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A Digital-First Authoring Environment for Enriched e-Books using EPUB 3

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Abstract. The overall majority of books are currently being made with primarily a printed outcome in mind. To make a digital version of these books, most manuscripts need to be re-processed, which usually results in customary built e-books. This need for a customized authoring workflow for every electronic version of a book makes it impossible to build e-books in a cost-effective way. In this paper, we propose a novel workflow that incorporates both print and digital book authoring.

By charting the currently most widespread workflow Flemish publishers use to author print books and e-books, we are able to identify the most pressing problems. These are the print-first approach, the vendor lock-in situation of the e-reader market, and the high cost of updating and/or maintaining the content of an (e-)book. To overcome the aforementioned problems, we devise a new workflow that follows a digital-first approach using Open Web standards, separating content, structure, and layout. We evaluate the proposed workflow by building a proof-of-concept authoring environment.

Using this new workflow, both digital and print books can be built without significant additional costs. The proof of concept is evaluated using an experts group of Flemish publishers, and received general positive reception, with concerns on how to incorporate the proposed workflow into production environments. By not limiting the proof of concept to a fixed data model, it could handle content from more content providers, facilitating further research into the possibilities and future requirements of the EPUB 3 specification.

Keywords. Authoring environment, EPUB 3, Open Web standards

Introduction

In recent years, digitized and possibly enriched versions of print books (*e-books*) have evolved from a novelty to an integral part of the book reading market. More and more people are reading digitally, and there are many indications this trend will continue, resulting in a market where e-books will become at least as important as their printed counterparts [1].

Meanwhile, e-book authoring is usually seen as an afterthought, and the authoring of most books is still largely based on the same publishing and associated printing techniques of the last decades of the twentieth century (i.e., *print-first*) [2]. These workflows

follow a basic **linear progression**, from the author that provides the content to the publisher that prints that content, after which e-books are produced.

However, there are three main discrepancies between print book authoring and digital book authoring:

- Authoring for print books is primarily **page-centric** instead of content-centric, which results in a tight coupling between content and layout.
- Current publishing software enforces a **print mindset**, therefore lacking digital-only book elements such as interactive quizzes, animations, and videos.
- Print book authoring has only one outcome in mind, whereas digital book authoring requires the need for **multi-platform publishing**. Indeed, digital books are not only read on e-readers, but also on smartphones, phablets, tablets, and desktops [1].

Besides the great diversity among current reading platforms (e.g., smartphone versus desktop), there is also a great diversity in terms of e-book formats [1]. As *EPUB 2*, the previous standard for e-books, could not handle advanced interactivity and multimedia features, e-reader vendors developed **custom e-book formats** to provide advanced features to their readers. These custom formats are not portable between reading systems, and force customers to reside with one reading system [3], as customers would have to re-buy their e-books if they would switch between vendors. This situation is called *vendor lock-in*. Examples of vendors and their formats include (1) Amazon, with its proprietary format KF8 for Kindle, and (2) Apple, with its iBooks format. Note that Apple e-readers currently also support the open EPUB 3 format [4].

The above-mentioned three discrepancies, and the existence of multiple e-book formats contribute to the fact that authoring a digital book based on a print book format is cumbersome and labor intensive. First, the content has to be decoupled from the print layout and a new digital layout has to be devised. Second, books have to be enriched afterwards by experts on a book per book basis. And third, different e-book formats have to be ported to one another, and possible corrections in the manuscript have to be propagated to all used e-book formats.

This current situation leads to the so-called **e-book price paradox**. Publishers are motivated by the market growth to author e-books as well as print books, but the extra effort needed to author e-books increases their price [5]. In the meantime, the consumer market expects a digital book to be cheaper than a printed copy, assuming that there are practically no costs associated with the authoring of e-books. Publishers are thus forced to lower their prices, making it currently impossible to author e-books in a cost-effective way [6]. This holds especially true for small organizations, which typically have less technological and budgetary resources than market leaders. As such, a strong need exists among publishers for tools that allow overcoming the issues that contribute to the high cost of current e-book authoring.

The remainder of this paper is organized as follows. After a review of previous research efforts in Section 1, we analyze the current publishing workflow of Flemish publishers in Section 2, subsequently identifying and discussing the most prominent issues. In Section 3, we introduce a new workflow. Next, in Section 4, we discuss and evaluate the proof of concept authoring environment that we have built to validate the newly proposed workflow. Finally, we present conclusions and directions for future work in Section 5 and Section 6, respectively.

1. Related Work

Previous analysis of a print-first workflow has resulted in two general recommendations on accommodating this workflow to the new requirements of authoring e-books. In the first recommendation, the book is processed as usual, using current printing techniques, after which a conversion is performed to make the book ready for digital publication [7]. The second recommendation states to completely redesign the workflow to be adaptable to both the traditional print books and the newer e-books [8]. Because of the heterogeneous e-reader market [1], developing a general authoring tool to output all e-book formats is labor intensive, and many publishers have adopted the first alternative to lower development costs [9].

There are a number of digital book authoring tools that do exist (e.g., OERPUB, PressBooks, and Pubcoder, but none of them are built with general applicability in mind. Moreover, these tools typically have a limited support for interactivity and multimedia features, and have very limited customization options. There also exist digital-only distribution channels (Issuu/Open Edition) and hybrid sites that offer personal authoring and publishing facilities (Ourboox). However, all these alternatives¹ are targeting authors. As they lack the link with print book publishing, and are tailored to individuals publishing their own digital books, they cannot be used in current publishing environments.

Meanwhile, since the fall of 2011, the IDPF² finalized EPUB 3, the latest version of the open e-book standard [10]. The most important improvement of EPUB 3 in comparison with EPUB 2 is the **support for Open Web standards**, including *HTML5*, *CCS3*, and *JavaScript*. By fully supporting those standards, the possibilities of the e-book format have increased greatly, and adding interactivity and multimedia features to an e-book has become easier and more maintainable [11, 12], foregoing the need for vendor-specific solutions to build enriched e-books.

With EPUB 3 supporting advanced features by default, custom formats are no longer necessary, making it possible for the e-reader market to become more homogeneous. Publishers can now choose to build valid EPUB 3 e-books, supporting interactivity and multimedia features, and the need no longer exists to port this EPUB 3 to custom e-book formats. This makes rethinking the current authoring workflow more advantageous than trying to extend the current workflow of print book authoring that uses e-book authoring as a last step [13, 14].

2. Current Workflow for Digital Book Authoring

By querying an experts group of nineteen publishers, we identified the **most widespread workflow** in which books are currently being authored in Flanders, resembling the publishing chain used in Britain and America, as presented by J.B. Thompson [9] (Figure 1). The dashed arrows indicate where no automatic conversion between formats is possible.

Analyzing this workflow together with the experts group, we identified three major problem areas that need to be solved in order to be able to move towards cost-effective e-books: the current *print-first approach*, *vendor lock-in*, and the *costs of corrections and updates*.

¹www.oerpub.org, www.pressbooks.com, www.pubcoder.com, www.issuu.com/openedition, and www.ourboox.com, respectively

²<http://idpf.org/>

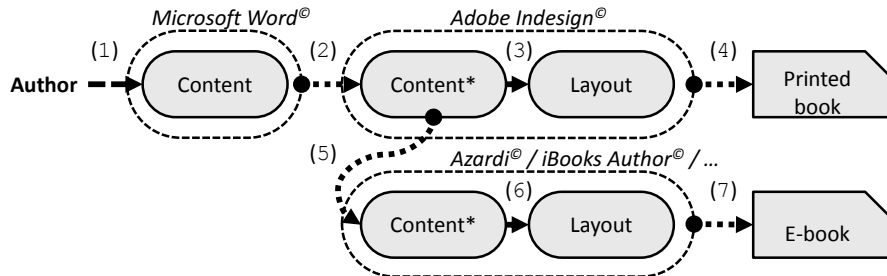


Figure 1. The current workflow books are usually produced in, identified by querying an experts group

Print first The making of a new book starts with the writing of a text by an author using text processing software (1). Then, once the author has finished his or her version of the text, this version is provided to the publisher (2). In a number of cases, a selection is made out of the provided content to appear in the book, which is denoted in Figure 1 by the asterisk at *Content**. Then, layout and structure are added to the content, using specialized software (3). After the layout has been completed, the book is ready for print (4).

However, when a proper electronic version of the book is requested, the **structure and layout usually need to be redone** (5, 6). This is because of the fact that the proprietary format of layout software is tailored to meet the strict requirements of a print book, whilst e-books generally provide a lot more possibilities than a print book. A digital book can have a dynamic layout, adjustable to the reading environment, with interactivity and multimedia features, and dynamic content. These are properties that are not present in a print book, and that have to be added afterwards, which is a cumbersome and expensive task.

Vendor lock-in Our inquiry made clear that a significant amount of authoring print books is done using proprietary software. *Microsoft Word* is the prevalent market leader among authors to write their content in, and *Adobe Indesign* is mainly used to edit the structure and layout of a print book. When authoring e-books, many software packages exist, but *Azardi* and *iBooks Author* are used primarily.

Also, most e-book authoring software is still tailored to output proprietary e-book formats. This vendor lock-in leads to very strict **limitations with regard to innovation and creativity**, since vendors often decide to only partially implement a standard, to guarantee their vision of what a good user experience constitutes [15]. For example, Apple poses significant limitations on their devices regarding interactive scripts and simultaneous video playback [16].

Corrections and updates Because of the uni-directional way of making a book (the author provides the content, after which the publisher puts the content in a certain layout, and where the result is finally published in different formats), it becomes very challenging to make adjustments once in the layout phase of the workflow. These adjustments can no longer be done by the author, but have to be done by the layout designer, as these layouts are made in a specialized application, and there is **no current way of updating the content without interfering with the layout**.

The situation worsens in a *multi-channel* publishing environment. As we see that usually no automatic conversion is possible between the content of a print book and

a digital book ((5) of Figure 1), the content does not only have to be adjusted in the layout software for the print book, but also in the specialized software for authoring the electronic versions of the book.

3. Proposed Workflow

As EPUB 3 fully supports the latest Web standards, it becomes clear that e-books are shifting from static content pages towards **packaged interactive web pages** that can be easily accessed offline. This opens the possibility to rethink the authoring of e-books as if it were designing Web pages. Many concepts of Web design can thus be reused to our advantage.

Our proposed workflow, as depicted in Figure 2, tackles the most prominent issues with the current way of authoring books, listed in Section 2. As also suggested by Silva and Borges [8], a dynamic information flow is devised, focusing on digital publishing with a clear division between content, structure, and layout.

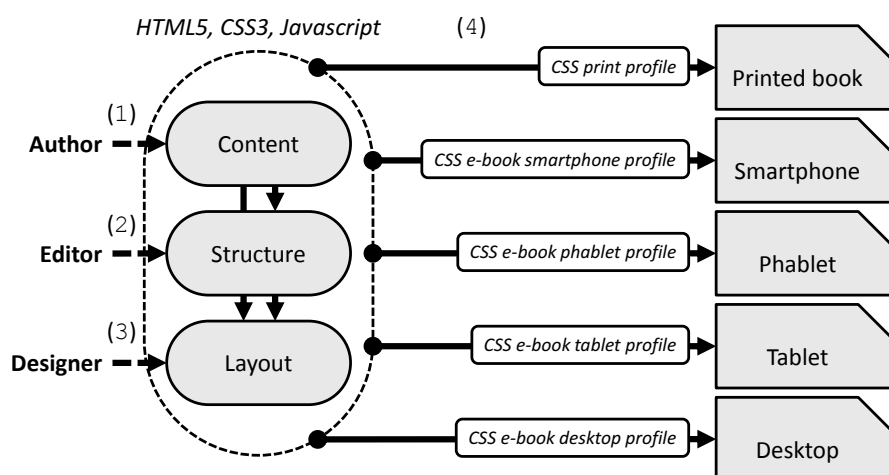


Figure 2. The proposed workflow, tackling the most pressing problems of the current most widespread workflow of (e-)book authoring

Focus on digital As e-books offer a lot more possibilities than traditional books, the proposed workflow focuses on the digital product. By using tools that focus on a digital outcome instead of a printed outcome, a book can be created that makes full use of the possibilities provided by the Open Web standards.

By using *graceful degradation*, a concept that originates from the area of Web design [17], a book can be authored once, and visualized differently in multiple reading systems. When using graceful degradation, the most advanced interactivity and multimedia features can be integrated as primary content, and *fall-backs* are introduced as a replacement when a reading system does not support those advanced features. For example, when a video is embedded in a book and a printed version is requested, a fall-back

can be created as a representative still from that video, a textual representation, or the video could be omitted in the printed version altogether.

Using this concept, only one version of the book is necessary, as long as good fallbacks are used for different reading platforms. The distributed versions of the book are then all alike for different reading platforms, except for the **different styling profiles** that are applied to the different versions ((4) of Figure 2).

Division between content, structure, and layout To address the problem of maintaining corrections and updates, we envision a strict division between content, structure, and layout, as it is the case in modern Web design. As shown in Figure 2, authors, editors, and designers can work collaboratively ((1), (2), and (3)), and their changes are **automatically passed on to each other** (as shown in Figure 2, using the filled arrows between *Content*, *Structure*, and *Layout*).

Open standards A logical consequence of focusing on a digital outcome is the embracing of the latest Web standards to produce an e-book. As is shown in Figure 2, no proprietary software is part of the publishing workflow. By using the same open standards that are used by EPUB 3, **no conversion is needed** between the content built by the authoring tool and the packaged e-book (hence the filled arrows between the application and the (e-)books). This idea results in an integrated design software which is purely Web based, where the author and publisher can both work in, without the need of proprietary software.

4. Proof of Concept

To validate the proposed workflow, we have built a proof of concept implementation, resulting in a **Web-based authoring environment** using a *Software as a Service* (SaaS) model, i.e., an application completely running in a web browser. This proof of concept is the result of multiple iterations of rapid prototyping [18]. These iterations have undergone multiple feedback sessions with the experts group, in the form of meetings and hands-on workshops.

A back-end provides the RESTful Web service [19] that can edit the different elements of the book, whereas a front-end is provided in the shape of a Web interface. Figure 3 depicts the system design, together with the distinctive views that are provided by the front-end. Three views are available in the application, accommodating the three most important roles in the book authoring process:

- a *content view* for the author, where individual blocks of content (e.g., a paragraph, a video, or a heading) are uniformly defined.
- a *structure view* for the editor, where (non-)linear links between chapters can be defined and content blocks can be assigned to the different chapters.
- a *layout view* for the layout designer, where visual adjustments can be made to the individual content blocks.

These separated views enable multiple people with different expertise to collaboratively work together on the same book.

Because both the application and the content are based on Open Web standards, searching content is automatically provided by any Web browser, and multi-platform

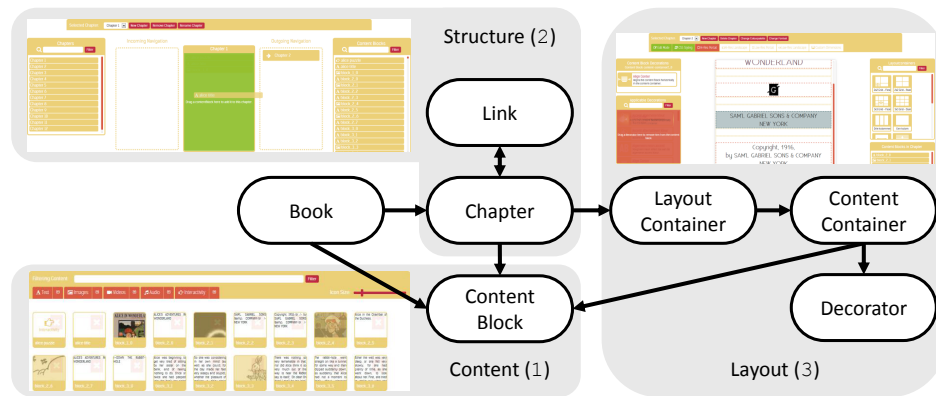


Figure 3. System design showing the division between content, structure, and layout, as well as their visualizations in the built proof of concept

compatibility is provided by default. A demo video of the proof of concept implementation is available³, where an EPUB 2 file is loaded into the application, adjustments are made to the content, structure, and layout, and where the result is exported as a valid EPUB 3 file, retaining all interactivity and multimedia features.

Content (see (1) of Figure 3) In our authoring environment, every atomic part of a book, further referred to as a *content block*, is handled individually. By design, no distinction is made between different types of content blocks. In practice, this means no distinction is made between regular text, images, videos, and interactive widgets. Also, custom types can be defined using an XML-template, making the application extensible. **The homogeneous handling of heterogeneous content** encourages content providers to cut loose from the habits of the old book authoring process, where flat text is seen as the single most important aspect of a book, and multimedia and interactivity features are added afterwards. This also implies that adding an advanced feature requires the same effort or skill as adding regular text for a user of the authoring environment.

Structure (see (2) of Figure 3) By decoupling the structure from the content, the editor can decide how to divide the content blocks between different chapters. This makes it possible to prevent particular content blocks to appear in the eventual book. That way, unfinished content blocks can be present in the authoring environment during the editing process, whilst the publisher can remain sure the exported e-book will always be a *camera-ready* version. This enables *lean publishing* [20], in which books are published multiple times in intermediate versions, to receive feedback early-on from readers, and receive traction among the readers base of publishers.

Also, no linear direction of chapters is forced by the application. Instead, *Links* can be made between chapters in an arbitrary way. This makes it possible to make a hierarchical table of contents, and to **interlink chapters in multiple ways**. This is particularly interesting for cookbooks (where chapters can be clustered by type of dish), educational books (where chapters can be linked according to multiple lesson plans), or travel guides, where landmarks can be interconnected based on their relative distance.

³http://users.ugent.be/~bjdmeest/PotF_demo.mp4

Layout (see (3) of Figure 3) The layout is decoupled from the structure and content using two types of wrappers: *layout containers* and *decorators*. Layout containers can consist of multiple *content containers*, and each content container can contain exactly one content block. The layout containers decide how content blocks are positioned relative to each other using these content containers (e.g., a caption content container underneath a main content container). The decorators add special styling to a content container (e.g., changing the color of the background of a content container).

In the front-end, a *What You See Is What You Get* (WYSIWYG) editor is provided, where designers can do the markup of a book, and possibly extend the default layout containers or decorators with custom templates.

In the layout view, it is also possible to **preview the book in different e-reading environments** (i.e., switching between the resolutions of a smartphone, phablet, tablet, or desktop).

4.1. Qualitative Evaluation

The proof of concept of the proposed workflow was evaluated using a hands-on workshop with eight organizations that are stakeholders in the Flemish publishing landscape. This includes five publishers, two ICT organizations, and the metadata center for the Dutch book trade.

Using a 5-point *Likert scale* [21] and an open questionnaire, we surveyed the participants about their prospects for (interactive) e-books in general, the feasibility of the proposed workflow in a production environment, and the usability of the proof of concept. The potential of electronic publishing is rated highly among all participant, with little variance between e-book use cases (e.g., education versus fiction). However, the proposed workflow received mild acceptance among participants. Many questions have been received about how the workflow could be integrated into their current publishing processes, and significant concerns were raised at how well the proof of concept handles already published e-books. Positive feedback has been received regarding the ease of adding interactivity and multimedia features to an existing e-book. Concerning usability, reactions were largely positive, but no consensus was found on who would gain most benefit using the proposed proof of concept (e.g., authors versus publishers). Opinions differed on whether authors are willing to write and edit their content in the authoring environment.

5. Conclusions

Based on an inquiry of an experts group, we identified the most prominent issues with the current book authoring processes in Flanders as the **print-first approach, vendor lock-in, and cumbersome corrections and updates**. We addressed these issues by proposing a new workflow that uses a digital-first approach. As a consequence, open standards can be used to output truly interactive EPUB 3 files, with elegant fall-backs for printed media.

We developed a proof of concept as a RESTful web service using Open Web standards to facilitate an evaluation of the devised workflow by a group of Flemish publishers of different domains (mostly educational and children's books). Evaluating the proof of concept, we see that although the importance of electronic book publishing is understood

by the publishers, considerable concerns are raised about incorporating this new form of publishing in their current workflow and handling legacy content.

By **handling any type of content block uniformly**, advanced features that are supported by the EPUB 3 format can be integrated into a book with no extra effort. Using a **digital-first approach**, Open Web standards can be used fully without having to take into account the limitations of the print book format. By strictly **separating content, structure, and layout**, users are encouraged to collaboratively work in parallel on the same book, without the possibility of influencing the work of each other. Also, maintenance costs are lowered, as adjustments in one editing view (e.g., Content View) are automatically propagated to the other editing modes (Structure and Layout View).

However, by using a strict data model in our proof of concept (Chapter > Layout Container > Content Container > Content Block), we are limited in supporting legacy content without a conversion between formats. In addition, connections with other publishing services and workflows become more complex. Furthermore, limiting the workflow to a purely digital-first approach creates high concerns among publishers, as it is orthogonal to their current workflow.

6. Directions for Future Work

Using a more **flexible data model**, it should be possible to handle legacy content more robustly, as well as connections with content providers through the use of services. This could result in a hybrid approach, where print and digital are handled equally, allowing for an easier integration into current workflows, thus increasing production applicability.

Also, an important factor that is currently missing from the workflow is the addition of *metadata* to the content. A well annotated e-book opens the door for books being discovered more easily, dynamic on-topic extra content, semantic search engines, etc. [1, 22, 23].

As e-books are currently only being built as a last step in the publishing process, no effort is done to correctly annotate the content in any prior steps. Moreover, as manually annotating books is cumbersome and expensive, this step is usually omitted altogether. However, with the proposed workflow, (semi-)automatic **semantic annotation can be incorporated into e-books from the very first step** of the authoring process. Indeed, the proof-of-concept that separates the content from the other parts of the authoring process is an ideal base to analyze and annotate the content in a (semi-)automatic way.

Further research is encouraged to explore solutions into incorporating annotation techniques into the proposed workflow and proof-of-concept, as to investigate the possibilities these annotations bring with them.

Furthermore, the proposed generic authoring environment can be used to do further research on experimental features of future e-book formats, as proposed by the W3C Digital Publishing Activity⁴.

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⁴<http://www.w3.org/dpub/>

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