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Tooling requirements to support mapping

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1 Introduction

The development of mappings to external classifications has been, and will continue to be, and important part of the content development activity within the International Edition of SNOMED CT. With the development of the international workbench for the purposes of maintaining and developing SNOMED CT, it is essential that the workbench provides the functionality to support mapping activities. Mapping is a core activity of content development and maintenance, and as such the required functionality within the workbench will be provided as integrated functionality, and not as separate module(s).

2 Purpose

The purpose of this document is to set out the functional requirements for an integrated tooling solution to support mapping activity in the international workbench.

The specification of the requirements in this document is based on the experience of developing SNOMED CT to ICD-10 maps, as part of the phase 1 mapping project. As the IHTSDO moves forward with its own internal mapping service, these requirements have been further enhanced to meet the current, and future, requirements. The mapping, as specified in this document, relates to the mapping activity undertaken between the International Edition of SNOMED CT and any international code systems

3 Scope

This document details the IHTSDO's tooling requirements for mapping. The requirements aim to meet a number of specific use cases for map tooling. These requirements can be summarized as follows:

- For use by IHTSDO to create new maps from SNOMED CT to one or more target International code systems.
- For use by IHTSDO to maintain existing maps from SNOMED CT to target International code systems to support:
    - correction of reported map errors
    - enhancements/amendments as required/requested
    - updates of source terminology (SNOMED CT)
    - updates of target code systems

- To incorporate mapping functionality into the IHTSDO workbench suite, supported by suitable workflows i.e. end to end functionality, including development of workflow processes to support:

    - Management/Review of batches
    - Dual independent review and conflict analysis
    - Mapping functionality
    - Quality Assurance – expert and technical
    - Production of release files
- To view multiple targets (ICD-10, ICD9-CM and ICPC-2) and switch between the target coding systems

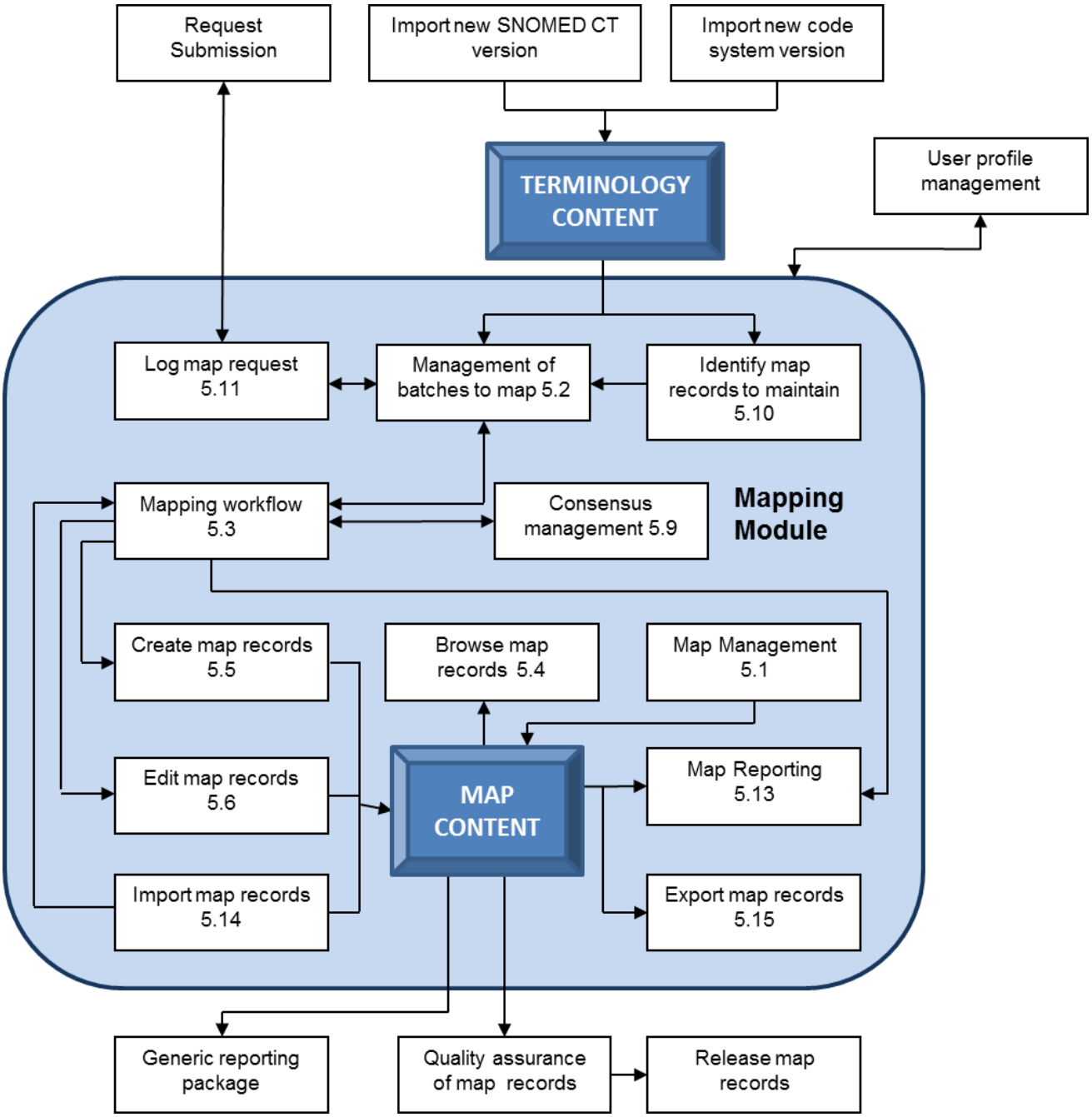
These requirements address only the use cases listed above, and are not intended to meet future requirements that are currently unknown. An example of these could be mapping from other code systems to SNOMED CT.

Mapping is carried out in one direction from source SNOMED CT concepts to target codes building in the target coding system standards, rules and conventions.

The production and release of maps may require either a simple map (by which one to one, or one-to-many relationships can be represented, but without additional information) or a complex map (by which SNOMED CT concepts may be mapped to a number of alternate codes from a target code system, depending on the context of use within an EHR or other operational system). Following a baseline release of mapping data, follow-on releases will need to properly support the RF2 specification for “full” and maintain history properly across time.

4 Description of Mapping Activity

This diagram gives a high level view of the activity which would need to be reflected in a mapping module within the workbench, and how this should interact with other tooling.



The diagram shows functionality that one might expect to be present in a general purpose mapping tool. Such a tool should be capable of collaborative use by members of a mapping team to produce

maps from SNOMED CT to one or more target code systems in RF2 format. The paragraphs below describe in outline the function of each box in the diagram.

Configuration and management information for each map may be defined and maintained using the 'Map Management' function. Once a map has been defined, the content to be mapped can be defined and allocated using the 'Management of batches to map' function. Once a batch has been allocated to a map specialist, the 'Mapping workflow' function can be used to guide each Concept to be mapped through from initial creation (using the 'Create map records' function) through a review process, and perhaps escalation or update (using the 'Edit map records' function), before finally moving on to acceptance. As the 'Map content' is generated, is it checked using the 'Quality assurance of map records' function, prior to release in RF2 format, using the 'Release map records' function.

As new versions of either SNOMED CT or a target code system are released, the 'Identify map records to maintain' function may be used to identify which Concepts that have already been mapped may need to be reviewed and potentially amended. Requests for changes to released maps as well as any identified issues may be recorded on an external Request Submission system. Requests that relate to mapping may be managed using the 'Log map request' function, which will ensure the Request Submission system is then kept in line with the work progresses on the request in the Mapping Module.

Existing 'Map content' may be imported in RF2 format using the 'Import map records' function, and later exported - perhaps after some modification as a result of functions described in the previous paragraphs - using the 'Export map records' function; these import and export functions should allow interoperability with other mapping tools that have similar import and export mechanisms. 'Map content' may also be browsed and reviewed using the 'Browse map records' function, and the 'Map reporting' function may be used to provide progress and overview reports specific to mapping projects.

5 Description of Mapping Requirements

The following sub-sections describe the mapping requirements in more detail by providing a bulleted summary of the functionality covered by each box shown in the diagram in Section 4.

5.1 Map management

This function should allow creation and maintenance of a new map, including:

- Creation and maintenance of the metadata describing the structure of the map (for example, as either a simple or a complex map reference set).
- Creation of any map category records that are required for the map.
- Definition of any constraints on the map type that might guide the authoring process, to keep it consistent.

- Definition of any contextual parameters (either numeric or value-set based) that may be referenced from map rules (for example, Gender or Age).
- Definition of the areas of SNOMED CT that are within the domain of the target code system.
- Management of the versioning of the map records. It is possible that multiple versions of a map may need to be maintained in parallel, where it is required to maintain maps from current or previous versions of SNOMED CT to current or previous versions of a code system.
- Definition and maintenance of the version of SNOMED CT and the version of the target code system to which each version of a map relates.

Requirement	Priority	Description
5.1.1	1	Tooling must support the recording and storing of metadata as part of the mapping process
5.1.2	1	Tooling must support the recording of data against an agreed mapping template
5.1.3	1	The tool must support the definition of areas of terminology content in scope of the target code system and also the source terminology
5.1.4	1	The tool must support the versioning of map records
5.1.5	1	The tool must support the versioning meta data associated with the map record
5.1.6	1	The tool must allow users to set a default view attached to their log in, so for example a map lead should be able to open the tool with two windows open for conflict resolution
5.1.7	1	The tooling must support the definition of different map types, to allow descriptive metadata and format

5.2 Management of batches to map editing

This function should allow management of batches of SNOMED CT Concepts for mapping, including:

- Creation of a batch using a query to identify Concepts that are to be mapped.
- Ability to remove Concepts that have already been mapped, from a batch.
- Ability to split a batch up into a number of sub-batches.
- Ability to assign batches to map specialists.
- Ability to track batches through the mapping and consensus process.
- Ability to re-assign partially completed batches in the event of holidays or sickness.
- Batches may also be initiated following a release of a new version of SNOMED CT or a target code system (via the ‘Identify map records to maintain’ function); or from an external Request Submission system, via the ‘Log Map Request’ function, in which case Concepts may be identified, for which map records are to be updated, retired or created.
- Ability to create a “lightweight batch” that doesn’t have all of the tracking (and mutual exclusivity) requirements to support quality assurance activity. The idea is that concepts can

be pulled into a batch and reviewed without needing to participate in other aspects of the workflow system.

Requirement	Priority	Description
5.2.1	1	The tool must support the creation of a map repository of SNOMED CT concepts by loading an enumerated subset or by a query specification
5.2.2	1	The tool must support the ability to edit the content of the repository once created
5.2.3	1	The tool must support the ability to group concepts in the repository into batches according to prescribed criteria, such as size of batches, keeping related concepts in a batch etc.
5.2.4	1	The tool must support the ability to assign batches to Mapping Team Members
5.2.5	1	The tool must support the ability to track batches as they progress though the mapping and consensus process
5.2.6	1	The tool must support the ability to reassign batches
5.2.7	1	The tool must support new map requests to be automatically generated, and require map records to be updated, retired or created
5.2.8	1	The tool must support the new map requests generated through external sources, and require map records to be updated, retired or created
5.2.9	1	The tool must support the blind authoring against legacy map, conflict management with an automatic escalation where the map target differs
5.2.10	1	The tool must support the ability to develop bespoke workflows within the tool by mapping team staff
5.2.11	1	The tool must allow the generation of QA batches for review – these can be routine pre-determined QAs or special one-time QAs. The search criteria for generating these batches should be customizable through the tool
5.2.12	1	The tool must allow the loading of legacy map records to use as independent source for validation of the manual maps

5.3 Mapping workflow

This function should track individual elements in a batch through a pre-defined authoring and review workflow, including support for:

- Concept-level workflows.
- Initiation of workflow from a number of sources, including:

    - Assignment of a batch of Concepts to a map specialist.
    - Manual creation or amendment of a map record that is not already in workflow.
- Dual-blind authoring, with escalation to a map lead where there is a difference in the map records that are created by the two authors.
- Blind authoring against a legacy map, with escalation to a map lead where there is difference between the map record created by the author and that held in the legacy record.
- Other workflow paradigms, if required, via configuration.

Requirement	Priority	Description
5.3.1	1	The tool must support the creation of batch a map repository of SNOMED CT concepts by loading an enumerated subset or workload using by a query specification
5.3.2	1	The tool must support the ability to edit the batch content of the repository once created
5.3.3	1	The tool must support the ability to sub-divide group concepts in the repository into batches once created according to prescribed criteria, such as size of batches, keeping related concepts in a batch etc.
5.3.4	1	The tool must support the manual creation of new map record by mapping team members
5.3.5	1	The tool must support blind parallel independent mapping with automated comparison and conflict identification of maps from different sources authoring against legacy map, conflict management with an automatic escalation where the map target, rule, or advice differs. The tool must support the ability to resolve conflicts identified in this manner.
5.3.6	1	The tool must support the ability to develop bespoke workflows within the tool by mapping team staff

5.4 Browse map records

This function should allow browsing of map records in a format that is understandable by the users that maintain and review the maps, including:

- Presentation of map data in an easily digestible form – for example, a graphical presentation, using a recognized and agreed diagramming standard
- A search facility to find map records of interest.
- Navigation to a map record from either the source or the target code system.
- An ability to test the result of a map by entry of contextual information.

Requirement	Priority	Description
5.4.1	1	The browser search facility must include key word, text

		string and wild card functionality and support Search by concept ID, ICD-10 code, description, map advice, flags
5.4.2	1	The browser must allow the user to travel up and down the tree view
5.4.3	1	The browser must allow the user access to contextual information when available
5.4.4	1	The browser must allow the user to set the default for viewing all descendants expanded or collapsed.

5.5 Create map records

This function should allow a map specialist to efficiently create a map record for a SNOMED CT Concept, guided by the constraints that are imposed by the type of map that has been defined in the 'Map Management' function. Functionality should include the following:

- Ability to create one or more map records against the source Concept, optionally including map rules that may reference contextual parameters (defined in 'Map Management').
- Ability to identify a code for each map record from a target code system, either semantically or lexically.
- Ability to add flags and standardized notes to each map record or to the source Concept to be mapped.
- It should also be possible to create or edit a map record for a Concept outside of workflow, in which case the Concept should be added at an appropriate stage into the workflow for review.

Requirement	Priority	Description
5.5.1	1	The tool must allow the creation of multiple map records against a source concept
5.5.2	1	The tool must allow the map record to identify target code system, this can be either lexically or semantically
5.5.3	1	The tool must allow the map record to allow the user to flag the record, add notes to the record or to the source concept
5.5.4	1	The tool must allow the users to create and edit map records that do not form part of the normal workflow
5.5.5	1	The tool must be able to support separate coding options, e.g. sequencing of paired codes such as dagger and asterisks

5.6 Edit map records

This should allow a map specialist to edit an existing map record and should have the same functionality as creating a map record (see section 4.5).

Requirement	Priority	Description
5.6.1	1	The tool must allow users to find an existing map record using the same level of search functionality provided within the browser
5.6.2	1	The tool must allow users to edit existing map records, and this must include the ability to view and edit additional metadata

5.7 Locate an existing map record

This should allow a map specialist to easily and efficiently locate an existing map record.

Requirement	Priority	Description
5.7.1	1	The tool must support the ability to browse maps
5.7.2	1	The tool must allow the concept details and map to be viewed
5.7.3	1	The tool must allow the map and concept details to be saved to allow the details to be exported.

5.8 Mapping content

Any data authored in the Mapping Module should be persisted as ‘Mapping content’.

A full state valid history should be held of all map records that are created, edited and retired, together with the a date stamp of each change and a unique id of the author making the change. The Map Module should allow collaborative working, so map specialists should all access a common repository holding the ‘Mapping content’. Individual editing should not be able to overwritten, and this should be supported through the agreed workflow. The audit trail should be visible to the Mapping Team members.

Requirement	Priority	Description
5.8.1	2	The tool must provide a full state valid history for all map records. This should include creation, editing and retirement of a record, and should detail the date/time and identification of the author making the change
5.8.2	2	The tool must allow the an audit trail which should be visible to all the Mapping Team members

5.9 Conflict and consensus management

The process of dual authoring of the maps, a map requires there to be agreement on the allocation of all key elements of the map e.g. the maps target(s) code(s), sequencing, map advice etc. between the mapping team. Where this cannot be achieved then a process for conflict and in some cases consensus management is implemented. This operates at differing levels, and may will require the workflow to support referral to solely and resolution by the map lead, SNOMED CT terminologist or author, or may involve the referral to and resolution by the Consensus Management Panel.

Requirement	Priority	Description
5.9.1	1	The tool must support the implementation of a workflow to deliver conflict management, e.g., allocate, assign, edit, and save the conflict, with the functionality found in the current tool
5.9.2	1	The tool must support the implementation of a workflow to deliver consensus management
5.9.3	2	The tool must support the following groupings in respect of the map lead workflow: • The tool opens the map record of both specialists side by side when selecting a concept from one of the Map Specialists batches • The tool highlights all the conflicts by using either bold print or colour • The tool identifies missing map advice • The tool sorts conflicts in a batch first by flag (Map Lead, Consensus, Editorial)
5.9.4	2	The tool must populate the SNOMED Detail View with the SNOMED CT concept when it is selected from one of the Map Specialists batches
5.9.5	2	The tool displays the Map Specialists notes in a pop-up when present upon selection of a concept
5.9.6	2	The tool must provide the ability to open a new Map View window and paste a copied mapped concept for editing. Once edited, the tool must provide the ability to copy the edited concept to the resolved folder
5.9.7	2	The tool must flag or grey out the concept in both Map Specialists batches that has been resolved and added to the resolved folder
5.9.8	2	The tool must support crosschecking of resolved conflicts that have been committed to those not yet resolved (avoids up and down propagation)
5.9.9	3	The tool must provide the ability to view a concept without checking out a batch

5.10 Identify map records to maintain

As new releases are made of SNOMED CT or target map systems, concepts and codes may be created, amended and retired. These changes will have an impact on the map records. A particular version of a map should be tagged as being from a specified version of SNOMED CT to a specified version of a target code system.

This function is responsible for identifying all concepts in SNOMED CT that should be reviewed as a result of version changes and passing them on to the 'Management of batches to map' function, including:

- Identification of any concepts that have been added or retired in an area of SNOMED CT that has been identified as being in the domain of the target code system (in the 'Map Management' function).
- Identification of changes to the definition of a concept (by way of its qualities, its Descriptions or its Relationships) that has already been mapped to the target code system.
- Identification of concepts that are mapped to one or more codes in the target code system that have been updated.

Requirement	Priority	Description
5.10.1	1	The tool must allow the identification of all mapped and unmapped content in the domain of the target code system
5.10.2	2	The tool must have the ability to identify changes that occur in SNOMED CT from one release to the next, and create batches of SNOMED CT concepts that have been: 1. Added to the map, for a mapper can map them 2. Flagged as changed, for a mapper to review and respond as required 3. Inactivated in the map, so that the resulting map Refset members would be represented as inactive members in the exported RF2 file
5.10.3	1	The tool must allow the identification of concepts that are mapped to one or more target codes to allow updating of map records
5.10.4	1	The tool must identify changes in SNOMED CT that affect mapping e.g. retired concepts (to find replacements), change in number of descendants (low/high level concepts)
5.10.5	2	The tool must identify changes in target classification that affect mapping e.g. retired codes, significant name changes, code became invalid for coding (new descendants), new sibling codes which may be better map targets
5.10.6	2	The tool must support the need to be able to display retired concepts and codes

5.10.7	2	The tool must support for updating target terminology version - in particular ability to highlight certain nodes in a map record and provide a note or directive to the mapper about what they should look at (e.g. “consider additional siblings”) • More generally, have a means to highlight portions of the map record with “task notes”

5.11 Log map request

This function acts as the interface between the Mapping Module and the Request Submission system. A work item on the Request Submission system may result in a need for creation, amendment or deletion of one or more map records. To do this:

- The request on the Request Submission system will be assessed and used to define a batch of Concepts to map, using ‘Management of batches to map’.
- Once the work on the batch of changes is complete, the original request on the Request Submission system will be updated.

Requirement	Priority	Description
5.11.1	2	The tool must interact with the request submission tool to allow batches of concepts to be allocated to members of the mapping team
5.11.2	2	The tool must support the sharing of data between the request submission tool and the mapping tool to allow information to be recorded against a request and to allow requests to be uploaded to the mapping tool to be incorporated in batches of work

5.12 Identify map records for maintenance

This function enables the identification of all mapped content and the remaining concepts not yet mapped that are in scope. This function also enables a comparison of mapped content against a RefSet. For example, RefSets may be provided by the Member Countries that contain priorities for mapping. To ensure these concepts are mapped prior to others, a comparison would occur between the SNOMED CT concepts found in the most recently released map to those found in a RefSet resulting in a list of concepts not found in the map.

Requirement	Priority	Description
5.12.1	1	The tool must allow the identification of all mapped and unmapped content in scope of the map
5.12.2	2	The tool must have the ability to perform a comparison of mapped content against a RefSet and identify concepts not

		contained in the most recently released map
5.12.3	1	The tool must create a list of concepts that are not yet mapped so they can be batched and mapped

5.13 Map reporting

This function enables reports specific to mapping activities to be produced, including:

- Reporting on workflow activities to provide an update of the current flow of work, broken down by batch, by map specialist, by map lead, and by period of time, including information on the number of map records created, amended, retired, and approved.
- Reporting on statistical information, identifying total number of concepts have been mapped to each target code system.
- Change report detailing all changes to mapped concepts (showing previous and new map)
- Reporting of batch number, number of concepts in a batch, number of discrepancies, percent with discrepancies, Mapping Specialist who mapped the concept, Mapping Specialist who mapped the concept, ConceptID and fully specified name
- Reporting of maps flagged for consensus review (should include any notes)
- Reporting of maps flagged for editorial review (should include any notes)
- Reporting of maps flagged for Map Lead (should include any notes)
- Reporting of mapping history
- Reporting of how the conflict was resolved

For example reports see Appendix 6.4

Requirement	Priority	Description
5.13.1	2	The tool must allow an audit/reporting facility to be used against any field recorded in the tool. This should allow report templates to be specified, that can then be run at scheduled times, and also ad hoc reporting
5.13.2	2	The tool must have the ability to easily retrieve statistical information related to workflow, e.g. the number of concepts mapped, number of concepts/batches at different stages of mapping

5.14 Import map records

This function enables importing an existing map, in RF2 format, from an external system. Where map records are incrementally imported into a map already held in the system, it may be necessary to review each of these records as part of a standard workflow. This requirement supports the use of donated legacy maps. This requirement has a dependency on the existence of a process to convert all map files into RF2 format from their original format.

Requirement	Priority	Description
5.14.1	1	The tool must allow the import of existing maps into the tool from an external system, where they are specified in RF2 format. Metadata referenced by the RF2 data needs to exist in the system into which the data is being imported

5.15 Export map records

This function enables exporting a map, in RF2 format, to an external system and supports the external validation of maps

Requirement	Priority	Description
5.15.1	1	The tool must allow the export of simple or complex map file in RF2 format to an external system
5.15.2	2	The tool must allow the export one or multiple map records in a human-readable format to facilitate discussion (current option is to take only a screen shot, which may look different from the final map)
5.15.3	2	The tool must support the export of one or multiple maps in a single file that is shareable and readable by other users of the tooling solution

5.16 User Interface Requirements

To support the workflow of the Mapping Team, there are specific requirements that relate to the usability of the tool. These are extremely important requirements that make the tooling a success. It is expected that the current tooling prototype in use should be used as an exemplar for any future tooling approach, and that current functionality should be incorporated into the new tooling solution.

Requirement	Priority	Description
5.16.1	1	The tool must support the use of map category abbreviations
5.16.2	1	The tool must allow the automation of assignment of default advices where defined
5.16.3	1	The tool must allow the use of dialog boxes, which can be defined and set by the user
5.16.4	1	The tool must allow batches to open by single clicking the batch details
5.16.5	1	The tool must allow reset functionality, which should be available in the tool which resets the view. This default view should be configurable by the user

5.16.6	1	The tool must support a browser view which has a user configurable default setting related to degree of expansion of the tree
5.16.7	2	The tool must support the target system's browser to have a forward and back feature available
5.16.8	2	The tooling must have cut and paste functionality to allow concept and target code details to be used in the tool and browsers
5.16.9	1	The tool must have sizing and scroll functionality available for all views, e.g. concepts and notes
5.16.10	1	The tool must support the browser view of the concepts to have plus and minus signage to signify available further hierarchy details
5.16.11	1	The tool must support conflict resolution functionality to be assisted in the tool through the use of colors to signify where differences have occurred
5.16.12	1	The tool must support text boxes to have word wrap enabled to ensure that information in the text box is easily visible to the user
5.16.13	1	The tool must have undo and redo functionality available in when editing a map record
5.16.14	2	The tool must support the use of hyperlinks in the notes section of the map record
5.16.15	2	The tooling must support the use of colour change to represent status changes to individual workflow items, for example to show when a change has been committed, or that there are conflict issues or discrepancies
5.16.16	1	The tool must support the function to automatically add map data elements (e.g. map advice) according to set criteria (e.g. range of target codes). If some advice are routinely assigned automatically, they need to be displayed differently e.g. greyed out to avoid manual picking
5.16.17	1	The tool must support the function to ensure that map target values are always exactly as they appear in the files (e.g. do not walk up the tree to find a matching code, or if the tool does this (which it may for good reason), indicate to the user somehow how it happened
5.16.18	1	The tool must support the ability to apply a certain map data element e.g. map advice, map target to all descendants
5.16.19	2	The tool must support having the options of defining which level of codes in the target classification is valid as map targets e.g. only leaf nodes or any level

5.16.20	2	The tool must allow the copy/paste of a whole map record including map advice/map rules to another concept. This maybe useful in mapping descendants and also be helpful in resolving map conflicts
5.16.21	1	The tooling must support having an option of flagging the map accuracy/confidence level. For example, if the map is exact match (term match or maps based on ICD guidance) or the map is based on interpretation of map specialist e.g. based on the target of the parent concept
5.16.22	1	The tooling must allow the mapping tool to have some degree of searching function in the target code system (e.g. keyword searching in the alpha index or tabular list including inclusions). The results of the search should be hyperlinked so that users can move to the target code screen with a click.
5.16.23	1	The tooling must allow the install of customizable QA rules in the map tool, which can prompt users at the time the map is created/saved e.g. • Output tags may not contain empty map target codes. • Predicate tags of type “concept” MUST contain a concept id • Explicit mappings for LLCs should exist for all descendants in group 1 • ‘DESCENDANTS NOT EXHAUSTIVELY MAPPED’ should only be valid for HLCs • ‘DESCENDANTS NOT EXHAUSTIVELY MAPPED’ should be required for HLCs • Map groups must have a default rule • Map targets to codes not explicitly in the ICD10 terminology should not be allowed • Map entries for “false” descendants should be removed (e.g. happens during terminology upgrade) • Only valid map advices should be allowed in the saved record.
5.16.24	2	The tooling must support cut and paste functionality to support workflow particularly relating to browsers
5.16.25	2	The tooling must be able to support changes in workflow which may be required in the future as business needs dictate.
5.16.26	1	The tooling must support the provision of an Advice selection box to allow the mapper to select the relevant advice. The selection box must be capable of manipulation to allow filtering, and selection should be by advice phrase

		or checkbox
5.16.27	2	The tooling must support a Reset Perspective. This should reset the view to the classification rather than the terminological view
5.16.28	2	The tooling must support a view of the detail for individual codes and categories. Where these are blank in the classification data, the tooling should provide a view of children codes within the classification hierarchy

5.17 Updating of source terminology and target coding scheme

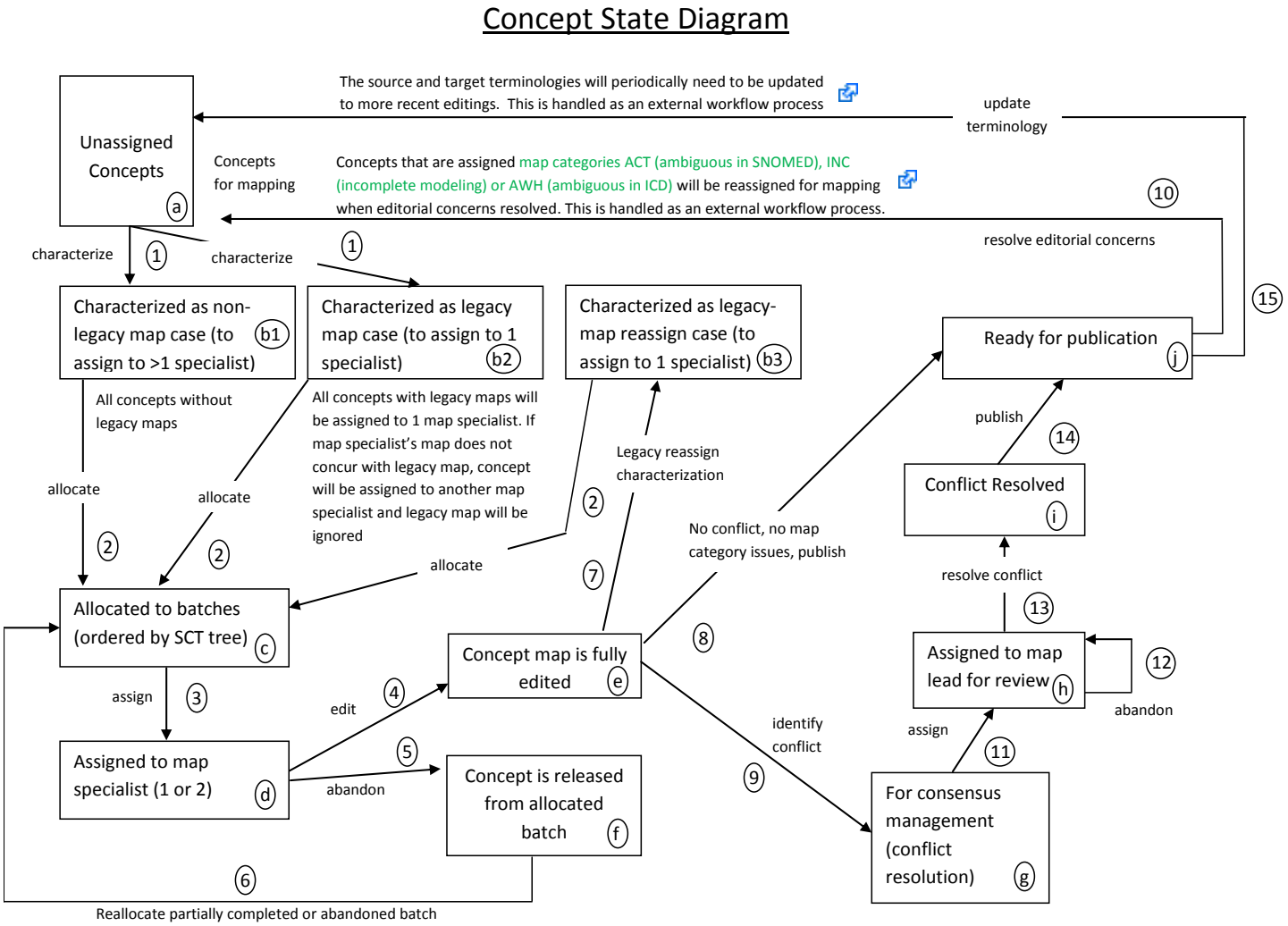
The tooling should be capable of holding different versions of the source SNOMED CT as well as different target code systems and different versions of those systems.

It should be clear to the user which source, target and version is being accessed. It should be possible to easily and efficiently update the mapping tool as new versions of the source target become available.

Requirement	Priority	Description
5.17.1	1	The tool must provide the ability to update the source terminology/classification to enable to mapping team to be working on the correct version of the terminology and the correct version of the international code system
5.17.2	2	The tooling must make the version of the terminology and international code system being used clearly visible to the user through the interface
5.17.3	1	The tool must support the loading of a national extension of SNOMED CT represented in RF2 format
5.17.4	1	The tool must support the loading of a local code system (as the target code system) through defined data representation format(s)

6 Appendices

6.1 Concept State Diagram



Concept Status (internal data element, not published): a metadata concept identifier which designates the status of the SNOMED source concept in the editorial and consensus management process. Valid options are:

- **a: Unallocated, Uncharacterized:** concept is in initial data set and has not yet been processed
- **b1, b2, b3: Unallocated, Characterized:** the concept has been characterized as needing to be assigned to 1 or 2 map specialists. Concepts with legacy maps will need to be assigned to 1 map specialist (b1), concepts without legacy maps will need to be assigned to 2 map specialists (b2). Concepts may need to get re-assigned to 1 map specialist if they have legacy maps and the initial map specialist disagrees with the legacy map (b3).
- **c: Allocated, Characterized:** the concept has been allocated to a batch which will be assigned to 1 or 2 map specialists.
- **d: Allocated, Characterized, Assigned:** the concept has been allocated to a batch and has been assigned to 1 or 2 map specialists.
- **e: Edited:** the map record for the concept has been fully edited and saved (by all specialists to which it was assigned). It is now ready for back-end processing.
- **f: Deallocated:** the concept has been released from its allocated batch (either due to abandonment or completion of editing)
- **g: For Consensus Management:** conflicting map records for the concept have been identified and referred to map lead for consensus review. This may be completed by the Map Lead alone, or may involve the Consensus Panel
- **h: Assigned to Map Lead:** the various conflicting states of the map record for the concept have been assigned to a map lead for resolution.
- **i: Conflict Resolved:** there is now one, correct and fully edited state of the map record for this concept.
- **j: Ready for publication:** map record for concept is ready to be published

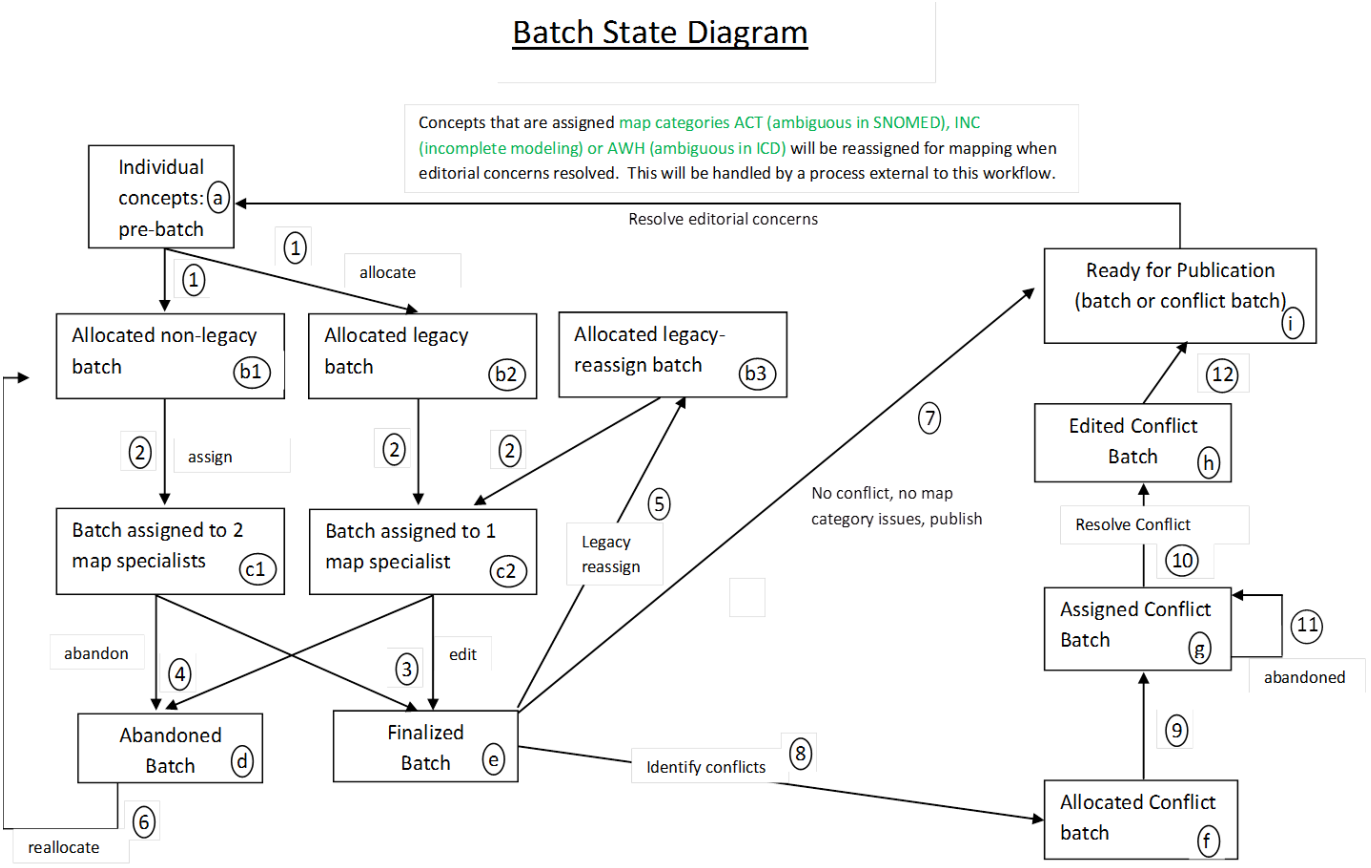
Processes:

- **1: Characterize Concept (A):** Determine what kind of case this is and how many specialists will need to look at it.
- **2: Allocate to Batch (A):** Associate this concept with a particular batch – ideally one that it shares siblings within the SNOMEDCT hierarchy.
- **3: Assign to Specialist (ML):** Assign this concept (via its batch) to one or more map specialists. The capability for the Map Specialist to assign a batch to themselves.
- **4: Edit Concept (MS):** Create a map record for the concept.
- **5: Abandon Concept (MS):** Occurs when a specialist abandons a batch before it is fully edited, this means that they are not committed for some reason and are to be mapped later. Any unmapped concepts in the batch are considered abandoned.

- **6: Reallocate Concept (A):** Reallocate concepts to new batches. This occurs when either a concept is abandoned by a map specialist or a concept is given a map category or flag that indicated editorial concerns and those concerns have been addressed.
- **7: Legacy Reassign Characterization (A):** Characterize concepts as legacy-reassign cases if the map specialist created a map record for the concept that disagreed with the original legacy map. These cases will need to be allocated to legacy-reassign batches and assigned to new map specialists.
- **8: Identify Map Records Ready for Publication, Mark as Ready (A):** Identify cases of map records for a concept that are harmonized across multiple map specialists and do not have problematic map category assignments. Mark them as ready for publication.
- **9: Identify Map Record Conflict (A):** Identify cases of map records for a concept that are in conflict across multiple map specialists. Allocate these cases to conflict batches. A conflict occurs when two map specialists' have map records for the same concept that are semantically different (the order of rules within a group can be different), with the exception of the Age and Gender rules which must be ordered right before the 'else' rule. Thus if map category assignments are different, or target concepts, or the number (or content) of rules or groups is different, then there is a conflict.
- **10: Resolve Editorial Concerns (N/A: external):** A map record for a concept may be marked with a map category indicating certain editorial concerns. The concept should be able to be marked for editorial review by allocating a flag under notes within the tool. The concerns are resolved externally to this workflow and concept map records published with these map categories may be fed back into the system for re-editing. In a case where one map specialist marks a map record with a problematic map category or via the flag and another map specialist does not, this is considered a conflict. The conflict and consensus management process will determine whether it should be published with the problematic map category or as a normal map record.
- **11: Assign Map Record Conflict (ML):** Assign this concept (via its conflict batch) to a map lead.
- **12: Abandon Map Record Conflict (ML):** Occurs when a lead abandons a conflict batch before it is fully resolved. Any unresolved conflicting map records are considered abandoned and will need to be reassigned.
- **13: Edit Map Record Conflict (ML):** Choose the correct form of the map record for the concept (and optionally edit it further). Indicate that the conflict is resolved. Where conflict cannot be resolved by the map lead, there should be a process for sending it through the consensus workflow.
- **14: Mark Conflict-Resolved Map Record as Ready for Publication (A):** Identify cases of concepts for which conflicting map records were resolved. Mark the final, correct, map record for the concept as ready for publication. Where conflict cannot be resolved by the map lead, there should be a process for sending it through the consensus workflow.
- **15: Terminology Update (N/A: external):** Periodically, the terminologies involved in the mappings will need to be updated to more current versions. This may result in new

concepts to be mapped, changes in existing mappings, and in some cases map records will need to be retired as the underlying concepts will no longer be active. This process is handled externally to this workflow and may feed new concepts in to the next editing cycle.

6.2 Batch State Diagram



The batch state diagram is an approximation of the concept state diagram based on tooling that knows how to interact with batches. In this case, the tooling is described in terms of the standalone mapping tool and the supporting back-end workflow script-based tooling developed by NLM.

Batch States:

- **a: Pre:** concepts exist only on initial list, no batches yet.
- **b1, b2, b3: Allocated Batch:** concepts have been portioned into batches (legacy and non-legacy) ordered by SNOMEDCT tree in groups of approximate size 50
- **c1, c2: Assigned Batch:** the batch has been assigned to 1 or 2 map specialists
- **d: Abandoned Batch:** A batch that has been left in an incompletely edited state. Some of the concepts may be mapped others may not be mapped. A determination must be made as to whether the entire batch should be reassigned, or only those non-edited portions. This decision is made more complicated if it is a non-legacy batch and only one of two map specialists partially abandoned the work (or both partially abandoned it but in different ways).
- **e: Finalized Batch:** A batch that has been completely edited, saved, and marked as done.

- **f: Allocated Conflict Batch:** conflicted map records from two (or more) edited versions of a batch are allocated to a conflict batch (of the same name).
- **g: Assigned Conflict Batch:** A conflict batch that has been assigned to a map lead. If abandoned, it is simply reassigned to a new lead (there is no "abandoned conflict batch" state). Where conflict cannot be resolved by the map lead, there should be a process for sending it through the consensus workflow.
- **h: Resolved Conflict Batch:** A conflict batch in which all conflicting map records have been resolved. Where conflict cannot be resolved by the map lead, there should be a process for sending it through the consensus workflow.
- **i: Ready for publication:** A batch whose contents (or portions of its contents) that is ready for publication. If there are no conflict states, an entire batch becomes ready for publication. If there are, those non-conflict states become ready for publication and the conflict states must be resolved. Once resolved, they then are added to the ready for publication batch.

Tools:

1. Batch creation tool
    - **a.** Requires UNIX environment with network access to Collabnet mapping workspace repository
    - **b.** Allocates initial concept pool to batches
2. Subversion client (third party tool)
    - **a.** Requires network access to Collabnet mapping workspace repository
    - **b.** Loads allocated batches into repository
3. Status tool
    a. Requires UNIX environment with network access to Collabnet mapping workspace repository
    b. Report on the status and history of a concept, including all mappings that it has received (through the conflict resolution process).
    - **c.** Report on the complete history of a batch (including current states of each map/concept in the batch).
    d. Report on the complete history of a map specialist (or lead), including states of each of the batches that has been assigned to them
    - **e.** List map specialists (or leads) who have been assigned a particular batch.
    - **f.** List batches in a particular state (e.g. assigned, unassigned, finalized, legacy reassigned, conflict, conflict assigned, conflict resolved, etc)
4. Conflict identification tool
    a. Requires UNIX environment with network access to Collabnet mapping workspace repository
    - **b.** Identify conflicts and generate master legacy-reassign or conflict batches
    c. Mark non-conflict maps for publication.
5. Publication tool

a. Requires UNIX environment with network access to Collabnet mapping workspace repository
b. Process resolved conflict batches for publication

Workflow Operations/Tooling Support

1. Batch Creation plus loading into batches Subversion repository
    a. DOCUMENTATION: n/a
    b. TOOLS: Batch creation tool, Subversion client
        i. Batch creation tool used to allocate priority list concepts to legacy and non-legacy batches, order them by SNOMED CT hierarchy, and organize them into batches of about 50 concepts each.
        ii. Subversion client is used to load batch creation infrastructure into Collabnet (or other) Subversion repository for remote access.
    c. DESCRIPTION:
        i. Contents are ordered according to SNOMED CT hierarchy
        ii. Batches average about 50 concepts
        iii. Batches are organized into “legacy” and “non-legacy” areas.
2. Assignment of batch to a map specialist
    a. RECURRING: Manual action by a map lead, performed once or twice per batch, also for the map specialist to assign a batch to themslves
    b. DOCUMENTATION: See *Mapping Tool Workflow Guide (*to be developed)*: Assigning a Batch.
    c. TOOLS: status tool
        i. Status tool used to report batches that have not been assigned
        ii. Status tool used to report batches that have been assigned
    d. DESCRIPTION:
        i. Assigned batches are Subversion *branches* of the master “legacy” and “non-legacy” repository projects.
        ii. “legacy” batches should be assigned to a single map specialist
        iii. “non-legacy” batches should be assigned to two separate map specialists.
        iv. An email should be sent to the map specialist with details of the batch, informing them of the assignment.
3. Editing of a batch
    a. RECURRING: Manual action by a map specialist in response to being assigned a batch, performed by each map specialist for each batch.
    b. DOCUMENTATION: See *Mapping Tool Workflow Guide*: Working with a Batch
    c. TOOLS: Status tool
        i. Status tool used to identify edited batches that have been finalized (marked as *done*).

ii. Status tool used to identify batches assigned but not yet finalized (in progress)
iii. Status tool used to report on batches of a particular map specialist

d. DESCRIPTION:
i. Map specialists assign mappings for the concepts in their batches.
ii. Work can be saved at any time.
iii. Work can be committed at any time.
iv. When all work on a batch is completed, it should be *finalized*, or *marked as done*.

4. Handling of an assigned but never completed batch.
a. RECURRING: Manual action by a map lead in response to being informed that a batch was abandoned. Performed by a map lead each time an assigned batch is abandoned for any reason.
b. DOCUMENTATION: n/a
c. TOOLS: n/a
d. DESCRIPTION: If a map specialist abandons a batch before it is finalized, it should be removed from that specialist's area and reassigned to another specialist. For this, see the stage "Assignment of batch to a map specialist" above.

5. Processing of an edited batch: disagreement between a map specialist and a legacy map
a. RECURRING: scripted action by administrator in response to a legacy batch being finalized, performed for each legacy batch finalized by a specialist
b. DOCUMENTATION: n/a
c. TOOLS: Conflict identification tool, Status tool
i. Conflict identification tool used to identify cases where a map specialist has disagreed with a legacy map and allocate new batches for later reassignment and editing.
ii. Status tool used to identify batches that have been finalized and are now ready for this process.
iii. Status tool used to report on the status of each concept from a batch, indicating those that have been prepared for reassignment due to disagreement with a legacy map
d. DESCRIPTION:
i. Verify that legacy batch has been finalized and is a branch of the expected master.
ii. In any case where the map specialist *dis*agreed with the legacy map, create a legacy-reassign batch of the concepts involved in the disagreement.
iii. Later, this batch will be assigned to another map specialist.

6. Reallocation of an abandoned batch.
a. RECURRING: manual action by administrator in response to a map specialist abandoning a partially or completely unedited batch.

b. DOCUMENTATION: n/a
c. TOOLS: Status Tool
    i. Status tool used to identify uncompleted batches assigned to a particular map specialist.
d. DESCRIPTION:
    i. For now, this is handled as a completely ad hoc and manual process. If a specialist abandoned a batch and we want to save the specialists work, we have to split this batch and resolve any disharmony with respect to other map specialists working on the same batch.
    ii. This should be avoided if possible (if not too much trouble, just reassign the entire batch to a new specialist and redo the work).

7. Processing of an edited batch: marking concepts/batches as “ready for publication”
    a. RECURRING: scripted action by administrator in response to a batch begin finalized, performed for each legacy batch finalized by a map specialist, or each non-legacy batch finalized by two map specialists, or a legacy-reassign batch that has been finalized by a map specialist.
    b. DOCUMENTATION: n/a
    c. TOOLS: Conflict identification tool, Status tool
        i. Conflict identification tool used to identify cases that are NOT in conflict and do not have any other workflow issues.
        ii. Status tool used to identify batches that have been finalized and are now ready for this process.
        iii. Status tool used to report on the status of each concept from a batch, indicating those that have been marked as ready for publication.
    d. DESCRIPTION:
        i. Verify the batch has been finalized and is a branch of the expected master.
        ii. For a legacy batch, in any case where the map specialist agreed with the legacy map, copy those concept mappings from that batch to the publication area.
        iii. For a non-legacy batch, in any case where the two map specialists agreed with each other, copy those concept mappings from that batch to the publication area.
        iv. For a legacy-reassign batch, in any case where the reassign map specialist agreed with the original map specialist, copy those concept mappings from that batch to the publication area.
        v. A map category of ACT, INC, or AWH will indicate further review is needed.
8. Processing of an edited batch: conflict identification
    a. RECURRING: scripted action by administrator in response to a batch being finalized, performed for each legacy batch finalized by a specialist, or each non-legacy batch finalized by two specialists, or a legacy-reassign batch that has been finalized

b. DOCUMENTATION: n/a
c. TOOLS: Conflict identification tool, Status tool
    i. Conflict identification tool used to identify cases that ARE in conflict between two specialists and create a master set of conflict batches for later assignment and review. The algorithm for *conflict* has a lower bound of “any difference except in editorial notes”. If more sophisticated algorithms are needed, they can be devised.
    ii. Status tool used to identify batches that have been finalized and are now ready for this process.
    iii. Status tool used to report on the status of each concept from a batch, indicating those that have been identified as begin in conflict.
d. DESCRIPTION:
    i. Verify the batch has been finalized and is a branch of the expected master.
    ii. For a non-legacy batch, in any case where the two map specialists *dis*agreed with each other, create a conflict batch containing those disagreements. The conflict batch will have the same name as the original batch but will only contain entries for those mappings in conflict. The conflict batch will contain both the specialists’ edits.
    iii. For a legacy-reassign batch, in any case where the reassign map specialist *dis*agreed with the original map specialist, create a conflict batch containing those disagreements. The conflict batch will have the same name as the original batch but will only contain entries for those concept mappings in conflict. The conflict batch will contain both the specialists’ edits as well as the original legacy map.
    i. In both cases, conflict batches contain a *resolved* folder, into which the final, resolved map is to be placed (and will then be ready for publication, barring other issues). The folder will contain details of the conflict and also the resolution

9. Assignment of a conflict batch to a map lead
    a. RECURRING: Manual action by a map lead in response to conflict batch creation, performed for each conflict batch
    b. DOCUMENTATION: See *Mapping Tool Workflow Guide*: Assigning a Conflict Batch.
    c. TOOLS: status tool
        i. Status tool used to report conflict batches that have not been assigned
        ii. Status tool used to report conflict batches that have been assigned
        iii. Status tool used to report conflict batches assigned to a particular lead
    d. DESCRIPTION:
        i. Assigned batches are Subversion *branches* of the master “conflict-legacy” and “conflict-non-legacy” repository projects.
        ii. Conflict batches are assigned to a map lead (for conflict and consensus review).

iii. An email should be sent to the map lead indicating they have been assigned that batch.

10. Editing of a conflict batch
    a. RECURRING: Manual action by a map lead (either with or without utilizing the consensus panel) in response to being assigned a conflict batch, performed by for each conflict batch.
    b. DOCUMENTATION: See *Mapping Tool Workflow Guide*: Working with a Conflict Batch
    c. TOOLS: Status tool
        i. Status tool used to identify edited conflict batches that have been finalized (all conflicts *resolved*).
        ii. Status tool used to identify conflict batches assigned but not yet finalized (in progress)
        iii. Status tool used to report on conflict batches of a particular specialist
    d. DESCRIPTION:
        i. Map leads review all states of the mapping, choose the best one and copy it to the *resolved* folder. The folder will contain details of the conflict and also the resolution.
        ii. The map lead then (optionally) makes additional edits as desired.
        iii. Work can be saved at any time.
        iv. Work can be committed at any time.
        v. A conflict batch is considered *finalized* when there are committed versions of all conflict mappings in the *resolved* folder.
11. Handling of an assigned but never completed conflict batch.
    a. RECURRING: Manual action by a map lead, performed by a map lead each time an assigned conflict batch is abandoned for any reason.
    b. DOCUMENTATION: n/a
    c. TOOLS: n/a
    d. DESCRIPTION: If a map lead abandons a conflict batch before it is edited, it should be deleted from that map lead's area and reassigned it to another map lead. For this, see the stage "Assignment of conflict batch to a map lead" above.
12. Publish resolved conflicts
    a. RECURRING: Scripted action by administrator in response to finalization of a conflict batch.
    b. DOCUMENTATION: n/a
    c. TOOLS: Publication tool, status tool
        i. Publication tool used to mark concept mappings from a finalized conflict batch as ready for publication. For now, this assumes that a conflict batch will always be edited to a state in which each record is ready for publication (or it will be abandoned).
        ii. Status tool used to identify concepts on a batch for which there are concept mappings marked for publication.
    d. DESCRIPTION:

i. Verify the conflict batch has been finalized and is a branch of the expected master.
ii. Copy the concept mappings in the *resolved* folder of the conflict batch to the publication area for the corresponding batch.

6.3 Example Reports

Example.1.

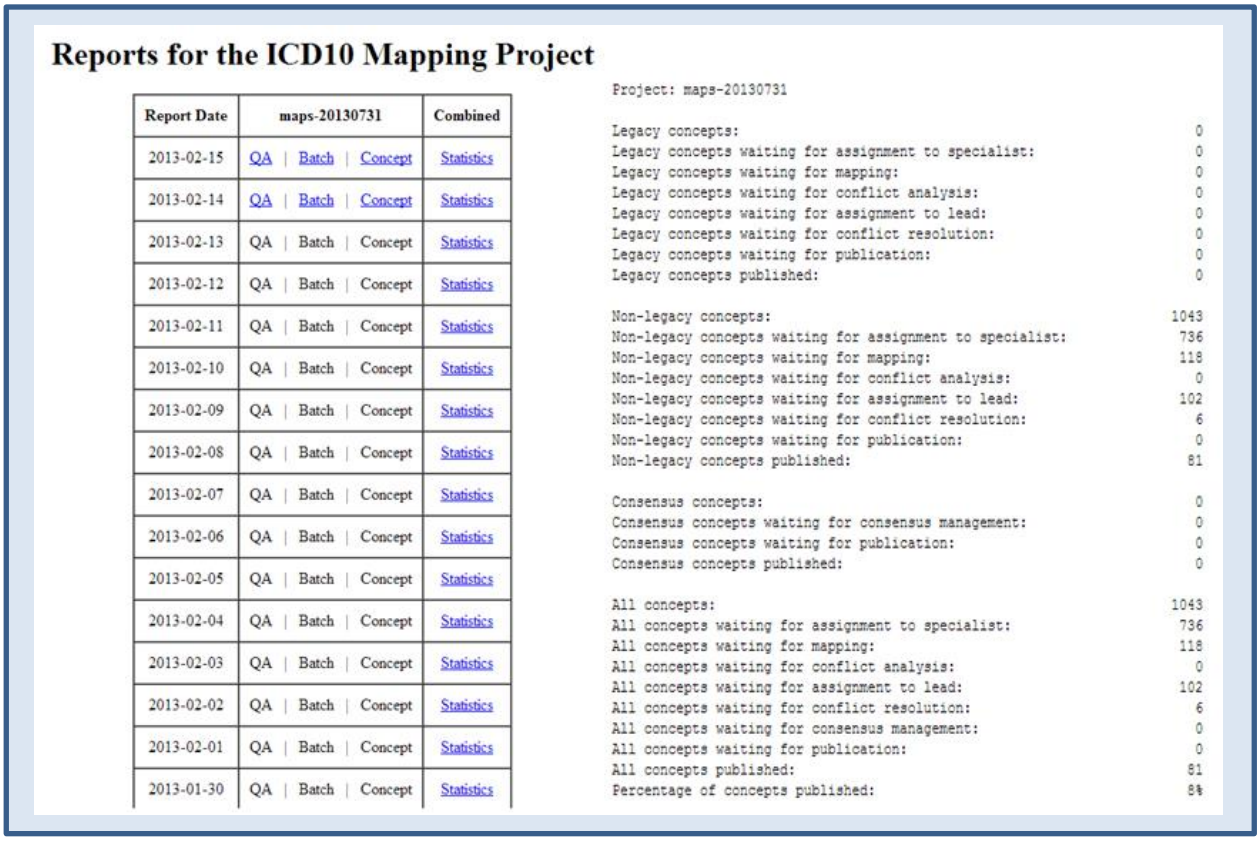
The scope of publication of the MAP includes:

- 21,819 SNOMED CT source concepts including:
- 21,256 clinical findings
- 163 events
- 400 situations with explicit context
- XX source concepts could not be assigned a map target due to issues of ambiguity or target scope
- 4,470 source concepts have complex maps
- 2,287 mapped concepts have multiple mapGroups
- 31,858 map members (map records); with a range of 1-18 members per Map group and 1-19 member per Map source concept
- 20,162 source concepts will always yield a mapTarget at run-time
- 21,068 source concepts will sometimes yield a mapTarget at run-time
- 751 source concepts cannot or should not be mapped

The source scope of the MAP was expanded to include exhaustive mapping of all children of low level concepts. Such concepts have 10 or fewer descendants. The MAP source content contains:

- 2,454 high level concepts (more than 10 descendant SNOMED CT concepts)
- 3,499 low level concepts (1-10 descendant concepts)
- 12,340 descendants of low level concepts
- 3,526 leaf concepts (no descendants)

Example.2.



Reports for the ICD10 Mapping Project

Report Date	maps-20130731	Combined
2013-02-15	QA | Batch | Concept	Statistics
2013-02-14	QA | Batch | Concept	Statistics
2013-02-13	QA | Batch | Concept	Statistics
2013-02-12	QA | Batch | Concept	Statistics
2013-02-11	QA | Batch | Concept	Statistics
2013-02-10	QA | Batch | Concept	Statistics
2013-02-09	QA | Batch | Concept	Statistics
2013-02-08	QA | Batch | Concept	Statistics
2013-02-07	QA | Batch | Concept	Statistics
2013-02-06	QA | Batch | Concept	Statistics
2013-02-05	QA | Batch | Concept	Statistics
2013-02-04	QA | Batch | Concept	Statistics
2013-02-03	QA | Batch | Concept	Statistics
2013-02-02	QA | Batch | Concept	Statistics
2013-02-01	QA | Batch | Concept	Statistics
2013-01-30	QA | Batch | Concept	Statistics

Project: maps-20130731

Legacy concepts:	0
Legacy concepts waiting for assignment to specialist:	0
Legacy concepts waiting for mapping:	0
Legacy concepts waiting for conflict analysis:	0
Legacy concepts waiting for assignment to lead:	0
Legacy concepts waiting for conflict resolution:	0
Legacy concepts waiting for publication:	0
Legacy concepts published:	0
Non-legacy concepts:	1043
Non-legacy concepts waiting for assignment to specialist:	736
Non-legacy concepts waiting for mapping:	118
Non-legacy concepts waiting for conflict analysis:	0
Non-legacy concepts waiting for assignment to lead:	102
Non-legacy concepts waiting for conflict resolution:	6
Non-legacy concepts waiting for publication:	0
Non-legacy concepts published:	81
Consensus concepts:	0
Consensus concepts waiting for consensus management:	0
Consensus concepts waiting for publication:	0
Consensus concepts published:	0
All concepts:	1043
All concepts waiting for assignment to specialist:	736
All concepts waiting for mapping:	118
All concepts waiting for conflict analysis:	0
All concepts waiting for assignment to lead:	102
All concepts waiting for conflict resolution:	6
All concepts waiting for consensus management:	0
All concepts waiting for publication:	0
All concepts published:	81
Percentage of concepts published:	8%

6.4 Review Group

Name	Role
Ian Green	Chair
Jane Millar	Senior Responsible Officer
Kathy Giannangelo	IHTSDO Map Lead
Donna Morgan	IHTSDO Map Lead
Kin Wah Fung	Map SIG Representative
Hazel Brear	Map SIG Representative
Brain Carlsen	Technical Specialist
Rory Davidson	IHTSDO Technical Manager
Robert Turnbull	IHTSDO Technical Manager