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Interactive Enterprise Architecture – using scalable vector graphics (SVG) for self-explanatory heat maps

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Abstract

In the context of enterprise architecture management, complex diagrams of proprietary software systems are often created. Working with these diagrams is often not self-explanatory, as multiple layers of information are contained in the overview. Changing the design and style is often not supported within the hierarchical structure of the diagrams and is impossible outside the original software product. Separating content from structure provides a solution to this problem. The use of scalable vector graphics (SVG) not only allows free scaling compared to traditional pixel-based formats, but also the integration of interactive elements (e.g., focus regions) or help texts. Additional animations and graphic design can guide the reader in understanding. As part of the international adaptation of the Global Higher Education Reference Model (HERM) from English to German, a neutral SVG structural template was developed. The adaptation of all designations into any language was automated based on a UTF8 text file containing the translated labels. This simplifies the application and distribution of HERM in the European context.

Keywords: adaptive help, interactive diagrams, accessibility

1 Introduction

In Enterprise Architecture Management (EAM), as well as other disciplines, users sometimes struggle with highly complex diagrams. Particularly in EAM, the hierarchical structure of content requires the stacking of multiple levels of recursive containing boxes, including their verbal labels. Shortening labels and minimizing font sizes run counter to allowing for an easy overview and visually perceived structure. In the end, diagrams are printed on large-sized paper and are mockingly referred to

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as “wallpaper”. Most design programs in EMA allow users to export the results. Flexibility is limited, especially in terms of changing the diagrams outside the proprietary software. Displaying heat maps based on project progress or other factors requires merging data output from other sources with the results of the EAM diagrams. The output of the EAM software normally bundles structure, design and language into one PDF, which does not enable easy and automatic replacement of any element.

Many tools support the separation of design, structure, and content in modern web pages. For complex diagrams, however, all three typically remain combined and independent manipulation is not possible. The use of scalable vector graphics (SVG) offers an innovative potential in multiple regards. The format is easy to generate, text based, and supports cascading style sheets (CSS) and unrestricted access is guaranteed by the W3C (2001-2022) community. In addition, many tutorials, the complete online reference (W3C, 2011c) and online demonstrations, open-source editors (like Inkscape[2]), and the W3C (1998-2022) validation[3] support the user on all levels.

In this article, a general SVG template for the Global Higher Education Reference Model (HERM) Version 2.6.0 (CAUDIT Enterprise Architecture Community of Practice, 2021) is presented. Using this SVG template enables the user to change the structure and the design via CSS, and/or the content of all labels and the interactive help via UTF8 text. In addition, the result can be further modified to change general design features or individual boxes based on automatically generated input CVS files.

The template, further documentation and all tools necessary to modify the HERM diagram have been published on Zenodo (von der Heyde, 2022) as supplementary material to support the EUNIS community and other users of the HERM worldwide.

2 Advantages of SVG

There are several advantages and disadvantages to using SVGs. The main disadvantage is the loss of all interactive features while embedding SVGs into PDFs. However, users only see this disadvantage once they know what they advantages are and use them regularly:

- Text based editing. The hierarchical structure of all objects in SVGs can either be generated by programs or done by hand in any plain text editor. In the current project, using special IDs and labels allows users to replace content using automatic scripting. Additional formatting can be inserted at pre-defined places into the template.
- Seamless integration. SVGs are displayed by all standard browsers without requiring JavaScript. Potential leaks and security problems are not expected.
- Integrated help. All SVG objects can be embedded into links and therefore are able to display the title text as bubble help. Further descriptions for all objects can be included to enhance accessibility as described by the W3C (2011a), and to implement the Web Content Accessibility Guidelines (WCAG) of the W3C (2018).
- Using a medium level of abstraction, distinct focus areas can be defined to allow specific target navigation. This can either be used to enter the model on different levels or link objects to allow an interactive zoom-in.
- On all zoom levels, all text and graphical objects stay visually clear and do not show any pixel-based artefacts. The free scalability even on sub-windows and focus regions supports

2 See https://inkscape.org/
3 See https://validator.w3.org/check

users taking in information on various levels of abstraction. This also helps to scale fonts and visuals for visually impaired users.

- All labels in the diagram are searchable (using ctrl-F in the browser). Indexing of content also works, offering additional support for search engines to find contextualized content. Sadly, not all browsers support finding text within the integrated help texts in title tags, which are often rendered as bubble help.
- All elements in one level of abstraction can quickly be adapted by the use of cascading style sheets (CSS). Nearly all visual parameters (e.g., colours; fill, font and line styles) can be altered in one location to take effect everywhere. The exception is font size, which can only be scaled outside the SVG in general or at all relevant text boxes.
- While being injected into a web page, external CSS definitions can be inherited by the SVG. Adaptation to corporate design guidelines and other requirements is possible without changing the individual derived SVG. SVGs can be configured to inherit external styles and therefore follow the embedding context of the website.
- All elements can be altered so that they do not have to match the CSS defined general appearance. This is useful for highlighting single boxes or groups of elements. In particular, automatically generated data can be fed into heat maps or similar colour-coded diagram styles.
- To further guide the users, animations of all elements can be included for all visual properties of the individual elements (W3C, 2011b). Blending in multiple layers of abstraction one by one or displaying an intended project plan across the diagram can be preconfigured and fed by values from text files.

All features discussed above are well documented by the W3C (2011c) standard. The template presented here makes use of those features by the careful design of the SVG document structure. The concept and flexibility of the template is discussed in the following paragraphs.

3 Separate structure, design and content

The key to using the advantages of SVGs for the described purpose is the separation of structure, design, and content. The following paragraphs discuss the stages of the development in detail. All required scripts and text examples are published as supplementary material in von der Heyde (2022).

For each step in the process, a small picture of the BCM is included in the paragraph. Each picture is linked to a web-based version to demonstrate the interactive features – especially the bubble help. Please make use of the free scaling capacity within the publication, and again please excuse the inability to offer the interactive features within the PDF version.

3.1 Structure

In the case of hierarchical models in Enterprise Architecture, the structure is often given by the hierarchy of the model itself. In the particular case of the Business Capability Model (BCM) of the Higher Education Reference Model (HERM), this is reflected in the core capability levels Learning and Teaching, Research and Enabling Capabilities. Those three areas split the overall model into three distinct parts. Within each part, sub-areas reflect level 1 and level 2 capabilities. In the core capability area, the model was also grouping different level 1 capabilities underneath various value streams, which were arranged from left to right in the diagram.

The overall structure of the BCM is a tree-like hierarchy of elements. Therefore, the corresponding SVG needs to be organized in the same hierarchical way. To support visual guidance, all sublevel elements were originally designed in regular shapes and styles with dimensions supporting essential text lengths. Building the overall diagram required a half- automated procedure to recursively generate SVG elements from inside to outside, starting on level 2 and expanding required dimensions at level 1 and upwards. With a few exceptions introduced by the overarching value stream elements in the Teaching and Learning core capability area, the Creative Commons 4.0 logo, and the caption of the diagram, this led to a regular SVG code reflecting the complete BCM as a general structured template. The design and content remain open for further adaptation. It suffices to build this template once and redistribute it with upcoming versions of the BCM or HERM respectively.

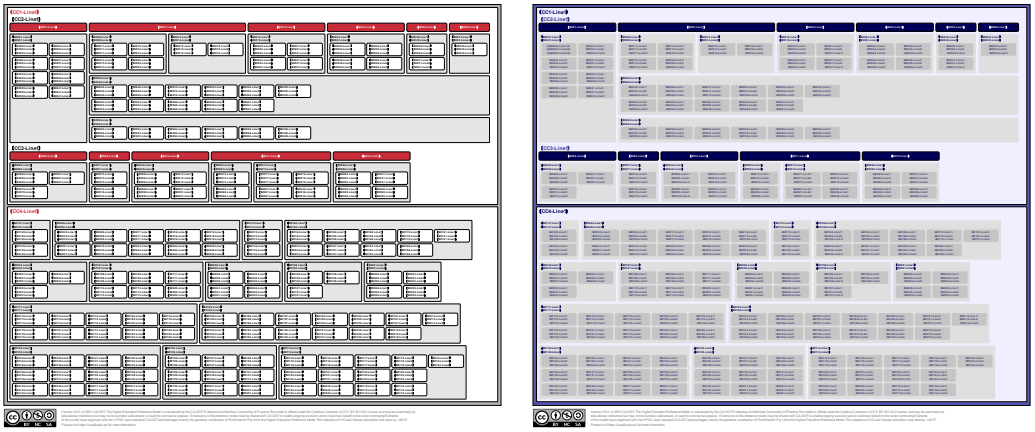

Figure 1: The BCM-HERM Template implements just the hierarchical structure of the capability model. On the left-hand side the original style was imitated. On the right-hand side, a custom CSS changed only a very few colour definitions. For demonstration purposes, the adapted version does not use bold fonts but centred text alignment at the highest level (innermost boxes) of the BCM.

3.2 General Design

Changing CSS to fit external web pages is recommended at this template stage in order to avoid having to adapt to business requirements several times per institution (see the right-hand side of Figure 1). Only a few colour definitions were changed to adapt the overall diagram in an easy way. The specific CSS statements could also have been adapted to reflect external definitions from specific higher education or corporate websites. However, individual design of single boxes should be left until the last stage of the process.

3.3 Content

Filling in content is done in the next stage of the adaptation. General templates to reflect specific wording in translations could be provided by the national higher education IT associations in each country. Translations of the original English BCM are known to exist in Norwegian, Finnish, French and German. The translation might start with just the level of labels but could also incorporate the longer definitions of all labels. In the end, the translations can be injected into the SVG by a search and replace procedure. In support of this, all lines in the template refer to the naming principles of the BCM. Boxes on different levels can contain various numbers of lines. Currently the visual structure was designed to allow one line of text on level 0, two lines on level 1 and three lines on level 2 of the BCM.

Institutional adaptations might be chosen to be added at this stage for particular names or other local requirements. Since changing all labels is based on text files (in comma separated value format, CSV) and requires only seconds, the re-labelling also is an opportunity to adapt the bubble help to project specific updates or explanations matching the institutional process.

3.4 Individual Design

Finally, the SVG can be modified to show additional design changes for individual capability elements to highlight special information. Since this access to the capability model nodes remains included in the content injected version, this can be changed even in iterative processes. Since the SVG standard does not allow repetitions of individual format definitions of a single element, this process has to be planned with care to avoid the violation of the SVG format.

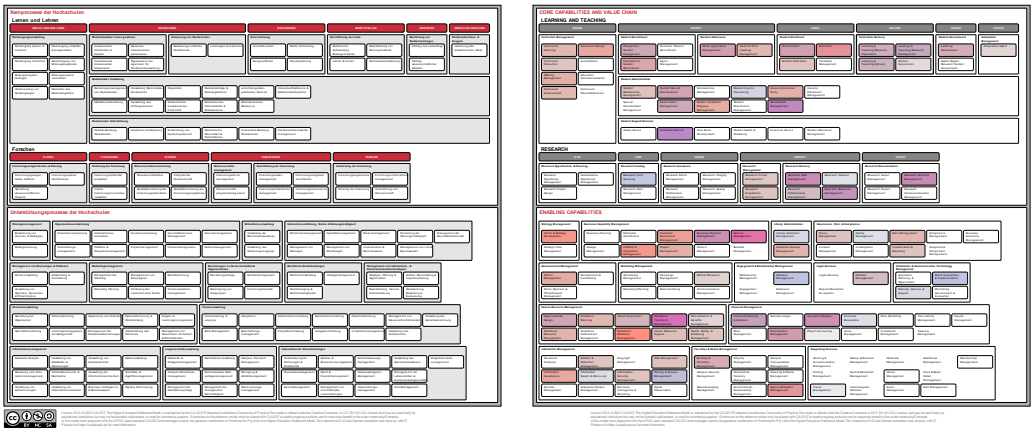

Figure 2: Individualised versions of the HERM. Left: A German version without heat mapping. Right: An English version with heat mapping.

3.5 Validation of final result

The final result of the process should follow all SVG standard definitions like the template (see left side of Figure 1) in the beginning of the process. The template referred to was validated successfully using the W3C (1998-2022) service. It is generally recommended to use this service to test the individual result of the process.

4 Summary

Reflecting the hierarchical structure from Enterprise Architecture Models in a structured Scalable Vector Graphic (SVG) offers a number of advantages. We demonstrated the application by introducing a semi-automatically generated template of the Business Capability Model (BCM) of the global Higher Education Reference Model (HERM). Separating structure from global and local design as well as content enables the user to establish a workflow to automate the generation of heat maps in this complex diagram.

National translations are able to support and help all institutions in the adoption of the HERM. Future versions will be easier to maintain and quicker to adapt since all template files are text based

and independent from commercial and proprietary products. This also supports the national initiatives for digital sovereignty.

The final result offers interactive features to be individually filled with institutional content. Since adaptation to institutional design requirements can be separated from this process, collaborations of higher education institutions are supported without having to give up the individualization and contextualization of one's own institution.

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6 Author biographies

Dr. von der Heyde received his PhD with topics in cognition research at the Max Planck Institute for Biological Cybernetics in Tübingen. He was head of the central IT service centre at Bauhaus University Weimar from 2003-2011. Since 2011, Dr. von der Heyde has been advising colleges, universities, and public cultural and research institutions on a wide range of digitalisation topics (governance, organization, strategy, research data management, information security, IT service management) as part of vdH-IT, and conducts independent research on these topics (see ResearchGate). Since 2018, he has been an Adjunct Professor at the School for Interactive Arts and Technology (SIAT) at Simon Fraser University, Vancouver. Dr. von der Heyde is also active as a volunteer in a variety of non-profit organisations (GI, ZKI, EUNIS, Educause). In 2020, he founded SemaLogic UG to use semantic and structural logic technologies to automatically map and validate natural language regulatory texts. The application of these technologies to study regulations and accreditation is currently being implemented with partners from the university environment. See further details at LinkedIn, or Google Scholar.