# Novel Approach for Creation, Storage and Presentation of Online Information Content

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## Abstract

The paper provides an overview of a methodology for creation, storage and presentation of online information content (in World Wide Web environment). It is primarily intended to be utilized by open source content management systems and applications for publication of articles, news, papers etc. Open source software and, in particular, content management systems are broadly used in areas such as agriculture, rural development, public and non-profit sector. The methodology covers processes of content creation and updating in general, storage structure and presentation with consideration for sharing and exchanging possibilities. Authors can benefit from easier content creation process as well as consistent output visibility in real time. Structured and standardized storage structure can simplify development of modules, extensions or application libraries. Moreover, the process of CMS (or application) upgrade or transition to a different one which utilizes the methodology and its standards can be simplified and accelerated as well. Finally, the methodology can bring economic benefits by acceleration of CMS development and publication process.

## Keywords

WWW, information content, CMS, HTML, WYSIWYG.

## Introduction

Use of the Internet and the World Wide Web (WWW) has rapidly spread over the population during past years. The last two decades have seen a significant departure from classical printed media such as newspapers or magazines. In order to stay relevant in light of these changes, many outlets switched to online publication or at least increased their online presence (Das et al., 2009).

Establishing and managing such websites and portals have become easier as of late. At the beginnings of WWW, websites were static and to publish anything meant to write each page using raw HTML. Throughout time, dynamic technologies such as JavaScript, PHP or ASP allowed websites to become more interactive. Due to the development of internet and web technologies, especially content management systems (CMS), even users without knowledge of desired technologies (HTML, CSS, JavaScript) can manage the online content nowadays (Brown, 2014). Creating online information content mostly means writing in form of articles (in general). Most of current open source CMSs use mainly WYSIWYG editors (What You See Is What You Get). These editors strive to work like conventional desktop text editors such as Microsoft Word. Nevertheless, the output is not always as intended and seen in the editor. Some users claim that working with advanced positioning is still tricky (Masner et al., 2015). Output from these editors can potentially generate an inconsistent HTML code, which needs to be resolved programmatically (Spiesser and Kitchen, 2004). In addition, complex WYSIWYG editors can be a security thread (Javed and Schwenk, 2015).

Open source software and open source content management systems in particular are highly exploited in the field of online publication. In areas such as agricultural sector, rural development, government and local government and non-profit sector, the open source software is very popular. It is a logical way of saving expenses for own development.

Among the most important content management systems are WordPress, Joomla, and Drupal. For example, Drupal is used by US White House or Czech television. The current market share

according to WebsiteSetup (Mening, 2017) is shown in Figure 1. Other market share statistics show rather similar results.

Some CMSs, such as Drupal, are starting to provide more advanced way of content creation. The content can be composed from separate, simpler and more independent blocks using native fields and the Paragraphs module (Nikolíc and Šilc, 2016; ANON, 2017; Czerniak, 2015). Other systems have a different approach or are not this far yet. For example, posts in WordPress can be composed from blocks, but their features are limited. Joomla offers this type of content composition by providing many extensions with various different features, mostly with narrow purposes.

Internet and WWW environment has also changed the way journalism is done nowadays (Dailey and Starbird, 2014). The interactivity, social media, open journalism and other opportunities are changing the journalists work (Villi and Noguera-Vivo, 2017; Fu, 2016; Grubenmann, 2016). Contemporary journalism is not a domain of newsrooms of major media outlets anymore and is significantly expanding to non-profit sphere (Paulino and Rodrigues Xavier, 2015).

Current information content should focus not only on the appearance of the result shown in a browser but also to be accessible for humans as well as for machines (Minin et al., 2015). As (Rudman and Bruwe, 2016) stated: "Web 3.0 entails an integrated Web experience where the machine will be able to understand and catalogue data in a manner similar to humans." Content is also commonly viewed on variety of devices, especially smartphones and tablets (Šimek et al., 2014). Some media

portals have their own application, which can provide added value in comparison to simple responsive website (Mendoza, 2014). The structuring of content also helps to display it more responsively. To sum up, the structured and semantic content is crucial for the modern WWW environment.

The main goal of the proposed methodology is to bring standardisation to creation, storage and presentation of the information content in WWW environment. As Sahay (2003) shows, the standardisation simplifies software development and enables utilisation of widely used libraries, modules and frameworks based on open source code. Using open source software components has therefore a positive influence on development speed (Merilinna and Matinlassi, 2006). Current trend in web development leans towards small applications modules, reusable components and microservices. For example, ecosystem around Node.js is based on NPM packages and reusable libraries. Node.js is currently the world's fastest growing open source platform (Node.js Foundation, 2016). According to w3techs statistics (w3techs, 2018) the growth in the percentage of servers running Node.js is shown in Figure 2.

| # | WEBSITES USING | MARKET SHARE % | ACTIVE SITES | # OF WEBSITES IN MILLION |
|---|---|---|---|---|
| 1 | WordPress | 59.9 % | 26,701,222 | 239,139 |
| 2 | Joomla | 6.6 % | 2,009,717 | 13,480 |
| 3 | Drupal | 4.6 % | 964,820 | 23,330 |
| 4 | Magento | 2.4 % | 372,915 | 12,095 |
| 5 | Blogger | 1.9 % | 758,571 | 15,779 |
| 6 | Shopify | 1.8 % | 605,506 | 11,587 |
| 7 | Bitrix | 1.5 % | 200,210 | 3,925 |
| 8 | TYPO3 | 1.5 % | 582,629 | 3,568 |
| 9 | Squarespace | 1.5 % | 1,390,307 | 9,799 |
| 10 | PrestaShop | 1.3 % | 262,342 | 2,099 |

Source: Mening, 2017

Figure 1: Use of content management systems across websites.
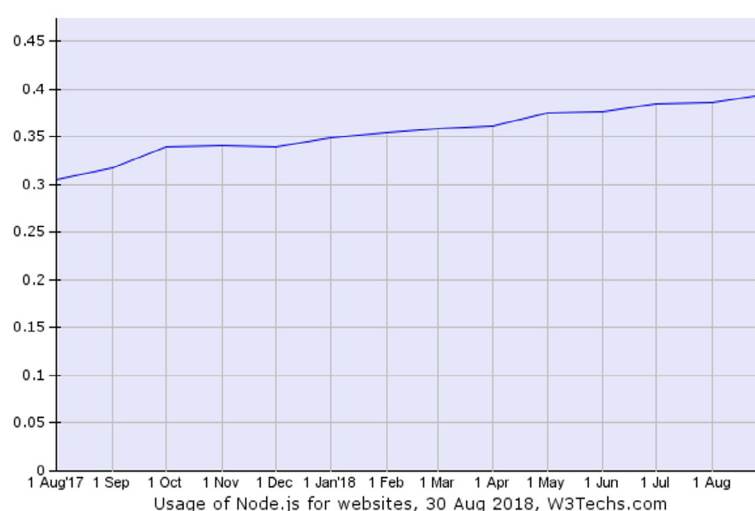
Figure 2: Usage of Node.js for websites, August 2017

## Materials and methods

First of all, we carried out a several Focus Groups sessions with editors and people authoring online information content. Focus Groups is an informal method firstly defined by Jacob Nielsen. Its goal is to determine user's needs and thoughts before the process of design and development of an application (Nielsen, 1997). The interviews conducted during the sessions consisted from the following core questions and some discussion around:

1. Could you describe the process of authoring an article?
2. Do you use MS Word or compose the article directly in your CMS?
3. Do you use any WYSIWYG in your CMS and how do you feel about it?
4. If so, is the output from the WYSIWYG editor always as it looks like while editing?
5. What is the structure of the content you commonly create?
6. How would you feel about composing an article from separate blocks?

We performed an analysis of the open source CMS market share and the applications itself. We analysed features available for content authoring and composing especially in terms of how the systems store data. We have also investigated options of transitioning between the systems or at least exporting the data to a machine-readable form such as XML(W3C, 2008) or JSON (ECMA, 2013) for subsequent usage.

One of the core ideas of the proposed methodology is a standardisation of the storage format. Current most used CMSs are using PHP and MySQL database in background. But there is also a significant growth of applications written in JavaScript, running on Node.js and using NPM packaging system (Wittern et al., 2016). These applications usually utilise a NoSQL type of database. However, many of the frameworks used are database engine independent.

Therefore, rather than defining any strict relational model, the methodology uses a Domain model of UML Class diagram. The implementation then has to follow a set structure instead of specific database model.

The online information content can be defined as the part of website that is shown to the user and holds the main independent message of a page. Specifically, it is placed inside the <article> element. To form the model, we firstly analysed what is possible to store regarding the information content and HTML. The goal is to enable structuring of content as much as possible and to be machine readable and understandable. We focused on the HTML5 specification (W3C, 2017), its Content models and possibilities of atomization. Content model in the HTML5 specification says which elements can certain element contain (W3C, 2017).

To facilitate portability of the content, an exchange format based on the storage structure needs to be defined. In WWW environment, there are basically two formats used to store and exchange data – XML and JSON. As (Sandrih et al., 2017) stated, both formats are very commonly used and are exchangeable and inter-transformable.

Many authors point out that JSON format is faster in processing and less data-intensive, especially for use with mobile devices (Nurseitov et al., 2009; Jorstad et al., 2008; Lin et al., 2012). JSON is therefore appropriate exchange format to be used within web services and by server side APIs in communication with mobile applications.

The previous chapter is currently a work in progress. The exchange format is highly dependent on a storage model. So, the results in this area are under active development and will be published within further research.

## Results and discussion

### Creation and updating of the content

Results from Focus Groups sessions can produce confusing results as users can think of needs that they would actually not use given the opportunity (Nielsen, 1997). For that reason, we subjected them to a rigorous criticism. The most important and relevant results can be summarized as follows:

- Users mostly edit their content in MS Word and then insert it into the CMS. The main reason is that the CMS tool is not as user friendly and comfortable as the desktop text processor.

- Desktop text processors saves the data immediately and works offline. Current CMS are usually written in PHP and need to reload the whole page to save the edited content. Saving content in real-time like cloud office suits do would be the solution.

- Most users create the content mainly in WYSIWYG editors. The resulting output of more complicated parts usually slightly differs.

- Users rated positively the composition of content from separate blocks. They also highlighted the need of seeing the result as immediately as possible.

- There was a consensus that there are certain content types or certain parts of content written repeatedly. The good idea would be to implement some templates. On the other hand, the templates should not be too static.

### Content storage

All the three major content management systems slowly adopt the way of content creation by composition from independent blocks. The most advanced is the Paragraphs module in Drupal. The module has most of the features mentioned above. However, it still lacks in the ability

of real-time saving and previewing of the content.

The structure used to store the content in various CMSs is usually very different and there are currently very few tools for exporting, importing or exchanging the content between systems. Therefore, if a developer decides to change the CMS, the export and import of current information content needs to be done on a database level. Typically, many web administrators start with a simple CMS and as the website grows, they end up needing a more complex one.

Regarding the specification, information content can be generally placed in the following elements:

- Headings (<h1> to <h6>)
- Paragraphs (<p>)
- Lists (<ol>, <ul>, <dl>)
- Tables (<table>)
- Embedded content (<audio>, <canvas>, <embed>, <iframe>, <img>, <math>, <object>, <svg>, <video>)

The specification for each element mentioned defines its Content model. By default, it is very generalised and open. For the purpose of the methodology, we have defined stricter Content model. It allows straightforward application of the storage model. The new rules are shown in Table 1. The table is made according to the current HTML5 specification (W3C, 2017). In order to provide valid output, limitations defined in the specification still have a higher priority.

| Element | New Content model |
|---------|-------------------|
| **h1, h2, … h6** | Elements defined in 4.5 Text-level semantics |
| **p** | Elements defined in 4.5 Text-level semantics |
| **ul, ol** | <li> elements exclusively |
| **dl** | <dt> and <dd> elements exclusively |
| **li, dd, dt** | Elements defined in 4.5 Text-level semantics |
| **table** | Table elements - <caption>, <thead>, <tbody>, <tfoot>, <tr> |
| **td** | Elements defined in 4.5 Text-level semantics |
| | Elements defined in embedded content cathegory |

Source: own processing

Table 1: Newly defined Content model.

To help in development of libraries and frameworks, there is a need to unify the form and structure of the content. Therefore, we proposed a model of the content structure. The model is shown in Figure 3 using the Domain model from UML Class diagram.

Source: own processing

Figure 3: Model for storage of the information content.

The descriptions of classes from the Figure 3 are as follows:

**Article**

Article is the main class and holds the main information about the content instance. It holds general information about the content such as title, dates, lead paragraphs, pictures etc. General metadata about the content instance can be linked here.

**Block**

Article consists of Blocks and Block groups. Block is a basic structure item of the Article. It contains an atomized content and forms the structure. Later on, it can be supplemented by metadata (e.g. Microdata).

**Block group**

Blocks can be put together into groups. The Block group class represents more complex part of content. It can be a pair of an image and a caption or anything which does not fit in a simple Block. Block group should have defined some rule for presentation. Basically, there should be at least a HTML template to assemble the Blocks within the group.

**List, Paragraph, Table, Embedded content**

These classes hold the atomized content in a machine-readable form. The form of the content is defined in Table 1.

**Simple content**

Simple content is a basic content which does not make sense to continue to divide. It is may contain elements from section 4.5 Text-level semantics of HTML5 specification exclusively. Optionally it can be contained in one element – element name attribute.

**HTML field**

Even though, all the information content should fit in the classes above, there still needs to be an option to insert general HTML. Some authors are advanced users and are familiar with HTML. Sometimes it is needed to insert a non-standard piece of code, e.g. widget supplemented by JavaScript code.

**Externally defined content**

In content management systems, a piece of content from a different source is often inserted. It is usually embedded photo gallery, poll, form or any other interactive form. In this case, the Block is only a link to an external entity. The final presentation is then provided by the CMS.

## Conclusion

Nowadays, there is a significant departure from conventional printed media. More and more information is published online. Publishing on web is not exclusively a task for professionals in the area any more. Using content management systems, almost anyone is able to run a web site and publish articles. The information content in contemporary WWW environment is read and interpreted not only by humans, but by machines as well.

WYSIWYG editors are likely to be supplanted in the near future. To ease the authoring of the information content as well as enable its easier structuring, creation by composition from separate blocks presents itself as the logical next step.

Our proposed solution follows the trends in creation structured content. There is a need to utilize templates, but some WYSIWYG features are still necessary. However, they can be minimized to basic inline text editing features (Text-level semantics). Many users mentioned that it is important for them to see the result. In response, using modern technologies, the content can be saved and the result projected in real-time. We therefore proposed the two-pane editing layout, where user edits the content on one side and see the result on the second. The composition from blocks can also help responsiveness (at the input as well as at the output) and can produce consistent and semantic HTML.

The results of the suggested approach for editing content are highly dependent on its final implementation. The live preview of the result can be even omitted, especially for experienced users. However, the strict usage of predefined templates and well-designed Block groups are necessary.

Nowadays, the development of software is driven by open source libraries and frameworks. Standardisation helps the development in this area. In addition, there are issues in exporting and exchanging content. Therefore, we proposed the unified structure of the content for storage. We used a universal Domain model from UML Class diagram instead of any database model. Although the main content management systems use solely MySQL, there is a significant growth of NoSQL databases used with JavaScript applications. The result is shown in Figure 3.

### Benefits and new opportunities

The structured composition of content can help authors produce superior content. The content can be more unified across the website as the content creation environment would lead the user to do so. The templates for repeating content types can do most of the work.

The structured form of content allows much more efficient transformation for the presentation. The content can be displayed in a different way on mobile devices and in desktop browsers. Moreover, the more stringent separation of content from appearance would help in any future redesign process. Additionally, more interactivity can be employed.

In general, the structured approach can be used not only for websites publishing news. For example, scientific journals can provide the editing environment for authors. There can be available templates specifically adjusted for the desired journal and its format. There can be defined validation rules on input, so the author is forced to insert correct formats, appropriate sizes of images, etc. Finally, the process of online or desktop publishing can be more automated and managed by software.

Open source software and, in particular, content management systems are broadly used in areas such as agriculture, rural development, public and non-profit sector. The knowledge of ICT technologies is significantly on a lower level within those areas. The proposed methodology can significantly improve working with the online content and can help produce more consistent superior content. For farmers as content consumers, it can help easier access the desired content.

In conclusion, there are opportunities for economical savings in development as well as in administration of content management systems.

### Further research

To help further research, we have developed a prototype application which implements all the findings and results we achieved. It will be used for more user testing such as Think aloud protocols.

There is still more work to be done, especially in the area of content storage. The model also needs improvements in the semantics area. It is crucial to find optimal way to attach metadata. There are various metadata formats used in connection with HTML5 including Microdata, RDFa, JSON-LD or Microformats.

Finally, the methodology will have to be consulted among the professional public in order to be accepted and implemented. The developers of popular content management systems would probably need to adjust it and propose their own improvements.

### Final summary

In previous chapters, we introduced emerging methodology for creation, storage and presentation of online information content. The methodology can be divided into three main areas. Each deal with different aspects of the content life cycle.

In the paper, we dealt mainly with the first two areas. The description of them is as follows:

- Creation and updating of the content
  - Basic principles of the content creation
  - Set of rules and recommendations
- Content storage
  - The core of the methodology
  - Model of a standardised structure for storage
- Presentation, semantics and archiving
  - Presentation of the content
  - Exchanging, exporting, etc.

The proposed methodology could bring many new opportunities as well as improvements for the current state of art. It is still a work in progress. It will need to engage interest groups in the research and development process. Even though, the whole methodology will not be implemented, empowering partial aspects can probably help in the desired field as well.

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