online networking methods” as compared with 66.9% in the “methods that existed pre-internet”.

**TAKE IN FIGURE 8**

**CAPTION: Responses to Question 11: How do you make contacts with individuals for information or participation in your research (e.g. interviewees, other researchers)?**

**Q12. Have you ever conducted research that integrated music with another discipline?**

This question was significant because of the focus on interdisciplinary research in VRE development. Of the 41 respondents, 28 (68%) had engaged with a subject area outside of music in the course of their research. Those who answered “yes” were asked to specify the other discipline. These other disciplines included history, medicine, physics, geography and languages. All disciplines mentioned are listed in Table 2.

**TAKE IN TABLE 2**

**CAPTION: Responses to Question 12: Q12. Have you ever conducted research that integrated music with another discipline? If yes, what was the other discipline?**

**Q13. Have you ever collaborated with another researcher on a project?;**

**Q14. How did you communicate and share materials with your collaborator(s)?**

Question 13 dealt with collaboration among researchers, another prerequisite for implementation of a working VRE. Responses were almost evenly split with a ratio of 21:20 in favour of positive responses. Confirmation of collaboration in Question 13 routed respondents to Question 14. Twenty people answered Question 14, as summarised in Figure 9.

“Email”, “phone calls” and “meeting in person” were the most common methods of sharing information and materials with their collaborators, with 20 (100%), 17 (85%) and 19 (95%) responses respectively. Eleven respondents (55%) stated that they used post, 6 (30%) used YouSendIt and 5 (25%) used Google Docs. Instant messaging (IM) and video conferencing both received two responses (10% each). No respondents used social networking sites for this purpose. There was one (5%) “other” response, citing Dropbox as a collaborative tool.

**TAKE IN FIGURE 9**

**CAPTION: Responses to Question 14: How did you communicate and share materials with your collaborator(s)?**

**Q15. Below is a list of challenges faced by music researchers. Please rank them 1-5 where 1 is the least problematic and 5 is the most problematic. Are there any other challenges you wish to highlight?**

This question was designed to identify and measure the challenges that this group of researchers face in the course of their research. Participants were presented with a list of challenges, identified through preliminary discussions in the pre-pilot stage of this survey, and asked to rank them from least problematic to most problematic. Results are summarised in Figure 10.

Most concern was shown for “access to materials” and the “location of materials”, with 26 (72%) and 22 respondents (61%), out of the 36 responses, rating them among their top two challenges. This was followed by the “quality of materials”, “frequently changing formats” and “problems making contacts”.

**TAKE IN FIGURE 10**

**CAPTION: Responses to Question 14: Below is a list of challenges faced by music researchers. Please rank them 1-5 where 1 is the least problematic and 5 is the most problematic.**

Participants were then asked to highlight any other challenges integral in their work. There were 11 responses to the open component of this question; these were subsequently coded and analysed. Several central themes emerged.

The works and original manuscripts of Irish composers are held in several different holdings in Ireland. These important primary sources are not fully catalogued and access is provided on a limited basis. One researcher proposed an “online Irish Composer digital database archive that would provide access to the works of Irish composers so that

researchers, students, writers and other can visually access the sheet music or manuscripts online from any source around the globe.” Recordings of Irish art music are also limited and many are difficult to source.

The ‘value’ of music scholarship in academic institutions was a major concern. It was felt that music is treated as a “minority interest at third level institutions” and key texts are sometimes unavailable from university libraries, thus resulting in the need for inter-library loans or travel. Copyright difficulties are also prevalent. One respondent stated that “downloading and copyright laws can hinder research and presentation. Obscure sources can often only be found peer-to-peer, and certain tools (scores, recordings) cannot be used if the copyright is prohibitively expensive.”

**Q16. Imagine an online environment where music researchers can access resources, share materials and collaborate through one interface. Here are some possible features. Please rate the value of each one for you personally. Do you have any other suggestions or comments?**

In Question 16, the term ‘Virtual Research Environment’ was not used; a description of the VRE concept was used instead. This was due to the findings from a previous study which showed a low degree awareness of VREs among Irish researchers (Rock, 2008).

Participants were presented with a list of five components that a music VRE could potentially support:

- Digital scores that can be annotated, saved and shared
- Sharing of audio and video files

- Communication tools such as instant messaging (IM), social networking and video conferencing
- Database of digital scores with accompanying audio tracks
- Facility to cross-search multiple sources

These components were determined via the literature review, existing VRE projects and digital libraries, and suggestions from participants in the pre-piloting stage. Participants were asked to rate the value of each component to their own research.

The results, illustrated in Figure 11 and 12, demonstrate predominantly positive responses to all items. Thirty-two (94%) of the 34 respondents considered a “database of digital scores with accompanying audio tracks” to be “very useful” (29 responses) or “fairly useful” (3 responses). “Digital scores that can be annotated, saved and shared” also scored highly, 25 (73%) selecting “very useful” and 6 (18%) selecting “fairly useful”. A “facility to cross-search multiple sources” received 30 positive responses (88%), One individual (3%) did not think it would be useful at all and 3 (9%) did not know. “Sharing of audio and video files” received a positive response from 28 respondents (82%) and “communication tools” received 20 positive responses (59%).

There was an indication that the practical research tools involving databases of digital scores with audio tracks and annotation tools out-ranked the more social collaborative suggestions of file sharing and communication. This may indicate a priority of improving functionality over facilitating collaboration at this stage.

Question 16 incorporated an optional sub-question which invited participants to make their own suggestions or comments on the topic. There were a total of 6 responses to this question. Digitisation featured strongly among the suggestions. Comments such as

“digitisation of printed books and journals”, “digitisation of scores held in libraries”, “time spent making scores available online rather than providing photocopies” and the “digitisation of Irish music collections in their entirety” were included in the responses.

A central point of access for relevant materials was another theme in the answers to this sub-question. This idea was expressed variously as “a union catalogue” of digitised scores, a “common platform” and a “central online catalogue of Irish library and third-level institutions' holdings.”

Another suggestion was “a wiki where prototype ideas (e.g. notations, software, playing techniques) can be experimented with and feedback offered.” One respondent expressed their concerns that too much attention has been given to “integrating the latest fads into library organisation (for example, social networking, flicker [sic] and so on)” when improving “basic access issues” and quality of materials (scores and recordings) should be the main priority.”

#### **TAKE IN FIGURE 11**

**CAPTION: Responses to Question 16: Imagine an online environment where music researchers can access resources, share materials and collaborate through one interface. Here are some possible features. Please rate the value of each one for you personally.**

#### **TAKE IN FIGURE 12**

**CAPTION: Responses to Question 16 using percentage scale: Imagine an online environment where music researchers can access resources, share materials and collaborate through one interface. Here are some possible features. Please rate the value of each one for you personally.**

### **1. Scenarios for VRE implementation**

There follows two possible scenarios for the implementation of a music VRE.

#### **Scenario 1: Using a VRE as a gateway to dispersed resources**

Accessibility was the core concern of researchers, many of whom provided an extensive commentary on this issue. Irish composers' manuscripts appear to be valuable primary sources for this community. These items are dispersed between several institutions, such as Trinity College Dublin and the National Library of Ireland. According to several respondents, access to these collections is restricted and reproductions are costly.

One of the core functions of a VRE is the integration of tools and sources. In this instance, a VRE could serve as an access point to several digital libraries, similar to the functionality of the DIAMM. This would be dependent on the various institutions making steps towards the digitisation of their collections and ensuring that certain technical standards are co-ordinated and adhered to in order to ensure interoperability.

The objective of the Irish Composer's Project [8] is to digitise the collection of works by Irish Composers held in the Contemporary Music Centre. The project's aims are:

- To create a digital collection of scores and audio recordings from the works in the holdings of CMC
- To enable online access to these works and disseminate Irish contemporary music to a larger user-base
- To digitally preserve the collection for future research and performance

The National Archive of Irish Composers [9] provides a searchable database of "high quality digital copies of sheet music from the collections at the National Library of Ireland dating from the late eighteenth to mid nineteenth century".

The latter two projects could provide a suitable foundation on which to build a VRE, linking other collections, implementing a federated search engine and integrating tools for

collaboration. Although this may not be realisable in the short-term, due to funding restraints, it demonstrates that there is a valid case for a music VRE in Ireland. Such a VRE might not directly address the perceived lack of recognition of the value of music scholarship but it could go a long way to ameliorate its effects by making key resources more readily available,

## **Scenario 2: Using a VRE as a collaborative environment for the typesetting of music**

A problem with the quality of music available to researchers is evident from the results of this study. The quality and legibility of unpublished scores, particularly older manuscripts, has negative implications for analysis and performance. Digitisation offers the potential to digitally restore the works and retrieve some of the quality that has been lost through age and unsuitable preservation. Digitisation also offers remote access.

However, the virtual score is lagging behind text-based documents in the adaptation to digital forms. Despite considerable developments, Online Character Recognition (OCR) of music notation, or OMR (Optical Music Recognition), has not reached the same level of accuracy or widespread availability as text encoding. This has implications for display as well as for retrievability. When scores are scanned without encoding, they are searchable solely through accompanying metadata and, unlike text documents, do not have the capacity for content-based searching (Dougan, 2010). The substantial number of handwritten works in existence that were never typeset is particularly problematic. This is confirmed by participants of this study. Confined to original manuscripts, photocopies or basic scanned documents, the full potential of music notation for digital optimisation and preservation has yet to be realised (Rebelo, 2010).

A collaborative typesetting initiative or environment would mean that digitised handwritten works could be viewed by researchers or typesetters in dispersed locations and entered into music notation programs to produce works of high print quality. MusicXML (Grindley, 2007) makes it possible for a variety of different software programs to produce interoperable and machine-readable music notation. These projects can be stored on repository servers, both in finished formats and as workflows, allowing for sharing, proofing and editing, as seen in operation in the DIAMM and myExperiment. Additional tools for communication and collaboration could be integrated in this framework, such as video conferencing, instant messaging and collaborative editing. Such a system would greatly enhance the richness of the digital library it served and would result in a lasting cultural resource.

## **6. Conclusions**

The main aim of this research was to consider the potential of a purpose-built music VRE. The practices of music researchers have adapted to the increased level of ICT in research, and most traditional sources have migrated to these platforms. This includes digital audio, electronic scores and digital instruments, as well as the electronic databases and journals typical of most academic disciplines. These new formats have had a transformative influence on music and music research, but a platform through which all of these sources can be consolidated and accessed simultaneously has not yet been realised. It is in this area, in particular, that a VRE could help to improve the potential of music scholarship.

By considering a small community based around a specific research topic, it was possible to gain a coherent impression of that community's research practices as well as the

key factors that enhance and hinder their work. The evidence demonstrates that there is considerable scope for the establishment of a VRE for music researchers. Results indicate that the group in question are engaging in collaborative activities and interdisciplinary research. There are also indications of strong ICT fluency and a familiarity with Web 2.0 tools and services among some of the researchers in the study.

There are major challenges surrounding accessibility, location and quality of material for this research community, thus it is not difficult to see how the intervention of a VRE could be of benefit. With the early signs that digitisation is now having an impact on this discipline, and with crucial primary sources entering the virtual realm, the case for a VRE for researchers of Irish composition appears to be growing.

## Notes

[1] 'Third-level' is a European term for higher education.

[2] Society for Musicology in Ireland: <http://musicologyireland.com/>

[3] AIRS: <http://vre.upei.ca/airs/node/117>

[4] CSAGE: <http://www.jisc.ac.uk/whatwedo/programmes/vre1/sage.aspx>

[5] NEMA: <http://www.music-ir.org/?q=node/12>

[6] DIAMM: <http://www.diamm.ac.uk/redist/pdf/Database.pdf>

[7] BVREH: <http://bvreh.humanities.ox.ac.uk/>

[8] The Irish Composer's Project (<http://www.cmc.ie/digitalarchive/index.cfm>) is funded by the Research Committees of St. Patrick's College, Drumcondra, (SPCD) and Dundalk Institute of Technology (DKIT), the Contemporary Music Centre (CMC) and An Foras Feasa (SPCD, DKIT and National University of Ireland, Maynooth).

[9] The National Archive of Irish Composers: <http://www.naic.ie>

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**TAKE IN APPENDIX: Online Questionnaire**

Music Research Practices	
<b>1. Your Role in Music Research</b>	
<b>1. Which of these terms do you think best describes your involvement in music composed in Ireland?</b>	
<b>(Please select one answer only)</b>	
<input type="radio"/>	Lecturer/Academic staff
<input type="radio"/>	Postgraduate researcher
<input type="radio"/>	Performer
<input type="radio"/>	Composer
Other (please specify)	
<input type="text"/>	
<b>2. How did you present your most recent research?</b>	
<b>(Please select all that apply)</b>	
<input type="checkbox"/>	Composition
<input type="checkbox"/>	Conference paper
<input type="checkbox"/>	Journal article
<input type="checkbox"/>	TV/radio/online broadcast
<input type="checkbox"/>	Book or encyclopaedia entry
<input type="checkbox"/>	Programme of music for a performance/recording
<input type="checkbox"/>	Newspaper/magazine article
<input type="checkbox"/>	Other (please specify)
<input type="text"/>	

# Music Research Practices

## 2. Research Practices - Sources

### 3. How do you collect data?

(Please select all that apply)

- |   |  |
|---|--|
| <input type="checkbox"/> Conducting interviews  | <input type="checkbox"/> Listening to recordings                             |
| <input type="checkbox"/> Fieldwork              | <input type="checkbox"/> Watching videos                                     |
| <input type="checkbox"/> Attending events       | <input type="checkbox"/> Print or web published sources (i.e. desk research) |
| <input type="checkbox"/> Other (please specify) |  |

### 4. How important are each of these sources to your research?

(Please rate each one)

	Unnecessary	Not very important	Fairly important	Essential
Books	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E-books	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Print journals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electronic journals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Print music scores	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digital music scores	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Library catalogues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google scholar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CDs/tapes/records	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Audio streaming websites (e.g. spotify)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Newspaper/magazine archives	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electronic databases (e.g. JSTOR)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digital libraries (e.g. CHARM)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blogs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Music downloading websites (e.g. iTunes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Podcasts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Videos/DVDs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you use any other sources?

## Music Research Practices

### 3. Research Practices - Tools and Applications

#### 5. How much of your research is conducted online?

(Please select one answer only)

- 0-25%
- 26-50%
- 51-75%
- 76-100%

#### 6. How often do you use each of these applications?

(Please rate each one)

	Daily	A few times a week	A few times a month	A few times a year	Never
Music notation tools (e.g. sibelius, finale)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Media players (e.g. itunes, windows media, real player)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Field recording equipment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Office applications (e.g. Microsoft Office)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Midi and audio software (e.g. Pro Tools)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Referencing Software (e.g. Endnote)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Music Research Practices

### 7. How often do you use each of these online services?

(Please rate each one)

	Daily	A few times a week	A few times a month	A few times a year	Never
Audio recommendation services (e.g. LastFM)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Audio sharing sites (e.g. soundcloud)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Audio streaming websites (e.g. spotify)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blogs (e.g. blogspot)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discussion lists	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Email	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instant messaging (IM)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Microblogging sites (e.g. twitter)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Photo sharing sites (e.g. flickr)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
RSS feeds/readers (e.g. google reader)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social bookmarking tools (e.g. delicious)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social networking (e.g. facebook, mySpace)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Video conferencing (e.g. skype)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Video sharing sites (e.g. youtube)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Web directories (e.g. Yahoo! Directory)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wikis (e.g. wikipedia)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### 8. Which of these file extensions\* do you use when storing and listening to audio?

(Please select all that apply)

\*A file extension is the suffix at the end of a filename that tells a computer, and the computer user, which program is needed to open the file e.g. .doc may be opened by Microsoft Word.

- .mp3 (MP3 Audio File)
- .wav (WAVE Audio File)
- .aiff (Advanced Interchange File Format)
- .wma (Windows Media Audio File)
- Don't know
- None
- Other (please specify)

## Music Research Practices

**9. Which of these file extensions\* do you use when viewing/notating/composing music?**

**(Please tick all that apply)**

- .sib (associated with Sibelius)
- .mus (associated with Finale)
- .xml (MusicXML)
- .mid (MIDI)
- .pdf (Portable Document Format)
- Don't know
- None
- Other (please specify)

**10. Have advances in computers and the World Wide Web influenced your research practices? Please explain.**

5

6

## Music Research Practices

### 4. Collaboration

**11. How do you make contacts with individuals for information or participation in your research (e.g. interviewees, other researchers)?**

**(Please select all that apply)**

Social networking

Meeting at conferences

Websites

Through personal contacts

Groups and societies

Other (please specify)

**12. Have you ever conducted research that integrated music with another discipline (e.g. music and philosophy)?**

Yes

No

If yes, what was the other discipline?

**13. Have you ever collaborated with another researcher on a project?**

Yes

No

## Music Research Practices

### 5. Collaboration Cont.

#### 14. How did you communicate and share materials with your collaborator(s)?

(Please select all that apply)

- Email
- Google Docs
- Instant Messaging (IM)
- Meeting in person
- Phone calls
- Post
- Social networking sites
- Video conferencing
- YouSendIt
- Other (please specify)

	5
	6

## Music Research Practices

### 6. Challenges

15. Below is a list of challenges faced by music researchers.

Please rank them 1-5 where 1 is the least problematic and 5 is the most problematic.

	1	2	3	4	5
Tools and formats change frequently (e.g. cassette to CD)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Music resources are in many different locations (either virtual or geographical)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Materials are often of poor quality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is difficult to make contacts with other researchers in your field	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Music resources are difficult to access	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are there any other challenges you wish to highlight?

## Music Research Practices

### 7. Virtual Research Environment

**16. Imagine an online environment where music researchers can access resources, share materials and collaborate through one interface. Here are some possible features. Please rate the value of each one for you personally.**

	Not useful at all	Not very useful	Fairly useful	Very useful	Don't know
Communication tools such as instant messaging, social networking and video conferencing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sharing of audio and video files	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digital scores that can be annotated, saved and shared	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facility to cross-search multiple sources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Database of digital scores with accompanying audio tracks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have any other suggestions or comments?

Figure 1

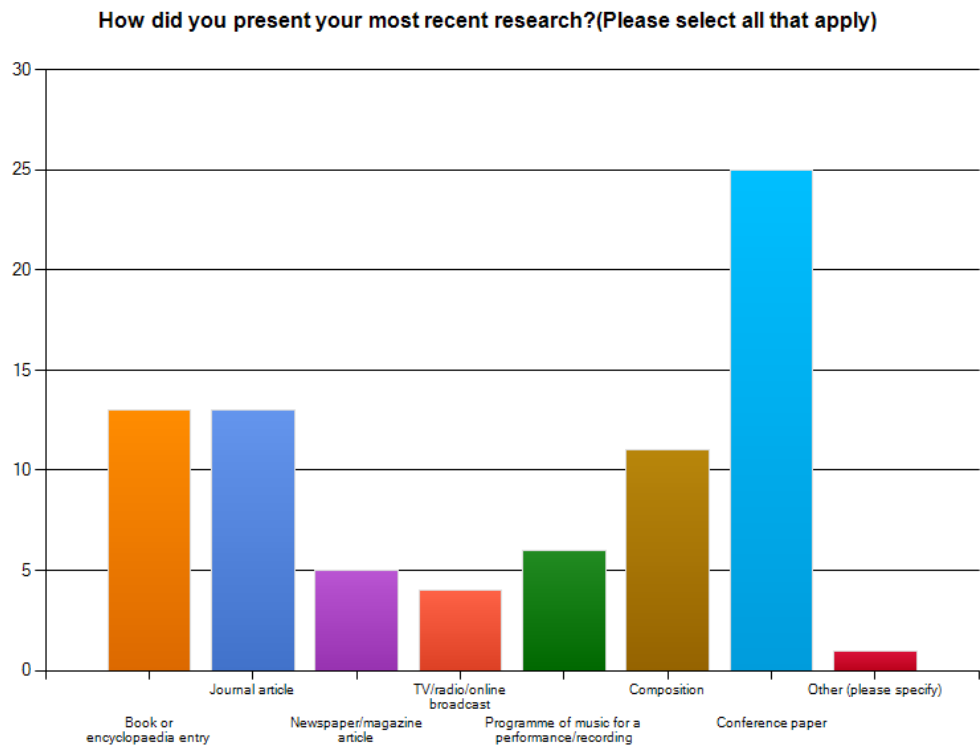


Figure 2

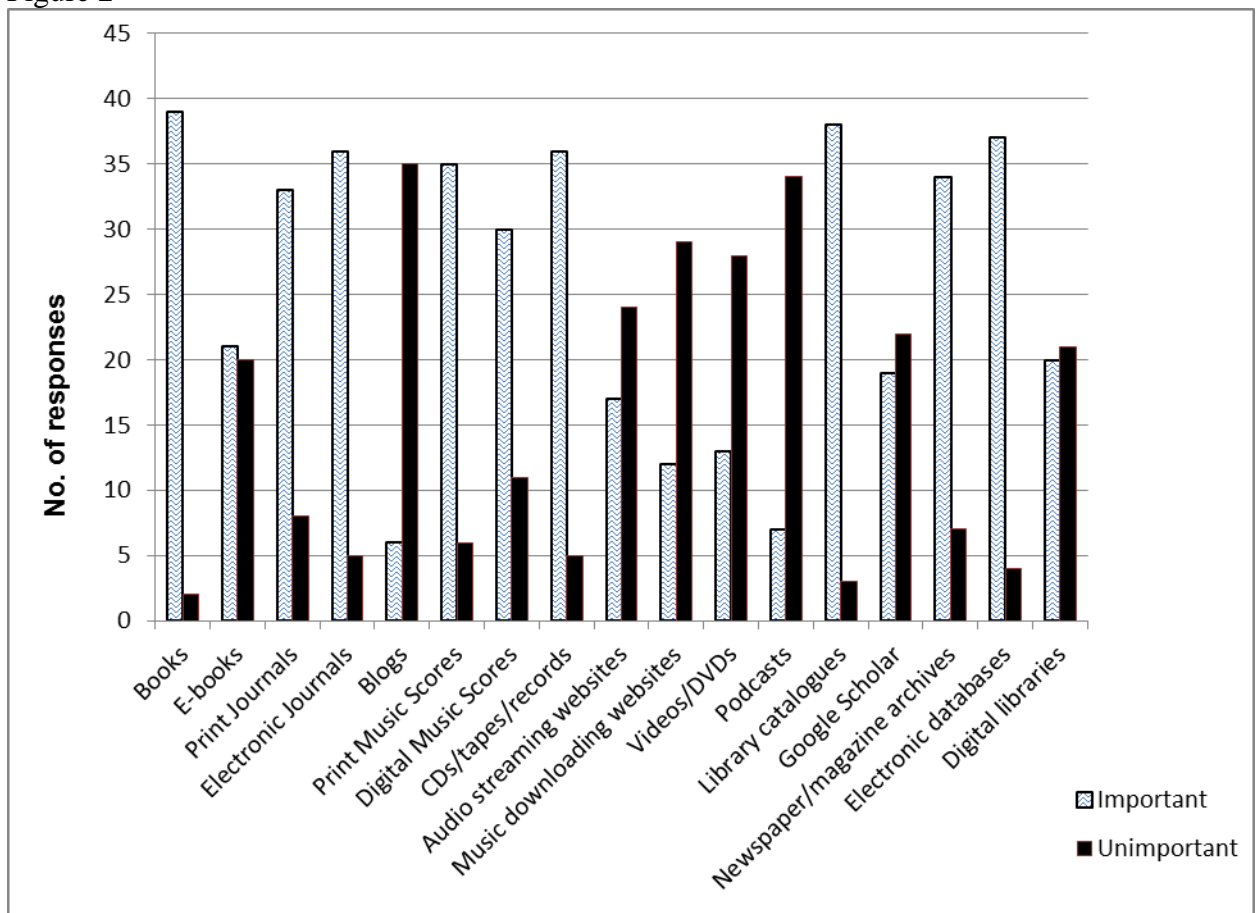


Figure 3

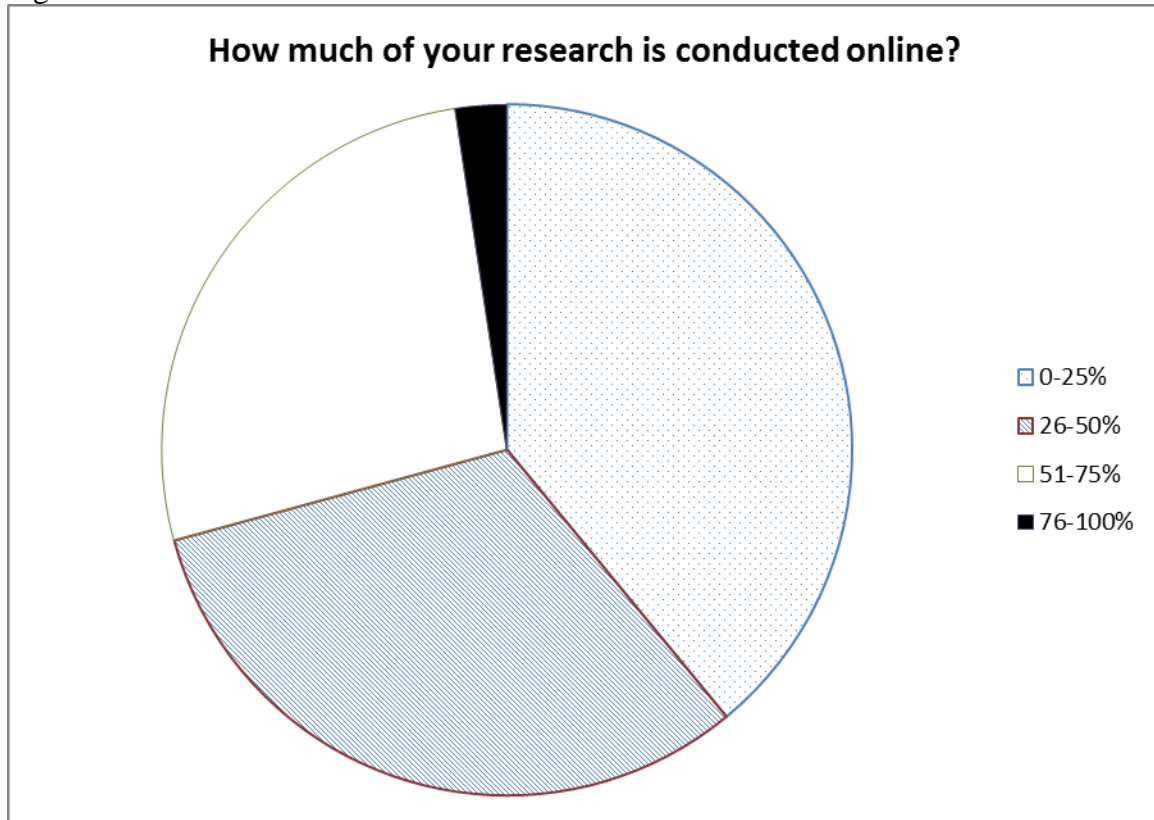


Figure 4

How often do you use each of these applications?(Please rate each one)

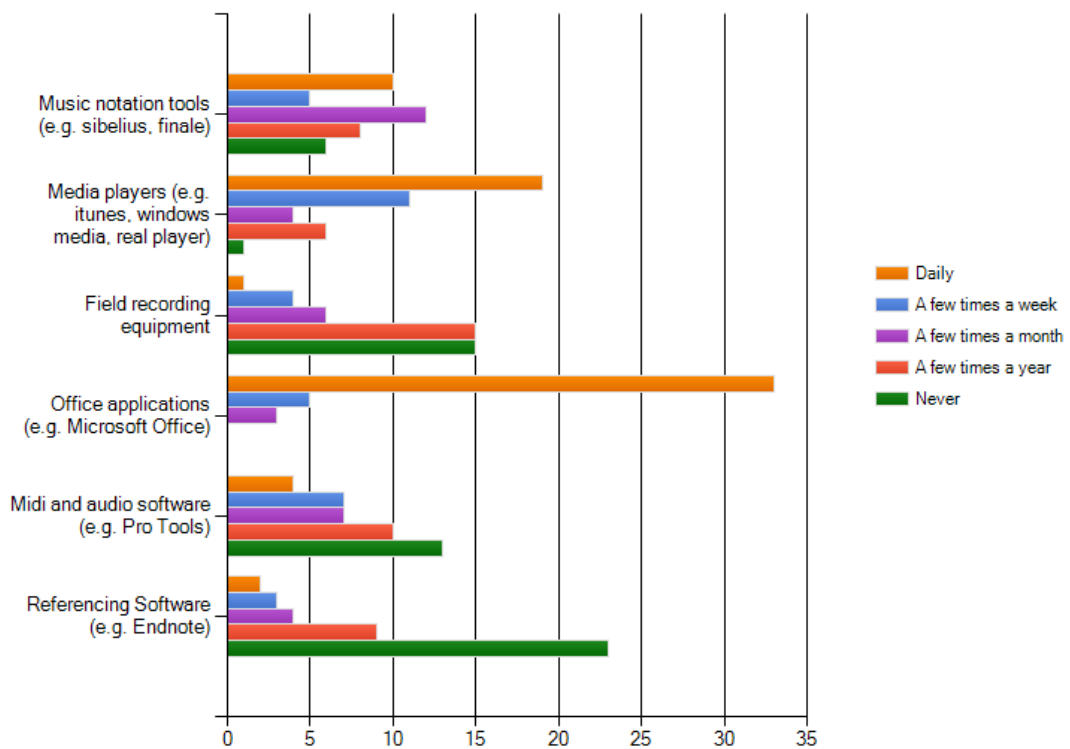


Figure 5

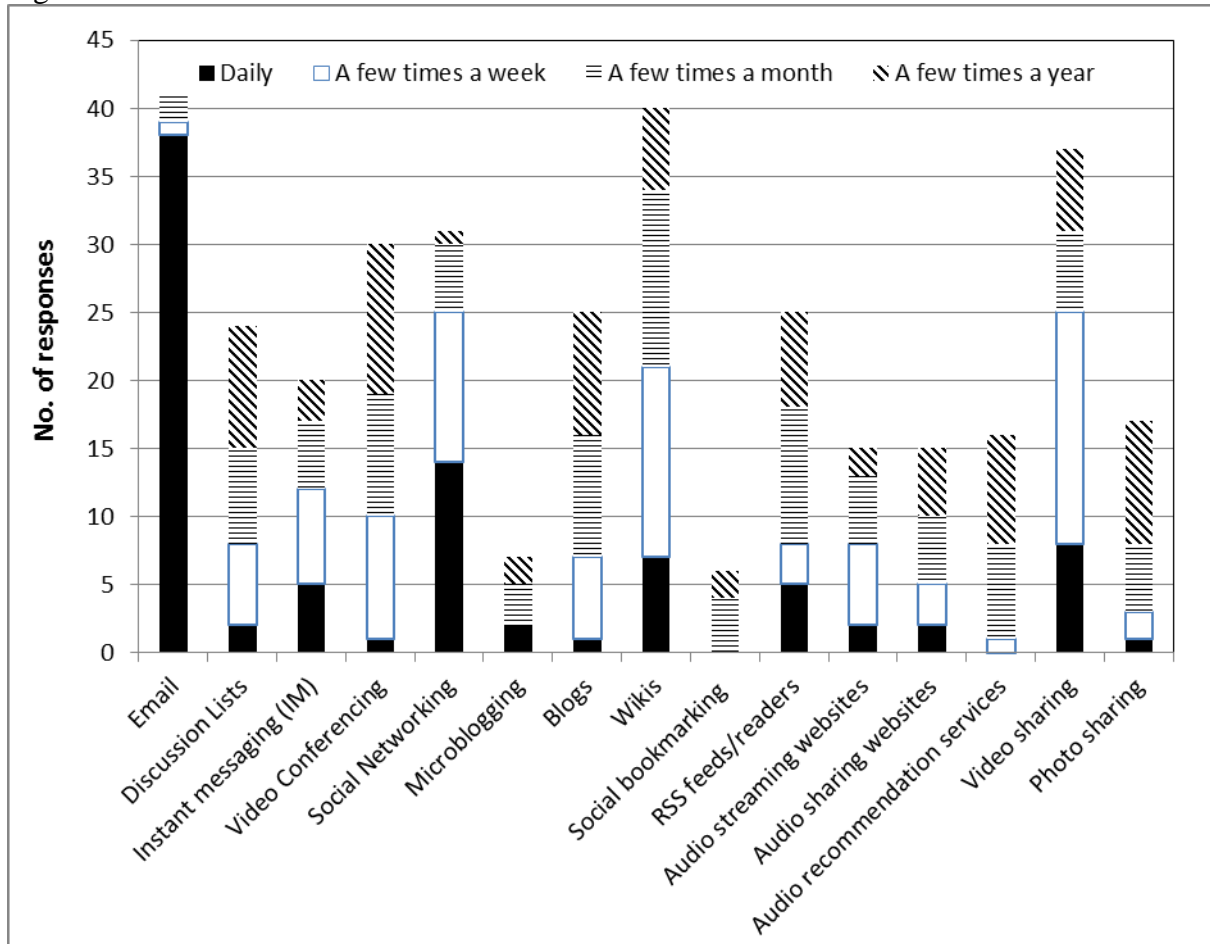


Figure 6

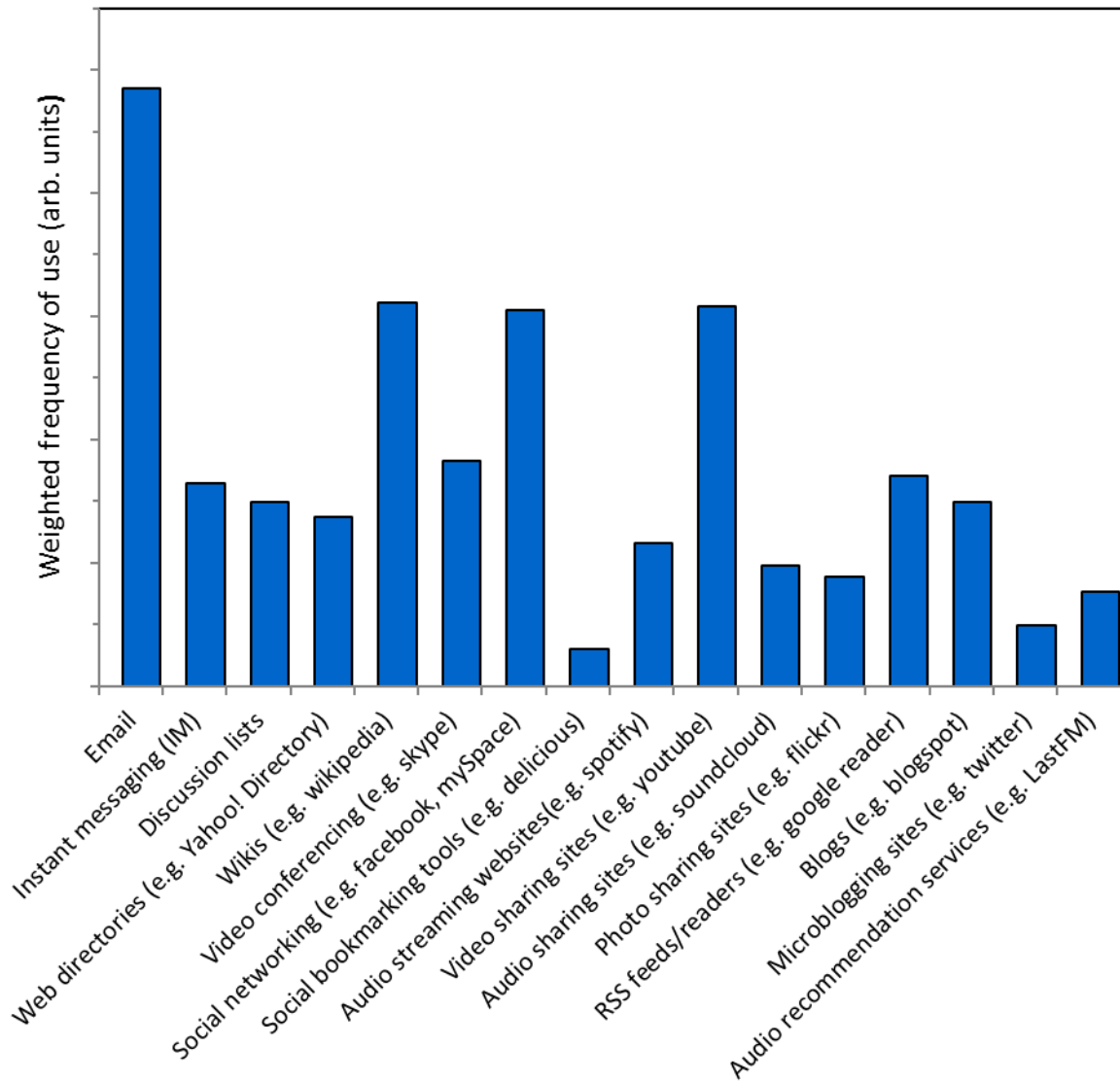


Figure 7

Which of these file extensions\* do you use when storing and listening to audio?(Please select all that apply)\*A file extension is the suffix at the end of a filename that tells a computer, and the computer user, which program is needed to open the file e.g. .doc may be opened by Microsoft Word.

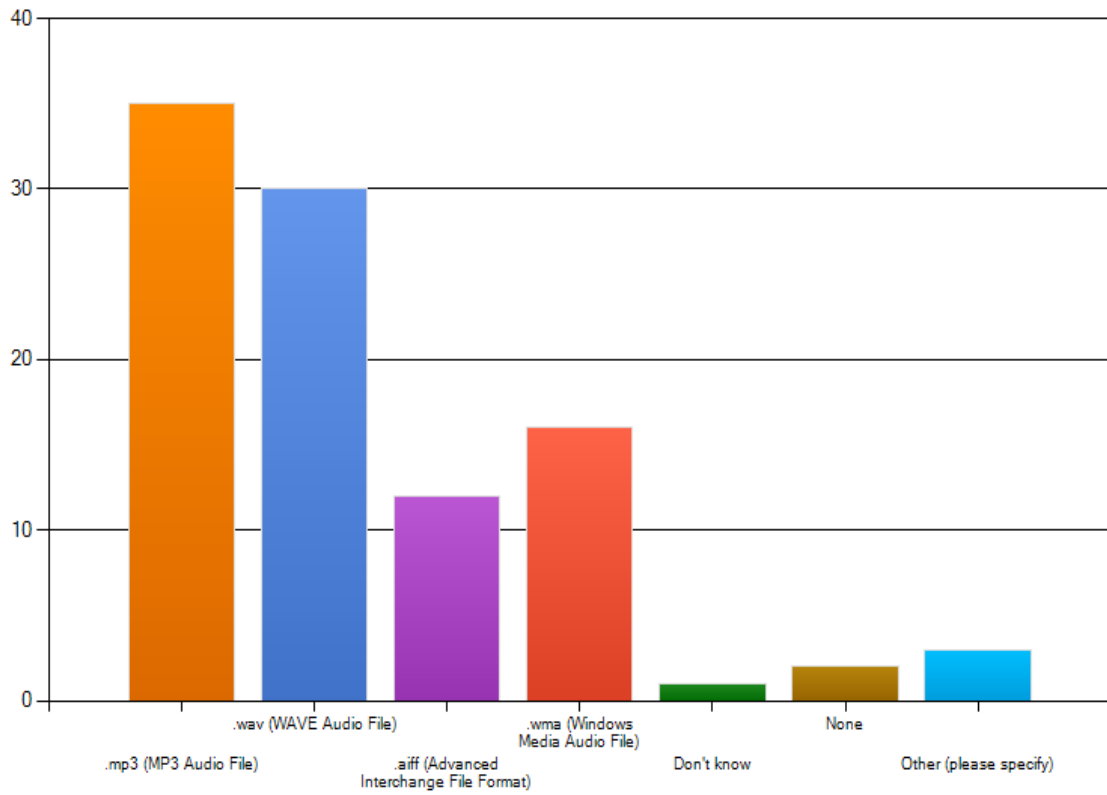


Figure 8

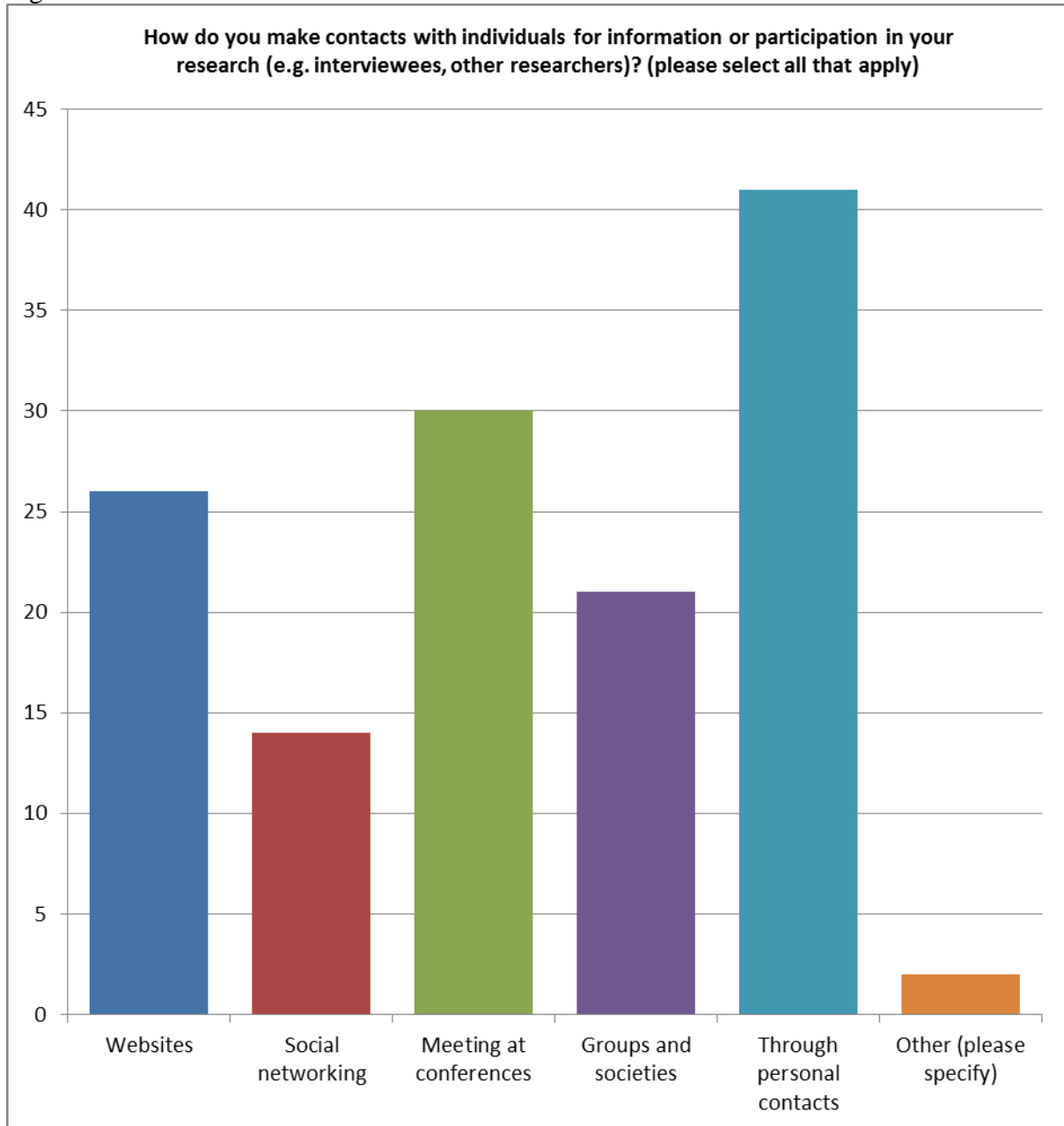


Figure 9

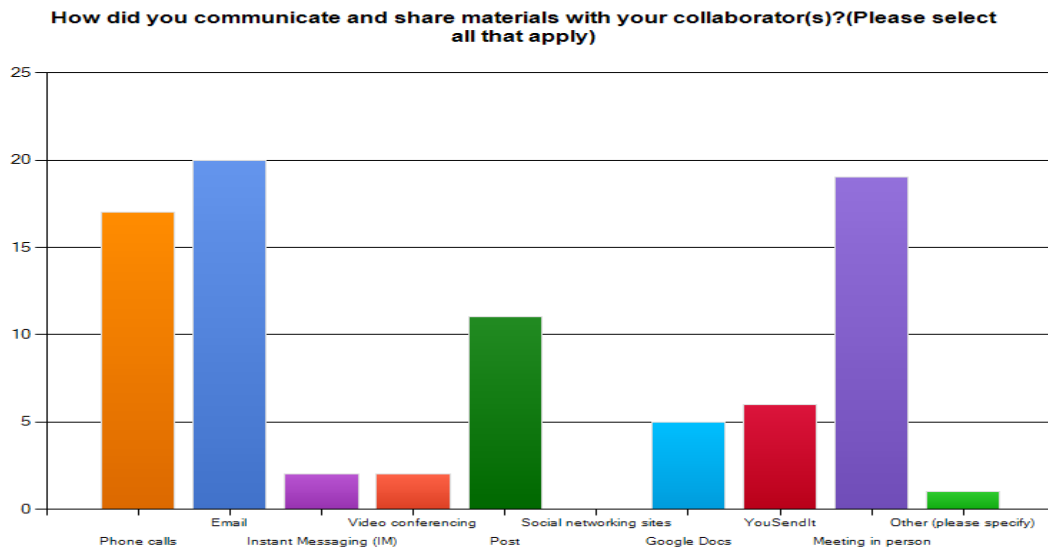


Figure 10

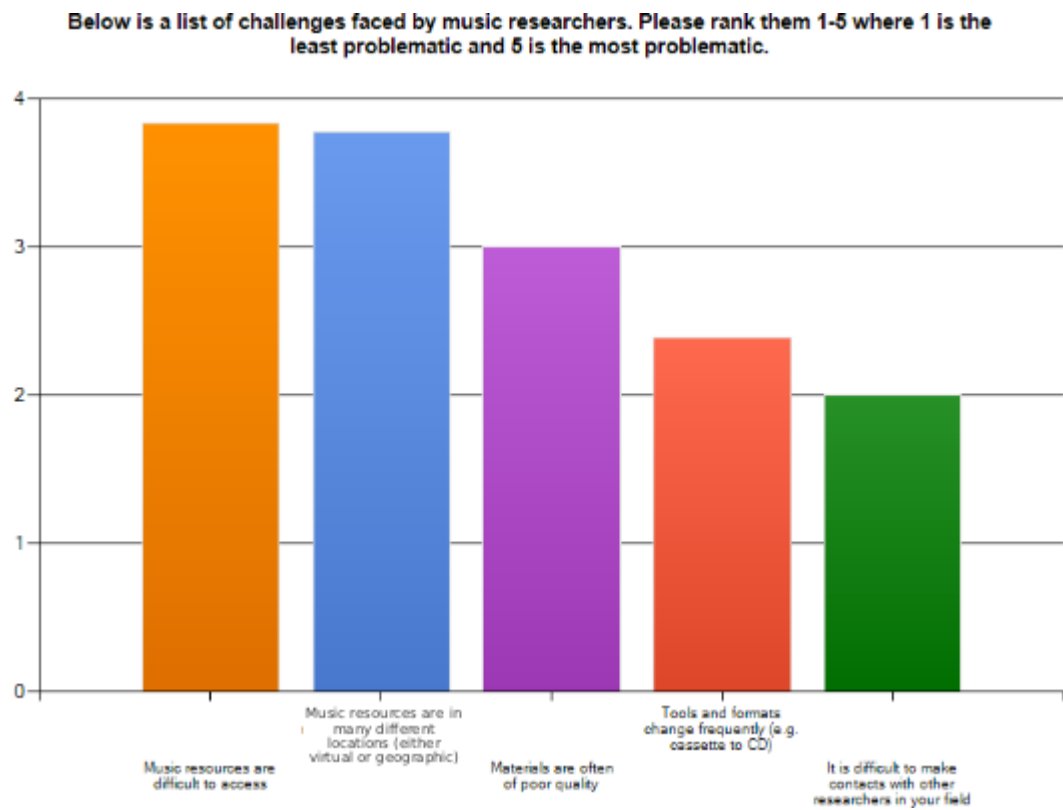


Figure 11

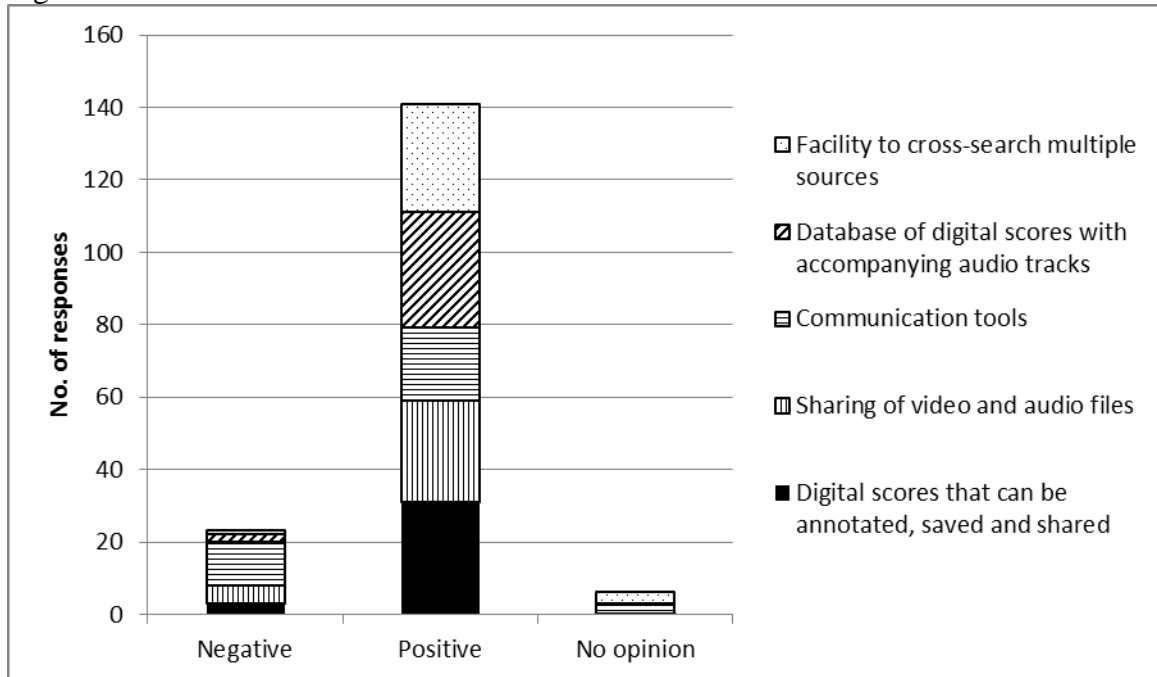


Figure 12

