Requirements for an interactive user tool for music braille conversion: from the DAISY Music Braille Project

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## References

* **Reference 1: Requirements document for professional music braille conversion tool:**“Findings from the DAISY Music Braille Conversion Tool Requirements Survey.” 2019. at <https://dl.daisy.org/Findings_from_the_DAISY_Music_Braille_Conversion_Tool_Requirements_Survey_15.4.2019.docx>
* **Reference 2: Requirements survey for interactive user tool for music braille:**“Requirements Capture for Interactive User Tools for Music Braille.” 2020.
at
<https://dl.daisy.org/projects/musicbraille/Interactive_User_Tool_Requirements-Capture_DAISY_Music_Project_03.12.2019.docx>

# Executive Summary

The DAISY Music Braille Project has a primary objective of supporting the development of a sustainable software tool, or tools, which enable rapid and accurate conversion of digital scores in MusicXML format, into embossable music braille scores. The requirements for this kind of tool, primarily to be used by professional transcribers, have previously been identified, prioritized and published (*Reference 1*).

The Project also recognizes that blind musicians themselves also need tools for writing, reading, exploring and manipulating music in accessible ways, such as through musical sounds, synthetic speech, embossed and refreshable braille, and in ink print.

A second objective of the Project is therefore to identify, prioritize and publish requirements for an interactive user tool, which builds on the requirements of the ‘professional’ tool, adding interactive features and multimedia output. This report concerns the additional requirements needed in such a tool.

25 respondents took part, though the majority of features were rated by 19 people.

19 respondents (including 9 end-users, as well as music teachers, transcribers and other experts) from 19 countries and 10 organisations rated a list of interactive features needed in addition to the original requirements, and a further 6 very short responses were received, thus 25 respondents took part overall in some form.

In contrast to the original requirements survey, this time we proposed ratings for most features, allowing people to agree, or propose an alternative rating as Essential, Desirable, Nice to Have, or Not Needed.

The features were grouped into the following sections in the Requirements Document and survey, and this report follows the same order, though some sections had no additional requirements for an interactive user tool:

1. Accessibility and Usability
2. File Handling
3. Formatting/Layouts - No additional requirements for the interactive user tool.
4. Country Codes - No additional requirements for the interactive user tool.
5. Options
6. Conversion of Musical Symbols
7. Output
8. System Requirements
9. Business Arrangements
10. Note about Funding - No additional requirements for the interactive user tool.
11. Anything Else.

The small number of full responses received (19) plus 6 short responses, is clearly only indicative of the opinions of the sector and of individual blind musicians, but they do give some weight to the proposed priorities for development. Happily, half the respondents had multiple roles so were considering different points of view in their answers. Most features were rated by 19 respondents, giving credibility to the final rating.

The additional features for an interactive user tool in this report supplement those already documented for the professional tool which will also be needed in the user tool. Some of these features included things which might be considered obvious in an interactive music braille tool, such as the addition of auditory musical output, being able to step through the score in detail, and being able to enter music yourself for it to be converted into braille. However some proposed features gave more control and sophistication to these basic features – including for example making fine adjustments to the detail of the output, and allowing dynamic changes between braille and audio, and having versions of the tool which work on smartphones, or on braille notetaker devices.

There was general agreement about the basic essential features for an interactive user tool for music braille, with the implications of the more advanced/technical features being less-well understood, and the prioritized list of features reflects the highest priority requirements for such a tool.

There were fewer comments left in this survey compared to the original requirements survey. This is possibly because many of the features were quite technical/niche, or because we had already proposed a rating for each feature, so perhaps respondents felt there was less need to pass comment if they agreed. However, the report includes all comments received so that developers can appreciate the user needs for each feature.

The prioritised requirements are listed below, together with any other suggestions received from respondents in Section 11, and the rest of the report gives detail for each of these features individually. These ranked requirements are indicators of how a small cross-section of the music braille sector feels about future functionality in interactive user tools for music braille.

## An invitation to developers

We now invite developers to consider and respond to all these prioritised requirements (the original requirements and the additional requirements for the interactive user tool) giving their views on which features are easy/complex to build in their product, at what cost, in what timeframe, and which main target group or groups their product is most likely suited for.

## All prioritised requirements (summary list)

Requirements are all numbered. Requirements for the interactive user tool are prefixed UT (for ‘User Tool’) and written in green. The original requirements have no prefix. They are all collated into a single list here so there is a single requirements list for the interactive user tool. If you only want to read the user tool requirements on their own please refer to the *Appendix*.

For detail of the original requirements please refer to the original Requirements Document (*Reference 1*), and for detail of each of these additional requirements please refer to the main body of this report where each is described in more detail with respondents’ comments.

### 1. Accessibility and Usability

**Essential**

* 1.2 Blind people rate it as easy to use with at least one of the main screen-access solutions (e.g. Jaws, NVDA, SuperNova).
* 1.4 When navigating through the digital score, it supports: Select, Go To, and Browse Next-Previous, by: note, voice, stave, system, print line, and braille line.
* UT 1.1 When navigating through the musical score, it gives information in several levels, e.g. braille dots only, musical elements, or silent with only midi sounds for notes.

**Essential-Desirable**

* 1.3 The tool can be translated into other languages.

**Desirable-Essential**

* 1.1 Sighted users rate it as easy to learn and to use.

**Desirable**

* UT 1.2 The verbosity of whole categories of symbols can be adjusted (e.g. for all dynamics, for all articulations, for all notes).
* UT 1.3 A "play-along" function enables users to play the score by voice, part, bar or in different tempo, adjusting these options on-the-fly.

### 2. File handling

**Essential**

* 2.1 It can handle large files up to 100 MB.
* 2.2 It accepts the latest MusicXML or MNX input files, as well as older versions.
* 2.3 It can handle the full range of stave notation imports.
* UT 2.1 It handles and represents files in a fully accessible way, e.g. multimedia content such as print, braille, voice, midi…).

**Essential-Desirable**

* 2.4 It can accept a MusicXML file with an infinite number of parts, and the user should be able to select from any of those parts.
* 2.6 It is future-proof by allowing for the addition of agreed DAISY-defined new signs for special notation.
* 2.7 It accepts SMuFL specifications in the MusicXML file.
* 2.8 It allows users to specify the order of pieces in a volume, or over multiple volumes.
* 2.9 It can split a large file into several segments; and combine segments into a complete file/full score.

**Desirable-Essential**

* 2.5 It validates MusicXML/MNX input and provides automated or proposed corrections.

**Desirable**

* UT 2.2 Add agreed metadata into the created file before sharing with online collection.

**Nice to Have-Desirable**

* 2.11 It can save different revisions for comparison, or rolling back.

**Nice to Have**

* UT 2.3 Be able to control both source (including MusicXML/MNX and related images/sounds) and braille in one project.

### 3. Formatting/Layouts

**Essential**

* 3.1 Single Line.
* 3.2 Bar-Over-Bar, (with option for Line-Over Line).
* 3.3 Line-By-Line (Open Score).
* 3.4 Section-by-Section (with option for Stave-By-Stave).
* No additional requirements for the interactive user tool.

### 4. Country Codes

**Essential**

* 4.1 It can produce at least the main country codes: e.g. UK, USA, European *[to be specified].*

**Essential-Desirable**

* 4.2 It can handle multiple languages in one file.
* No additional requirements for the interactive user tool.

### 5. Options

**Essential**

* 5.1.1 Fingering (on/off)
* 5.1.6 Bar numbers (on/off)
* 5.1.9 Define interval direction (specified)
* 5.1.14 Repeat handling (specified)
* 5.5 It can transcribe according to specific instrument types, so that the same symbol can be transcribed to appropriate braille equivalents.
* UT 5.1 It can automatically or manually categorize texts and do additional braille formatting.
* UTs 5.3/5.4/5.5/5.6/5.7/5.9: Options for in-accords, moving notes, choir music handling, interval signs, lyrics, embellishments, dynamics, tempo, prefixes for shaped notes, nuances, ornaments, chord symbols, accents, sixteenth groupings, fingering, pitch, octave, duration.

**Essential - Desirable**

* 5.1 The tool permits options to show/hide features in particular layouts to suit different user needs, e.g. for learners, or those learning the score in a particular way
* 5.1.2 Print line numbers (on/off)
* 5.1.4 Position of braille page number (specified)
* 5.1.8 Print page numbers (on/off)
* 5.1.12 Paper size (specified)
* 5.1.13 Doubling convention (specified)
* 5.1.15 Transpose a single part/voice (specified)
* 5.1.16 Rehearsal letters (on/off)
* 5.1.18 Octave signs at the start of each line (on/off)
* 5.1.19 Lyrics (contracted/uncontracted)
* 5.1.20 Braille page number (on/off)
* 5.4 When editing, it can automatically move objects in a braille staff or system, like modifying texts in MS Word or Duxbury Braille Translator.
* UT 5.2: It can redefine and restart print/braille page numbers and bar numbers.

**Desirable - Essential**

* 5.1.7 Bar number location (side/top)
* 5.1.10 Indentation (specified)
* 5.1.11 Hide empty staves (on/off)
* 5.1.17 Position of rehearsal letters (specified)
* 5.2 User profiles (configurations and definitions) can be saved for users with different requirements.
* 5.3 It can provide dynamic on-screen visual and braille music notation.

**Desirable**

* UT 5.8 Switching between interfaces in different languages
* UT 5.10 For a song with several verses with the same melody, have on/off option for writing out the print music repeat…

**Desirable - Nice to Have**

* 5.1.3 Position of print page number (specified)
* 5.1.21 Running header (on/off)

### 6. Conversion of Musical Symbols

**Essential**

* 6.1 Accents are correctly converted, according to NIM and MBC.
* 6.2 Supports both types of breath marks, according to NIM and MBC.
* 6.3 Chord symbols are accurately translated according to NIM and MBC.
* 6.4 It presents clefs accurately, according to NIM and MBC.
* 6.5 It converts dynamics appropriately, whether written as symbols or words, or combinations, following NIM and MBC.
* 6.6 It converts fingering for keyboard, string instruments (right and left hands) appropriately, according to NIM and MBC.
* 6.7 Markings for strings are correctly translated according to NIM and MBC.
* 6.8 Grouping/beaming of notes is converted correctly according to NIM and MBC rules.
* 6.9 In-accord signs are handled correctly, following NIM and MBC for various situations.
* 6.11 Long and short-value signs are presented, and whether a bar in 4/4 begins with a semiquaver, following NIM and MBC rules.
* 6.12 Vocal music conversions confirm to NIM and MBC.
* 6.13 Unison signs are correctly used, showing two or more parts on the same note.
* 6.14 Tremolos are translated appropriately, as per NIM and MBC. E.g. repetition, alternation and doubling of note repetition signs.
* 6.15 Time signatures are correctly translated, even if they are not numeric.
* 6.16 Ties are presented so they are distinguishable from each other: single note, chord tie, accumulating tie/arpeggios.
* 6.17 It can present stem signs.
* 6.18 Different kinds of slurs are presented accurately.
* 6.20 Ornaments are correctly translated, following NIM and MBC rules.
* 6.21 Octave signs are correctly presented following NIM and MBC rules.
* 6.22 Nuances are correctly presented.
* 6.27 It combines musical symbols in the right order.
* 6.28 Multiple Bars' rest are presented in a compact manner, following NIM and MBC rules.
* 6.29 It handles bars appropriately…
* 11.12 *From an end-user*: Good support for percussion notation is 1. Essential because there are lots of percussionists out there.
* UT 6.1 Essential to have correct braille code within word expressions in the music.

**Essential-Desirable**

* 6.10 Instrument names are correctly presented according to language, and where instrument names change within a single part, the translation is correct.
* 6.19 Prefixes for shaped notes are correctly translated according to the most usual symbols.
* 6.23 It can present Tablature (notation indicating instrument fingering rather than musical pitches) following the agreed specification.
* 6.25 It can present Figured Bass following NIM rules.
* 6.26 In ensemble scores, it can control part names flexibly…

**Nice to Have**

* 11.15 *From a transcriber and developer:* Defining tabular notation this is nice for guitar music, nice to have.

### 7. Output

**Essential**

* 7.1 Conversion generates an e.g. >80% error-free success rate when an agreed range of samples is tested *[to be specified]*
* 7.2 It either: generates output which can be compiled in a braille editor as part of a production workflow; or can handle mixed text-music files entirely.
* 7.3 It can output the full range of stave notation (single line, vocal (including multi-voice), keyboard, full score, lead sheet, continuo part, all standard instrument-specific articulation and other techniques).
* 7.4 It can extract parts from, e.g. chamber music or orchestral scores.
* 7.5 Outputs a file suitable for embossing (e.g. BRF, BRL (text file) format).
* 7.7 Outputs an eBraille/Text file [in BRL text format] for use on a refreshable braille display.
* 7.10 It notifies the user of conversion progress, success or failure.
* UT 7.5 MIDI playback to allow users to check their work by listening.

**Essential-Desirable**

* 7.8 Outputs a printable file of stave notation.
* UT 7.2 and 7.3 Use Unicode braille.

**Desirable-Essential**

* 7.6 It can reformat Bar-Over-Bar material using different braille page sizes [to be defined].

**Desirable-Nice to Have**

* UT 7.4 Generate and play the sound-representation of each musical event in parallel with the Braille representation.
* UT 7.1 Make dynamic conversions in real time depending on the needs of the user, which will change during use of the score.

**No Ranking**

* 7.9 When using a publisher’s master file, it disables hard-copy printing, only displaying stave notation on-screen.

### 8. System Requirements

**Essential**

* 8.2 It must be programmed in such a way that it can be further developed.
* UT 8.1: Must have built-in screen-access, or work with a low-cost/free screenreader.

**Desirable-Essential**

* UT 8.2 It can be installed (or at least used) on both regular computers and the most popular braille notetakers.

**Desirable**

* UT 8.4 The program should be portable to all (PC/Mac/Android...) platforms.

**Nice to Have**

* UT 8.3: It can also be installed (or at least used) on a mobile device running Apple or Android.

**Not ranked**

* 8.1 If installed locally, it must work with XX technology, and uses no more than 2GB RAM even for the most complex files. *[minimum specification to be defined].*

### 9. Business Arrangements

**Essential**

* 9.4 Operate a system for reporting bugs, issues and requests, and for sharing updates on implementation.
* UT 9.3 Documentation should be available in a range of accessible formats
* UT 9.4 Feedback, because things do not get better without feedback.
* UT 9.6 Clearly document the system.

**Essential-Desirable**

* 9.1 Annual service level agreement available to secure fixes and support *[define an acceptable response time for support questions]*
* 9.3 Offer the service for a minimum term, e.g. 5 years *[to be defined].*
* UT 9.1 Be available both as a trial version (as for example a 30-day-demo) and as a full version.

**Desirable-Essential**

* 9.2 If server-based, provide built-in redundancy for server failure/recovery to minimise downtime *[define acceptable downtime]*

**Desirable**

* UT 9.2 Have a cut down version without so many options for beginner users…

### 10. Note about Funding

**Essential-Desirable**

* 10.1 The sector should aim to secure the future of a tool, or tools, which together support both agency production as well as education.
* No additional requirements for the interactive user tool.

### 11. Anything else?

**Essential**

* UT 11.1 Ability to enter 6-key braille music from the keyboard
* UT 11.2 Contribute to/promote the accessibility features of mainstream user interactive software like MuseScore
* UT 11.3 Option to make notes and annotations
* UT 11.4 Make the product Open Source

**Desirable**

* UT 11.5 Ability to output as MusicXML
* UT 11.6 Ability to over-ride default choices where a passage can be transcribed in different ways.
* UT 11.7 Ability to select the language(s) for lyrics
* UT 11.8 Ability to add/edit new parts and instruments, and adjust the reading key, transposition etc.
* UT 11.9 Ability to convert and present the score for low-vision musicians
* UT 11.10 Ability to back-translate from braille to generate print output.

**Nice to have**

* UT 11.11 Options for placement of asterisked explanations
* UT 11.12 Option to re-group notes according to their own insights.
* UT 11.13 Ability to enter notes through a MIDI keyboard
* UT 11.14 Provide/link to a score overview summary tool

# Introduction

## Vision

Blind braille-reading musicians enjoy timely and affordable access to increased numbers of accurate music braille scores in hard-copy and digital formats produced by effective and reliable conversion tools.

Additionally, blind musicians themselves have effective ways to convert, listen, explore, learn, edit and output music scores independently and in multi-media ways, with powerful, flexible and easy-to-use interactive tools.

## Mission

Through collaboration, we wish to achieve greater automation for music braille production, not just in production houses but also for personal use and for music education.

Compared with the features needed in tools for agency production of music braille, interactive user tools for music braille must include greater interactivity and flexibility for exploring and customizing music in accessible ways. However, just like the tools needed by agencies, these user tools also need improvements. These interactive tools can be used by blind students, amateur and professional musicians, blind transcribers, and sighted people supporting them.

In addition to securing at least one sustainable music braille production tool which is already underway, we also hope to secure the further development of at least one sustainable interactive user tool. This kind of tool will provided blind musicians with a user-friendly and effective experience of converting, reading, exploring, editing and outputting music scores in braille as well as in multi-media ways: through sound, synthetic speech, embossed and refreshable braille, and in ink print. Transcribers will be able to use the same tool to control the braille output required by blind students/musicians to maximise their learning and reading experience.

The tool will be supported by a robust business plan with a financial plan in place to ensure its sustainability (e.g. for at least 5 years) as well as providing support and maintenance services.

## Description of intended user

It is expected that the primary users of the interactive music braille tool(s) will include blind learners just starting to learn music through braille, as well as more advanced blind music students, amateurs or professional musicians. The user may also be a blind or sighted music teacher or transcriber preparing music for their students or performers, and receiving music from them. Users will therefore have a range of knowledge of music terminology and music braille, from very limited to proficient. They may be users of screen-access technology. The resulting tool should accommodate all of these user types.

## The survey process

The Requirements Capture Document for interactive user tools for music braille (*Reference 2)* set out additional high-level functionality required compared to the professional tool for agencies It also reminded readers of the features already prioritized for the professional music braille conversion tool which will also apply to the interactive user tool. All these requirements were drawn from international surveys and Round Table meetings conducted by the DAISY Music Braille Project.

These features are those which agencies, transcribers, and end-users have reported that a user tool should do in future, to make the converted braille music scores not only accurate and reliable and suitable for sharing, but providing additional multimedia features which enable blind musicians themselves to create and access music scores in various ways.

This survey did not repeat functionality requirements which had already been prioritized by the sector in the original survey and published for the professional conversion tool (*Reference 1*). It only covered additional features which would be essential for an interactive user tool. It did, however, include any relevant suggestions received from the first requirements survey which had not previously been rated.

Note: these features were not intended to be a comprehensive list of all features that a tool should (and may already) provide; merely those which would help to shape the design and implementation of future features.

The Requirements survey (in MS Word format this time, not Survey Monkey as before) was circulated to the project mailing list (around 150 people); hosted on the project webpage, and promoted by other organisations where appropriate. One developer also circulated it to their expert user group, and one agency phoned a small number of their music braille users asking them a small selection of key questions from the survey.

We informed participants that the resulting prioritised Requirements would be shared with Developers, seeking their comments and estimates for pricing and timeframe for implementation.

## Prioritisation

In contrast to the original requirements survey, this time we proposed ratings for most features, allowing people to agree, or propose an alternative rating as Essential, Desirable, Nice to Have, Not Needed or No Opinion. This was felt to be a faster way for people to respond than asking them to rate every single question. Respondents could add a comment on each feature if they wished.

Some features had been proposed by respondents in the previous survey and had not been reviewed or rated by others, so were rated here for the first time. Respondents could also make proposals for any other features they would like to see in an interactive user tool in the final section.

If a respondent rated a feature as 0 No Opinion, or did not give a rating, it was counted as Skipped.

## Reference rule books

Throughout the document, reference may be made to two main rule books:

* NIM: New International Manual of Braille Music Notation, 1996
* MBC: Music Braille Code, Braille Authority of North America 2015

## The report structure and analysis method

### Order of the report

The main body of the report presents the results in the same order as asked in the Requirements survey. Each section starts with a list of features in ranked order, followed by details with ratings and comments for each feature. The report is written to be as accessible as possible.

### Differences in respondent ratings

For each feature, if there were any particular differences in ratings/respondent types (e.g. between ratings from organisations vs individuals; or from teachers vs end-users etc) this is highlighted. If no mention is made of any difference, ratings were spread across all respondent types.

### Anonymity

Where it is helpful to identify a specific responding agency they are named, but otherwise responses have been reported anonymously. Any feedback from developers commenting on what their particular product can do has been removed, ready for their formal response to these prioritised requirements.

### Number of responses to each feature

Respondents only completed questions where they had relevant experience or views, so not every question was answered by every participant. The total number responding to (and skipping) each feature is stated. Of the 31 features, most features received 19 ratings, with a range from 12 ratings (for 2 features) to 21 ratings (for 3 features).

### How ratings were calculated

Some features were rated in the same way by the majority of participants and where more than 50% of respondents gave the same rating, that determined the ranking of that feature.

For features which had a greater split of ratings where no single rating scored more than 50% or where it was very close to 50%, the ratings on either side were taken into consideration, to promote/demote the ranking; this meant that some features fell between Essential and Desirable and so on.

The final ranking is highlighted in yellow in the data table, and stated underneath together with the numbers giving each rating.

### Out of scope

Some of the features included in the original requirements and in the user tools requirements survey have now been deemed as out of scope, as they are not relevant to the development of the user tool:

* 2.10 Scores can be given encrypted copy protection.
* UT 7.6 Develop APIs for other transcription software to call the music transcription tool as a subprocess.
* UT 9.5 Need a database for scores produced, as world wide as possible.

# Respondents

25 people responded to the survey:

* 19 full responses were included in the analysis, with most people answering most, if not all questions. The numbers of exact responses received for each feature is given for clarity.
* We also received 6 very short responses from several individual blind musicians, who did not complete the whole survey, but if they gave ratings/answers/comments on specific features these are included.

Any feedback received about specific features of an existing tool were shared with the relevant developers privately.

## Respondent types

* 11 individual respondents gave their own personal views. Four of these indicated that they worked for an organisation.
* 8 official organisational responses were received (where staff had collated their responses into a single response, or a staff member/s had responded to the survey on behalf of their organisation)
* 6 very short responses from individual blind musicians were received, who had commented about just four features (UT 1,1, UT 1.3, UT 8.2, UT 9.2), and/or gave a few comments.

## Countries represented

* 19 countries were represented, with the following number of responses:
* Canada (1), France (1), Germany (1), Italy (1), Netherlands (3), New Zealand (2), Spain (1), UK (6), USA (2), Vietnam (1).

## Roles

Respondents were asked which of the following roles they had: Transcriber, end-user, music teacher, developer, other. Many had multiple roles, with the following numbers:

* 11 transcribers
* 9 end-users
* 8 music teachers
* 5 developers
* Other roles:
	+ musicologist
	+ research fellow
	+ conducting student
	+ accessibility coordinator
	+ composers
	+ arrangers
	+ computer scientist
	+ braille specialist.

9/19 respondents stated they had a single role, whereas 10 respondents reported having more than 1 role; six with 2 roles, and two each having 3 or 4 roles.

Despite some of these respondents being long-standing experts at teaching and/or using music braille, several commented that there were some technical requirements listed in this survey which were outside the scope of their expertise, so they could not rate/comment on all the features. Compared with the original requirements survey, very few comments were received for each of these features.

## Organisations responding

Responses came from 10 organisations worldwide, and those marked with \* stated that they were submitting an Organisational response; whereas others gave their organisational affiliation but stated they were responding as an Individual:

* \*Sao Mai Center for the Blind, Vietnam
* \*Blind and Low Vision Education Network, New Zealand
* RNIB, UK
* \*New College Worcester, UK
* Department of Media and Culture, Utrecht University , Netherlands
* \*CNIB, Canada
* \*Biblioteca Italiana per I Ciechi “Regina Margherita” – ONLUS, Italy
* \*Royal Dutch Visio Apeldoorn/Dedicon, Netherlands
* \*IRIT (Institut de Recherche en Informatique de Toulouse), France
* \*Dancing Dots, USA

# 1. Accessibility and Usability

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 1.2 Blind people rate it as easy to use with at least one of the main screen-access solutions (e.g. Jaws, NVDA, SuperNova).
* 1.4 When navigating through the digital score, it supports: Select, Go To, and Browse Next-Previous, by: note, voice, stave, system, print line, and braille line.
* UT 1.1 When navigating through the musical score, it gives information in several levels, e.g. braille dots only, musical elements, or silent with only midi sounds for notes.

**Essential-Desirable**

* 1.3 The tool can be translated into other languages.

**Desirable-Essential**

* 1.1 Sighted users rate it as easy to learn and to use.

**Desirable**

* UT 1.2 The verbosity of whole categories of symbols can be adjusted (e.g. for all dynamics, for all articulations, for all notes).
* UT 1.3 A "play-along" function enables users to play the score by voice, part, bar or in different tempo, adjusting these options on-the-fly.

## Features for interactive user tool in detail

### UT 1.1 When navigating through the musical score, it gives information in several levels, e.g. braille dots only, musical elements, or silent with only midi sounds for notes.

Why: To enable blind musicians to read, learn and explore the music score in various ways for different tasks.

Proposed Rating: 1 Essential.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 18 | 1 | 2 |  | 21 | 1 |

Essential: 18/21 agreed that this is an Essential feature, 1 Desirable, and 2 Nice to Have.

Comments: The verbosity of the navigation should be carefully considered, perhaps depending on the complexity of the music, and different information being conveyed by each output medium.

### UT 1.2 The verbosity of whole categories of symbols can be adjusted (e.g. for all dynamics, for all articulations, for all notes).

Why: New learners and proficient musicians require different amounts of verbal description (verbosity), and it is helpful to be able to apply global settings to groups of symbols at once.

Proposed priority: 2 Desirable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 6 | 11 | 1 |  | 18 | 1 |

Desirable: 11/18 agreed this is a Desirable feature, though 6 felt it should be Essential, 1 Nice to Have.

Comments: A couple of respondents felt that this was necessary as it could be very time-consuming to get the desired information if everything was shown for each note. Another commented that this could be a setting.

### UT 1.3 A "play-along" function enables users to play the score by voice, part, bar or in different tempo, adjusting these options on-the-fly.

Why: To turn the music score into a multi-track player or Karaoke machine, letting blind musicians perform along with the score or analyze the score quickly.

Proposed priority: 3 Nice to Have.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 6 | 7 | 7 | 1 | 21 | 1 |

Desirable: This didn’t receive a clear priority from respondents: with an even spread across all ratings: only 7/21 agreed with the proposed priority of Nice to Have, with a further 6 saying it was Essential, and another 7 saying it was Desirable, 1 felt it was Not Needed.

Comments: This was felt to be useful for various reasons, especially as it is already possible in most score-writing software, sequencers and DAWs (Digital Audio Workstations). Good for users who do not have advanced knowledge of music braille and could listen to and analyze the score while studying the braille symbols. Especially useful if it could do it by voice or part bar, for learning (especially if you can slow it down too), and to filter out mistakes in a multi-voice score. As a conductor it would be useful to be able to access the lyrics through a voice synthesizer. One respondent commented that this feature could be done with other software if it could not be done in the user tool itself.

# 2. File handling

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 2.1 It can handle large files up to 100 MB.
* 2.2 It accepts the latest MusicXML or MNX input files, as well as older versions.
* 2.3 It can handle the full range of stave notation imports.
* UT 2.1 It handles and represents files in a fully accessible way, e.g. multimedia content such as print, braille, voice, midi…).

**Essential-Desirable**

* 2.4 It can accept a MusicXML file with an infinite number of parts, and the user should be able to select from any of those parts.
* 2.6 It is future-proof by allowing for the addition of agreed DAISY-defined new signs for special notation.
* 2.7 It accepts SMuFL specifications in the MusicXML file.
* 2.8 It allows users to specify the order of pieces in a volume, or over multiple volumes.
* 2.9 It can split a large file into several segments; and combine segments into a complete file/full score.

**Desirable-Essential**

* 2.5 It validates MusicXML/MNX input and provides automated or proposed corrections.

**Desirable**

* UT 2.2 Add agreed metadata into the created file before sharing with online collection.

**Nice to Have-Desirable**

* 2.11 It can save different revisions for comparison, or rolling back.

**Nice to Have**

* UT 2.3 Be able to control both source (including MusicXML/MNX and related images/sounds) and braille in one project.

**Out of scope**

* 2.10 Scores can be given encrypted copy protection.

## Features for interactive user tool in detail

### UT 2.1 It handles and represents files in a fully accessible way, e.g. multimedia content such as print, braille, voice, midi…)

Why: To make the braille music scores and the software interactive, versatile and user friendly, capable of multi-media score representation and exploration.

Proposed priority: 1 Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 17 | 1 |  |  | 18 | 1 |

Essential: 17/18 agreed that this was an Essential feature, with 1 saying it was Desirable.

Comments: One music teacher said that this is essential for young learners working alongside classroom and private music teachers who have no knowledge of braille. The feature could be clarified as the ability to not only import and export files in appropriate formats, but also represent the music in various ways, such as displaying visual music and braille on-screen, playback of the score etc.

### UT 2.2 Add agreed metadata into the created file before sharing with online collection

Why: So files can be easily found when searching in online collections and the origins of the file clearly indicated.

Proposed priority: 2 Desirable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 2 | 14 | 2 | 1 | 19 |  |

Desirable: 14/19 agreed this was a Desirable feature, with two feeling it was Essential, two Nice to Have, and 1 feeling it was Not Needed.

Comments: This was not felt to be of relevance to an end-user themselves who wouldn’t want to include this data in the files they create, probably only needed for agencies or professional transcribers producing scores which could be re-used. The metadata would ease library management and cataloguing. One suggestion was to capture at least: ISMN number, Edition, Voice part(2), language used for the lyrics. It was also suggested to be useful if users want to manage their own scores, e.g. managing a playlist, sorted by title, composer, publisher, publication date or braille layout/format.

### UT 2.3 Be able to control both source (including MusicXML/MNX and related images/sounds) and braille in one project

Why: To ease data handling for both transcription, navigating, editing, feature definition and debugging.

Proposed Priority: 3 Nice to Have

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 3 | 2 | 12 | 1 | 18 | 1 |

Nice to Have: 12/18 agreed that this is a Nice to Have feature, though 3 felt it was Essential, 2 Desirable, and 1 felt it wasn’t needed.

Comments: One respondent felt that we should keep to standard file types, rather than inventing a new one, as people are already used to handling e.g. Word files, Duxbury files and braille files, so could do the same with these files. The feature could be clarified by saying that it would be an adapted format, not a brand new one – it was proposed to be an archive of files, rather than a new format.

# 3. Formatting/Layouts

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 3.1 Single Line.
* 3.2 Bar-Over-Bar, (with option for Line-Over Line).
* 3.3 Line-By-Line (Open Score).
* 3.4 Section-by-Section (with option for Stave-By-Stave).

No additional requirements for the interactive user tool.

# 4. Country Codes

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 4.1 It can produce at least the main country codes: e.g. UK, USA, European *[to be specified].*

**Essential-Desirable**

* 4.2 It can handle multiple languages in one file.

No additional requirements for the interactive user tool.

# 5. Options

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 5.1.1 Fingering (on/off)
* 5.1.6 Bar numbers (on/off)
* 5.1.9 Define interval direction (specified)
* 5.1.14 Repeat handling (specified)
* 5.5 It can transcribe according to specific instrument types, so that the same symbol can be transcribed to appropriate braille equivalents.
* UT 5.1 It can automatically or manually categorize texts and do additional braille formatting.
* UTs 5.3/5.4/5.5/5.6/5.7/5.9: Options for in-accords, moving notes, choir music handling, interval signs, lyrics, embellishments, dynamics, tempo, prefixes for shaped notes, nuances, ornaments, chord symbols, accents, sixteenth groupings, fingering, pitch, octave, duration.

**Essential - Desirable**

* 5.1 The tool permits options to show/hide features in particular layouts to suit different user needs, e.g. for learners, or those learning the score in a particular way
* 5.1.2 Print line numbers (on/off)
* 5.1.4 Position of braille page number (specified)
* 5.1.8 Print page numbers (on/off)
* 5.1.12 Paper size (specified)
* 5.1.13 Doubling convention (specified)
* 5.1.15 Transpose a single part/voice (specified)
* 5.1.16 Rehearsal letters (on/off)
* 5.1.18 Octave signs at the start of each line (on/off)
* 5.1.19 Lyrics (contracted/uncontracted)
* 5.1.20 Braille page number (on/off)
* 5.4 When editing, it can automatically move objects in a braille staff or system, like modifying texts in MS Word or Duxbury Braille Translator.
* UT 5.2: It can redefine and restart print/braille page numbers and bar numbers.

**Desirable - Essential**

* 5.1.7 Bar number location (side/top)
* 5.1.10 Indentation (specified)
* 5.1.11 Hide empty staves (on/off)
* 5.1.17 Position of rehearsal letters (specified)
* 5.2 User profiles (configurations and definitions) can be saved for users with different requirements.
* 5.3 It can provide dynamic on-screen visual and braille music notation.

**Desirable**

* UT 5.8 Switching between interfaces in different languages
* UT 5.10 For a song with several verses with the same melody, have on/off option for writing out the print music repeat…

**Desirable - Nice to Have**

* 5.1.3 Position of print page number (specified)
* 5.1.21 Running header (on/off)

## Features for interactive user tool in detail

### UT 5.1: It can automatically or manually categorize texts and do additional braille formatting

Why: To place or format texts in different types according to braille music convention. MNX has dedicated text categories, and MusicXML files which lack text categorization can also be marked (e.g. some tempo indications, titles of non-first movements, and stage directions, which are usually only labelled as <words>.

Proposed priority: 1 Essential.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 15 | 4 |  |  | 19 |  |

Essential: 15/19 agreed this is an Essential feature, with 4 stating it was Desirable.

Comments: Essential, so that the text has the correct meaning and is associated with the correct part of the score, so that the score makes sense. Two respondents commented that automated categorization might be Desirable/Nice to Have, rather than Essential. To clarify, the feature is designed to improve workflow for the user, where both automated and manual methods would be needed.

### UT 5.2: It can redefine and restart print/braille page numbers and bar numbers

Why: To deal with sources whose starting point is not at page 1 bar 1. This is often seen in score files split during engraving due to very different layout from section to section. The function enables blind users to get correct page and bar numbers, to communicate smoothly with their sighted teachers/peers.

Proposed priority: 2 Desirable.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 10 | 9 |  |  | 19 |  |

Essential-Desirable: 10/19 felt this was Essential, though 9 agreed it was Desirable.

Comments: Essential when, for example: there are Roman numeral print page numbers for prefatory matter, or unnumbered blank pages for some initial pages. Bar numbers may need re-setting for a second-time bar, or have to start at 0 for a partial bar etc. Essential as students referring to bar numbers in a score for examination purposes need it to be accurate and precise regardless of which version/format of the score is used because the examiner will use the version endorsed by the exam board. Essential for orchestral conductors/students when working with the orchestra – need bar numbers and Stage letters/numbers. One suggested that the tool should allow the possibility to renumber after automatically converting from the source material. Feature clarification: This feature would deal with source files with incorrect bar numbering, e.g. part of a piece with bar numbering starting from 1, or a score with pickup or uncounted cadenza bars not numbered as X’s (implicit measures).

### UT 5.3 Need settings for in-accords or moving notes, and options for choir music handling, options for e.g. interval signs but not lyrics *[from a music teacher and end-user]*

Proposed priority: 1 Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 12 | 5 | 1 |  | 18 | 1 |

Essential: 12/18 agreed this is an Essential feature, though 5 felt it was Desirable, and 1 Nice to Have.

Comments: Respondents weren’t entirely sure what this suggestion from a music teacher and end-user really meant, but it is assumed that it meant having options available for in-accord and moving notes since some vocal scores will show divided voices with equal rhythm pulse as intervals with moving signs (e.g., voice 1 half and voice 2 two slurred quarters), and to have options to show/hide other musical notation.

### UT 5.4 Embellishments; dynamics; tempo; prefixes for shaped notes; nuances; ornaments ... (on/off) *[from a transcriber and music teacher]*

Proposed priority: 1 Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 14 | 4 | 1 |  | 19 |  |

Essential: 14/19 Agreed this was Essential, though 4 felt it was Desirable, and 1 Nice to Have.

Comments: Respondents felt it was essential to have separate options for different parts, for example, when transcribing as ‘Accompaniment with Outline’ (at RNIB), or to support learners with different levels of braille music understanding, so you could have a very simplified score right up to a full score.

### UT 5.5 Chord symbols; accents; dynamics; sixteenth groupings - on/off for all those features *[from a transcriber, end-user, and music teacher]*

Proposed priority: 1 Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 16 | 3 |  |  | 19 |  |

Essential: 16/19 agreed this was an Essential feature, though 3 felt it was Desirable.

Comments: As for 5.4 above, separate options are needed for different parts , for example, when transcribing as ‘Accompaniment with Outline’ (at RNIB). These kinds of options make it possible to include as many score markings as possible to give equality with the printed score, but also to be able to customize the score for efficiency and ease of readability, but need to keep a usable options screen/interaction method. Supports learners with different levels of braille music understanding, so you could have a very simplified score right up to a full score. Feature clarification: the on/off for such elements should be global and selection-wide to fulfill requirements for either whole or part of a score. The on/off of note grouping is needed, e.g., to show full note values for beginners, then grouped for the same score to teach them how to do note grouping. Also, some groupings should be turned off when meeting certain irregular bars, or manually breaking a long tuplet into two braille lines.

### UT 5.6 Lots more options

e.g. show/hide clef signs, nuances, ornaments, dynamics/expressions - options to strip a score down right from the complete score, through to just the notes. Also: whether to show every bar number; how many bars are shown per section; whether the number sign (numeric indicator) is shown for bar numbers or not; what kind of slur sign is used (simple C, or phrase 56-B, or both)… [from a transcriber and end-user]

Proposed priority: 1 Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 16 | 2 | 1 |  | 19 |  |

Essential: 16/19 agreed this was Essential, though 2 felt it was Desirable, and 1 Nice to Have.

Comments: This was felt to be very similar to features 5.4 and 5.5 above – allowing the creation of full scores down to simplified scores. Being able to show/hide these features is particularly important for beginning readers so they can access scores without an overwhelming amount of information. Some music for exams is transcribed with every bar numbered, on a free line above the music (at RNIB). Customization should be possible whilst retaining usability.

### UT 5.7 Many other items to include in the section about fingering

for instance, slurs, ornaments, dynamics [from a transcriber, end-user, and music teacher]

Proposed priority: 1 Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 14 | 2 | 1 |  | 18 | 1 |

Essential: 14/18 agreed this is Essential, though 2 felt it was Desirable, 1 Nice to Have.

Comments: Similar to previous comments in this section.

### UT 5.8 Switching between interfaces in different languages

[from an end-user]

Proposed priority: 2 Desirable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 1 | 12 | 4 |  | 17 | 2 |

Desirable: 12/17 agreed this was a Desirable feature, though 1 felt it was Essential, and 4 felt it was Nice to Have.

Comments: It was recognised that making a tool which had more than one language for its interface would make it more attractive to more countries, and might make it easier to obtain funding. The tool should be built to permit this possibility, even if it can’t have more than one language at the start.

### UT 5.9 Options should permit production of a score of nothing but pitch, octave, and duration through facsimile score.

[from an end-user, developer, and music-teacher]

Proposed priority: 2 Desirable

Comments: This is repeating previous features in this section, and will be grouped with other features in Section UT 5.

### UT 5.10 For a song with several verses with the same melody, have on/off option for writing out the print music repeat.

[from a transcriber]

Proposed priority: 2 Desirable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 2 | 14 | 2 |  | 18 | 1 |

Desirable: 14/18 agreed this was Desirable, though 2 felt it was Essential, and 2 Nice to Have.

Comments: The ability to use repeat signs is essential for music braille. Being able to write repeats out in full is especially helpful when reading on an electronic device. A question was asked: when writing out the print music repeat how should variations in word-setting be handled – e.g. slurs which are only applicable in some verses? Answer: Different verses are numbered in the source, such as “lyric number=’1’”. The variations of slurring and syllabic association is provided in the source file as long as the score is well engraved, so this is not a problem.

# 6. Conversion of Musical Symbols

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 6.1 Accents are correctly converted, according to NIM and MBC.
* 6.2 Supports both types of breath marks, according to NIM and MBC.
* 6.3 Chord symbols are accurately translated according to NIM and MBC.
* 6.4 It presents clefs accurately, according to NIM and MBC.
* 6.5 It converts dynamics appropriately, whether written as symbols or words, or combinations, following NIM and MBC.
* 6.6 It converts fingering for keyboard, string instruments (right and left hands) appropriately, according to NIM and MBC.
* 6.7 Markings for strings are correctly translated according to NIM and MBC.
* 6.8 Grouping/beaming of notes is converted correctly according to NIM and MBC rules.
* 6.9 In-accord signs are handled correctly, following NIM and MBC for various situations.
* 6.11 Long and short-value signs are presented, and whether a bar in 4/4 begins with a semiquaver, following NIM and MBC rules.
* 6.12 Vocal music conversions confirm to NIM and MBC.
* 6.13 Unison signs are correctly used, showing two or more parts on the same note.
* 6.14 Tremolos are translated appropriately, as per NIM and MBC. E.g. repetition, alternation and doubling of note repetition signs.
* 6.15 Time signatures are correctly translated, even if they are not numeric.
* 6.16 Ties are presented so they are distinguishable from each other: single note, chord tie, accumulating tie/arpeggios.
* 6.17 It can present stem signs.
* 6.18 Different kinds of slurs are presented accurately.
* 6.20 Ornaments are correctly translated, following NIM and MBC rules.
* 6.21 Octave signs are correctly presented following NIM and MBC rules.
* 6.22 Nuances are correctly presented.
* 6.27 It combines musical symbols in the right order.
* 6.28 Multiple Bars' rest are presented in a compact manner, following NIM and MBC rules.
* 6.29 It handles bars appropriately…
* 11.12 *From an end-user*: Good support for percussion notation is 1. Essential because there are lots of percussionists out there.
* UT 6.1 Essential to have correct braille code within word expressions in the music.

**Essential-Desirable**

* 6.10 Instrument names are correctly presented according to language, and where instrument names change within a single part, the translation is correct.
* 6.19 Prefixes for shaped notes are correctly translated according to the most usual symbols.
* 6.23 It can present Tablature (notation indicating instrument fingering rather than musical pitches) following the agreed specification.
* 6.25 It can present Figured Bass following NIM rules.
* 6.26 In ensemble scores, it can control part names flexibly…

**Nice to Have**

* 11.15 *From a transcriber and developer:* Defining tabular notation this is nice for guitar music, nice to have.

## Features for interactive user tool in detail

### UT 6.1 Essential to have correct braille code within word expressions in the music .

(may well be different from the code used for lyrics in the same music.)

*[From a transcriber and end-user]*

Proposed priority: Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 13 | 1 | 2 |  | 16 | 3 |

Essential: 13/16 agreed this was an Essential feature, though 1 felt it was Desirable, and 2 Nice to Have.

Comments: One respondent explained why this is essential: the braille code for word expressions is different: e.g. brackets in UEB versus "special brackets"; e.g. contracted for lyrics and uncontracted for word expressions.

# 7. Output

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 7.1 Conversion generates an e.g. >80% error-free success rate when an agreed range of samples is tested *[to be specified]*
* 7.2 It either: generates output which can be compiled in a braille editor as part of a production workflow; or can handle mixed text-music files entirely.
* 7.3 It can output the full range of stave notation (single line, vocal (including multi-voice), keyboard, full score, lead sheet, continuo part, all standard instrument-specific articulation and other techniques).
* 7.4 It can extract parts from, e.g. chamber music or orchestral scores.
* 7.5 Outputs a file suitable for embossing (e.g. BRF, BRL (text file) format).
* 7.7 Outputs an eBraille/Text file [in BRL text format] for use on a refreshable braille display.
* 7.10 It notifies the user of conversion progress, success or failure.
* UT 7.5 MIDI playback to allow users to check their work by listening.

**Essential-Desirable**

* 7.8 Outputs a printable file of stave notation.
* UT 7.2 and 7.3 Use Unicode braille.

**Desirable-Essential**

* 7.6 It can reformat Bar-Over-Bar material using different braille page sizes [to be defined].

**Desirable-Nice to Have**

* UT 7.4 Generate and play the sound-representation of each musical event in parallel with the Braille representation.
* UT 7.1 Make dynamic conversions in real time depending on the needs of the user, which will change during use of the score.

**No Ranking**

* 7.9 When using a publisher’s master file, it disables hard-copy printing, only displaying stave notation on-screen.

**Out of Scope**

* UT 7.6 Develop APIs for other transcription software to call the music transcription tool as a subprocess.

## Features for interactive user tool in detail

### UT 7.1 Make dynamic conversions in real time depending on the needs of the user, which will change during use of the score.

*[From a developer*]

No proposed priority.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 2 | 7 | 4 | 1 | 14 | 5 |

Desirable-Nice to Have: 11/14 rated this as Desirable (7) or Nice to Have (4), 2 as Essential, and 1 Not Needed.

Comments: Most translation programs allow you to hit a button to translate, or see the translation in a window, so this would be useful. This would be a great addition for users to have the same capability to make personal notations on the score, for their own use, rehearsal reminders etc. Feature clarification: this refers to on-the-fly conversion of any changed or corrected notation, such as a change of note on the visual side, or a change of text category which may affect the layout of some braille lines. Sometimes adding a missing symbol not included in MusicXML will yield additional conversion and formatting of certain braille lines. This is what was meant by “dynamic conversion” (e.g. try the free literary braille translation software “BrailleBlaster”, enter and then modify some texts in the text window and see how the braille translation will be affected).

### UT 7.2 and 7.3 Uses Unicode braille.

To avoid, or better solve the different language codes.

*[From an end-user*]

No proposed priority.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 5 | 5 | 2 |  | 12 | 7 |

Essential-Desirable: 10/12 rated this as Essential (5) or Desirable (5), with 2 Nice to Have, though 7 did not rate the feature.

Comments: On respondent said that the output should be in a format like Unicode – unambiguous – in every country the same ‘What you see is what you get’. However, some respondents commented they did not know anything about Unicode and 7 skipped the question. One developer commented that in order to implement this, symbols would need to be proposed for music braille symbols. One asked how delivery of their 6-dot hard-copy braille would be affected by using Unicode braille? Another felt that this was only Nice to Have since they felt that Unicode braille has not really been widely adopted and most braille files are still in a local encoding (e.g. US computer code). Another said that although most braille notetakers do not support Unicode, it would be essential when working on the computer with a screenreader, and suggested a conversion from Unicode to ANSI would be helpful when using notetakers. However, another commented that Unicode braille has been implemented by certain software, and is proved to be the universal way of sharing braille materials among agencies and users around the world, to break the barrier of encoding differences, and when ASCII braille is needed, appropriate conversion tables will be used according to the user’s choice.

### UT 7.4 Generate and play the sound-representation of each musical event in parallel with the Braille representation.

*[From a developer*]

No proposed priority.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 5 | 5 | 6 |  | 16 | 3 |

Desirable-Nice to Have: Ratings were evenly split across respondents: 5/16 Essential, 5 Desirable, 6 Nice to Have.

Comments: Some felt that this would be really good for beginning readers as a tool to assimilate the musical meanings associated with each symbol (for those which have a sound!). One person commented that this could be hard to achieve unless the original score is accurately coded so the braille and sound are accurately linked. Some respondents said they had assumed the tool would have some kind of musical audio playback (e.g. MIDI).

### UT 7.5 MIDI playback to allow users to check their work by listening.

*[From an end-user*]

Proposed priority: Essential.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 14 | 1 | 2 |  | 17 | 2 |

Essential: 14/17 agreed this was an Essential feature, with 1 feeling it was Desirable, 2 Nice to Have.

Comments: Some felt that this was essential for an interactive music braille tool, and would be especially important for musicians of any level to control their composition work – hearing what they are writing and playing it back. Another commented that this feature is the same/related to the earlier feature UT1.3 – audio playback while navigating.

### UT 7.6 Develop APIs for other transcription software to call the music transcription tool as a subprocess.

*[From a transcriber and end-user*]

No proposed priority.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 2 | 4 | 7 | 2 | 15 | 4 |

Out of Scope: 11/15 felt this was Desirable (4) or Nice to Have (7), with 2 saying it was Essential, and 2 Not Needed.

Comments: Most respondents felt that this was not particularly important to have in a user tool, but one felt it might be valuable to be able to use with the score playback the use of VST instruments/libraries. It was felt it wasn’t really needed for a user tool, especially if the tool supports both text and music translation in a single package. Connections with VST and other libraries do not require an API. We have ruled this out of scope for the interactive user tool.

# 8. System Requirements

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 8.2 It must be programmed in such a way that it can be further developed.
* UT 8.1: Must have built-in screen-access, or work with a low-cost/free screenreader.

**Desirable-Essential**

* UT 8.2 It can be installed (or at least used) on both regular computers and the most popular braille notetakers.

**Desirable**

* UT 8.4 The program should be portable to all (PC/Mac/Android...) platforms.

**Nice to Have**

* UT 8.3: It can also be installed (or at least used) on a mobile device running Apple or Android.

**Not ranked**

* 8.1 If installed locally, it must work with XX technology, and uses no more than 2GB RAM even for the most complex files. *[minimum specification to be defined].*

## Features for interactive user tool in detail

### UT 8.1: Must have built-in screen-access, or work with a low-cost/free screenreader.

Why: to allow easy independent use by the greatest number of users, even those on a low budget.

Proposed priority: 1 Essential

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 19 |  |  |  | 19 |  |

Essential: All 19 respondents agreed that this is an Essential feature.

Comments: One respondent commented that if the software is written properly then accessibility with any screenreader would be possible, by using standard OS components and widgets. Another commented that it should be able to work with at least the free screenreaders (e.g. NVDA) to allow greatest access.

### UT 8.2: It can be installed (or at least used) on both regular computers and the most popular braille notetakers

Why: To let blind musicians read, learn, listen to and edit braille music scores using their portable braille devices.

Proposed priority: 2 Desirable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 6 | 10 | 3 | 2 | 21 | 1 |

Desirable-Essential: 16/21 felt this was Essential (6) or Desirable (10), 3 Nice to Have, 2 felt Not Needed.

Comments: Some respondents felt this was important, so that music scores are portable on different devices to take to rehearsals, lessons etc. However, others wondered whether keeping up with specific braille models/notetakers might be very difficult, especially since braille note takers often have hardware constraints and different platforms, and may not even accept third-party applications. They went on to say that as long as the music braille interpreter is capable of sounding audio as you read, that’s all you really need. Maybe the later ability to back-translate to generate print output would be useful. Another commented that many of the notetakers do in fact use the Windows system (e.g. Esytime (Win 7) and ElBraille (Win 10)), so only small modifications might be needed to apply the tool to meet keys on such machines. They use Jaws, NVDA and Window Eyes, so the migration may be not too difficult, and some notetakers may use Android, which could be implemented later. One commented that the notetakers to be considered should perhaps just be standard Windows or Android devices, and perhaps a cutdown reader for reading music braille could be possible on those devices.

### UT 8.3: It can also be installed (or at least used) on a mobile device running Apple or Android.

Why: To enable blind musicians to navigate and listen to music scores using these devices.

Proposed priority: 3 Nice to have

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 3 | 3 | 9 | 2 | 17 | 2 |

Nice to Have: 9/17 agreed this was a Nice to Have feature, 3 Essential, 3 Desirable, and 2 Not Needed.

Comments: This was felt to be nice to have to make it very portable especially with the growth in mobile devices in all settings, but some felt it might make it too complex (and expensive) to develop and to use. One suggested a ‘lite’ version with basic features which could be used on mobile devices. One commented that the requirements for a mobile version might be quite different from the main version, so perhaps a viewer, rather than an editor, could be delivered first. Another commented that it could contain a MusicXML reading function with very basic braille output for a Bluetooth-connected display, and it could load a compiled music braille project file to read with speech output, braille and music.

### UT 8.4 The program should be portable to all (PC/Mac/Android...) platforms.

*[From a developer*]

No proposed priority.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 4 | 7 | 4 | 1 | 16 | 3 |

Desirable: This didn’t get a clear prioritization: 7/16 felt it was Desirable, while 4 felt it was Essential, 4 Nice to Have and 1 Not Needed.

Comments: Whilst some commented that this would be nice so that users weren’t limited to specific technology, others felt that developing for multiple operating systems would be expensive and complex to do. One suggested that we start with Windows, and if time and money allows, extending to other platforms later; and that the requirements for a phone-based system would be very different from a computer-based system.

# 9. Business Arrangements

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential**

* 9.4 Operate a system for reporting bugs, issues and requests, and for sharing updates on implementation.
* UT 9.3 Documentation should be available in a range of accessible formats
* UT 9.4 Feedback, because things do not get better without feedback.
* UT 9.6 Clearly document the system.

**Essential-Desirable**

* 9.1 Annual service level agreement available to secure fixes and support *[define an acceptable response time for support questions]*
* 9.3 Offer the service for a minimum term, e.g. 5 years *[to be defined].*
* UT 9.1 Be available both as a trial version (as for example a 30-day-demo) and as a full version.

**Desirable-Essential**

* 9.2 If server-based, provide built-in redundancy for server failure/recovery to minimise downtime *[define acceptable downtime]*

**Desirable**

* UT 9.2 Have a cut down version without so many options for beginner users…

## Features for interactive user tool in detail

### UT 9.1 Be available both as a trial version (as for example a 30-day-demo) and as a full version.

*[From an end-user]*

No proposed priority

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 8 | 9 |  |  | 17 | 2 |

Essential-Desirable: The 17 respondents were almost evenly split, rating this as either Essential (8) or Desirable (9).

Comments: Several participants stated that in order to secure funding for purchase of new technology they had to demonstrate evidence of a successful trial. Individuals felt that being able to try out the tool before purchase was important to avoid an unnecessary purchase. Some said that a free trial, for e.g. 30 days, would be nice, or a very low-cost solution would make it attractive. Two respondents commented that the final software should be affordable. Two respondents suggested two models: the fully-functional paid version with perhaps a free viewer on mobile devices; or something similar to the Sibelius model - a free ‘lite’ version (e.g restricted to a limited number of parts and with limited features).

### UT 9.2 Have a cut down version without so many options for beginner users…

*[From a music teacher]*

No proposed priority

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 6 | 5 | 5 | 3 | 19 | 3 |

Desirable: There was no real clear prioritization for this feature - of the 19 respondents, half felt this was Essential (6), Desirable (5), or Nice to Have (5); or Not Needed (3).

Comments: Some respondents felt that if options are easy to switch on and off as required then it would not be necessary to have a simplified cut-down version, and users could gradually increase the options/complexity as they become more experienced. Others felt that this could tie-in with the cut-down free/trial option/low-cost option in requirement UT 9.1 and those comments applied here.

### UT 9.3 Documentation should be available in a range of accessible formats

user manuals, quickstart guides, keyboard shortcut lists; HTML, plain text, BRF, ...

*[From an end-user]*

No proposed priority

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 15 | 3 | 1 |  | 19 |  |

Essential: 15/19 respondents felt this was Essential, 3 Desirable, 1 Nice to Have.

Comments: Of course this is an essential priority, with accessibility to braille readers and print readers being vital. Some suggested HTML versions and BRF as a minimum, maybe with recorded human audio at some point. One commented that if the interface and output is multilingual then the documentation should be too. PDFs are OK for sighted users but not always for users of assistive technology. Documentation mentioned included: user manuals, quickstart guides, keyboard shortcut lists, supporting guides, tutorials and support to help all levels of user learn how to use it, especially documentation which does not assume a high level of technical expertise.

### UT 9.4 Feedback, because things do not get better without feedback.

*[From a transcriber and developer]*

No proposed priority

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 12 | 4 | 1 |  | 17 | 2 |

Essential: 12/17 respondents felt this was Essential, 4 Desirable, 1 Nice to Have.

Comments: This is the same as the original requirement 9.4, and is equally important for the user tool – since without feedback from users the developers will not know what to fix/add.

### UT 9.5 Need a database for scores produced, as world wide as possible

so we avoid all the double productions we have now.

*[From an end-user and music teacher*]

No proposed priority

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 8 | 6 | 1 | 3 | 18 | 1 |

Out of scope. Essential-Desirable: 14/18 respondents felt this was Essential (8) or Desirable (6), 1 Nice to Have, 3 Not needed.

Comments: Whilst it was generally recognised that this requirement should not be part of the user tool itself or this project, respondents felt that this kind of service would make it so much easier to source music and for end-users to explore new repertoire, and knowing that files had already been converted into braille would save users a lot of time. It links with UT 2.2 (agreed metadata), and one respondent asked what could be learned from finding files in other music software (e.g. MuseScore). So, if the user tool could save any metadata with the file, or connect into online collections thus supporting easy file-sharing in online collections that would be desirable. We will remove this from scope of this project.

### UT 9.6 Clearly document the system.

*[From a transcriber and end-user]*

No proposed priority

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Essential | Desirable | Nice to Have | Not Needed | Total | Skipped |
| 13 | 3 |  |  | 16 | 3 |

Essential: 13/16 respondents felt this was Essential, 3 Desirable.

Comments: This relates to UT 9.6 (documentation in accessible formats), and was generally understood to mean that users should have documentation to learn how to use the tool (e.g. user guide), as well as technical documentation being available (e.g. development guide, API guide, file format specification etc), and that it should be organised, maintained, easily accessed, in good English, and translated well into relevant languages.

# 10. Note about Funding

All requirements are numbered for ease of reference. The original requirements have no prefix and the additional requirements for Interactive User Tools are prefixed with UT and written in green. The list below integrates all requirements in priority order.

## Ranked according to ratings

**Essential-Desirable**

* 10.1 The sector should aim to secure the future of a tool, or tools, which together support both agency production as well as education.

No additional requirements for the interactive user tool.

# 11. Anything else?

This final section of the Requirements Survey was an open invitation to submit other issues/suggestions.

Nine respondents raised 16 additional comments between them, included in this section with their proposed priority. Note: these have not been read or rated by others. They are prefixed with UT and written in green.

## Additional suggestions ranked according to suggested rating

**Essential**

* UT 11.1 Ability to enter 6-key braille music from the keyboard
* UT 11.2 Contribute to/promote the accessibility features of mainstream user interactive software like MuseScore
* UT 11.3 Option to make notes and annotations
* UT 11.4 Make the product Open Source

**Desirable**

* UT 11.5 Ability to output as MusicXML
* UT 11.6 Ability to over-ride default choices where a passage can be transcribed in different ways.
* UT 11.7 Ability to select the language(s) for lyrics
* UT 11.8 Ability to add/edit new parts and instruments, and adjust the reading key, transposition etc.
* UT 11.9 Ability to convert and present the score for low-vision musicians
* UT 11.10 Ability to back-translate from braille to generate print output.

**Nice to have**

* UT 11.11 Options for placement of asterisked explanations
* UT 11.12 Option to re-group notes according to their own insights.
* UT 11.13 Ability to enter notes through a MIDI keyboard
* UT 11.14 Provide/link to a score overview summary tool

## Suggested Essential features in detail

### UT 11.1 Ability to enter 6-key braille music from the keyboard

* Proposed priority: Essential
* Suggested by: Dancing Dots (Developer & end-user & music teacher & transcriber)
* Why: To significantly improve the efficiency of data entry for expert braille music users. Will promote learning of braille music. This would render in print, talking score, etc. Dancing Dots has done some preliminary work on this feature. Another end-user commented that alongside 6-key entry they’d like to see braille translation back and forth between print and braille, like importing a braille music file and getting it translated to print music. Also that they’d like to be able to make use of the braille display routing touch keys.

### UT 11.2 Contribute to/promote the accessibility features of mainstream user interactive software like MuseScore

* Proposed Priority: Essential
* Suggested by: SAO MAI (Developer & end-user & music teacher & transcriber)
* Why: so we do not reinvent the wheel. Mainstream software will show its long-term sustainability, especially with large number of user community. It saves more resource to tackle in such approach. While a basic user interactive tool should be considered for basic editing features to help both blind individuals and transcribers to edit and customize the sheets to be well-handled in Braille translation and/or access with screen reading software + Braille devices. One other respondent commented in a similar way: I agree - most of the composing/writing features should be done in an existing notation software such as Musescore, and Musescore’s accessibility is constantly improving. The editing feature in the braille music translation software should be a supplement for the translation, to compensate some limitations coming from MusicXML/MNX, and for those scores with unusual features which are not able to be represented in standard ways in MusicXML/MNX or the notation software itself (e.g., special symbols, lines and graphics).]

### UT 11.3 Option to make notes and annotations

* Proposed priority: Essential
* Suggested by: Musicologist, and End-Users
* Why: users might want to make notes to remember decisions about performance or technique.

### UT 11.4 Make the product Open Source

* Proposed priority: Essential
* Suggested by: Transcriber & Developer
* Why: It allows for more collaboration with the community as well as integration/combination with other open source music production tools, like lilypond.

## Suggested Desirable features in detail

### UT 11.5 Ability to output as MusicXML

* Proposed Priority: Desirable
* Suggested by: Dancing Dots (Developer & end-user & music teacher & transcriber)
* Why: The tool should have a robust MusicXML output feature ideally as comprehensive as its MusicXML input feature, to allow user to prepare intermediate to advanced level pieces which can be exported to commercial music notation programs such as Sibelius without significant loss of information. Some sighted users, especially publishers, prefer the built-in options for house styles. Some sighted musicians just like the overall look of the scores produced by their favorite notation editor application. Another respondent commented about something similar: suggesting that the braille should be stored as a semantic format, or that the file should contain the original XML source with the braille adaptation. This could be BMML, or an imported MusicXML file with braille features added, which can then be backwards compatible with mainstream notation software. More advanced appearance features such as house styles may not be perfect in XML files, but MNX may have better support.

### UT 11.6 Ability to over-ride default choices where a passage can be transcribed in different ways.

* Proposed Priority: Desirable
* Suggested by: RNIB (transcriber)
* Why: The human choice may be difficult to program. The following examples are taken from RNIB's Braille Music Training Manual:
* Guidelines for choosing whether to use a full With (and put-in rests) or a Little With (pages 91-2).
* When transcribing chords, choosing between doubling intervals or using repeats (pages 75-6).
* Another example from another respondent: Some passages with the same features (e.g., hand alternations or complicated voice distribution) in XML source should be transcribed in different way in braille, especially in piano music. These different passages should be selected and translated again with different settings, or could be changed automatically by altering options after selection.

### UT 11.7 Ability to select the language(s) for lyrics

* Proposed Priority: Desirable
* Suggested by: RNIB (transcriber)
* Why: For example, if the source file has Latin text, with an English translation, the customer may only want the Latin. Ideally this feature could be applied to different sections, as required e.g. for Honneger's Christmas Cantata.
* Another example from another respondent: if there are several lines of lyrics in several languages, different translations should be applied to different language lines.

### UT 11.8 Ability to add/edit new parts and instruments, and adjust the reading key, transposition etc.

* Proposed priority: Desirable
* Suggested by: End-User
* Why: for have more composing possibilities at the reach of your hand.

### UT 11.9 Ability to convert and present the score for low-vision musicians

* Proposed priority: Desirable
* Suggested by: DEDICON (transcriber)
* Why: The number of seriously visually impaired people is larger, if the tool could present adapted visual output, with magnification, contrast, colour options etc that enhance the target group enormously.

### UT 11.10 Ability to back-translate from braille to generate print output.

* Proposed priority: Desirable
* Suggested by: End-User and Developer
* Why: for blind musicians who need to share print music with sighted teachers/fellow musicians/students.

## Suggested Nice to Have features in detail

### UT 11.11 Options for placement of asterisked explanations

* Proposed priority: Nice to have
* Suggested by: RNIB (transcriber)
* Why: To reduce the amount of re-formating needed in the output file. The treatment of asterisked explanations, using the music asterisk (NIM 14-16 and Example 8-9). In the UK we use cell 3-1 layout for the explanation; we choose whether to place it immediately after the relevant Braille parallel *or* at the end of the print page grouped with any other askerisked explanations (RNIB's Braille Music Training Manual, pages 65-6).
* [Comment on this from another respondent: This has to be done by transcribers. The explanations are entered as <words> or <credit-words> in MusicXML, and the transcribers have to make correct text category and then the software can determine where to put them according to the settings].

### UT 11.12 Option to re-group notes according to the users’ own insights.

* Proposed priority: Nice to have
* Suggested by: Musicologist
* Why: If there is an option to toggle on/off certain categories, this might be necessary, for instance if in a piano piece arpeggios are spread out over two hands consistently, one might want to hear only these arpeggios (without any bass or treble melodies that might also be in the score), or a user might want to only practice one voice in a counterpoint.

### UT 11.13 Ability to enter notes through a MIDI keyboard

* Proposed priority: Nice to have
* Suggested by: End-User
* Why: To be faster in the music writing and more efficiently. One participant commented that this could be done using standard accessible notation software like Musescore or Sibelius.

### UT 11.14 Provide/link to a score overview summary tool

* Proposed priority: Nice to have
* Suggested by: Developer
* Why: Braille scores are not as easy as print music to skim read and pick out the important details. Talking scores begin with a kind of summary, so perhaps a braille score could too. I made a sample tool for talking scores to automatically produce a summary of structure and identifies repetitions/patterns, intervals, chords, inversions etc in the score – which could be useful for braille scores too. Visit: <https://www.youtube.com/watch?v=z6w7pnJFypk>

# Appendix – Prioritized Requirements for the User Tool Only

### 1. Accessibility and Usability

**Essential**

* UT 1.1 When navigating through the musical score, it gives information in several levels, e.g. braille dots only, musical elements, or silent with only midi sounds for notes.

**Desirable**

* UT 1.2 The verbosity of whole categories of symbols can be adjusted (e.g. for all dynamics, for all articulations, for all notes).
* UT 1.3 A "play-along" function enables users to play the score by voice, part, bar or in different tempo, adjusting these options on-the-fly.

### 2. File handling

**Essential**

* UT 2.1 It handles and represents files in a fully accessible way, e.g. multimedia content such as print, braille, voice, midi…).

**Desirable**

* UT 2.2 Add agreed metadata into the created file before sharing with online collection.

**Nice to Have**

* UT 2.3 Be able to control both source (including MusicXML/MNX and related images/sounds) and braille in one project.

### 3. Formatting/Layouts

* No additional requirements for the interactive user tool.

### 4. Country Codes

* No additional requirements for the interactive user tool.

### 5. Options

**Essential**

* UT 5.1 It can automatically or manually categorize texts and do additional braille formatting.
* UTs 5.3/5.4/5.5/5.6/5.7/5.9: Options for in-accords, moving notes, choir music handling, interval signs, lyrics, embellishments, dynamics, tempo, prefixes for shaped notes, nuances, ornaments, chord symbols, accents, sixteenth groupings, fingering, pitch, octave, duration.

**Essential - Desirable**

* UT 5.2: It can redefine and restart print/braille page numbers and bar numbers.

**Desirable**

* UT 5.8 Switching between interfaces in different languages
* UT 5.10 For a song with several verses with the same melody, have on/off option for writing out the print music repeat…

### 6. Conversion of Musical Symbols

**Essential**

* UT 6.1 Essential to have correct braille code within word expressions in the music.

### 7. Output

**Essential**

* UT 7.5 MIDI playback to allow users to check their work by listening.

**Essential-Desirable**

* UT 7.2 and 7.3 Use Unicode braille.

**Desirable-Nice to Have**

* UT 7.4 Generate and play the sound-representation of each musical event in parallel with the Braille representation.
* UT 7.1 Make dynamic conversions in real time depending on the needs of the user, which will change during use of the score.

### 8. System Requirements

**Essential**

* UT 8.1: Must have built-in screen-access, or work with a low-cost/free screenreader.

**Desirable-Essential**

* UT 8.2 It can be installed (or at least used) on both regular computers and the most popular braille notetakers.

**Desirable**

* UT 8.4 The program should be portable to all (PC/Mac/Android...) platforms.

**Nice to Have**

* UT 8.3: It can also be installed (or at least used) on a mobile device running Apple or Android.

### 9. Business Arrangements

**Essential**

* UT 9.3 Documentation should be available in a range of accessible formats
* UT 9.4 Feedback, because things do not get better without feedback.
* UT 9.6 Clearly document the system.

**Essential-Desirable**

* UT 9.1 Be available both as a trial version (as for example a 30-day-demo) and as a full version.

**Desirable**

* UT 9.2 Have a cut down version without so many options for beginner users…

### 10. Note about Funding

**Essential-Desirable**

* No additional requirements for the interactive user tool.

### 11. Anything else?

**Essential**

* UT 11.1 Ability to enter 6-key braille music from the keyboard
* UT 11.2 Contribute to/promote the accessibility features of mainstream user interactive software like MuseScore
* UT 11.3 Option to make notes and annotations
* UT 11.4 Make the product Open Source

**Desirable**

* UT 11.5 Ability to output as MusicXML
* UT 11.6 Ability to over-ride default choices where a passage can be transcribed in different ways.
* UT 11.7 Ability to select the language(s) for lyrics
* UT 11.8 Ability to add/edit new parts and instruments, and adjust the reading key, transposition etc.
* UT 11.9 Ability to convert and present the score for low-vision musicians
* UT 11.10 Ability to back-translate from braille to generate print output.

**Nice to have**

* UT 11.11 Options for placement of asterisked explanations
* UT 11.12 Option to re-group notes according to their own insights.
* UT 11.13 Ability to enter notes through a MIDI keyboard
* UT 11.14 Provide/link to a score overview summary tool