# LEARNING CONTENT DEVELOPMENT PROCESS BASED ON DITA LEARNING OBJECTS AND DIFFERENT KNOWLEDGE LEVELS

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*Abstract: Educational institutions like BMU recognizes a need to move from creating and delivering large inflexible training courses, to CCMS learning objects that can be reused, searched, and modified independently from their delivery media. This decision creates a need to define more clear strategy in the course authoring guidelines. The strategy includes standards and processes for designing and developing Reusable Registry of DITA [1] components, based on which authors can produce interactive courses with adaptive elements. This paper will present key reasons, elements and decisions in process of preparing the standard guidelines document.*

*Keywords: E-Learning, DITA, Content authoring, CMS*

## 1. INTRODUCTION

The standardization process of developing the educational content based on reusable components, known as learning objects [ 1 ], brings many benefits, among which the most important are the following:

- Raising the quality,
- Content reusability and
- Collaborative work.

The aim of this paper[1] is to emphasize the need for standardization of the process and to offer concrete recommendations for a document that formalizes the standardization.

The course guidelines is the document that guides content authors through the complete course development life cycle for an online, web-based course. The document will show how to create a course outline, how to write learning objectives, how to structure, write and design the lesson materials for online presentation, and how to write quizzes and assignments. It will also provide information about online delivery techniques and evaluation procedures.

### Terminology

The terminology can be a source of confusion and ambiguity, especially when the same term is used in two different domains. This is especially noticeable in e-learning environment. Therefore at the very beginning, we will clearly define the meaning of terms that will be used in this paper.

**LT** ─ A Learning Topic is one from a set of DITA topics (Learning Overview, Learning Content, Learning Summary, Learning Assessment, Task and Concept)

**DA** ─ Digital Asset is a file representing a Figure, Picture, Audio, Video, PDF, Power Point or Office document.

**Legacy Content** is usually used in the context of a course migration process.

**LO** ─ A Learning Object is a map of the learning topics, according to the DITA definition of LO.

**RLO** – A Reusable Learning Object is Learning Object (LO) stored in a Reusable Registry (RR) ready for reuse or re-purpose.

**RR** – A Reusable Registry is a separate space in the Content Management System (CMS), which contains LO, LT and DA, approved and ready for reuse or re- purpose.

**Author** – This term will be used for all roles that are involved in creation of e-learning content in any way.

### Technology Assumption

The prerequisite for the development of such guidelines is that an established technology for the production of content already exists. It can be assumed that an organization has a DITA authoring system - for creating and editing DITA content - based on the DITA learning and training specialization, such as QDITA [2] and LMS that supports the SCORM 2004 standard.

## 2. OTHER RELATED WORKS

There are many research and technical articles about learning objects, learning content and standardization [3, 4].

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Due to the lack of space, a review of related work is not presented here.

## 3.    REUSABLE REGISTRY (RR) – CONCEPT

Considering the time and effort invested by experts to create content, reusing content would be prudent for e-learning. Institutions could spend time on improving or localizing existing modules. The very existence of digital repositories holding modular learning objects provides an opportunity to create modules "on-the-fly" to meet various contexts.

IEEE defines reusability as: "the ability of a component to function and integrate outside the environment for which it was primarily designed."[5].

Implementation of this concept requires digital repository (pool of learning objects and digital assets) available to the authors. Many educational institutions, in an effort to follow the open access/content model, resorted to creating monolith digital repositories by using proprietary software and standards without a common data exchange format, thereby creating a major limitation in collaborative development of e-courses.

These online digital repositories have taken the approach of binding the content to the presentation layer, (Figure 1). The comfort of reusing objects and modules was missing in this approach. Driving force behind the concept of learning objects (LO) and reusable repositories (RR) was the need to separate the content from the presentation layer (Figure 2). There is no need to elaborate the importance of reusing content in e-learning.
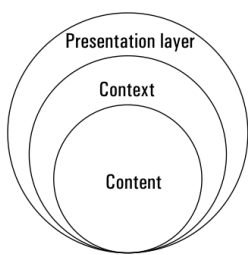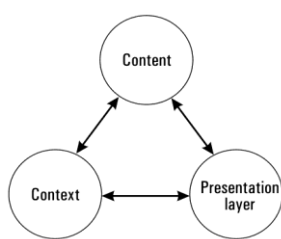


Fig 1                              Fig 2

Metadata, defined as "information about an object; be it physical or digital", of a LO is used to facilitate search and reuse of that LO. Standards for metadata such as the EEE's LOM (Learning Objects Metadata) and Dublin core metadata initiative [6] facilitate interoperability.

Around a dozen online services, which exist on the Web, facilitate the creation of digital repositories. While the creation of RR is an efficient way to store digital content, the problem arises when these objects are not sharable, reusable and adaptable in various contexts.

There are some barriers for re-usability. First of all, unstructured authoring technologies are unsuitable for reuse. To avoid this weakness, RR should be implemented as a set of structured content components. DITA standard [1] is a good choice because it is designed to enable reuse. DITA can solve or ease many of the technical problems associated with reuse. DITA support re-usability on different levels:

***Element-level reuse***. Sometimes there is a  need to reuse information at the most granular level (paragraphs, phrases, notes). DITA's solution is content referencing (conref). Any element can be a pointer to another element in another file by using the conref attribute.

***Conditionality.*** Near-identical information can be used in multiple situations. It is needed to differentiate conditions in the output.

Solution: Conditional coding.

***Topic-level reuse***

Entire topics need to be reused in different venues.

Solution 1: include a topic in multiple ditamaps.

Solution 2: include a topic in multiple ditamaps, but activate filtering.

Solution 3: reuse a topic inside a combination of topics.

***Map-level reuse***

The highest level of reuse is achieved through architecting and reusing entire maps.

Any number of maps can be embedded in a map. Our recommendation is to use reusability at the topic and LO level, and possibly conditionality.  For the needs for reusability at lower levels of granularity, we propose the use of special RR such as Glossary Digital asset Registry.

## 4. GUIDELINES ELEMENTS

The document that gives recommendations and definition of course production in BMU and similar institutions should have two sections. The first section describes the processes and roles in the process of content creation, and the second deals with the structure and recommendations for writing individual parts of content.

### 4.1.  Course Creation Process

The entire process of creation goes through 4 stages:

**Stage 1: Prewriting**

Phase of preparation. Most important parts here are planning and course structure definition.

**Stage 2: Writing and revising**
Phase of content production. It goes in multiple cycles that include writes and changes.

**Stage 3. Editing**
APhase where reviewers give their opinions and further improvement recommendations.

**Stage 4. Publishing**
The final step of the writing process is publishing. This means putting the course content into LMS and makeing it available to students.

The process of creating the course content will typically involve more people with different roles throughout the process. (Figure 3).
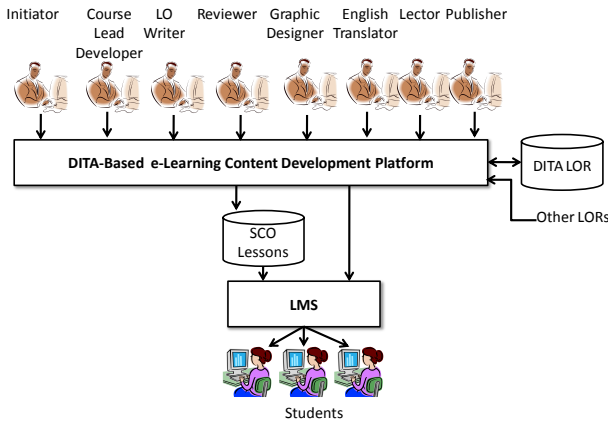


Figure 3: Typical roles of the content development

These roles need to be clearly and precisely defined in the guidelines document. This is particularly important when the content is used for the preparation of a software system.

1. *Course Initiator and Approver (CIA):* She/he initializes the course content development project, specifies the course aim, descriptions, learning objectives and structure in the Course Content Initiation Project Document (CCIP Document). Practically, this specifies the Course Overview and is the first part of the Course Syllabus Document. CIA assigns a person (typically a professor) to be the Course Developer Lead. At the end of the development process, CIA also approves the achieved results.

2. *Course Developer Lead (CDL):* She/he creates the course structure, with all lessons and their topics, learning outcomes, examples and study activities. He/she finds already developed DITA learning objects (LOs) in the reusable DITA LOR and other accessible LORs. CDL assigns LO development tasks to LO Writers and manage and validate their work. CDL integrates the developed LOs, together with all digital assets (figures, tables, audio and video objects).

3. *LO Writer (LOW):* One or a group of LOWs develop LOs needed for each lesson. Typically, they can be teaching assistants or external experts with specific knowledge and skills. LOWs find needed information and develop LOs, according to the specifications obtained from CDL.

4. *Digital Asset Designer (DAD):* DAD is a technical person using offline software tools to produce digital assets. CDL or LOW can assign tasks to them. Typically DAD works on designing some illustrations, tables, figures, video clips, and other possible digital assets. She/he takes care about the course style. She/he provides digital assets in course space in suitable formats for LOW and CDL.

5. *Lector for Serbian or English language (LS or LE):* She/he provides the correctness of textual information objects in Serbian and/or English language.

6. *Reviewer (R):* She/he assesses the developed learning content and prepares the Review Report document. ]

7. *English Translator (ET):* She/he translates, if needed, the content into English.

8. *Publisher (P):* She/he produces the online course content in form of SCOs or other formats required by the target LMS.

9. *RR Librarian*: She/he is responsible for RR administration. He/she puts content into RR, after which such content is made available for search and use in other courses.
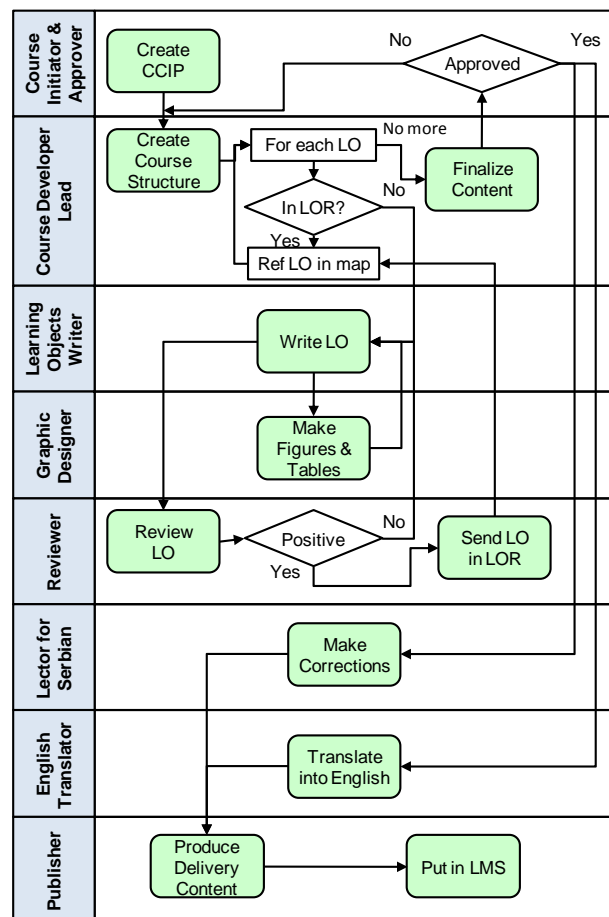
Figure 4 shows the content development process.



Figure 4: The content development process

Course Initiator and Approver (CIA) initiates the process by creating CCIP document and assigns the Course Developer Lead (CDL). She/he specifies the course structure and finds needed LOs, if available from LORs. For missing LOS, she/he assigns LO Writers. Graphic Designer helps LO Writers with needed figures, tables

and other graphic objects. Each created LO is reviewed by Reviewer. She/he prepares Review Report. If LO is not accepted by the Reviewer, LO Writer has to make corrections and send LO back to Reviewer. If LO is accepted, it is sent to LOR and to Content Developer Lead (CDL). CDL collects all needed LOs and finalizes each lesson of the course and sends the completed content (as a DITA map) to CIA for approval. CDL has to make required changes, together with LO Writers. If CIA approves the course content, then Lector for Serbian makes necessary corrections and finalizes the Serbian version of the content,  nd English Translator translates the content into English and creates the English version of the content. Both versions are sent to the Publisher. She/he produces contend in the required format for the LMS. In general, the output standard form should be in SCORM format. If LMS does not supporting SCORM 2004 4th Edition (required to support sequencing and navigation of learning activities), than the content has to be in specific formats supported by the LMS (HTML, PDF etc.).

## 4.2. Creating a structured content

When creating a structured content, a special attention must be paid to the consistency of the structure. Consistent structure will allow users to navigate through content with ease.

### Writing to the structure

Writing to the structure means that the writer has already defined outlines ("categories"), and now follows the outline and fills out  content based on the previously designed analysis.

On the other hand, writing structured, reusable content goes beyond following an outline. In addition to the outlines, writers also need written guidelines on how to write content consistently within that structure.

As emphasized in section 3 - Reusable content concept, DITA specification is a good platform for the realization of the concept of reusable components. For the realization of such content BMU will use DITA learning and training specialization.

The DITA 1.2 Learning and Training specialization [8] provides a set of specialized DITA topics, a learning interactions domain, a learning metadata domain, and a learning map domain to support creating and delivering structured learning content. According to this the content used in the course in BMU will be composed of:

| Learning Content | |
| Learning Overview | |
| Learning Summary | |
| Learning Assessment | |
| Concept | |
| Learning object map | |
| Task | |

Each DITA component has a role in the proposed structure of BMU courses.

## Structure pattern of a BMU Course

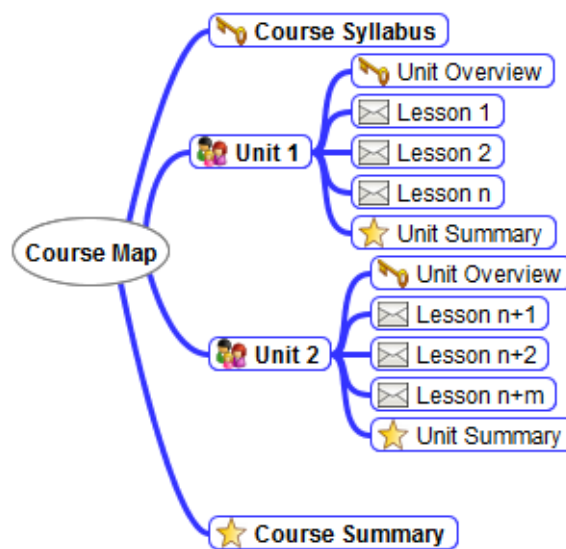Figure 5. represents a typical proposed  BMU structure.



Figure 5. Course structure

## Structure pattern of a BMU Lesson

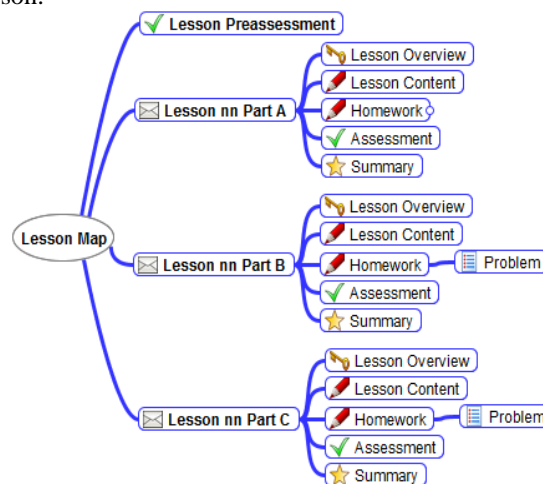Figure 6. represents a typical proposed structure of one lesson.



Figure 6. Lesson structure

DITA LO is the highest level of granularity in the reusable content.

Each content that is placed in RR is available to authors for reuse or repurpose. For the purpose of creating lessons that can also be found in RR, the use of DITA LO maps is recommended.

**Learning Content (LC)** is the key topic, used in building Lessons. Figure 6 shows the internal structure of the Learning Content component. When author creates LCs, she/he specifies what they are, what they contain, and how they are structured. The following example describes the fragments of LCs needed to get a well-structured content topic. All writers need to follow this structure to ensure the

consistently structured content. Yellow boxes indicate mandatory fragments; white boxes indicate Optional components.

**Learning Overview** is the topic, used in building Course Syllabus, Module Overview, and Lesson Overview. Figure 7 shows the internal structure of the topic. Yellow boxes indicate mandatory fragments; white boxes indicate optional components.
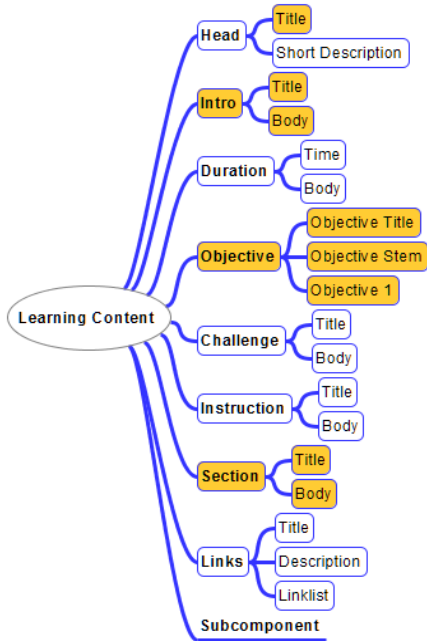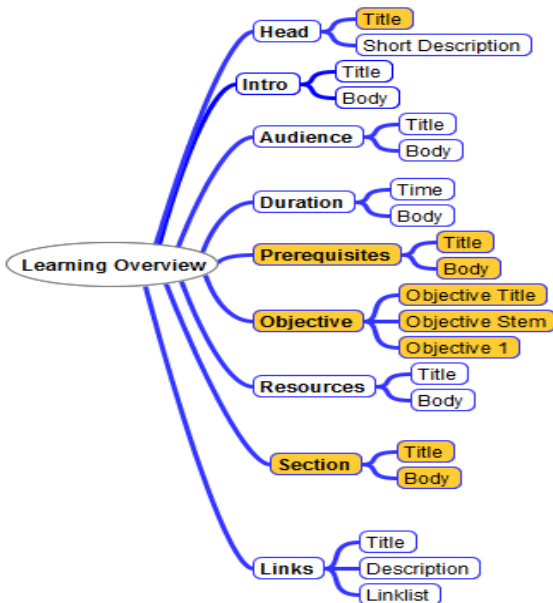


Figure 7. - Learning content structure



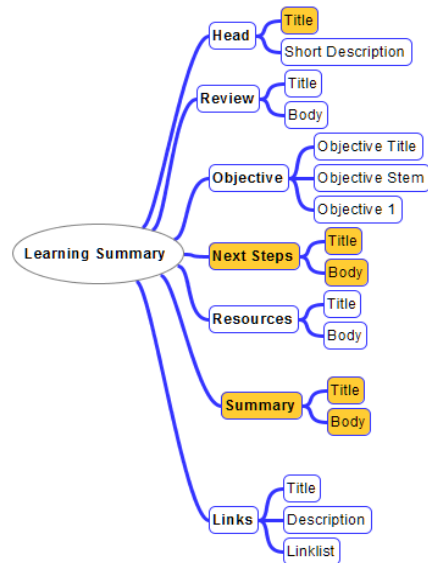Figure 8 - Learning Overview structure



Figure 9. - Learning Summary

## Issues with writing for reuse

Although writing reusable content makes sense, it's not as easy as it sounds. In article in *The Content Wrangler*, [7] Scott Abel describes "10 DITA Lessons Learned from Tech Writers in the Trenches." Lesson #5 points out that "some writers CANNOT write reusable content".

There are a number of challenges, to avoid this fact. Some of them are:

- Authors need to plan ahead; they need to thoroughly analyze the content in order to create a reuse strategy which will not compromise the content.

- To ensure that the content can be used in different places and media, authors need to follow guidelines that ensure the content consistency.

- Authors need to make sure that content is identified properly with the use of metadata, so that others can easily find it and reuse it.

- Sometimes authors need to create content outside of its context, having in mind that it will be used within a certain context.

### Planning for reuse

Planning where and how to reuse content will help overcome some of the challenges. Author's first task should be to figure out where content will be used. Online Course? Book? Collateral? Online help? Handheld device?

Determining where content will be reused and thinking about how it will be structured for reuse is the beginning of creating information architecture. The information architecture describes the containing course elements and their order, as well as the structure of the individual LOs.

At a very basic level, the information architecture might look similar to the one showed in Table 1, with M indicating mandatory, O indicating optional, and a blank cell indicating a LO, or the a ITA component is not required in that information product:

| LO/ DITA Component | Process A | Process B | Process C |
|---|---|---|---|
| Definition of Supply chain | M | O | O |
| Case IKEA | | M | M |
| Quiz 1 | M | | |
| Quiz 2 | | M | |
| Quiz 3 | | | M |

When authors know that they will reuse certain components such as "Case IKEA", they can plan how to structure and write them to support reuse.

### Glossary

In technical writing, it is preferred to use one term to consistently express a given concept, so that communication is clear, and to keep translation costs low. Consistent application of this approach can significantly improve the quality of teaching materials, and can eliminate potential confusion introduced by inconsistent terminology, different definitions for the same concept, and so on. For this reason, when synonyms and variants do exist in popular usage, it is common practice in commercial environments to choose one of the terms as the "preferred term".

Among content developers, there is an increasing requirement to be familiar with synonyms, acronyms and abbreviation. To address these requirements, DITA 1.2 has added a glossary specialization with a markup that supports Terminological information. The Specialization [8] serves as container to the Glossary entry for Term Definition, Acronym, Synonym, Short Form and Abbreviation. In accordance with the proposed specialization, we propose the introduction of a single Glossary on the University level following the same principle proposed for the LO. Therefore a glossary entry should be a part of the Reusable Registry. The Guidelines document should introduce internal rules (or process), which define the handling of records in a Glossary, including the initial creation, approving and status changing.

### 4.4. Migrating from legacy content

Migration from legacy content is an important part of guidelines document. It defines and proposes the migration methodology. One of the goals of the guidelines is the migration of the existing course content, to the new environment using the DITA structural writing methodology. Migration of old content is a complex and specific task. For each specific case it is necessary to develop a procedure to provide clear instructions on how to implement the migration process. In this paper we will only mention the elements to be included in the migration methodology.

The proposed methodology:

**Phase I - Analysis**
- Analyze content.
- Analyze exporting content.
- Categorize content.
- GAP analysis of needed mapings of legacy course structure to the course structure in DITA Learning Map and DITA Elements.

**Phase II - Semi-automatic tools**
- Identifying material that is suitable for automated translation and developing an appropriate XSL transformation. Transforming the HTML content into DITA.
- Identifying the need for development of the output classes.

**Phase III - Migration**
 Reorganization of content into a format suitable for migration: The classification of the material of the legacy content, quizzes and HTML candidates for transformation into DITA
- Import Legacy material into Reusable Registry.
- Creating Learning Maps.
- Identifying material that is to be picked manually.
- Import legacy material into a course project.
- Import external material into a course project.
- Reference DITA components into a map.

**Phase IV - Preview and Verification**
- Preview in QDITA Authoring Application.
- Publish.
- Check output.

### Using offline tools

Digital assets can be divided into two groups:
- Media files (images, videos, audio)
- Digital library (reading chapters - pdf documents, flash objects, PowerPoint presentations, web site archives)

All of these assets can be prepared offline, using any appropriate application. There are no restrictions on the software used to create them, it is only important that the output format is appropriate, so it could later be imported into the project.

## 5. CONCLUSION

The need to standardize the process of creating interactive courses for educational institutions, such as the BMU, has been identified in this paper. An emphasis has been also put on the essential elements that have been a part of the course preparation guidelines document development. Also, additional emphasis has been put on the importance

of structured writing and the Reusable Repositories of Learning Objects.

This paper also identified potential problems with providing access to the development of the Reusable Learning Objects registry, based on the DITA Learning and Training Specialization, with explanations on how to overcome these problems. Moreover, the structure for online courses has been proposed, along with the overview of the migration process for existing legacy content.

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