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New process to create VDMA libraries

- Research of possible creation methods

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New process to create VDMA libraries

- Research of possible creation methods

This thesis searched for new methods to create and manage VDMA libraries. The research objective was to improve the company's internal process of storing and controlling important data about products. This had to be done using standard tools, which can be found on the market. This work aimed to find and suggest an application that provides efficiency and savings for the company in this process.

The theory part handles purchase need assessment, data management, and safety products' restrictions or requirements and why they exist. The focus is on data management and converting different data types because they are an essential part of work and life. That is why it is important to control these in a visual and human-friendly way.

Work methods used in this project started with defining requirements together with the company. Based on those, more profound research was done on the applications that are likely suitable. All possible applications were evaluated by information provided by the application's creator and in a real test with a trial version of the application. The best options from the evaluation were presented to the company, and chosen application was proved to be suitable by performing an update for the VDMA library.

Keywords: VDMA library, XML, Product comparison, Software selection

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Jesse Numminen

Uusi prosessi VDMA kirjastojen luomiseen

- Tutkimus mahdollisista luontimenetelmistä

Tässä työssä etsittiin uusi metodi luoda ja hallita VDMA kirjastoja. Tutkimustavoite oli parantaa yrityksen sisäistä prosessia, jossa säilötään ja hallitaan tärkeitä tuotetietoja. Tämä tuli saavuttaa käyttämällä ohjelmistoja, jotka löytyvät markkinoilta. Työn tavoite oli etsiä ja ehdottaa yritykselle sovellusta, jolla parannetaan tehokkuutta ja luodaan säästöjä kyseiseen prosessiin.

Teoria osuus käsittelee tarvekartoitusta, tiedon hallintaa, sekä mitä säädöksiä tai vaatimuksia turvallisuustuotteilla on, ja miksi ne ovat olemassa. Painotus on tiedon hallinnassa ja tyyppimuutoksissa, koska ne ovat nykyisin elintärkeä osa työtä, sekä elämää ja siksi on tärkeää, että niitä voidaan hallita visuaalisesti ja ihmisystävällisesti.

Työ alkoi määrittelemällä ratkaisun vaatimukset yhdessä yrityksen kanssa. Vaatimuksien pohjalta tehtiin yksityiskohtainen tutkimus soveliaista vaihtoehtoista. Kaikki mahdolliset sovellukset arvioitiin sovellusten valmistajan tarjoamien tietojen mukaan, sekä tekemällä käytännössä testejä kokeiluversioilla. Paras vaihtoehto esiteltiin yritykselle, sekä todistettiin toimivaksi tekemällä päivitys VDMA kirjastoon.

Asiasanat: VDMA kirjasto, XML, Tuotevertailu, Ohjelmiston valinta

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List of abbreviations

ACCDB	Access database – File type in Microsoft Access
C++	General-purpose programming language
CRC32	32-bit Cyclic Redundancy Check
CSV	Comma-Separated Value
DB	Database
DBMS	Database Management System
DTD	Document Type Definition
EEA	European Economic Area
EN	European Standards
ERP	Enterprise Resource Planning
HTML	Hypertext Markup Language
IEC	International Electrotechnical Commission
IFA	Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung - Institute for Occupational Safety and Health of the German Social Accident Insurance
ISO	International Organization for Standardization
IT	Information Technology
MS	Microsoft
NoSQL	Not Only SQL
PLC	Programmable Logic Controller

SISTEMA	Safety Integrity Software Tool for the Evaluation of Machine Applications
SQL	Structured Query Language
VBA	Visual Basic for Applications
VDMA	Verband Deutscher Maschinen- und Anlagenbau e.V. - Mechanical Engineering Industry Association
XML	Extensible Markup Language
XSD	Extensible Schema Definition

1 Introduction

The world is getting more digitalized at a rapid pace. More digital services mean huge amounts of data created every day. Data is vital for companies, and data management has a big impact on whether a company performs operations successfully or not. If data is managed correctly, processes are efficient and important information is always available for the right person to take advantage of it. Poorly managed data often means data losses, slow processing time, and incorrect information, which can cause big problems for the whole company.

Safety products or components in machinery and industry are highly controlled because human lives are involved and must be protected. Mechanical Engineering Industry Association (Verband Deutscher Maschinen- und Anlagenbau e.V., VDMA) libraries were invented because these products must have globally and unequivocally presented product information. VDMA library is a collection of device information. Devices included in the VDMA library are safety products, which are regulated by EU law, Machinery directive, that must be fulfilled to have any products on the market. Managing a VDMA library can increase workload if it is not done with proper methods. The library format is standardized, so it cannot be done with any tool.

In a digital world, data can be managed in many ways. Databases (DB) are one of the most common, efficient, and critical methods to store and query data. For different purposes, there are different DB types, and they support different features, so it might be necessary to do research before new software or applications are implemented in the company's tool selection.

1.1 Objectives and research questions

Creating VDMA libraries is an internal process. Libraries are meant to be shared internally inside the company, but the same files are also provided indirectly for customers. Final libraries are available for everyone, and they can be downloaded online. The customer also is not the one giving guidelines or

restrictions for the content, but they are defined by standards that control safety products.

The previous method to create VDMA libraries contains a part where a self-written program is used. This program got corrupted, so it cannot be used anymore. This thesis aims to find a new solution to create and manage VDMA libraries to avoid manual work, which is the current way of working with VDMA libraries.

This work's main objectives are to develop a new process to create VDMA libraries and to create savings by simplifying the process. The company to which this work is done gives requirements that need to be fulfilled with the new process. Besides these requirements, they provide suggestions and an approach that is ideal for them. This leads to two research questions.

The research questions are:

1. Is it possible to create this process using the database application Microsoft (MS) Access?
2. What is the best alternative solution if it is impossible to do with Microsoft Access?

The structure of this thesis starts with the theory part, which covers need assessment for software selection, data and data management principles, and a description of safety products and restrictions that must be taken into notice when a manufacturer wants to put safety products on the market. In the case section, there is an explanation of methods used to test, analyze, compare, and evaluate different applications considered suitable options. This part starts with analyzing the current method and defining the criteria for the new solution. Lastly, it is presented how this project proceeds and what kind of results each step provides.

2 Theoretical framework

The theory in this thesis is divided into three main topics. The first one presents how to build criteria for software selection. Second deals with data. This chapter explains the principles of data and how data should be managed in the business. The last topic describes the safety product industry and what requirements and standards these products must fulfill so that they are allowed to be on a global market.

2.1 Software need assessment

The process of purchasing anything begins with a need assessment. It is important to notice that needs are always different for every industry or company because they have their perspective and specific customers. Needs and requirements in their business drive the purchase process. Need assessment must be done carefully because it is impossible to find suitable options if product features are not determined by their importance. (Nieminen, 2016)

Need assessment must be done professionally and unequivocally. It should be documented and shared with all parties involved in purchasing. Need assessment can be divided into two categories, technical- and customer- or user-related features. These topics should be defined when planning new purchases. Technical features mean a product's capability to perform its wanted tasks or if regulations or rules limit what a product can be or how it should perform. Customer-related features mean what a product should do, how these things are done, or how the product's user experience is for the customer. The emphasis between these categories depends on the product or purchase project. They offer a different perspective to view the current market. Naturally, regulations must be fulfilled, but if they are the only technical requirements given, it is possible to focus more on the features which are essential for the customer. This way, options from the market are limited only to regulations. The creator of the need assessment must think critically. All features need to be analyzed, whether they are

necessary, or whether is it possible to downgrade or completely leave out some features. Features have a significant impact on the price of purchase. The profitability of the acquisition will suffer if bought technology is not utilized to its full capabilities. (Nieminen, 2016)

2.2 Data management

2.2.1 Data

To understand data management, first, need to go through data principles. Data is raw facts or figures, usually presented in a simple way. It is not organized, and on its own, it does not have a real purpose. In order to have a meaning for data, it must be interpreted. To do that, data should be analyzed and organized. Interpreted and analyzed data is called information. This means that information brings value to the user because data is organized and tells something. Information is data's conclusion when implemented in the proper context, which can be used to make decisions or present outcomes from a study or research. (Tang, 2016, 2-3, 5)

Data itself can be divided into different categories, metadata and master data. The previous chapter explaining data describes master data, which is the data used in communication between different platforms, analyzing markets, or anything similar. Metadata, on the other hand, is data explaining the data. Metadata is structured, and it is possible to represent it with a model. Metadata can be descriptive, which means it can give information about one specific piece of data. For example, it can tell information from a photo. Information such as shooting time or what settings the camera used. Another type of metadata is structural. Structural metadata means the data describing a field in a table, commonly known as a title, so the user understands the context and what the data in this field covers. (Hillard, 2010, pp. 82–85)

2.2.2 Importance of data management in business

Because nowadays, data is deeply involved in all parts of the business, it is vital to manage it properly. Faults in data management often become visible when a company is updating documentation processes or other information technology (IT) systems, and data must be transferred from old databases or applications to a new one. If previously created data is not in the format that it should be, transforming tasks becomes extremely difficult, and the workload grows drastically. This is because typically, this includes a lot of manual work, and if multiple faults can be found, it is expected that there are many other faults, and the quality of all data should be checked. With a massive load of data, manual work is always inefficient, and combining or transferring data manually creates a high risk for mistakes. (Väre, 2019, p. 11)

Data can be described as the structure or foundations of the whole organization. If foundations are not strong, the organization will collapse at the latest when any new actions are added. Often data management gets significant attention when, for example, a new Enterprise Resource Planning (ERP) system is implemented. These systems provide a desirable environment for data, which will be used in core business actions. Without this, master data, which is critical info for business, cannot be utilized in the way it is planned, and other activities will be impossible to implement. In business, there are multiple layers of data. Master data differs for each sector, department, or individual person. For example, when decisions about new strategies are created, data utilized in this is entirely different from data in the Research and Development department. (Väre, 2019, p. 21)

Companies cannot run a business without data. Businesses are created to have a purpose and direction and push toward it. Since data is everything and everywhere, it becomes clear why data management is important. No actions can be taken if relevant information or data cannot be found and utilized. Everyday operations may still be running successfully, but that does not mean that data is managed efficiently and reasonably. From this point, making any changes or updates in operations is challenging since there is nothing to compare to or rely

on because previous methods are not documented or data is lost. (Väre, 2019, pp. 21–25). When everything must be documented, the amount of data managed is massive. According to Wise, “2,5 quintillion bytes of data is created every day.” (Wise, 2022, p. 2). With proper tools, this data can be transferred into valuable information. Without correct tools, it can cause many problems in data management when transferring to new programs or even in the usage of current data. (Wise, 2022, p. 15)

Three key points of mastering data management are common practice, agreed decision-making power, and data usage control and regulation. Common practice, or data policy, is the alignment of data management, and this is an official and accepted document. Decision-making power should be defined so that there is a named person with enough knowledge to make the final decision in cases where any disagreement arises. This does not have to be only one person but also can be a group of issue-relevant persons. Regulation and controlling limits define what data is accessible to each user. This protects classified data and makes it more user-friendly because all users do not need all the files in the company. (Väre, 2019, p. 146)

2.2.3 Efficiency in data management

Efficiency means faster actions and easier handling of things. Efficiency leads to savings in work time, so more effort can be put into the topics which genuinely need it. In data systems, it also means that the same data is not written more than once unless required and that all needed data is always available at the right time. Efficiency can be achieved via automated processes. Automating processes brings satisfaction to customers and personnel, which also should lead to savings in costs when there is minimum manual work. (Väre, 2019, p. 49)

2.3 Data management tools

2.3.1 Database

A database is a collection of data. The point of a DB is to store and manage data inside it. This can be done with different formats and different types of databases. In most cases, data from databases is utilized for applications or analytics to make business decisions. The database's structure includes both master data and metadata. The main task of a database is to store data efficiently, meaning no overlapping, and that data is usable via queries. Databases are vital nowadays since everything done online must be linked to a DB somewhere. (Taylor, 2010, pp. 8–11)

When designing a DB, always need to pay attention to the data model. Data models are simplified presentations of the organization's software system and data elements. The main point of it is to facilitate interactions between software designers, application programmers, and the end user. Data modeling can help the whole organization understand how different pieces of business come together and their impact on each other. A DB designer must consider these points, as well as Database Management System (DBMS) principles when creating the structure and relations for a DB. Even a good DBMS cannot perform well if the design of a database is not developed with enough knowledge. (Coronel & Morris, 2017, p. 37)

Database types

Nowadays, databases are typically sorted into two categories. These are called relational databases and Not only SQL (NoSQL) databases. The language used in relational databases is Structured Query Language (SQL). According to Taylor, relational databases “store their data in tables that are related to each other.” (Taylor, 2010, p. 13). This means that tables contain their data, which can be modified as wanted, and when modifications happen, the other tables, which are related and contain data from this one, automatically includes updated data. They are convenient because it is possible to change the structure of the whole DB

without modifying any applications based on the old DB version. This brings great flexibility to work, and making changes, updates, or entirely new versions requires little work compared to an application where the DB structure is hard-coded. This is why relational databases have replaced most earlier types of databases. However, data is always structured in tables, and the tables are connected to each other's, so this limit use cases where it can be used efficiently. (Taylor, 2010, pp. 12–14)

A relational database's table is a two-dimensional structure containing related information. Tables are built from rows and columns. Rows are collections of data, for example, all information of one product. Columns contain all data of one type of information, for example, the names of all customers. The intersection of a row and column is called a field. To enable designers to create a well-performing database, the designer needs to have a deep understanding of master data and metadata because these are both used in designing a DB structure. Besides that, the designer must also know the data model and DBMS to create correct relations and relationships between tables by defining primary- or foreign keys for each table. Keys are attributes that uniquely identify records in tables. (Bryla, 2004, pp. 3–6)

Other types of databases are called NoSQL. They are more flexible and bring a lot of variability to database creation. A remarkable difference is that they do not use SQL as a query language. The second distinguishing factor is that they are not based on tables but on multiple different solutions. The main benefits of non-relational databases are supporting different data types and data handling. Cloud services and real-time web apps can be used via this. (Ahuja, Gosain, Jatana, Kathuria, & Puri, 2012, pp. 3–4)

Database Management System

DBMS is a system that translates data in both directions between a DB and physical representation. A DB can be challenging for the human eye to read or control, so DBMS is the visual interface between the user and the DB. In DBMS, the user can manage data, but also the DB engine and schema. DBMS can

permit users or even other programs to modify data. A considerable advantage is that all operations happen centrally from one software. DBMS is the most critical part of user experience, and through that also for work or process efficiency. Poorly performing DBMS takes out the advantage of modern databases. Due to this, it is possible to control which kind of details each user can see and control, so use is not overwhelming or confusing. (Ishwarya, Jeyaram, & Vidhya, 2016, 22-23, 26-29) These software are specialized in different required needs, and currently, there are multiple options on the market from where to choose. The most common software are Oracle, MySQL, and SQL Server (Statista, 2022).

2.3.2 XML file type

XML

Extensible Markup Language, or more commonly known as XML, is a markup language created to carry data. XML works similarly to Hypertext Markup Language (HTML), but the idea behind it is different. HTML focuses on how data looks, and XML focuses on what data is. This brings high value in tasks where data must be transported or shared, for example, to different platforms. Usually, data in different platforms is in incompatible formats, which makes data-transfers complex, and time-consuming, and the process can lead to data losses. In these cases, XML comes handy because data is structured and formatted in a standard way with rules, so multiple platforms can understand the file as it is intended. In addition, because XML is written in text format, it also brings benefits from being human-readable. (Ayers, Fawcett, & Quin, 2012, pp. 3–5)

Since XML is human-readable, it can be used as a source for a DB but also as a DB itself. This works well if the file does not contain too much data. XML syntax has a hierarchical model, which is useful and visual, but it is beneficial only for up to a certain amount of text. This way, in some cases, there is no need to have another application as an interface for the data, but it is possible to cut corners

by taking advantage of the natural format of an XML file. (Bourret et al., 2004, pp. 6–7)

XML files consist of a particular structure. As the following figure presents, it is made from elements, tags, attributes, and values or text.

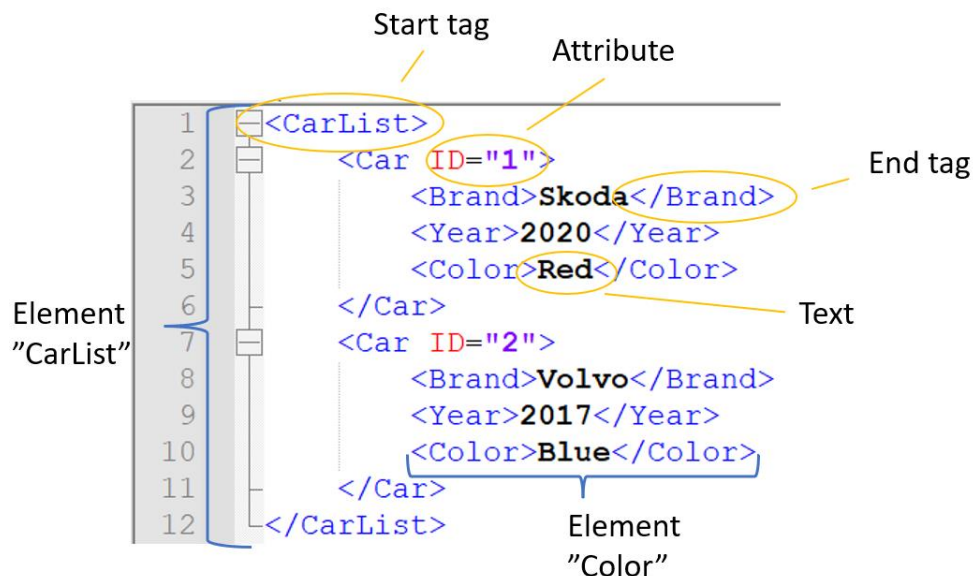


Figure 1 XML structure example

Figure 1 above shows that an element can be described as a building block containing everything from the start tag to the end tag. An element can contain other elements, which are then called sub- or child-elements. Besides elements, it can contain attributes or text. There is no limitation on which ones can be used together, as they can be mixed as the creator wants. Tag is one individual start tag or end tag. Tags will always be a part of an element since an element contains a minimum of two tags and all content between them. An attribute is a name-value pair. An attribute is written inside a tag, and its value is marked with quotation marks. Attributes present data of a specific element. The text itself is the value or data of any element or attribute. (Deane & Henderson, 2009, 15-16, 18-19)

XML file validation

Validation of an XML file is important if the file is used in any internal or external application. Validation confirms that the file is created how it is meant to be so that programs can understand and utilize data from it. This can be done by validating XML file against Document Type Definition (DTD) or XML Schema Definition (XSD) file. These files define both structure and content allowed in an XML file. XSD is a newer, updated version from DTD, and it has many added features to improve user experience, which leads to XSD being more used nowadays. (Deane & Henderson, 2009, p. 55)

Korol presents different types of XML files. These are element-centric and attribute-centric. As the names describe, the element-centric file contains only elements, not any attributes, and attribute-centric contains both elements and attributes. Element-centric files are simpler and easier to work in an application. Therefore, Microsoft Access supports only element-centric type files. However, there is a way to go around this limitation. Inside MS Access, there is Visual Basic for Applications (VBA), which is an Event-Driven programming language created by Microsoft. In VBA, there is a way to convert an attribute-centric file into an element-centric file so it can be worked on in MS Access. (Korol, 2019, pp. 1069–1073)

2.3.3 Text editors

Text editors are programs that allow a user to modify or view a text file. These are usually used by software code designers. Their purpose is to provide an easier or more transparent platform for the user to write or edit code. This can be achieved, for example, with syntax highlight, keyboard shortcuts, or interface view. Text editors offer flexibility and variety in text editing. Users can write notes or letters, structured text, programming code, or create specific reports with these programs. Text editors can be used to allow files to be viewed or used by other persons or other programs. There are hundreds of text editors, and users can choose between them the most suitable for their needs or even use multiple text

editors during the same project because they are planned to serve different needs, so they offer various benefits. (Moran & Roberts, 1983, pp. 1–6)

2.4 VDMA

VDMA is an association in the mechanical engineering industry. It is founded in Germany and currently represents the economic, technical, and scientific interests in Europe. One of its main points of it is to bring companies together in the industry and serve as a networking platform. This way, companies benefit from sharing relevant business information and building new relationships, whether their interest is finding new customers, globalizing business, or other similar topics. VDMA does not limit only to mechanical engineering but offers help for its members in multiple areas. These areas are Education & Modern Work, Digitalization & Industry 4.0, Research, Innovation & Technology, Management & Business Strategies, Markets & Economy, Mobility, Sustainability & Energy, Legal, Taxes, Technical Rules & Standards, and Economic & Social policy. (VDMA, 2022)

2.4.1 VDMA 66413

Under VDMA topic *Technical Rules & Standards*, there are a lot of regulations to provide cooperation at the national and international levels. These help different manufacturers to combine their products since they will be done with the same principles and standards. They also provide security and safety because these are based on international standards or laws. (VDMA, 2022)

Because industry involves human safety, there are laws requiring machines to be safe. Since the 29th of December 2009, manufacturers must meet minimum requirements with their machines if they want to enter the European Economic Area (EEA) market (“Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) (Text with EEA relevance)”). Details for this are defined by European standard

(EN), International Organization of Standardization (ISO), and International Electrotechnical Commission (IEC) in Machinery directive harmonized standards, like EN ISO 13849-1 and EN/IEC 62061. (Verband Deutscher Maschinen- und Anlagenbau e.V., 2012, p. 5). Besides these, other safety standards are also created to protect workers and the environment. These topics can be found in previously mentioned standards, but workers' protection has additional standard EN/IEC 61508, and environment protection is specified standard EN/IEC 61511. (Schneider Electric, 2010, p. 12)

Specification VDMA 66413 is a “Universal data format for safety-related values of components or parts of control systems” (Verband Deutscher Maschinen- und Anlagenbau e.V., 2012, p. 1). This standard defines what information must be found in the VDMA library and how it must be presented. VDMA library is a standardization tool for manufacturers to share the functional safety-related information required by Machinery directive harmonized standards for safety products.

Safety information is exchanged between manufacturers, notified bodies, and calculation tool suppliers. To make this possible, information must be in an unambiguous format, so this standard was created. It is based on international standards ISO 13849-1:2006, ISO 13849-2:2003, IEC 61508:2010, IEC 62061:2005 and ISO 639-1:2002. VDMA library has a defined structure. The structure includes the main entity of the file, manufacturer's information, device information with use cases and device types, and language information. (Verband Deutscher Maschinen- und Anlagenbau e.V., 2012, pp. 4–6)

Figure 2 is a short capture from one of Schneider Electric's VDMA libraries. It contains manufacturer information and info for one device.

```

<Name>SE_VDMA_PROECESSING_2020_02_24</Name>
<DBFileName>Schneider Electric SE_VDMA.xml</DBFileName>
<Information Key="KeyInfo_Manufacturer"/>
<IconFileName>.\png\SE.png</IconFileName>
<URL>www.schneider-electric.com/machinesafety</URL>
- <Devices>
  - <Device>
    <Identifier>ASISAFEMON | AS-i safety</Identifier>
    <Group Key="KeyGr_AsiSafe"/>
    <Name Key="KeyName_ASISAFEMON"/>
    <PartNumber>ASISAFEMON</PartNumber>
    <Revision>02. Feb</Revision>
    <Description Key="KeyDesc_ASISAFEMON"/>
    <IconFileName>.\png\ASISAFEMON.png</IconFileName>
    <DocFileName Key="KeyDoc_ASISAFEMON"/>
    <Archive>>false</Archive>
  - <UseCases>
    - <UseCase>
      - <Constraints>
        <Hierarchy1 Key="Logic"/>
        <Hierarchy2 Key="CPU"/>
        <Hierarchy3 Key="#NotApplicable"/>
        <Hierarchy4 Key="#NotApplicable"/>
        <Hierarchy5 Key="#NotApplicable"/>
      </Constraints>
      - <Function>
        <InputFunction>>false</InputFunction>
        <LogicFunction>>true</LogicFunction>
        <OutputFunction>>false</OutputFunction>
      </Function>
      <InfoConfig>CAT_4</InfoConfig>
      - <Parameter>
        - <DeviceType1>
          <PL>PL_e</PL>
          <SILCL>SIL_3</SILCL>
          <PFH_d>9,00E-09</PFH_d>
          <TM_T1>20</TM_T1>
        </DeviceType1>
      </Parameter>
    </UseCase>
  </UseCases>
</Device>

```

Figure 2 Schneider Electric processing device VDMA library (Schneider Electric, 2020)

The displayed figure presents the overall look of a VDMA library. XML syntax is highlighted and formatted hierarchically. This makes it easier for the reader to understand the text's relevant sections or rows.

2.4.2 SISTEMA

The VDMA library is not the only outcome of the process in this thesis. A process chart in [figure 4](#) shows the second outcome is the Safety Integrity Software Tool for the Evaluation of Machine Applications (SISTEMA) library. SISTEMA library is a collection of manufacturer's devices and their information on device reliability

values, which can be accessed, viewed, or modified in SISTEMA. SISTEMA is a computer program that describes aspects of the analysis procedure used to determine the probability of control systems' failure (Deutsche Gesetzliche Unfallversicherung, 2022). Values in SISTEMA tell, for example, how likely a fault occurs, how likely this fault will be detected, and several other risk-determining parameters. These are the same values, which can be seen in the VDMA library illustrative [figure 2](#). Data found in SISTEMA is utterly available for users or customers. Every manufacturer's SISTEMA library can be downloaded from their website or from the website of the Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), which has a collection of all published links for the websites or direct downloads for the files. This same principle of file availability also applies to VDMA libraries. (Hauke, Huelke, & Lungfiel, 2016, p. 2)

3 Case study

Company introduction

Schneider Electric is a global company in electrical industry. The company's primary focus is on energy management and digital automation. Schneider Electric is a French company that was founded in 1836. Currently, Schneider Electric operates in over 100 countries and has more than 128 000 employees. The company's revenue was 28,9 billion euros in 2021. This is achieved by producing various products and services, from simple switches to entirely customized hardware and software solutions to satisfy customers in multiple areas, for example, buildings, homes, data centers, power distribution, and industrial control and safety systems. Schneider Electric's current purpose is to "empower all to make the most of our energy and resources" ("Company profile | Schneider Electric Global," 2022).

Schneider Electric Automation GmbH is a subsidiary of Schneider Electric, responsible for industrial automation products and services. This thesis is done for Schneider Electric Automation GmbH. The company's headquarter is located in Marktheidenfeld, Germany.



Figure 3 Schneider Electric logo (Schneider Electric, 2021).

Safety products

Safety products typically are components that are part of a single electrical machine or a part of a whole production line. They do not include personal safety equipment for a person to wear. The main task of these components is preventing accidents, or in case of an accident, minimizing damages primarily for humans

but also for material, depending on which type of machine is in question. (Schneider Electric, 2010, 7, 17-20)

The simplest example of these products is a Stop button. In case of an emergency, an operator will press the Stop button, which cuts the circuit and leads the machine to turn off. An advanced example of these products is Programmable Logic Controllers (PLC). This means that they are controllers customized for each specific use by programming them differently. They include sensors reading and providing data for the controller, and if any value goes out of the range of the set limits, logic will stop the machine with control. Actions after emergency stops are also defined, which means the requirements that must be fulfilled to allow the machine to turn on again. This also covers actions happening inside the machine, in which order actions happen when turned back on.

VDMA in this case

Based on manufacturers' device values, customers can determine which devices are needed in their machines or solutions. The VDMA library and SISTEMA library are not dependent on each other. For example, during this period, when the previous VDMA library creation tool did not work, the VDMA library was not updated, but data was still added to the SISTEMA library. This can be done because SISTEMA is a separate program, which is not part of VDMA library creation and creation order depends on how information is provided for the person making edits. They only share nearly all the same information. Part of this thesis was to update the new VDMA library, and this information was taken from the SISTEMA library.

The Schema file for the XML is created from relevant standards. All manufacturers that want to publish a VDMA library must use this Schema file to validate their XML file to prove that all required standards are fulfilled so that other parties can have the necessary information about their desired safety products. In most cases, the client or another external organization is creating the XSD file because they need you to provide information correctly for their systems, which are the base for the XSD file. In this case, providing them with an XML file

happens by using a template with XML editing application or creating a needed file from scratch, but that requires a lot of attention in writing it exactly as XSD requires so that it can be validated and used properly.

3.1 Starting point

This chapter starts the case study. To understand what must be done to get to the desired goal, first, the current VDMA library creation process is explained. This process described how VDMA libraries are done in this company. There are no standardized or controlled methods in the creation process. The final library must fulfill all the needed requirements. After a detailed description of the process, including all faults in it, the requirements from the company for the new process are defined. These will work as guidelines during to development project.

3.1.1 Current situation

The current method used to create a VDMA library

The current process for creating new versions of a VDMA library is presented in the following figure.

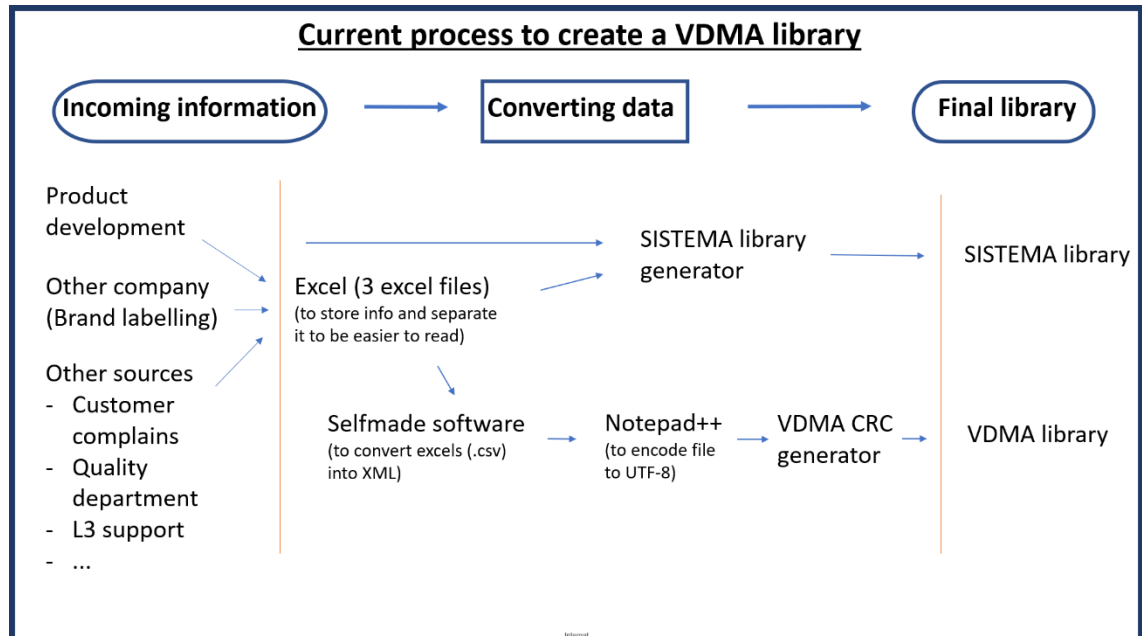


Figure 4 Process chart of the current method to create VDMA library

Figure 4 shows that the complete process of creating a VDMA library consists of several steps. The main sectors are receiving information, managing and converting data, and the final sector provides a completed library to release. The sector where it is possible to make any changes is in the converting since information coming or going to external parties usually cannot be modified.

Incoming information

The process begins with receiving product information. There are several different sources to provide this information. One of them is the Product Development department. It is a common source, and it is used when the company itself entirely creates a new product or an update for an old product. However, this is not always the case. Another common source for new

information is another company. In many industries selling “brand labeled” products is regular. This means that the company is buying products from another company, and aims to make as minor changes as possible to hardware and software, only to make it look like “their product”. When this is the case, the product’s information is received from the original manufacturer, which may require handling before it can be added to the company’s systems.

Updates to a VDMA library can be necessary if any faults are detected internally or externally. Internally, several possible departments utilize this data, and occasionally, mistakes occur. Complaints can also come from the customer when they go through other departments starting from customer service.

Converting data

With multiple sources to receive information, it needs to be collected in one place, and the format of information must be correct. The place used to collect and store this information is Microsoft Excel. There is a total of three Excel files. This separation is because one file would be too large and visually complicated to read with all products and their data and metadata included. Also, the current method to export information from Excel requires separate files. Exporting product information from the Excel Comma-Separated Values (CSV) file to the XML file is done with a self-made program written in the programming language C++. This program takes information from all three Excel files simultaneously, combines information from these files, and outputs an XML file. The next step is to open this previously created XML file in a different program, Notepad++. This needs to be done because the file is not encoded correctly, and in Notepad++, this is easy to fix. After that, the file requires a new 32-bit Cyclic Redundancy Check (CRC32) code. A specialized tool, CRC generator, is used to create this. The program creates a unique code for this specific version of the file to detect in the future if this file is the most recent one or if any changes or file corruption has occurred. SISTEMA library generator means the SISTEMA program itself. From these steps, the SISTEMA library generator and VDMA CRC generator are external tools that cannot be replaced or deleted from the process.

Final library

Finalized products of the process are the outcoming VDMA library and SISTEMA library. These are used to prove to customers and other organizations product details. The process for the SISTEMA library is more straightforward since it is its own program that only contains the same information as the VDMA library.

Problems with the current method

The current method is complex and includes multiple different applications to perform the complete process. This always creates more files to store and manage, which requires more space from devices and, more importantly, knowledge from the user to manage all specialized tools. As mentioned before, reading or checking raw data in Excel is difficult because Excel is not a database application. It does not include hierarchical and visual filtering or formatting that could be used in this case, which would still fulfill the requirements for exporting with the self-made program.

The features mentioned above make the process inefficient and unnecessarily complicated. However, the biggest issue currently is that the self-made program got corrupted, so it does not work anymore. This leads to a situation where all changes to the VDMA library must be done manually. It is not only the XML file that needs to be updated but also that information must be stored somewhere, which is still the Excel files. This means that information is written two times in different places by hand. It is impossible to copy-paste this data since it is in different file types. Any backup for the self-made program cannot be found, and due to this, the VDMA library is not up to date with all new products.

3.1.2 Demands for the new application

Requirements for new application

Requirements are defined to find the most suitable applications to investigate for this project. In this work, technical features describe features that must be fulfilled. These are the cornerstones of creating a VDMA library. If an application does not

support these, it is not considered an option. User-related features are more flexible and also offer “nice-to-have” features. They are also important, but these do not reject applications immediately if they are not included or supported. These are used to compare suitable options with each other, so they are evaluated with numeral ratings rather than as a polar question, which is the way of evaluating technical features.

The first feature in technical need assessment comes from external organizations because the outgoing file of this process will go to these organizations. The format of the file must be XML, and it has to be validated against the correct schema, which in this case is VDMA 66413 XSD file. In other words, the application must support these markup languages. The second technical feature is the type of application. To learn from previous mistakes, the new process cannot be performed with self-made or customized tools. It must be done with a standard tool. This means that the solution must be found in the public market, so there will be a possibility to get help and support if any technical issues arise. The third technical feature focuses on visual tools. The new solution must have a visual interface. A big problem with current methods is that information is almost unreadable to the human eye, making inspecting and correcting information challenging, which often leads to a low-quality outcome. Since there are different product groups in the same file, visualization does not limit to only presenting one product at a time. There need to be various kinds of grouping and categorization possibilities. Devices should be easy to locate or search, and it should be possible to present multiple devices or only one device at a time. Information in the VDMA library is hierarchical, so there needs to be flexibility to modify the structure of the information.

After defining technical features, user-related features are defined. These are characteristics, which are focusing more on the application itself and its use. The first point is to make the process more efficient. It would be desirable to minimize the number of different tools needed. Ideally, only one application would be capable of fulfilling all requirements. This simplifies the whole process and creates savings in workload, which naturally means savings for the company

since employees can manage their time more efficiently. However, this is not obligated, multiple tools can be used, but applications must cooperate flawlessly. Price has a big impact on the decision. Free or cheap options should be inspected and evaluated first, and with them, more flexibility is allowed with additional features. However, for the final proposal, the most crucial point is to find the most suitable application for this purpose, not the price of it. The next feature with high emphasis is user-friendliness. This feature can be defined by the view of the interface or how easy it is to access different tools inside the application. Also learning curve has an effect since it is not efficient if a user must study unreasonable time only to learn daily operations. The application should be programmed in a way that makes sense for our tasks. This means that no excessive number of clicks are needed to perform basic steps, or the applications' windows are not confusing or complex for the user. The application should be straightforward and clear to operate.

Lastly are defined features that bring value but are not limiting factors. These can make applications stand out from others. Other than XML features, for example, supporting more advanced or different functions are desired bonuses. If these are included, it is also possible to take advantage of the application in other tasks. These features include but are not limited to support of other file types, different built-in tools, programming code language support, or assistance to fill out or edit text. Possible license types or packages are appreciated. This is not highly emphasized, but because usually, these applications can be used in other use cases, it is valuable to know what kind of package deals or discounts they offer. Also, if no free trials are offered, it is difficult to confirm whether the application performs all necessary tasks and how it should be rated compared to others. Since the focus is on a tool that manages data, not alone stores it, connectivity to database platforms brings additional value because databases are vital and continuously used in different tasks. The task is done in an international company, so it is appreciated if multiple language options are available. The person responsible for the VDMA library can change over time, or it would be a bonus if the application could be used in another office or task.

Suggestion and wishes

The company had an idea and wishes how this new process could be done. Their idea is to have a DB as an information storage system, and the platform's interface would offer visual tools. This DB should fulfill all previously listed requirements, and the task of this thesis is to search and examine databases and figure out whether it can be done with a database or if some other solution is better.

The company does not have previous knowledge or experience in creating a complete DB structure, but their number one DB application proposal is MS Access. This is because MS Access is included in the Microsoft Office Enterprise package, which is already in use all over the company. Being able to build the process around MS Access, there would be no costs for a new application. Also, MS Access provides a similar interface to MS Excel. This is convenient for all users because this would create the least amount of studying of any new applications.

Another practical advantage comes from the company's new software accepting process. In Schneider Electric, to be able to install any programs on any computer, you always need admin rights to control your computer. To gain these rights, you need to apply for them from the IT department, and to receive admin rights, you need good reasoning. However, this is different when a program is completely new for Schneider Electric. In such a case, the new application must be inspected and accepted by the IT department. This will take time and creates complications in implementing any new application. The same point also covers application updates. MS will ensure that their products are up to date, and for everyday users, all information about these comes through the company's IT department, so there is no need to do additional work on them. Besides MS Access, no other database generation applications were found already in use in Schneider Electric.

3.2 Development project

This chapter handles all parts of the work done in this thesis. Guidelines and requirements from the company are implemented and respected in testing and comparisons. The project started with trying the capability of Microsoft Access for this task and afterward continued with XML editors' research.

3.2.1 Database

This thesis started by examining the company's requirements and wishes by determining whether this is possible with the existing tool, MS Access. Test to try DB as a solution is done in MS Access by creating own structure for a DB of the VDMA library. This is done because no clear answer is found in books or directly from Microsoft. However, the MS Access application and user instructions provide information that principles needed in this work can be found, meaning that it supports XML file importing and exporting, and the DB can be relational and created with a hierarchy.

Experimenting whether MS Access is suitable for this use means a structure for a new DB for this specific purpose must be done. It is possible to find out only by trying if MS Access can deal with VDMA 66413 specification schema and convert that from the Microsoft Access database file type (ACCDB) to an XML file. This whole process is made with the "trial and error" method. This means that everything is tried in practice, and upcoming error codes are dealt with to make conclusions about suitability.

After first looking at tools found in the application, importing and exporting XML files seemed to work without issues. Tests with simple and short XML files were done, and these features worked as intended. The next step was determining whether the tables inside MS Access fit our purpose. Relations between different tables were logical and successful. Everything seemed to be going great at this point, and this was an appropriate option.

However, due to a lack of knowledge about the application and technology, the first tests were made with simple files to find out the application's principles to determine if MS Access could work with the idea of the VDMA library. After this, the next thing to pay attention to is the most important requirement, can the outgoing XML file fulfill VDMA 66413 standard formatting? The tables and their structure in the DB must be correct to export XML files from MS Access in the correct format. Because the VDMA 66143 schema contains a complex structure with many elements and attributes, MS Access could not support this. The biggest issue is that MS Access can only support element-centric XML files. Since VDMA 66413 schema is attribute-centric, importing or exporting these files into the DB cannot be performed with the built-in wizard.

VBA was used to make necessary file conversion, but during tests with VBA, it became clear that MS Access would be too complicated to use as a tool to create VDMA libraries. That is because it would need multiple file type conversions, and still, in the end, it needs another XML editor or program to validate file structure against the required schema.

At this point, thesis question number 1 was answered negatively, so the focus was turned to the second question: What is the best alternative solution if MS Access is not suitable? At this point started the process of searching for alternative applications. Other types of databases were inspected and tested, but due to technical need assessment, none of them seemed suitable at first look. At this point completely different approach was necessary. When looking at the process backward, the first thing to do is to validate the XML file against the schema. The next idea was to search for applications designed to manage or modify XML files. Market analysis and product research had to be done on applications with built-in features to support XML files. These applications are called XML editors.

3.2.2 XML editor

Any application that understands XML language and allows file modification can be described as an XML editor. Since XML is written in text format, it can be opened and read with any text editor. XML can often be also modified in a text editor. Still, because there is no syntax highlight, or any other assisting tools available, the user must write down every character correctly and later use a separate XML syntax validator to see if it is written perfectly.

The next level from the text editor is a program that understands coding languages. In these programs, it is possible to validate syntax while creating a file and use many other tools developed to make modifying easier for the user. These often are visual help, for example, syntax highlight or pretty print. Programs like this are usually free, but they are not explicitly created for XML, so features that can be found are limited. However, these are handy if only minor changes are needed or the file is not too large or long.

The most advanced version of an XML editor is a program wholly designed for XML. They support Schema files, so creating a new XML file from zero or existing DTD or XSD is possible. Also, validating XML files against a schema or even creating and editing your own schema can be done with it. Besides this, they have an integrated visual view of the file. In most cases, it is called Grid-view. That is ideal for editing big XML files effortlessly with higher speed and quality when compared to the traditional way of working with an XML file. Other built-in wizards support the user with an outline tree view or automatically filling structure after a schema is connected to the file. These applications can provide many additional features depending on the manufacturer and their focus. These can be, for example, other language code generation. This kind of applications always costs something. They come reasonable when the number of XML files to be modified is large or any type of visualization is desired.

Market analysis

The goal of market analysis is to find out what options or products are currently in the market and which would be suitable to fulfill this project's requirements. Since XML editing is supported in many applications, dozens of options exist. Many of them did not have a lot of recognition or informative website, but data mining was done online. A list of potential applications was gathered by searching options from forums, application comparisons or evaluations, the product's own websites, and downloading a test version of the application and getting familiar with it.

The first framing was done to find the most common, used, and best-evaluated options from forums or product comparisons. Usually, the lists of options were long. To have reliability for the applications, chosen ones had to be mentioned at minimum in two different sources, but preferably in three or more, as a good option, to be considered part of more detailed research. This research means getting familiar with features, descriptions, and use cases found in their introduction.

Sources to gather the application list could not be any webpage. The online source had to be recent, meaning it could not have been written more than two years ago. Websites had to be at some level professional, so there needed to be a clear structure and not only names of applications but also a justification for how this option ended up on the list. Only five sources were searched to manage the scope of the work.

Sources for this created list are the following websites:

- [Geekflare.com](https://www.geekflare.com) (Ghimire, 2021).
- [Slant.co](https://www.slant.co) (Slant, 2022).
- [Softwaretestinghelp.com](https://www.softwaretestinghelp.com) (Software Testing Help, 2022).
- [Sourceforge.net](https://sourceforge.net) (Sourceforge, 2022).
- [Techgeekbuzz.com](https://www.techgeekbuzz.com) (techgeekbuzz, 2022).

These websites were analyzed, and according to multiple descriptions, criteria fulfilling applications were listed for more detailed inspection. In this matter, criteria mean technical features defined in the need assessment. The list is not

intended to be exhaustive. There are hundreds of options in the market. The list covers options for this specific task taking into account the time and work delimitations of this work.

These applications were:

- Adobe FrameMaker
- Altova XMLSpy
- EditiX
- Emacs for XML
- Komodo Edit
- Liquid studio
- Notepad++
- Online XML tools
- Oxygen XML Editor
- Stylus studio
- XML Grid
- XML Notepad
- Xpublisher

This is still a rough breakdown. These 13 listed options are evaluated by introduction and data provided by their manufacturer. After this detailed check, only six applications were suitable for this process, according to their introduction. The best potential applications were downloaded and compared in product comparison.

Product comparison

The structure for comparison is created and based on the defined criteria. Each application is evaluated with information from the product description and introduction by the manufacturer and by running tests with the application. Points are given for every question in the comparison. The emphasis of each requirement defines the maximum points for each question.

These six suitable applications from a rough breakdown were taken into comparison. This detailed investigation showed that even if products are described as XML editors and have good online evaluations, they did not match the needs of this project. 50% of these options did not support needed visual

features, and the interface was not desirable for this usage. Rest three of the six were designed for this purpose and served well in the first test. However, one of them had to be turned down because the application's user experience was so bad that it could not be recommended to be used. A detailed comparison can be found in the annexes. This comparison did not define the best option, but limited options out of the full comparison, so the total points given in this phase did not determine the proposed application. The best two options were taken into full comparison. All features they support were listed, price and package options compared, and visualization evaluated, and both carried out a test run, including modifications to a VDMA 66413 structured XML file.

3.3 Results

3.3.1 Most suitable application

The results of the detailed comparison between the two options are evaluated, and the most suitable application is found. This application is named Oxygen XML Developer. The solution was presented to the company, and the proposal got accepted. This application is proved suitable for this task by creating the newest update for the VDMA file. This is done during the application trial period.

Oxygen XML Developer is evaluated as the best option because it gives the most and has the best price-to-feature ratio. It provides the most significant number of supported features, including valuable built-in tools, making XML file editing more user-friendly. Besides visual Grid-view and many other features found in both options, Oxygen XML Developer has an additional Tree-view tool, which makes editing a long XML file convenient. It also supports opening different file types inside the application. This makes working with projects easy because you can see and open all needed files from any specific folder without changing between multiple applications. Another appreciated feature is that users can copy-paste directly from an Excel file, which has traditionally been a method of transferring information.

3.3.2 Benefits of an XML editor

XML editor fulfills all requirements defined by the company. It simplifies the whole process significantly. With only one application, the user can do the same work, which previously took three different applications. This is possible by taking advantage of the XML file itself. In this case, the XML file is used as the database, and it is checked, managed, and modified in an application that makes the XML file visual and editing intuitive. Incoming and outgoing files always will be XML files in the correct format and validated against the schema, so there is no longer a need to make file type conversions.

Process chart of new, improved way of creating a VDMA library:

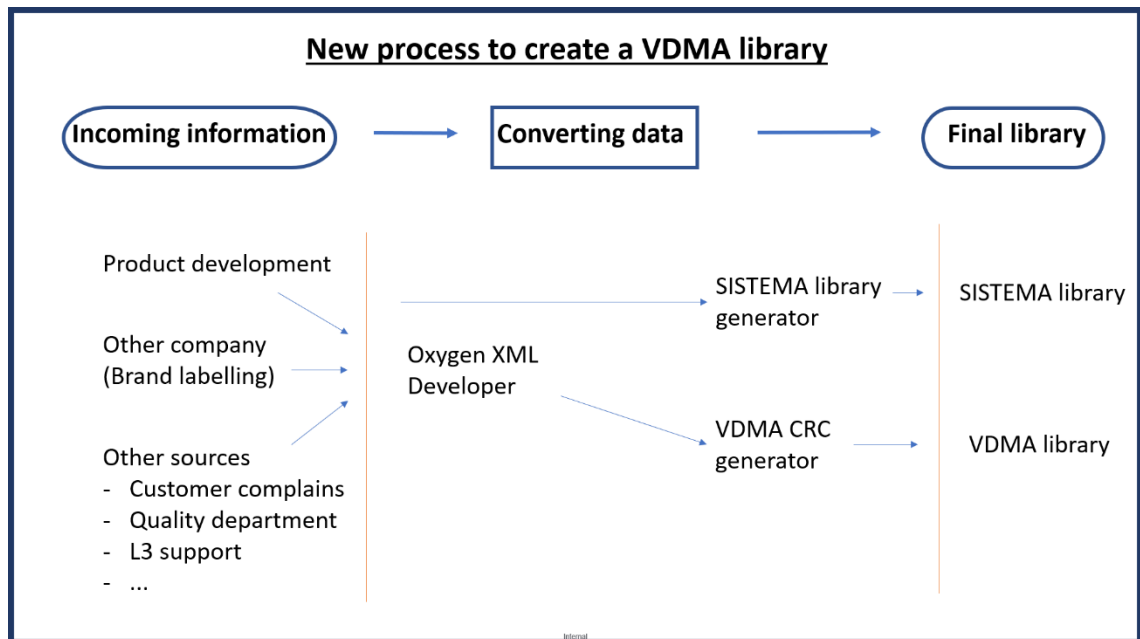


Figure 5 Process chart of the new method to create VDMA library

From figure 5, it is possible to see that the goals defined at the beginning of the thesis were achieved. There is a new method to work with these files, and, at the same time process is more manageable for the user.

Savings in time are significant. Not only because everything is accessible with one application, but this application has visual benefits, so its use is simple and

efficient for the user. This is also beneficial when new people are introduced to updating or managing the VDMA library. Since the whole application is created for XML editing, user tasks are easy and fast to do, and everything is clear, thanks to visual tools. New persons are quick to orientate to the process since only one instruction sheet is needed. The creation of the instruction sheet was part of this thesis. Instructions were tested with a student colleague, and the test showed that the basic use of the application could be learned in one to two hours.

Estimated savings in updating the VDMA library's workload dropped from 4-5 days of work to 1-2 days of work. This means 2-4 days of work saved per every library update, which means that time used in the process is a minimum of 50 % less. Usually, this file is updated 1-3 times per year. This counted on a yearly level; saved workload can be up to 12 working days. Although this application has paid licenses, it pays itself back already at the first update.

4 Conclusion

The main point of this thesis was to search for a new method to create VDMA libraries, with requirements and guidelines from the company that provided this topic. The results indicate that the first suggestion, a database used to manage VDMA libraries, was not suitable due to the complexity of the process of changing between file types, which cannot be ignored because international standards define file types. After that, carried out market analysis and product comparison showed that alternative options exist and are a perfect fit for this purpose. The proposed application is called Oxygen XML Developer. This is an application created specifically to create and edit XML files visually. The benefits of the new process were proved by finishing this project with an update for the VDMA library.

This best application result is according to this research and the options considered in this work. Outside of this work's specified list, there are tons of other options, which can have better features or prices, but due to defined requirements and the progress of the work, every application could not be taken into account.

Since the company is satisfied with the proposed application, the main problem of the thesis is solved. The most significant benefits from further research would be related to the application and its other use cases. Product comparison includes a compilation of features that are supported. Research could be done on other supported features inside the application besides XML editing that could be utilized in other processes. Further research would discover all other use cases in the company where this application is beneficial. These can be related to XML files or other supported features. Improvements in this process showed that significant savings could be achieved by simplifying the process with proper tools.

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XML editor comparison

XML editor Comparison	Altova XMLSpy https://www.altova.com/xmlspy-xml-editor	Points
Price	459€ per licence	1 / 5
Packages/licence types	User packages: 1, 5, 10, 20, 50+. Support and Maintenance Package can be bought on yearly billing.	2 / 2
Free trial	Yes, 30days	1 / 1
Features	Designing, Editing and Debugging: JSON XML XML & JSON Schema XSLT Xquery Web services OOXML (Office Open XML) Visual Studio Eclipse plug-ins HTML & CSS Grid-View SmartFix Validation Java, C#, C++ code generation EPUB editing +others	4 / 5
Connectivity to databases	Yes, 13 different common databases listed	2 / 2
Visual presentation of files	Grid-view, text-view + others	5 / 5
Intuitiveness, user friendliness	Took only couple of hours to figure out basic things in the application.	5 / 5
Languages	English, Deutsch, Spanish, Japan, France	2 / 3
Other/Comments	Lists all possible choices according to schema when creating new 'Device'. 1p Object preview with mouse. 1p	2 Extra Total 24 / 28

XML editor Comparison	Oxygen XML Developer https://www.oxygenxml.com/	Points
Price	423\$ per licence (including 1y SMP)	1 / 5
Packages/licence types	User-based & floating licence. If 20+ users, you need HTTP server.	1 / 2
Free trial	Yes, 30days	1 / 1
Features	Designing, Editing and Debugging: JSON XML XML & JSON Schema XSLT Xquery SOAP WSDL Web services OOXML (Office Open XML) Eclipse plug-ins HTML Grid-View Intelligent XML editing Visual XML Editor Ant Relax NG XProc CMS Integration SVN Client EPUB Markdown Compare and merge tools +others	5 / 5
Connectivity to databases	Yes, 5 different common databases listed	1 / 2
Visual presentation of files	Grid-view, text-view + others	5 / 5
Intuitiveness, user friendliness	Easy main menu and controls. Easy symbols, but in the beginning can be confusing to find or use.	4 / 5
Languages	English, Deutsch, France, Japan, Dutch, Chinese	2 / 3
Other/Comments	Outline tree view. 1p	2 Extra
	Huge amount of options to choose or edit. 1p Field titles don't follow when scrolling down. -	Total 22 / 28

XML editor Comparison	XML Notepad https://microsoft.github.io/XmlNotepad/	Points
Price	FREE	5 /5
Packages/licence types	FREE	2 /2
Free trial	Yes	1 /1
Features	<p>Only XML editor.</p> <p>XML</p> <p>XSLT</p> <p>XML Schema (xsd)</p> <p>Import .csv and .htm files</p> <p>XML Statistics</p>	1 /5
Connectivity to databases	No	0 /2
Visual presentation of files	Tree view only	1 /5
Intuitiveness, user friendliness	Functions easy to use	4 /5
Languages	<p>English.</p> <p>Pop-up messages in computer's pre-defined language.</p>	2 /3
Other/Comments	<p>Suites small and simple xml files. VDMA structure and length of rows is hard and unclear to utilize efficiently.</p> <p>No identifiers visible unless open specific "Device" folder in tree view.</p> <p>Very little help found online.</p> <p>Drag and drop in tree view. 1p</p> <p>Dynamic help = instructs all text rows.</p> <p>Application froze 3 times while using. When trying to expand too big element file.</p> <p>CANNOT RECOMMEND THIS APPLICATION FOR OUR PURPOSE</p>	<p>1 Extra</p> <p>Total 17 /28</p>

XML editor Comparison	Liquid Studio https://www.liquid-technologies.com/xml-studio	Points
Price	284,04€ per licence	2 / 5
Packages/licence types	Single installed licence, package for 10, virtual, installed single domain site licence.	2 / 2
Free trial	Yes, 15days	1 / 1
Features	Designing, Editing and Debugging: XML JSON & XML Schema XSLT Xquery REST and SOAP Web service Tools WSDL OOXML XBRL Visual Studio Projects and source control Text editor for CSS, CSV, DTD, XHTML, RSS, TXT, XDR	3 / 5
Connectivity to databases	Yes, most common databases + other connectivity	2 / 2
Visual presentation of files	Grid-View, Text-View, Split-View	4 / 5
Intuitiveness, user friendliness	See comments below	0 / 5
Languages	English. Pop-up messages in computers pre-defined language.	2 / 3
Other/Comments	No autofill in text view, when creating new 'Device' etc. Platform is very laggy when using any bigger file, every click freezes for few seconds. Is it because it's free test version? In text-view works OK. Does not offer assistant when filling out new device, auto-error detection does not apply in all modes. BASED ON MY TRIAL I CANNOT RECOMMEND THIS APPLICATION FOR OUR PURPOSE	Extra Total 16 / 28

XML editor Comparison	Xpublisher (Xeditor) https://www.xpublisher.com/products/xeditor	Points
Price	Not available for public -> always need to contact company. NO RESPONSE FROM COMPANY	/5
Packages/licence types	Not available publicly -> always need to contact company. NO RESPONSE FROM COMPANY	/2
Free trial	NO RESPONSE FROM COMPANY	/1
Features	XML editor XML Schema editor CMS CCMS	/5
Connectivity to databases	NO RESPONSE FROM COMPANY	/2
Visual presentation of files	NO RESPONSE FROM COMPANY	/5
Intuitiveness, user friendliness	NO RESPONSE FROM COMPANY	/5
Languages	Bulgarian, Chinese (Simplified), Croatian, Czech, Dutch, English, French, German, Hungarian, Indonesian, Italian, Japanese, Norwegian, Polish, Portuguese, Romanian, Russian, Serbian, Slovak, Slovenian, Spanish, and Turkish.	3 /3
Other/Comments	Online Access via cloud	Extra Total 3 /28

XML editor Comparison	EditiX https://www.editix.com/	Points
Price	179\$ per licence	3 / 5
Packages/licence types	179\$ one licence per person for unlimited time. Discount for 6 or 10 licences	1 / 2
Free trial	Yes, 30days	1 / 1
Features	Designing, Editing and Debugging: XML XSLT XPath Xquery Grid editor XML Schema validation Project management Template support Open XML Format editor CSS editor XML comparison Xinclude OTD HTML JSON	3 / 5
Connectivity to databases	Yes, XIncode and Oracle pre-set	1 / 2
Visual presentation of files	Only text- and tree-view	1 / 5
Intuitiveness, user friendliness	Very basic interface. Options easy to find, but overall it's limited.	3 / 5
Languages	English only	0 / 3
Other/Comments	Semi-auto filling ion text view. Only text view. BASED ON MY TRIAL I CANNOT RECOMMEND THIS APPLICATION FOR OUR PURPOSE	Extra Total 13 / 28