

“Music Braille Production in 2018”

a Phase 2 Research Report from the DAISY Music Braille Project

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Executive Summary

This report presents research findings from Phase 2 of the DAISY Music Braille Project, focussing primarily (but not exclusively) on the production of paper-based music braille. It set out to explore specific areas of music braille production in greater depth than in the Phase 1 survey, and summarises responses from 23 participants (17 agencies/companies, and 6 end-users), from Australia, Canada, China, Europe and the USA. Whilst not every agency/technology company may not yet have responded or even been reached, this report does give an indication of the current state of the sector so we can start to take joint action. We would welcome others to join the collaboration by contacting us at musicbraille@daisy.org

Phase 2 explored four areas of our sector in detail with agencies, technology developers and end-users/teachers, which would give us the most efficient methods of production with a good end-user experience. We need:

1. the input files to be as good as they can be at the start of the process;
2. conversion and mark-up tools to be accurate and reliable, suitable both for end-users and for agencies, and capable of being integrated into an agency's workflow systems;
3. good access to existing intermediary files;
4. good teaching, learning and promotional resources.

1. We need the input files to be as good as they can be at the start of the process

a) Files received from publishers are not always in a useful format, or of sufficiently high quality for agencies to convert efficiently. The findings suggest that advising publishers of what we need, and agreeing standards for those files, such as high-quality PDFs or MusicXML files, could help us greatly. There are good relationships in the sector to draw on. There are several plug-ins available which help with conversions with both mainstream and specialist tools.

End-users tend to source their materials online, or hard-copies via their national agency, with some users able to draw on funding to pay for these. Users are editing their files themselves, using XML editors and tools such as Braille Music Editor, GOODFEEL, or BrailleMUSE ready for embossing, or are reading it on a braille display.

b) The report introduces a debate about the merits of a standardised format such as MusicXML and/or BMML (Braille MusicXML), where it may depend on a combination of factors - such as the tools in use, the type of material, and whether the user is sighted or blind - as to which file format is most useful in a specific situation. Further dialogue is vital on this topic, perhaps with the help of W3C if we are to try to standardise file formats for file conversion tools, file exchange and efficient production. A validation tool for music braille files could help to improve the quality of the source file, similar to the existing tools in e.g. Hodder from DZB which error-check OCR (Optical Character Recognition) and OMR (Optical Music Recognition) output against common problems.

c) Improving the tools which create and process digital representations of scores seems like a high priority for the sector. Improvements needed in OCR tools and in the conversion and mark-up tools were mentioned across the board in order to improve the source file and the mark-up stages, and to make the tools accessible to blind users. It was generally agreed that a poor quality source file leads to a poor quality music braille file.

d) No agency has yet tried outsourcing music braille to an off-shore company (e.g. in India) in the same way they do with literary books. It is possible that with sufficient training they could do some, but maybe not all, of the processing of music files, which could increase the volume of materials produced.

e) Quick and Dirty music braille files are not acceptable to agencies or to users, and proofreading of music braille is a skilled task which is typically done several times during production – with the bulk of the effort needed in the preparation of the source file. More sophisticated tools which reduced likely errors and could correctly transcribe, format and lay out the material would be welcomed.

2. We need conversion and mark-up tools to be accurate and reliable, suitable both for end-users and for agencies, and capable of being integrated into an agency's workflow systems

a) A suite of tools was generally preferred by both agencies and users, making it flexible and affordable, and able to be incorporated into various workflows. Agencies were asked to report which tools worked well together in their experience: and the range of combinations included: Capella/Sibelius-Hodder; GOODFEEL-Duxbury; MuseScore-GOODFEEL-Duxbury; MuseScore-BrailleMUSE-Duxbury; GOODFEEL-BME; and Finale/Sibelius-BrailleMUSE-GOODFEEL. Improvements were said to be needed in all the tools mentioned, relating to functionality, accuracy, and accessibility, and several specific ideas were proposed. Adding a new DAISY Pipeline tool was not thought to be necessary; instead it was thought better to improve existing tools, which could be added to the Pipeline if it improved efficiency.

b) Online conversion tools were not typically used by agencies, mainly because they did not deliver sufficiently professional results, but several end-users were using them including BrailleMUSE, MakeBraille/Hodder with MuseScore (with BrailleMUSE), PDF and MusicXML being the most commonly input files, with BRF being returned as the output file, edited manually in a text editor, then read on a braille display or embossed. Improvements needed in these online tools were also identified. Bookshare is considering adding an online conversion service for music braille files, based on market needs and collaboration opportunities.

c) Country differences in layout are a potential barrier to effective international file-sharing; whilst expert music braille users can manage to read materials in other layouts, less experienced users find it very difficult. Transcribers Notes and metadata can help explain the layout, but converting from one layout to another is not likely to be effective within the conversion tools – it is proposed that it is better to start from the source file to create different layouts as required. Updating the braille code books, documenting country differences, and incorporating those into conversion tools would be helpful, though care should be taken that we do not seek to make changes which break existing tools which are working successfully.

d) Open Source tools were generally felt to be advantageous in our small sector, though it was agreed that proprietary software is often updated and fixed more reliably. The sustainability of tools was considered an important factor, and various agencies/companies offered opportunities and resources for the development of specifications, technical development and/or testing of tools.

e) A single source file for the creation of music braille, and other music formats, was considered beneficial, including Capella, Lime, MusicXML, and BMML. The generation and mark-up of a quality source file is again reported to be crucial for efficient production.

f) Regarding using music braille on braille displays (e.g. the new Orbit 20 and Canute 360), several users said they had successfully used digital files for learning pieces for performance, though it required a different way of working. Country layout differences still appear on braille displays, and the requirements of the user, instrument and type of music may require specific formatting which is yet to be specified. Agencies reported that their output files of PEF, BRF, DXB (all braille files), and plain TXT files, were likely to be readable on a braille display, and several offered expertise to help with technical requirements.

g) End-users reported using a mixture of tools to find, create, edit and in some cases, print their own music, including GOODFEEL, MuseScore, Braille Music Editor, Lime, LilyPond, and Finale, as well as editing in a plain text editor. Improvements were identified as being needed in all tools. Text-to-Speech in editing tools was considered vital for users, and building accessibility into mainstream tools (e.g. Sibelius, Finale,

Capella) would be valuable. Multi-modal output of the music file in one tool is considered beneficial (e.g. speech, sound, braille, and print).

h) Most music materials contain text as well as the music, and tools vary in their sophistication for handling this reliably, and again, improvements were identified for how the OCR and mark-up tools might handle mixed text-music resources better.

3. We need good access to existing intermediary files

a) Canada, Australia, Israel and the European Commission have already ratified the Marrakesh Treaty, and European countries anticipate implementation in late 2018 (e.g. comes into force in the UK in October 2018). Most countries are already sharing files internationally where they can, but think that the Treaty may unlock further opportunities for file sharing. Certainly Bookshare will be able to host music braille files after Marrakesh (which they have not yet legally been able to do). One agency is currently using MuseScore and music exam boards websites to share their music braille files.

b) Agencies are keen to progress file-sharing to increase the speed and availability of music braille. Nine out of ten agencies said that they would want files from other agencies, and all ten said that their files would be of interest to other agencies; making them available as PEF, BRL, and DX files. Two agencies have already ingested each other's music braille catalogues. Some limitations may restrict the sharing of some files, despite Marrakesh, e.g. where imposed by the funder, or agency constitution.

c) Agencies were unanimous that we should agree minimum standards of metadata for music braille files, to ensure effective sharing, search and retrieval, and a range of metadata fields were suggested, some very complex, some much simpler. Collections will also need to resolve how to handle updated/corrected versions of original scores, and whether/how to notify users if a new version becomes available.

d) Agencies did not seem to know very much (yet) about the developing collections of music braille, such as NLS, Bookshare and OpenScore, but the ABC Global Library was considered a good one-stop shop for making easy searches across multiple collections, since many agencies are already doing this for books. Direct download of files from these services may, or may not, be possible, and end-users themselves may, or may not, be able to download files themselves from these services.

e) End-users reported some success at finding files online for themselves using a variety of online catalogues or downloadable collections, but several only ever requested hard-copy paper braille from their national libraries which they were very happy with. Users of digital files then used tools such as MuseScore, Lime and GOODFEEL, Duxbury to edit them, and either read them on a braille display, or emboss them. A range of improvements were suggested by end-users to make their online searches more effective.

f) NLS and Vision Australia are digitising back-catalogues, and Dedicon and the Music School also reported activities to digitise their collections, and they shared the tools and processes they're using. Seven agencies had advice to give to others who were considering digitising their collections, highlighting for example that generating good quality source files are most useful, and agencies should prioritise on the music which is actually needed or at least most likely to be used. Improvements to the process are needed to make digitising collections more efficient.

4. We need good teaching, learning and promotional resources

This is a significant area of activity which needs some attention, as everyone reported a lack of suitable learning and teaching materials, especially for those in the early stages of learning music and for those who are learning in an integrated school setting. Additionally, a lack of music braille transcribers and of music braille teachers was also identified as a barrier to children/adults learning music braille. Certainly a more coordinated approach to the sharing and dissemination of useful resources would be beneficial alongside a promotion to potential music teachers and users, with intensive training opportunities being available.

Users felt that there weren't enough knowledgeable experts on hand, and would like training opportunities to be available, even online, to help them. They also need ways of exploring and writing music braille, using tools such as Braille Music Editor, but some improvements in these tools are needed. Multi-modal music braille resources are recommended which combine speech, music, braille, sound and print, and new technologies offer opportunities to teach music braille in a modern way. Several types of resources for teaching and learning music braille were identified.

A note on the report structure

The report mainly presents the questions in the same numerical order as in the survey, apart from a few instances where a few questions have been grouped together for ease of comprehension. Each section starts with the 'Context' from the Phase 2 survey in italics as background to the topics in question.

Respondents only completed questions where they had relevant experience or views, so not every question was answered by every participant.

Where it is useful to identify a specific responding agency they are named, but otherwise responses have been collated and summarised.

Introduction

Phase 1

This DAISY Music Braille Project started on 27 October 2017 when Arne Kyrkjebø of the Norwegian Library of Talking Books and Braille (NLB) wrote to the DAISY board to invite colleagues to join a collaboration around music braille, with a view to sharing knowledge and expertise to secure paper music braille production in particular. Interest quickly grew across the sector, and interested people signed up to join the group.

The first phase of the project was to invite comments on a 'Draft Research Outline' circulated in January 2018 which attempted to identify key projects, technology, processes, concerns and interests in the sector. Fifteen respondents submitted comments, from Europe, USA, Canada, Israel and Australia. One agency simply responded that all their issues were covered, whereas others submitted more substantial feedback. Two of the 15 respondents were technology developers, the remainder were blindness agencies, libraries for the blind, or supporting agencies.

The comments received helped to identify a number of further initiatives, groups, products and interests/concerns across the sector, which fed into the design of the more focussed Phase 2 survey.

Whilst not every agency/technology company may not yet have responded or even been reached, this report does give an indication of the current state of the sector so we can start to take joint action. We would welcome others to join the collaboration by contacting us at musicbraille@daisy.org

Phase 2

From Phase 1, it was clear that the overall goal for most projects/initiatives in the sector is the same - to ensure that more music scores are available to more blind musicians in a timely and cost-effective manner. They may focus on particular aspects of that activity, but we share the same main goal. The DAISY project is primarily focussed on the production of paper-based music braille at the present time.

Of the numerous areas identified in the Phase 1 Draft Research Outline, four main areas were identified as being those which the DAISY collaboration should focus on, keeping in close touch with related projects who are working on other angles.

In order to make music braille production as efficient as it can be, and to maintain a good end-user experience - we need four things:

1. the input files to be as good as they can be at the start of the process;
2. conversion and mark-up tools to be accurate and reliable, suitable both for end-users and for agencies, and capable of being integrated into an agency's workflow systems;
3. good access to existing intermediary files; and
4. good teaching, learning and promotional resources.

The Phase 2 survey covered these four areas in depth, covering specific questions about technical issues and processes involved in the production of paper-based music braille. The survey was circulated during April and May 2018 to anyone expressing an interest in the project, including to:

- Agencies – organisations producing and/or supplying hard-copy or digital music braille files;
- Developers – technologists who are writing software for music braille production and use;
- End-Users & Teachers – blind musicians and teachers of blind musicians using music braille.

Survey findings

Respondents

We received 23 responses to the Phase 2 survey (12 agencies responded in both Phase 1 and Phase 2), with 5 new agencies/companies taking part in Phase 2, together with 6 new end-user respondents.

a) 17 agencies/companies included libraries for the blind, music schools, blindness agencies, standards bodies and technology companies, from Australia, Canada, Europe, Japan, and the USA:

- Benetech/Bookshare (USA)
- BrailleMUSE (Japan)
- CNIB (Canada)
- Dancing Dots (USA)
- Dedicon (Netherlands)
- DZB (Germany)
- Filomen M. D'Agostino Greenberg Music School/Lighthouse Guild (USA)
- Italian National Library for the Blind (Italy)
- MTM (Sweden)
- Music21 (USA)
- NLB (Norway)
- NLS (USA)
- ONCE (Spain)
- SBS (Switzerland)
- Statped (Norway)
- UK Association for Accessible Formats (UKAAF) (UK) – includes agencies and end-users
- Vision Australia (Australia).

b) 6 end-users - from the UK, Switzerland and China:

These respondents ranged from new music braille users to experienced users highly proficient with music braille code, conversion and some with technical development knowledge. Some are also professional transcribers.

1. We need to get the input files as good as they can be at the start of the process

1a) Standards for publisher files

Context: Although some publishers are releasing files to agencies/end-users for the purpose of transcribing them into music braille, the files released are not always useful. Publishers involved in our sector include: ABRSM, Barenreiter, Boosey & Hawkes, Breitkopf, Butz, Carus Verlag, Chester Novello (Music Sales Classical), Hal Leonard, Henle Verlag, McGraw Hill, OUP/Peters Edition, Pearson, Royal Conservatory of Music, Schott, Trinity College, Universal Edition, Universal Music Publishing Classical.

Arrangements with publishers and files received?

Very few agencies reported sourcing files directly from publishers, as most work with sheet-music sent in by customers, or a PDF, and some are finding publishers reluctant to give agencies the digital file. Many often-used works do not exist in a digital format anyway (as they are engraved). Some publishers are sharing PDFs, or occasionally MusicXML files, or even Finale or Sibelius files. In some cases, the PDFs are reported to be good enough, although others reported that they are not always sufficiently high quality (or structured) for a good OCR scan to be made, and the XML files can vary in quality. The Finale/Sibelius files are reported to be easily transcribed into braille. The quality of the digital materials from living composers has been said to be more useful.

Publishers don't always understand what formats are needed, and might send a PDF textbook file where the music sections are embedded images, rather than MusicXML, and are therefore not useful. Furthermore, automated conversion from PDF into braille isn't always reliable.

Some publishers are however quite supportive. For example, in the UK the most frequently used music braille piano and flute exam pieces are available for download from the exam board's website as .BRF files, and they were even happy to take responsibility for the costs of transcription.

The UK website 'UK Scores Reformed' was highly recommended by one user-transcriber: <https://scoresreformed.co.uk/> who is liaising with the publishing company to convert many of their high-quality scores into braille and making them available to other blind musicians on their site <http://www.brailleorch.org>.

Elsewhere, Henle, Breitkopf and Butz have all been open to working with agencies, and they produce high quality resources. Experiences have found some publishers to be more commercial (e.g. Carus, Schott), others harder to work with (e.g. Peters), and some with unsuitable quality materials (e.g. Sikorski).

In Japan, a braille music consortium is trying to evaluate the effectiveness of BrailleMUSE, using MusicXML files into braille, which are released from a publisher (Music Eight LTD) under an agreement.

Additionally, Bookshare reported that they have a long history with the publishing industry, receiving (literary book) titles from around 850+ publishers for distribution to qualified members, and are actively working on 'Born Accessible' programs and certification with the publishing industry.

Minimum standards for publisher files?

There was wide agreement that guidance/standards for publishers (and self-publishers) should be agreed if that would give us better quality files which would improve production. A created MusicXML file or a high quality PDF are reported to be the most desirable file formats to receive from publishers. We would define our requirements and share them with publishers appropriately. Also, higher-quality automated conversions from PDFs into braille would be welcomed.

Music braille plug-ins?

There are a few plug-ins for mainstream and specialist music publishing software which might be useful to us when we receive structured music files (and there may be others too):

- for Capella in Hodder (from DZB) which has a braille display for Capella; as well as an error checker for Capella OCR.
- for Sibelius and Finale in GOODFEEL (from Dancing Dots) which save the score to MusicXML and launch Lime music notation software so that it can be transcribed automatically.
- for Braille Music Editor 2 (BME2) (from the Italian National Library for the Blind) which imports MusicXML into Braille MusicXML (BMML), and allows end-users to read, listen and edit the imported music file.
- Plug-in for Finale, Do-diesis, was used by Dedicon; but this may no longer be available.

End-user experience of files from publishers/hard-copies from agencies?

End-users don't seem to approach publishers directly very often - they often source their materials from their national braille library or from online collections of braille files. Publishers do sometimes send MusicXML or PDF files directly to end-users, or may ask them to contact the editor or composer. Users may be required to own the original print music first, and often the braille file is provided at no charge, or at a subsidised rate, and the files are typically supplied very quickly to the users.

Many agencies provide free, or low-cost, music braille to clients in hard-copy or as .BRF files, often at the same price as the printed work. Where payment is required some users can claim from specific funding, for example, 'Access to Work' funding in the UK for professional musicians. Some agencies provide free music transcription to clients - paid for by Federal Funding to the agency (Australia), or by a special fund made available by the agency or by a national insurance (Switzerland). Where there is a charge for transcription, it is comparable with other transcription work which is chargeable.

Sourcing and reprinting an existing braille file is obviously significantly cheaper and faster, taking just a week or so, rather than starting from scratch, which might take months to be produced. Everyone would like a greater selection of materials available for quicker access to needed scores. One respondent requested a simpler payment option e.g. PayPal.

What do end-users do with the files they receive?

End-users reported using the following tools to work with files from publishers/agencies: including XML editors (e.g. XMLSpy, Oxygen XML Editor), Lime/GOODFEEL, BrailleMUSE, and Capella and BME (Braille Music Editor 2), as well as sending files to a transcription agency, to produce the hard-copy braille they need. They are also reading the .BRF files on a braille display, or embossing it themselves if they have the equipment.

1b) Standard mark-up format

Context: In order to exchange files and make better automated conversions, standards for a mark-up format(s) are required. There are various music braille file formats, with Braille MusicXML (BMML) being the choice of many for further development and standardisation, based on the Contrapunctus project. But, there are gaps in what it (and other formats) can mark up. Formats include: MusicXML, BMML, MIDI; as well as: MDML, XMusic, MNML, MusicML, JSCOREML, MEI, NIFFML, SMR, PLAY.

Is BMML the best choice for mark-up language? What improvements are needed to this, or other formats?

An international group led by the Italian National Library for the Blind in Monza is proposing that a shared markup format should be used, Braille Music Markup Language - known as BMML. This is proposed as an effective way of describing what is required in braille for a music score which cannot be represented by MusicXML, and holds both braille and print notational information. It is currently used by two proprietary software tools – it can be created by their commercial tool Braille Music Editor (BME), and read by their free tool Braille Music Reader (BMR). BME allows you to write music in braille, so could be considered a manual rather than automated process.

The potential for BMML is liked by several agencies, although the code BMML and these two software tools both require updating and improvements if it is to be more widely used – something the Italian Library is seeking funding and collaborators to achieve. Furthermore, some agencies reported they did not see the need for an alternative to MusicXML when current software tools allow relatively effective conversion into music braille without requiring another file format.

The Italian Library's proposal is that we would obtain digital files from publishers in MusicXML format, compatible with almost all music editing software (including Finale and Sibelius etc). Then, conversion tools (currently BME or BME2, or any future tool which allows BMML creation) transform the MusicXML file into BMML, which is compatible with tools such as their Braille Music Reader (Free). BME2 was developed to allow blind musicians to write their music in braille, to listen and edit it and export it as MusicXML. This export is being used to import that MusicXML file into a music notation software like Finale or Sibelius for printing for sighted people. The files within BME2 have the extension .bmml. They report that the export from BMML to MusicXML is working quite well.

It was reported that BMML (and BME and BMR) need some improvements concerning lyrics, symbols, and other minor issues, including being able to store MusicXML 3.1. Also that BMML cannot represent everything which is needed to represent fully qualified braille. However, the code is public domain (Open Source) and anybody can introduce further developments to the code (although not to the software tools themselves which are proprietary). Whilst some feel that BMML does have potential, others felt that it was only useful when working with the tools BME and BMR – but these tools were valued by blind musicians in particular.

Interestingly, many transcribers have experienced no limitations with MusicXML files with the tools they are using, and they believe that MusicXML captures almost everything necessary for their conversion tools, so are not yet convinced of the need for a different file format. Sighted transcribers reported that it is a pity that BMML isn't supported by a lot of standard programs that have a GUI (e.g. Finale, Sibelius) which could be a good alternative to BME.

Other XML file formats are very well developed, such as the format used in Hodder developed by DZB over 15 years, which has more than 800 tags plus attributes and value representations, However, this is not designed to represent print, braille and audio information at the same time, so each format has their own limitations.

One respondent reminded us to consider the various ways of producing braille, which might require specific consideration – whether transforming braille directly to MusicXML; importing a file or typing it in manually; or editing in an editor.

One respondent mentioned the new file format currently called MNX which is being developed by W3C Music Notation Committee as an eventual successor to MusicXML (see <https://www.w3.org/community/music-notation/2016/05/19/introducing-mnx/>).

The developer of Hodder said it might be better to use MusicXML files and build the options for braille formatting into the authoring tool. The developer of BrailleMUSE also feels that MusicXML is not bad, and that the most merit of MusicXML would be a de facto standard and already has a large amount of resources in the world. They would like to suggest a discussion of the problems of MusicXML first.

Some improvements in existing tools were proposed by respondents: e.g. more extensive incorporation of literary braille within music braille; in GOODFEEL, support for more than one vocal line in a score; in BrailleMUSE, chord presentation needs improvement. One agency reported that “In general, more clarity is required in all music notation software. Errors in translation are common. Less ambiguity in notation is required.”

Validation tool?

A couple of respondents proposed the development of a MusicXML validation tool – to ensure that created files conform to an agreed standard specification. This could make automated conversions much more efficient and reliable. This could for example, check things such as: that page numbers haven't been put in as stave text, that it has a title, that dynamics have been put in as dynamics and not just lyrics, etc., that you don't have overlapping symbols, or multiple simultaneous expression marks, or suspicious amount of lyrics (i.e. too many for one syllable) etc.

The tools written by DZB for Hodder/Capella include an error checker for the most common OCR (Optical Character Recognition) and OMR (Optical Music Recognition) problems which do a similar kind of job.

Mark-up tools used?

Tools used by agencies for mark-up include Braille Music Editor (BME), MuseScore, Oxygen, and Capella Edit. Sharp-Eye for OCR. There is reported to be a need for good MusicXML import in the mark-up tools, which Capella seems to have, and for advanced editing tools and the same file formats. The accessibility of these tools was important to several respondents.

GOODFEEL is preferred by some, because of their regular software updates and rapid response to queries. For simple materials it is reported to be quicker to transcribe manually rather than using any conversion tools.

One respondent in China has written an almost complete framework for the design and specification of a sophisticated music transcription package and is looking for interested parties to bring it to life – see <http://www.brailleorch.org/en/about/>.

Do we need W3C's help?

Certainly, there is a general agreement that we should agree a standard for Braille Music – that is, if MusicXML is agreed not to be sufficient – and that perhaps W3C could (should?) facilitate this work, and that all mainstream tools should support the format we agree. Additionally, there should be more strict rules to control the content of MusicXML files – each software exporting MusicXML currently produces something different. File format consolidation would make it much easier to share, store and convert files. The developing file format to succeed MusicXML, MNX, should be investigated too.

1c) More automated mark-up

Context: Agencies and end-users are using a variety of tools and human expertise to scan and mark-up a file, including music OCR tools, e.g. capella-scan, SharpEye in GOODFEEL, and the OBR tool Neovision, etc.

What needs to be improved in the OCR and mark-up tools?

Improvements to the accuracy of OCR tools, such as Sharp Eye (in GOODFEEL) and capella-scan, especially for complex music, is repeatedly mentioned by respondents, where mistakes and missing items have to be manually fixed. In fact, some respondents said they find it quicker to input the file directly, rather than using OCR and then fixing the scan, especially if the original print is of bad quality. However, the company developing capella-scan is receptive to requests for improvements, and high quality PDFs in capella give good scan results, with edits made easily in capella. Some tools have produced very poor MusicXML output (e.g. SmartScore). The OBR software Neovision for scanning braille has had a high error rate and the company has gone out of business, so new solutions are being sought by at least one agency.

The accessibility of the OCR tool is also of interest to blind transcribers and blind users – though it can be hard for them to correct a score independently without being able to see the print original. SmartScore makers might be open to making their software more accessible. Certainly SharpEye is reported to have made some improvements for accessibility. One blind respondent reports getting good results for PDF files using the conversion tool PDFtomusicPro, which outputs into for example MusicXML which can be edited (though they mainly use MusicXML and translated plain ASCII braille for editing and producing music braille. This limits the flexibility to adapt different requirements of layout and format from different countries). One user respondent mentioned the cost of the tools – and hoped that affordability for entry-level tools would be considered.

Several respondents felt that OCR tools were improving all the time, but may never reach 100 percent accuracy because music scores present far too many variables - and that importing MusicXML (or some other reliable digital format) will always be preferable to scanning print scores.

Other agencies reported that the software itself works well, especially with good source files such as MusicXML or a high quality PDF. Problems usually come from a poorly created source file, inconsistencies between publisher files, and poor quality online source files created by individuals.

How could these developments be made?

One respondent summarised the situation: “clearly the way forward is to focus on building and improving tools that can process digital representations of scores. Between agencies and developers there will be a great deal of knowledge about what is required from OCR/OBR or Optical Music Recognition tools, and dialogue between them would be crucial for sector-wide improvements.”

The developer of BrailleMUSE said “we should understand the difference between braille music notation and staff notation: braille notation is digital one where all symbols belong to a note. On the other hand, a visual score is analog and some symbols do not necessarily belong to a note. For example, a pedal symbol may be written between notes. The MusicXML is similar to Visual Score. We, or an automated system, need to recognise to find notes to which those symbols belonged, before translating into braille. Those systems should have a recognition algorithm, in order to improve their accuracy.”

One respondent is hoping to make a much more accurate OCR and OMR technology, together with a more complete mark-up language and parser to enhance music braille transcription (see <http://www.brailleorch.org/en/about/>).

There is general consensus that having standards used by everyone will make our conversion efforts more streamlined and not bespoke.

1d) Experience of using off-shore companies to mark-up files

Context: Many agencies are using companies, e.g. in India, to mark-up XML files for text files.

Liaison/standards for offshore companies?

Some agencies reported using off-shore companies e.g. in India, to mark-up XML files for text files for accessible book production (e.g. BarrierBreak, AELData, DataEsperto, also Contentra, Technofunda, sometimes Integra) which produce rapid and cost-effective files ready for production.

But nothing much seems to have been explored yet to use such companies for scanning/mark-up of music (at least by the respondents in this survey). One agency suggested that we could try outsourcing some music mark-up to Indian companies with expertise in accessible book mark-up. Of course, this requires agreed standards and guidelines for music mark-up and transcription, and perhaps more automated tools. This mark-up would probably need to be done by people with a knowledge of both mark-up and music. It may of course be too complex a job to outsource.

These standards and guidelines are likely to be part of the work needed to agree a standard for file formats. Agencies like DZB who develop Hodder have an extremely detailed data format to describe their meta data on music notes. These data are shared only partially. For example some data are used for catalogues (online or print), others for internal research or selling processes.

Several independent professional transcribers can accept commissions from individuals or agencies for reasonable prices and rapid turnarounds – and these transcribers could of course also be considered as outsource/sub-contractor options.

1e) Proofreading/correction stages

Context: Agencies vary in when and how much proofreading takes place. It is assumed that accuracy is essential for music braille, and the tools should support this.

When and what is done?

Agencies vary in when and how much proofreading takes place. It is assumed that accuracy is essential for music braille, and the tools should support this.

Agencies reported a range of proofreading practices, viewed as essential as errors are detected at every stage of the production process, and most agencies will only tolerate a low error rate in the final materials. Where music braille is sub-contracted to another agency, they are responsible for proofreading the materials they create.

The first proofread/correction is often done by the person who did the first transcription or manual input and mark-up stages. This can be done aurally using the BME software. A second final proofread/correction is often done by another colleague. A blind musician is often involved in the proofreading stages, but not always. Another method reported is to check the print score in sound (aurally) and the braille against the print. One agency reported just doing one proofread at the end of the production process.

DZB reported that they use three kinds of proofreading depending on the kind of scores and product:

- Single check by transcriber or
- Single check by transcriber and a blind person or
- Single check by a blind person only (readability check, the notes are assumed to be correct)

Opportunities for increased efficiency?

Respondents felt that there were opportunities to make the proofreading stages more efficient. Particularly if we can get better quality automated production processes so that the bulk of the proofreading and quality checking can take place during the preparation of the source material – which would need music-braille experts.

If more sophisticated software could correctly handle all transcription, layout and formatting rules, this would help to reduce the proofreading load, and make it easier for different options to be applied by the user, or for specific purposes. DZB reported that more than 90% of mistakes that are found are a result of scanning errors.

It was reported that tools such as the Braille Music Editor parser can check the braille reasonably quickly, but may not deal with local custom or complex materials. Documenting and eliminating differences in music braille (e.g. country and transcriber differences) would certainly help. And, knowing where the tools make errors - and reducing those errors in the software - certainly helps focus proofreading attention (e.g. in the DZB Hodder/Capella tools). Validation tools could be valuable to help reduce proofreading required – based on the agreed standards/guidelines, and maybe this validation/correction stage is something which could be outsourced e.g. to Indian companies.

Are quick and dirty files possible/acceptable?

On the whole, quick and dirty music files were not acceptable to agencies or end-users, because the majority of users are performing or studying from these materials so they have to be accurate and usable. Producing a quick and dirty file is also not conducive to file-sharing with other agencies/users.

One respondent specifically mentioned that the needs of the user (and of the instrument) are of primary importance when providing these materials, whether it is for an undergraduate analysing a piece, or an infant-school pupil learning a recorder piece.

DZB are confident that their production tools create quick, but not dirty, files, and another agency suggested that MIDI files might be good in some instances where a quick turnaround is required.

2. We need conversion and mark-up tools to be accurate and reliable, suitable both for end-users and for agencies, and capable of being integrated into agencies' workflow systems

2a) A single solution, or a suite of complementary tools?

Context: Many of the larger agencies rely on a suite of tools, linked into their own production workflow. Some have developed their own tools, which other agencies have purchased. Smaller agencies or schools/universities/end-users for example, often prefer a single solution for their music braille production, which may be tied into a specific screen-reader and braille translation programme. Tools include for example: Braille Music Editor 2, BrailleMUSE, capella, capella-scan, Dorico, Finale, FreeDots, GOODFEEL, Hodder, IBOS MusicXML Reader, Music21, Sibelius, (but Toccata seems to be no longer available) etc.

Single tool or a suite of tools?

Generally, agency respondents preferred a suite of tools rather than a single all-purpose tool, to allow them the flexibility to use the tools as they needed to, depending on the nature of the materials and their own production workflow. It was felt that a suite would also mean that the tools could be developed, maintained and updated more easily.

Several agencies reported that their workflows allowed them to use a variety of tools to complete specific functions, and could incorporate alternative tools as required, as long as they had a described GUI to allow integration.

Two agencies said that their music braille production was totally separate from their literary braille production, aside from one of them using Duxbury for the final formatting.

There was some preference for an Open Source suite of tools with an Open Source GUI, rather than a closed 'black box' suite of tools – but overall, it was felt that having a fast, accurate, reliable automated tool capable of handling various requirements was more important than how it was built.

GOODFEEL may feel like a single tool to users but of course it is actually comprised of a series of connected tools. Some respondents said they liked the single solution of GOODFEEL and that it was definitely quicker when it went through all its processes than doing the music manually.

Further, any tool should have the capability to modify options for presentation, layout and formatting to be able to convert from one to another to suit a users' needs, and one agency reported a need for being able to open and save as text files.

A proposal for a new music braille tool has been written by one respondent which "should have music braille and text conversion, playback, editing, writing and formatting functionalities. An external OCR and OMR tool is of no problem" - see <http://www.brailleorch.org/en/about/>

Interestingly users typically preferred a suite of tools too, despite agencies thinking they might prefer a single tool. One user commented "I think a suite of tools is more suited to the multitude of music formats and Digital Audio Workstations or music publishing applications. This also can make it more affordable to entry level users of braille music."

Which tools connect well together?

Several agencies reported that they had not yet found the perfect solution of tools for music braille, but they and users specified the tools they were using. Several also mentioned using MusicXML.

- Some respondents are finding the most successful combination of tools to be capella, with Hodder (from DZB), where good input files get good outputs, and the scanning, editing and transcription tools all work well together.
- Dedicon currently uses BME to produce .PLY files for music braille. Then after some editing and layout they create the .BRL file for embossing.
- However, Dedicon is currently trialling: capella-scan, manual proofread, capella, Hodder, print supported by an ERP workflow system (they use AFAS Profit) to guide the activities.

Hodder takes capx (capella) and MusicXML files in, and outputs an ASCII file for embossing. Text editors (e.g. KEDIT) can be used to do the page separation on the file before embossing. Hodder is the only conversion-tool that works with capella files. That is a strength as the tools are tailored to work together, but there is a risk if Hodder becomes unavailable, that the solution ceases to work.

- The Lighthouse Guild Music School uses: Goodfeel, Duxbury.
- SBS uses: capella-scan, capella, Hodder.
- UKAAF members use: MuseScore/GOODFEEL/Duxbury, or MuseScore/BrailleMUSE/Duxbury.
- DZB uses: capella-scan and capella. As Hodder is used mostly with capx it fits perfectly with capella.
- Dancing Dots: GOODFEEL can automatically transcribe Lime files. Lime files can be created using three methods: direct entry using Lime's editor, import of MusicXML, and music OCR with SharpEye or other applications that can export results as MusicXML which Lime can import.
- Two users: Goodfeel and BME (Braille Music Editor).
- User: Finale/Sibelius with BrailleMUSE/GOODFEEL. I prefer to use BrailleMUSE, which can process very large and complicated scores.
- User: MuseScore/GOODFEEL/Duxbury, or MuseScore/BrailleMUSE/Duxbury.
- User: MusicXML and BrailleMUSE.
- (NLS uses: DAISY Pipeline connected tools, XML conversion - for books, not music).

Improvements needed?

Generally, respondents requested greater automation, fewer bugs, and better upgrades! Some specific examples of improvements needed were also mentioned, e.g:

- BrailleMUSE does not align bars properly, and chords are not displayed well
- GOODFEEL does not cope with certain combinations of musical symbols
- MuseScore is currently only partially accessible
- Mark up tools do not work well with multiple instruments and complex music scores.
- Better music braille output and layout functions.

Dancing Dots described how they could build on their in-house plug-ins for Sibelius and Finale in GOODFEEL to give a streamlined user experience in those tools such as: "Open Score in Sibelius/Finale, Click on Dancing Dots plug-in, Emboss score or open for review in Dancing Dots BrailleView application. In order for this user experience to occur, we would still be using a number of components in the background. Plug-in creates MusicXML and passes to a dll version of Lime; Lime passes Lime notation file to GOODFEEL;

GOODFEEL applies automatic transcription and presents Braille Destination dialog offering option to emboss or review braille score.”

Dancing Dots reported that “some problems may arise because some GOODFEEL users do not realize that their screen reader has applied the rules of literary braille transcription to a formatted braille file, which results in an unreadable mess when opening the file in an editor like Notepad. They advise that the solution is to set the screen reader to use ‘computer braille’ (which is what GOODFEEL does for JAWS for Windows, the most popular Windows-based screen reader). The user must set an option in the Duxbury Braille Translator when opening formatted braille music in that program to open them ‘without interpretation’. Otherwise, Duxbury tries to add signs like page numbers.”

They also report that “whilst GOODFEEL supports more than 90 percent of the standards set in the 1997 NIM which is sufficient for the vast majority of their users, continuous ongoing improvements have only been possible to date through subsidizing sales with third-party funding such as from grants. That is, revenue from sales alone has not been consistently sufficient to underwrite ongoing development. Future funding support will be needed to ensure that further improvements are made. Collaboration with a partner or group of partners motivated to fund specific enhancements that would advance their own work while improving the quality of braille music transcription for all users of GOODFEEL would be ideal.”

New DAISY pipeline tool needed?

Respondents were uncertain as to whether a new tool for DAISY Pipeline was needed. Some felt that a standalone tool would be more flexible than a tool integrated into the Pipeline2 framework, but if it offered superior quality and fewer steps than currently available then it would be welcomed. Dancing Dots has ideas of how this could be built, simplifying the process from GOODFEEL. One requirement for such a tool would be that it should be able to handle large files (which can be done in later versions of Pipeline).

New tools with promise?

Several tools were mentioned where agencies/developers/users felt there was promise:

- IBOS MusicXML Reader was mentioned by MTM, with a possibility of adapting/translating it for Swedish users. Another respondent commented that this could be incorporated into browsers to deliver a cost-effective solution.
- Dedicon is expecting good things from Hodder (from DZB) during their trials over the summer months, because it seems both up to date and well developed.
- MuseScore is reported by UKAAF to be working on improving accessibility.
- Dancing Dots is improving some areas with bug fixes for GOODFEEL, reported by UKAAF
- PDFToMusic Pro (from the French company Myriad) which often does an excellent job of converting PDFs to MusicXML.
- Toccata (from the Australian company Pentronics) – which hasn’t been upgraded for some time.

2b) Online conversion tools – how effective are they?

Context: Several online tools exist allowing an agency (or an end-user) to search for, or upload, a file and request a downloadable digital music braille file. E.g. BrailleMUSE, FreeDots, Music21, DZB-MakeBraille (using hodder) etc.

Experience of online tools and resulting files?

Agencies did not tend to use online conversion tools very much, feeling they weren't up to the job for professional use, though some users said they were using them.

DZB-MakeBraille (using Hodder) produces Braille from capx and MusicXML files, and is being trialled at Dedicon over the summer of 2018 and they will be able to report their experiences later in the year.

BrailleMUSE and MuseScore was mentioned by a couple of user and agency members, with varying degrees of success, whereas Music21 was reported by one participant to be too inaccurate and requires programming knowledge.

UKAAF also suggested that FreeDots is useful for the very beginning of stages of learning about braille notation. These tools were reported to be working fairly well, but with bugs and some limitations.

File conversions reported included:

- PDFs in, returned as .BRF
- MusicXML in, returned as .BRF
- MusicXML in, returned as ASCII brl

One user said they would like to submit midi files and get BRF files out (and vice-versa).

[A point of clarification: Note that the terms ASCII braille and BRF or BRL file are all, almost synonymous, for practical purposes - they are often used interchangeably – see separate report from James Bowden regarding different braille file formats].

What is done with the returned files?

Files received from these online conversion services are reported to be embossed, or edited and/or reformatted as required, or read on a braille display. UKAAF reported that they usually go via a MusicXML file and end up with a .BRF or .DXB file (and .DXP for providing an annotated copy). If a beautifully formatted copy is wanted, then reformatting is necessary throughout; but if a braille display is used then nothing is done as format becomes irrelevant.

Two blind respondents said that they use their braille notetaker Pac Mate, or a PC to edit the braille scores, using Notepad or Duxbury. They do heavy editing if they are producing standard braille scores for distribution, but no editing is needed if they just keep the braille for personal study.

UKAAF and a couple of users reported that they would like to see improvements in these online tools such as: Much less intervention; Alignment of bars in bar-over-bar format; Variable number of bars per line; Side issue of regional variations; More accurate text translation; Identification of bar zero (incomplete bar at start of piece and incomplete bars within a piece) automatically; Different options with or without fingers, dynamics, layout (for example bar over bar); Better output of the layout of music braille.

Bookshare reported that they may consider an online conversion service for music braille files: “our initial deliverable is a ‘pass-through’ of the files that are added to the library, with appropriate social DRM to reflect the person requesting the download. Benetech may expand its conversion capabilities for music as it has done for books and periodicals, based on market needs and collaboration opportunities.”

2c) Layout/formatting differences – are conversions necessary?

Context: When users have access to increased numbers of music braille files, created following different country’s layout/formatting rules, we need to be sure that end-users can read them successfully. Getting a Unified Music Layout Standard may well be unnecessary and unachievable.

How easily can users use materials with different layouts?

Agencies reported that they felt that, with experience, clear Transcribers Notes, and as long as the “New International Manual of Braille Music Notation” (NIM) by Bettye Krolick is followed, most materials are universally readable.

However, they reported that it is not easy to convert from one layout to another, and for example, Bar-over-Bar format is hard to read by many German musicians especially when having to learn by heart. Also, if specific requirements have been incorporated into the transcription to suit a particular conductor/course/user the score may not be usable by another musician.

One agency reported that “The biggest problems between countries when it comes to braille music are printer tables (countries using some variation in ASCII characters for the same braille music-cell). This problem is solved by the UNICODE standard.” Another agreed and felt that minimum and consistent standards would help. One respondent reported that they had written conversion tools for their own use to convert between different character sets – these would need to be developed further to be used by others, but this could be done if desired.

Users themselves reported a range of difficulties reading files with other layouts. For experienced music braille users, it doesn’t appear to be a problem – they are adaptable and sufficiently experienced to manage. However, for newer users of music braille, who might still be learning from NIM, they said it takes extra time and effort to follow and comprehend, and they find it much harder work. It also might not be suitable for their purposes. They said it also makes it much harder when the music is also complex.

For example, one user said “It’s not that easy. It takes time to familiarise myself to a new layout, especially with significant differences such as bar by bar instead of phrase by phrase in vocal music” (this is likely to mean one line of measure followed by text; instead of section by section grouped by phrase). Whereas another user said “I am used to reading and to working with scores from different countries. No difficulties”.

What would help users follow a different layout?

Some users felt that clear Transcriber’s Notes which accurately describe the layout were sufficient to help them become familiar with a new layout, and commented that recent braille translations were mostly easier to read than old ones. Scores must be usable, not just readable, or they’re not really fit for purpose.

In addition, some users were more specific about the additional information they wanted to help them with a new format: Black dots on white background; Layout must include line and bar numbers and print page indicators if teaching sighted students; Choral scores must be laid out line by line; Rehearsal letters must come at the start of a new line and bars should not be split over a page break; Labelling of parts/hands.

What can we do to reduce the impact of country differences?

In addition to the 'New International Manual of Braille Music Notation' 1997 (NIM) (Krolick) where the main signs are set out, most countries should have documented their own music braille rules where they diverge from NIM, especially where a Braille Authority exists. The Braille Authority of North America (BANA) may be updating the BANA music book 2015 to include some topics not in NIM (but the status of this revision is unknown). The International Council on English Braille (ICEB) has recognised that this needs doing as an international activity and is working to that end.

If further work to update NIM and/or to further harmonize country music braille codes is underway that would help the sector enormously. In any case, these country rules could be incorporated into conversion tools to make conversions easier and more accurate. On this point DZB further commented that "The manual offers different possibilities of writing similar music. Hodder uses a subset of it. We tried to find a Braille notation that always looks equal – in any situation and that can be read by any user without problems. At the moment there is no contradiction to the manual. When updating the manual this could change. But: the notations that Hodder uses cannot/won't be changed: They are interrelated and interdependent. They have been harmonized and perfected over 15 years, and done in collaboration with 3 blind proofreaders/professionals." This indicates that we should not rush to modify anything without careful consideration of the impact on existing tools.

Dancing Dots suggested that "the 'Transcription Options' in GOODFEEL could allow three main formats: North American, UK and International; where country formats were stored and applied. Once the country format is applied, then if needed, further customization can be applied with individual checkboxes. For example: if a user chooses UK Format in GOODFEEL, they see braille clef signs, staff numbers at start of left-hand part, metronomic markings shown with the stem sign indicator, etc. If they choose North American format, they see no clef signs or staff numbers and metronomic marking is shown according to the international standard defined in the 1997 manual."

In addition to clear Transcribers Notes, it would be good to be able to use a common editable source file to produce music braille in different formats – based on country rules, and personal preferences (e.g. system by system, section by section, and bar over bar). Being able to make conversions between these formats would be helpful to agencies from different countries, or even for users undertaking different activities. Consistent meta data mark-up would also help.

Several agencies felt that having a USA to Rest of the World converter might be useful (e.g. Bar over Bar versus Section by Section); but several others commented that this might not be useful - with one stating "the philosophies of both formats are too different. A converter would force compromises of both formats which would lead to suboptimal braille music representations."

Instead, using a good source file (e.g. MusicXML) to create the new layout would be more effective, which allows both for personalisation as well as country-specific layouts.

2d) Development code - open-source or proprietary?

Context: Businesses selling conversion tools are typically developed as proprietary code. This usually has the advantage of being well documented and well supported by the developers, who can schedule new developments according to business need. On the other hand, various tools in use, including some online tools, are open-source, allowing everyone to access, develop and share their tools. Both types of development have advantages and disadvantages.

Is Open Source or proprietary development best for the future? What could you contribute to?

Most respondents felt that OpenSource would be the best way forward, so we can share everything we have in this small field of accessible media - but would accept anything that does the job properly. However, it was acknowledged that proprietary software typically has better updates and bug fixes, especially the OCR tools – which of course has a bigger mainstream market for sighted musicians. Several agencies volunteered their expertise of tool development, subject to shared funding being available: MTM; NLB (Java and xproc); Dedicon (“any tools currently in any of our production workflows - which for Braille Music might become BME2 and cappella/Hodder in the near future. Of course BME2, capella nor Hodder are open-source, so it is open how much knowledge we can gather and how much development contribution we can deliver on these tools”); and DZB (“capella-scan and capella - and if BME became open source could contribute there”).

Other agencies offered support with testing, developing requirements and specifications etc: SBS (for Libraries Tables for Text); UKAAF; and a user.

One agency stated that sustainability and continuity planning should be carefully considered – tools must continue to be available and developed even if a firm goes out of business (for any reason). In addition, upgrades should be ongoing so that tools don't stop working when other software gets upgraded (e.g Sibelius Speaking which is no longer supported).

Music21 (made at MIT) shared that “We have a roadmap for continuing the implementation of braille in music21 [OpenSource], but currently no programmers on the project; if there's anyone with Python development skills who is interested, please feel free to contact Michael Scott Cuthbert”:
cuthbert@mit.edu.

The principals of Dancing Dots Braille Music Technology, L.P., are open to discussing ways to build on the strong foundation of their 20 years of development of GOODFEEL to add whatever new capabilities will suit the requirements of a proposed shared repository of scores. Contact Bill McCann:
info@dancingdots.com.

One respondent in China has written an almost complete framework for the design and specification of a sophisticated music transcription package and is looking for interested parties to bring it to life – see
<http://www.brailleorch.org/en/about/>.

The developer of BrailleMUSE commented that whilst Open-Source sounds good, braille music translation programs often have important internal dependencies between modules, created by programmers with expertise in music braille notation and development, and proprietary software may be the only way to ensure high quality and stable developments. If additional staff were available, BrailleMUSE would also like to consider developing conversions from MusicXML into BMML.

2e) Single source file?

Context: Some agencies rely on a single source file to create multiple output formats, especially for literary braille, e.g. creating audio, large print, braille etc from a single source file. Is this also true for music braille, where large print/modified stave notation and music braille are created from a single file?

Do you need a single source file for music? And what do you use?

A few agencies said they did not need a single source file for music, as the way they create large print (modified stave) notation is done differently, or they do not get requests for large print music.

But a number of agencies said that a single source file would be helpful, cost effective and efficient in order to generate other versions as long as edits can be made for each version. Additionally, being able to produce other formats, such as audio versions, talking scores, and MP3 would also be desirable.

Several agencies are already using single source files to create multiple music file output:

- DZB reported that they use the capella file (capx) or MusicXML as their single source file for Hodder to create any kind of output;
- The Lighthouse Guild Music School, and Dancing Dots said that Lime notation files are their single source file which in GOODFEEL can create modified stave notation, as well as being used with Jaws speech output as a Talking Score, a braille score, and print score. Lime can already output to MIDI and MusicXML.
- Bookshare - every book in their collection is saved in DAISY as an initial file type, but now they automatically generate EPUB and DOCX files for each title, and may do something similar for music file types depending upon market needs.
- UKAAF – MuseScore, MusicXML
- Vision Australia – MusicXML with GOODFEEL and manual transcription
- Dedicon – would like to work with BMML because it can be used for music editing and also used for layout, reading or printing.

Improvements needed?

Agencies reported that improvements are of course, always needed. Especially as some agencies are using tools which have become too complex and outdated. And of course, a high quality MusicXML file is expected.

DZB reported that they develop checklists and tests to ensure that capx source files from Capella are media-neutral to produce any format.

Dancing Dots would like to improve GOODFEEL's Lime MusicXML export function which currently exports just the basics. They are also seeking funding to add DAISY export from Lime, making Lime a DAISY authoring tool.

BrailleMUSE has developed a commercial braille music editor BrailleScore; which converts a music score in MusicXML to braille music, and enables both visually impaired and sighted users to edit the one file with braille notation and/or staff notations. It also outputs MIDI and MusicXML. However, it is (currently) only supported in the Japanese language.

2f) Output suitable for refreshable braille displays

Context: With new displays coming into the market (e.g. Canute 360, Orbit 20), we will want the music braille output files from conversion tools to be suitable for those displays (e.g. PEF and BRF), or some refinements may be required in the conversion/layout tools to make the music braille file usable. Who can do these developments?

Do country differences disappear using a braille display?

No they do not disappear - most agencies felt that country differences would still be apparent when reading the file on a braille display, and some felt that music braille on a braille display may warrant its own kind of formatting. Tools would need to accommodate this - not just for line length, but also for bar by bar; bar over bar; and section by section formats. And ideally, the source file should allow us to output in different ways.

What is it like using music braille on a braille display?

Some users reported that reading music braille on a braille display in recent trials (e.g. of Orbit Reader 20, and Canute 360) requires a different way of working, but it has been possible to learn and study scores both for performance and for pleasure – both by students and by professional musicians.

The multi-line braille displays such as the Canute 360 offer some further advantages in being able to have more under your fingers at any time. Reading files from BrailleMUSE which had poor formatting on the braille display was no problem because the Orbit Reader 20 compresses spaces.

However, one felt that so much editing was required to make the file usable on a display meant that it wasn't more efficient than paper for them, and a teacher commented that it's quite hard to follow the student's playing if they're using a braille display rather than paper braille. It was also reported that braille displays make good page layout redundant and slow down the reading and learning process – because these helpful cues for paper braille ruin the flow of the digital music file.

One agency was careful to state that user requirements for music braille on a braille display must be carefully taken into account, depending on the user's age, ability, type of music and purpose for reading it. One layout will almost certainly not fit all these scenarios. They suggest that there may even be a case for reintroducing Bar-By-Bar format as it is a regular structure of one left, one right in a linear fashion.

What outputs can your tools deliver for a braille display? Can you help with requirements?

Formatted braille files were commonly mentioned by respondents: PEF, BRF, DXB, as well as plain TXT files. GOODFEEL outputs .GF files, but as most hardware note-takers don't recognise this file, they must be renamed to .BRF for them to be read as music braille, therefore Dancing Dots is seriously considering revising GOODFEEL to produce .BRF files directly.

Most agencies have had little, or no experience with music braille on braille displays yet, but many are keen to get involved and collaborate with the development of solutions.

Several agencies said they had expertise to help with the technical requirements for music braille on a braille display: MTM, Dedicon, NLB, UKAAF, Dancing Dots, Vision Australia.

2g) Musicians need to compose, edit their own music, and share it

Context: They need to do this for rehearsal/learning scores, and when studying and composing. What are the tools like from their perspective?

What tools do you use to create and edit your own music?

Users/their representatives reported a mixture of software tools:

- Music School: GOODFEEL suite; Plain text editor; personal note-taker; word processor.
- UKAAF: “Quick Windows Sequencer (QWS) and MuseScore. Braille Music Editor is a possibility. Using a sequencer is sometimes a quicker way to input the basic music and the sequencer may have a raft of tools not present in a score writer - such as invert, reverse, transpose, velocity adjust etc. However, there is then always an import stage to add musical dynamics, slurs, ornaments etc. QWS has been described as the best MIDI editor program for visually impaired users.”
- Dancing Dots: “Many intermediate to advanced music students use our accessible Lime notation editor to create, revise, and print out their music theory assignments, arrangements and compositions. I have used Lime myself to make print parts for sighted musicians to perform and a companion braille score for myself.”
- Vision Australia User: The Goodfeel suite, direct Braille.
- ONCE: BME2, MuseScore.
- User: Propellerheads Reason 10, with screen magnification, custom MIDI remote control and am looking at writing a basic MIDI editor in PHP.
- User: BME; it is very important for me, also in the process of learning music Braille.
- User: Lilypond in the past, and now Sibelius Ultimate.

When they needed to print it in ink print as well as in braille users reported using:

- Music School: Finale, Lime, LilyPond.
- UKAAF: MuseScore for print; GOODFEEL can be used to make a braille copy (note this way round).
- Dancing Dots: Lime and GOODFEEL.
- Vision Australia: I’ve not tried it, but my program of choice would be Braille Music Editor.
- User: I've previously used Finale but haven't needed to print music for quite a while.
- User: Finale, MuseScore.

Improvements needed?

Users themselves requested improvements such as: better XML import and export; accessibility improvements (some being made in MuseScore already); for GOODFEEL - a more versatile and responsive feedback script i.e. how many systems in each print pages, delineation between stem up/stem down and other details such as placing instructions which relate to a certain passage. BME2 was reported to need accessible 'Help' and 'Cut and Paste' commands, to be able to open text files, and a working braille keyboard.

One respondent reports having seen one or two products for conversion of braille to print music but is yet to be able to do this effectively and reliably. They would like to be able to write music braille and produce accurate print music from this but they have concerns about the accuracy of the printed music output.

Dancing Dots reported that they have made a start at adding automatic formatting of the print score in GOODFEEL to prevent score annotations from colliding with each other, and at giving visually impaired users a certain amount of options for where certain annotations are placed relative to their associated note. Both of these are relatively new features which need improvement.

One user said they would like MuseScore also to produce music braille (like IBOS), but they currently find IBOS almost useless in braille because it shows chords as strings of notes and shows each chord in a random order. Another user who writes their own tools reported that they were looking at writing a web user interface for Reason to give parameter feedback and a guide to MIDI remote controls of selected virtual devices in the virtual rack.

One participant commented that there is also the specific problem of accessibility to stave music notation packages – whether with a screenreader or magnification tool – this would help blind musicians to use more software more easily.

The commercial Braille music editor, Braille Score, usable by both blind and sighted people, is currently only supported in the Japanese language.

How important is TTS (Text to Speech) in the tool?

Users almost all reported that TTS was crucial, or at least very important in their tools – for the interface as well as for spoken musical notation. Several users relied both on screen magnification as well as speech output, whereas others relied purely on the speech output. Speech (and sound/music) output was particularly liked by novice blind musicians to quickly navigate and learn to read and write music braille, as well as by more advanced users.

One user and one agency suggested that accessibility options should be built into standard music notation software (e.g. Sibelius, Finale, Capella, MuseScore), so that blind musicians could read and write music directly in the standard tools which are versatile, regularly updated, and have longstanding mainstream audiences. The accessibility developers should maintain close cooperation with the mainstream developers.

Dancing Dots reported that a long time ago they wanted to allow users to choose the modality/modalities which allowed them to study a piece most effectively in GOODFEEL. They wanted to augment braille with musical playback, descriptive speech, magnification and special tracking features. They made their first version with the "Talking Score" feature in GOODFEEL back in 2002 and say they have improved it steadily ever since.

2h) How well can the tools cater for integrated literary and music braille files?

Context: In an integrated tool a file containing both literary and music braille should be easily handled.

How common is the need to create an integrated literary and music braille file? Improvements needed?

Very common – most respondents reported that almost all music contains text; whether it's a music text book, a vocal piece, an instrument piece, or something for analytical work. These are usually treated as a music braille file, but with text passages. Tools such as GOODFEEL have an optional integration with the Duxbury Braille Translator, so that both music and text can be handled appropriately in the same file by Lime and Duxbury respectively. Duxbury produces the single unified braille document containing both literary and music passages. This can even be done in Polish now.

Respondents were hopeful of future improvements: that a suite of tools would handle mixed text and music files automatically and with little expertise required from the user; reliable OCR software which does both text and music perfectly to create a good source file; be able to import XML into a tool with semi-automated conversions of the music scores, with the ability to export content into a braille conversion tool. Also a tool which can reliably handle text, vocal, orchestral scores, and the different source file types; getting good quality source files (e.g. not PDF with the music stored as an image); and GOODFEEL to be updated to the latest version of JAWS.

3. We need good access to existing intermediary files

3a) Implementation of the Marrakesh Treaty

Context: Some countries (e.g. Israel) have already implemented the Marrakesh Treaty into legislation, but other countries are further behind.

Timeframe, impact?

Several countries reported that they had already ratified the Treaty: Canada, Australia and Israel. In Europe, the EU Commission ratified the Treaty in February 2018, and it will take effect automatically 12 months later. The UK Government is running a consultation on the implementation of the Treaty, which comes into force in Europe on 12 October 2018 (see <https://www.gov.uk/government/consultations/uk-implementation-of-the-marrakesh-treaty>). Other countries (USA, Switzerland and Norway) guessed at implementation in late 2018/early 2019.

Several agencies reported that they already participate in various international file-sharing initiatives, and that the Treaty would serve to increase their reach to other signatories. Others were more uncertain about whether the Treaty would affect current arrangements, and identified that some publishers still needed to be engaged/persuaded. One agency had seen commercial opportunities opening up in certain markets and is actively pursuing those in order to free up more funds to further their public cause.

Bookshare shared the good news that “Our copyright exception has not enabled us to support music in the past, but with the ratification of the Marrakesh Treaty, Bookshare will be able to support publisher’s flows, volunteer- or local library uploads for music scores, plus distribution rights to qualified members.”

3b) File formats for file sharing between trusted intermediaries

Context: Many agencies are keen to share music braille files – both those they create, and those created by others. Some agencies may have a business reason why they do not wish to (or cannot) share their files without financial recompense, but once the Marrakesh Treaty comes into force in each of the signatory countries, there should at least be no legal/copyright reason why intermediary files cannot easily be shared between trusted parties. The ABC Global Library (formerly TIGAR) is used by many agencies, but direct arrangements between individual agencies are also very common.

File sharing opportunities

When asked whether they would want files from other agencies, 10 out of 11 respondents said they would, and one said they were considering it. All 11 said that their files were also likely to be of interest to other agencies.

Two agencies said they were likely to make their files available as PEF, five reported BRL, one stated plain TXT, and one mentioned Duxbury files. One agency suggested that a common Unicode file standard might be preferable.

The UK reported that some of their files are signposted on RNIB Bookshare (which cannot currently take BRF files, and others are hosted on MuseScore. Many agencies said that they would make files available to partners in the ABC Global Library, and those they have direct exchange agreements with.

A few agencies said they could make their files available anywhere where licences permit, one said just within the European Union, and another would share with those who have ratified the Marrakesh Treaty. BrailleMUSE also has over a thousand music braille titles available to download already.

Several agencies felt that they would continue to share their files directly to other agencies on request, or via their own online catalogue, or via exam boards, whereas others mentioned using ABC Global Library and Bookshare. Some agencies have already ingested each other's catalogues – e.g. SBS and ONCE have exchanged their music braille file collections with each other incorporating metadata into their own catalogues.

Bookshare will offer a direct-to-consumer online library that allows qualified members to discover and access musical or literary works, and would “like to encourage members and volunteers to correct or contribute scores to the collection, so that they could be shared with others (with attribution, of course!). We would like to be able to offer workflows for sharing scores, just as we have for volunteers who want to share accessible books, including attribution for the source of the score.”

For different collections there may be differences as to whether the files are available for download from the online catalogue, or merely for searching, followed by a request to the originating agency for a copy. One user-producer already makes their files available for download for free for blind musicians on their website <http://www.brailleorch.org/en/about/>.

Agencies are keen to progress file-sharing to increase the speed and availability of music braille, and most had no reservations. However a few agencies had concerns: that they were only allowed to file-share to catalogues specifically for blind or low-vision users; that some transcription work had been financed with specific restrictions on sharing; that security measures needed to guarantee commitment with the publishers; and not being able to meet high demands for music files generated by an online catalogue.

3c) Metadata standards

Context: Specific information will be required to undertake an effective search for a music braille file, however the file came into existence.

Should we agree minimum standards? What should they be?

Agencies were unanimous that we should agree minimum standards for metadata to ensure effective search and retrieval by end-users/end-user agencies. And indeed, that we need to be able to share metadata successfully between agencies. However, various data formats already exist for these materials, and the completeness of any agreed metadata will make the biggest difference. At the present time, metadata is not consistent across collections, and there are often gaps in metadata (e.g. about format), which impedes successful searches.

Seven agencies gave specific suggestions for the metadata needed for music braille files, and there was a range of levels of detail proposed. With increasingly complex metadata comes the risk of incomplete records; but simple metadata might not provide effective retrieval of a piece.

Suggestions included:

- Title, Composer, Instrument, Genre.
- Minimum DC; full cataloguing record in MARC.
- ISBN if available, Name of score, Author of original music, Producing music party if a specific performance. If there is some sort of international music category classification that would be helpful to implement as well.
- Title, Compiler, Arranger, Author, Editor, Composer, Publisher, Publisher information, Edition, ISBN, ISMN, Key, braille page size, braille format, number of pages, volumes, language, braille code used, accurate listing of contents (for collections of pieces).
- Composer, Title, Subtitle, Publisher, Indication if only a part of the Inkprint score is brailled, Braille-format such bar over bar, sections.
- Title, composer, subject headings – particularly the specific voice/s or instrument/s. The publisher information can be useful, but often isn't available for older records.
- Bookshare's proposed metadata for musical scores is currently: Title, Subtitle, Composer, Lyricist, Copyright, Creation Date, Arranger, Instruments, Source, Translator, Movement Number, Movement Title, Work Title, Work Number, Part Name, Format Type (bar by bar, bar over bar, etc.).

In addition, Bookshare raised some interesting questions relating to the metadata of any corrected versions of files stored in a collection – if an existing score is corrected and a newer version is uploaded to the collection, should the original be replaced by an improved version, or should all versions exist? Should users be notified if one of their downloaded files has a corrected/new version available? Bookshare would like to know how frequently this kind of correcting and uploading situation might be.

3d) Online library records vs online repository

Context: There are various ways to access existing files: downloaded from a central file repository; sourced from an agency via a central online catalogue; or from an agency via their own searchable library records and archive. Several projects are underway to include music braille files in online collections, e.g. ABC Global Book Service, Bookshare, NLS, OpenScore.

What do you know about them? Which might you join?

Some agencies didn't know the specifics of the NLS, Bookshare and OpenScore collections, or were just starting to consider them, so couldn't comment on those. But agencies felt that they would like more linking of directories of resources, and perhaps a common database, and an easy way of getting scores from different libraries.

Online catalogues (such as ABC Global Library) were generally considered to be a good one-stop shop for agency members – where a single search produces results from many global sources making selection much easier and faster. Searching a particular agency's catalogue serves organisations with exchange agreements with that agency. Delivery of files is easy once permissions have been acquired, and acquiring files from another country that has ratified the Marrakesh Treaty is quick and easy.

It wasn't clear whether files would be available for download from these types of collections, and/or whether the system would handle file requests between the agencies. Data ownership issues was mentioned by one agency as a possible concern for online collections.

Bookshare has a global reach and supports direct-to-consumer downloads – where qualified Bookshare members, or patrons of the Bookshare Private Libraries will be able to search metadata of the music scores alongside their searches for books and periodicals. It will also be interesting to know whether blind end-users will have access to some/all of these collections, or only agencies.

3e) Searching for scores online yourself

Context: Blind musicians often successfully locate a digital music file from publishers or online collections, and can also have it transcribed using online services. Some agencies also use these services, e.g. BrailleMUSE, OpenScore etc.

What do you use? What do you do with the files you get? Improvements?

One agency responded that “Online services provide an additional useful resource, [and] there is plenty of opportunity for their improvement. OpenScore promises to be a potentially very useful resource but has not taken off as much as hoped. Online searching for music is an avenue which could be used more. Searching needs to be quick and accessible using speech and not cut into already stretched learning/practice time. The possibility of obtaining files from international sources is clearly helpful.”

End-users reported using a variety of online catalogues to try to find files themselves: NLS, RNIB, Golden Chord, BrailleMUSE, DZB’s DaCapo, MusicXML catalogues, and for public domain print music IMSLP. Some users only ever requested files via their national agency (e.g. RNIB, SBS, Vision Australia) from whom they said they got a very good service, and would wish to see these services maintained.

When they receive their files, several users reported using MuseScore, Lime and GOODFEEL, Ebrai, Duxbury, and sometimes a braille display to read the braille files and edit them in a text editor.

End-users reported they would like a greater selection of music, and more accurate metadata from some services. Also, they’d like more downloadable scores, more MusicXML files available, format standardisation and more flexible formats through programming. One user reported that they’d “like to make a more open, more comprehensive list which is based on the public domain projects such as the public domain sheet music sites such as CPDL or IMSLP”. Another said they would like to see “free user contributed based music braille download in standard BRF format for use with Canute or other braille displays (much like the free user contributed MIDI music download sites)”.

3f) Digitised archive files

Context: Some agencies are digitising their hard-copy music braille collections into a digital format, e.g. NLS.

Process/tools? Progress?

Several agencies reported that their entire collection is already digital/digitised (e.g. MTM, Music School, SBS), and others are in the process of digitising some/all of their collections (e.g. NLS, CNIB, ONCE, Vision Australia). Some have accepted that they are unlikely to digitise all their older hard-copy collection, but are ensuring that their new productions are all digital (e.g. NLB).

In terms of the tools being used for digitising collections:

- NLS is using the DotScan Scanner with proprietary software; and a flatbed scanner with OBR Software. See blogs mentioned in this blog: <https://blogs.loc.gov/nls-music-notes/2018/04/digitizing-braille-music-2018/>. They report that their process has room for improvement, and a great deal of proofreading is currently needed.
- Dedicon currently produces materials manually, then uses BME, and embosses. They report that they get good quality materials, but it is very time-intensive, and therefore the number of productions is low. They are currently trialling for future production: scanning with capella, editing with capella, converting with Hodder, embossing. Or, could fall back to: manual, BME2, emboss.
- The Music School is using GOODFEEL and Finale, and report that this process is working very well.
- Vision Australia is comparing the several thousand files currently stored with titles in the collection in hard copy only. Then, updating records matching the files to current cataloguing standards and uploading the files to their Storage Area Network. From here the titles can be downloaded or embossed. Cataloguing pieces with a file but no current record, and then uploading the files. Duxbury Braille Translation software is used to confirm the metadata in the files. They reported that approximately half of the available files have been checked and uploaded.
- ONCE is using braille to braille scanner on a small scale.

Advice for others?

Agencies had various pieces of advice for other agencies considering digitising their collections:

- Bookshare highlighted the benefits of free distribution once you have digital works.
- Dedicon advises “ideally you want to prepare your collection to have decent enough quality to be digitized, and enhance the quality of the digitized pictures before ‘feeding’ them to your converter. So darken any greyed out music files, smooth out any creases (or make copies onto new sheets) before digitizing, enhance notes and lines after digitizing that might be not clear enough, etc. If you just ‘scan and feed’ the amount of errors after converting will be much higher. And spotting and correcting mistakes after converting is much more time consuming as preventing them from arising. Convert to BMML format or any other that is the result of your digitized production process in order to use the same source files for further cataloguing.”
- The Music School advises to purchase GOODFEEL.
- SBS advises not to throw away the source.
- NLB advises to buy the services externally (they do not do in-house music braille production).
- UKAAF advises to consider the benefits of re-transcribing the file from an original: it’s probably most useful to have an up-to-date score in a current format than an old score in an old format.
- DZB advises that error detection and prevention are crucial for any digitisation work.
- ONCE advises to make time for edits and corrections.

Worthwhile?

Digital files are obviously going to be more useful in the modern age than hard-copy masters – but many agencies felt that it wasn't necessarily always worthwhile to convert entire back-collections – as old editions may be out of date, old format, low quality, and some materials are rarely requested. Certainly materials that are in demand are worth having in digital format, as well as newly produced materials. Once the digital files exist, staff time is needed for uploading the files.

However, NLS report that they are looking for more efficient ways to digitise music braille with an output of more accurate and reliable .BRF files which they wish to provide as downloadable files to their patrons.

4. We need good teaching, learning and promotional resources

Context: Agencies are well-aware that the take-up demand for music braille services requires not only efficient production, but also resources to help musicians to learn to read music braille, and to know it exists, and so teachers can learn to teach music braille. Several agencies and European projects have prepared resources for teachers and end-users, although most acknowledged that more could be done to extend this reach – providing they can meet the increased demand for music braille that this might generate. This could be an area for later attention, or for another group to work on.

Are there sufficient resources to teach and learn music braille?

Many respondents felt that sadly, there were insufficient resources to teach and learn music braille - especially for the early stages of learning music (and music braille), and for those children integrated into mainstream schools and for those who wish to be learning at the same age as their sighted peers. Dedicon reported that they have produced new teaching resources in recent years. ONCE felt that resources for students might be sufficient, but there were fewer resources for adults.

One user mentioned that they didn't know which were the right resources for them to buy, and would like to be able to attend a teacher-led music class with music braille, online or close to their home town. Another said they would like to see remote teaching of music braille for new users, as well as for experienced music braille users.

Vision Australia felt that there were materials available - but the problem is a shortage of teachers of music braille. Similarly, CNIB reported their problem is a lack of existing music transcribers and a lack of interest in learning how to do it. UKAAF also reported that they would like to see more (and more confident) teachers of music with braille in the UK.

The New International Manual of Braille Music Notation (NIM), and the Introduction to Braille Music Transcription from the USA were mentioned as being useful for readers and transcribers, but in some countries, e.g. China, there are fewer resources. However, one user respondent has translated NIM into Chinese which has been published by their braille library last year.

Users also reported that while learning music braille it is important that you can write music braille correctly – and one said that Braille Music Editor (BME) could be a perfect tool for this – if it worked well enough.

It was reported that in addition to the existing teaching resources, teachers often have to design their own materials to suit the exact purpose of their lesson, and these may have less re-use potential. Resources were being updated (e.g. in the UK) for the Unified English Braille rules.

The Italian National Library for the Blind reported that in their experience a combination of different output makes a positive difference to the success of learning music braille – using paper, braille display, synthetic voice and sound – where redundant information makes learning more attractive and easier (and more flexible). Tools which permit this multi-modal presentation will be helpful, e.g. as in GOODFEEL.

They also commented that teaching music literacy must go hand-in-hand with braille literacy, and the use of technology gives new opportunities (e.g. ePub, distance learning, multi-media products), and suggested that we should focus our attention on promoting learning music to potential users who might not be familiar with accessible ways of learning, reading and creating it.

UKAAF suggested intensive camps to train teachers or students, with more active promotion campaigns, better resources and consultation to help improve the situation. Additionally, that teaching music braille needs to reflect the use of the Tonic sol-fa system as in the Colour Strings/Colour Flute methods. Furthermore, it should be less keyboard based and reflect the way music is taught on a variety of instruments.

It could be that there are sufficient resources available world-wide, but perhaps an ongoing collation and signposting of these resources (e.g. as on the ICEB website music page) with specific promotion to teachers and users would be valuable so that they know about available resources, and potential musicians are encouraged to become musically literate.

Dancing Dots reported three resources they have produced/become aware of in recent years to improve the teaching and learning of music braille using multi-modal formats:

1) Music Touch with the Talking Tactile Tablet

The initial content came from the Lesson Exercises volume of Part I of Richard Taesch's Introduction to Music for the Blind Student: A Course in Braille Music Reading (which Dancing Dots have published in print and braille for many years). The user places a specially prepared sheet of hardcopy braille on top of the Talking Tactile Tablet (TTT) hardware. The user responds to verbal cues by lightly pressing on a particular braille character. We have built a series of teaching and testing modules. We are seeking funding support to complete the last 10 percent of work needed to release this product.

Link to a brief video of Bill McCann using Music Touch:

[https://www.dropbox.com/s/2p0110zwsb2aj/Music Touch Overview.MOV?dl=0](https://www.dropbox.com/s/2p0110zwsb2aj/Music%20Touch%20Overview.MOV?dl=0)

2) Braille Musik from Handy Tech – potential for integration into GOODFEEL

Sigi Kipke and his engineers at Handy Tech have created Braille Musik which allows the user to hear the pitch of the braille music note he is reading with his finger. When one presses the right or left cursor arrow in Lime, it effectively does the same. That is, the current note sounds. But Braille Musik leverages Handy Tech's patented Active Tactile Control hardware that tracks the reading finger and triggers a MIDI synthesizer to play the correct pitch. Dancing Dots would like to make this ingenious device compatible with Lime and their existing access methods; they believe that Braille Musik has great potential as a teaching tool, and that separate apps might be developed to leverage that potential.

Link: <https://www.youtube.com/watch?v=GADsPfyYpuM>

3) TACK-TILES for Music

Low-tech teaching aid using jumbo braille dots mounted on blocks that fit onto a Lego-style board. Each block has the meaning of the braille character printed on the side for sighted teachers. For example: "DO, Half-note."

Link: <http://www.dancingdots.com/prodesc/tacktile.htm>

End
