

A generic interface to support the verification of configuration knowledge in the K- & V-Matrix

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Abstract

The K- & V-Matrix and the related software-tool provide a useful support for analysing and structuring product variety focussing on aspects about the configuration. One of the main benefits of method and software is the deep integration to each other. Furthermore one of the most useful features is the possibility to verify the data of the method with a query-tool. In order to enable an immediate verification, a generic, product-independent user interface is required. In this contribution an approach of a simple, web-based and product-independent interface is presented and discussed.

1 Introduction

Over the last years, enterprises have reacted to the diversification of the product-demand by offering an increasing product-variety. Often the internal product complexity is augmented, causing an increasing number of exceptions in existing product structures [5]. Thus, the product-configuration process becomes more complicated for vendors and customers. Although the product configuration is an issue in many companies, it is usually not treated in a methodical way.

The K- & V-Matrix-Method enables enterprises to represent configuration knowledge in a structured way [1]. The method deals with the challenges concerning the configuration of variant products. Its focus is on small and medium sized enterprises (SMEs) and is both easy-to-use and easy-to-understand for people with or without technical background.

1.1 The knowledge representation

The K- & V-Matrix-Method is based on two kinds of matrices, the K-Matrix (configuration matrix, "*Konfigurationsmatrix*" in German) and the V-Matrix (compatibility matrix, "*Verträglichkeitsmatrix*" in German). The method allows the representation of a major part of the configuration knowledge [1]. A detailed description of the method can be found in [1] and [6] and an example is described in [8].

The components of the method are as follows:

- A customer view

It is a functional description of the variant product with relevant properties for the customer and is used during the sales process.

- A technical view
Description of the variant modules of the product.
- The K-Matrix
The matrix fields represent the (consistent) mapping between the functional and the technical view.
- The V-Matrix
The matrix fields describe the compatibilities of the properties with each other of both views of the product.

An overview about the components and about the whole method is given in Figure 1.

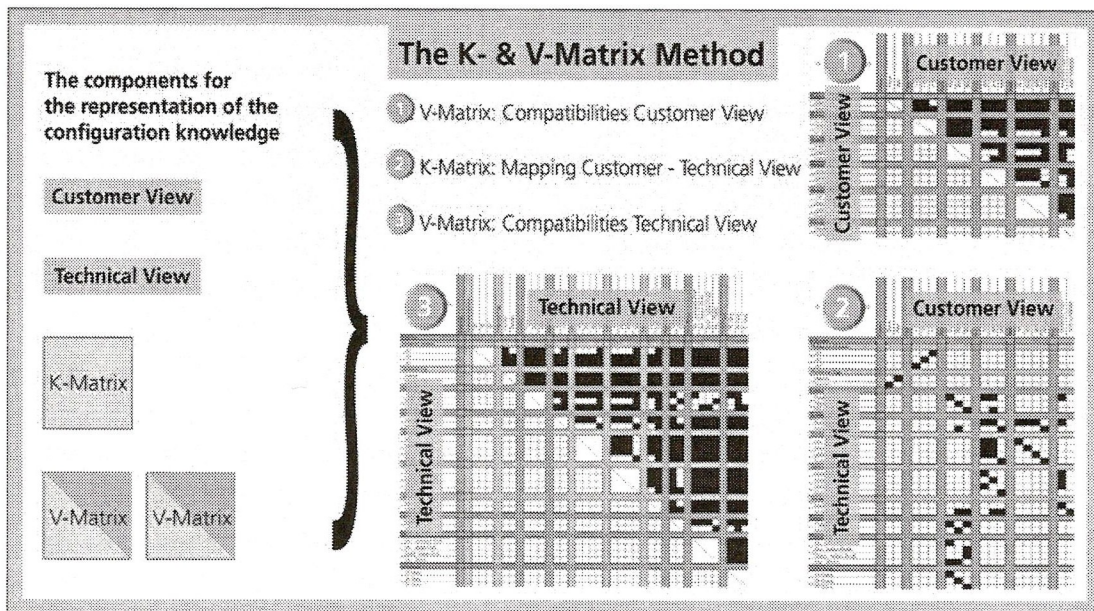


Figure 1. The structure of the K- & V-Matrix method.

2 The software to support the K-&V-Matrix

In order to support the main objectives of the K- & V-Matrix, a software-tool has also been developed. The aims of the software are:

- to simplify the management of the configuration knowledge,
- to support the analysis of the configuration knowledge and
- to permit a fast verification of the modelled data in the method by defining configurations.

The integration of software and method is a main difference as compared to other configurators. Actually, software-systems for the configuration are often not integrated with existing design methods or description languages [2].

An overview of the software-architecture of the K- & V-Matrix-tool is given in Figure 2.

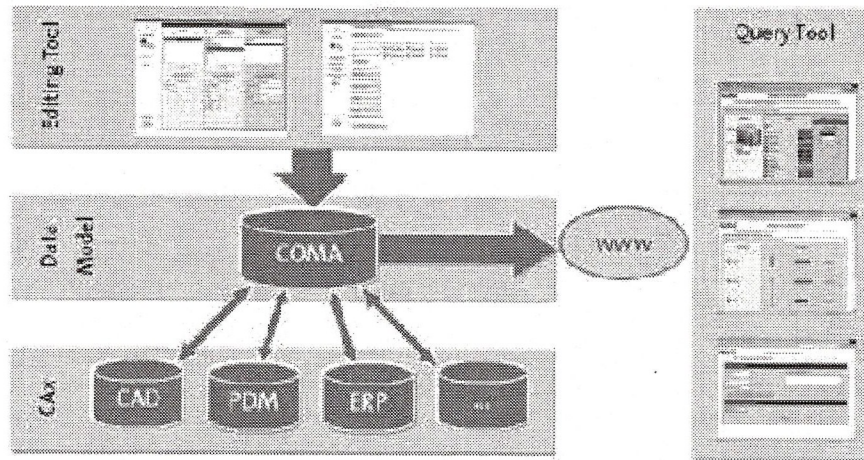


Figure 2. The architecture of the software-tool

An editing-tool provides the possibility to define and maintain the configuration knowledge easily without having to interact directly with the tables in the database. The content of the database is visualised in a graphical user interface using a similar representation as the method. Moreover, it allows the analysis of the data in the K- & V-Matrix using specific algorithms [7].

A query-tool lets the users verify the configuration knowledge and configure a product. Besides this verification, the tool provides ways to integrate additional product-specific information such as further product-specifications or 3D-Visualizations from existing CAX-tools. It therefore becomes an information-platform of the products for employees in the sales and in the engineering department as well as for customers.

The main characteristics of the software also meet the needs of SMEs and are summarised as follows:

- The development environment of the system is common and inexpensive.
- The software is web-based. Thus it can be used in a internet as well as in an intranet environment.
- The editing-tool reflects the characteristics of the methodology, which allows the users to easily edit the data in the matrices.
- The query-tool enables users (e.g. customers and/or vendors) to directly configure the products based on the data defined in the description language.
- All the components of the software are product-independent and adaptable to the requirements of different companies.
- The software allows the integration of specific data (like price, delivery-date and so on) in different systems (PLM, ERP) in order to guarantee a consistent data-management.

2.1 The correlations between configuration knowledge and the queries

The configuration knowledge – i.e. the product views and the content in the matrices – represents the core element of all queries in the query-tool. During a configuration-session, a user interacts with the data of one of both product-views defined in the method. After every

selection, the compatibilities of the V-Matrix in the related view are checked (see Figure 3, a) and the incompatible elements are eliminated from the current configuration-session. Additionally, the user has the possibility to change the product-view (see Figure 3, b) and select elements of the other view at any time. Whenever the views are changed, the query-tool executes the mapping between the product-views according to the knowledge represented in the K-Matrix.

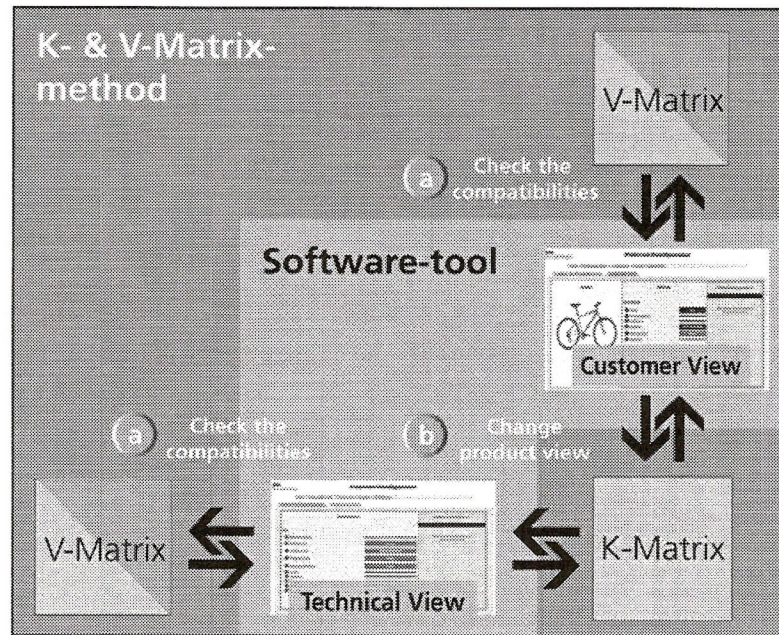


Figure 3. The interdependencies between method and software tool in the query

2.2 The need of a generic interface for the verification of the data

Many cases in industry have shown that the method and the software are particularly useful when the configuration knowledge can be immediately verified with the query-tool. This way, a fast verification is possible by configuring the concrete product.

The possibility of a quick verification of the data can only be fulfilled, by having a product-independent interface-structure. Although the majority of configuration-software have the possibility of integrating the knowledge represented in the matrices, a standardised, intuitive interface is often not available. The high software customizing effort for the interface design prevents a fast verification of the configuration knowledge and is time-consuming. In fact some commercial configurators need more than 50% of the customising time for the design of the user interface.

2.3 Requirements for the interface

In order to guarantee a fast verification of the data in the method, the graphical user interface (GUI) of the query-tool must:

- Reflect the principle of the query-tool (see Figure 3).
- Use common user interface elements to interact with the data in order to comply with the interface standards.

- Use an intuitive way to navigate and select the data on the interface so that specific training is not needed.
- Enable the representation of different products in a similar way.

3 The interface of the query-tool

In order to meet the above mentioned requirements, a generic structure for the interface of the query-tool has been developed and implemented. A major problem in the design of the structure is representing the management of the different kinds of information, e.g.:

- Corporate identity (CI) information, e.g. the logo of the company.
- Information related to the product, e.g. the describing data in the views of the method, general information about the product, etc..
- Structural and organisational information in the software tool, e.g. navigation within the software-tool, interactions with the product data and information about the configuring process etc..

3.1 Overall structure of the site

All of these aspects have been taken into account for the design of the site. A first main classification of information to be represented can be done by a differentiation of the information displayed:

- Some data do not change during a session, e.g. CI information (see Figure 4, 1) and the navigation (see Figure 4, 2) in the software tool.
- However data related to the product are dynamic and change after every selection during the configuring process.

These data are the most important on the interface. Thus, it is placed in the central position of the interface (see Figure 4, 3) in order to lead the user's attention on the interaction to the product related data.

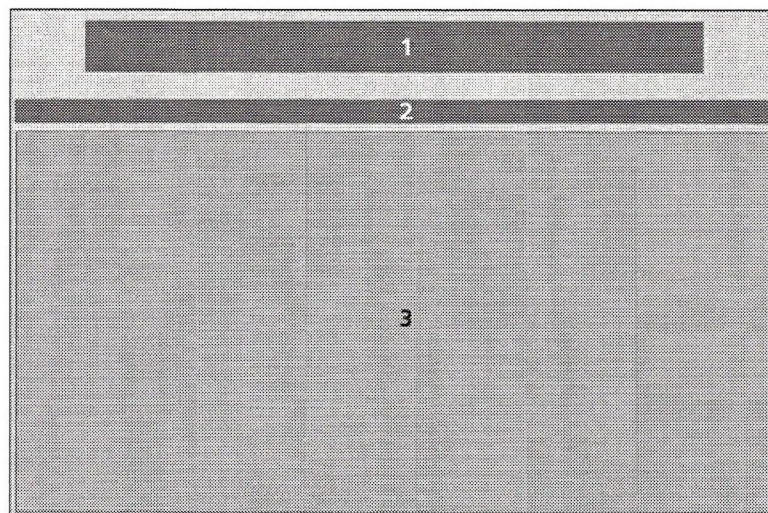


Figure 4. The site-structure of the query-tool

3.2 Interface elements

As implicitly mentioned above, two main activities characterise the product configuration: the navigation and the selection of the data related to the product. For these two activities some typical interface elements have been defined or taken from existing standards of the graphical user interface theory [3] (see Figure 5):

- A link for navigation
- A single selection list box for the selection of a value
- A selected link, or a chosen value
- Some nested and bordered surfaces to show the affiliation of the elements in the small surface to those in the bigger surface
- Two tabs, one for customer view and one for technical view

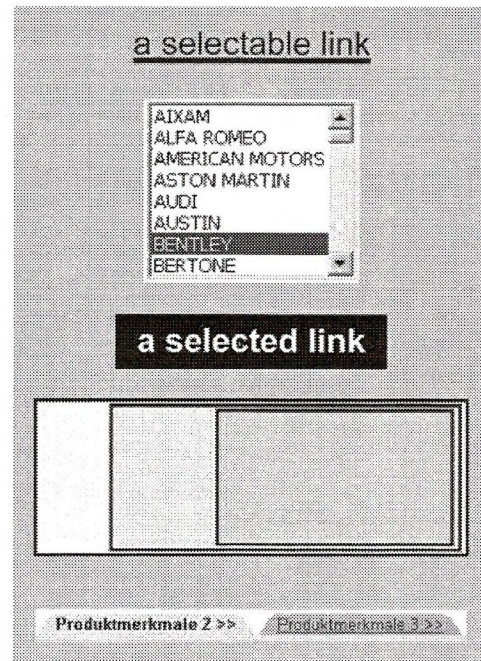


Figure 5. Some examples of interface elements

The combination of the site structure with the mentioned elements has led to the design in Figure 6. The views are selected using tabs at the head of the dynamic surface of the interface (see Figure 4, 3). The tab as an interface element represents the best functional possibility to change the product view without restrictions and reflects the principles of the queries.

The central column displays the properties of a product view (e.g. the customer or the technical view) in a list. This way there are not any restrictions on the number of properties to be shown on the interface. If some products need a lot of properties to be described, there is the possibility to define groups of properties. The user then selects a group of properties with the related elements in order to begin the configuration-session.

On the right column in the main part of the interface (see Figure 4, 3) the values of a selected property can be defined. This way only values of a single property can be selected at a time and the respective compatibilities are checked after every choice.

In order to enable a certain degree of customisation of the interface, pictures related to the product or a logo can be inserted (see Figure 6 and 7). These elements can be controlled by some entries in the database. This way the idea of a generic interface is given.

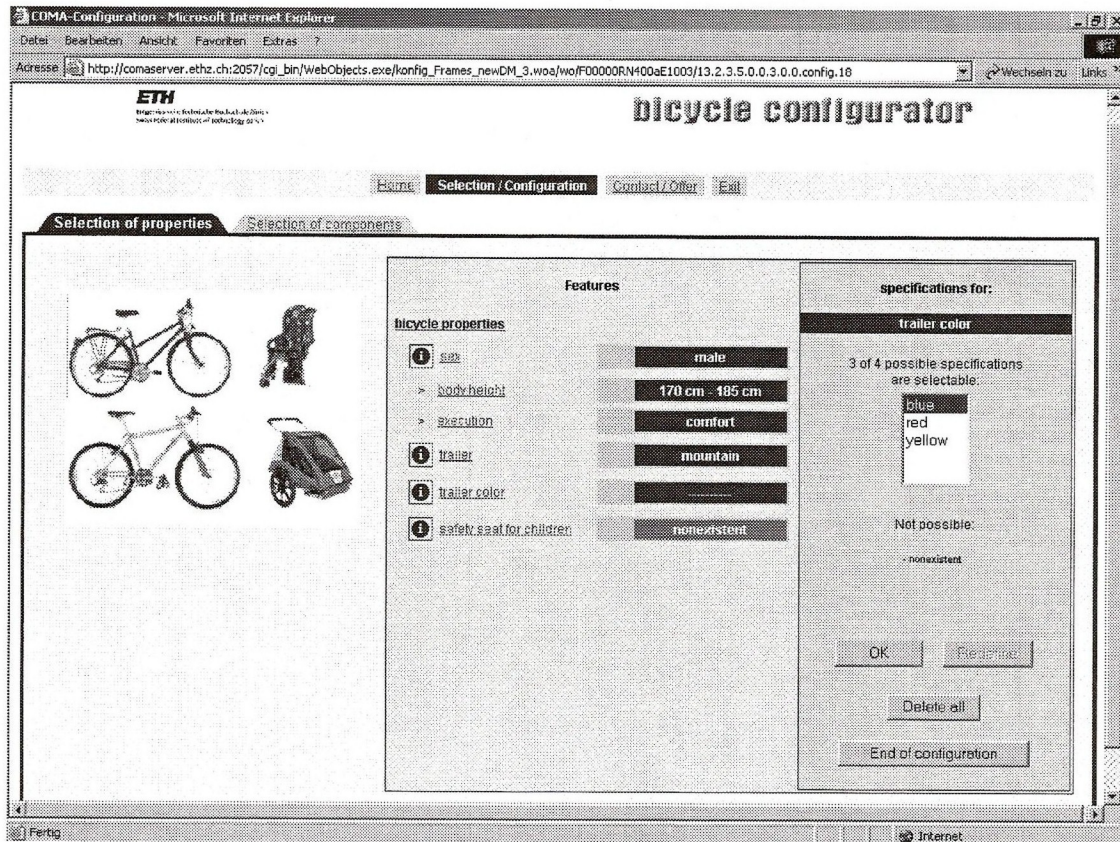


Figure 6. The interface of the customer view in the query-tool

The presented approach has been verified in accordance with [4]. First, empirically observing users by the interaction with the system and secondly in a structured way, performing usability tests. The results generally confirmed the intuitivity of the interface and pointed out some weaknesses, which could be corrected. Generally the verification of the interface-principles like the navigation of the tool and of the product-data as well as the interaction with the data could be validated.

The benefits of the interface can be summarised as follows:

- Use of comprehensive interface elements, which allow interaction with the query-tool without a specific training.
- A pleasing look and feel of the interface, which should support the acceptance of the software-tool.
- A generic structure basis, which is independent from the product as well as from the CI-elements.

The generic structure of the interface, combined with the deep integration of tool and method as well as the architecture of the software-tool, provides the necessary prerequisite for a fast verification of the configuration knowledge in the K- & V-Matrix.

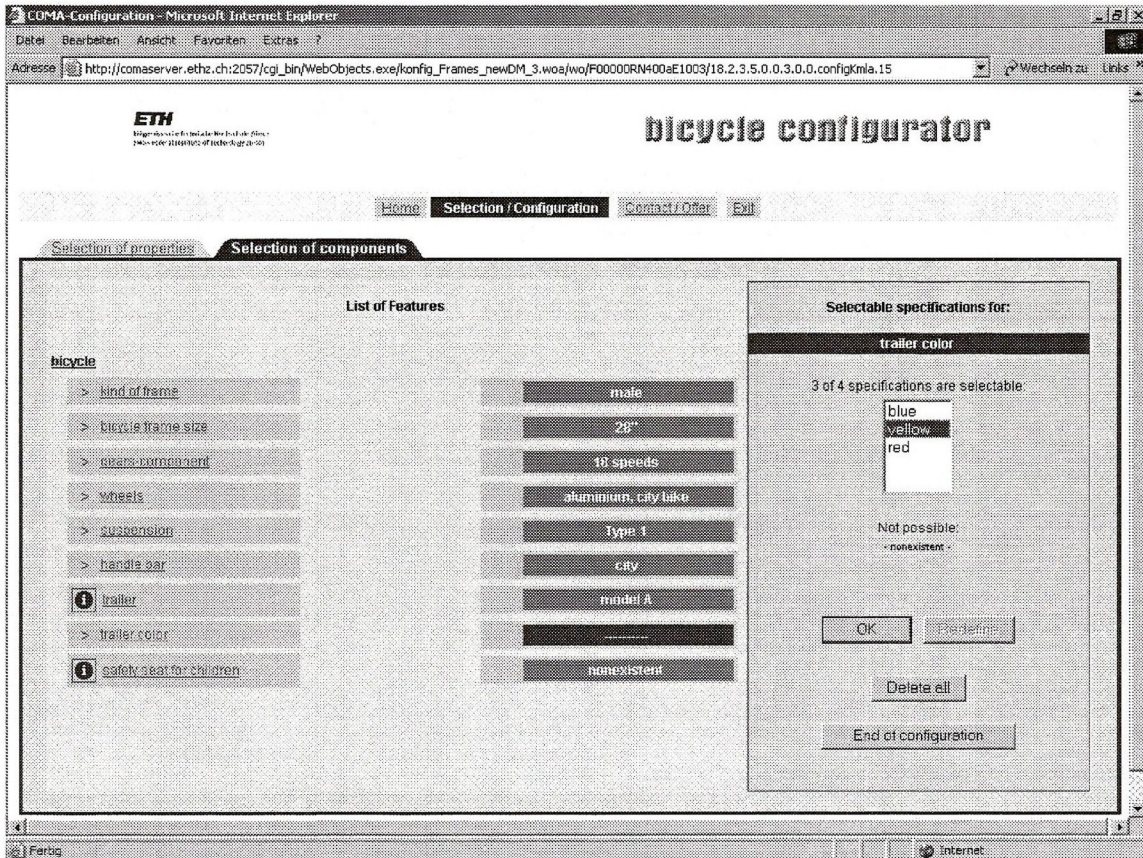


Figure 7. The interface of the technical view in the query-tool

5 Conclusion

The K- & V-Matrix and the related software-tool enable enterprises to focus on configuration issues. A major benefit of the method and the tool is to enable enterprises to immediately verify configuration knowledge represented in the method. In order to allow this kind of *rapid prototyping* of the knowledge-base modelled with the method, a web-based and product-independent interface-structure has been presented. The verification in industry and some tests in a usability-lab validated the approach of a product-independent interface. However, further investigations are still necessary, in order to optimise the entire concept (method and software-tool).

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