MASTER THESIS

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Degree Program Information Systems Management

Analysis of the optimization of manufacturing business processes through cloud-based integrated business information systems focusing on Microsoft products

By: Ing. Dominik Scheuringer, BA
Student Number: 1610302022

Supervisor 1: Mag. Ing. Christoph Weiss
Supervisor 2: Mag. Jürgen Salaböck

St. Marienkirchen, 31.05.2018

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Software-Anbieter von modernen Business-Informationssystemen (BIS) haben einen hohen Fokus auf zwei wichtige Trends gelegt in letzter Zeit. Zum einen, die vertiefte Integration zwischen den am häufigsten verwendeten Arten von BIS wie Enterprise Resource Planning (ERP)-, Customer Relationship Management (CRM)-, Business Intelligence (BI)- und Collaboration-/Office-Systemen. Zweitens, die Bereitstellung dieser integrierten Systeme als Software-as-a-Service (SaaS)-Lösungen. Daraus ergab sich als Motivation für den Autor, solche cloud-basierten integrierten Business-Informationssysteme detaillierter zu analysieren aufgrund der hohen Relevanz dieser zwei bedeutsamen Trends. Dabei war das Ziel des Autors herauszufinden, ob die analysierten Systeme eine Optimierung von Geschäftsprozessen ermöglichen. Um die Aussagekraft der Ergebnisse zu erhöhen, wurde die Analyse für eine ausgewählte Branche gemacht, nämlich die Produktionsbranche, mit Fokus auf den Auftragsfertigungsprozess. Da eine Vielzahl der betroffenen Systeme am Markt existieren, hat sich der Autor auf die Software-Systeme von drei Software-Giganten bezogen, nämlich Microsoft, SAP und Oracle NetSuite, mit Hauptfokus auf die Microsoft-Produkte. Das im Zuge dieser Masterarbeit gewonnene Wissen kann als wertvolle Informationsquelle für zukünftige Implementierungsprojekte innerhalb Produktionsfirmen verwendet werden, sowohl von den Implementierungspartnern als auch den Endkunden.

Zur Problemlösung hat der Autor folgendes Vorgehen ausgewählt. Zu Beginn wurde eine Literaturanalyse durchgeführt, indem die wichtigsten Inhalte der Grundlagen von IT Business Informationssystemen, der Integration zwischen verschiedenen BIS und über die Grundlagen von Cloud-Computing, mit Fokus auf SaaS, zusammengefasst und verglichen wurden. Danach wurden als wesentlicher Teil dieser Masterarbeit 16 Experteninterviews durchgeführt mit dem Ziel die wichtigsten Kriterien und Erfolgsfaktoren von cloud-basierten integrierten BIS zu identifizieren. Um eine hohe Aussagekraft aufgrund verschiedener Sichtweisen zu gewährleisten, wurden einerseits sowohl Experten von IT Beratungsfirmen als auch Key-User und Entscheidungsträger von Produktionsfirmen, jeweils ausgestattet mit fundierten Erfahrungen, befragt. Andererseits haben die befragten Personen Wissen über verschiedene Systeme von verschiedenen Software-Anbietern. Aufgrund der aufschlussreichen und umfangreichen Ergebnisse der Interviews wurde dann ein Kriterienkatalog über die wichtigsten Erfolgsfaktoren inklusive einer Definition der Bewertungskriterien erstellt. Als zweite umfangreiche Methode wurde dann eine Implementierung und Evaluierung von Prototypen durchgeführt. Dabei wurde eine zuvor definierte Auftragsfertigung von Fahrrädern, welche CRM-, ERP-, BI- und Collaboration-Aktivitäten enthält, innerhalb der drei ausgewählten Systeme Microsoft Dynamics 365, SAP Business ByDesign und Oracle NetSuite implementiert. Die Implementierung wurde mittels textueller Beschreibungen und Screenshots dokumentiert, mit Fokus auf die nahtlose Integration zwischen den Systemen.

Aufgrund der gerade erklärten Methoden wurden zahlreiche erkenntnisreiche Ergebnisse festgestellt. Zuerst wurde eine Liste von 22 der am meisten relevanten funktionellen und nicht-funktionellen Kriterien von cloud-basierten integrierten BIS erstellt. Zweitens wurde eine Validierung der drei ausgewählten Systeme anhand einer Bewertungsmatrix basierend auf dem Kriterienkatalog erstellt, inklusive einer Begründung für die Bewertung jedes Kriterium. Als drittes Resultat wurde eine Liste von 23 qualitativ beschriebenen Optimierungen des Auftragsfertigungsprozesses erstellt, indem argumentiert wurde, wie zuvor festgestellte Schwachstellen von isolierten On-Premise-Systemen eliminiert werden konnten und somit eine Prozessoptimierung erzielt werden konnte. Als viertes und letztes Ergebnis wurde eine Zusammenfassung von Potentialen aber auch Herausforderungen von cloud-basierten integrierten BIS aufbereitet, wiederum mit Fokus auf die Produktionsbranche.

Schlagwörter: Integration, SaaS, Microsoft Dynamics 365, SAP Business ByDesign, NetSuite, Auftragsfertigung

Abstract

Software providers of modern business information systems (BIS) have been focusing increasingly on two important trends in recent times. First, the deeper integration between the most frequently applied different types of BIS like Enterprise Resource Planning (ERP)-, Customer Relationship Management (CRM)-, Business Intelligence (BI)- and Collaboration-/Office-systems. Secondly, the deployment of those integrated systems as Software-as-a-Service (SaaS)-solutions. Consequently, the motivation of the author was to analyze such cloud-based integrated business information systems in more detail due to the high relevance of those two disruptive trends. Thereby, the goal of the author was to find out whether the analyzed systems enable the optimization of business processes. In order to increase the validity of the results, this analysis was done for a selected industry, the manufacturing industry, with a focus on the make-to-order process. As a great number of the involved systems exist on the market, the author included the software systems of three top players on the software market, Microsoft, SAP and Oracle NetSuite, with a main focus on Microsoft products. The gained knowledge of this Master's Thesis shall be usable for upcoming implementation projects of business information systems within manufacturing companies, for both implementation partner companies but also the end customers.

In order to solve this problem, the author chose the following approach. It started with a literature review summarizing and contrasting the current state of the field of IT business information systems fundamentals, the integration of business information systems and cloud fundamentals with a focus on SaaS. Afterwards, a major part of this thesis was conducting interviews with 16 experts with the goal to determine the most important criteria and success factors of cloud-based integrated BIS. In order to enable a high expressiveness based on different perspectives, on the one hand, both experts of IT consulting companies and key users of manufacturing companies of different management positions and with profound experience were interviewed. On the other hand, the interviewees have knowledge of different systems from different software providers. Based on the insightful results of the expert interviews, a criteria catalogue of the most important success factors including a definition of the evaluation criteria was established. The second comprehensive method was the implementation and evaluation of a proof of concept. Thereby, a pre-defined make-to-order production of bicycles, including CRM-, ERP-, BI- and collaboration-activities was implemented within the three selected systems Microsoft Dynamics 365, SAP Business ByDesign and Oracle NetSuite. The implementation was documented by means of textual descriptions underpinned with screenshots out of the software systems, whereby the focus was put on the seamless integration between the different types of BIS.

Based on the aforementioned methods, many insightful results were determined. First, a list of 22 of the most relevant functional and non-functional criteria of cloud-based integrated BIS, which shall be regarded when selecting the systems, was created. Secondly, a validation of the three selected systems by means of a decision matrix based on the criteria catalogue including a justification for each criteria grading by referring to expert interviews, the proof of concepts and further literature was done. As a third main result, a list of 23 qualitative described improvements of the make-to-order process was established, by arguing how the previously identified vulnerabilities of isolated on-premise systems could have been eliminated or optimized. Thus, it was demonstrated that the make-to-order processes could be improved based on the analyzed systems. Finally, as a fourth result, a general summarization of the potentials as well as the challenges of cloud-based integrated BIS, with focus on the manufacturing industry as far as possible, was done.

Keywords: Integration, SaaS, Microsoft Dynamics 365, SAP Business ByDesign, NetSuite, Make-To-Order

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1 Introduction

In this introductory chapter, the author depicts the initial situation, the problem area and the subsequent targets and motivations of this thesis. Afterwards, the treated research questions, the applied scientific methods and the expected results, i.e. the constructed hypothesis of the author, are described. This chapter is concluded by a short overview about the scope and structure of this work.

1.1 Initial situation and problem area

The author works for the company NAVAX Consulting GmbH[1], which is a provider of IT services. The main tasks of NAVAX are to plan, implement and support software solutions for the transaction of business processes. The offered software solutions consists of Enterprise Resource Planning (ERP)-, Customer Relationship Management (CRM)-, Business Intelligence (BI)- and Collaboration-systems. Microsoft, the main partner of NAVAX, has been focusing increasingly on the **Cloud** in the recent time. Currently they are working on a new product called "Microsoft Dynamics 365"[2]. Thereby the goal is to **integrate** ERP (Microsoft Dynamics AX, Microsoft Dynamics NAV), CRM (Microsoft Dynamics CRM), BI (Microsoft Power BI), Collaboration (Microsoft Office 365), Internet of Things-Services (Microsoft Azure), Cortana Intelligence and further third-party business information systems (which can be purchased via an AppSource) into a common Cloud Service. Based on this circumstance and trend the author would like to generalize this problem area (by neglecting the focus on the company NAVAX) and would like to analyze such "cloud-based integrated business information systems" generally in more detail. This shall be done using mainly the example of **Microsoft products** but by also comparing it with two other software systems from two other well-known software providers (SAP[3] and Oracle/NetSuite[4]). The goal is to find out whether such cloud-based integrated business information systems can help **manufacturing companies** to improve their business processes (with the example of **the make-to-order process**).

1.2 Targets and motivation

The thesis deals with IT business information systems (with a main focus on ERP systems) and analyzes such systems in two different areas:

- The **integration** of different types of IT business information systems, which are most common in manufacturing companies. Thereby, the thesis focuses on ERP-, CRM-, BI- and Collaboration systems.
- The application of these systems within the **cloud**.

Both topic areas were derived due to the importance and priority of those two disruptive trends and their need to investigate such cloud-based integrated business information systems in more detail. Thereby, the analysis is done for a specific industry, which is the **manufacturing industry**.

Consequently, the potential use of this work is to gain a comprehensive insight into the application of cloud-based integrated business information systems whose knowledge can be used for upcoming implementation projects of business information systems within manufacturing companies.

[1] www.navax.com (Accessed 10 Jan. 2018)
[2] https://dynamics.microsoft.com/en-us/ (Accessed 10 Jan. 2018)
[3] www.sap.com (Accessed 25 Jan. 2018)
[4] http://www.netsuite.com/ (Accessed 25 Jan. 2018)

1.3 Research questions, methods and expected results

The thesis focuses on one broad **research question**, which is further broken down into four supportive questions in order to achieve a valuable conclusion:

> *How can cloud-based integrated business information systems improve the make-to-order business processes of manufacturing companies?*

The author's **overall hypothesis** is that cloud-based integrated business information systems build the foundation for optimizing the make-to-order business processes by increasing the flexibility, productivity and scalability of manufacturing companies. It is also hypothesized that cloud-based integrated business information systems will become especially for startup-companies and small- and medium-sized enterprises a very powerful model for conducting their IT systems.
The following **supportive research questions** shall support the author's hypothesis:

> *Supportive question 1: Which criteria should be regarded when selecting cloud-based integrated business information systems in manufacturing companies?*
>
> *Supportive question 2: Which of the cloud-based integrated business information systems Microsoft Dynamics 365, SAP Business ByDesign or Oracle NetSuite currently fulfill these criteria at best?*
>
> *Supportive question 3: How can the make-to-order processes of a manufacturing company be improved by integrating ERP-, CRM, BI- and other types of business information systems?*
>
> *Supportive question 4: What are the potentials and challenges of cloud-based integrated business information systems for manufacturing companies?*

In order to investigate these research questions, the following **methods** shall serve as a foundation for this thesis:

- Literature Review
- Expert Interviews
- Prototype (Proof of concept)

In a **literature review**, the current state of the field of IT business information systems fundamentals, the integration of business information systems and cloud fundamentals with a main focus on software-as-a-service (SaaS)-based business information systems, as well as important concepts for the thesis are introduced to the reader.
The **expert interviews** will serve as the main inputs for the identification of the most important criteria and success factors of cloud-based integrated business information systems, which will result in the creation of a criteria catalogue.
Afterwards, a validation of the selected software systems (from Microsoft, SAP and Oracle/NetSuite) based on that criteria catalogue and by means of the application of a **proof of concept (prototype)** with the selected systems is done.
Finally, the results are analyzed and discussed and conclusions for further research are drawn.

The following table summarizes the applied methods for each research question and the expected results and hypothesis of the author for each of them:

Research question	Method	Expected result(s) and hypothesis
Which criteria should be regarded when selecting cloud-based integrated business information systems in manufacturing companies?	Conduction of expert interviews including qualitative content analysis.	Criteria catalogue, which contains the most essential requirements and selection criteria for cloud-based integrated business information systems. *Hypothesis 1:* „*The failure safety, availability of IT resources, data volume, performance and costs are essential criteria, which should be regarded when selecting cloud-based integrated business information systems."*
Which of the cloud-based integrated business information systems Microsoft Dynamics 365, SAP Business ByDesign or Oracle NetSuite currently fulfill these criteria at best?	Expert interviews, proof of concepts and further literature review.	Validation of the three selected systems based on the criteria catalogue. *Hypothesis 2:* „*Microsoft Dynamics 365, SAP Business ByDesign and Oracle NetSuite function at a similar level even if SAP Business ByDesign and Oracle NetSuite eventually have some advantages as these two products have already been established on the market for a longer time."*
How can the make-to-order processes of a manufacturing company be improved by integrating ERP-, CRM-, BI- and other types of business information systems?	Proof of concepts (implementation of a pre-defined make-to-order business process scenario within three selected systems).	List of qualitative described process optimizations (elimination/optimization of vulnerabilities of isolated on-premise systems, which have been identified through the expert interviews). In this way it should be demonstrated if the make-to-order processes can be improved through the integration of different application systems running in the cloud or not and to what extent. *Hypothesis 3:* „*By integrating IT business information systems within a company it enables a consistent and central database of real time data, an integrated view of business processes, a faster and more transparent reporting and a more efficient usability and administration."*
What are the potentials and challenges of cloud-based integrated business information systems for manufacturing companies?	Evaluation and analysis of the results of the proof of concepts and the expert interviews.	Based on the results of the proof of concepts and expert interviews it shall be investigated several issues in order to answer the research question and in order to enable a discussion (relationships between results, generalization of results, limitation of results, interested findings, conclusions etc.). *Hypothesis 4:* „*Cloud-based integrated business information systems build the foundation for optimizing the make-to-order business processes of companies by increasing the flexibility, productivity and scalability of manufacturing companies."*

Table 1: Overview research questions, methods and expected results

1.4 Approach, scope and structure

This Master's Thesis is structured in six chapters. The first chapter serves as an **introduction** to the topic and a description of the research and problem area. The second chapter gives an overview and defines the applied **research methodologies**. Chapter 3 is intended to summarize past and current **literature** on the three main disciplines of this thesis, namely, business information systems fundamentals, the integration of business information systems and cloud fundamentals with focus on Software-as-a-Service. The fourth chapter describes the application and the results of the **empirical methods**. It starts with a summary of the main results of the **expert interviews.** The second sub-chapter describes the establishment of the **criteria catalogue** based on the results of the expert interviews. Finally, the third part of chapter four is the description of the application of the **proof of concepts** with the selected systems including a specification of the initial parameters of the proof of concepts, a summary of the implementation and an overview about the evaluation. Chapter 5 describes the **results of the posed research questions** using the obtained information from the aforementioned methods. Finally, chapter 6 **concludes** this Master's Thesis with possible implications and an outlook.

2 Research methodology

This chapter describes the research methodology of this thesis and contains a description of each research method used. The theoretical section (chapter 3) was done based on a literature review. The second section, the empirical study (chapter 4) was done based on a qualitative empirical research design in order to answer the research questions optimally. This ensures that the resulting gain in knowledge is both theoretically grounded as well as enriched by practical knowledge. Therefore, expert interviews and a proof of concept, based on a criteria catalogue, were conducted by the author.

2.1 Literature review

According to Fink, a literature review is a reproducible, explicit and systematic approach for the identification and evaluation of the existing content of completed and recorded work created by researchers, scholars and practitioners (Fink, 2005).

Thus, the goal of this literature review, which is done in chapter 3, is to provide the author and the reader the fundamental and required information to research the topic of this thesis. Furthermore, the essential terms are defined and presented.

The main tasks of the literature review, based on Fink (Fink, 2005), which the author conducted, were the following:

1. **Selection of research questions:** The research questions of this thesis are described in chapter 1.3.
2. **Selection of bibliographic or article databases**: The author collected literature sources from both the library of the UAS Technikum Vienna and from multiple web-based scientific search engines (Springer Link[5], ScienceDirect[6], BASE[7], ResearchGate[8], WISO[9], ECONBIZ[10], Google Scholar[11] and IEEE Xplore[12]).
3. **Selection of search terms**: For the three main topic areas of this thesis – business information systems fundamentals (chapter 3.1), integration of business information systems (chapter 3.2) and cloud fundamentals with focus on SaaS (chapter 3.3), each time at least 10 words and phrases were used to search the selected databases.
4. **Application of practical screening criteria**: Thereby, the title, abstract and conclusion of the papers were read and afterwards it was decided whether the papers are appropriate for this thesis or not.
5. **Application of methodological screening criteria:** Thereby, the author applied the following criteria:
    a. Paper must have been published in the last 15 years (apart from general definitions, then older papers were also regarded).
    b. Papers must have been published in English language (apart from some exceptions).
    c. Papers must not be written for a specific country (e.g. just for Austrian companies).
    d. The author mainly chose primary sources.

[5] https://link.springer.com/ (Accessed 15 Jan. 2018)
[6] https://www.sciencedirect.com/ (Accessed 15 Jan. 2018)
[7] https://www.base-search.net/ (Accessed 15 Jan. 2018)
[8] https://www.researchgate.net/ (Accessed 15 Jan. 2018)
[9] https://www.wiso-net.de/ (Accessed 15 Jan. 2018)
[10] https://www.econbiz.de/ (Accessed 15 Jan. 2018)
[11] https://scholar.google.at/ (Accessed 15 Jan. 2018)
[12] http://ieeexplore.ieee.org (Accessed 15 Jan. 2018)

6. **Execution of the review**
7. **Synthetization of the results**: The results of different sources were contrasted and interpreted.

It is worth mentioning that for the better management of the literature resources the author used the software tool Zotero[13].

2.2 Expert interviews

According to Bogner, Littig and Menz, Expert interviews are an often-used research method in social sciences, even if their role, form and methods used to analyze the outcomes might vary from case to case. Speaking with experts, especially in the beginning of projects, while exploring the research area, it is a very efficient method compared to an observation or systematic quantitative survey. The main advantage is that experts often deliver insider knowledge, which could not have been gained with quantitative surveys. It is often the case that the interviewer and the interviewees have the same scientific background which enables a high level of motivation as well as eliminates the necessity for further justifications (Bogner, Littig and Menz, 2012). Based on that, the main goal of the author by conducting the expert interviews was to gain **short-term qualitative data**.

For the interviews, only experts were considered. The term **expert** results from the role-specific knowledge of a person. This is applicable for persons who have a profound knowledge about rules and procedures within a firm or a project (Helfferich, 2011).

The thesis contains two types of expert interviews, each time with different requirements in the context of this thesis:

Expert group	Minimum requirements of the interviewee
Experts from IT companies	- Well-founded knowledge in the integration of different business information systems (at least ERP-, CRM -and BI-systems) and the deployment of these systems in the cloud. - Practical experience of the implementation of these systems within manufacturing companies.
Experts with employees of selected companies (software users)	- Employees from manufacturing companies. - Not only companies using Microsoft Dynamics applications but also companies using business information systems from other software vendors (e.g. SAP). - Mixture of companies using their business information systems on-premise and companies using SaaS-based business information systems. - Expert has good knowledge about the business information systems within his/her company (e.g. CIO, Key-User).

Table 2: Minimum Requirements of the interviewees

The reason for the two different expert groups is to get information from different perspectives in order to cover all requirements of the analyzed systems. Information about the finally selected interviewees can be found in chapter 4.1.1.2 of this thesis.

[13] https://www.zotero.org/ (Accessed 17 Jan. 2018)

The main feature of the problem-centered expert interview is its open, semi-structured form (Buber and Holzmüller, 2009, p.425). This form is characterized by having an **interview guide**, which was also created by the author. More details about the interview guide are described in chapter 4.1.1.1 and in appendix A. The purpose of the interview guide is to cover all relevant information and questions that can be asked during the interviews (Flick, 2011, p.134).
The execution of the interview is based on the steps referring to Mayring:

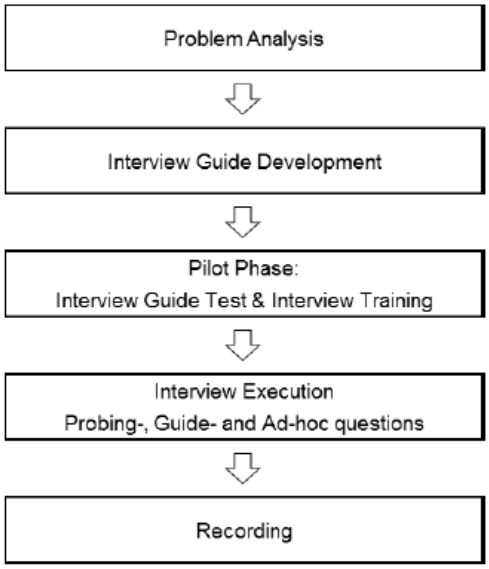

Figure 1: The Model of Problem-Centered Interviews (Mayring, 2002, p.71)

By means of the recording and analysis of the results of the interviews, all required information that is necessary for the creation of a criteria catalogue and the validation based on the proof of concept should be identified, like for example:

- Potentials, which the experts see in the SaaS-based deployment model of business information systems.
- Current extent of integration between their running business information systems.
- Current troubles with isolated business information systems.
- Which business processes are affected by more than one running business information system?
- And many more.

Based on the results of the expert interviews, a **criteria catalogue** will be developed, which identifies the **most important criteria and success factors** of cloud-based integrated business information systems for manufacturing companies. In order to gain the required knowledge about these criteria, expert interviews and further content analysis are conducted.
The goals of this criteria catalogue are the creation of a solid foundation for the extensive assessment of selected cloud-based integrated business information systems and the categorization of relevant criteria for the analysis (Bauer et al., 2008, p.523).

The reasoning for the establishment of such a criteria catalogue is the systematic identification of success factors for the implementation of cloud-based integrated business information systems, which can be used for a validation of concrete systems afterwards. Thus, the expert interviews mainly serve as an input value for answering the first research question („*Which criteria should be regarded when selecting cloud-based integrated*

business information systems?") but can also provide valuable hints for the other research questions. The criteria catalogue is the result and answer for the first research question.

2.3 Prototyping (Proof of concept)

According to Kriglstein et al, a prototype is an **executable artifact**, comparing to theoretical artifacts like designs or concepts. Another often-used name for prototypes is the proof of concept (Kriglstein et al., 2016, p.400).

The goal of this method is that selected cloud-based integrated business information systems on the market shall be validated based on the defined criteria catalogue and by means of the application of a proof of concept with the selected systems. Thereby it should be possible to find out if the **make-to-order processes of manufacturing companies** can be improved or not through the application and integration of the selected systems.

The main focus of this thesis is put on the cloud-based integrated business information systems from Microsoft. In addition to that, and as a comparison, systems from SAP and NetSuite are part of the analysis of this thesis.

The proof of concept analyzes a make-to-order process within selected application systems, which has the following structure (**high-level description**):

- Proposal system and contact management is done in the CRM system.
- Manufacturing order processing including shipment and invoicing is done in the ERP system.
- The post calculation and a dashboard is created in the BI system (break-even-analysis etc.).
- The integration of office/collaboration software (e.g. e-mail-delivery, SharePoint integration for storage of documents, etc.) is included.

Thus, the goal is to show the integration between an ERP-, CRM-, BI- and collaboration-system running in the cloud within the product families of Microsoft (main focus of this Master's Thesis), SAP and NetSuite. A detailed definition of the "concept" and of the "proof" is done in chapter 4.3.

Finally, the created prototypes are analyzed based on the created criteria catalogue by doing the following steps:

- Determination, which advantages are derived due to the integration of the business information systems and how far the defined make-to-order process could be optimized.
- Comparison of the cloud vs. the on-premise deployment model.
- Identification of potentials and challenges of cloud-based integrated business information systems in general.

Therefore, the proof of concept is the basis for the answer of the research questions 2 („*Which of the cloud-based integrated business information systems Microsoft Dynamics 365, SAP Business ByDesign or Oracle NetSuite currently fulfill these criteria at best?*"), research question 3 („*How can the make-to-order processes of a Manufacturing company be improved by integrating ERP-, CRM, BI- and other types of business information systems?*") and of the research question 4 („*What are the potentials and challenges of cloud-based integrated business information systems for manufacturing companies?*").

3 Literature review

In the following chapters essential terms and concepts, which are necessary for the understanding of this thesis, will be explained. Thereby, the author will give an overview about the three main topics of this thesis, which are the fundamentals of business information systems (BIS), the integration of business information systems and the fundamentals of cloud computing with focus on Software-as-a-Service (SaaS). This section will also be the foundation for the empirical methods of this thesis. Due to the big size of these three topics, the author will not go in detail but only describes the themes, which are relevant for this thesis.

3.1 Business information systems fundamentals

The IT software systems, which are analyzed during this thesis, are business information systems, because all of them support a company and their employees in their daily work. In the following, Business Information Systems will be abbreviated with **BIS**. According to Ferstl and Sinz, a BIS is the automatized part of an information system. They are used for the storage, recovery and connection of information, all of which support business processes both inside a company and also to their external environment (Ferstl and Sinz, 2006, p.2). Hardcastle defines BIS as „*a group of interrelated components that work collectively to carry out input, processing, output, storage and control actions in order to convert data into information products that can be used to support forecasting, planning, control, coordination, decision making and operational activities in an organization*" (Hardcastle, 2008, p.8). Today's dynamic business is characterized by increasingly complexity with functional divisions requiring evermore inter-departmental data flow to enable better decision making, timely and efficient procurement of goods and a better management of inventory, accounting and distribution of goods. Thereby, efficient BIS increase the competitiveness through cost reduction and better logistics (Holland and Light, 1999).

The **goal of BIS** is to support and integrate all business processes of a company (such as financial accounting, purchasing, manufacturing, sales, human resources, etc.) and to promote a seamless integration of all the information flowing through a company, which is also called the **value chain** (Tambovcevs and Tambovceva, 2013, p.215). According to **Porters' Value Chain Model**, it can be differentiated between primary and support activities (Porter and Millar, 1985):

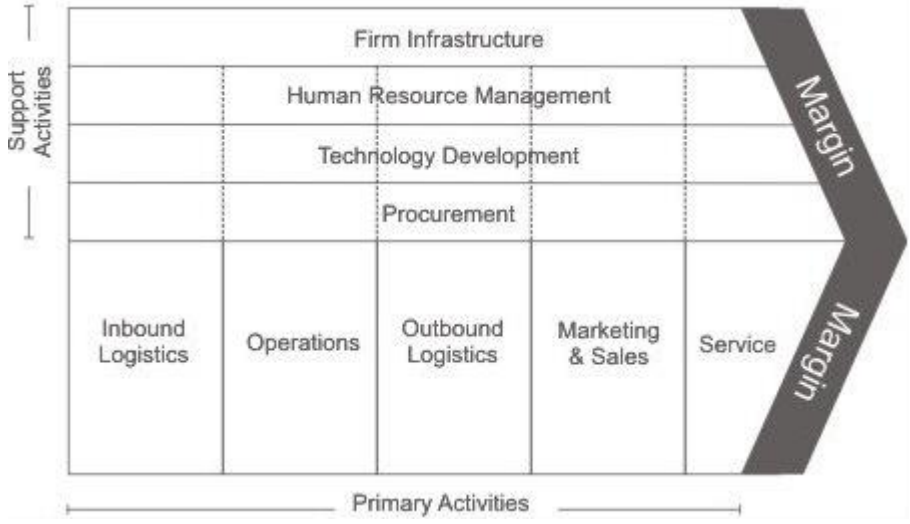

Figure 2: Porter's Value Chain Model (Porter and Millar, 1985)

All these primary activities and support activities can be handled and optimized by means of different BIS, which will be explained in more detail in the following chapters. BIS itself may be divided into two categories. **Operations Support Systems** are concerned with transaction processing, process control and collaboration. **Management Support Systems**, on the other hand, are concerned with supporting managerial decision making (Hardcastle, 2008, p.8).

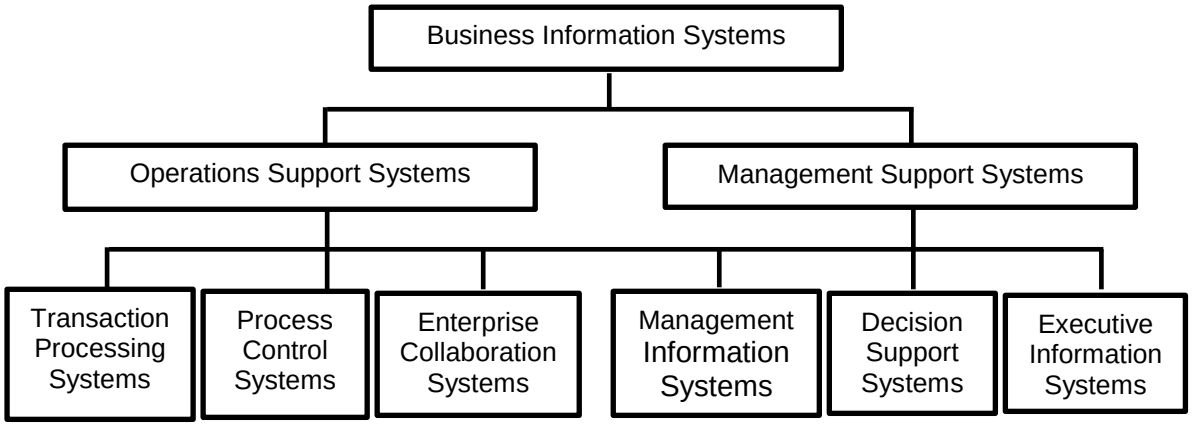

Figure 3: Types of Business Information Systems (Hardcastle, 2008)

In the following four subchapters the author will describe the fundamentals of four of the most important BIS for companies which are Enterprise Resource Planning (ERP)-systems, Customer Relationship Management (CRM)-systems, Business Intelligence (BI)-systems and Collaboration systems. All of these BIS can be assigned to one of the types of Figure 3. However, modern ERP systems for example cut across both operational and management systems by integrating different information systems which is also an important issue of this thesis (Hardcastle, 2008, p.8).

3.1.1 ERP systems

The BIS, on which this thesis will put the most focus, is the Enterprise Resource Planning (ERP)-system as it is the most important BIS and the "backbone" for most companies. Yen and Sheu claim that ERP system have become a "must have" for improving nearly every company's competitiveness in the recent years (Yen and Sheu, 2004, p.212).

3.1.1.1 Historical development and terminology

Ray defines ERP systems as „*an integrated information system built on a centralized database and having a common computing platform that helps in effective usage of enterprise's resources and facilitates the flow of information between al business functions of the enterprise (and with external stakeholders)*" (Ray, 2011, p.4). On the contrary, Madanhire and Mbohwa define an ERP system as the „*strategic tool which synchronizes, integrates, and streamlines data and processes of the organization into one single system to gain a competitive edge in the uncertain business environment*" (Madanhire and Mbohwa, 2016, p.2015).

One important aspect of this definition is the **integration**, which is built on a centralized database. This enables a flow of information between all business functions of an organization and also with external parties (Ray, 2011, p.19). ERP systems resulted in one data store, one source of the truth, and the focus switched from functional to process orientation (Bradford, 2010, p.1). Even if an ERP system itself is already an integrated BIS,

the goal of this thesis is also to determine whether and how far ERP systems are integrated with other typical BIS like CRM (Customer Relationship Management)- or BI (Business Intelligence)-systems. As this thesis has a focus on the manufacturing industry, the author would also like to refer to O'Leary, who claimed that manufacturing entities traditionally treated each transaction separately, as they are built around strong boundaries of specific activities that a specific application is meant to cater for. ERP systems or BIS in general should stop treating transactions as isolated functions but rather consider them as part of the interlinked processes that make up the business. It is based on the principle that the whole is greater than the sum of its parts (O'Leary, 2000). Uwizeyemungu and Raymond confirm the importance of the integration as they list it as one of the three most important characteristics and minimal requirements for a system to be qualified as an ERP system, which are the integration, flexibility and transversality (Uwizeyemungu and Raymond, 2012, p.74).

ERP systems started their history in Material Requirement Planning (**MRP**), which was only focused on production and material planning. The next milestone was **MRP II**, which extended MRP with processes from business planning, sales planning, forecasting, demand management and so on. Finally, ERP systems started emerging in the late '70s and early '80s. ERP expanded MRP and MRP II with functionalities in the areas of warehouse management, plant management, quality management, service management, human resource management etc. The last main stage was that ERP applications today are moving towards enterprise business information systems, a set of other applications like CRM, BI, PLM (Product Lifecycle Management), SRM (Supplier Relationship Management) or SCM (Supply Chain Management) beyond ERP (Ray, 2011, p.9).

In the past, ERP systems were often only used by large companies. Meanwhile, due to increasing market competition and globalization, small- and medium-sized companies (SME) are also implementing ERP systems in their organizations in order to improve their business processes (Mahara, 2013, p.365).

The implementation of an ERP system is a very complex, time-consuming and expensive project for a company. Without going into details about this topic, the author only wants to highlight the **critical success factors** (CSF) for ERP implementations. According to Finney and Corbett, the most important CSF are top management support, change management, business process reengineering (BPR), software configuration, training and support, project management, system quality, business plan and vision, consultant quality, organizational readiness, system integration and vendor support (Finney and Corbett, 2007; Dezdar and Ainin, 2011; Kwahk and Lee, 2008; Al-Mashari, Al-Mudimigh and Zairi, 2003). Johansson and Newman brought up, that in the value chain of ERP implementation projects, there are at least three **stakeholders**, which are ERP software vendors, ERP resellers/distributors and ERP end-user organizations (Johansson and Newman, 2010, p.1). One of the most important phases during the implementation of an ERP system is the **customization** phase. According to Bradford, customization is necessary to support a business process that may be unique or provide them with a competitive advantage. As a result, customization often requires programming (Bradford, 2010, p.86).

3.1.1.2 Architecture of ERP systems

Rashid, Hossain and Patrick define the following required architectural characteristics of an ERP system (Rashid, Hossain and Patrick, 2002, p.6 pp.):

- The base and foundation is a centralized common database management system (DBMS).

- Modular design comprising several business modules such as financial, manufacturing, accounting, distribution, etc. (more details regarding the modules please see chapter 3.1.1.3).
- The modules are integrated and provide a seamless data flow among the modules, resulting in increasing operational transparency by means of standard interfaces.
- They are generally complex systems, which involve high costs.
- Time-consuming tailoring and configuration setups to enable an integration with the company's business functions are required.
- Modern ERP systems need to be internet-enabled.

The following figure summarizes the basic concept of ERP systems:

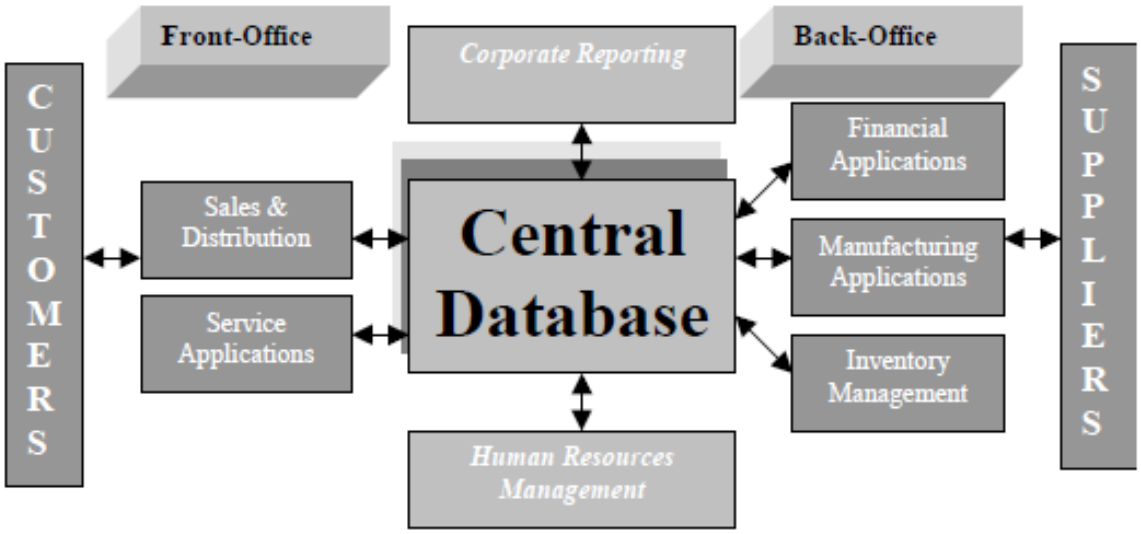

Figure 4: Basic concept of ERP systems (Rashid, Hossain and Patrick, 2002, p.3)

Modern BIS, including ERP systems, operate a multi-tier architecture. Currently, the most common architecture principle is the **three-tier architecture**, which is illustrated in Figure 5.

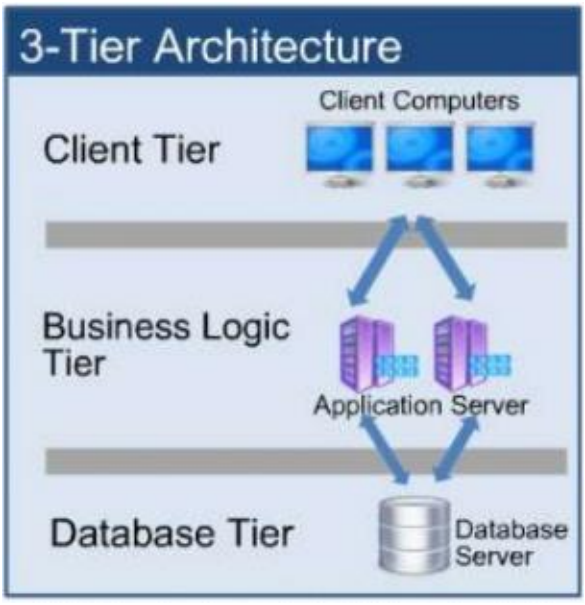

Figure 5: 3-Tier-Architecture (University of Engineering and Technology Taxila, 2011)

Thereby, one or more application servers are placed between the client tier and the database server(s) (Bradford, 2010, p.16 pp.; Rashid et al., 2002, p.8):

- The **client tier / presentation layer** is responsible for the presentation of the information by running a GUI (Graphical User Interface) to request information from the application tier. Nowadays, ERP systems are not solely accessed by classical PCs and notebooks, but also by web browsers and mobile devices like tablet computers or smartphones.
- The **application / business logic tier** provides and executes the business logic (as explained above in terms of several modules) and manages the communication with the client application. It contains business rules, functions, logic, and programs acting on data from the database servers.
- The **database tier** on the last level stores the ERP data in form of a relational database where it can be accessed by the application tier in order to respond to user actions. It mostly employs industry standard relational database management systems (RDBMS) supported with the structured query language (SQL).

This logical arrangement enables the ERP user interface to run on the clients, the processing modules to be executed on the middle-tier application servers and at the bottom level the database system to run on the database servers (Rashid, Hossain and Patrick, 2002, p.8).

3.1.1.3 Targets and range of functions

ERP systems are composed of several **functional modules**, which are groups of related programs that perform a major function within an ERP system. Figure 6 shows some typical modules of ERP systems. Even if companies mostly do not acquire and implement all available modules of an ERP system, the real benefit results from the interaction of multiple, at best all modules. Thus, external interfaces are not necessary (Bradford, 2010, p.2).

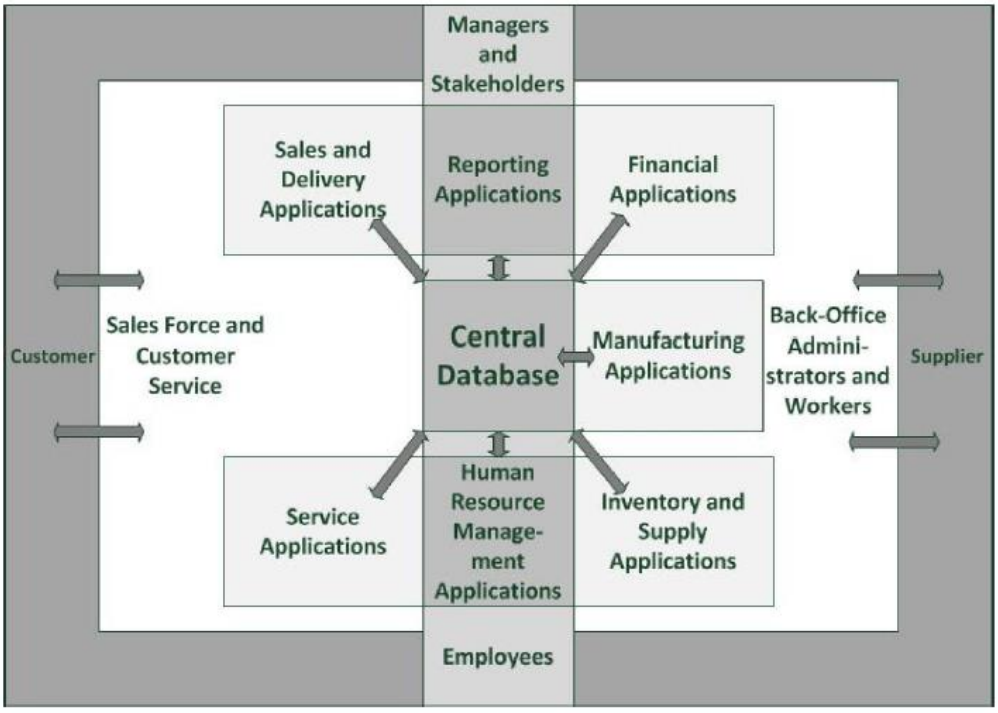

Figure 6: ERP modules (Davenport, 1998, p.4)

A description of the functionality of each module will not be done in this thesis. The author refers in this respect to the further literature like Hesseler & Görtz, Ray, Bradford or Jacob.

An ERP system pursues, among others, the following **targets and benefits**:

- Once data is entered into an ERP system, it is readily available **on-line and real-time** throughout the company to users in all departments, provided they have the required permissions. Consequently, information is available sooner and the communication throughout the company enhances (Bradford, 2010, pp.5–6).
- **Single point of entry**: for example, article master data are only entered within one master data card. As a result, human errors are reduced as it reduces the risk of inaccuracies in master data and transaction data (Bradford, 2010, p.6).
- **ERP brings best practices**: ERP systems come up with a predefined way of running processes, based on experience from numerous leading companies. This enables a standardization of processes and the automatization of business processes (Ray, 2011, p.10; Gronau, 2004, p.4).
- **Flexibility**: ERP systems support several scenarios, which can be configured by means of parametrization. For example, different manufacturing scenarios like make to stock or make to order can be configured without the need of new programming (Ray, 2011, p.12).
- **Scalability**: Possibility to enhance the range of functions through Add-On-Modules (Rashid, Hossain and Patrick, 2002, pp.33–34).
- **Global interconnection**: Through enhanced integrated modules like CRM or SCM (Rashid, Hossain and Patrick, 2002, pp.33–34).

In comparison with the above described targets and benefits, Akkermans et al. outline the following functions of an ERP system (Akkermans et al., 2003):

- It can substitute outdated, old software systems by using integration technologies and a maintainable software.
- It offers organizations a framework of transactions.
- It can help to transform a function-oriented company into an operation-oriented organization.

Other advantages of ERP systems, proposed by Yusuf, Gunasekaran and Abthorpe, include the optimization of supply chain management by means of e-communication and e-commerce, the reduction of operational costs, the provision of information which are required by the clients and management's ability to operate with external clients, external suppliers and corporate alliances as a virtual enterprise (Yusuf, Gunasekaran and Abthorpe, 2004). Siriginidi also found some intangible benefits including better customer satisfaction, increased flexibility, improved vendor performance, reduced quality cost, improved information accuracy, improved resource utility and improved decision-making capability (Siriginidi, 2000). Kositanurit, Ngwenyama and Osei-Bryson add that the usage of ERP systems is a major factor influencing work at the individual level and the user performance is a direct outcome of system usage (Kositanurit, Ngwenyama and Osei-Bryson, 2006). Somers and Nelson claim three major business drivers for adopting ERP systems, which are improving productivity, the provision of competitive advantage and satisfying customer demands (Somers and Nelson, 2004, p.257).

3.1.1.4 Deployment models

As the way to run the ERP system is a very important cornerstone of this thesis, the author gives a short overview about two important concepts regarding the deployment of ERP systems.

- **ERP on-Premise vs. ERP on-Demand**: According to Duan et al., **ERP software on-Premise** is characterized by the acquisition via a license model, which is loaded onto servers and computers in-house, which means that the company itself has to maintain the servers and the required space (Duan et al., 2013, p.3). On the other hand, **ERP on-Demand** means a firm accesses its ERP system over the Internet, delivered via the SaaS-Model. Thereby the ERP software and in many cases also the required hardware (e.g. database servers) do not need to be managed by the company as this is done by the vendor company. The analysis of which benefits cloud-based ERP systems derive is a main research topic of this thesis.
- **Standard ERP software vs. Open Source ERP software**: The most well-known and distributed ERP software systems (e.g. SAP, Oracle, Microsoft Dynamics, Sage) are **Standard Software**. Gluckowski, Gabriel and Dittmar define standard software as „*programs, which are designed for universality and multiple use*" (Gluchowski, Gabriel and Dittmar, 2008, p.11). On the other hand, according to Schatz, Egri and Sauer, **Open Source software** is software whose source code is public accessible, everybody has the freedom to run the program for any purpose, the freedom to study how the program works and the freedom to redistribute copies of it. Renner et al. identified seven benefits for open source software which are adaptability, reusability of source code, higher quality, independence of software vendor, better security, open standards and no license fees (Schatz, Egri and Sauer, 2011, p.11; Renner et al., 2005, pp.16–19).

The main focus of this thesis will be put on the analysis of On-Premise ERP vs. Cloud ERP. The theoretical fundamentals about this topic will be described in chapter 3.3.

In comparison with the aforementioned categorization, Keller distinguishes between the following deployment models (Keller, 2006):

1. **Build**: The ERP solution is individually developed for the company (either by the company itself or by an external IT company). This corresponds to individual software.
2. **Buy**: An existing standard ERP system is purchased. This corresponds to standard software.
3. **Rent**: The ERP software is rented from an external provider. This corresponds to ERP on Demand, for example SaaS.
4. **Outsource**: The organization and maintenance of the company's business processes and ERP system is done by an external company. This is also called a **hosted ERP solution**. Cloud-based ERP and hosted ERP systems have overlapping advantages, but potential clients should carefully consider their options to ensure the solution they select delivers the business value they expect. Scavo, Newton and Longwell also indicate that ERP systems marked as "cloud based" are in fact hosted ERP systems (Scavo, Newton and Longwell, 2012).

3.1.1.5 Current trends

As in general for information technology, ERP systems are part of an ongoing development process. Currently, major trends regarding ERP systems are the following (Ray, 2011, p.17):

- **Cloud ERP**: New deployment models like SaaS (Software-As-A-Service) make ERP applications more effective. More details about this topic will be handled in chapter 3.3.2.
- ERP vendors are coming with **more BIS** like CRM, BI, PLM, SRM, SCM, etc. which makes it difficult for specialized ERP vendors. Thereby, the ERP system should seamlessly integrate with such best-of-breed applications, which means that the

user interface should remain the same. This requires integration technologies like EAI (Enterprise Application Integration) or SOA (Service-oriented architecture) which will be discussed in more detail in chapter 3.2.

- **Mobile ERP**: Users get access to the ERP system by means of different devices and regardless where they are.
- **Social ERP**: ERP system enriched with social media elements (e.g. integration with LinkedIn or Facebook).
- **Vertical solutions**: Industry specific solutions, e.g. for the automobile industry.

Definitely two of the most important emerging trends are the first two points, which also build the main focus of this thesis. According to Ray, the abovementioned trends can be summarized by the buzzword "**ERP II**". The most important change from ERP to ERP II is the shift of focus from completely enterprise-centric and focus on internal resource optimization and transactional processing to a new focus on process integration and collaboration with external parties like customers and suppliers. Thereby, ERP II is based on the power of the Internet (Ray, 2011). The consequences of these trends for manufacturing companies will be analyzed in this thesis.

3.1.2 CRM systems

Today's business is characterized by increasingly expectations of customers. Bradford has determined that they require (Bradford, 2010, p.106):

- „*Know me and know my business*".
- „*Help me solve my business problems*".
- „*Make it easy for me to do business with you*".

In order to fulfill these customer demands, Customer Relationship Management (CRM)-systems are adopted by many companies, in many cases additionally to their ERP-system.

3.1.2.1 Historical development and terminology

Buttle defines CRM as the development and establishment of long-term partnerships with strategically important customers which brings advantages for both parties (Buttle, 2001). On the contrary, Stone and Woodcock have the following definition: „*CRM is a term for methodologies, technologies and e-commerce capabilities used by companies to manage customer relationships* (Stone and Woodcock, 2002, p.4)". Bradford states that a CRM solution enables a customer-centric enterprise and increases performance by maintaining strong customer relationships, which enables the fulfillment of operational and strategic business goals (Bradford, 2010, p.107).

The term CRM emerged in the mid-1990s for the first time, evolving from **sales force automation (SFA)** software. The intention was to describe how sales, marketing and service need to work together not just within their departments, but also together. Comparing to SFA software, CRM possesses more functionality and the selling point is the **analytics**, i.e. to make business decisions out of CRM data (Bradford, 2010, pp.107–108). Yetter, Mathena and Hosteler identified four stages of CRM's evolution which are the following (Yetter, Mathena and Hosteler, 2009, p.3):

- **Individual CRM**: Isolated information about customer-related data.
- **Department CRM**: Disconnects different sources of information in order to consolidate customer-related information and to automatize departmental processes.
- **The CRM Suite**: Crosses departmental boundaries in order to provide a 360-degree view of customers.

- **Beyond CRM boundaries**: Encompasses other business relationships and pushes the boundaries of CRM as an application framework.

CRM systems provide a **360-degree view** of customers by capturing customer data, purchase histories and every customer communication and using that information in order to improve the relationship with customers (Bradford, 2010, p.106).

According to Buttle, there can be differentiated three levels of CRM which are the following (Buttle, 2004):

- **Strategic CRM** focuses on developing a customer-centric business culture.
- **Operational CRM** focuses on automatizing the customer-facing parts of the business by means of Marketing Automation (MA), Sales Force Automation (SFA) and Service Automation (SA).
- **Analytical CRM** is concerned with exploiting customer information in order to provide valuable information to customer and company owners.

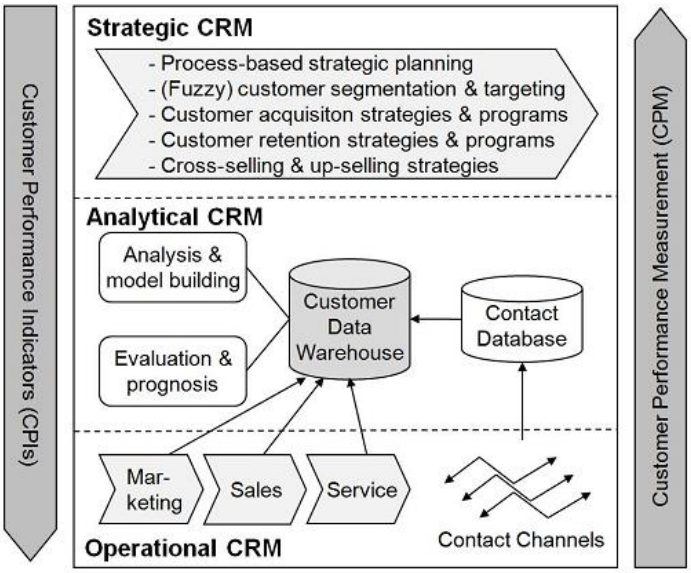

Figure 7: Three levels of CRM (University of Fribourg, 2017)

Wahlberg, Strandberg and Sandberg add as a fourth category the **Collaborative CRM,** which comprises new possibilities for communicating with customers based on new IT technologies. It is the basis for a channel management strategy (Wahlberg, Strandberg and Sandberg, 2009, p.193).

Bradford claims that the foundation of a successful CRM strategy contains three elements: **people, process and technology**. During this thesis, the author focuses on technology. However, generally, if any of these three elements is neglected, the whole CRM system will not reach its full potential. (Bradford, 2010, p.110). Ray confirms this opinion as he states that CRM is not only about technology as it also involves strategy and redesign of business processes in order to reach the goals of CRM (Ray, 2011, p.434). In other words, citing Greenberg: „*CRM is a philosophy and a business strategy, supported by a system and a technology, designed to improve human interactions in a business environment* (Greenberg, 2004, p.64)".

Another important term in that context is **CRM 2.0**, which has emerged through the development of social media and new technologies. This is very similar to **Social CRM.**

3.1.2.2 Architecture of CRM systems

The general architecture of CRM systems is quite similar to the architecture of ERP systems. The foundation is also mostly composed of a three-their architecture including database server(s), application server(s) and clients. Figure 8 summarizes the typical CRM infrastructure components. Important aspects of the CRM architecture, which the author would like to bring up, are the following:

- CRM applications are often **integrated with other BIS**, as also described in chapter 3.1.2.3.
- A **variety of client models** is used, because many mobile workers are using CRM application, which often also requires offline functionalities. This is also called **Mobile CRM**. Kostojohn states that the most dominant approach to access CRM systems today is via a secure web browser. Another frequently used access model is the Microsoft Outlook-integration CRM application, as Outlook represents a primary tool for customer interaction (Kostojohn, Johnson and Paulen, 2011).
- CRM applications offer equally **deployment models** as ERP systems, i.e. on-premises, application hosting and SaaS. Therefore, the author will not go in detail regarding these deployment models again and refers to chapter 3.1.1.4.

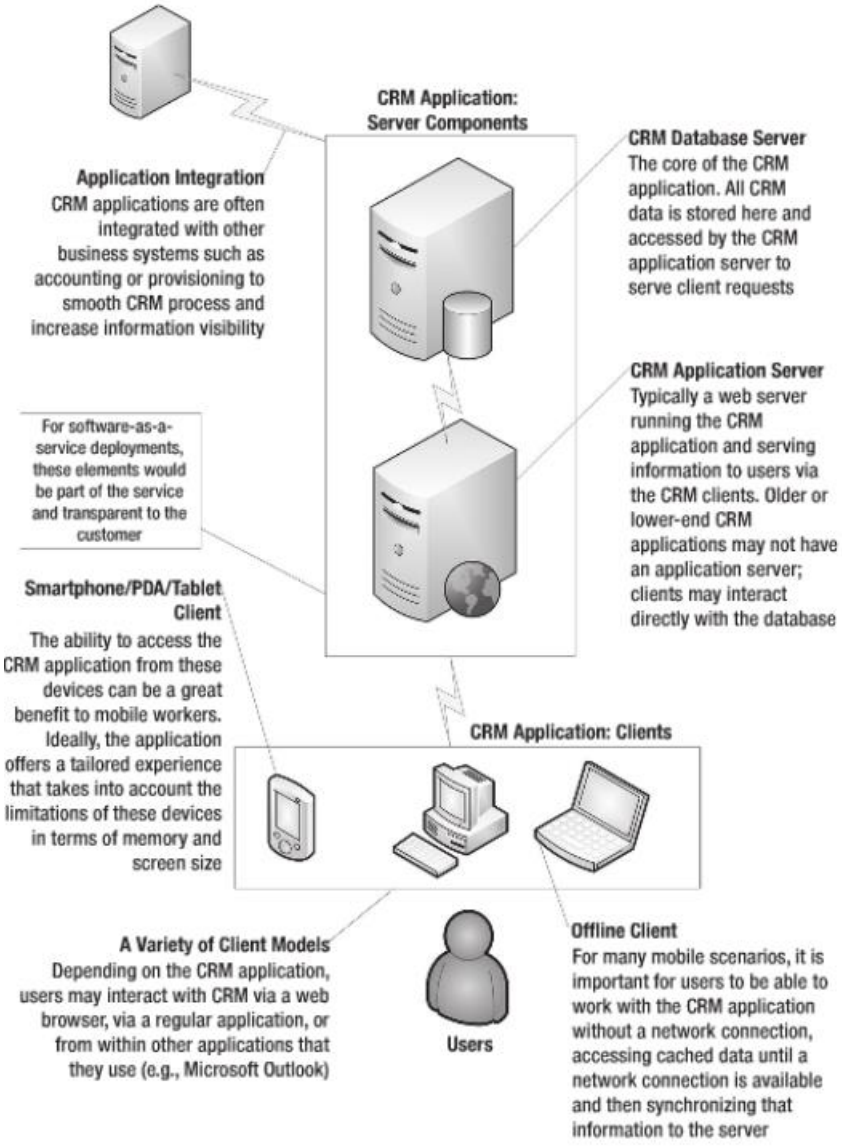

Figure 8: Typical CRM application infrastructure (Kostojohn, Johnson and Paulen, 2011)

3.1.2.3 Touch points between CRM and other BIS

Bach and Österle point out that CRM systems need information from internal departments like purchasing, product development or manufacturing departments in order to provide the call center with the required information from the customer. Thus, the integration of the CRM system into the whole IT landscape is an important issue because the required information may come from different data sources like ERP-, DMS-system or from a data warehouse (DWH) (Bach and Österle, 2000, p.30). Some important use cases for integration are application integration (integration with other BIS like an ERP-system), E-Mail-integration (e.g. with Microsoft Outlook), telephone integration or Web integration.
Bradford also found some touchpoints between CRM and ERP systems: they transfer sales invoice information to accounts receivable managed in ERP systems or they transfer order information to inventory and warehouse modules. For example, when an invoice is generated in the CRM system, a debit posting to accounts receivable and a credit posting to sales account within the ERP system must be done. Through this ERP-CRM-integration, data only needs to be captured once and can then be used throughout the organization without re-entering (Bradford, 2010, pp.106–108). Ray confirms these touch points as he claims that CRM brings together information from all data sources within a company (and eventually from external sources too) in order to enable a 360-degree-view of customers.

3.1.2.4 Targets and range of functions

CRM systems support companies in the management of their customer relationships by pursuing the following **targets** (Bach and Österle, 2000, p.19; Bradford, 2010, pp.111–113; Ray, 2011, p.435):

- Increase of customer profitability by using the potentials for customer retention, -selection and –acquisition while simultaneously improving the efficiency of CRM processes.
- By having more information about existing customers and putting attention on profitable customers, customer satisfaction will be increased which finally also increases customer retention.
- Decrease of selling expenses through fewer and more productive sales calls, optimizing data analysis, reducing communication and transaction costs and preventing data redundancy.
- Better opportunity close rates: CRM systems support in enhancing the percentage of leads that are converted to sales through opportunity and lead management.

Bach and Österle define three main processes of operational CRM which are **Marketing, Sales and Service** (Bach and Österle, 2000, pp.23–26). The **main capabilities** of CRM solutions can be summarized as the following (Bradford, 2010, p.112; Ray, 2011, p.437):

- Maintenance of **customer and contact information** through the whole lifecycle.
- Identification of additional **opportunities** with customers due to existing information about the customer or market segments (Cross-Selling, Up-Selling).
- Provision of timely and detailed information about the status of an opportunity in the **sales pipeline**.
- Maintenance of **marketing campaigns** and analysis of their effectiveness.
- Integration of **various channels** (phone centers, e-mail, website, EDI-resources) into the sales process.
- **Customer service** by supporting issues and inquiries.
- **Analytical functions** like tracking and analyzing sales performance by various factors (region, campaign, customer, product, etc.) and sales forecasting.
- **E-Commerce applications,** which includes e-Marketing, online ordering, online product configuration, online exchange and online billing and payment.

3.1.3 BI systems

ERP- and CRM-systems are transaction-oriented applications, which are required to support and manage business processes. The next BIS, which are being reviewed, are the Business Intelligence (BI)-systems, which have the main goal of supporting strategic decision-making. The author also considers these BI systems within the applied integration scenarios in chapter 4.3.

3.1.3.1 Terminology

Haertzen defines Business Intelligence (BI) as „*the set of practices and tools for displaying and exploring data for decision-making. Techniques and tools associated with BI include* ***dashboards****,* ***scorecards****,* ***drilldown*** *and* ***slicing*** *and* ***dicing*** *data.*" (Haertzen, 2012, p.11). Bradford contends that BI „*is a discipline using a variety of technologies that helps the end user make sense of the sea of information captured by the organization's ERP system*" (Bradford, 2010, p.179).
Azvine describes BI systems with the following **typical properties** (Azvine, Cui and Nauck, 2005, p.215):

- Reports and visualization
- Trend analysis
- Analysis of the customer behavior
- Predictive modelling

Another important term in that context is **Analytics**, which Haertzen defines as „*the practice of supporting decision-making through number crunching. Analytics include techniques like data mining, statistical analysis and regression modelling"* (Haertzen, 2012, p.11).

Enterprise Data Warehousing (EDW) is a process for collecting, storing and delivering decision support data for an organization or business unit. A **data warehouse** is the result of the data warehousing process. Haertzen defines a data warehouse as a „*database that contains a copy of operational and other data, rather than being a source of original data*" (Haertzen, 2012, p.12). An important aspect of a data warehouse is the fact that data is obtained from various, different data sources and it is the basis for strategic decision-making. Data stored in data warehouses is different from operational data (e.g. data from ERP-systems), as it is focused on historic and trend values while operational databases are optimized for transaction processing by means of a normalized database design. Data warehouses use a **multi-dimensional design** instead, organized into facts and dimensions. Another difference is that operational data is frequently updated whereas data warehouse data is not updated, it is loaded instead (Haertzen, 2012, p.12 pp.). A data warehouse is the data store for BI. Another data store is a **data mart**, which is a subset of a data warehouse (Bradford, 2010, p.183).

BI systems belong to the class of **OLAP** (Online Analytical Processing) applications, in contrast to the **OLTP** (Online Transaction Processing) applications, which are used to run the business transactions (like for example ERP- or CRM-systems) (Ray, 2011, p.512). OLTP and OLAP workloads are mostly processed by separate specialized database management systems (DBMS) in order to prevent mixed workloads which would result in bad performance (Kemper and Eickler, 2011). This can also be seen in the following picture:

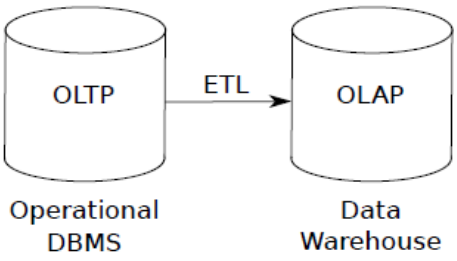

Figure 9: Separation of OLTP and OLAP (Kemper and Eickler, 2011, p.34)

In order to transfer the data from the OLTP (e.g. from ERP- or CRM-system) to OLAP the so-called Extraction – Transformation – Load (**ETL**) process is used.

Another buzzword relating to BI is **Big Data**, which deals with the maintenance of multi-terabytes of typically unstructured data which is very critical to the success of companies like Google, Facebook or Amazon (Haertzen, 2012, p.22).

Just as explained for ERP- and CRM-systems, BI systems can also be deployed in the **cloud**. It is accessible via any web browser by means of a SaaS model (Das, 2013, p.2993). More details about this deployment model are explained in chapter 3.3.2.

3.1.3.2 Touch points between BI systems and other BIS

BI systems have many touch points with multiple different BIS, as their job is to **analyze data coming from other BIS**. BIS like ERP- or CRM-systems provide online reports. It has been found out that ERP- or CRM systems are not the best tool for reporting, mainly because of the volume of data. The basis for BI systems are data warehouses, which contain data coming from various sources, as for example ERP-, CRM-, legacy applications but also external data sources. In addition to that, another important aspect is that if large amounts of data, needed for reporting, were to be saved in transactional systems like ERP systems, this would deteriorate the performance of those systems. Therefore, the data should be kept in data warehouses. Most important for BI systems is that their success depends on the **quality of the data** coming from the data sources: they must be timely, accurate and comparable (Haertzen, 2012, p.23; Ray, 2011, p.502). Bradford also claims that in order to get valuable insights, data from different BIS and perhaps also from external sources must be combined and afterwards stored into a data warehouse or data mart for analysis (Bradford, 2010, p.191). According to Nedelcu, most transactional systems offer complex tools, which enable generating reports. However, these reports will be restricted to the transactional systems, which generated them. In order to find answers for complex questions, reports usually require data from multiple transactional systems (Nedelcu, 2013, p.14). Therefore, an integration is required.

3.1.3.3 Targets and range of functions

Regarding the targets of BI, Nedelcu differentiates between strategic, tactical and operational level. At a **strategic level**, BI enables the establishment of objectives in a precise mode and following their fulfillment, allowing comparative reports or forecasting results based on assumptions. On the other hand, at a **tactical level**, BI can be the base for making marketing, sales, finance or management decisions. Finally, on the **operational level**, BI solutions can be used for ad-hoc reporting and –analyzing, e.g. answering questions related to cooperations with suppliers or customers (Nedelcu, 2013, p.15).

BI and analytics have many practical applications, used in many different areas. Haertzen made the following **categorization of BI applications**:

- **Supply chain and manufacturing BI applications**: As this master thesis has a focus on the manufacturing industry, supply chain and manufacturing analytics are significant for this work. They include examples like supplier performance analysis, supply chain forecasting and planning, transportation efficiency analysis, inventory analysis and sales analysis. Their goal is to optimize the procurement and delivery of goods, which enables manufacturing companies to improve efficiency, inventory levels and sales.
- **Operations BI applications**: Next to the manufacturing BI applications, the operations BI applications are also relevant for this thesis. Their goal is to support the effective production of goods and services. This includes capacity planning, inventory analysis, labor scheduling and cost management.
- **Financial BI applications**: Includes examples like asset management, budget management, collections effectiveness, cost management and overhead reduction analysis. The results of financial analysis and KPIs are an important input to performance management and the Balance Scorecard (BSC).
- **Performance management BI applications**: Includes for example Balance Scorecard analysis or compensation analysis.
- **Risk management BI applications**: Includes credit risk analysis, hedging analysis etc.

Nedelcu categorizes **five styles of BI applications** which are visualized in the following picture (Nedelcu, 2013, p.13):

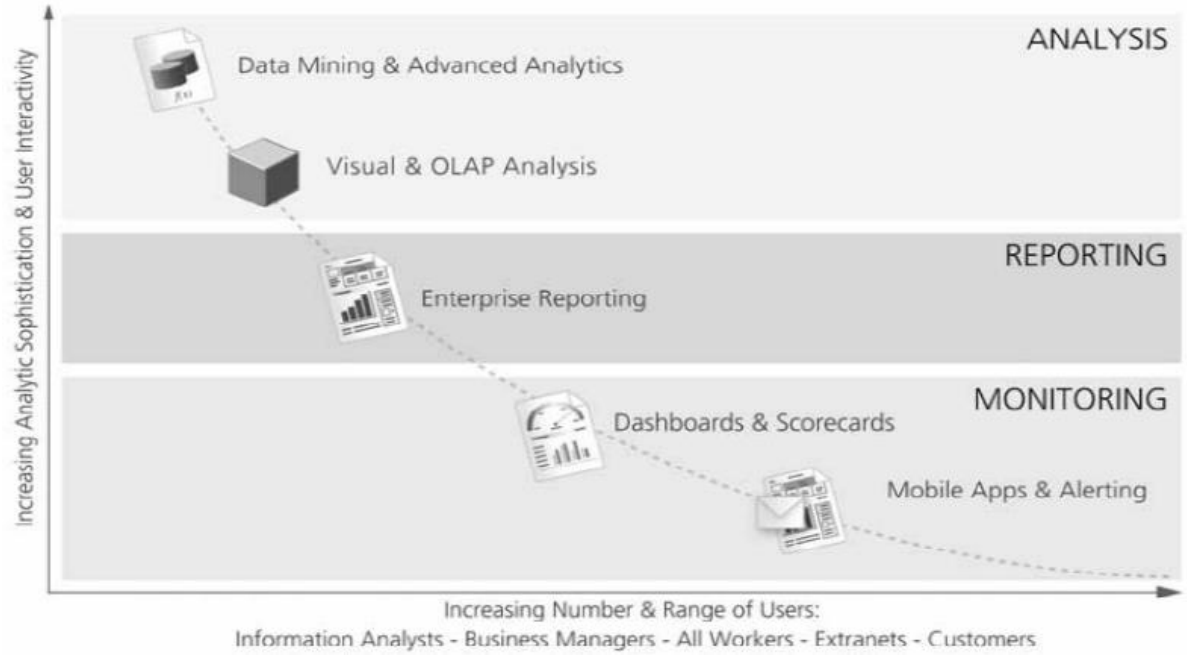

Figure 10: 5 Styles of BI applications (Nedelcu, 2013, p.13)

According to Ray and Bradford, BI tools provide the following functionalities (Ray, 2011, p.519; Bradford, 2010, pp.181–183):

- **Alerts**: For example, if there is a difference between a planned and an actual performance, an automatic alert should be triggered.
- **Dashboards:** Display the state of performance metrics, compared with target values.
- **Ad hoc query:** Self-service reporting for users.
- **Predefined reports:** Standard reports and graphics supplied with BI systems.

- **Workflow:** Definition which user should get which report or alert at which time.
- **Predictive modelling:** Based on data mining and advanced mathematical techniques.
- **Data Mining:** Looking for correlations, trends and patterns by analyzing large amounts of data
- **Visualization:** Data visualization in different forms like charts or interactive pictures.
- **Data slicing and dicing:** Drill down, drill across within data and drill from one data dimension to another dimension.

3.1.4 Collaboration / Office systems

Mattessich, Monsey and Murray-Close consider that **collaboration** has the capacity to bring previously separated companies into a new structure with full commitment to a common mission. Such relationships require comprehensive planning and well-defined collaboration channels operating on multiple levels. In these new relationships, authority is determined by the collaborative structure and risk is much greater because each member of the collaboration contributes its own resources and reputation (Mattessich, Monsey and Murray-Close, 1992). In contrast, Pearsall defines collaboration as an act of working mutually on an activity or project (Pearsall, 1999). Mattessich, Monsey and Murray-Close note that the „*collaborative environment includes a commitment to mutual relationships and goals*" (Mattessich, Monsey and Murray-Close, 1992, p.12).

Renner et al. define **office suites** as the composition of software for the execution of office works, as the make-up of texts, the creation of calculations, presentations or schedules. They are one of the most fundamental software products, which are used by companies. Typical components of an office suite are the following (Renner et al., 2005, p.83):

- Text processing
- Spreadsheet
- Presentation software
- Mail client
- Scheduling
- Address management
- Databases

According to Renner et al. the **most distributed office systems** are Microsoft Office, OpenOffice.org, Word Perfect Suite, Lotus Smart Suite, KOffice and Gnome Office (Renner et al., 2005, pp.84–85).

A typical **touchpoint of office systems with other BIS** (which are explained above) is the Microsoft Outlook Integration with an ERP system. Greenberg states that this is one of the most important sales-friendly feature because of the huge amount of Outlook-users in the world. Thus, there is a wide familiarity with the features and functionalities of Outlook. Outlook often constitutes the contact administrator and the basis of a more substantial sales-related program (Greenberg, 2004, p.91).

According to Ray, another important IT collaboration system with regard to BIS like ERP- or CRM-systems is the **portal**, which is the „*one common user interface for number of business applications that a user may need for doing his daily job. Portals can be categorized into different areas like public portals, employees portals and e-Business portals*" (Ray, 2011, p.499).

3.2 Integration of business information systems

The second main topic of this thesis deals about the integration of different BIS. As the goal of this thesis is to analyze in how far and to what extent the integration of different BIS within a company can optimize business processes, this chapter explains the most essential theoretical fundamentals about this topic.

3.2.1 Definitions and concepts

The term "**Integration**" has several different meanings as it is used in different areas. During this thesis, the following **three contexts** will be regarded (Kähkönen, Smolander and Maglyas, 2017):

- Integration as the interoperability of systems.
- Integration as establishing communication between systems.
- Integration as inter-organizational process reengineering.

Hwang, Yang and Hong define integration as „*the degree to which a firm achieves unity in organizational subsystems by synchronizing different departments, modules, software, and legacy systems*" (Hwang, Yang and Hong, 2015, p.4). **Enterprise Integration** is defined by Venkatachalam as the „*the strategic concept of integrating technology, processes and people for the purpose of facilitating better flow of information and effective decision-making across the enterprise, whereas ERP systems is one solution*" (Venkatachalam, 2006, p.2).

Venkatachalam identified the following **six integration types**: system integration, information integration, application integration, knowledge integration, human capital integration and functional domain integration (ERP, CRM, SCM etc.) whereas Enterprise Integration comprises all of them (Venkatachalam, 2006). The main focus of this thesis is the **functional domain integration**, i.e. the integration between different types of BIS.

According to Mertens et al., the following **forms of integration** can be differentiated (Mertens et al., 2005, pp.6–8):

- **Scope**: inter-company, cross-company.
- **Object**: programs (user-interfaces), functions, data.
- **Direction**: horizontal, vertical.
- **Size**: complete, partial.

A **horizontal integration** takes place within several functions (e.g. purchase and manufacturing) and departments whereas the **vertical** integration is mainly suitable for analytical purposes (interconnection of information among various aggregation levels). The scope defines whether the integration is done between several functions of the same department, between several departments of the same company or even between various different companies (**cross-company**). The object of the integration can be data, functions or entire programs. The goal of the **data integration** is to create a common consistent data basis. When **integrating functions**, the results of one function can be directly processed further by the next function. The **integration of programs** is based on a mutual interface, which is used for the data exchange. The size defines to what extent the integration takes place. The ideal situation is a **completely integrated** system. However, in reality it often happens in companies that only partial areas, as for example manufacturing and logistics or accounting and finances, are integrated (Mertens et al., 2005, pp.6–8). This issue will be investigated by means of this thesis.

For the integration of different BIS, one possibility would be the development of a separate database interface between all the different BIS of a company. This is also called a **Point-to-Point-Architecture**, as demonstrated in the following picture:

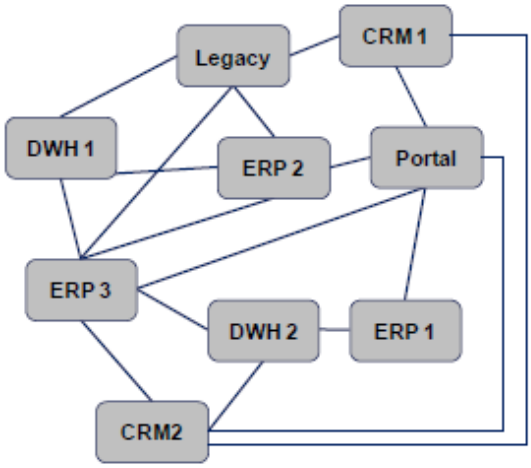

Figure 11: Point-to-Point Architecture (Edler, 2014, p.60)

The drawback of this architecture is that the more systems, which needs to be integrated, the higher is the effort for the development of new interfaces and the maintenance of existing interfaces. In order to solve this problem, the **Enterprise Application Integration (EAI)** concept was created, which is explained in more detail in chapter 3.2.3.

A related technology regarding the integration of BIS is the **portal.** Ray defines a portal as the common front-end for all BIS, i.e. a single portal enables a user to log on to multiple BIS like ERP, CRM or PLM. Thus, the portal supports in employee's productivity (Ray, 2011, p.489). Greenberg argues that a portal aggregates all relevant systems into a coherent whole, but has also a personal corporate history and preferences available through a single sign-on and secure password (Greenberg, 2004, p.399). However, the portal will not be focus of this thesis.

3.2.2 Integration targets and purpose

According to Boissier et al., enterprise systems are complex systems that consist of multiple sub-systems that are providing crucial business functionalities like financials, material management, BI, CRM and much more (Boissier et al., 2014, p.1). Thus, a very big challenge for many companies today is that they **operate multiple systems** simultaneously. Even if ERP system's intention is to replace all of them by a single program and database, that is often not the truth (Ray, 2011, p.539). Consequently, over the years, ERP vendors have recognized that it is nearly impossible to address every business need of all industries within one ERP system (Ray, 2011, p.541).
The motivation of companies from a technical perspective is the **establishment of a long-term integration** of a standardized and extensible IT platform (Adam and O'Doherty, 2000). Thereby, legacy systems and isolated applications should be replaced, because of a lack of interfaces, a lack of support and a lack of expendability. Thus, the competitiveness is weakened (Parr and Shanks, 2000; Muscatello, Small and Chen, 2003). Over a longer period, not only the maintainability of redundant systems becomes costly, also the adaptability is negatively affected because data sharing between components and also the data consistency becomes increasingly complex in isolated architectures (Boissier et al., 2014, p.1). Due to the high investment costs, BIS normally have a very long lifecycle.

The chronological shifted acquisition of the different BIS within a company in the past has led to **isolated data and applications**. The demonstration that it is beneficial and necessary to integrate these isolated applications to a greater whole can be done by means of a typical sales process which requires data of different BIS (Edler, 2014, p.59):

- **Sales**: Firstly, the order must be created and acquired.
- **Manufacturing**: Based on the order positions, the required manufacturing steps and material requirements are obtained.
- **Inventory Management**: The material requirements must either be provided from the warehouse or purchased from a supplier.
- **Accounting**: After manufacturing and shipment has been completed, an invoice must be created and the payment must be monitored.

Even if many modern ERP-systems can handle all the above-mentioned processes, various companies additionally use separate systems for specific processes, e.g. CRM-systems for the sales activities. In that case, the integration between the ERP- and CRM-system is an important aspect.

Consequently, the integration of BIS into the whole IT landscape of a company is essentially. Bach and Österle claim that for example CRM systems need to retrieve their required data from different data sources, as for example from an ERP-system, document management system or from a data warehouse. This information will be collected and compressed and finally be used as basis for the communication with customers (Bach and Österle, 2000, p.30). Bradford confirms this by claiming that often when companies implement the core ERP system, they have a best of breed CRM system that needs to exchange data with the core ERP. Technologies like Enterprise Application Integration (EAI) and Middleware (more details regarding these technologies please see chapter 3.2.3) enable this integration (Bradford, 2010, p.20).

Ray identified the following **challenges of isolated systems** which shall be compensated with integrated systems (Ray, 2011, pp.5–7):

- **Duplication of data**: Isolated BIS require entering the same information multiple times in different systems.
- **No interaction between these systems**: However, in practice, it is often not possible to perform a business process without the interaction of multiple BIS.
- **No online update of all relevant information possible**: Some BIS possess not up-to-date information (e.g., a CRM system still has a wrong customer balance).

In comparison, Özkarabacak, Çevik and Gökşen determined the **following business drivers for integration** (Özkarabacak, Çevik and Gökşen, 2014):

- Decrease of application migration costs during transition to new systems.
- Improvement of visibility of information across the company by linking disparate applications without developing separate interfaces.
- Reduction of data entry time, costs and errors.

Greenberg determined that a frequent problem in companies is that the supply chain and the demand chain are each seen as a discrete set of processes that are independently managed and optimized. The relationship between them has been parallel at best, but not integrated. Greenberg continues by claiming that CRM and SCM need to be integrated to prevent disconnects on the one hand and to improve efficiencies and customer satisfaction on the other hand. An important aspect thereby is that the “pure technical” integration is not enough, but rather the **integration of business processes and systems at multiple**

levels, sometimes even among several companies, is necessary (Greenberg, 2004, pp.393–395).

An important cornerstone of the integration of ERP-systems with other systems ("**The Extended ERP**") is the Internet. This environment of accessing system resources from anywhere and anytime has supported ERP vendors to extend their "legacy ERP applications" by integrating with external business modules such as supply chain management (SCM), CRM, sales force automation (SFA), advanced planning and scheduling (APS), BI and e-business applications (Rashid, Hossain and Patrick, 2002, p.12). This should be demonstrated with the following picture:

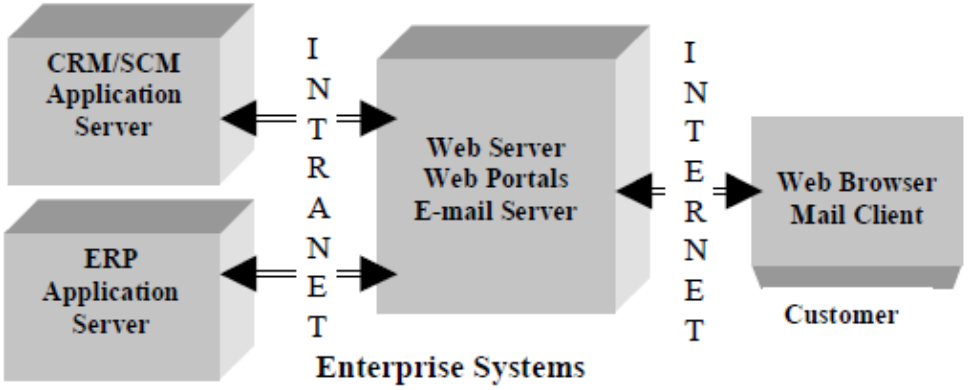

Figure 12: Web-enabled extended ERP system (Rashid, Hossain and Patrick, 2002, p.14)

At the end of this chapter, the author would like to show the integration between multiple BIS by means of another **example** (Greenberg, 2004, p.386):

- A sales order is created in a CRM system.
- The order is booked in the financial system (ERP).
- The order is applied to a compensation program, which is part of a human resources (HR)-system, tailored specifically to the salesperson who closed the deal.
- The order management system (ERP) identifies the available product inventory and sends this information to the logistics department.
- The logistics department packs and delivers the product.
- An e-mail is automatically sent to the customer on the expected shipping date and delivery date, depending on how the shipping was handled.

A similar scenario will be handled in chapter 4.3.1.1.

3.2.3 Enterprise Application Integration

The horizontal internal integration of data and functionalities, which is the main focus of this thesis, is also called Enterprise Application Integration (EAI). EAI-systems are mainly used for existing old systems (**Legacy Systems**) and within a heterogeneous system landscape, respectively (Masak, 2005, pp.169–170). Ray defines EAI as „*an integration framework composed of a collection of technologies and services that form a middleware to enable integration of systems and applications across the enterprise*" (Ray, 2011, p.539). The term **EAI platform** is defined by Alonso et al. as „*software systems that facilitate the integration of heterogeneous, coarse-grained applications*" (Alonso et al., 2004, p.91).
Allweyer states that the **target of EAI-systems** is the reduction of the effort for interface programing (Allweyer, 2005, p.341). Instead of developing a separate interface for two BIS

each time, a central conversion unit is setup, which can handle with communication standards of different systems. However, this integration only considers the data transformation and not the control flow of the superior business processes, which can be done with BPMS (business process management systems) (Allweyer, 2005, p.342).

The realization of EAI can mainly be done based on the following two methods (Edler, 2014, pp.60–63):

- **Hub-and-Spoke-Architecture**: The integration tasks (control of the interfaces, central data transformation and –transfer and in rare cases also the management of business processes) are done by the EAI-Hub. All BIS, which need to be integrated, have interfaces to the EAI-Hub. The main drawback of this architecture is the Single Point of Failure of the central EAI-Hub.

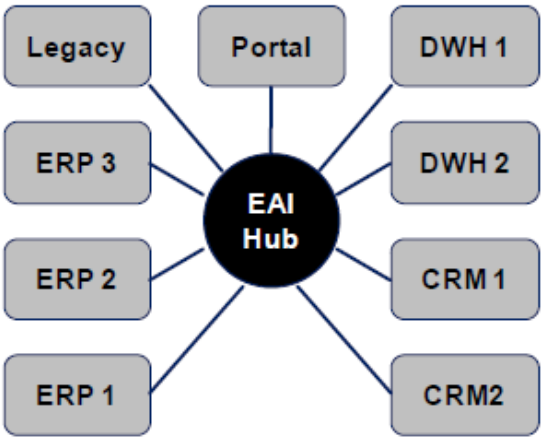

Figure 13: Hub-and-Spoke Integration Architecture (Edler, 2014, p.61)

- **Bus Architecture:** the integration tasks are done by an EAI-Bus. All the individual BIS are connected with separate interfaces to the bus system. The bus system has a central directory, which handles the control and distribution of data, messages and technical workflows. The directory possesses replication mechanisms, which solves the single point of failure problem.

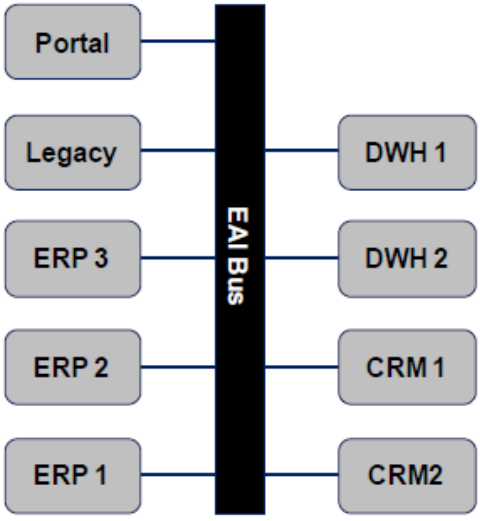

Figure 14: EAI-Bus-Integration Architecture (Edler, 2014, p.62)

The integration components (EAI Hub, EAI Bus) are also called **middleware**. Some well-known examples of these middleware-platforms are Java Enterprise Edition, the .NET Framework from Microsoft or NetWeaver from SAP. The following picture underpins the differences between traditional integration and EAI-Integration.

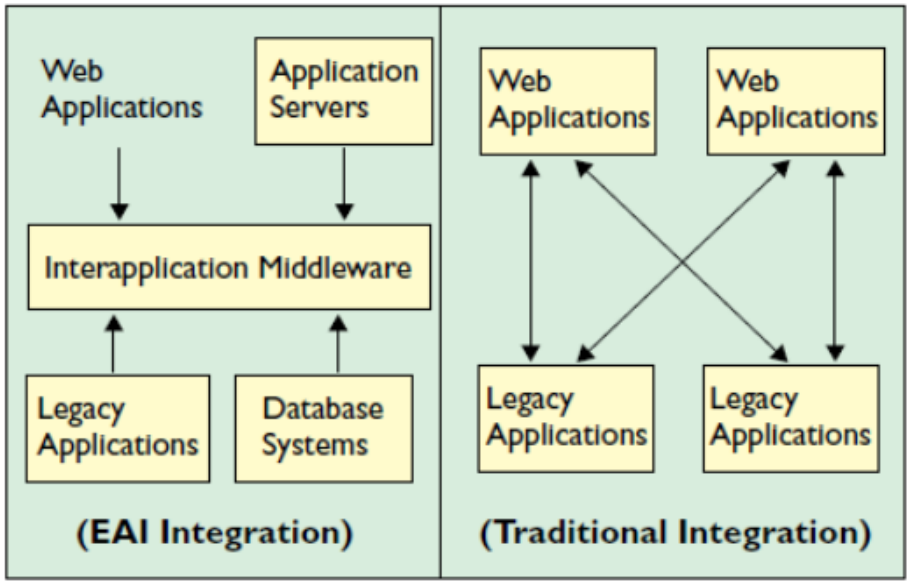

Figure 15: EAI Integration vs. Traditional Integration (Lee, Siau and Hong, 2003)

Recently, a frequently used integration concept is the **SOA-Framework (Service Oriented Architecture)**, which realizes EAI with the aid of **Web Services** (Edler, 2014, p.61). Web-Services are „*functional building-blocks accessible over standard Internet protocols independent of platforms and programming languages*" (Ray, 2011, p.532). Ray states that „*service-oriented architecture is a new model of building applications for tomorrow using reusable and modular services that can be exposed from different applications and can be combined together to build a new application with minimum programming and integration hassles*" (Ray, 2011, p.524). This should be demonstrated with the following example: A sales order management process shall be designed where the creation of the sales order will be done in SAP CRM system, the pricing of the order in Oracle ERP system and finally a credit check within a legacy system. In the past, this scenario would have required many programming of various interfaces. With SOA, this exercise is much easier, by integrating a service of order entry from SAP CRM, a service of pricing from Oracle ERP and a service for the credit check from the legacy system to establish a new business process running across multiple systems (Ray, 2011, p.532). Bradford asserts that integrating multiple systems using SOA is relative straightforward because the main task is to find appropriate services and not to understand the technical nuances of a system (Bradford, 2010, p.19).

In contrast with EAI, **Business to Business Integration (B2B)** deals with the external integration between different business partners. Linthicum defines B2B integrations as the approaches to allow connected companies, such as suppliers and consumers, to exchange data in support of common business events (Linthicum, 2001). Business to Business-Integration is not part of this thesis.

3.3 Cloud fundamentals with focus on SaaS

The last main chapter of the literature review deals about cloud computing with a main focus on **Software-As-A-Service (SaaS)** and SaaS-based BIS. Because Cloud Computing is a huge topic, the author only covers a selection of themes, which are relevant for the understanding of this thesis.

3.3.1 Definitions and concepts

Schubert and Adisa defined Cloud Computing as „*the operation of infrastructure, platforms and software in a virtualized environment whose components can be accessed and used over the Internet. The word 'cloud' signals that services are offered without the need of explicit knowledge about where these services are physically located*" (Schubert and Adisa, 2011, p.10). This definition is based on the U.S. National Institute of Standards and Technology (**NIST**) definition. According to Miller, cloud computing is associated with a significant change in how we store information and execute applications. Instead of running them on individual desktop computers, it is hosted in the cloud, which is a nebulous cluster of computers and servers accessible via the Internet. If personal computers crash, the software is still available for others to use. Unlike traditional computing, the cloud-computing model is not PC-centric, it is **document-centric**, because it does not matter which PC you use to access a document. For the end user, the technology and infrastructure behind the cloud is not visible. Miller summarizes his explanations of cloud computing with the following definition: „*Cloud computing enables a shift from the computer to the user, from applications to tasks, and from isolated data to data that can be accessed from anywhere and shared with anyone*". The term **cloud** is defined by Miller as „*a massive network of servers or even individual PCs interconnected in a grid. These computers run in parallel, combining the resources of each to generate supercomputing-like power*". The **cloud architecture** can be quite complex and therefore will not be described in detail within this thesis. A simple explanation about how cloud-computing works is that a network of computer operates as a single computer to serve data and programs to multiple users over the Internet. The network exists in the cloud of IP addresses – the Internet – and offers massive computing power and storage capabilities, which finally enables wide-scale group collaboration (Miller, 2008, pp.7–15). A key concept for cloud computing is **server virtualization**, which is defined by Velte, Velte and Elsenpeter as „*the configuration of a physical server that allows installing multiple instances of virtual servers on a single machine*" (Velte, Velte and Elsenpeter, 2010, p.317).

3.3.1.1 Service Models

A cloud system can be based on the following three different **service models**:

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

IaaS offers consumers the most options and is defined as the provision of computing resources (CPU cycles, memory, storage, network equipment and other fundamental computing resources) to a consumer by an outsourcing vendor (Velte, Velte and Elsenpeter, 2010, p.15). The consumer has no control over the underlying cloud infrastructure but has control over operating systems, storage and deployed applications, and possibly limited control of specific network components as for example firewalls (Mell and Grance, 2011, p.3). A well-known example of IaaS is Amazon EC2[14].

[14] https://aws.amazon.com/en/ec2/ (Accessed 4 Jan. 2018)

PaaS can be defined as the capability for the consumer to deploy onto the cloud infrastructure consumer-created or acquired applications created using tools supported by the provider. The consumers have no control over the underlying platform including network, servers and operation system but they can control the deployed applications and configuration settings. PaaS is often used for the development, test and deployment of custom (web-) applications by its customers (Lehrig, Eikerling and Becker, 2015; Mell and Grance, 2011, pp.2–3). Examples for PaaS are Windows Azure[15] or Google App Engine[16].

Finally, **SaaS** is defined as „*a deployment technology where the software system and users' data are stored off-site in a central location run by the vendor*" (Ma and Seidlmann, 2008, p.4). As the focus of this thesis is on SaaS, there is a separate chapter about it (3.3.2).

The following figure summarizes the three service models and their purpose.

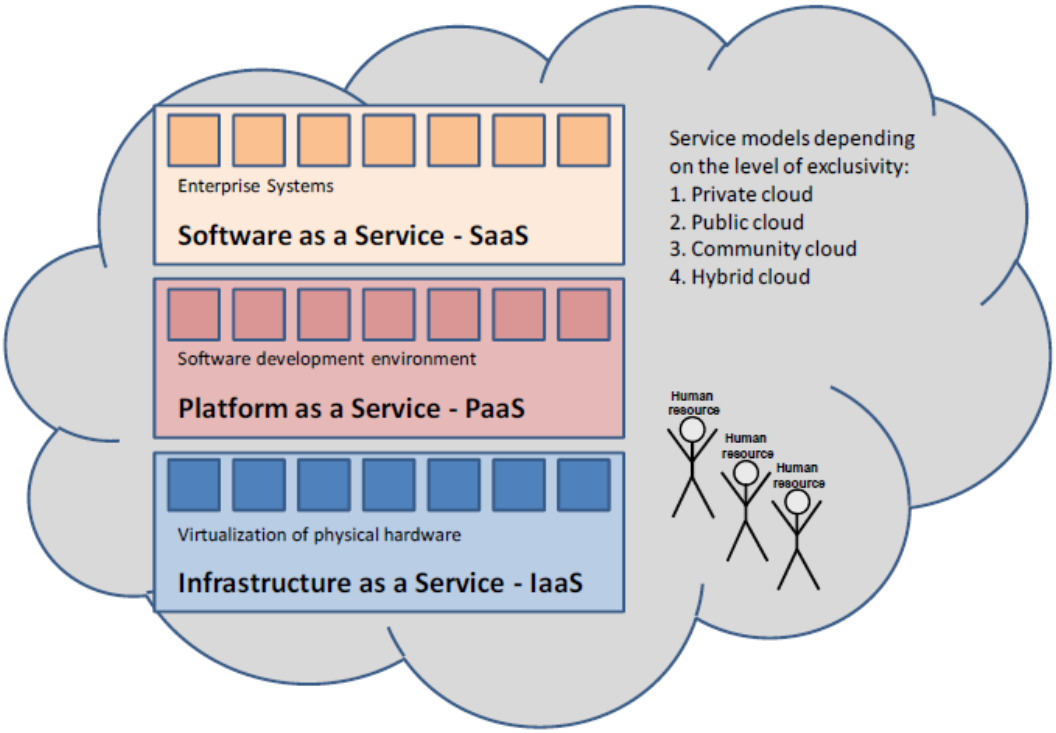

Figure 16: Service models of cloud computing (Schubert and Adisa, 2011, p.11)

3.3.1.2 Deployment Models

According to Mell and Grance, a cloud system can be differentiated into **four different deployment models**. They differ in usage, security and cost factors. Selecting the right system is very essential, especially for ERP systems. The following four types exist (Mell and Grance, 2011, p.3):

- Private Cloud
- Community Cloud
- Public Cloud
- Hybrid Cloud

[15] Windows Azure is Microsoft's Cloud platform
[16] Google App Engine is a platform provided by Google for the development and deployment of Web applications.

In a **private cloud**, the cloud infrastructure is provisioned for exclusive use by a single company, which consists of multiple consumers, e.g., business units. It can be owned and operated by the company itself, a third party organization or some combination of them and it may be applied on- or off-premises. In a **community cloud**, the cloud infrastructure is provisioned for exclusive use by a community of defined consumers from companies with shared concerns (e.g. the same mission, security requirements, policy or compliance considerations). A community cloud may be owned and operated by one or more of the companies in the community, a third party or some combination of them. As for the private cloud, it may exist on- or off-premises. In contrast to a community cloud, a **public cloud** is provided for open use to the general public. This time, it may be owned and operated by a business, academic, a government organization or some combination of them. It always exists on the premises of the cloud provider. Finally, a **hybrid cloud** is the composition of two or more distinct cloud infrastructures (private, community or public) that remains unique entities (Mell and Grance, 2011, p.3).

3.3.1.3 Advantages

The following **advantages of cloud computing** can be summarized based on different authors (Miller, 2008, pp.24–28; Mell and Grance, 2011; Buyya, Broberg and Gościński, 2011; Kaur and Kinger, 2014; Linthicum, 2009):

- **Lower-cost computers for users**: As the programs run in the cloud and not on the desktop PC, that desktop PC does not need the processing power or hard disc capacity as required for traditional desktop software.
- **Lower IT infrastructure costs**: Companies do not need to invest in many powerful servers anymore.
- **Fewer maintenance issues**: Both, hardware and software maintenance are reduced.
- **Lower software costs**: Only software packages for employees actually using an application need access to the application in the cloud. Furthermore, IT staff are saved the cost of for the installation and maintenance of the applications on each desktop in the organization.
- **Self-service**: Customers have on-demand access to resources, the system provides computing capabilities on demand.
- **Multi-tenancy**: Capability to serve multiple customers by one pool of resources.
- **Instant software updates**: When apps are web-based, updates are done automatically when the user logs in to the cloud the next time.
- **Scalability**: Companies can add but also reduce as much capacity as needed, simply by increasing or decreasing spending. Thus, organizations can get what they need and whenever they need it. Thereby, peak periods can be supported.
- **Unlimited storage capacity**: The cloud offers virtually limitless storage space.
- **Easier group collaboration**: Ability for multiple users to easily collaborate on projects and documents (full participation from all involved, faster completion of group projects etc.).
- **Removes the tether to specific devices**: Users are no longer tethered to single computers or networks. Documents and programs are the same no matter what computers are used.
- **Reliability**: Established by the usage of multiple redundant sites which implies a higher failure safety if one node gets offline.
- **Faster time to market**: The company simply signs up and after initial setup, it has access to the cloud resources that are needed.

3.3.1.4 Disadvantages

In contrast to the above mentioned advantages, the most authors determined the following **disadvantages of cloud computing** (Miller, 2008, pp.28–30**;** Salum and Rozan, 2015**;** Linthicum, 2009**;** Kosasi, Harsono and Yuliani, 2014, p.21):

- **Constant Internet connection is required**: When you are offline, cloud computing does not work, which could be a deal breaker. Similarly, low-speed Internet connections make cloud computing painful and often impossible.
- **Can be slow**: Web-based applications can sometimes be slower than running a program on a desktop PC, as all the information must be sent back and forth from a PC to the computer in the cloud. Thus, bandwidth and response times must be high.
- **Features might be limited**: Web-based applications sometimes do not have all the features of the desktop-based version (for example Google Docs vs. Microsoft Word).
- **Stored data might not be secure**: That is probably the biggest obstacle why companies are not moving their business data and applications into the cloud. There are still many doubts whether unauthorized users may gain access to company's confidential data.
- **Loss of control about data**: The customer has no control where the data will be stored and how the security will be ensured.
- **Openness**: Cloud platforms are proprietary in their nature. Once the system has been set up using the cloud provider's tools and architecture, it may be difficult to move the system to other cloud providers or back onto on-premise.

Despite all the security concerns the reviewed literature conveys the impression that this is more an emotional problem and that there are not real security risks (Linthicum, 2009, p.32).

3.3.2 Software-as-a-Service based business information systems

In the SaaS model, the BIS is provided by the cloud service provider. The roles of cloud service provider and BIS vendor are merged in this setting, which is also called **vertical integration** (Schubert and Adisa, 2011, p.14). With **SaaS**, a single application is provided to multiple (sometimes thousands of) users from the vendor's servers (**multi-tenancy**). Thereby, customers do not pay for owning the software, but rather they pay for using it (**pay-per-use pricing model**). Customers do not have to make upfront investments in servers or software licenses (Miller, 2008, p.40). The customer does not need to manage the servers or software, because the provider has this responsibility (Bradford, 2010, p.8). Thereby, cloud-based BIS are the contrary to classical **on-Premise systems**. Another common term for SaaS is **on-Demand**, but in the following, the author always uses the term SaaS. The customer is able to access the software over the network with a client interface. This interface can be a **thin client** (web browser) or a **thick client**, e.g. an installed client on the client's side. The cloud vendor is responsible for the maintenance, deployment and configuration of the software in the cloud (Lehrig, Eikerling and Becker, 2015; Mell and Grance, 2011). According to Chen, Liang and Hsu the cloud BIS platform consists of **three major players**: the cloud service provider, which enables communications among BIS providers and enterprise customers; the BIS providers, which provide computer-readable descriptions of web services for the execution of various application functionalities and the enterprise customers, which select and lease the Web Services to meet their BIS objectives (Chen, Liang and Hsu, 2015, p.129).

Current examples of SaaS based BIS are the ERP system SAP Business ByDesign[17], the CRM system salesforce.com[18] and the collaboration systems Google Docs[19] and Microsoft Office 365[20]. But also data warehouse environments and BI solutions can be provided as SaaS, e.g. Qlik Sense Cloud[21] (Haertzen, 2012, p.93), even if also many PaaS-based BI solutions exist, as for example Oracle Cloud PaaS[22] (Muntean, 2015, p.59). Further examples of cloud based BIS including a proof of concept will be described in chapter 4.3.

3.3.2.1 Characteristics

The main characteristic of cloud-based BIS and distinguishing marks comparing to on-Premise systems are the **multi-tenancy** (as described above) and the high **degree of standardization** which is necessary in order to ensure high quality (Buxmann, Diefenbach and Hess, 2011). Based on that, the configuration and implementation of cloud-based BIS is often faster as for the on-Premise variant (Hufgard, Legner and Winkelmann, 2012).

Reese has determined the following **characteristics of SaaS based BIS** (Reese, 2009, p.3):

- **Availability via a web browser**: The installation of a software is not required on the desktop computers. Instead, the software is accessed through a web browser using open standards or ubiquitous browser plug-ins.
- **On-demand availability**: As soon as you have access, you can go back into the software at any time and from anywhere.
- **Payment terms based on usage**: Infrastructure investments or complex setups resulting in massive setup fees are not required. Companies just have to pay for the parts of the service they use and if they do not need specific services anymore, they can stop paying.
- **Minimal IT demands**: Servers or networks infrastructure do not need to be acquired. SaaS systems only require some technical knowledge for their configuration.

3.3.2.2 Decision criteria

Even if there exists a great number of decision criteria for adopting BIS in the cloud, the author determined the following criteria as most important:

- Scalability
- Costs
- Customizability
- Integration

Scalability is for sure one of the biggest pro-arguments of cloud based BIS. On-premise systems are installed on one or more servers within a company, which have limited processing power. But also software limitations, like restrictions in supported size of datasets can cause problems, in the worst case downtimes of the whole BIS can be the consequence. The deployment of BIS in the cloud promises to be the solution for that scalability problems (Gargeya and Brady, 2005; Subashini and Kavitha, 2011).

[17] https://www.sap.com/austria/products/business-bydesign.html (Accessed 7 Jan. 2018)
[18] https://www.salesforce.com/ (Accessed 7 Jan. 2018)
[19] https://docs.google.com/ (Accessed 7 Jan. 2018)
[20] https://www.office.com/ (Accessed 7 Jan. 2018)
[21] https://www.qlikcloud.com/ (Accessed 7 Jan. 2018)
[22] https://cloud.oracle.com/paas (Accessed 9 Jan. 2018)

Cloud based BIS can be associated with **cost reductions**. Cloud providers can offer their services for a lower price because of their ability to scale their software systems and infrastructure on demand. Thus, clients can be offered flexible monthly calculable costs, which can reduce both startup costs and maintenance costs and thus finally the **total cost of ownership** (TCO) of BIS. The main reasons therefore are much lower hardware costs, reduced license costs, elimination (or at least reduction) of upgrade costs and reduction of consulting costs for the implementation of the hard- and software (Lechesa, Seymour and Schuler, 2012; Sun et al., 2008; Lewandowski, Salako and Garcia-Perez, 2013).

When it comes to **customization** the advantages for a cloud vendor decline since the cloud vendor wants to sell as much standardized products as possible. In order to avoid mass customizations, the cloud-based BIS must be made highly configurable, i.e. the BIS can be adapted to the business processes of a company by means of setups and parameters and without changing program codes (**"configuration"**). Thereby, not all parts of the SaaS application can be individually customized, as they are part of the fixed code kernel, which is provided equally for all consumers. Generally, it can be said that the customization possibilities of SaaS-based systems are limited comparing to on-Premise systems (Jiang, Zhang and Liu, 2010; Mietzner and Leymann, 2008; Kim and La, 2009; Föckeler, 2009; Kurbel and Nowak, 2013). Benlian and Hess state that companies which are implementing cloud-based ERP systems must be aware, that changes at the process and organizational level will be necessary, even more as for on-Premise systems (Benlian and Hess, 2009). Ray confirmed this by claiming that the success of ERP/CRM software as SaaS depends on offerings of industry best-practice configurations and the ability for the customer to do further configurations (Ray, 2011, p.527). The following picture shows customization possibilities on the example of SAP Business ByDesign, the cloud-based ERP system from SAP.

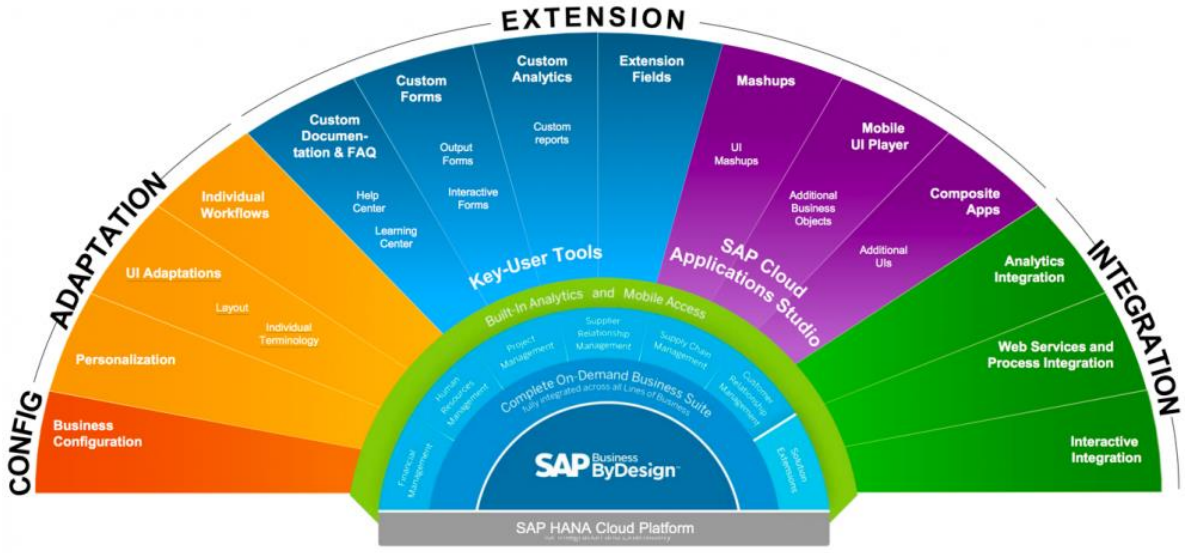

Figure 17: Customization possibilities of SAP Business ByDesign (Pinnacle Computer Systems LLC, 2016)

The next factor that needs to be considered, and which is also a very important aspect of this thesis, is the **Integration**. According to Liu et al., many companies do not realize all their applications as SaaS solutions. Thus, the SaaS applications must be integrated into the existing IT landscape (Liu et al., 2010). Companies mostly have a mix of SaaS applications and On-Premise applications, which often also have different user interfaces.

Therefore, a harmonization and integration of the user interfaces must be done. On the one hand, **Single Sign-On (SSO) interfaces** can be implemented, which require only a one-time login to the system and afterwards enable access to all applications. On the other hand, **Mashups** can be used, as they enable applications to use data from other applications. Beyond that, it is necessary to integrate the business processes, which are handled by various applications. On the data level two different types of data must be regarded – master data and transaction data. Both data types must be synchronized between the existing systems. It must also be considered that each data type only has one source master data in order to ensure the consistency of the data (Sun et al., 2007). Hai and Sakoda state that even if SaaS has enormously changed the application lifecycle, it has not significantly reduced the complexities of the integration with SaaS systems. Companies are still concerned with vendor-specific APIs and varying levels of integration capabilities from different SaaS vendors. Integration-as-a-service solutions are starting to simplify integrations, especially in the Cloud-to-Cloud space, but they do not offer the same level of features as their on-premise counterpart yet (Hai and Sakoda, 2009, p.264)

In comparison, Linthicum (Linthicum, 2009, p.22) has investigated when BIS should be deployed in the cloud (SaaS) as well as when on-premise approaches should be used. Summarized, the **SaaS approach fits best when**:

- Processes, applications and data are largely independent, or when they are not tightly coupled with other applications or information.
- The points of integration are well defined (there are well-defined points within an application, where it can share data, behavior, and processes).
- Lower level of security is sufficient and the information within the cloud-computing environment requires a low level of security.
- The core internal enterprise architecture is clearly defined and thus it is much easier for SaaS systems to become part of that architecture.
- The Web/Internet is the desired platform and deploying the user interface within an Internet browser is appropriate.
- The initial investment costs need to be cheap.

In contrast, Linthicum summarized the following **scenarios where SaaS is not the best option** (Linthicum, 2009, p.22):

- Processes, applications and data are largely coupled.
- There are not good mechanisms in place to synchronize the data and processes hosted on cloud computing providers with those systems that exist within the company.
- High level of security is required or companies just cannot trust systems, which they do not completely control.
- The enterprise architecture is dysfunctional. In that case, extending the architecture with cloud-based platforms is not a good idea.
- The application requires a native interface.
- The application is legacy. Just as new applications are much easier to move into the cloud, legacy applications are not.

3.3.2.3 Possible threats

The development of BIS in the cloud is connected with both **operational threats** and **security threats**.

One of the most essential operational threats is the **vendor lock-in**, which describes the lack of a software to cooperate with other software systems, for example an ERP system with a CRM system. The intention of the vendor is to gain competitive advantage. As changing software from one vendor to another vendor is expensive, the client is mostly

unable to leave the vendor's offer. Next, there is the **lack of interoperability**, which means the troubles of exchanging data between different cloud systems. For example integrating the ERP system from vendor A with a CRM system from vendor B. The **lack of standardization**, which occurs when different cloud services are based on different languages and technologies. Finally, there is the **lack of portability**, which prevents the easy moving and reusing of data and applications independent of the choice of cloud provider, operating system or storage format (Viseur, Charlier and Van de Borne, 2014, pp.305–307). Ray also indicates that low **system availability** leading to downtimes of the BIS can have tremendous consequences for companies (Ray, 2011, p.527).

Other threats, which can have an influence on adopting BIS in the cloud, are **security threats**. First, there are the **data privacy issues**, as already mentioned above in chapter 3.3.1.4. Clients do not know the exact location of the servers where their data are stored. For example for companies with R&D data or other very sensitive business data, this can be a big issue (Peng and Gala, 2014, p.12). Another security threat is the **threat of multitenancy**. Even if this was explained as advantage in chapter 3.3.1.3, it can also become a security threat as multiple companies are using the same instance of for example an ERP system with different data pools. A data-leak between the different companies could have grave implications (Hashizume et al., 2013, p.4).

Schubert and Adisa assert that most of the data, which are stored in BIS databases, especially in ERP databases, represent company assets and thus are critical to company operation and success. Therefore, managers are not likely to move this data and the processing power into the cloud as long as it is not guaranteed that confidentiality of the data is assured and that the system performs at least at the same level as a comparable on-premise solution (Schubert and Adisa, 2011, p.15)

Some further **challenges of BIS in the cloud** which the author could find in the literature are strategic risks (dependency on the vendor), loss of IT competencies, SLA issues, hidden costs in contracts and organizational challenges (Abd Elmonem, Nasr and Geith, 2016, p.4).

Despite these general threats of running BIS in the cloud, the **acceptance** also varies among different cultures and countries. Beyond that, also data regulations and laws can have a major impact on that decision (Chen and Zhao, 2012). However, this will not be considered in more detail in this thesis.

4 Empirical methods

4.1 Expert interviews

In order to identify the most important criteria and success factors of cloud-based integrated business information systems, the author conducted expert interviews. More information about why the author decided to conduct expert interviews and about the target group of the interviewees can be found in chapter 2.2 This chapter describes how the author developed the interview guide which was used for the interviews and introduces the finally selected interviewees. Afterwards the main results of the interviews are described. The transcripts of the complete interviews can be found in the appendix B.

4.1.1 Preparation

4.1.1.1 Interview guide

In order to achieve a standardization of the conducted interviews, an interview guide based on the literature review from chapter 2.2 was developed. This should improve the comparability and facilitate further analysis (Mayring, 2002, p.70).

According to Helfferich (Helfferich, 2011, p.180), the interview guide should fulfill the following requirements:

- It must ensure the fundamental principles of qualitative research.
- It should be clearly formatted.
- It should be clearly structured, similar to the logical flow of this thesis.
- It should not contain too many questions, as spontaneously produced narrative should be a priority.

The following table describes the structure of the interview guide:

Part	Description
Initial situation and targets	• University and department • Title of the Thesis • Target of the interview • Duration
Information to the interviewee	• Name of the interviewee • Company • Industry • Position • Date, Place • Interview recording • Anonymity
Questions to IT experts	• Questions to the integration of business information systems • Questions to cloud-based business information systems
Questions to key users of manufacturing companies	• Questions to the integration of business information systems • Questions to cloud-based business information systems

Table 3: Structure of the interview guide

As the different perspectives of the two target groups of the expert interviews (IT experts and key users, more details see 4.1.1.2) should be regarded in the interviews, two different questionnaires were developed by the author. The complete interview guide with all questions for both types of interviews (IT experts and key users) can be found in appendix A.

4.1.1.2 Selection of experts

As described in chapter 2.2, expert interviews with two types of target groups were conducted: one group involving IT experts of IT companies and the other group involving employees of manufacturing companies applying business information systems. Finally, 16 experts were selected. All of them have profound knowledge in the relevant topics of this thesis.

The following table introduces the selected interviewees including their company, industry and position. In the column “SW provider” it is described the provider(s) of the business information systems, for which the interviewee has knowledge either because the interviewee is a consultant for the software (IT expert) or because the interviewee is a user of the software (key user). Additionally, the date, place and duration of the interviews is summarized. The second column “Type” defines the type of the interview, whereby IT stands for “IT Expert” and KEY stands for “Key User”.

	Type	Inter-viewee	Company / Industry	Position	SW provider	Place / Date	Dur-ation
A	IT	Gerd Frick	BITS Better IT Solution GmbH[23] / IT Consulting	CEO	Mesonic (ERP); CAS Software AG (CRM)	Telephone / 2018-02-21	23 min
B	IT	Peter von Zimmer-mann	Alta Via Consulting GmbH[24] / IT Consulting	CEO	Oracle NetSuite	Telephone / 2018-02-21	32 min
C	IT	DI Peter Weiss	FULCRUM Consulting GmbH[25] / IT Consulting	CEO	SAP Business ByDesign	Telephone / 2018-02-22	22 min
D	KEY	Anonym-ous	Anonymous / Machine Engineering (Hydraulics)	CEO / CIO	ABAS (ERP), SAGE (HR), Kardex(WM) Habel (DMS)	Unterweit-ersdorf, 2018-02-23	46 min
E	IT	Marco Mülleder	NAVAX Consulting GmbH[26] / IT Consulting	Head of Product Manag.	Microsoft	Linz, 2018-02-23	17 min
F	IT	Ing. Roland König, BA	König Engineering GmbH[27] / IT Consulting	CEO / Senior Consult.	myfactory	Wolfsegg, 2018-02-23	27 min
G	IT	DI (FH) Dominik Aigner	NAVAX Consulting GmbH / IT Consulting	Leader CC Manu-facturing	Microsoft	Linz, 2018-02-26	32 min
H	KEY	Thomas Boogert	Secrid BV[28] / Manufacturing of wallets	IT Manager	Oracle NetSuite	Telephone, 2018-02-28	58 min

[23] www.bits.co.at (Accessed 21 Feb. 2018)
[24] http://www.altavia.de/ (Accessed 21 Feb. 2018)
[25] http://www.fulcrum.at/ (Accessed 22 Feb. 2018)
[26] https://www.navax.com/ (Accessed 23 Feb. 2018)
[27] http://www.koenigengineering.at/ (Accessed 23 Feb. 2018)
[28] https://secrid.com/ (Accessed 28 Feb. 2018)

I	KEY	Mario Engleder	Röchling LERIPA Papertech GmbH & Co. KG[29] / Plastics industry	CIO	Microsoft (ERP) QlikTech (BI)	Oepping, 2018-02-28	25 min
J	IT	Marcel Merz	Full Speed Systems AG[30] / IT Consulting	CFO / Project leader	Oracle (NetSuite, JD Edwards)	Telephone, 2018-03-02	28 min
K	KEY	Anonym-ous	Anonymous / Manufacturing electronics company	CIO	Microsoft Dynamics NAV / CRM	Engerwitz-dorf, 2018-03-02	17 min
L	KEY	Raimund Scheurin-ger / Thomas Kaltseis	Aspöck Systems GmbH[31] / Car motif industry	Team Leader SCM / CIO	SAP (R3, WMS, ME, B1, BW)	Peuerbach, 2018-03-02	36 min
M	IT	Mag. Jürgen Salaböck	NAVAX Consulting GmbH / IT Consulting	Team Leader NAV	Microsoft	Linz, 2018-03-07	36 min
N	KEY	Anonym-ous	Anonymous / Car motif industry	CEO	Microsoft Dynamics NAV	Waizen-kirchen, 2018-03-08	23 min
O	IT	Jana Lukic	Microsoft Austria GmbH[32] / IT	Solution Sales Profess.	Microsoft	Vienna, 2018-03-13	29 min
P	KEY	Anonym-ous	Anonymous / Telecommunication (with Manufacturing)	Project Manager	Microsoft (ERP/CRM), IBM Cognos	Vienna, 2018-03-15	23 min

Table 4: Key facts about the expert interviews

As can be seen in Table 4, a total of 9 interviews with IT experts from IT consulting companies and 7 interviews with employees from manufacturing companies were conducted. Another important fact concerning the conducted interviews are the different software providers and products, which were considered during the interviews. In total, **12 different software providers of BIS** were examined, which are the following:

- Mesonic (ERP/CRM system “Mesonic WinLine”)
- CAS Software AG (CRM system “CAS genesisWorld”)
- Oracle (NetSuite, JD Edwards)
- SAP (SAP Business ByDesign, SAP R3, SAP WMS, SAP ME, SAP BW, SAP Business One)
- ABAS (abas ERP)
- Sage (Sage HR Suite)
- Kardex remstar (stock management software Power Pick Global)
- Habel (document management software)
- Microsoft (Microsoft Dynamics product family, Microsoft Office/SharePoint)
- Myfactory (ERP, CRM, PPS)
- QlikTech (BI system QlikView)
- IBM (Planning- and BI-system IBM Cognos TM1)

[29] https://www.roechling.com/ (Accessed 28 Feb. 2018)
[30] http://www.fss-group.com/ (Accessed 2 Mar. 2018)
[31] https://www.aspoeck.com/ (Accessed 2 Mar. 2018)
[32] https://www.microsoft.com/de-at/unternehmen/ (Accessed 13 Mar. 2018)

4.1.2 Evaluation of the interviews

Each interview was conducted personally, recorded and transcribed. The author translated statements from dialectal German into High German (Dresing and Pehl, 2015, p.21). Additionally, during the interviews the author made some notes about the most important statements. The complete interview transcriptions of all interviews can be found in appendix B. Each interviewee received the interview for review if requested. This chapter contains a summary, interpretation and comparison of the core statements of the interviews. In the end of this chapter, the key statements of each interviewee are illustrated and contrasted within a tabular overview. The evaluation of the interviews is done through a **qualitative content analysis** as defined by Mayring. Thereby the transcribed interview text is reduced to the most important content and typical and mutual contents of the interviews are identified (Mayring, 2000, p.68). Furthermore, in the criteria catalogue in chapter 4.2 the author also refers to key statements of the expert interviews.

4.1.2.1 Interview A (Gerd Frick / BITS Better IT Solution GmbH)

Integration possibilities have a very high influence on the selection of business information systems. Without integration, it is not possible to implement IT projects. The requirements regarding integration are on the one hand the management wants a low-maintenance system with few interfaces and a platform, which enables fast management decisions. On the other hand, the end user wants an easy system. The integration requirements are often derived from the customers, but also in order to optimize processes. The biggest integration challenges are, on the one hand, the definition of the required level of integration and, on the other hand, the middle- and long-term maintenance. The main problems of isolated applications are redundant data storage and duplication of efforts. An example of how to improve manufacturing processes through integration is Internet of Things (e.g., machines in the field notify demands), factory data capture and machine data logging integration. The highest pressure regarding integration comes from the accounting department, as they need consolidated data. Interviewee A made the experiences that integrated CRM functionalities within ERP systems only cover limited functionalities. The most important data, which should be synchronized between ERP and CRM system, are addresses, statistic data, outstanding items and project information. The integration of BIS with office products is a prerequisite, especially the integration with Word (e.g. bulk letters) and Excel (e.g. calculations), Outlook not necessarily, as many CRM systems have integrated groupware functionalities. In order to enable sustainable systems, standard interfaces shall be used.
The **deployment of BIS in the cloud** mainly depends on the region (e.g. in Switzerland the tendency is quite high, in Austria and Germany much lower), the company size (smaller companies are more prone to the Cloud) and the industry (sensibility of data). Another circumstance where companies often tend to use the cloud is if they have a company structure, which is not very stationary. Currently, CRM systems are more often deployed in the cloud. Interviewee A does not see higher risks regarding security and data protection. According to him, the highest risks are their own employees. There are limitations regarding the functionality (usability, performance, interfaces, etc.) and regarding the customizing options (less possibilities). On the other hand, the upgrade capability is higher because of less customizing options. Consequently, as more standard functionality is used (or has to be used), the implementation duration is shorter comparing to on-premise variants. However, there are often problems regarding the data migration from an existing cloud solution into a new system.

4.1.2.2 Interview B (Peter von Zimmermann / Alta Via Consulting GmbH)

The influence of **integration** on the selection of BIS depends on each case (the existing system landscape, the process requirements etc.). Within NetSuite, the grade of integration within the system landscape is very high, thus only few interfaces are required. However, what is still often needed are integration possibilities with Third-Party-Logistic companies or other external services. The requirements regarding integration are that the integration must work stable and robust, it must have an error management and a monitoring. The triggers of an integration are always the business processes whereas the biggest challenges are the different technologies, which are provided by the software vendors (e.g. SOAP (Simple Object Access Protocol), REST (Representational State Transfer), even if there is a strong technological change. As the business processes do not have regards for the underlying IT applications, isolated applications are no alternative; the business processes enforce the integration within the system landscape. Regarding the ERP-CRM integration the most important information, which needs to be synchronized frequently are the product stocks, as a product can only be sold if it will be on stock on the required date. NetSuite works with automatic upgrades in the background, which also works if the system is customized and integrations with other systems by means of Add-On-developments are realized.

NetSuite is a pure **Cloud** solution. According to interviewee B, the trend of SaaS-based BIS is ongoing and uninterrupted. 9 years ago, as Alta Via Consulting GmbH started with NetSuite, many German companies had big doubts about the Cloud and therefore they focused on Startups and small companies. Today, even manufacturing SME are switching to the Cloud. The essential point is the upgrade capability. Due to experiences of interviewee B, BIS where the cloud is still not the best solution are warehouse management systems and POS (point of sales) cash systems. Because they must be available at 100 %, otherwise the business is interrupted. Otherwise, there are no specific requirements for the deployment of a BIS in the cloud. However, the cloud model is especially suitable for international companies, fast growing companies and companies, which do not want to bind to an On-Premise application. Therefore, a successful market for NetSuite is Africa, as their information is stored in a safe data center in California and cannot be stolen, destroyed, etc. Regarding security, interviewee B states that data centers are very safe nowadays; the biggest challenge here is the willingness of the companies. Data protection is another discussion point with companies. In case of NetSuite, the issue is that even if their data centers are located in Amsterdam, the company (Oracle) is still a US company and many companies have problems with that. Regarding functionality and customizability, the main difference is that the cloud solution cannot directly access the database. Even if many cloud-based BIS have no or limited customizing possibilities comparing to the on-premise variant, the distinctive feature of NetSuite is the development environment, which is also part of the cloud, which enables customizing which is upwards compatible at upgrades (which are done automatically in the background), thus NetSuite has no limitations regarding customizing.

4.1.2.3 Interview C (DI Peter Weiss, FULCRUM Consulting GmbH)

Unfortunately, many companies do not understand the high importance of **integration** possibilities when selecting BIS, because often they do not understand how expensive and sophisticated it can become in a worst-case scenario. The main requirement of the management regarding integration is little total cost of ownerships (TCO), the end user wants to see all relevant information with one double click, even if it comes from different systems. An important aspect when it comes to the realization of the integration is the availability of standard APIs. If they do not exist, the implementation can become quite complex. Otherwise, if the integration does not work and isolated applications are in place, higher costs, poor processes, poor data and reports, and thus a lack of a decision-making

basis is the result. Thereby, a full integration must be the goal, whereby the controlling and accounting benefits at most in the end. Interviewee C claims that within the ERP-CRM-integration, the most important data, which should be synchronized, are unpaid invoices (from ERP to CRM), so that sales persons can ask the customers at meetings regarding the status of these open items. Another example are sales histories of customers (e.g. all customers who bought a product last year, but not this year up to now), in order to plan specific marketing events. Regarding office integration, a main use case is the possibility to easily distribute files (e.g., Excel files containing information from a CRM-system) within the whole company, among all hierarchies, and afterwards re-import the data into the CRM-System. The upgrade strategy of SAP prevents integration problems after release changes. Thereby, the release changes are included in the license costs. If the development of interfaces was done based on the SAP rules (works with Bolt-Ons and Web-Services) and software development kit (SKD), the interfaces also work after a release upgrade, otherwise SAP is responsible for the fixes. Thus, no additional TCO, everything is included in the license costs. And there is no surprise after releases, whether interfaces are still working.
According to Interviewee C, there is a clear trend toward **cloud**, at all software vendors and their products. The advantage for the customer is the lower TCO, the main advantage for the software vendor is the lock-in effect. Thereby, it does not matter which type of BIS is used, the main issue is the software architecture behind the product. Typical cloud customers are medium sized enterprises and companies with several locations, as they do not have to think about the communication technology (e.g. VPN) between the different locations. As discussed already with interviewees A and B, interviewee C does not see any higher security risks as for on-Premise. There is a main difference regarding the customizability between on-Premise and SaaS-based BIS, which is the availability and access to the source code in on-Premise systems, which can be modified without limits. In cloud solutions on the other hand, it must be used pre-defined API's, Web-Services and Bolt-Ons, which do not allow every modification of the standard system. Interviewee C made the experiences that the implementation duration is three times faster for the cloud implementation, e.g. comparing SAP S4/Hana on-Premise and SAP Business ByDesign (cloud solution).

4.1.2.4 Interview D (Anonymous)

The anonymous machine engineering company uses ABAS as a core ERP system. Beyond that, SAGE is used as a human resources system, Power Pick from Kardex as warehouse management system and the document management system from Habel. Thereby, the deepest **integration** is between ABAS and PowerPick. The main experiences during the integration projects are the issue that you need a superordinate person who knows all involved systems in the integration at a good level as the consultants of the software vendors of the involved systems mostly only take into account their own systems. Therefore, you need a person who identifies with the company and many small- and medium sized enterprises do not have this employee. Another important aspect is the documentation and knowledge sharing about the implementation of the integration. The integration possibilities were finally the reason why they selected PowerPick as a warehouse management system (and not a different system, which was also in the final selection round). Currently, the order processing applies all aforementioned systems, which are ABAS, PowerPick and Habel DMS. On the other hand, the company does not use a separated CRM system, the CRM activities are done within the ERP system. A separated CRM system is not necessary, as the company only has a small number of customers, they make 90 % of their revenue with 25 customers. Also, the BI reports and analysis are done within the ERP system and a separated BI system is not in operation. In ABAS, queries are used to create the reports. Only some inventory reports are created out

of PowerPicks. The main reason why the integration project was started was the fact that within the company there was no stock loyalty. There were too many errors as the system did not guide the employees, for example when taking materials from the warehouse. The biggest challenge of the integration implementation was the Go-Live on day X, which had to be postponed the first time. Another challenge, as for all integration projects, is the migration of legacy data or generally the adaption of the data so that a successful integration is possible. The CEO of the company, i.e. the interviewee, strictly prohibits isolated applications, e.g. self-created access databases for product databases of suppliers. Such requirements are always getting implemented within ABAS. Regarding the office-integration, the company extensively uses Excel, in order to provide customers with required information, e.g. bill of materials or order information. According to interviewee D, there is no department in the company, which benefits at most, all departments have some benefits due to the integration. In order to maintain a sustainable system, the interviewee decided to upgrade only to versions, which are used in the business at least for one year, and just to R4 releases, whereby the upgrades are one-month projects.
The company of interviewee D currently uses no **cloud**-based BIS because of a lack of a powerful data line infrastructure, thus the bandwidth is currently insufficient. Therefore, interviewee D has not thought about the cloud topic very much. According to him, the USA is a pioneer within this topic.

4.1.2.5 Interview E (Marco Mülleder / NAVAX Consulting GmbH)

The **integration** requirements are one of the main reasons why companies are starting IT projects with BIS and contact IT consulting companies like NAVAX Consulting GmbH. Because without integration, companies often have a non-transparency which creates big problems with a certain company size. The goal of the companies is to obtain consistent figures in a fast and efficient way, which often do not exist with isolated applications. Thus, the controlling must invest a lot of time and money in order to check the correctness of the data coming from different systems. In manufacturing companies, a very important figure is the capacity, which needs to be controlled and planned as good as possible. The main challenge for a successful integration is the exactness and accuracy, which must be fulfilled in all involved systems. A good example of how to optimize manufacturing business processes by means of integrated systems is the capacity planning, where the user needs information from different sources, e.g. information about machines, projects, maintenance tasks, set-up times, manufacturing orders etc. Referring to the ERP-CRM-Integration, interviewee E says that the most important information, which should be synchronized, is the sales history, which may also be relevant for after-sales-services, which is often a topic for manufacturing companies.
According to interviewee E, for BIS where both, SaaS and on-Premise are offered, the emphasis is still on on-Premise applications. The trend goes towards **cloud** services, but slowly. Use cases, where the cloud model is not appropriate are systems, which enforce high-availability, e.g. cash systems, or companies with very sensible data. On the other hand, the cloud model is suited very well for companies that have different workloads during the year, i.e. different number of users and different performance requirements. Interviewee E also does not see security risks within cloud-based BIS. On the contrary, he sees the main challenge in the execution of confidence-building measures. The main functional limitations of SaaS-based BIS comparing to their on-Premise variants is the user interface as there are still limitations in the Web Browser comparing to programmed applications. Updates will be done automatically for SaaS-based BIS, although many companies eventually do not want these automatic updates.

4.1.2.6 Interview F (Ing. Roland König, BA / König Engineering GmbH)

The main requirements for **integration** are, on the one hand, technical issues like a common connected platform (independent of device type) and, on the other hand, organizational issues which mainly involve the establishment of continuous processes and the prevention of media disruptions. For the management it is essential to have their required information in real time and per mouse click. The user, on the other hand, only wants to learn one system and not different systems with different user interfaces for different purposes. The biggest challenge during the implementation of integration projects is the communication between customer and software vendor. The vendor must be able to understand the customer's requirements, which becomes even more difficult because of the increasing complexity of the software systems. Other challenges are the motivation of the employees and the migration of existing data. One interesting problem of isolated applications which interviewee F mentioned is the platform limitation. An example for a final result of an integration project is a central purchasing through a central invoice verification center, which was done in different places and departments in the past. Thereby, costs can be reduced. Another example is a structured warehouse and the elimination of chaotic warehouses. From a successful integration of BIS, the top management achieves the most benefits, as they receive important business data much faster based on a management information system and thus can carry out actions much faster. Regarding Office integration, interviewee F sees a more cutthroat competition, as for example CRM with its groupware functionality can replace Outlook to some extent. According to interviewee F, small update components are the basis for a successful update strategy. Workflows can optimize business processes of a company, even if the integration of different BIS (like for example ERP, CRM, PPS) already specifies a specific workflow in a company.
Interviewee F has made the experiences with his customers, that already existing customers are not completely convinced about the **cloud** whereas new customers decide to deploy their ERP-system within the cloud at 95 %. As main advantages, he mentions the unnecessary acquisition of the server infrastructure, the platform overlapping and that the customers can focus on their core competencies. As a main requirement, the company needs a well-functioning and powerful Internet connection. However, the cloud solution shall be designed in a way that they can also handle lower bandwidth rates, without crashing. For interviewee F, the cloud model is particularly suitable for small companies and Startups, which cannot afford to invest in initial hardware costs, and also for companies with several locations and branches. There are no real security and data protection risks. MyFactory, the ERP system in the portfolio of interviewee F, uses a high-security server in Cologne. Within MyFactory, there are some functional limitations between the on-Premise and the SaaS-based solution when it comes to PPS, otherwise, there are no other differences. However, there are differences regarding the customizability. Thereby the software is offered as a very cheap variant in the public cloud, whereby no customizations are possible. The private cloud variant, on the other hand, is more expensive but also customizable.

4.1.2.7 Interview G (DI (FH) Dominik Aigner / NAVAX Consulting GmbH)

For manufacturing companies, it is often difficult to consider the **integration** possibilities of the software system already in the selection phase, as they do not know the system well enough in order to get a feeling if the planned integrations can be realized or not. Beyond that, for the selection of BIS, a lot of other issues also must be considered. The integration of different BIS shall be as simple as possible for the end user. The user should only work in one system, within the leading system, which is often the ERP system, and should not permanently need to switch different applications. The triggers for a necessary integration of BIS are the establishment of a centralization and the definition of a leading system, which supplies other integrated systems but is also supplied by other systems. For

example, a manufacturing company often needs a CAD system, which cannot be done within an ERP system. Within the CAD system, the bill of materials is created. However, the bill of materials from the CAD system should not be manually inserted into the ERP system, it should be automatically imported via an interface. Finally, the goal is to use the purpose of the specific systems, but always in context with a leading system, which in most cases is the ERP system. The biggest challenge during the implementation is the finding of a mutual language between software vendors and customers. E.g. what a bill of materials is, what the leading system is etc. The main drawbacks of isolated applications are double data capturing, data discrepancy (e.g. one system has an item inventory of 10 pieces, another system has an item inventory of 15 pieces) and consequently no single point of truth and the flow of information is slower. Interviewee G has the opinion that many different departments in manufacturing companies can benefit from the integration, e.g. sales department with the Webshop-integration, the manufacturing department with the integration of PDM- or CAD-systems and the purchasing department with the integration of supplier portals.
According to interviewee G, the deployment of BIS goes towards **cloud**, but more slowly than the software vendors would like. The main advantages of SaaS-based BIS are less administration, e.g. if a server breaks down, you do not have to take care of such problems and you do not have to acquire expensive hardware. Based on the experiences of interviewee G, small companies are more interested in cloud-based BIS, mainly because of less initial and more scalable costs. The bigger the company, the more often cloud computing is denied because of concern decisions. Interviewee G believes, that cloud-based BIS have a higher level of security and data protection as on-premise installations in most small- and medium sized enterprises. Data centers employ experts in data security and they most likely have much more knowledge and expertise in that area as manufacturing companies. Even more, the implementation duration of cloud-based BIS will be reduced, mainly because software vendors will try to enforce standardization.

4.1.2.8 Interview H (Thomas Boogert / Secrid BV)

Secrid BV, which is a Dutch manufacturing company of wallets, uses Oracle NetSuite as their primary system whereby CRM, order processing, manufacturing, financial management, supply chain management and warehouse management are covered by NetSuite at Secrid. Beyond that, on the outside, they have some integrated systems with NetSuite, which are e-commerce Systems. They use the Canadian B2C eCommerce system Shopify[33] and the Dutch B2B e-commerce system CloudSuite[34]. After placing the orders in the e-commerce systems, they put the orders into NetSuite, process it in NetSuite and afterwards they have some further integrations that tell the e-commerce-systems that the shipment has been made and the customers are getting informed. Beyond that, they have integrations with a payment service provider and with delivery partners, e.g. FedEx. Thereby, all systems are highly dependent on each other. For example, once an order is processed and completely shipped in NetSuite, the invoice is created automatically. The goal of Secrid in all those integrations is to keep the work always in NetSuite. They have a backend for their e-commerce-systems, but due to the integration, no employee has to touch the e-commerce-system. Therefore, as a goal of their integration projects, they try to keep the administration work as much as possible in the ERP system NetSuite. According to interviewee H, **integration** is very difficult and highly depends on the available documentation of the involved systems. Another issue is that software providers often develop new capabilities, but the related web services do not keep up. They also made the experiences that integration within a cloud platform with on-premise systems can also

[33] https://www.shopify.com/ (Accessed 1 Mar. 2018)
[34] https://www.cloudsuite.com/en_US/platform/e-commerce (Accessed 1 Mar. 2018)

become quite complex. For that reason, they try to select only cloud software. There are three types of integrations. The first one is the out-of-the-box integration, which is the cheapest possibility but often not possible because of customized processes. Therefore, you need to expand this standard integration, which is the second option. And the third option, which Secrid mainly uses, is the usage of middleware software. Concretely, Secrid uses the middleware integration platform Dell Boomi[35], which also has a standard NetSuite connector. They found out that, in comparing to the first two integration options, the usage of Boomi results in higher flexibility and better maintenance. Even if integration possibilities have an influence on the selection of their BIS, interviewee H believes that it is almost impossible to see if the integration possibilities are good enough upfront. The triggers of why they started to integrate their systems are mainly scalability (as the company is growing very fast), performance and the data integrity. The department, which is able to do more stuff in less time thanks to the high level of integration, is the order-processing department. Right now, in 2018, they employ two FTE for order processing comparing to four FTE in 2015, but they have grown about 400 % since 2015. Based on their used integration platform Dell Boomi, they are also able to build workflows between the different business information systems.
Secrid uses **cloud**-based BIS as much as possible. They do not have some large servers running for business applications. Even their emails are stored in the cloud based on Office 365. According to interviewee H, they have many advantages connected with the cloud model. First of all, they do not need database experts internally. Other points worth mentioning are the speed of implementation, calculable maintenance costs and free updates. As for potential disadvantages, interviewee H mentions the non-existing influence on the performance of the system and that you have no control over the maintenance. However, interviewee H does not really see this as a disadvantage, because problems will be probably solved faster as companies could solve it by themselves. Interviewee H reviewed, that when having a supply chain as Secrid operates it, you could not work as efficiently as Secrid is doing it now if all your applications would be installed on-Premise. Regarding security and data protection, interviewee H believes that even if a hacker most likely tries to hack data centers more often as individual companies (as they get much more data), data centers are providing a much higher level of security as individual companies mostly can provide. The important aspect is the choice of the right cloud platform.

4.1.2.9 Interview I (Mario Engleder / Röchling LERIPA GmbH & Co. KG)

Röchling Leripa, a manufacturing company in the plastics industry, uses Microsoft Dynamics NAV as their main ERP system. Beyond that, they have QlikView[36] as a BI-system and Elo[37] as a document management system implemented. In the technical area, they have some further applications (CAD-, CND-system and so on) and also for payroll accounting, they have separated software systems in use. Within all those systems, integrations exist, as there are many dependencies. A standard sales process for example, beginning from the contacting, sales offer, order confirmation right up to the invoicing affects more than one system. In the near future, they are also implementing a separated CRM-System (Microsoft Dynamics CRM), in order to get a 360-degree view of customers.
Integration possibilities always have an influence on the selection of BIS, whereas the main factor for them is how the systems can be integrated organizationally. When they started to implement their BIS, they did not have a full integration at the beginning. Based on the lack of interaction among those systems they decided to integrate and adapt their systems seven years ago. Thereby, their strategy is to use certified Microsoft products as

[35] https://boomi.com/ (Accessed 3 Mar. 2018)
[36] https://www.qlik.com/us/products/qlikview (Accessed 3 Mar. 2018)
[37] https://www.elo.com (Accessed 4 Mar. 2018)

much as possible, in order to be able to use standard interfaces as much as possible and thus avoid some typical interfaces problems. Because in former integration projects they often had the problem of version incompatibility between different systems, which made updates of specific systems not possible. Other big challenges during the integration projects were data migrations and the required process changes. Another challenge is the adaptation of implemented systems due to changed market needs, which often also enforces a change of existing interfaces and integrations. The department to benefit the most since the integration of their BIS is the sales department, even if all other departments also gained some benefits due to the integration. However, there are still improvement potentials for the future. For example, customer information must currently be entered twice in some cases, as sales people are creating them within their local Outlook systems and later, if a business relationship is created, the customer information needs to be re-entered into the ERP system. This bottleneck shall be eliminated by means of a current process optimization project. Another improvement potential is the deeper integration of machine-data from the production into the ERP-system and later into the BI system in order to enable more reliable real-time reports.
Currently, Röchling Leripa is using no **cloud**-based BIS at all. Nevertheless, the reason therefore is only that the relevant products did not have the market maturity for the cloud at the time of selection some years ago. Meanwhile, interviewee I is aware of the gain of cloud services and is also not hostile to cloud-bases BIS anymore. Therefore, the upcoming CRM-system will be deployed as SaaS. Also exchange server and active directory will be implemented within the cloud. Interviewee I connects some advantages with cloud-based BIS, which are mainly the worldwide availability, the reduction of the local infrastructure and the much faster availability of services. Regarding the security and data protection, interviewee I has the same opinion as many interviewees before, that the security level of cloud-based BIS is very high meanwhile and that the risk of social engineering is much higher as technical security issues.

4.1.2.10 Interview J (Marcel Merz / Full Speed Systems AG)

Interviewee J works for an Oracle partner, which offers both, on-Premise systems like JD Edwards and cloud solutions like NetSuite. Interviewee J has experienced, that **integration** possibilities only play a medium priority when evaluating and selecting BIS. Companies mainly focus on functionalities rather than on technical issues like integration possibilities. Beyond that, people who are normally doing the evaluations often do not have the sufficient knowledge base in order to make a decision regarding integration capabilities. But interviewee J has also noticed, that integrations are necessary for each implementation, already starting at the beginning of projects when migrating legacy data. The main challenges during the implementation are, on the one side, the communication between customer and implementation partner, and, on the other side, the non-applicability of standard interfaces, as most companies have customized business processes. Even if isolated applications cause the known problems like manual and redundant data administration, they are also connected with a major advantage, which is the independency of the involved systems, which eliminates problems of version upgrades. Furthermore, the integration of systems also always implies an additional effort. On the other hand, through the integration of different BIS, companies are able to select specialized solutions in each area, which is also called a Best of Breed. Full Systems AG, the company of interviewee J, has the strategy to eliminate integrations as much as possible and to cover as much as possible within NetSuite. Within NetSuite, ERP and CRM is covered within one solution, for example. Beyond that, other popular software solutions like classical office products are merging more and more with NetSuite. Interviewee J perceives as potential reasons for isolated applications, if a company is not managed centrally and if different parts of a company are implementing their own solutions. For interviewee J, one of the main

advantages of NetSuite is the automatized release upgrade functionality. Different from on-premise solutions, it is not the customer who decides when an upgrade is done, it is NetSuite who makes this decision. Customers are informed about upcoming updates and can make tests in advance, otherwise they do not have to worry about the updates. The only problem is, if a company has many interfaces and integrations, because all of them need to be tested when doing upgrades. Therefore, Full Systems AG tries to eliminate integrations with foreign systems.
For interviewee J, it is very clear, that the trend of BIS goes unambiguously towards **cloud**. Actually, there are two main requirements for the deployment of a business software in the cloud. First, the company must be willing to store their business data externally. At manufacturing companies, they often have recipes and do not want to "publish" this data into the cloud. However, companies with this strategy are decreasing. The second factor is the network connectivity, especially if manufacturing companies have factories outside of cities or even in mountains. But also this circumstance is getting better and better and even more, NetSuite is able to work with very low bandwidths. The main advantage of NetSuite is the possibility to make developments and programing, thus, it is actually a PaaS solution. What is most important in this regard is the fact, that NetSuite guarantees that the implemented developments are also releasable which distinguishes it from most on-premise solutions, where you can damage your solution through wrong programing. Regarding security and performance, Oracle is offering different variants. Companies can choose high-availability, distributed among different data centers, or also cheaper variants within just one data center. Thereby, Oracle is expanding their data centers massively. In 2018 for example, 15 new data centers are planned which enable higher security standards as on-premise installations mostly can provide. When deciding to implement NetSuite, 24 hours after signing the contract, the full environment is available for the company. Thus, the implementation duration is reduced considerably.

4.1.2.11 Interview K (Anonymous)

The manufacturing electronics company, for which interviewee K is working as CIO, uses as main BIS the ERP-system and also the CRM-system from Microsoft, which are the products Microsoft Dynamics NAV and Microsoft Dynamics CRM. Beyond that, they operate some further individual software systems, which support and optimize the manufacturing business processes of the company. Between the ERP- and the CRM-system, it exists a dependency and therefore an **integration**. Sales quotes are created within the CRM-system and are finally transferred to the ERP-system as sales orders. The same happens for contacts in the CRM-system, which are converted into customers within the ERP-system. Thus, the integration is required due to the sales processes of the company, which affects both systems, and was a prerequisite of the company, in order to prevent redundancies and incorrect entries. Like other interviewees, interviewee K has experienced that the main challenge at the implementation of system integrations is the communication between all the involved parties, which are the software vendor, the IT department of the company and the key users of the company. On the one hand, the IT department of the company needs to identify the requirements of the key users, and on the other hand, the software vendor needs to understand the requirements of the IT department. The integration possibilities of the systems had a very high influence on the selection of the systems; therefore they decided to implement the ERP- and CRM-system from the same software provider (Microsoft), because standard interfaces already existed in that case. Thus, they eliminated isolated applications, even if they still have some of them, which are their individual software systems. However, they have already started projects in order to centralize also these business logics, in order to eliminate the multiple maintenance of systems. They also have a strong integration between the CRM-system and the collaboration software Microsoft SharePoint. Actually, all documents like sales

quotes, sales orders, etc. are stored within SharePoint. Another reason why they are operating both ERP- and CRM-system from Microsoft is the simplification of upgrades of both systems.
Regarding the deployment of BIS in the **cloud**, the company has a strict prohibition of cloud-based software. They have a corporate policy with the guiding principle “Company Data only on Company Devices”. Thus, the cloud has (currently) no relevance for them. The reasons therefore are mainly security reasons but also the new General Data Protection Regulation (GDPR). However, interviewee K would also see some benefits of the cloud model, mainly for the establishment of small plants, as no expensive infrastructure is required. He also recognized that nearly all software vendors are increasingly tending to the cloud deployment model and he is afraid that someday, you will be forced to change to the cloud because otherwise you eventually have functional limitations. But on the other hand, interviewee K still sees some security issues with the cloud model. First, that you cannot be totally sure, what really happens with your data and who can access it. He also sees problems in the obligation to produce proof and in the data leaving.

4.1.2.12 Interview L (Raimund Scheuringer, Thomas Kaltseis / Aspöck Systems)

Aspöck Systems GmbH, the company for which the interviewees L are working as team leader supply chain management and as CIO, is a manufacturing company in the car motif industry. The company uses their main BIS from SAP, which are SAP R/3 as ERP system, SAP EWM (Extended Warehouse Management) for the inventory management, SAP ME (Manufacturing Execution) for the production scheduling, SAP BW (Business Warehouse) as their data warehouse application and as basis for BI, SAP Business One as the ERP system for their sales branches in England and SAP HCM (Human Capital Management) for human resources management. On the other hand, they have no separated CRM system. Beyond that, they also apply software systems from other software providers, which are org.manager from Ingentis GmbH[38] and Talentmanagement from Infoniqa[39]. Apart from SAP Business One, which is currently applied as an isolated application, all the aforementioned systems have a strong **integration** with each other. SAP ERP, SAP EWM and SAP ME have an especially strong integration. For example, a new manufacturing order is created within SAP ERP, forwarded to SAP ME after being released, and from then the manufacturing order is handled in SAP ME and cannot be processed and edited in SAP ERP anymore. Thereby, SAP ME must also communicate with SAP EWM for the material staging. SAP EWM and SAP ME were implemented some years after SAP ERP and they have replaced a foreign software system from a different software provider with many tailor-made interfaces, which caused many problems and it was necessary to deviate from SAP standard processes. In order to close that gap, another SAP systems (EWM and ME) were implemented which enabled the usage of standard interfaces and standard integrations, which finally eliminated some problems, and optimized business processes within the company, mainly within the supply chain management department, which won the most benefits. Nowadays, the company has a high level of automation in the manufacturing, which would not be possible without the deep integration of those systems. Thus, the actual triggers for this integration were process optimizations and automation. A potential improvement for the future is the integration between the main ERP system and SAP Business One in the sales branches and thus the elimination of one of the last isolated applications within the company. Consequently, after creating a purchase order in SAP Business One, a sales order shall be automatically created in SAP ERP. For a better

[38] https://www.ingentis.de/ (Accessed 13 Mar. 2018)
[39] https://www.infoniqa.com/talent-management (Accessed 13 Mar. 2018)

cross-company integration of processes, which is difficult in some cases with SAP, the workflow management system K2[40] is currently being evaluated. Even if, due to the implementation of multiple different specialized software system, business process could have been optimized to a high level, the upgrade of the systems has been complicated, especially if the systems have different versions, which has happened because of a successively implementation of the different systems. Thus, a continuous release cycle is currently not possible and releases are done on demand. As the different SAP systems have also slightly different interfaces, the existence of an integration platform, an enterprise service bus, has relieved the implementation of the integration a lot.
As **cloud**-based BIS (SaaS), the company currently only operates Office 365 including Skype4Business. The reason why the company currently does not apply more cloud-based BIS is not a corporate policy, but the consequence of cost-benefit calculations. For example, as they selected SAP Business One as ERP system for their small companies, they also evaluated SAP Business ByDesign, but finally decided for the on-premise system SAP Business One because of cost-effectiveness considerations. Another problem, which they consider with cloud-based BIS, is the new GDPR, in combination with the license terms and online service terms of Microsoft as a cloud provider, for example. As a result, they have legal doubts. Regarding the technical security and protection, they believe that the Cloud allows a very high level of security.

4.1.2.13 Interview M (Mag. Jürgen Salaböck / NAVAX Consulting GmbH)

Integration possibilities are a very important factor when selecting and implementing BIS and are getting even more important in the future. Customers require a complete solution, if possible from one software provider. Thus, software providers, who offer integration platforms, which enable an efficient integration, will have competitive advantages in the future. The integration of systems mainly determines the further development and maintainability of systems. The triggers for a necessary integration are, on the one hand, the technology transitions. Companies have to integrate their systems in order to operate state-of-the-art, and, on the other hand, inner-organizationally process optimizations, because otherwise, there will also be some gaps, which need to be closed organizationally. Otherwise, the higher the integration level must be, the higher is the effort, both costs and time. Thereby, companies have to find a balance, which often also depends on the industry. Interviewee M has experienced in many different implementation projects, that communication is the main challenge during integration projects, mainly because there are different partners involved and the companies need somebody, who develops a total solution. Obviously, also the provided budget is essential at the implementation. But as already mentioned, the integration results in a value for the company and eliminates isolated applications. Isolated applications mean that multiple applications need to be maintained which results in higher costs for data capturing, IT infrastructure, maintenance contracts and reporting, as there is no consistent and accurate view of business data. However, in many companies the level of integration is not good enough in order to enable all required reporting. Therefore, an additional layer is put on the top, and in many cases, this is a data warehouse, which collects data from different applications. The required level of integration also highly depends on the company size (the bigger the company, the higher the required integration level). The advantages of the integration are the elimination of media disruptions, i.e. no data need to be converted or mapped between different applications. Another advantage, which has not been mentioned in the interviews up to now, is the fact, that organizational weaknesses in companies are revealed faster and more easily. The higher the integration, the more complex is the operation, as there are more dependencies and, in many cases, specific master data and setup data are required.

[40] https://www.k2.com/platform/workflow (Accessed 14 Mar. 2018)

The interviewee also identified some already-mentioned advantages like faster and more accurate data, faster processing, less paper consumption and so on. The fewer different systems, that are required, the better it is for a company, as this means less interfaces. Even if software vendors are providing even more and deeper integrations between their products, companies need to gauge, which products and integrations make sense for them and their business processes. According to interviewee M, the update-/release management is currently one of the most challenging topics concerning the maintenance of BIS. The market requires ongoing and automatic updates and release changes, which are much cheaper as they are currently in many cases. Especially if different integrated systems are in place, it may be necessary, to always operate up-to-date versions. Interviewee M believes that this will change a lot in the future, also in combination with the cloud.
The trend of the deployment of BIS is clearly towards **cloud**. Even if in Austria, or generally in Europe, we have some lags compared to the United States. What is more noticeable is that for manufacturing companies, it is often even more a challenge to switch their BIS into the cloud, because of many interfaces with hardware and specific machines. For professional service or financial service companies on the other hand, it is often more easily to change to cloud-based BIS. Another important factor is Internet connectivity. Equally as many other interviewees, interviewee M recognizes very good protection measures of cloud providers, even if such companies are a high potential target for attacks. In the future, there will be no functional limitations of cloud-based BIS. The question is rather, if the software provider is willing to offer the same functionalities in the cloud as on-premise. Regarding upgrade capabilities, the cloud-based versions will bring one of the greatest benefits as the implementation will be done in a way that automatic updates are possible, with less or no manual effort at all.

4.1.2.14 Interview N (Anonymous)

The company of interviewee N, a medium-sized company in the car motif industry, uses the ERP system Microsoft Dynamics NAV as their main BIS, which covers accounting, purchasing, sales, warehouse management, manufacturing, service, time recording and HR management. They are also using the NAV-integrated CRM functionalities and have further integrated an EDI- and car motif-module inside Dynamics NAV. The goal is to cover as many processes within one system, which is NAV in their case. In addition to NAV, they are also applying Microsoft SharePoint as a documentation tool, e.g. for quality management in order to have a verifiability of quality documents, and Microsoft Office 365 as collaboration tools. As can be seen from the used products, the strategy of the company is to use Microsoft products as much as possible. Within all the used modules of NAV and also with SharePoint, there exists a very deep **integration**, e.g., the development and research process within the company uses both systems very extensively. The integration possibilities of Dynamics NAV were the crucial factor why they decided to implement NAV in 2010. In order to achieve that level of integration, a well-functioning project management was the most important success factor for them, and not the software itself or the employees. Another main goal, as they started the implementation in 2010, was to completely prevent and eliminate isolated applications. For the future, their plan is to achieve a higher integration level of their manufacturing machines with Dynamics NAV. Currently, each department in the company has some benefits and added values because of the well-integrated systems. For example, the manufacturing department has a real time purchase price, they know exactly the progress, the costs and the completion date of a product at a particular time. Interviewee N explained two examples of how processes could have been optimized. First, the chemicals mixing unit, which is an essential machine for their manufacturing processes, is integrated with the ERP system Dynamics NAV. The machine gets the input data from NAV, which are stored in manufacturing bill of materials

in NAV and also contains the mixing times. After the manufacturing of the machine, an answer is sent to NAV where material consumptions are posted automatically. Consequently, considerably less correction postings are required, the stock management is more accurate, and process reliability has increased enormously. A second example is the EDI-integration with NAV. Thereby, blanket orders in NAV are created automatically because of EDI messages from the customers. Based on that, the creation of sales orders, planning, manufacturing, shipping and invoicing processes are launched automatically in NAV, which results in a much higher process automatization.
As **cloud**-based BIS, the company currently only uses Microsoft Office 365. However, interviewee N is impressed by cloud services, mainly by their easy management and the fact, that all employees always have the latest version. Thus, the deployment of their ERP system in the cloud would also be a possibility for them. The only doubt and prerequisite, that they have, is the availability. Because an outage of their IT and ERP system would have fatal consequences which must not happen at all. In the case of Office 365, this is not such a big problem, but in case of their ERP system an outage would mean that they could not continue the manufacturing. Otherwise, interviewee N is a big fan of cloud services. He also does not recognize higher security risks comparing to on-premise systems.

4.1.2.15 Interview O (Jana Lukic / Microsoft Austria GmbH)

Nowadays, technical **integration** possibilities have a quite high importance for companies compared to the past, where companies often selected BIS by department, e.g. they introduced the best-in-class manufacturing system for the production department relatively independent if and how far this can be integrated with other systems like for example a finance tool. Meanwhile, companies have realized that this is not an efficient way of working, especially if they consider digital trends like Internet of Things, which are enforcing that systems are integrated. Companies are more aware of that and therefore they are choosing the systems that are technically connected. On the other side, integration also has an organizational influence, mainly in terms of how people work together and if they have full transparency into other departments. For example, as a sales person you need to be fully aware of what is going on in the background, about the activities of the manufacturing department for example. Otherwise, the sales persons cannot address certain points with the customers because they do not know if this is actually feasible. Therefore, an integrated system is required. The main requirement of a company's management about an integrated system is the possibility to do an efficient, real-time reporting by means of dashboards based on information from all required systems. Additionally, often mentioned arguments are the increase in efficiency, better control of processes and information and the actual increase of success factors like KPIs. Much like the other interviewees, interviewee O sees both soft challenges, as each integration is connected with a change management process in a company and hard challenges, which is the actual technology. Manufacturing companies often have an IT landscape of 50 plus systems, which are not necessarily talking to each other, or they are integrated through complex integration tools. The technical challenge is to move away from such an approach to an integrated system, which is often also very costly. An exemplary process optimization through integrated systems in the optimization of the prospect-to-cash process of a manufacturing company. Integrated systems eliminate the scenario that the production team does not know what the sales team is doing and the sales team does not know what the marketing team is doing. Once a sales order is available, it can simply be forwarded. The production team already knows what kind of customers they are dealing with, what their preferences are, and they know what needs to be produced or what needs to be offered, if it is not an individual customer product. Once this has been done, it can go back to the finance department. This is still not the end of the process. After selling the product, service needs to be offered which goes back to sales, marketing and so on.

Regarding the integration between ERP and CRM, the sales history of the customer is most important, as this is the basis for cross- and up-selling opportunities. However, the reflection of CRM data within ERP can also be useful, especially open opportunities, so which products may be sold in the next quarter for example, as this may be relevant for the cashflow and forecast within the ERP system. In order to retain a sustainable system, the focus must be to be careful with customizations, which need to happen outside of the code and outside of the platform in order to enable easy and seamless updates, which should be done as soon as possible. Another important tool in order to connect different systems in terms of the information flow are workflow systems, as they are able to connect different systems and not only processes within individual systems.
Regarding the trend of **cloud**-based BIS, interviewee O has the same opinion as many other interviewees that a shift has happened in the last three years. Some years ago, there were many emotional fears about the cloud, which have decreased in the recent times, mainly because of the additional intelligence you can get out of it. The key decision manufacturing companies need to take when deciding about the cloud is what they want to achieve with their ERP or CRM system. If they are talking about a tool that is intended to help them save their data and finish their processes as they are, then they need not necessarily get immediate benefits out of the cloud. But if they are talking about intelligence and they want the system to give them information that they do not have, then we are talking about cloud computing. So, innovations like predictive production, predictive maintenance, anything that is based on machine-learning modules, are only possible with cloud technology. One of the main advantages of a cloud system and also the prerequisite of a cloud system is that a standard system remains, that you are not changing the standard code of the system. Customizations need to be done outside of the platform, which means that you are eligible for easy and seamless updates. Thus, updates are done more often and automatically, which is also, however, sometimes perceived as a disadvantage and emotional pressure for some companies. Based on this, the implementation duration is much faster comparing to on-premise installations. Interviewee O states, that in case of Microsoft, cloud-based BIS have already functional advances comparing to the on-premise solutions, and this gap will even more increase in the future.

4.1.2.16 Interview P (Anonymous)

The company of interviewee P, a big international company in the telecommunication industry, which also has a manufacturing department, is equipped with a big IT landscape with many software systems. Thereby, the main BIS, which all have integrations among each other, are Microsoft Dynamics NAV as a group-wide ERP-system, Microsoft Dynamics CRM as CRM-system, IBM Cognos TM1[41] as a planning- and BI-system, Microsoft SharePoint and the document management software systems Pro.File[42] and DocuWare[43]. Even if they have a separated ERP- and CRM-system, the two systems are not integrated, as this is not required because of the business model of the company and due to a small number of customers. According to interviewee P, the **integration** of systems always has implications to the organizational processes, even if they are often not visible in advance. That is also the reason, why they still have some lacks of integrations, as they would also require adaptions of their business processes, which is often not so easy. But they are aware of the negative consequences of isolated applications, which they perceive as dual maintenance and data discrepancies. Current examples of dual works are the data maintenance of users or cost centers, which need to be done within several systems. Other reasons of why an integration of their BIS is necessary for them are mainly changes of the business model and changes of technologies. They also operate a

[41] https://www.ibm.com/at-en/marketplace/cognos-tm1 (Accessed 19 Mar. 2018)
[42] https://www.procad.de/produkte/pro-file/ (Accessed 20 Mar. 2018)
[43] https://start.docuware.com/ (Accessed 21 Mar. 2018)

dedicated data warehouse, which enables them reporting based on different data sources. Currently, the only desired report, which they cannot fulfill, is the stock of inventory across the whole group. When they developed the international template for all their entities, even if they made lots of customizations, they always took care of not changing the core standard functionality in order to sustain the support- and release capability.
The company currently does not use any **cloud**-based BIS, even if they are aware of the trend and will also take it into account in the future (e.g. they are currently planning to change their Exchange Server to a cloud service). There are some reasons why cloud-based BIS currently do not have a high relevancy for them. First, it is often not possible because of their strict information security policies. Other criteria are the limited customization possibilities, the costs and the possibility to maintain the system. Interviewee P does not see big benefits of the cloud for their company, as it provides the main power and infrastructure in order to deploy the systems on-premise and thus they can also protect themselves in a good manner. Otherwise, for small companies, interviewee P believes that cloud-based systems can provide a higher level of security and data protection.

4.1.2.17 Summary of key statements

After summarizing each conducted interview, the author made an **interview content analysis**, which compares and contrasts the opinions of the interviewees regarding the key topics. The basis for the interview content analysis is a category system as defined by Mayring (Hienerth, Huber and Süssenbacher, 2009, p.131). According to Kuckartz, the definition of the evaluation categories can be either done inductively out of the interview data or deductively based on a theoretical approach. In this thesis, the author did an inductive category formation as the two categories were defined based on the interview guide (Kuckartz, 2010, p.202 pp.).

#	Category	Description
C1	Integration of business information systems	This category investigates the integration of multiple different business information systems, and also the integration within individual BIS. Thereby, factors like requirements, triggers, challenges, achieved process optimizations, related problems with version upgrades, etc., are analyzed and investigated.
C2	Application of business information systems in the cloud	This category investigates the application of business information systems in the cloud (as SaaS). Factors like advantages, disadvantages, prerequisites, security risks, functional and customizing limitations and the consequences of the cloud for implementations and upgrades are analyzed and investigated.

Table 5: Evaluation categories of interview content analysis

Within the two categories, the author further divided them into more detailed sub-categories. As the number of sub-categories for both categories would be too high in order to depict all of them within one table, two separated tables for the two categories are created. If an interviewee could not give an answer to a specific question, the corresponding cell in the tables below is marked with n.a. (not answered).

Sub. #	Influence on selection	Require-ments	Triggers	Challenges	Problems of isolated applications	Process optimiza-tions	Most benefiting department	ERP-/CRM data availability	Office Integration	Version upgrades	Work-flows
A	Very high	Low/easy maintenance, fast decision	Customers, process optimizations	First-time definition, maintenance	Duplication of efforts, redundancy	Internet Of Things	Accounting	Addresses, outstanding items	Pre-requisite	Usage of standard interfaces	Currently not existing
B	Very high, depends on case	Robust, error managem., monitoring	Business processes	Integration technologies (APIs, etc.)	Isolated systems are no option	N.a.	Backoffice	Stocks, outstanding items	Should be standard functionality	No problems (NetSuite)	Available
C	Often too low	Low TCO, fast information	Business processes	Availability of standard APIs	Lack of decision fundamentals	Reduction of TCO	Accounting, Controlling	Outstanding items, sales history	Easy distribution of files	Included in license, SKD	No functional reliability
D	Very high, reason for selection	Full integration possibilities	Warehouse management problems	Superordinate person, Go-live on day X	Prohibited in the company	Automatic warehouse handling	All departments	No separated ERP / CRM	Excel for data transfer	Every two years	Announc-ed feature of ABAS
E	Main reason for IT projects	Consistent figures	Exact figures, e.g. capacity	Exactness	Costly check of validity of data	Capacity planning	Finance and Controlling	Sales history of customers	Can help in many use cases	Docu-mentation	Independ-ent of data
F	Prevent-ion of media disruption	Real time information, few trainings	N.a.	Communicat-ion SW vendor and customer	Platform limitation	Central purchasing	Top management	Customer master data	Cutthroat competition	Small update comp.	Competi-tive factor
G	Medium priority	Easy handling, one UI	Automation, centralization	Finding of a common language	Double data capturing, no SPOT	Improved detailed planning	All departments	Sales history of customers	Ongoing improve-ments	Only one place for changes	N.a.
H	High, but difficult to consider	Administra-tion work in one system	Scalability, performance, integrity	Every integration is different	They have no isolated applications	Automated order processing	Order processing	N.a.	Barely used	N.a.	Dell Boomi
I	In the past not, by now high	Consistent products (Microsoft)	Non-interaction of different BIS	Version compatibility, data migration	They have no isolated applications	Faster information flow	Sales department	N.a.	Standard functionality is used	Certified standard systems	Invoice approvals
J	Medium priority	Modern technologies	Business processes	Communicat-ion, Project management	Manual and redundant data admin.	Best of breed applications	Management	No separated ERP / CRM	Outlook and Excel often used	Interfaces must be tested	Available in NetSuite

K	Very high	System compatibility, standards	Sales business processes	Communicat-ion	Redundancy, incorrect entries	Elimination of multiple maintenan-ce	Sales department	Sales history of customers	CRM with SharePoint	Certified standard systems	Not within their BIS
L	In the past too low	Consistent products (SAP)	Automation, process optimization	Ongoing maintenance	Double data capturing in R/3 and B1	Automation of manu-facturing	Supply Chain Management	No CRM system in use	SAP standard functionality	Complex-many interfaces	In evaluation
M	Very high	Further development, maintainabili-ty	Technology, process optimization	Communicat-ion, total solution	Higher maintenance costs	Elimination of media disruptions	Depends on the company	Contacts, sales quotes	Deep integration at MS products	Ongoing and automatic	Required for full integrat-ion
N	Very high, reason for selection	Consistent products (Microsoft)	Quality management (verifiability)	Project management	Less process reliability, error-prone	Accurate stock, automation	All departments	N.a.	Deep integration at MS prod.	Should be automatic	Invoice approvals
O	Getting higher	Efficient working / reporting	Digital trends like IoT, transparency	Change management, technologies	Less efficiency, no transparency	Prospect-to-Cash-process	Customer phasing departments	Sales history, open opportunities	Basis for efficient working	No change of standard	System overlapp-ing
P	Very high	Efficient maintenance, process alignment	Changes of business models / technologies	Alignment of organizational processes	Dual maintenance, data discre-pancies	Data maintenan-ce, e.g. Item Master	Administrati-ve depart-ments (FI, CO, SCM)	No integration required	SharePoint, Excel imports and exports	No change of standard	Not within their BIS

Table 6: Interview content analysis C1

Sub. / #	**Trend / influence**	**Advantages (+) disadvantages (-)**	**Better (+) / worse (-) suitable**	**Prerequisites**	**Security / data protection**	**Limitations functionality**	**Limitations customizing**	**Upgrade capabilities**	**Implemen-tation duration**
A	Must be considered	+ Anytime,-where - functional limitations	+ Small companies - sensible data	Company size, region, stationarity	Not higher than on-premise	Usability, performance	Limited possibilities	Better, as less customizing	Faster, as more standard
B	Ongoing and uninterrupted	+ Upgrade capability	- Warehouse management, POS	Internationality , fast growing	Not higher than on-premise / US	No limitations at NetSuite	No direct access to DB	Full upwards compatible	No differences
C	Ongoing and uninterrupted	+ Lower TCO - lock-in effect (+ for vendor)	No differences	Distributed companies	Not higher than on-premise	Depends on product/vendor	No access to Source code	Better as for on-Premise	Much faster (factor 3)
D	Not possible for company	N.a.	N.a.	Technical infrastructure, bandwidth	Many concerns of the employees	N.a.	N.a.	N.a.	N.a.

E	Yes, but slowly.	N.a.	- Sensible data - high availability	Different workloads	Confidence-building actions	Usability	Limited possibilities	Automatic (negative?)	Slightly faster
F	New customers tend to cloud	+ No infrastructure + multiple platforms + focus core comp.	N.a.	Good internet connection, distributed	Not higher than on-premise	Some limitations for PPS	No customiz. for public cloud	No differences at myfactory	No differences
G	Yes, but slowly.	+ Calculable costs + less administration	- Realtime applications	No political concern decisions	Better security as on-premise in most SME	N.a.	N.a.	N.a.	Slightly faster
H	Extensive use of cloud-based BIS	+ Fewer experts required, speed - Less control	N.a.	N.a.	Higher hazard of hacking, but better security	N.a.	N.a.	N.a.	Faster
I	Ongoing and uninterrupted	+ Worldwide available, faster implementation	N.a.	Market maturity	Not higher than on-premise	No limitations, even more functionality	N.a.	N.a.	Faster
J	Ongoing and uninterrupted	+ Faster implementation + no infrastructure	Depends on program architecture	Network infrastructure, data strategy	Better security as on-premise	No limitations	No limitations as PaaS solution	Automatized, full releasable	Faster
K	Ongoing / no relevance for them	+ No infrastructure - security issues	N.a.	Corporate policy	Obligation to produce proof, data leaving	N.a.	N.a.	N.a.	N.a.
L	Ongoing / increased relevance	+ No infrastructure + higher security levels	N.a.	Cost-benefit calculation	Legal issues with GDPR	N.a.	N.a.	N.a.	N.a.
M	Ongoing and uninterrupted	+ Higher security levels + cost optimization	+ Service company - manufacturing companies	Network / machine infrastructure	Higher hazard of hacking, but better security	Gap will be closed in future	Gap will be closed in future	One of the greatest benefits.	No differences
N	More relevance in the future	+ Easy management + always up-to-date	+ Office application - business critical processes	Availability	Not higher than on-premise	N.a.	N.a.	N.a.	N.a.
O	Shift since some years towards cloud	+ Enables intelligence + seamless updates	+ CRM - ERP General: technical architecture	Depends on what wants to be achieved	Reduced risks when selecting right provider	Advanced functionality (even more in future)	No change of standard code / platform possible	More often automatic updates	Much faster
P	More relevance in the future	N.a.	- Big companies with own IT departments	Security, customizing, costs	Depends on company size / infrastructure	N.a.	Limited possibilities	N.a.	N.a.

Table 7: Interview content analysis C2

4.2 Criteria catalogue

According to Oppmann et al., **criteria assessment methods** are used to evaluate specific criteria of software systems. One of the criteria assessment methods defined by Oppmann et al. are **guideline-oriented evaluation methods**. Thereby, software systems are evaluated by means of a pre-defined criteria catalogue, which is also used by the author at this Master Thesis (Oppmann et al., 1992).

This chapter presents this criteria catalogue, which will be used as a basis for the evaluation of the selected systems (chapter 4.3.1.3) afterwards. The tabular summary of this evaluation can be found in chapter 4.3.3.

4.2.1 Foundation

Generally, various criteria catalogues for the evaluation of BIS are available. However, as the author analyzed a very specific topic (the integration of BIS and the application in the cloud), no dedicated criteria catalogue could be found in the literature regarding this topic. Thus, based on the main insights of the **expert interviews** (chapter 4.1) and further **literature research**, the author created a new criteria catalogue about the most important success factors of cloud based integrated business information systems. In the description of each criterion in chapter 4.2.3, a reference to the related expert interviews or further literature is made. Thereby, the author tried to include not only functional criteria, but also economic and subjective user opinions. The author put the focus on a big picture about what is most essential and not on a deep analysis of detailed criteria.

Additionally, the author considered international software quality models. According to the literature, different models exist (McCall, Boehm, Dromey, ISO 25010, etc.), but the **ISO 25010** standard is the most complete one (P. Miguel, Mauricio and Rodríguez, 2014, p.48) and therefore it will also be considered for this Master Thesis. ISO 25010, which replaced the former ISO 9126-1:2001, is an international standard for quality criteria of Software and Software Engineering. This ISO standard "*can be used to identify relevant quality characteristics that can be further used to establish requirements, their criteria for satisfaction and the corresponding measures*" (ISO/IEC, 2011, p.1). The scope of the standard defines a "quality in use model" and a "product quality model". The "quality in use model" is composed of five characteristics (including sub-characteristics) that corresponds to the outcome of interaction when a system is used in a specific context of use. The "product quality model" (including sub-characteristics), on the other hand, is composed of eight characteristics that correspond to static features of software and dynamics features of the computer system. All these characteristics and sub-characteristics supply coherent terminology for specifying, measuring and evaluating system and software product quality. Additionally, they offer a set of quality features against which stated quality requirements can be evaluated for completeness (ISO/IEC, 2011). Within this Master's Thesis, only the characteristics of the "Product quality model" will be considered, which are depicted in Figure 18. Some of the criteria, which the author identified during this Master's Thesis (see chapter 4.2.3), are quite similar to the criteria of the ISO 25010 standard. Some of the criteria, on the other hand, are very specific regarding the main topics of this Thesis and therefore they are rather sub-criteria and extensions of the ISO 25010 criteria. This is also the reason why the author did not completely apply the ISO 25010 criteria as foundation for the criteria catalogue of this work, as the ISO 25010 criteria are generally valid and not specifically defined for the integration and cloud capabilities of BIS. However, within the description of each criterion in chapter 4.2.3, a reference to the related and appropriate characteristics / sub-characteristics of the ISO 25010 standard, if possible, was made. A definition of each characteristics can be found on the official ISO homepage.

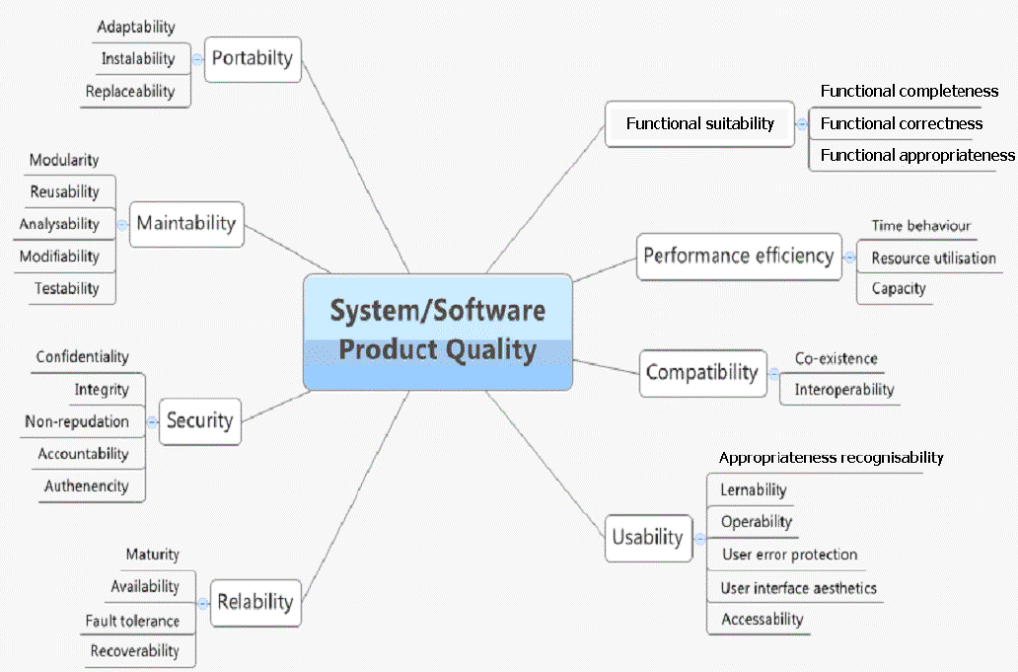

Figure 18: The ISO/IEC 25010 classification of product quality (Werewka, 2015, p.7)

4.2.2 Evaluation criteria

Within the criteria catalogue, depending on the criterion, three types of scales will be used: a nominal scale, a cardinal scale and an ordinal scale.

For the criteria, which are evaluated based on a **nominal scale**, the criteria are evaluated with 1 or 0. 1 means that the functionality is available (“criteria fulfilled”) and 0 means that the functionality is not available (“criteria not fulfilled”).

The evaluation of criteria of a **cardinal scale** on the other hand, will be done with the following points:

- 0 points: the functionality is not available at all (possible extensions are not considered).
- 0.5 points: functionality is possible with workarounds.
- 1 point: functionality is fully available.

For the evaluation of **soft criteria**, a grading by marks is done (**ordinal scale**). Thereby, the mark 5 means no points, the mark 4 will lead to 0.4 points, the mark 3 means 0.6 points, the mark 2 results in 0.8 points and finally for the mark 1 it will result in 1 point.

4.2.3 Definition of the criteria

The criteria catalogue can be divided into two parts:

- **Functional criteria**: they comprise functionalities and features, which can be directly assigned to a specific software system.
- **Non-functional criteria**: they comprise functionalities and features, which cannot be directly assigned to a specific software system.

In the following two sub chapters, the functional and non-functional criteria will be described including a definition of how the evaluation of each criterion will be done and a reference to the related ISO 25010 characteristics / sub-characteristics (ISO/IEC, 2011).

4.2.3.1 Functional criteria

C1: Limitations of functionality comparing to the on-premise variants	
Description:	This criterion determines if the SaaS-based business information systems have any major limitations in the functionalities comparing to the on-premise variants. This includes main functionalities, which are available for the on-premise systems but not available for the cloud versions. Other cases, e.g. different usability of specific functions, will not be regarded as limitations. The expert interviews resulted in different opinions regarding this criterion.
Evaluation:	This criterion is evaluated with marks. 1 means that there are no limitations at all, 5 means there are very big limitations.
Reference to ISO 25010:	Functional Suitability (Functional Completeness)
C2: Standard Interfaces	
Description:	The purpose of this criterion is the verification of whether the software vendor provides out-of-the-box standard interfaces and integration capabilities between the different types of business information systems, which were analyzed during this Master Thesis (ERP, CRM, BI, and Collaboration) which means that no custom-made interfaces must be developed. According to interviewee A, only standard interfaces enable a long-term sustainable system. Interviewee C confirms this by stating that the existence of standard APIs is an essential aspect at the implementation of integrations. Interviewees H and I have the same opinion and state that out-of-the-box standard interfaces are always the cheapest integration possibility and prevent typical interface problems.
Evaluation:	The evaluation of this criterion will lead to 1 point, if standard interfaces for all four defined types of business information systems exist, 0.5 points if only partially standard interfaces exist and 0 points if no standard interfaces exist at all.
Reference to ISO 25010:	Compatibility (Interoperability)
C3: Mobile Access (Web-/Phone-/Tablet client)	
Description:	The possibility to access the different types of business information systems through a web browser will be checked by this criterion. Therefore, it will not be taken into account if in some cases only specific web browsers are regarded. Similarly, it will be examined if a mobile access (anytime, anywhere) with all common types of mobile devices like Smartphones or Tablets is possible (Engebrethson, 2012). Such a mobile access is, for many interviewed manufacturing companies, currently not possible, even if they would like to have this possibility.
Evaluation:	The availability of a web client and a mobile client for all analyzed types of business information systems will result in 1 point. If only specific business information systems (e.g. only the ERP-System, but not the CRM-system) can be accessed with a web-/mobile client, then 0.5 points will be graded and if no analyzed systems at all provides a web-/mobile client, it will lead to 0 points.
Reference to ISO 25010:	Usability (Accessibility) Reliability (Availability)

C4: Dashboards based on information from different business information systems	
Description:	It will be proved if it is possible to create out-of-the-box dashboards and other types of BI-reports containing information from other business information systems (mainly ERP- and CRM-system) in order to run a business in real time with live dashboards. Interviewee A claims that the management requires a platform that enables quick management decisions. For example, in many manufacturing companies, a very important figure is the capacity (see interview E) or for interviewee N, it is important to know exactly the progress, the costs and the completion date of a manufacturing product at a particular time. A graphical display of such information is very beneficial for decision makers. This is confirmed by interviewee O, who states that the main requirement of a company's management about an integrated system is the possibility to do an efficient, real-time reporting by means of dashboards based on information from all required systems.
Evaluation:	If dashboards based on information from different BIS can be created out of the box, it will lead to 1 point. If workarounds (e.g. installation of additional add-ins, etc.) are necessary 0.5 points and otherwise 0 points.
Reference to ISO 25010:	Maintainability (Analyzability)
C5: Office-/collaboration integration	
Description:	This criterion inspects whether there exists a seamless integration between ERP-/CRM-system and collaboration software systems like Microsoft Word, Excel and Outlook. According to interviewee A, the integration of BIS with office products is a pre-requisite. The detailed analysis of which integration functionalities exactly are available would go beyond the scope of this work. As a representative business case it will be checked if it is possible to see business data from ERP/CRM (e.g. customer data, product data, sales history) directly in Outlook, but also the possibility to perform business transactions within the ERP- or CRM-system, e.g. the creation of a sales quote directly from Outlook. Furthermore, it will be verified, if an integration with Word and Excel is generally available with the possibility to access live data directly from Excel to update ERP- or CRM-data and to customize outgoing documents such as quotes and invoices in Word. According to most interviewees, classical office products are merging increasingly with BIS like ERP- or CRM systems.
Evaluation:	If the described functionality is possible out of the box, it will lead to 1 point. If workarounds (e.g. installation of additional add-ins etc.) are necessary 0.5 points and otherwise 0 points.
Reference to ISO 25010:	Compatibility (Co-existence)
C6: Limitations of customizability comparing to the on-premise variants	
Description:	No two manufacturing companies are alike; therefore, possibilities to customize and configure the software systems are required. Therefore, this criterion shall inspect whether there are limitations regarding the customizability and configurability of the cloud-based business information systems comparing to the on-premise variants. Thereby, one question for example is, if the development environment of the system is also part of the cloud, as with NetSuite for example, according to interviewee B. During

	the expert interviews, different opinions have been recognized. According to interviewee C, for example, there must be a difference, as the source code is not available for the cloud solutions. Interviewee J on the other hand claims, that in case of a PaaS solution like NetSuite, no limitations regarding customizability exist compared to on-premise systems. Interviewee F states, that this depends on the subscription fees.
Evaluation:	This criterion is evaluated with marks. 1 means that there are no limitations at all, 5 means there are very big limitations.
Reference to ISO 25010:	Portability (Adaptability)
C7: User friendliness	
Description:	As the user-friendliness of software systems also depends on user preferences the author will mainly review with this criterion, if the different business information systems (mainly ERP- and CRM-system) have a consistent user interface. Consequently, IT and training overheads can be reduced. Interviewee A states that the end user wants an easy to use system. Interviewee F also claims that the user wants to learn only one system. According to interviewee E, there are still some limitations in the user interface of SaaS-based BIS because of the operation in the Web Client. This issue will also be considered in the evaluation of this criterion.
Evaluation:	This criterion is evaluated with marks. 1 means that there is a very high consistency of the user interface between the different systems, 5 means that the consistency is very low.
Reference to ISO 25010:	Usability (Appropriateness, Recognisability, Learnability, Operability)
C8: Integration / development platform	
Description:	By means of this criterion, the author will consider the integration and development platform, which is provided by the analyzed software vendors. Actually, it will be investigated, as to how this integration platform enables a flexible and low-effort integration of additional cloud services and systems, which may be beneficial for the manufacturing company. Another factor, which will be analyzed, is whether the development environment of the product is also part of the cloud, which is very essential according to interviewee B. According to interviewees F, L and M, the existence of an integration platform simplifies the integration of different systems a lot. The access to advanced technology is also taken into account (Saugatuck Technology Inc., 2009).
Evaluation:	This criterion is evaluated with marks. 1 means that there is a very powerful integration and development platform, 5 means that the integration platform is very poor or does not exist at all.
Reference to ISO 25010:	Portability (Installability) Compatibility (Interoperability)
C9: Consistent availability of material information	
Description:	It will be checked, whether important information about materials like stock, prices, etc. can be made available in both the ERP- and CRM-system and eventually in other involved systems. Thereby, the definition of which information exactly should be synchronized shall be parameterizable within the software. According to interviewee D, the lack of stock loyalty was one of the main reasons why an integration of their systems and

	material information was necessary. Interviewee G confirms this and states that a single point of truth of material information is very important for companies, there should be no data discrepancies.
Evaluation:	This evaluation of this criterion will lead to 1 points if this configuration can be done out of the box, to 0.5 points if workarounds are necessary and to 0 points if this scenario is not possible at all.
Reference to ISO 25010:	Functional Suitability (Functional Correctness)
C10: Direct conversion of sales offers into sales orders	
Description:	Thereby, it will be checked if it is possible to directly and seamlessly convert sales offers from the CRM-system into released sales orders within the ERP-system which is a typical sales process in many companies, e.g. in the company of interviewee K.
Evaluation:	This evaluation of this criterion will lead to 1 point if this scenario can be done out of the box, 0.5 points if workarounds are necessary and 0 points if this process is not supported at all.
Reference to ISO 25010:	Functional Suitability (Functional Appropriateness)
C11: Real time data visibility of information between ERP- and CRM-system	
Description:	According to interviewee A, integrated CRM functionalities within ERP systems often only cover limited functionalities. Therefore, separated and specialized CRM systems are often necessary. Sigala states that the integration of CRM with SCM and ERP enables a faster response to customer demand (Sigala, 2004, p.6). Interviewee I confirms this, therefore his company has recently decided to implement a CRM system additionally to their ERP-system. The goal of this criterion is to examine if it is possible to access CRM-data from the ERP-system and vice versa, which is, apart from some exceptions (e.g. because of the business model as for interviewee P), required in order to eliminate dual data maintenance. Thereby, the following business cases will be verified (based on the statements of the interviews): • CRM system has access to information about product stocks, customer financials (outstanding items), customer sales history (e.g. for sales activities and campaigns), order delivery status and pricing information from the ERP system (Litan et al., 2011, p.252). • ERP system has access to information about sales opportunities and sales quotes from the CRM system, which facilitates the demand planning.
Evaluation:	This evaluation of this criterion will lead to 1 point if this scenario can be done out of the box, to 0.5 points if workarounds are necessary and to 0 points if this process is not supported at all.
Reference to ISO 25010:	Reliability (Availability) Maintainability (Modularity)
C12: 360-degree view of customers from different business information systems	
Description:	It shall be possible to make a 360-degree view of customer information from within the ERP-, CRM- but also collaboration systems like Outlook. This reduces manual lookups in different systems in order to get an overview about the most important information of a customer. It will also be checked if contacts and customers are integrated and consolidated or if

	there are two different locations where users need to look for customer/contact information and also where users need to enter and update this information. Interviewee C states that users want to see all relevant customer information with one click, even if they come from different systems.
Evaluation:	If the above specified scenario is possible as described this criterion will be evaluated with 1 point, if it is only partially possible it will lead to 0.5 points and otherwise to 0 points.
Reference to ISO 25010:	Reliability (Availability)
C13: Support of workflows	
Description:	In order to improve and optimize the communication and interaction between different BIS, by means of this criterion the author controls if the software vendor provides tools which can be used to create workflows between the different BIS, e.g. for alerts and notifications. Interviewee F, O and other interviewees confirm that workflows can optimize business processes and the integration of different systems within a company. For the company of interviewee L, a workflow engine is required to enable a cross-company integration of processes, as the company has several companies and branches across the whole world.
Evaluation:	If the software vendor provides such an integrated workflow engine, this criterion will be evaluated with 1 point, otherwise 0 points will be the result for this criterion.
Reference to ISO 25010:	No appropriate characteristics
C14: Integration with document management system (DMS)	
Description:	As a last functional criterion, it will be checked if a seamless integration of business information systems like ERP- and CRM-system with DMS (e.g. Microsoft SharePoint or Microsoft OneDrive for Business) is possible. E.g., for the storage of specific manufacturing documents. For interviewee K, the operation of their CRM-system is only possible together with their DMS-system, in order to store all required documents. According to interviewee N, an additional DMS system, integrated with their ERP-system, is necessary in order to fulfill the verifiability of their quality processes and documents.
Evaluation:	If the software vendor provides such an integration, this criterion will be evaluated with 1 points, otherwise 0 points will be the result for this criterion.
Reference to ISO 25010:	Compatibility (Interoperability)

Table 8: Definition of functional criteria

4.2.3.2 Non-Functional criteria

C15: Subscription fees	
Description:	Obviously, the regular subscription costs are only a part of the total costs of software implementation projects (which is finally the decision factor for the selection). Interviewee C states that the main requirements of companies regarding the integration of systems are little total cost of

	ownerships (TCO). In any case, for the comparison in this Master Thesis, only the current valid subscription fees of the analyzed software systems and no further implementation costs, which make up the TCO, will be regarded.
Evaluation:	As software systems from three different software providers will be evaluated and compared, the lowest subscription fees will lead to 1 point, the second lowest subscription fees to 0.5 points and the most expense subscription fees to 0 points. The evaluation of this criterion will be done based on an Internet research.
Reference to ISO 25010:	No appropriate characteristics
C16: Online documentation	
Description:	The existence of publicly available online documentation for the different business software systems will be verified. According to interviewees D and H, the integration of different systems is very difficult and highly depends on the available documentation of the involved systems.
Evaluation:	If an online documentation is available, this criterion will lead to 1 point, otherwise to 0 points.
Reference to ISO 25010:	Usability (Learnability)
C17: Information security and data protection	
Description:	This is a very important criterion for cloud-based services and currently many manufacturing companies consider this criterion as a main barrier why they are not deploying their BIS in the cloud. The company's business data may not be accessed by unauthorized people on the network and within an organization (Mahara, 2013, p.369). Manufacturing company's data also needs to be backed up with a reliable recovery plan. The question is how the cloud vendor protects the business data. Therefore the level of encryption, authentication, security of data center facilities, etc., need to be considered (Misra, 2017, p.12). A detailed analysis of this criterion would go beyond the scope of this work. Therefore, the author will generally review the adopted measures of the three different software vendors how they realized information security and data protection. According to most interviewees, even if a hacker most probably tries to hack data centers more often as individual companies (as they get much more data), data centers are providing a much higher level of security than individual companies mostly can provide.
Evaluation:	This criterion is evaluated with marks. 1 means that the level of information security and data protection is very high, 5 means that the level is very low. The evaluation of this criterion will be done based on an Internet research.
Reference to ISO 25010:	Security (Confidentiality, Integrity, Non-repudiation, Accountability, Authenticity)
C18: Performance and availability	
Description:	One important aspect when operating cloud-based business information systems is the performance considering fluctuating network and server load (Mahara, 2013, p.369). As the performance enforces a holistic approach and depends on many factors (network performance etc.) a detailed analysis will not be done. According to interviewee B, the

	integration between different BIS must work robustly and must have an error management. It will also be controlled, if the SaaS-services are provided without interruption and loss of data which is very important for the productivity of manufacturing companies (Mahara, 2013, p.369). E.g. for interviewee N the availability of the cloud services is the main pre-requisite, because an outage of their ERP system would result in fatal consequences as the manufacturing would be completely stopped. The author will examine some reports, which tried to measure the performance of cloud providers, uptime guarantees and further reference stories and content analysis. For interviewee D, cloud-based BIS are not possible within his company, because the bandwidth is not high enough. Interviewee J on the other hand states, that modern cloud-based systems are able to operate with very low bandwidths.
Evaluation:	This criterion is evaluated with marks. 1 means that the performance and availability is very high, 5 means that the performance and availability is very low. The evaluation of this criterion will be done based on an Internet research.
Reference to ISO 25010:	Performance Efficiency (Time-behavior, Resource Utilization, Capacity)
C19: Upgrade capability	
Description:	Engebrethson claims that rapid updates and upgrades of cloud-based services may be a very interesting aspect for manufacturing companies (Engebrethson, 2012). This results in quicker response to innovation and new features. Thus, the deployment cycles and the efforts and costs for these updates provided by the analyzed software vendors will be investigated (Technology Evaluation Centers, 2016). What also needs to be considered in this context is the migration of customizations. Misra argues, that customizations and interfaces must automatically migrate with every upgrade, enabling companies to customize with confidence (Misra, 2017, p.10). These statements were also confirmed by many expert interviews. E.g., interviewee M claims, that the upgrade-/release-management is one of the most important factors in the maintenance of systems. Interviewee B and J claim that it must be possible to make customizations and developments, which are upwards compatible at upgrades and releases. According to many interviewees, e.g. interviewee B, the upgrade capability is one of the greatest benefits connecting with the deployment in the cloud, as cloud-based BIS often provide automatic updates. It will also be checked if only automatic updates are possible, or if still also manual updates are an option, as according to interviewee E and O, some companies may not be satisfied with automatic updates of their BIS.
Evaluation:	This criterion is evaluated with marks. 1 means that the upgrade capability is very high, 5 means that the upgrade capability is very low. The evaluation of this criterion will be done based on an Internet research.
Reference to ISO 25010:	Maintainability (Reusability, Modifiability)
C20: Implementation duration	
Description:	Utzig et al. state that cloud-based solutions can significantly reduce deployment times comparing to the on-premise variants (Utzig et al., 2013, pp.6–7). According to interviewees A and O, this is mainly because more

	standard functionality is used. Interviewee C confirms this and states that the implementation of cloud-based BIS is about three times faster as for on-premise systems. This statement will be analyzed through the investigation of reference stories.
Evaluation:	This criterion is evaluated with marks. 1 means that the average implementation duration is quite low (comparing to on-premise variants and the other analyzed systems), 5 means that the average implementation duration is quite high. The evaluation of this criterion will be done based on an Internet research.
Reference to ISO 25010:	No appropriate characteristics
C21: Flexibility and scalability through integrated add-on apps	
Description:	With this criterion, the author verifies if it is possible to acquire additional software and functions without going through the usual cumbersome software delivery process. For example, a manufacturing company wants to enhance their functionalities through the installation of bolt-on applications for advanced analytics or other industry extensions, which can seamlessly be integrated with the existing applications. This is enabled through web-based app stores that resemble the iTunes store for mobile phones (Utzig et al., 2013, p.7).
Evaluation:	It will be examined, if the software vendor provides such an app store (which will lead to 1 point) or not (0 points).
Reference to ISO 25010:	Portability (Adaptability, Installability)
C22: **Data Lock in**	
Description:	Due to several reasons, it might be necessary for a manufacturing company to change its software provider. However, many companies are not aware of this when selecting a specific system. Therefore, it is beneficial for the company if policies are available that easily enable data to be retrieved and migrated to other software providers (Mahara, 2013, p.369). The system must provide at least an open interface, which enables the retrieval of the data from the old system and the transportation into the new system. Interview C confirms the advantage of the lock-in effect for software vendors of cloud-based BIS. This criterion will also be evaluated based on reference stories and content analysis.
Evaluation:	This criterion is evaluated with marks. 1 means that the degree of data lock-in is very low, 5 means that the degree of data lock-in is very high.
Reference to ISO 25010:	Portability (Replaceability)

Table 9: Definition of non-functional criteria

The criteria are evaluated in the next chapter based on proof of concepts with the selected products (see chapter 4.3.3). Thereby, all analyzed systems will be installed by the author in order to verify their functionalities and to evaluate the defined criteria. Some criteria are getting evaluated by means of documentation and Internet research. Additionally, the criteria are also getting evaluated by experts of the three analyzed software systems.

4.3 Proof of concepts

This chapter describes the implementation and evaluation of the proof of concepts. Thereby the **concept** is the implementation of a pre-defined make-to-order business process scenario (see chapter 4.3.1.1) of a manufacturing company within SaaS-based integrated software system landscapes of three selected software providers (see chapter 4.3.1.3). The **proof** on the other hand is the evaluation of those system implementations by means of the pre-defined criteria catalogue (see chapter 4.2). Finally, the goal is to demonstrate, that through the integration of BIS like ERP, CRM, BI and collaboration systems and the application of those systems in the cloud, it is possible to eliminate the vulnerabilities of isolated on-premise applications and thus to optimize business processes.

4.3.1 Parameters

Before the implementation of the proof of concepts, the main parameters are described. First of all, the make-to-order process scenario, which is being implemented within the selected systems, is described. Afterwards, the in the course of the expert interviews identified vulnerabilities of manufacturing business processes, especially of the make-to-order process, when they are supported by isolated, on-premise applications, are identified. And finally, the three analyzed systems of the three selected software providers Microsoft, SAP and Oracle are described.

4.3.1.1 Make-to-order process scenario

The purpose of this sub-chapter is the **description of the business process scenario**. The author analyzed a typical **make-to-order process** as this process performs tasks in different business information systems. As a simple example, the **manufacturing and selling of custom-made bicycles** is used for the prototypes, even if the example only contains the major components and stages of production since the main focus of this work is the analysis of the integration between different cloud-based BIS but not the detailed analysis of specific manufacturing business processes within the individual BIS.

The **high-level-description** of the make-to-order process of the bicycle is the following:

1. **Pre-sales**: contact management, lead management and offer management.
2. **Sales and manufacturing**: planning, order management, manufacturing, shipment and invoicing.
3. **Post-sales**: post calculation, display of key performance indicators (KPIs) in a dashboard.

By means of this proof of concept, the integration of four different types of BIS is analyzed (ERP-, CRM-, BI- and collaboration systems, which are described in chapter 3.1). Thereby, the created prototypes with the selected software systems shall perform the following activities within these four different types of BIS. This process definition is based on (Carr and Duenyas, 2000), (Gansterer, 2015), (Magic Software, 2013), (Microsoft Dynamics 365 - Prospect to Cash Scenario, 2017), (Rytt, 2018) and the insights and results of the expert interviews.

Business information system	**Activities**
CRM system	• Contact management. • Lead management: creation of sales opportunities. • Creation and tracking of sales offers (using the pricing from the ERP system). Already in the offer process, it must be checked,

	if all the required materials are in stock (information coming from the ERP system) or if manufacturing is required. • Retrieval of sales/product history of a customer (from ERP system) which enables cross-/up-selling.
ERP system	• Creation of customer master record (based on CRM contact). • Sales order management (based on sales offer in CRM-system). • Creation and planning of manufacturing order (capacity-, material- and resource planning). Automatic ordering of semi-finished products and raw materials. • Processing of manufacturing order (posting of material consumptions). • Shipment of finished product and invoicing.
BI system	• Retrieves data from both CRM- and ERP-system. • During manufacturing order processing: calculation and display of workload based on information from CRM-system (sales offers) and ERP-system (dispatched sales orders). • Post calculation of manufacturing order from ERP system: calculation of contribution margin through comparison of sales opportunity from CRM system with actual figures from ERP system on different levels (entire order, individual components and tasks). • Display of KPIs by means of dashboards.
Collaboration system	• Office integration (Word, Excel, Outlook). • Document management system integration, e.g. SharePoint, OneDrive. • BIS overlapping workflows: Automatic creation of order documentation at shipment of final product. Automatic actions at change of sales-/manufacturing order status.

Table 10: Activities of the analyzed processes within the four different types of BIS

Finally, the following process is implemented within the prototypes of the three selected systems in chapter 4.3.2 and in appendix C. As can be seen this process goes all the way from the prospect until the sale is completed and the company gets the cash from the customer (“prospect to cash integration”).

Figure 19: Proof of concept process chart (Own creation by author)

Pre-Sales

A sales person receives an email from a new prospect (who is already a customer of the demo company or not) as the prospect is interested in a specific bicycle. Thereby, the sales person can directly verify in Outlook (without switching to the CRM-system) if a contact or customer already exists in the system. If the contact/customer does not exist, the sales person can create the contact in the CRM system directly from Outlook. Afterwards, a workflow is triggered which notifies a backoffice employee that they need to fill out the new contact card in the CRM system completely. Next, a new lead (sales opportunity / request for quotation) is created in the CRM system. Thereby, the sales person is supported by a BI dashboard (top customers, pipeline by status, sales order volume etc.) in the CRM system. Even more, a 360-degree view of a customer can be seen in the ERP-, CRM-system and also directly within Outlook. Based on the sales opportunity, a sales offer is created in the CRM system, which is based on current prices from the ERP system. The stock availability is also checked within the ERP system. Afterwards, the sales offer is sent to the contact or customer by means of Microsoft Outlook. Based on the sales offer, price negotiations between the sales person and the contact/customer are done. If the prospect is already a customer of the demo company, the sales person can check the sales/product history of a customer (from the ERP system) directly in Outlook, which facilitates cross-/up-selling. If the prospect answers to the email containing the sales offer (e.g. the quantity shall be changed), the sales person can directly see the sales offer in Outlook and does not need to open the CRM system. Furthermore, the created CRM data (sales opportunity, sales offer) can also be shown in the ERP-system with the possibility to open the sales opportunity card in the CRM-system directly from the ERP system.

Sales and manufacturing

Finally, the contact/customer accepts the sales offer and sends a purchase order. Both, a customer master record is created in the ERP system (if not already existing) based on the contact in the CRM system and a sales order is created in the ERP system based on the sales offer in the CRM system. Afterwards, the order confirmation is sent to the customer with Outlook. In order to initiate the manufacturing process, the MRP process is executed in the ERP system which includes the creation of the manufacturing order for the finished product (bicycle), the scheduling of the manufacturing order, the creation of purchase orders for semi-finished products and raw materials and the capacity and resource planning (work places etc.). Now the processing of the manufacturing order within the ERP system is started and executed. During the manufacturing, the consumption of semi-finished products and raw materials is posted. In order to demonstrate the integration with Microsoft Excel, the consumption journal is exported to Excel and provided to the manufacturing employees who enters the consumed quantities in Excel. Afterwards, the populated Excel file is imported into the ERP system and posted. Thereby, the manufacturing employees do not need access to the ERP system and user licenses can be saved. As a main indicator for the management of the demo company, a calculation and display of the workload based on information from the CRM-system (sales offers) and the ERP-system (dispatched sales orders) within the BI-system is done. As soon as the manufacturing of the bicycle is completed, a positive adjustment of the finished product is posted, and the manufacturing order is closed which triggers an automatic notification of the production manager. The logistics employee is equipped with a dashboard about finished products, which need to be shipped. Based on this, the shipment of the finished bicycle to the customer is posted which automatically triggers the creation of an order documentation and the storage within a document management system (e.g. SharePoint or OneDrive for Business) and the e-mail notification of the customer about the delivered product. As a last step, the outgoing invoice is created within the ERP system and sent to the customer with Outlook.

Post-Sales

After the sales and manufacturing of the bicycle, a post calculation of the manufacturing order of the ERP system is done. Thereby, contribution margins are calculated through the comparison of sales opportunities from the CRM system with actual figures from the ERP system on different levels (entire order, individual components and tasks). These KPIs, which are created in the BI-system, are displayed by means of dashboards within the ERP-/CRM-system.

4.3.1.2 Vulnerabilities of isolated on-premise systems

Based on the inputs of the expert interviews, the following main vulnerabilities within manufacturing companies due to isolated (not integrated) on-premise BIS could have been detected (with focus on the make-to-order business processes):

No.	Description	Consequences	Source
V1	Many custom-made interfaces (e.g. with 3rd-party-applications, production systems); lack of standard interfaces.	High costs and efforts for the maintenance of the software systems.	Interviews A, I, J, K, L
V2	Redundant data across multiple business information systems.	Lack of consolidated data; slow management decisions; time-consuming controlling. E.g. no real-time purchase price of a product for the manufacturing department.	Interviews A, F, M, N, O
V3	Different user interfaces of the involved business information systems.	High training costs; dissatisfaction of the users.	Interviews A, F, G
V4	Dual data maintenance and media disruptions (e.g. customer data in ERP and CRM; material consumptions in Excel and ERP; material data in CAD and ERP).	Duplication of efforts; inefficient business processes; lack of data integrity; lack of automation, as mapping of data between different applications is necessary; slower information flow (e.g. delayed creation of sales invoices); reduction of process reliability.	Interviews A, F, G, L, M, N
V5	Wrong or no product inventory information (from ERP system) within CRM system (data discrepancies).	Sale of products that do not have sufficient inventory at the required date.	Interview B
V6	Many customizations of the standard software functionality necessary in order to fit the business processes.	No fast and seamless version upgrades possible, thus new software features cannot be used immediately.	Interviews B, H, J, O
V7	No scalability in case of varying workloads (number of users, performance requirements).	Constant high IT costs (for licenses and maintenance) required.	Interview E
V8	No scalability in case of expansions (e.g. new production plants).	High IT costs required (for IT infrastructure, communication technologies, etc.).	Interviews B, F, H
V9	No information about open customer items from ERP system within CRM system available.	Salespersons have no basis for discussions with customers, thus delayed in-payments.	Interview C
V10	No information about customer sales history from ERP system within CRM system available.	Lack of knowledge for efficient planning of marketing activities and after-sales-services.	Interviews C, E, O

V11	Business information systems from different software providers in use.	Companies mostly have no superordinate person who has profound knowledge in all involved systems; multiple maintenance contracts, thus higher costs.	Interviews C, F, K, M, O
V12	No single point of truth for material stock (no leading system; self-created access databases for product databases of suppliers).	Uncertainty of the users including loss of trust in the systems; overheads, as multiple systems must be checked; inefficient delivery promises (incorrect or delayed).	Interviews D, F, G
V13	No consolidated data source of sales opportunities (CRM), already dispatched sales orders (ERP), maintenance tasks (ERP or CRM) and other planning parameters.	No efficient capacity planning possible, thus delayed deliveries of manufactured products.	Interview E
V14	Applied business information systems have no underlying mobile connected platform (platform limitation).	No mobile access ("anytime, anywhere") to business data is possible.	Interview F
V15	Invoicing and payment process is a manual process.	Negative consequences to the cashflow of the company.	Interview F
V16	No 360-degree view of customers possible within ERP, CRM and Outlook.	Slower sales decisions (information must be looked up in multiple systems).	Interview I
V17	Version incompatibility between different software systems.	No seamless updates and no consistent release cycle is possible.	Interviews I, L, N
V18	Time consuming and expensive integration of industry add-ins.	No implementation of industry add-ins is done due to high costs.	Interview I
V19	No continuous sales process between CRM- and ERP-System (e.g. sales offer cannot be directly transferred to a sales order in the ERP system).	Duplication of efforts, dual data maintenance, error-proneness.	Interviews K, M
V20	Lack of integration between ERP- or CRM-system and DMS-systems like Microsoft SharePoint.	No central storage of documents connected with ERP-/CRM-data (e.g. customer documents, order documentation); higher paper consumption; lack of verifiability of quality documents.	Interviews K, M, N
V21	No information about open sales opportunities from CRM system within ERP system available.	No accurate cashflow / forecast determination is possible.	Interview O
V22	No workflows connecting business processes among different business information systems available.	Lack of communication and interaction between different systems (e.g. for alerts and notifications).	Interview O
V23	Lack of BI dashboards containing KPIs (e.g. contribution margins) which can be shown within ERP-/CRM systems.	Lack of information basis for fast management decisions.	Interviews A, F, M, N, O

Table 11: Vulnerabilities of isolated on-premise systems

In chapter 4.3.3.2, the author verifies if the aforementioned vulnerabilities can be eliminated or optimized through cloud-based integrated business information systems, by referring to the proof of concept implementation in chapter 4.3.2 and in appendix C.

4.3.1.3 Analyzed cloud-based business information systems

This chapter gives a short overview about the software systems, which are analyzed in chapter 4.3.2 and in appendix C. As the evaluation of all available products on the market would go beyond the scope of this thesis, a selection of specific systems must have been done. The software systems being analyzed come from three well-known software providers, which are **Microsoft**, **SAP** and **Oracle/NetSuite**. Thereby, all software systems are **SaaS-based systems**. The reasons why these three software providers have been selected are, on the one hand, the high usage level within the companies of the interviewed experts and, on the other hand, the fact that they have currently the highest market shares as confirmed by the latest Panorama Consulting Clash of the Titans 2017 report (Panorama Consulting Solutions, 2017, p.7):

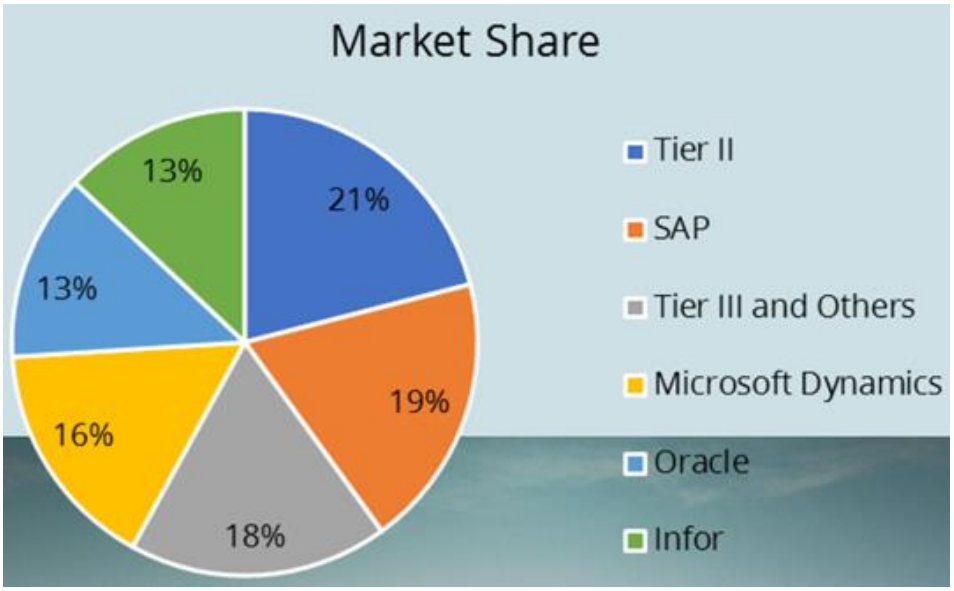

Figure 20: Clash of the Titans 2017 report (Panorama Consulting Solutions, 2017, p.7)

4.3.1.3.1 Microsoft

Microsoft is an international hardware- and software vendor and the biggest software manufacturer worldwide (Wikipedia, 2018a). As you can see on the official homepage of Microsoft[44], the company offers a large number of different software products. However, within this Master Thesis, only a small selection of cloud-based integrated business information systems will be considered, which are described at a glance now.

Business Information System	Name
ERP system	Microsoft Dynamics 365 for Finance and Operations[45]
CRM system	Microsoft Dynamics 365 for Sales, Business Edition[46]
BI system	Microsoft Power BI[47]
Collaboration system	Microsoft Office 365 Business[48]

Table 12: Analyzed Microsoft products

[44] http://www.microsoft.com/ (Accessed 24 Mar. 2018)
[45] https://dynamics.microsoft.com/en-us/finance-and-operations/overview/ (Accessed 24 Mar. 2018)
[46] https://dynamics.microsoft.com/en-us/sales/overview/ (Accessed 24 Mar. 2018)
[47] https://powerbi.microsoft.com/en-us/ (Accessed 24 Mar. 2018)
[48] https://products.office.com/en-us/business/office-365-business (Accessed 24 Mar. 2018)

Microsoft Dynamics 365 for Finance and Operations, is the cloud-based version of the former Microsoft Dynamics AX, which is a core business management solution, designed to meet the demands of mid-sized companies and multinational organizations and offers comprehensive standard functionality for financial management, supply chain management, production and shop floor control, project management, service management and human resources management (Luszczak, 2010, pp.1, 9).
Microsoft Dynamics 365 for Sales, Business Edition, is based on Microsoft Dynamics CRM Online. It includes features like contact and account management, lead and opportunity management, activity tracking (e.g. emails), management of product lists, generation of quotes and invoices, sales reporting and customer analytics (Molag, 2016).
Microsoft Power BI is a suite of business analytics tools that can connect hundreds of data sources in order to produce reports and publish them throughout an organization so that employees can consume them on the web and across mobile devices (Microsoft, 2018e). Power BI provides cloud-based BI services and it offers data warehouse capabilities (Wikipedia, 2018d).
Microsoft Office 365 Business is a cloud-based (subscription-based) version of Microsoft Office (Wilson, 2014) and it includes Word, Excel, PowerPoint, Outlook, OneNote, Publisher, OneDrive for Business and Access (Microsoft, 2018d).

These four products will build the main foundation of the prototype, which is implemented in chapter 4.3.2. Furthermore, some additional Microsoft products and productivity cloud services will be used which mainly improve the integration capabilities between the different business information systems. These will be the Microsoft Common Data Model, Microsoft Flows and Microsoft PowerApps.

Microsoft Flow[49] is a cloud-based service and part of Office 365, which enables to build workflows that automate time-consuming business tasks and processes across different (business) applications and services (Siciliano and Blythe, 2017).
Microsoft Power Apps[50] is a cloud service from Microsoft, based on Office 365 and Microsoft Azure, which enables to build business apps that run in a web browser or on a phone or tablet client without the need of coding (Kierland, 2018).
The **Common Data Model** is a cloud-resident business database. It comes with hundreds of standard business entities spanning both business processes (Dynamics 365) and productivity (Office 365) and brings all the data together as a single point of integration (Sunrise technologies, 2018). It is the basis for the **Common Data Service**, which is a cloud-based data storage and business application platform that makes it possible to easily create and extend applications with business data. Thus, it enables to bring data together into one central place from across the Microsoft Dynamics 365 family of services supported with PowerApps, Power BI and Microsoft Flow.

The following figure shows a solution stack diagram consisting all of the aforementioned products and services. All of them form a powerful and adaptable business application platform (Siciliano and Blythe, 2017). The basement of this business application platform is **Microsoft Azure**[51], which is the cloud computing service created by Microsoft for building, deploying and managing applications and services through a global network of data centers managed by Microsoft. It provides the infrastructure for all types of cloud computing (SaaS, PaaS, IaaS) (Copeland et al., 2015; Wikipedia, 2018b).

[49] https://flow.microsoft.com/en-us/ (Accessed 24 Mar. 2018)
[50] https://powerapps.microsoft.com/en-us/ (Accessed 25 Mar. 2018)
[51] https://azure.microsoft.com/en-us/ (Accessed 25 Mar. 2018)

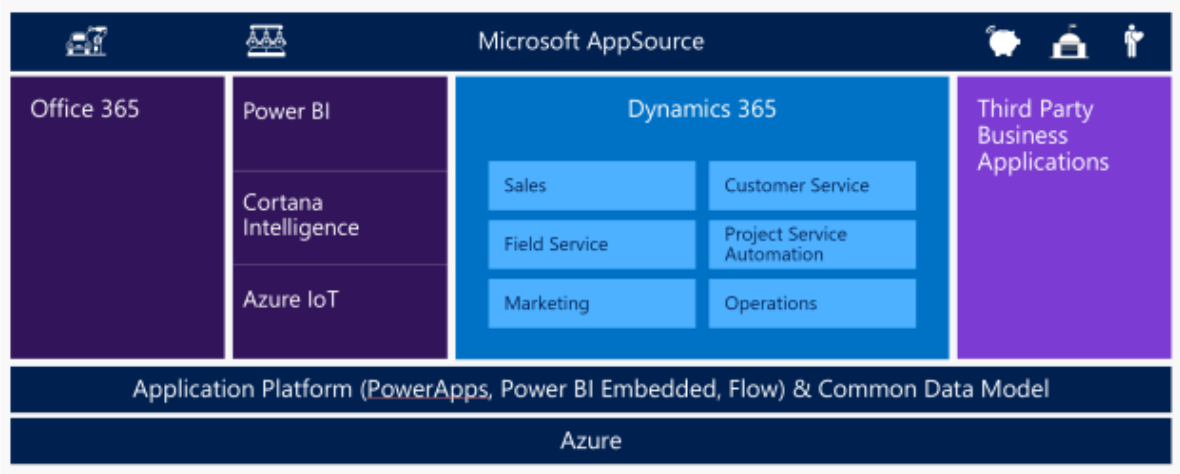

Figure 21: Microsoft business application platform (Chaudhury, 2016)

4.3.1.3.2 SAP

SAP SE[52] is the market leader in enterprise application software with more than 378.000 customers in more than 180 countries worldwide. As can be seen on the official homepage of SAP, the product portfolio is very big. However, as already mentioned in chapter 4.3.1.3.1 for Microsoft, only one specific product will be considered during this Master Thesis, which is **SAP Business ByDesign**, the Cloud ERP solution for midsize businesses from SAP (SAP SE, 2018f).
„*SAP Business ByDesign is a single cloud ERP solution for fast-growing, mid-market businesses to scale and compete without the complexity and cost*" (SAP SE, 2018c). It is a single end-to-end cloud solution and is equipped with the following key capabilities (SAP SE, 2018c):

- Finance (financial and managerial accounting, cash flow management).
- CRM (marketing, sales, service).
- Human resources (onboarding, time and attendance management, self-services, payroll, approvals).
- Project management (project collaboration and monitoring).
- Procurement (sourcing and purchasing).
- Supply chain management (product development, planning and control, manufacturing, warehousing and logistics).
- Industry specific functionality (manufacturing, professional services, wholesale distribution).

As can be seen above, SAP Business ByDesign has a powerful CRM module, thus no separated CRM system will be considered in the proof of concepts of this work. Additionally, the software is equipped with built-in analytical functions, thus no additional BI-system is required. The product uses an **In-Memory-Database**, which enables to store all transactional and analytical data in a single database with in-memory computing. Thereby, complexity can be cut and power users are enabled to access the data they need in real time (SAP SE, 2018c).

SAP Business ByDesign can be deployed both in the public cloud and in the private cloud, which mainly depends on user type and number of users and finally also determines the monthly subscription fees. More details about them can be found in chapter 4.3.3. As can

[52] https://www.sap.com/corporate/en.html (Accessed 26 Mar. 2018)

be seen in the SAP online help documentation, SAP Business ByDesign offers a great number of integration scenarios, where some of them will also be considered in the proof of concepts, e.g. the Microsoft Outlook Integration (SAP SE, 2018d).

Figure 22: SAP Business ByDesign key capabilities (TechTarget, Inc, 2018)

4.3.1.3.3 NetSuite

NetSuite Inc. is an American cloud computing company and was the world's first company dedicated to delivering business applications over the Internet. In 2016, Oracle purchased NetSuite. Today, NetSuite is used by more than 40.000 companies in more than 100 countries worldwide (Wikipedia, 2018c; Oracle NetSuite, 2018).
NetSuite is a cloud management business suite that connects ERP, CRM and E-Commerce in a single, web-based business solution. With regard to this Master Thesis, NetSuite has also a specialized manufacturing solution. Furthermore, NetSuite allows real-time BI reporting across the enterprise (Oracle NetSuite, 2018a).

Figure 23: NetSuite product overview (Explore Consulting, 2018)

As can be seen above, NetSuite offers a broad range of functionalities and tries to cover all business processes within one system. However, if third party cloud- or on-premise applications need to be integrated, NetSuite offers the integration platform **SuiteCloud Connect**, which enables out-of-the-box integrations with Salesforce.com, SAP or Google Apps. Beyond that, integration platforms like Dell Boomi[53] or Celigo[54] offer out-of-the-box NetSuite connectors (Oracle NetSuite, 2018c).

4.3.2 Implementation

This chapter provides a brief summary of the implementation of the proof of concepts. A detailed description including screenshots of the installed systems can be found in **appendix C**. As already mentioned, the highest focus and level of detail was put on the first prototype, which was the implementation with Microsoft Dynamics 365.

4.3.2.1 Microsoft Dynamics 365

4.3.2.1.1 Installation and setup

In order to implement the defined make-to-order process scenario (chapter 4.3.1.1) within the Microsoft Dynamics 365 product family, the author applied exactly the same cloud-based BIS and productivity cloud services as defined in chapter 4.3.1.3.1.

After finishing the registration for all these cloud services, the author had to make some setups and configurations to enable the implementation of the defined processes. As the focus of this thesis is put on the integration among multiple systems, only the **required setups for the integrations** are explained. Thereby, it can be differentiated between **data** and **process integrations**. Within this chapter, only the main aspects are described. More details including screenshots out of the installed systems and services can be found in appendix C.

Data integration

In order to achieve the required level of data integration between the involved systems, the author did the following steps:

1. **Conceptual definition of the data flow** between the two main operating systems of this proof of concept, which are the CRM-system Microsoft Dynamics 365 for Sales (in the following abbreviated as “Dynamics 365 Sales”) and the ERP-system Microsoft Dynamics 365 for Finance and Operations (in the following abbreviated as “Dynamics 365 FO”), which is depicted in the following figure. As can be seen in the following figure, the integration platform, which enables that the data can seamlessly flow between the two main operating systems, is the Common Data Service (in the following abbreviated as “CDS”). The figure also shows the main entities, which are required for this business process scenario including the direction in which the data shall be exchanged between the involved systems.

[53] https://boomi.com/ (Accessed 28 Mar. 2018)
[54] https://www.celigo.com/ (Accessed 28 Mar. 2018)

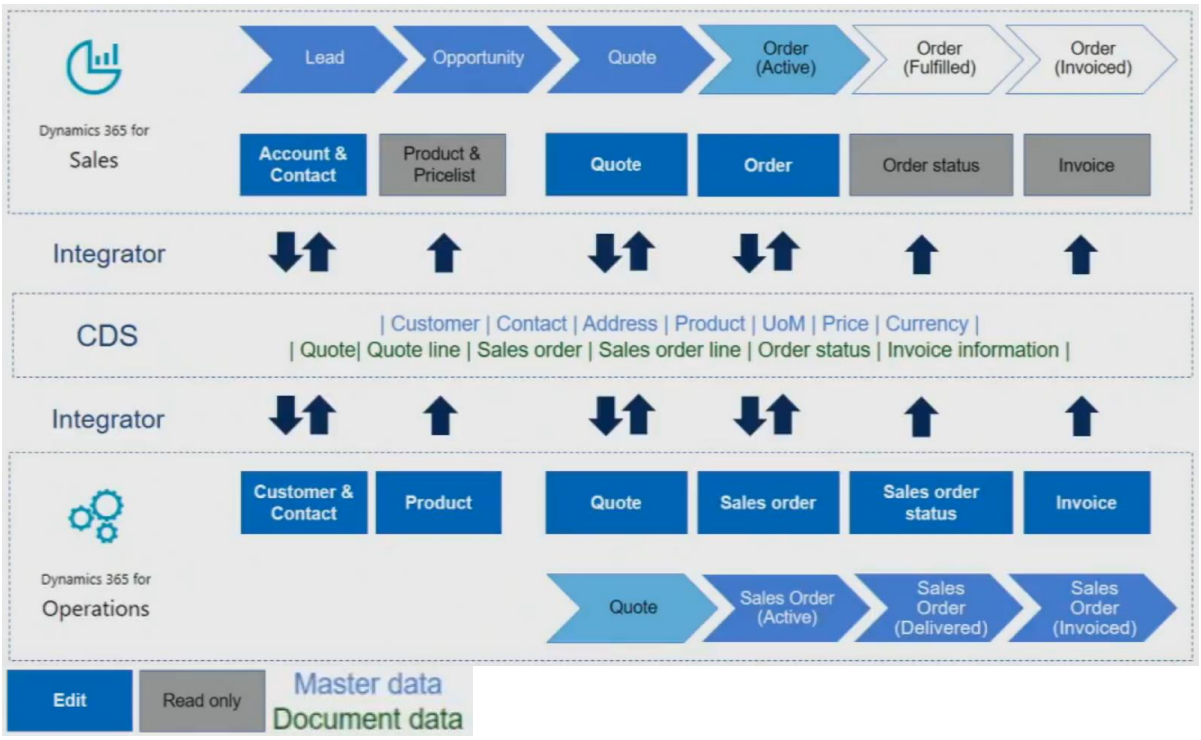

Figure 24: Make-to-order data flow in Microsoft Dynamics 365 (Own creation by author)

2. **Setup of data flow** by means of pre-defined **integration templates** within CDS, which include the mappings of the entities and fields between Dynamics 365 Sales, Common Data Service and Dynamics 365 FO. Thereby, the author applied multiple entity mappings in order to establish all the required data integrations for this scenario. For example, the mapping between the entities "*Customer*" (in Dynamics 365 FO), "*Account*" (in CDS) and "*Account*" (in Dynamics 365 Sales).
3. Creation of an **integration project** within the data integration admin center of Office 365 by selecting the integration template, a Dynamics 365 Sales connection, a Common Data Service connection and a Dynamics 365 FO connection.

As a result, **data integration tasks** within CDS were created, which provided the integration between records in Dynamics 365 Sales (Source) and Dynamics 365 FO (Destination) in both directions.

Process integration

Next to the data synchronization and integration, it had to be established that as soon as specific data shows up in a specific system, a specific business process shall be triggered in terms of a workflow. For that purpose, the author mainly used the cloud-based service **Microsoft Flow**.

The first **workflow**, which is relevant for this proof of concept, is that when a new contact is created in Dynamics 365 Sales (via Outlook), a back-office employee shall be automatically notified via email, that the newly created contact must be completed. In order to enable this process integration among multiple systems, a **combination and interaction of both CDS** (for the cloud-based data storage and data consolidation) and **Microsoft Flow** (for the process automation), eventually supported by **Microsoft PowerApps** (for mobile experiences) is required, which is summarized in Figure 25 below.

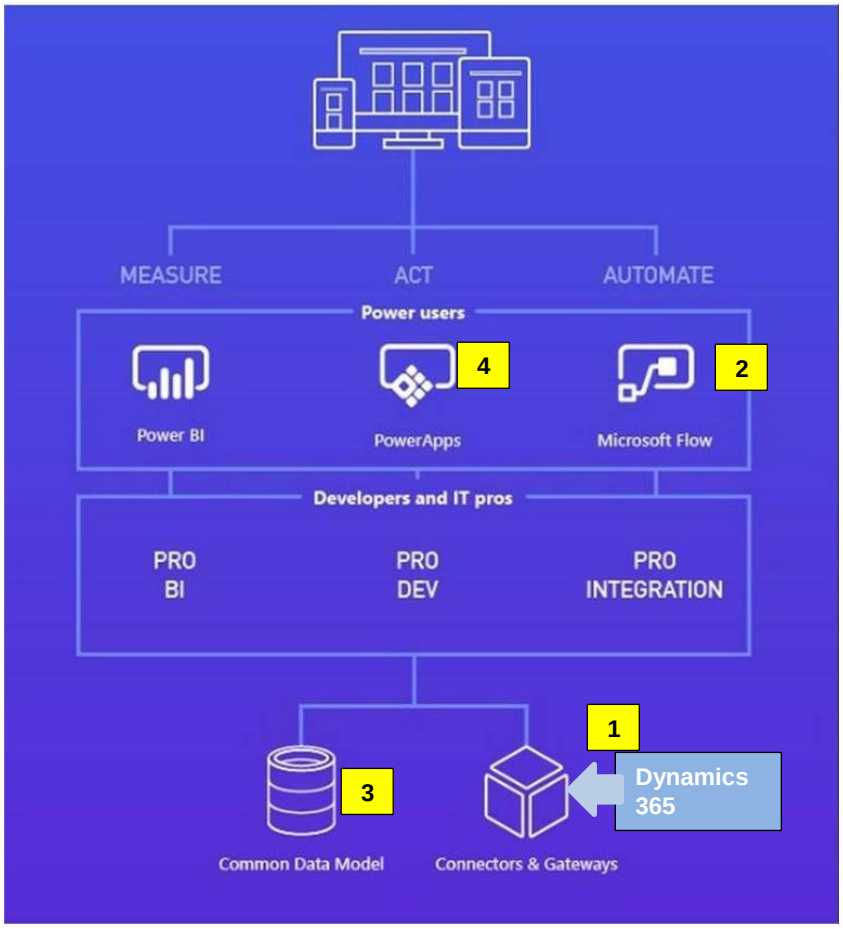

Figure 25: Process integration with CDM, Flow and PowerApps (Simens, 2017)

Thereby, the author did the following steps for the setup of the first workflow:

1. Creation of a new Microsoft Flow using a template.
2. Selection of a service (Microsoft Dynamics 365).
3. Selection of a trigger ("*Dynamics 365 - When a record is created*").
4. Selection of the related organization and entity (*Contact*).
5. Definition of an action (automatic e-mail delivery to a specific e-mail address).

For the other required process integrations (e.g. the automatic storage of an order documentation within Microsoft SharePoint), the author did similar steps. Beyond that, the standard integration between Dynamics 365 Sales and Microsoft SharePoint was activated within the Dynamics 365 Settings.

After establishing the data and process integrations, which means that business data from multiple different data sources is consolidated within the Common Data Model through CDS, custom-made mobile apps could be built by using **Microsoft Power Apps**. For example, an app for a customer success manager of a company, who needs to monitor the customer's usage and satisfaction from their products.

Finally, the following figure depicts a high-level overview about the relationships of the involved cloud-based services and systems of this proof of concept with Microsoft Dynamics 365:

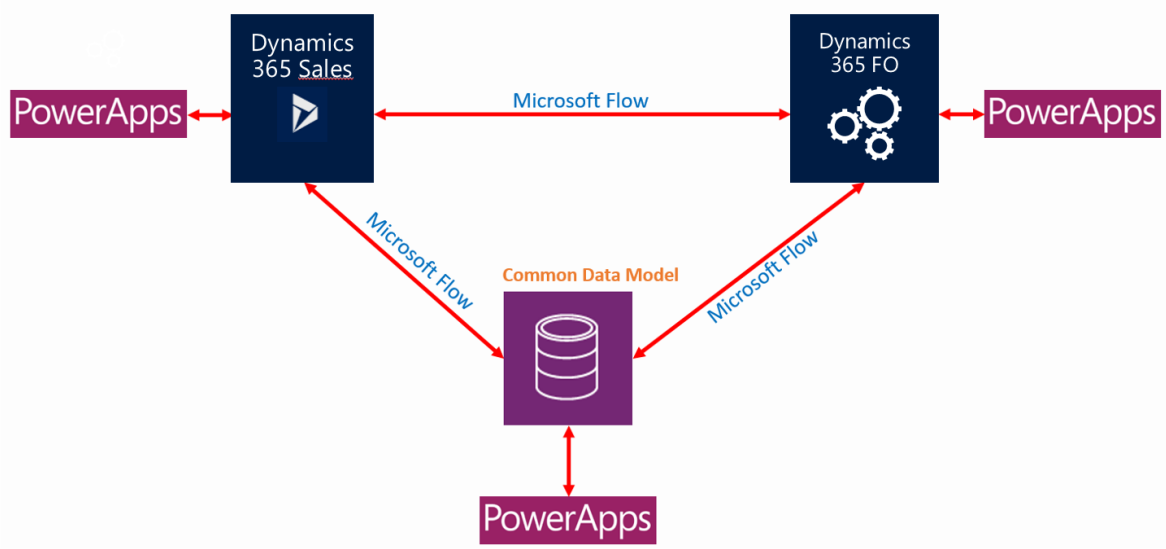

Figure 26: Service landscape Microsoft Dynamics 365 (Own creation by author)

4.3.2.1.2 Demo

After installing all the aforementioned systems (each time with a demo version) and setting up the data flow and process flow, it was possible to implement the defined make-to-order process scenario within the systems. Again, only the main aspects will be highlighted in this chapter. A demonstration with a rough iteration of the defined make-to-order process is done again in appendix C.

Pre-Sales

In the pre-sales phase, the sales persons are mainly supported with powerful **integration capabilities between Microsoft Dynamics 365 and Microsoft Office 365**:

- Display within an email in Office 365 if a CRM contact exists in Dynamics 365 Sales including some related information (statistical information, sales history, etc.).
- Possibility to directly create contacts and other CRM records (leads, opportunities) in Dynamics 365 Sales out of Office 365 Outlook including the possibility to directly open the CRM record in Dynamics 365 Sales out of Office 365 Outlook.
- Synchronization of data from Dynamics 365 Sales into Office 365. For example, after creating a new appointment for a contact in Dynamics 365 Sales, this is automatically added to the Outlook calendar of the relevant sales person.
- Possibility to read and reply to emails from a contact within Dynamics 365 Sales without switching to Office 365 Outlook.
- Possibility to display key facts about CRM documents (e.g. sales quotes) within e-mails directly in Outlook (e.g. product numbers, quantities, prices, etc.).
- Possibility to search for CRM data directly within Office 365 Outlook.
- Possibility to send documents like sales quotes to the customer's e-mail-address directly from Dynamics 365 Sales without switching to Outlook.

Consequently, the sales persons can do both CRM activities within Office but also Office activities within CRM. Thereby, no additional setup and configuration is necessary.

Additionally to these standard integrations between Microsoft Dynamics 365 and Microsoft Office 365, the data and process integrations as defined and setup above are applied:

- Based on the defined **process integrations**, after the sales persons create a new contact out of Office 365, a specified back-office employee automatically receives

an email about the newly created contact including a link to the contact in Dynamics 365 Sales. Thus, the back-office employee can directly open the affected contact card out of the email in Office 365 in order to fill out the contact card in Dynamics 365 Sales completely.
- Due to the defined **data integrations**, a customer in Dynamics 365 FO, based on the linked account in Dynamics 365 Sales, is created automatically. Product information including inventory data and unit prices from Dynamics 365 FO are synchronized into Dynamics 365 Sales. Sales quotes in Dynamics 365 Sales can be directly converted into sales order in Dynamics 365 FO.

During the whole pre-sales process, the sales persons are supported by means of **BI sales dashboards**. These dashboards, containing information from multiple systems (mainly ERP- and CRM-system), were created in **Power BI**.

Sales and manufacturing

This process phase was mainly done within the ERP-system Dynamics 365 FO, supported with the following integrations:

- **Integration with Microsoft Excel:** the quantities of the consumed semi-finished products and raw materials were entered into a Microsoft Excel file, which was exported out of Dynamics 365 FO. Afterwards, this data was written back to Dynamics 365 FO by means of the “Publish”-function in Microsoft Excel.
- **Power BI integration:** For the top management, e.g. the COO, a Power BI dashboard was created which contains, on the one hand, forecast data from Dynamics 365 FO and, on the other hand, sales data from Dynamics 365 Sales, which enables an easy comparison and fast management decisions.
- **Automatic e-mail notification:** after finishing the manufacturing in Dynamics 365 FO, the production manager was automatically notified via E-Mail based on an established Microsoft Flow. After posting the sales shipments of the finished products, the customers were automatically notified that they could expect the delivery of their products.
- **Integration with Microsoft SharePoint:** based on the posting of the shipment of the finished products to the customer, an automatic workflow was triggered which created and stored an order documentation within Microsoft SharePoint.

Post-Sales

In order to enable a post calculation of the manufacturing order from the ERP system, the display of KPI’s like contribution margins is required, which are calculated based on information from the CRM system (sales opportunities out of Dynamics 365 Sales) and from the ERP system (actual sales figures out of Dynamics 365 FO) on different levels (entire order, individual components and tasks). Equally as for the sales dashboard above, the required dashboard was created in Power BI and was finally selected and shown inside Dynamics 365 FO.

4.3.2.2 SAP Business ByDesign

4.3.2.2.1 Installation and setup

For the implementation with SAP Business ByDesign (in the following abbreviated as **SAP ByD**), the author registered for a 30-day trial version on the SAP homepage[55]. As the trial version only provides limited functionality (only specific guided tours can be reviewed), it was not possible for the author to implement the whole make-to-order process within this trial version. Thus, the author additionally checked some further literature.

[55] https://www.sap.com/austria/products/free-trials.html (Accessed 12 Apr. 2018)

The main difference to the Microsoft Dynamics 365 prototype in the previous sub-chapter is that SAP ByD has its own **CRM module** included and integrated, thus no additional CRM system is required. SAP ByD is a fully integrated solution; thus, the product follows the strategy to run a business with a single solution ("**Suite-in-a-box**"). However, due to its open product architecture, there exist standard interfaces to many third-party systems like for example the CRM-system Salesforce.com.

For the integrations with **Microsoft Excel and Outlook**, an Add-In must have been installed and afterwards it was possible to connect to SAP ByD from Excel and Outlook, but only with limited functionalities comparing to the integration between Microsoft Dynamics 365 and Microsoft Office 365. On the other hand, the author could not identify a standard integration between **SAP ByD and Microsoft SharePoint**.

4.3.2.2.2 Demo

The main insights, which the author identified during the implementation with SAP ByD, are the following (more details can be found again in appendix C):

- **Integration with Microsoft Outlook**: the author could not identify the same level of powerful integration capabilities between the two systems as for the Microsoft prototype. Equally as for Microsoft Excel, there exists an SAP ByD Add-In for Microsoft Outlook, which enables Users in Outlook to add emails to SAP ByD and associate them with specific records in SAP ByD. Another possible feature regarding the integration with Microsoft Outlook in this context is that within SAP ByD it is possible to add pre-defined sales activities to the sales opportunity. As a result, these activities are also added to Microsoft Outlook if the Outlook integration is activated. Thus, any emails that come in related to that sales opportunity can be set over and attached to the opportunity.
- **Follow-up activities** in SAP ByD enable the seamless conversion between different sales documents (opportunity, quote, order) and the automatic population of all the relevant information, thus no double work is required.
- Documents in SAP ByD, e.g. the sales order confirmation document, but also other documents like sales quotes, can be directly sent to the customers via email out of SAP ByD.
- As a basis for decision-making, the salespersons can immediately display the sales history of a customer in SAP ByD in order to get a **360-degree view** of the customer.
- For the delivery of the finished products, the logistics employees are equipped with a **dashboard containing all the pending deliveries** whereby they get an automatic notification as soon as a sales order was released for shipping.
- Additionally to an integrated CRM system, SAP ByD also provides **integrated analytics based on SAP HANA**, which is an in-memory computing platform, in order to gain real-time insights. Thereby, KPIs can be shown directly within dashboards of SAP ByD. Actually, the characteristics of those dashboards (e.g. filter criteria, display format) can be changed and adapted very quickly and easy by means of an integrated BI designer in SAP ByD.
- Next to the Microsoft Outlook integration, SAP ByD also provides an **integration with Microsoft excel**, thus you can export business data into Excel, refreshing live data and write them back to SAP ByD.

4.3.2.3 Oracle NetSuite

4.3.2.3.1 Installation and setup

Equally as for the proof of concept with SAP Business ByDesign, the author registered for a 30-day **trial version** at the homepage of a NetSuite implementation partner[56] and due to the limited functionality of this demo version, the author was not able to implement the entire pre-defined make-to-order process within this demo environment. Therefore, as already done for the SAP Business ByD implementation, the author also included further literature for this proof of concept.

For this proof of concept, the main BIS, which were used by the author, were **NetSuite ERP**- and **NetSuite CRM-system**, which are deeply integrated, thus no additional setup was required in order to achieve the integration between ERP and CRM. Equally as for SAP Business ByDesign, NetSuite is a **fully integrated system**. Additionally to NetSuite ERP- and NetSuite CRM-system, the following tools from NetSuite were used:

- **SuiteFlow:** For the setup of the required workflows, NetSuite's integrated workflow management suite called SuiteFlow was used.
- **Report Designer:** Regarding reporting capabilities and the creation of the demanded dashboards, this could also be done directly within NetSuite and no additional BI tool was necessary.
- **Office integration:** There is a "SuiteApp" available for download that integrates Outlook and NetSuite. It is called "NetSuite for Outlook" and it allows to fully synchronize data between the two applications like tasks, events, phone calls etc. (Jones et al., 2017). The same applies for the integration between NetSuite and Microsoft SharePoint, which is also not possible out-of-the-box. Therefore, 3rd-party middleware integration platforms like for example StarfishETL[57] must be deployed which was not done for this proof of concept.

4.3.2.3.2 Demo

The main insights, which the author identified during the implementation with NetSuite, are the following (more details can be found again in appendix C):

- **Integration with Microsoft Outlook**: the author could not identify the same level of powerful integration capabilities between the two systems as for the Microsoft prototype. Regarding Microsoft Excel, you can export all lists in NetSuite to Excel. Regarding Microsoft Outlook, you can email any record directly from NetSuite and you can create and send emails directly out of NetSuite. Calendar appointments can be created directly within NetSuite, which can also be synchronized with the Microsoft Outlook calendar. Furthermore, an automatic e-mail reminder can also be setup.
- **NetSuite CRM and NetSuite ERP** are tightly integrated. For example, a sales person can quickly add new product items in NetSuite CRM and immediately see their price and availability, which comes from NetSuite ERP.
- **360-degree view of customers**: As NetSuite ERP and NetSuite CRM are seamlessly integrated, a flexible and fully searchable 360-degree view of the customer is possible. Thereby, also graphical charts can be created.
- **Seamless document and information flow**: For example, out of the sales quote in NetSuite CRM, the sales order in NetSuite ERP can be created seamlessly, thus all the information flows through from the sales quote to the sales order.

[56] http://go.frankrimermanconsulting.com/Try-Netsuite-with-a-No-Obligation-Product-Tour
[57] https://www.starfishetl.com/crm-integration/Other/NetSuite/SharePoint (Accessed 18 Apr. 2018)

- **Dashboards**: For example, the warehouse manager gets an overview about approved sales orders, which need to be shipped; or the accounts receivable (A/R) dashboard notifies accountants to invoice customers in time.
- **Integration with delivery services**: The shipping process can be automated by means of NetSuite's integrations with UPS, FedEx and other delivery services.
- **Workflows**: Based on standard workflows in NetSuite, automatic e-mail notifications of customers can be setup.

4.3.3 Evaluation

4.3.3.1 Validation of selected systems

For the evaluation of the three selected systems, a **decision matrix** was used. According to Selmeci et al, a decision matrix is a table containing the possible options in columns and each of these alternatives is evaluated based on a preselected list of criteria and weightings, which was defined in chapter 4.2 (Selmeci et al., 2012, p.44). This decision matrix can be found in the following table. Afterwards the author gives a summary of the most important aspects of this criteria evaluation.

The **foundation** for this validation is the criteria catalogue evaluation of the author in **appendix D** and the criteria catalogue evaluation of experts of the three selected systems in **appendix E**, whereby the evaluations of the experts overruled the evaluations of the author, as the selected experts have in-depth knowledge and experiences with the specific systems for many years. All criteria evaluations in appendix D and E contain besides the grading also a justification and reasoning for the evaluations of each criterion for each system. Within the evaluation of the author in appendix D, the reasoning always contains a reference to the expert interviews, proof of concept or further literature source, which were the basis for the evaluation of a specific criterion.

The following decision matrix contains the grading of each criterion for all three analyzed systems, based on the criteria catalogue evaluations as just described. If a specific grading is written in italic font, then the expert's evaluation overruled the author's evaluation. Otherwise, if the grading is written in plain text, both evaluations were equally. Within the following decision matrix, no weighting was done. Thus, all criteria were weighted equally. In the upcoming chapter 5.1.2, the author also took a weighting of the most important criteria into account.

Criteria	Microsoft Dynamics 365	SAP Business ByDesign	ORACLE NETSUITE
FUNCTIONAL CRITERIA			
C1: Limitations of functionality comparing to the on-premise variants	0.6	0.8	1.0
C2: Standard Interfaces	1.0	1.0	*0.5*
C3: Mobile Access (Web-/Phone-/Tablet)	1.0	1.0	*1.0*
C4: Dashboards based on information from different business information systems	1.0	1.0	0.5
C5: Office-/collaboration integration	1.0	0.5	0.5
C6: Limitations of customizability comparing to the on-premise variants	*0.6*	0.8	*1.0*
C7: User friendliness	0.8	0.6	0.8
C8: Integration / development platform	1.0	0.8	0.8

C9: Consistent availability of material information	1.0	1.0	1.0
C10: Direct conversion of sales offers into sales orders	1.0	1.0	1.0
C11: Real time data visibility of information between ERP- and CRM-system	1.0	1.0	1.0
C12: 360-degree view of customers from different business information systems	1.0	0.5	0.5
C13: Support of workflows	1.0	0.5	1.0
C14: Integration with document management system (DMS)	1.0	0.5	0.5
NON-FUNCTIONAL CRITERIA			
C15: Subscription fees	0.5	1.0	0.5
C16: Online documentation	1.0	1.0	*1.0*
C17: Information security and data protection	0.8	1.0	*1.0*
C18: Performance and availability	0.6	*0.8*	*0.8*
C19: Upgrade capability	1.0	1.0	1.0
C20: Implementation duration	0.6	1.0	0.8
C21: Flexibility and scalability through integrated add-on apps	1.0	1.0	1.0
C22: Data Lock in	0.6	*0.8*	0.8
SUM FUNCTIONAL CRITERIA	13.0	11.0	11.1
SUM NON-FUNCTIONAL CRITERIA	6.1	7.6	6.9
TOTAL SUM	**19.1**	**18.6**	**18.0**

Table 13: Decision matrix

SAP Business ByD and Oracle NetSuite have been pure cloud solutions for many years, thus they have no or only slight **functional limitations** comparing to on-premise variants. Microsoft Dynamics 365, on the other hand, has only been for some years as SaaS-based solution on the market; therefore, there are still some functional limitations, even if the author and the experts expect that these limitations will be closed very soon. All three analyzed software systems contain a powerful **standard integration** between their ERP-, CRM- and BI-system. The same applies to integrations with Microsoft Office, even if Microsoft Dynamics 365 comes with the most powerful integration with Microsoft Office 365. All analyzed systems can be accessed via Internet browser and mobile apps, even if the **mobile app** for NetSuite has some minor functional limitations. Integrated **analysis- and reporting tools**, which enable the creation of dashboards, are integrated within all three systems. However, NetSuite's BI module is restricted to data within the NetSuite database. Regarding the **integration with Microsoft Office**, as the most frequently used collaboration system, Microsoft Dynamics 365 has for sure the most comprehensive functionalities, as it is the only system, which also enables the execution of business transactions (e.g. the creation of sales quotes) directly out of Microsoft Outlook. Equally as for functionality, Microsoft Dynamics 365 has currently the most **customizing limitations** comparing to the other two analyzed systems, as the development foundation for Microsoft Dynamics 365, which is based on so-called "Extensions", has just entered the market and is not so much established as the PaaS frameworks of SAP Business ByD and NetSuite. All three systems enable **custom integrations** between various systems, whereby the

author has experienced that Microsoft's Common Data Service is the most innovative integration platform and enables the most flexible integrations, also supported with Microsoft PowerApps, and without the necessity to use additional third-party middleware platforms. As demonstrated in the proof of concept, all three analyzed systems enable out of the box consistent availability of material information, the direct conversion of sales offers into sales orders and real time data visibility of information between ERP- and CRM-system. However, Microsoft enables the most flexible definition of data integrations by means of Common Data Service and their pre-defined integration templates. A **360-degree view of customers** is possible within the ERP- and CRM-system of all three analyzed software applications. The only system, which also enables a 360-degree view directly within Office 365 Outlook, is Microsoft Dynamics 365, which underlines the powerful integration between Microsoft Dynamics 365 and Office 365. Microsoft Dynamics 365 and NetSuite are equipped with full **workflow engines**, which also enable to build workflows across different (external) applications and services. Only Microsoft Dynamics 365 enables a standard **integration with Microsoft SharePoint**, as often-used DMS system in manufacturing companies. In case of SAP Business ByD and NetSuite, the integration with Microsoft SharePoint or other DMS systems is only possible with third-party middleware platforms.

With regard to the non-functional criteria, the **subscription fees** depend on many circumstances (e.g. number of users, type of users); however, currently Microsoft Dynamics 365 subscription fees are slightly more expensive as for SAP Business ByD. For NetSuite, the author could not find official prices. The **online documentation** is quite extensive in all three cases with little benefits for Microsoft and SAP as NetSuite's online documentation is limited to technical documentation. By evaluating the two criteria **security** and **performance**, a lot of circumstances must be taken into account and a detailed analysis would go beyond the scope of this work. The author summarized the most important aspects regarding these two criteria for all three systems in appendix D. Thereby, all three analyzed systems have a very similar level of security and performance. SAP Business ByD can be emphasized through its widespread data centers in Europe. The **upgrade capability**, as one of the main competitive advantages of cloud-based BIS, has an equal excellent level at all three systems, especially as all of them support automatic and seamless updates and version upgrades. The same applies to the possibility to extend all three systems by additional apps, as all three software providers offer an **app store** for their BIS. Finally, the quickest average **implementation duration** currently applies to SAP Business ByD, according to latest online statistics.

4.3.3.2 Make-to-order process optimizations

As the proof of concepts implemented in chapter 4.3.2 do not rely on a real business case, the author did not determine quantitative process optimizations by means of concrete indicator systems or process benchmarks (e.g. quantitative throughput times, material inventories, etc.). Thus, no accurate measurement of process optimizations (e.g. cost reductions, reduction of employees) was done. Instead, the author conducted a **qualitative assessment of process optimizations** within the analyzed make-to-order process. Thereby, the author analyzed whether, and to what extent, the identified vulnerabilities of isolated on-premise applications (see chapter 4.3.1.2) could have been eliminated or optimized, always referring to the implemented proof of concepts in chapter 4.3.2 and in appendix C as far as possible. The following table contains this qualitative assessment of the identified process optimizations.

No.	Description of vulnerability	Optimization with cloud-based integrated BIS
V1	Many custom-made interfaces (e.g. with 3rd-party-applications, production systems); lack of standard interfaces.	No third-party-solution is necessary to achieve the desired integration. As shown in the proof of concept with Microsoft Dynamics 365, the Common Data Service as an integration platform enables a configurable and flexible setup of data integrations among various BIS, based on pre-defined integration templates, which are provided by the software vendor. **→ Cost savings due to less maintenance, fewer support requests and simplification for IT administration.**
V2	Redundant data across multiple business information systems.	As underlined by many statements and examples of the expert interviews, redundant data are the main drawback of isolated systems. Based on cloud-based integrated BIS, as demonstrated in the proof of concepts, companies get consolidated data, which enable faster and more profound management decisions and a more efficient controlling. As an example, many manufacturing companies would like to have a real-time purchase price of their products, which is only possible through consolidated data. **→ Real-time data, more efficient and accurate controlling/reporting, faster month-end closing procedures.**
V3	Different user interfaces of the involved business information systems.	Easy system, which is perceived as one system by the employees as it looks equally and can be operated with the same usability, even if actually different systems (e.g. ERP- and CRM-system) are involved. As can be seen in the proof of concept with Microsoft Dynamics 365, the ERP-system Dynamics 365 FO and the CRM-system Dynamics 365 Sales have the same user interface and usability, but are actually two different systems. **→ Less training time and quicker adoption for employees; higher acceptance by employees (end-users).**
V4	Dual data maintenance and media disruptions (e.g. customer data in ERP and CRM; material consumptions in Excel and ERP; bill of materials in CAD and ERP).	Considering the example of the recording of bill-of-materials within the ERP- and CAD-system: Make-to-order manufacturers often have big bills-of-materials, which must be entered/created individually for each sales order (as they are changing for each sales order). The input of these bill-of-materials in multiple systems (ERP and CAD) can be very risky, because of the big vertical range of manufacture. Thus, small errors in the data capturing and mapping can have fatal consequences, which can finally result in the production of a wrong bicycle. A serial manufacturer, on the other hand, does not need to create so many bill-of-materials. Therefore,

		the risk is not so high in that case. **→ Higher quality through data integrity and real-time data, which helps to spot trends and prevent issues.**
V5	Wrong or no product inventory information (from ERP system) within CRM system (data discrepancies).	As demonstrated in the proof of concept, the product inventory from the ERP system can directly be shown within the CRM system. Also the information about the current unit prices, the price books and the inventory sites, where the products are located, can be retrieved from the ERP system and directly shown within the CRM system. It was also shown that in the case of changing quantities or delivery dates (e.g. during price negotiations), the stock availability can be immediately checked within the CRM system. Finally, this prevents the sale of products for a promised quantity and delivery date, which cannot be fulfilled by the company afterwards. **→ Accurate delivery date commitments and an increase of the process reliability.**
V6	Many customizations of the standard software functionality necessary in order to fit the business processes.	Considering the following comparison: in the past, the majority of on-premise BIS installations contained many customizations of the standard software functionality in order to fit the specific business needs of the companies. Thus, a release change resulted in enormous efforts, as these customizations must have been re-implemented within the new software releases. Now, with cloud-based BIS, the standard functionality cannot be changed anymore, only encapsulated extensions to the standard functionality can be implemented. Consequently, software updates and complete version upgrades can be done seamlessly with considerably less effort as before. Actually, updates are done automatically, thus companies always have the latest software versions and functionality. **→ Cost savings at software maintenance and the ability to innovate as always operating with the latest software features.**
V7	No scalability in case of varying workloads (number of users, performance requirements).	Considering this example: a company operates 50 users throughout the year, but requires additionally 20 users only for a few weeks every year (e.g. during the summer when lots of bicycles are sold). With an on-premise system, the company would need to acquire 70 total users even if 20 of them are only used 10% of the time. With a cloud-based system, on the other hand, the company could instantly scale up to 70 users before the summer and then scale back down to 50 users after the summer. **→ Cost savings as companies only have to pay**

		for used software licenses (pay-per-use pricing model).
V8	No scalability in case of expansions (e.g. new production plants).	Considering this comparison: in the past, when companies have been growing, they often implemented additional isolated software systems, which could shortly fulfill the purposes, but finally resulted in poor reporting and in a lack of scalability and flexibility. Now, with cloud-based BIS, (start-up) companies can start with only what they require and grow at their own speed to run their business securely in the cloud. **→ Cost savings and a more efficient management of corporate growth.**
V9	No information about open customer items from ERP system within CRM system available.	As demonstrated in the proof of concept, the synchronization of open customer items between ERP- and CRM-system enables salespersons to discuss with customers about outstanding sales invoices as they have access to this information directly in the CRM system and do not have to look up this information in the ERP system. **→ Faster payment receipts and improved liquidity.**
V10	No information about customer sales history from ERP system within CRM system available.	The requirement to access information about the customer sales history, coming from the ERP system, within the CRM system was mentioned several times during the expert interviews. Because only based on this information, CRM activities like marketing events (e.g. only for customers who did not buy a bicycle the year before) or after-sales-services can be planned and organized efficiently. In the proof of concept with Microsoft Dynamics 365, it was demonstrated that it is also possible to show that information directly within Microsoft Outlook. **→ Marketing optimization and automation.**
V11	Business information systems from different software providers in use (e.g. best-in-class manufacturing systems)	Specialized software systems in different areas from different vendors may have the advantage that companies get the best possible software solution for each area (“Best of Breed”) but it is also connected with some disadvantages as described in chapter 4.3.1.2. Therefore, many companies follow the strategy to implement their BIS from one software provider as far as possible, as also confirmed by some expert interviews. This results in benefits regarding costs (elimination of multiple maintenance contracts), software maintenance and integrations (standard interfaces can be used). **→ Simplification, standardization and higher transparency between different departments.**
V12	No single point of truth for material stock (no leading	As demonstrated in the proof of concept (see Figure 24), a leading system for product

	system; self-created access databases for product databases of suppliers).	information like stock must be defined. A single point of truth for business critical data like product stock guarantees confidence of the employees in the system. Beyond that, it reduces overhead costs (as only one system must be looked up) and prevents incorrect or delayed delivery promises. **→ Prevention of dead articles and long delivery times.**
V13	No consolidated data source of sales opportunities (CRM), already dispatched sales orders (ERP), maintenance tasks (ERP or CRM) and other planning parameters.	Considering this example: the sales persons work with an offline solution and transmit only once a week their newly created sales opportunities and orders to the backoffice, who need to enter them within the ERP system. Therefore, production- and capacity planning cannot be done timely and efficiently because of a lack of real-time data. Consequently, production peaks cannot be prevented which can result in bad delivery reliability. A consolidated data source of CRM- and ERP-data, which are required data for capacity planning, eliminates these problems. **→ Optimized workload through efficient capacity planning.**
V14	Applied business information systems have no underlying mobile connected platform (platform limitation).	As demonstrated in the proof of concepts, all three analyzed systems enable a mobile access to the BIS, both by means of a Web browser and with mobile apps. This is connected with many advantages and enables a lot of business cases for manufacturing companies. **→ Access to business data anytime and anywhere.**
V15	Invoicing and payment process is a manual process.	As demonstrated in the proof of concepts, on the purchase side, the system gives recommendations on when to pay vendors in order to use vendor discounts and avoid overdue penalties. On the sales side, the system supports a faster creation of sales invoices. These two process automations are only possible with an integrated system. Within the companies of some expert interviewees, the accounting software was isolated from the production and sales system. In that case, an automated invoicing and payment process was not possible. **→ Automation of invoicing and payment process, thus improved cashflow.**
V16	No 360-degree view of customers possible within ERP, CRM and Outlook.	As demonstrated in the proof of concept, a 360-degree view of customers can be made within the ERP- and CRM-system of all three analyzed systems. Additionally, it was demonstrated that with Microsoft Dynamics 365, it is also possible to show important customer information like customer balances, sales history information etc. directly within Microsoft Outlook. Beyond that, it is also

		possible to create sales quotes, process sales orders and submit invoices without leaving Outlook. **→ Fewer systems required to finish sales tasks, thus faster sales decisions.**
V17	Version incompatibility between different software systems.	Referring to V11, if independent software systems are in use, which have been connected through custom integrations, version upgrades of individual systems are not possible without adapting all custom interfaces. With cloud-based integrated BIS like Microsoft Dynamics 365, this problem does not exist, as standard integrations are available between the different systems like ERP and CRM. Beyond that, all of these systems are always on the latest version, thus an incompatibility cannot occur. **→ Improved software maintainability through consistent software release cycles.**
V18	Time consuming and expensive integration of industry add-ins.	A fast implementation and deployment of integrated add-on apps (provided by an App-Store through the software vendors) is possible, which enable to extend the standard applications to fit industry or special business needs. Beyond that, it is possible to build custom apps, which connect to various data sources and services like Excel files, SharePoint lists or CRM records, as demonstrated in the proof of concept with Microsoft on the basis of Microsoft PowerApps. For example, as described in the proof of concept, an app for the ERP-system, which displays shipping tracking information, could enhance the standard functionality. Thereby, this app is based on information from the ERP-system (sales shipments) but also other external cloud services (carriers). **→ Implementation of the entire business processes within BIS, which enables a continuous information- and value flow across the entire supply chain.**
V19	No continuous sales process between CRM- and ERP-system (e.g. sales offers cannot be directly transferred to a sales order in the ERP system).	As demonstrated in the proof of concepts with all three analyzed systems, a continuous sales process based on follow-up activities between the different sales steps, which are also partly done in different systems (ERP and CRM), is possible. Thus, for example, a seamless conversion from the CRM sales quote into the ERP sales order is possible which eliminates the problems connected with dual data maintenance. **→ Timely planning is possible; no outsourcing of (partial) orders is necessary and short delivery deadlines can be provided.**
V20	Lack of integration between ERP- or CRM-system and DMS-systems like Microsoft SharePoint.	The costs of using SharePoint storage are much cheaper than using the CRM Online storage components. Generally, SharePoint offers a central storage for documentation, which can originate

		from multiple BIS (e.g. ERP- and CRM-system). According to the expert interviews, some industries demand a verifiability of their quality documents (which originate from a BIS), which can also be done within Microsoft SharePoint. **→ Cost savings, standardization, traceability.**
V21	No information about open sales opportunities from CRM system within ERP system available.	A forecast- and cash-flow planning, which is mostly done within the ERP-system, depends on several factors. One of them are open sales opportunities from the CRM-system. Thus, the availability of this information within the ERP-system enables an accurate forecast determination, but also a more accurate production scheduling, as already described in V13. **→ Optimized workload.**
V22	No workflows connecting business processes among different business information systems available.	In the proof of concept, two examples of process optimizations, based on system overlapping workflows, have been demonstrated (creation of new contacts and shipment of finished bicycles). In both cases, multiple BIS were involved (in the first example it was Outlook and the CRM-system, in the second example the ERP-system, Outlook and SharePoint). This enables a higher level of process automation, which is important to improve efficiency for faster outcomes across individual customer experiences. **→ Process automation and improved productivity.**
V23	Lack of BI dashboards containing KPIs (e.g. contribution margins) which can be shown within ERP-/CRM-systems.	As demonstrated with several examples in the proof of concept, it enables companies to run businesses in real time with live dashboards. They can ask questions of their data in real time (e.g. decisions about production programs), automatically discover insights from their data and visualize insights in the context of their business. Based on this, they can guide employees to optimal outcomes. For example, a prediction can be done regarding when and what to replenish with built-in intelligence like sales forecasts or dynamically updated inventory levels. **→ More informed decision making and statements about profitability, efficiency and other KPI's can be made at any time.**

Table 14: Make-to-order process optimizations

5 Results and findings (Discussion)

The goal of this chapter is to discuss the research questions of this Master's Thesis by reflecting the answers and results of the empirical methods as described in chapter 4. Thereby, an answer to all four research questions will be given in the first sub-chapter. Afterwards, a generalization of the findings by answering the main research question of this thesis will be done. Finally, an overview about additional findings, strengths and limitations of the results will be given.

5.1 Answers to research questions

5.1.1 Supportive question 1

Which criteria should be regarded when selecting cloud-based integrated business information systems in manufacturing companies?

The answer for the first supportive research question can be found in detail in chapter 4.2, which contains a listing and description of the most essential requirements and selection criteria for cloud-based integrated business information systems. Thereby, the author derived the majority of these criteria out of the results of the **expert interviews**, which are described in chapter 4.1.2. Beyond that, some criteria were identified based on further **literature research**. Additionally, the author also made an evaluation against the international software quality standard **ISO 25010**, which is also described in chapter 4.2. Finally, all main characteristics and, with the exception of the five sub-characteristics "User error protection", "User interface aesthetics", "Maturity", "Fault tolerance" and "Testability", all sub-characteristics of the ISO 25010 standard were reflected by at least one criterion of the identified criteria catalogue.

The following table summarizes the identified criteria:

Functional criteria	**Non-Functional criteria**
Limitations of functionality comparing to the on-premise variants	Subscription fees
Standard interfaces	Online documentation
Mobile access (Web-/Phone-/Tablet client)	Information security and data protection
Dashboards based on information from different business information systems	Performance and availability
Office-/collaboration integration	Upgrade capability
Limitations of customizability comparing to the on-premise variants	Implementation duration
User friendliness	Flexibility and scalability through integrated add-on apps
Integration / development platform	Data lock-in
Consistent availability of material information	
Direct conversion of sales offers into sales orders	
Real time data visibility of information between ERP- and CRM-system	
360-degree view of customers from different business information systems	
Support of workflows	
Integration with document management system (DMS)	

Table 15: Criteria catalogue

As can be seen, 14 functional- and 8 non-functional criteria, a total of **22 criteria** have been identified. Referring to the main topics of this Master's Thesis – the integration of BIS and the deployment of BIS in the cloud – the criteria catalogue also confines to factors concerning these two topics. Each of these criteria is described in detail in chapter 4.2.3, including a reference to the expert interviews, which referred to the criterion, a description how the evaluation of each criterion is done during the proof of concepts and the reference to the related ISO 25010 characteristics.

When comparing to the **hypothesis** of the author - *Hypothesis 1: „The failure safety, availability of IT resources, data volume, performance and costs are essential criteria, which should be regarded when selecting cloud-based integrated business information systems."* - it can be inferred that all but one criteria, the data volume, are included in the actual criteria catalogue. However, the author's hypothesis was only limited to non-functional criteria, whereas the actual identified criteria catalogue is dominated with functional criteria.

As can be looked up in the evaluation of the expert interviews (chapter 4.1.2), all of the identified criteria were mentioned at several interviews. However, the **three most stated criteria** and success factors of cloud-based BIS according to the expert interviews are the availability of standard interfaces, the existence of dashboards based on consolidated data among all involved BIS and the upgrade capability of the software systems. These three criteria are assessed with a higher weighting in the upcoming chapter when answering the supportive question 2.

5.1.2 Supportive question 2

> *Which of the cloud-based integrated business information systems Microsoft Dynamics 365, SAP Business ByDesign or Oracle NetSuite currently fulfill these criteria at best?*

The foundation for the answer of the second supportive research question is described in detail in **appendix D** and **appendix E**. In appendix D, the author made an **evaluation of each criterion**, which was identified in supportive question 1, for the three cloud-based integrated BIS Microsoft Dynamics 365, SAP Business ByDesign and Oracle NetSuite. Appendix E, on the other hand, contains the evaluation of the criteria catalogue by **three selected experts** for each individual system. Thereby, each criterion was graded, and a textual justification was also given for the grading. In order to gain a fair and expressive evaluation, the author used the insights of the expert interviews and proof of concepts but also some further literature and online documentation as decision-making basis. However, due to the more in-depth knowledge of the experts about the analyzed systems, the author finally gave the results of the experts a higher priority as the results of the author.

Chapter 4.3.3.1 contains the tabular overview (*Table 13: Decision matrix*) about the grading of all criteria in the form of a **decision matrix** and afterwards a summary of the most important aspects of this criteria evaluation. The following table depicts an extract of this decision matrix including the **sum values**.

Criteria	Microsoft Dynamics 365	SAP Business ByDesign	ORACLE NETSUITE
SUM FUNCTIONAL CRITERIA	13.0	11.0	11.1
SUM NON-FUNCTIONAL CRITERIA	6.1	7.6	6.9
TOTAL SUM	**19.1**	**18.6**	**18.0**

Table 16: Total sums of decision matrix

As mentioned in chapter 4.3.3.1, the included decision matrix contains no **weighting** of specific criteria. As determined in the last chapter, when answering supportive question 1, three criteria could be identified as the most stated criteria during the expert interviews. Thus, the author weighted these three criteria with a factor 1.5 instead of 1.0 as can be seen in the following table.

Criteria	Microsoft Dynamics 365		SAP Business ByDesign		ORACLE NETSUITE	
FUNCTIONAL CRITERIA	Before	After	Before	After	Before	After
C2: Standard Interfaces	1.0	**1.5**	1.0	**1.5**	0.5	**0.75**
C4: Dashboards based on information from different BIS	1.0	**1.5**	1.0	**1.5**	0.5	**0.75**
NON-FUNCTIONAL CRITERIA	Before	After	Before	After	Before	After
C19: Upgrade capability	1.0	**1.5**	1.0	**1.5**	1.0	**1.5**

Table 17: Grading of the most stated criteria after weighting

However, as can be seen in the following Table 18, the weighting had no impact on the ranking, and the gap between Microsoft Dynamics 365 and SAP Business ByDesign remained constant. Just the gap between Oracle NetSuite and the other two solutions increased even more, as NetSuite had worse evaluations in the case of two top-weighted criteria.

Criteria	Microsoft Dynamics 365	SAP Business ByDesign	ORACLE NETSUITE
SUM FUNCTIONAL CRITERIA	14.0	12.0	11.6
SUM NON-FUNCTIONAL CRITERIA	6.6	8.1	7.4
TOTAL SUM (after weighting)	**20.6**	**20.1**	**19.0**

Table 18: Total sums of decision matrix after weighting

Consequently, the answer to the supportive question 2 is that **Microsoft Dynamics 365** currently fulfills the identified criteria at best. However, when considering the criteria evaluation in appendix D, it can be said, that there are not enormous differences between the three analyzed systems. All three systems offer equal functionalities and features on a high level. This aligns with the hypothesis of the author. However, the author expected that Oracle NetSuite and SAP Business ByDesign would gain a better result than Microsoft Dynamics 365 due to their longer existence as a cloud-based system. To restate, the hypothesis was: *Hypothesis 2: „Microsoft Dynamics 365, SAP Business ByDesign and Oracle NetSuite function at a similar level even if SAP Business ByDesign and Oracle NetSuite eventually have some advantages as these two products have already been established on the market for a longer time."*

Finally, the main reasons, why **Microsoft Dynamics 365** obtained the best results were the following:

- Highly developed **integration with Microsoft Office 365**, which is the main distinguishing feature of Microsoft Dynamics 365 comparing to the other two products. Microsoft Dynamics 365 contains a full and seamless bidirectional integration with Microsoft Office which enables and supports a great number of business cases, as demonstrated in the proof of concept of this Master's Thesis. As Microsoft Office is for sure the most widespread office- and collaboration software suite, this powerful integration is a main competitive factor of Microsoft Dynamics

365. Consequently, a lot of ERP- and CRM-activities can be directly executed out of Office 365.

- **Integration platform**, which enables flexible and out-of-the-box integrations with various applications. As demonstrated with some examples in the proof of concept, based on the Common Data Services and supported with Microsoft PowerApps and Microsoft Flow, powerful integrations, processes and apps can be established.
- Due to the deep integration between the ERP-system (Dynamics 365 for Finance and Operations), CRM-system (Dynamics 365 for Sales) and Outlook (Office 365 Outlook) a **360-degree-view of customer information** (and the same would also be possible with article information and other important master data) is directly possible out of all three systems. Within the ERP- and CRM-system, SAP Business ByDesign and NetSuite offer similar functionalities. However, the main distinctive factor of Dynamics 365 again is the possibility to enable that feature also within Microsoft Outlook. Consequently, a lot of business decisions can be taken directly out of Outlook without switching to the ERP- or CRM-system.
- The deep standard integration between Microsoft Dynamics 365 and **Microsoft SharePoint**, which is an often-used collaboration and document management platform. Many company also use it as Intranet portal and social network. Therefore, the integration with business data out of the ERP- and CRM-system provides many valuable business cases for manufacturing companies. Generally, it is also possible to establish Microsoft SharePoint integrations with SAP Business ByDesign and NetSuite, but only based on external additional middleware technologies.

Summarizing, the **powerful integration capabilities**, in order to establish an integrated end-to-end solution, are the key reasons why Microsoft Dynamics 365 was graded with the best result. Therefore, the **functional criteria** were the main decisive factors for Microsoft Dynamics 365. Regarding the cloud capabilities, which are mostly non-functional criteria, all three systems are on a very similar level, even with some advantages for NetSuite and SAP Business ByDesign as they are longer represented as cloud solutions on the market.

In contrast, the main benefits of **SAP Business ByDesign,** comparing to the two other systems, are the cheaper subscription fees, a well-defined security concept and the minimal average implementation duration. On the other hand, the user friendliness and user interface of SAP Business ByDesign are the main drawbacks comparing to the other two systems.

Oracle NetSuite, as a last analyzed product, convinces as a PaaS solution with very powerful customizing possibilities, but has limitations comparing to the other two systems in the mobile access, the possibility to build cross-system dashboards and the existence of less standard interfaces.

5.1.3 Supportive question 3

How can the make-to-order processes of a manufacturing company be improved by integrating ERP-, CRM, BI- and other types of business information systems?

ERP for the back-office, CRM for all departments with direct customer contact – the classical division of many companies – causes problems and vulnerabilities in manufacturing companies. In order to answer this research question, the author first identified potential and common **vulnerabilities**, which occur due to such isolated on-premise applications in manufacturing companies. As a result, 23 vulnerabilities have been identified, which are listed and described in chapter 4.3.1.2. Thereby, a short description of

each vulnerability including the negative consequences for the manufacturing company and a reference to the expert interviews, which were the information source for this vulnerability, is given in *Table 11: Vulnerabilities of isolated on-premise systems*. At that point, it must be noted, that some of these vulnerabilities are generally applicable and not only related to manufacturing companies.

The goal of the author was to find out, whether these vulnerabilities can be optimized or at best eliminated through cloud-based integrated BIS. Therefore, the author implemented **proof of concepts**, which was done and described in chapter 4.3.2 at a glance and in appendix C in detail, both times including a sub-chapter for each of the three analyzed systems. The definition of the "concept" and of the "proof" and all other input parameters for this proof of concept, especially the pre-defined make-to-order business process scenario, can be found in chapter 4.3.1.

As a result, a list of **qualitative described process optimizations** of the make-to-order processes was derived, by explaining how the aforementioned vulnerabilities could have been optimized. This can be found in *Table 14: Make-to-order process optimizations* in chapter 4.3.3.2 and constitutes the answer for supportive question 3.

Summarizing, the **most essential process improvements of the make-to-order processes** of manufacturing companies by integrating cloud-based BIS are the following:

- Faster and more accurate controlling and management decisions through consolidated real-time data, BI dashboards containing KPIs and fewer systems required to look up information (e.g. for decisions about production programs).
- Accurate delivery date commitments and an increase of the process reliability. This enables *available-to-promise* (ATP), by fulfilling delivery promises to the customers.
- Prevention of dead articles and long delivery times.
- Optimized workload through efficient and timely capacity planning and a more accurate production scheduling. Thus, short delivery deadlines can be provided and the outsourcing of (partial) orders can be prevented.
- Continuous information- and value flow across the entire supply chain, which enables shorter order cycle times, an increased order accuracy and a real-time inventory visibility.
- Improved cashflow through automation of invoicing and payment processes.
- Access to business data anytime and anywhere.
- Higher quality through data integrity, which helps to spot trends and prevent issues.
- Process automation and improved productivity through cross-system workflows.
- Less training time and quicker adoption of the software systems for the employees.
- Simplification, standardization and higher transparency between different departments, which enables faster payment receipts, improved liquidity and marketing optimizations.
- Cost savings due to less software maintenance, lower licensing costs and reduction of overhead costs.
- Ability to innovate as always operating with the latest software features.
- Higher scalability in case of varying workloads and company growth.

When comparing to the author's hypothesis - *Hypothesis 3: „By integrating IT business information systems within a company it enables a consistent and central database of real time data, an integrated view of business processes, a faster and more transparent reporting and a more efficient usability and administration."* – it can be verified that all of the aspects of the hypothesis are included in the aforementioned list of process optimizations.

5.1.4 Supportive question 4

What are the potentials and challenges of cloud-based integrated business information systems for manufacturing companies?

The last research question was stated in a more general way. Thereby, the goal of supportive question 4 is to generally identify the potentials and challenges of cloud-based integrated BIS for manufacturing companies. The answer for this question can be found within the results of the empirical methods performed in chapter 4, mainly the expert interviews and the proof of concepts. A summarization of the most important findings regarding this question will be done in this chapter in the following table, which contains a list of both potentials and challenges of cloud-based integrated BIS, both times with focus on the manufacturing industry as far as possible. Thereby the potential in the first column and the challenge in the second column within one line have no relation.

Potentials	Challenges
Faster deployment: no time for procuring and installing IT infrastructure is needed; the cloud-based BIS are equipped with basic configurations, which address the most critical needs of companies.	**Customizing:** the standard core functionality of the cloud-based BIS cannot be changed, as it was mostly possible with on-premise systems, which results in a limited range of customizing options.
Lower up-front costs: companies can treat the installation and deployment of the IT systems as operational expenses rather than capital expenses.	**Integration with legacy systems**: the integration with other on-premise applications and data (historically grown systems) can become difficult and complex.
Reduced upgrade/maintenance requirements: updates and version upgrades can be done seamlessly (without additional efforts) and automatically. Thus, companies always operate with the latest versions due to higher release capabilities. Beyond that, a simpler remote/field support is possible. A fully integrated system eliminates the maintenance and installation of custom integrations.	**Loss of governance**: companies cannot control the security of the systems and must trust the software providers. Well-defined SLA's are needed with clearly defined uptime provisions, a definition of the usage of customer's data, etc. As a finding of the expert interviews, this is often an emotional problem rather than a technical problem.
Transfer of risks: IT administration (backups, etc.) and associated risks are shifted to the software providers. Consequently, companies need less in-house expert staff for IT maintenance.	**Performance**: in the manufacturing industry, the system's performance is a critical issue. However, this also depends on external circumstances like latency and network/bandwidth limits.
Higher scalability and flexibility: based on a pay-as-you-go model, operating expenses can be aligned to the actual business volume, which makes cash flow management and planning much easier. Companies can start with what they require and grow at their own speed.	**Vendor lock-in**: companies agree to a high dependence on the software provider, which can make it difficult to transfer data and services to another cloud provider or also back to the in-house IT. This also needs to be clearly defined in the SLAs.
Higher standardization: cloud-based BIS normally allow no change of the standard code, which results in a higher level of the usage of standard systems.	**Compliance issues**: companies may encounter difficulties with audits or certifications, which are required for specific industries.
Focus on core competencies: as the IT administration is done by the external	**Application availability**: based on the expert interviews, the author found out that

software provider. Especially for small-sized companies without a big IT department this is an important factor. Additionally, companies are getting supported with cross-departmental collaboration.	the uninterrupted availability of the SaaS applications is one of the most critical concerns that manufacturing companies are worried about. Only short outages can have fatal consequences for the companies.
Increased visibility of information: real-time data and an accelerated search for information enable ad-hoc analysis. For example, automated and accurate forecasts of future product demands can be made.	**Loss of technical knowledge**: as companies no longer have to concern themselves about technical issues, they also loose technical innovative capacity on the other hand.
Integrated business process view: all process participants can immediately see the current status of the process. This enables faster responses to changes in the business environment and an improved order, inventory and quote management. Thus, an increased process efficiency across an organization is possible.	**Organizational resistance**: moving BIS to the cloud can create considerable organizational disruptions. IT organizations with a strong culture of pride of the ownership of their IT systems are likely to feel threatened by moving their BIS into the cloud (Utzig et al., 2013, p.10).
Faster business decisions: as no collection of information among various systems is needed, no time is lost with switching different systems and searching for information. Built-in intelligence proactively guides to optimal outcomes.	**Interoperability**: the steady increase of interface- and protocol formats complicate the efficient access to data sources. Attempts for standardization have not been successful yet.
Easier learnability: a fully integrated system with a consistent user interface quickly empowers users to handle the system and their day-to-day tasks.	**Leading system:** the definition and maintenance of a leading system (e.g. at article maintenance in both an ERP-system and a Web Shop) can become crucial.
Easier data administration and reduction of data duplication: especially the master data management of articles, customers and other important master data can be relieved and optimized considerably.	**Error handling:** when multiple systems are integrated, the error handling including conditions, responsibilities, defined handover points, etc., can become complex and sophisticated.
Globalization: cloud-based BIS enable companies to run their businesses more globally and also across the national borders.	
Mobility: access to BIS is possible anywhere, anytime and with any device.	
Access to state-of-the-art technology: the software systems are steadily equipped with latest functionality, customizing methodologies but also with up-to-date strong security facilities. Thereby, companies also benefit from shorter product development and release cycles.	
Extensibility: modern cloud-based integrated BIS enable to extend their standard functionality with productivity apps that users need every day, e.g. sales and service capabilities in CRM.	

Table 19: Potentials and challenges of cloud-based integrated business information systems

As can be seen in the table, and also as a general finding of this work, the author could identify both a number of potentials but also various challenges of cloud-based integrated BIS for manufacturing companies. However, the potentials prevail.

Comparing to the hypothesis of the author - *Hypothesis 4:* „*Cloud-based integrated business information systems build the foundation for optimizing the make-to-order business processes of companies by increasing the flexibility, productivity and scalability of manufacturing companies."* – the three attributes **flexibility**, **productivity** and **scalability** cover many of the aforementioned potentials. However, the author was not aware of a great number of available challenges when establishing this hypothesis.

5.2 Generalization of findings

After answering the four supportive research questions in detail, an answer to the main research question and a summary and generalization of the main findings of this Master's Thesis will be given.

The main research question asked:

> *How can cloud-based integrated business information systems improve the make-to-order business processes of manufacturing companies?*

Without repeating all the aforementioned aspects, as this main research question is like a summary of the four supportive questions before, the main issues concerning this main research question are the following:

- **Shorter throughput times**: for example, already in the offer phase, it should be checked if all required materials are in stock. When orders are placed, manufacturing related data should automatically be forwarded to the production scheduling. And many more manufacturing processes, which can be accelerated or automated based on integrated systems.
- **Improvement of the customer interaction**: in case of customer questions regarding a specific sales order, the sales department is immediately willing to give information, as they are accessing current manufacturing data.
- **Recognition of additional sales potentials**: a cross-system 360-degree view of customers including their sales history empowers the identification of cross- and upselling opportunities. The ad-hoc insight into the current warehouse situation enables faster sales decisions, e.g. regarding discounts for dead articles.
- **More productive master data management**: better transparency and elimination of media disruptions. Manufacturing companies are equipped with one single-point-of-truth of their important business master data, like products and customers.
- **Improved user comfort**: due to a continuous user interface, the end-users do not realize that they operate with different systems. This increases acceptability by the users and reduces the training costs.
- **Mobility**: this is especially important for the field team. They massively benefit from the mobile access to their business data, as they are always up-to-date of any changes occurring in the data of their customers, products, inventories, etc.
- **Streamlining of information**: the collaboration among different departments will be improved. The company's management can simply verify all operations with always up-to-date data based on BI dashboards, which offer one version of the truth in real time. As a result, overall productivity and sales will increase and finally the profit margins will gain.
- **Exploitation of the strengths of specialized systems**: even if most modern ERP-systems already contain CRM- and BI-functionalities, many companies need

additionally to their ERP-system separated CRM- and BI-systems, as they cover more comprehensive functionalities than the CRM- and BI-modules of ERP-systems. However, a seamless standard integration between the different systems is necessary due to the aforementioned aspects.

- **Globalization**: manufacturing companies with multiple facilities worldwide benefit from global data consolidation, analysis, and an easier information exchange between the different sites.
- **Focus on core competences**: manufacturing companies that follow the *"lean business philosophy"*, which means that all non-value-adding activities must be eliminated, do not have to deal with the complexity of an IT infrastructure. The same applies for start-up companies that cannot afford an on-premise IT infrastructure (Rohm, 2018, p.28).
- **Facilitation of new sales channels**: new sales and distribution channels such as e-commerce (e.g. a manufacturing company wants to offer B2C additionally to B2B) can be supported with cloud-based integrated BIS as technology foundation (Misra, 2017, p.8).

The boundary between systems like CRM and ERP has caused isolated data and processes in many manufacturing companies in the past. This Master's Thesis has shown that cloud-based integrated BIS, like Microsoft Dynamics 365, breaks down this separation and allows for greater extensibility and flexibility, whether companies focus on optimizing their business processes or adding custom business logic. This leads to the author's conclusion, that cloud-based integrated BIS streamline the complete make-to-order process, by offering a seamless flow without manual bottlenecks beginning from the lead in sales through to the payment in the back office.

5.3 Additional findings

In addition to the abovementioned research questions and their answers, this Master's Thesis identified the following additional findings:

- **Importance of communication and project management**: in every IT integration project, different parties and expert groups (customer, ERP implementation partner, CRM implementation partner, third-party-software providers, etc.) are involved. Only by means of clear communication, a well-marked change- and project management and the establishment of a common language, such projects can be successfully completed.
- **Foundation for digital trends:** cloud-based integrated BIS build the foundation for many digital trends like Internet of Things, Machine Learning, Predictive Analytics, etc. Some more details regarding this issue will be given in chapter 6.3.
- **Contrasting viewpoints between the two expert groups:** when considering the answers of the expert interviews and comparing the results between the two different expert groups (IT experts and key users of manufacturing companies) it can be concluded that the two expert groups have contrary opinions regarding some questions, mainly regarding cloud-related topics, e.g. concerning the current and upcoming trend of cloud-based BIS or regarding the consequences to the implementation duration.
- **Difficult comparability between different software systems:** the implementation and evaluation of the proof of concepts revealed that it is challenging to compare different software systems from different software providers, especially finding comparable criteria. However, the author tried to contrast the three analyzed systems as objectively as possible.

5.4 Strengths and limitation of the results

The first question that arises is whether the applied **research approach** was the correct and best one for this Master's Thesis. Generally, the author claims that it was the correct approach, as all research questions could have been answered by contrasting theoretical and empirical parts. Similarly, the author asks himself whether the chronological order of the applied methods was the correct one. Retrospectively, the author also believes that the order was applied meaningfully, as the applied methods built upon on top of each other. Thereby, the expert interviews were the basis for the criteria catalogue, and the criteria catalogue was the basis for the proof of concepts. Finally, all of these methods were the foundation for one or more research questions. The mainly **qualitative research approach** was also the appropriate choice, as for a quantitative research, on the one hand, a much higher number of interview partners would have been necessary and, on the other hand, it would have been rather difficult till impossible to quantify the constructed research questions realistically. The reason for applying an **inductive approach** was because this topic is rather new for manufacturing companies and thus less data is already available.

The semi-structured qualitative **expert interviews** were conducted with experienced interview partners (mostly with management positions) established in their field of work for many years and equipped with profound experiences of multiple projects in the manufacturing industry. Therefore, the interviews generated a considerable number of valuable and meaningful short-term qualitative insights. Additionally, different perspectives were considered by involving two different expert groups and different software systems from different software providers. This guarantees a strong level of validity and representation. As the interviews contained some rather complex questions, the identification of expert knowledge about these questions would have been difficult by means of surveys. As the author solely used open questions, a discussion was enabled, and further information could be obtained. Finally, the **qualitative content analysis** of the interviews enabled an inductive creation of categories, which built the basis and input for the established criteria catalogue. The **criteria catalogue**, which is limited to topics around the integration of BIS and the deployment of BIS in the cloud, is still quite extensive with its 22 criteria. The reconciliation of the results of the expert interviews with further literature research and with the criteria of the international software quality standard **ISO 25010** ensured that the most important success factors for the implementation of cloud-based integrated BIS were considered, which were used for a validation of concrete software systems afterwards. As a last method, the **proof of concept**, by analyzing well-known and highly distributed state of the art software products on the market, produced an executable artifact comparing to the theoretical artifacts before. Thereby, the executable artifact was the implementation of a pre-defined make-to-order process within three selected software systems and afterwards the analysis and evaluation of the systems and the implementations. For the evaluation of the analyzed systems, additionally to the criteria catalogue evaluations of the author, the evaluations from external experts in the specific systems were also taken into account, in order to guarantee an expressive result.
Finally, a **triangulation of the different methods** increases the internal validity and enriches completeness by fully addressing the original research problem.

However, there are still some **limitations** of the applied research methodology. The **expert interviews** could include bias. Additionally, through a strong focus on small- and midsized companies, the results are not completely generalizable. Regarding the **criteria catalogue**, only a very simplified weighting of the identified criteria was done, by giving the three most stated criteria of the expert interviews a higher priority. Otherwise, the author assumed that all criteria were equally important. Some criteria of the criteria catalogue are

changing at a quick pace and this Master's Thesis only offers a **snapshot** (e.g. the current subscription fees). Finally, within the **proof of concept**, only big software players (Microsoft, SAP and Oracle) have been considered, and not smaller and cheaper software systems or even open source systems. Beyond that, only for the Microsoft implementation, the author could use a full installed and configured system. For NetSuite and SAP Business ByDesign, only **demo versions** could have been analyzed. Additionally, only **one exemplary process** (a typical make-to-order process) was reviewed, which results in a lack of generalization (what about series- or mass-production processes?) and repeatability. Even more, the underlying make-to-order process scenario does not consider the whole **lifecycle**, e.g. the after-sales-service was not considered. As the three analyzed software systems have partly different product philosophies and architectures, the comparison between the different systems was partly very difficult. At the evaluation of the proof of concept, **no exact performance measurements** of the process optimizations based on specifically designed measuring indexes were done (e.g. by OLAP systems like for example the OLAP Information Cubes in Microsoft. Dynamics). At the validation of the selected systems, just expert evaluations from single experts for the particular systems were regarded, but no evaluation of all three systems through one expert was taken into account.

6 Conclusion

6.1 Overall conclusion

This Master's Thesis deals with could-based integrated business information systems, due to the current importance and relevance of these two disruptive trends (integration and cloud). The author started with an **introduction** in chapter 1 by revealing the research problem and the targets of this thesis, which were the analysis of IT business information systems (with focus on ERP-, CRM-, BI- and collaboration-systems) regarding the aforementioned two aspects. The intention of the author was, on the one hand, the analysis and comparison of real software systems and, on the other hand, the evaluation of process optimizations based on the analyzed systems, whereby the analyzed processes were focused on the Manufacturing industry. On the basis of these goals, the research questions were constructed including a definition of the research methods how to answer the research questions and the originally expected results of the author. The second chapter contains an overview, definition and justification of each of the defined **research methodologies**, which are the following: a literature review and expert interviews for data collection and a proof of concept, supported with a criteria catalogue, for data analysis.

The first method, the **literature review**, was conducted in chapter 3, which is intended to summarize past and current literature on the three main disciplines of this thesis, namely, business information systems fundamentals with focus on ERP-, CRM- BI- and collaboration-/office-systems; the integration of business information systems and cloud fundamentals with focus on Software-as-a-Service (SaaS). Therefore, the literature review provides fundamental and required information to research the topic and defines essential terms.

The fourth chapter, which is the most comprehensive chapter, describes the application and the results of the aforementioned empirical research methods.
As a first empirical method, the author conducted **16 expert interviews** with the goal to identify the most important criteria and success factors of cloud-based integrated business information systems. In order to receive different perspectives, the author selected two target groups of interviewees: IT experts of IT consulting companies on the one hand and key users and managers of manufacturing companies on the other hand. Beyond that, the interviewed persons have expert knowledge in different software systems from different software providers. Therefore, the author developed two different interview guides for the two interview target groups, including both times questions regarding the integration of business information systems and questions regarding cloud-based business information systems. Chapter 4.1.1 describes the interview guides and gives an overview about the 16 selected interview partners. The complete interview guides including all questions can be found in appendix A. All 16 interviews were conducted personally on-site or by telephone, recorded and transcribed. A transcription of each interview can be found in appendix B, whereby most interviews were done in German as this simplified the interviews. Based on the interview transcriptions, the author did a **qualitative content analysis** as defined by Mayring (2010). Within chapter 4.1.2, firstly, each interview was summarized to the most important statements and secondly, a comparison and contrasting of the opinions of the interviewees regarding the key topics of the interviews was done. Thereby, the key topics were derived based on an inductive category formation out of the interview data. As can be seen in Table 6 and Table 7, many equivalent answers between the different interviews, but also some rather contrasting answers, have been identified.

Based on the results of the expert interviews and further literature research, as a next step, the author developed a **criteria catalogue**, which is described in the second sub-chapter

of chapter 4. Thereby, the author also made an evaluation against the criteria of the international software quality standard **ISO 25010**. The goal of the criteria catalogue was to build a basis for the evaluation of specific software systems by means of the proof of concept and through external experts, which is described later on. After defining the rules how the evaluation of the criteria shall be done in chapter 4.2.2, a listing and description of the identified criteria, both functional- and non-functional criteria, was done. For each criterion, the author justified why it is important and crucial for cloud-based integrated business information systems and also pointed out the reference to the underlying expert interviews and further literature, which were the information source. Additionally, for each criterion it was defined how the evaluation was done and the reference to the corresponding ISO 25010 characteristics and sub-characteristics was given. Finally, the author identified 14 functional and 8 non-functional criteria, which are described in chapter 4.2.3. Thereby, the author put the focus on a big picture about what is most essential and not on a deep analysis of detailed criteria, as this would have gone beyond the scope of this work.

As a last step, the implementation and evaluation of a **proof of concept** was done. Thereby, the **concept** is the implementation of a pre-defined make-to-order business process scenario of a manufacturing company, which was defined in chapter 4.3.1.1, within three selected SaaS-based integrated software system landscapes (Microsoft Dynamics 365, SAP Business ByDesign and Oracle NetSuite), which are described in chapter 4.3.1.3. The **proof**, on the other hand, is firstly the evaluation of those software systems by means of the pre-defined criteria catalogue and secondly the demonstration that through the integration of business information systems like ERP, CRM, BI and collaboration systems and the application of those systems in the cloud, it is possible to eliminate the vulnerabilities of isolated on-premise applications and thus to optimize manufacturing business processes. Therefore, chapter 4.3 contains three subchapters. It starts with the **definition of the initial parameters** of the proof of concept, which are the analyzed make-to-order process scenario; a definition of potential vulnerabilities of isolated on-premise applications within manufacturing companies, which have been identified through the expert interviews and a short description of the three analyzed software systems. The second part gives a brief summary of the **implementation within the three selected systems**, whereby the detailed description can be found in appendix C. Thereby the focus was put on the analysis of the integration between different cloud-based business information systems but not the detailed analysis of specific manufacturing business processes within the individual business information systems. The biggest focus and level of detail was put on the implementation with Microsoft Dynamics 365. For each implementation, a short description of important installations and setups and afterwards an iteration of the defined make-to-order process was demonstrated, underpinned with descriptions and screenshots directly out of the installed systems (in appendix C). However, as already said, not each individual step and action of the process implementation was described and demonstrated with screenshots, as this would have gone beyond the scope of this thesis. The author tried to include all descriptions and screenshots, which are necessary in order to enable an objective comparison between the three analyzed systems and an evaluation of the defined criteria afterwards. The last part of the proof of concept was the **evaluation**, which is described in chapter 4.3.3. Firstly, for all three selected systems, each identified criterion was evaluated by means of a decision matrix, which can be found in chapter 4.3.3.1. This evaluation is consolidated on the grading of the author with the grading of external experts of the three analyzed systems. The **author's grading** is based on the results of the expert interviews, proof of concept and further literature research and is described in appendix D including a justification and reasoning for the evaluation of each criterion for each system. The **expert's grading**, which overruled the author's grading, is summarized in appendix E, again including a

reasoning for each criterion. Additionally, a **weighing** of the three most important criteria, which were the three most stated criteria during the expert interviews, was done. Secondly, the author conducted a **qualitative assessment of process optimizations** within the make-to-order process by analyzing whether, and to what extent, the identified vulnerabilities of isolated on-premise applications could have been eliminated or optimized, which is described in Table 14.

Finally, chapter 5 answers the research questions by using the obtained information from the aforementioned methods and summarizes the **results and findings**. As short answers to the four supportive research questions, it can be summarized: **22 criteria** have been identified as the most important criteria, which should be regarded when selecting cloud-based integrated business information systems (question 1). **Microsoft Dynamics 365** currently fulfills the identified criteria at best (question 2). **23 qualitative described process optimizations** of the make-to-order process by integrating ERP-, CRM-, BI- and other cloud-based business information systems could have been identified (question 3) and finally **16 potentials and 12 challenges** of cloud-based integrated business information systems for manufacturing companies were derived. Thus it can be concluded, that cloud-based integrated business information systems improve the make-to-order processes of manufacturing companies in several aspects, as summarized in chapter 5.2. Some additional findings, strengths and limitations of this Master's Thesis top the chapter off.

6.2 Possible implications

Based on the findings of the expert interviews, manufacturing companies, especially make-to-order processing companies, have some **specialties comparing to other industries**. First of all, they possess many business data, not only articles and prices, but also work plans, bill of materials, constructional drawings, quality assessment data, safety certificates, PLM data, country-specific checks, country-specific security laws and many more. Based on the variety of different data, they also often need multiple different systems like ERP, CRM, DMS, BI, PLM, CAD, factory data capture, calculation, quality assurance and eventually other specialized manufacturing systems. It was also discovered, that many manufacturing companies outgrow their basic accounting systems, legacy ERP systems and other systems. Consequently, they have isolated unconnected applications, leading to duplicate data and manual processes, which finally does not allow an efficient reporting. This was also confirmed by Marko Perisic, General Manager of Microsoft Dynamics 365, who states: "*Without having clear insights across different processes and be able to drive consistent reporting and predictive analytics, companies cannot make the right decision in the right time* (Perisic, 2018)*.*"

Cloud-based integrated business information systems based on a platform, which is integrated as seamlessly as possible by means of standard API's and enhanced by workflows, support eliminating these problems. They enable manufacturing companies to connect their business, to make more intelligent decisions and to support their corporate growth. In the past, such integrations were code-/development-heavy. Now, with modern cloud-based integrated systems, it is the work of Business Analysts or Software Architects.

Software providers of business information systems have been tending increasingly more to the Cloud recently. Thus, this **topic must be considered in upcoming implementation projects**. Manufacturing companies must prepare for that and must consider the consequences to the integration of their existing solutions. This work shows the possibility to optimize manufacturing business processes based on the effective implementation of cloud-based integrated business information systems. It shall serve as a

good basis for decision makers of business information systems to assess criteria and evaluate if there is optimization potential or readiness for a cloud-based integrated solution. However, this Master' Thesis and particularly the proof of concept implementations should not be understood as the only right way to set up a make-to-order process, but rather gives hints and start-up guidance.

The **personal opinion** of the author is, that especially for start-up companies, which do not have their own "real" individualized processes, which would require extensive customizations, cloud-based integrated business information systems like Microsoft Dynamics 365 are the perfect choice as they enable start-up companies to immediately operate with the standard processes of the software systems. Obviously, the reduced up-front costs are also beneficial for such start-up-companies. However, also for established and bigger companies, the author recommends the implementation of cloud-based integrated systems due to the potentials, which were identified during this work and in order to provide the foundation for future upcoming trends.

6.3 Outlook and further research

As the research topic of this Master's Thesis is quite extensive, it was not possible to include all related topics within this work. Therefore, there are still some open questions, which may be answered in a further research:

How can cloud-based integrated business information systems optimize the business process of other industries, for example financial industry or professional service industry?
Each industry has its own characteristics and its own special processes, which also have consequences to the underlying IT software systems.

Which influence has the new general data protection regulation (GDPR) for cloud-based integrated business information systems?
One big topic regarding cloud-based IT systems is data protection and data security. Thereby, the new GDPR will have considerable consequences, which need to be analyzed in more detail. Another topic in that context, which requires further research, is the analysis regarding the differences of the cloud deployment in Europe vs. the cloud deployment in the USA (in terms of data-protection laws, etc.).

How can machine data and hardware integration (Industry 4.0) optimize manufacturing business processes?
Every manufacturing company is equipped with production machines, which also shall be integrated with their business information software systems. Some interviewees clearly showed their interest in such a machine data integration.

Which upcoming trends are enabled based on cloud-based integrated business information systems?
According to some expert interviews, cloud-based integrated systems build the foundation for many current and upcoming trends, like Machine Learning, Artificial Intelligence, Big Data, Internet of Things, Blockchain and Predictive Production. SAP has already started an initiative therefore named "SAP Leonardo".

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List of Abbreviations

APS	Advanced Planning and Scheduling
API	Application Programming Interface
B2B	Business to Business Integration
BI	Business Intelligence
BIS	Business Information System
BPR	Business process reengineering
BSC	Balance Scorecard
CAD	Computer Aided Design
CEO	Chief Executive Officer
CIO	Chief Information Officer
CRM	Customer Relationship Management
CSF	Critical success factor
DBMS	Database Management System
DMS	Document Management System
DWH	Data Warehouse
EAI	Enterprise Application Integration
EDI	Electronic Data Interchange
EDW	Enterprise Data Warehousing
ERP	Enterprise Resource Planning
ETL	Extraction - Transformation – Load
FTE	Full-Time Equivalent
GUI	Graphical User Interface
HR	Human Resources
IaaS	Infrastructure of a Service
IoT	Internet of Things
IT	Information Technology
MA	Marketing Automation
MRP	Material Requirement Planning
NIST	National Institute of Standards and Technology
OLAP	Online Analytical Processing
OLTP	Online Transaction Processing
PaaS	Platform as a Service
PLM	Product Lifecycle Management
POS	Point of Sales
REST	Representational State Transfer
SA	Service Automation
SaaS	Software-as-a-Service
SCM	Supply Chain Management
SDK	Software Development Kit
SFA	Sales Force Automation
SLA	Service Level Agreement
SME	Small- and medium sized enterprise
SOAP	Simple Object Access Protocol
SQL	Structured Query Language
SRM	Supplier Relationship Management
SSO	Single Sign-On
TCO	Total Costs of Ownership
VPN	Virtual Private Network
WM	Warehouse Management

Appendix A: Interview guide

Initial Situation and Targets

- The Interview will be used for a Master Thesis at the UAS Technikum Vienna, program „Information Systems Management“.
- Title of the Master Thesis: “Analysis of the optimization of manufacturing business processes through cloud-based integrated business information systems focusing on Microsoft products”.
- The goal of this interview is the investigation and determination of the most important criteria and success factors of cloud-based integrated business information systems, which will be used as input for the creation of a criteria catalogue.
- Duration: approx. 30 minutes

Information to the Interview

- Name of the interviewee: ……
- Company: ……..
- Industry: …….
- Position: …….
- Date, Place: ……..
- Recording of the interview allowed ☐ Yes ☐ No
- Publishing of the name of the interviewee allowed ☐ Yes ☐ No

Questionnaire for IT Experts

Questions to the integration of business information systems

1. To what extent have the integration possibilities an influence on the selection of business information systems in manufacturing companies (both technically and organizationally)?
2. Which requirements regarding the integration of business information systems have companies from the standpoint of the management and from the standpoint of the users?
3. What are the triggers of a necessary integration of business information systems in manufacturing companies (organizational structure, business processes, etc.)?
4. What are the biggest challenges regarding the integration of business information systems in manufacturing companies?
5. Which problems and vulnerabilities are caused by isolated applications in manufacturing companies?
6. To what extent can manufacturing business processes (e.g. the make-to-order process) in companies be optimized through the integration of business information systems?

7. Which departments in manufacturing companies benefit most of all from the integration of business information systems?
8. For which ERP-data is a real-time availability within CRM-systems (and vice versa) useful and beneficial for manufacturing companies?
9. Which potentials do you see in the integration of business information systems (ERP- and CRM-systems) within office- and collaboration-products like Outlook, Word or Excel?
10. What should be the focus of versions upgrades of business information systems in the future, mainly relating to the integration architecture in order to ensure sustainable systems in the future?
11. To what extent can workflows optimize and improve the integration and communication of different business information systems?

Questions to cloud-based business information systems

12. How do you see the trend from on-premise applications towards cloud-services within business information systems?
13. Are there business information systems, which are better, and business information systems, which are worse suitable for the deployment in the cloud?
14. Which prerequisites must a manufacturing company fulfill in order to be able to operate their business information systems in the cloud and in which cases is the cloud model most suitable, respectively?
15. Which potential challenges and risks do you see in respect of security, data protection and compliance at the introduction of cloud-based business information systems in manufacturing companies?
16. Are there any limitations regarding the functionality of cloud-based business information systems comparing to the on-premise variants from your point of view?
17. To what extents are there differences regarding the possibilities of customizing and configuration between cloud-based and on-premise business information systems?
18. Which advantages (or also disadvantages) result in the upgrade-capabilities of business information systems through the deployment in the cloud?
19. Which effects has the introduction of cloud-based business information systems on the implementation duration in comparison to the on-premise variants?

Questionnaire for Key User

Questions to the integration of business information systems

1. Which business information systems are you using in your company?
   1.1. Which modules are covered by your business information systems?
   1.2. Are the systems provided by different software providers?
   1.3. Do you have systems, which depend on each other very much?

1.4. To what extent have your different business information systems a consistent user interface?

2. Have you already been involved in an integration project in your company? Which experiences have you made?
3. Did the integration capabilities have an influence at the selection of your business information systems? If yes, which one? (technical, organizational)?
4. Which of your business processes affect more than one business information system in your company?
5. Do you operate ERP- and CRM-activities within one software system or do you have separated software systems therefore?

   [IF ERP-system and CRM-system are separated systems]

   5.1. Upon which ERP-data do you currently have direct access within your CRM system and vice versa?

   5.2. Are there currently ERP- / CRM-data, which cannot be directly accessed from your CRM- / ERP-system, even if you would like to do?
6. In which system do you create analysis and reports of your ERP- and CRM-data? Do you have a separated BI-system therefore?
7. How is the current degree of realization regarding the integration of your business information systems?

   7.1. What are / were the triggers for a necessary integration of your business information systems (organizational structure, business processes, etc.)?

   7.2. What are / were the biggest challenges regarding the integration of your business information systems?

   7.3. Which potentials for improvement do you currently see in the integration of your business information systems (technically / organizationally)? How can these improvement potentials be realized from your point of view?

   7.4. Which problems and vulnerabilities cause possible existing isolated applications in your company?

   7.5. To what extent are office- and collaboration software systems (Word, Excel, Outlook, SharePoint, etc.) integrated with your business information systems (ERP-/CRM-system)?
8. To what extent have business process in your company been optimized through the integration of business information systems?

   8.1. Which departments benefit at most from the integration of your business information systems?

   8.2. Is it currently necessary to make double works (e.g. double recording of data both in ERP- and CRM-system) due to isolated applications? If yes, which one?

   8.3. Do you currently have a lack of real-time reports due to not integrated, multiple overlapping databases?

   8.4. Do you currently have dashboards, which analyze and report information from different business information systems and possible further data sources?

8.5. Are your sales persons currently able to react fast to customer enquiries without having to obtain information from different systems (e.g. article availability, article prices, sales history of the customer, general information of the customer)?

8.6. Do you currently have a consistent data basis of your customer information? If not, upon which systems are they distributed and does this result in problems for your company?

9. What should be the focus of versions upgrades of your business information systems in the future, mainly relating to the integration architecture in order to ensure sustainable systems in the future?
10. Do you currently have workflows between your different business information systems implemented?

Questions to cloud-based business information systems

11. To what extent does your company currently use cloud-based business information systems (Software-as-a-Service)?

    11.1. Which influence has the cloud on the selection process of business information systems in your company?
12. Which advantages and disadvantages do you see in cloud-based business information systems?

    [IF the company operates its business information systems on-premise]

    12.1. Because of which criteria is the application of your business information systems in the cloud (as Software-as-a-Service) currently not possible?

    12.2. Which prerequisites must have been fulfilled, in order that you would decide to operate your business information systems in the cloud?

    [IF the company operates its business information systems in the cloud]

    12.3. Why did you decide to operate your business information systems in the cloud?

    12.4. Which experiences have you made so far?
13. To what extent can Cloud Computing (mainly Software-as-a-Service) enhance the added value in a manufacturing company from your point of view (e.g. process optimizations, cost reductions)?
14. Is a mobile access to your business information systems (anytime, anywhere) currently be possible?
15. What is your opinion about the topics security and data protection with cloud-based business information systems? Which threats and risks do you see?

Appendix B: Interview transcriptions

Transcript of Expert Interview A – German

Name of the interviewee: Gerd Frick
Company: BITS Better IT Solutions GmbH
Industry: IT Consulting
Position: CEO
Date, Place: 2018-02-21, Telephone
Recording of the interview allowed: X Yes No
Publishing of the name of the interviewee allowed: X Yes No

DS[58] [00:00:00]: Die erste Frage ist, inwiefern haben die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben, sowohl technisch als auch organisatorisch?

A[59]: Die haben immer Einfluss. Ohne Integrationsmöglichkeiten wird es nicht gehen. Dabei sprechen wir aber nicht nur von ERP und CRM, wir sprechen auch von Lagerlogistik, eCommerce, Integration Kunde und Lieferant mit EDI und EDIFACT etc. Das heißt es gibt immer Integrationsthematiken die da mitspielen.

DS: OK, d.h. aus deiner Sicht haben die Integrationsmöglichkeiten einen sehr hohen Einfluss, richtig?

A: Ja genau, auf alle Fälle.

DS [00:02:51]: Das bringt mich schon zur nächsten Frage, die wäre welche Anforderungen bzgl. Integration von betrieblichen Informationssystemen haben aus deiner Sicht Unternehmen, einerseits aus Sicht des Managements und andererseits aus Sicht der Anwender?

A: Aus meiner Sicht hat das Management zwei Gesichtspunkte. Der eine Gesichtspunkt ist er will ein wartungsarmes System mit möglichst wenig Schnittstellen. Das ist der eine Gesichtspunkt und der andere Gesichtspunkt ist er hätte gerne eine Plattform mit der er die Informationen über vorhandenen Systeme im Sinne von Managemententscheidungen herausholt. Also im Sinne eines BI Systems. Und der Anwender hätte im liebsten nur eine Anwendung die alles kann und die den Knopf dort hat wo er ihn gerne hätte. Und das System muss das wissen wo er den Knopf gerne hätte.

DS: Genau, also nur ein System und das so einfach wie möglich.

DS [00:04:23]: Die dritte Frage ist was sind aus deiner Sicht die Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben, also z.B. die Organisationsstruktur betriebliche Prozesse und so weiter?

A: Oft passiert es aus Kundendruck. Also dass unsere Kunden einen Druck von deren Kunden bekommen, sei es eine Integration im Sinne von EDI, Edifact etc. Das ist mal diese Sicht, die einen Druck erzeugt. Die zweite Sicht ist natürlich redundante Datenhaltung zu reduzieren aus betriebswirtschaftlicher Sicht und Prozesse zu vereinheitlichen bzw. den Aufwand bei Prozessen zu reduzieren.

DS [00:05:19]: Nächste Frage wäre, was sind aus deiner Sicht die größten Herausforderungen die sich ergeben?

[58] DS = Dominik Scheuringer (Interviewer)
[59] A = Interviewee of Interview A

A: Das sind zwei Dinge aus meiner Sicht. Zum einen die Definition was will ich überhaupt für einen Integrationsgrad. Die zweite Sicht ist die mittel- und langfristige Sicht was ist es für ein Aufwand diese Integration aufrecht zu erhalten. Stichwort Updates.

DS: Ja stimmt, Updates sind ein guter Punkt.

DS [00:06:03]: Nächste Frage ist die Gegenfrage, wenn ich keine Integration habe, welche Probleme und Schwachstellen verursachen dann isolierte Applikationen (Insellösungen) in Produktionsbetrieben?

A: Doppelterfassungen oder Mehrfacherfassungen. Redundante Datenhaltung, hier spielt auch das Stichwort der Datenschutzgrundverordnung mit hinein, wenn zum Beispiel eine Adresse in 27 Systemen ist. Das sind aus meiner Sicht die größten Probleme.

DS [00:06:44]: Und inwiefern können Produktionsprozesse (z.B. Einzelfertigungsprozesse) in Unternehmen optimiert werden durch die Integration betrieblicher Informationssysteme?

A: Das wäre dann genau das Gegenteil der vorherigen Frage.

DS: OK verstehe, hast du ev. einen Punkt der dir speziell zu Produktionsprozessen einfällt?

A: Naja das ist natürlich das Internet of Things, das die Produktionsprozesse optimieren kann, sprich wenn irgendwelche Endgeräte, die im Feld stehen, Rückmeldungen und Daten darüber liefern, was haben wir für einen Bedarf an Produkten, sei es Ersatzteile, sei es Wartungszyklen etc. Und das ist auch ein gewisses Maß an Integration das Internet of Things. Und was da ev. auch noch hineingehört in die Prozesskette ist die Einbindung von Betriebsdatenerfassung und Maschinendatenerfassung.

DS [00:08:01]: Welche Abteilungen in Produktionsbetrieben profitieren am meisten von der Integration von betrieblichen Informationssystemen?

A: Der höchste Druck für die Integration kommt immer vom Rechnungswesen. Ganz klar, weil die wollen konsolidierte Daten. Der nächst größere Druck kommt eigentlich vom Bereich Materialwirtschaft, sei es Anbindung an Kunden, Lagerverwaltungssysteme etc.

DS [00:08:34]: Die nächste Frage betrifft jetzt gezielt die ERP-CRM-Integration, für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen (und vice versa) sinnvoll und vorteilhaft für Produktionsbetriebe aus deiner Sicht?

A: Das muss schon sehr branchenspezifisch sein. Generell haben wir die Erfahrungen gemacht, dass die integrierten CRM-Funktionalitäten von den ERP-Anbietern nur eine gewisse Bandbreite abdecken und wenn die Kundenanforderungen darüber hinaus gehen, dann geht sich das nicht mehr aus. Egal von welchem Hersteller. Bzgl. der Echtzeitverfügbarkeit kommt darauf an für was ich das CRM-System einsetze. Wenn ich es im Ticketing einsetze dann habe ich andere Anforderungen wie in der Vertriebssteuerung, dem womöglich eine Stundenaktualität der Statistikdaten reicht. Aber wenn ich zum Beispiel Healthcare in einem Krankenhaus hernehme, da wärs schon ganz nett, wenn ich aktuelle Daten habe, zum Beispiel Laborergebnisse.

DS: OK verstehe, aber wenn ihr jetzt euer ERP WinLine und euer CRM GenesisWorld getrennt einsetzt, werden die Daten dann integriert zwischen den zwei Systemen?

A: Ja klar, wobei wir sprechen da von Echtzeit von ein paar Sekunden. Aber die Echtzeit will jeder.

DS: Und welche Daten sind das hauptsächlich, die da ausgetauscht werde?

A: Adressen, Statistikdaten, offene Posten, Belege, womöglich Projektinformationen. Wir verwenden da eine Standardschnittstelle eines Partners zwischen Mesonic WinLine und GenesisWorld.

DS [00:11:02]: Die nächste Frage zielt auf die Integration mit Outlook-Produkten ab, und zwar welche Potentiale sehen Sie in der Integration von betrieblichen Informationssystemen (ERP- und CRM-System) innerhalb Office-Produkte wie Outlook, Word oder Excel?

A: Naja Potential, das ist Grundvoraussetzung. Speziell Word, Excel, Outlook nicht zwingend, weil viele CRM Systeme Groupware-Funktionalitäten wie Kalender und auch E-Mail-Clients integriert haben. Aber als Frontend im Textverarbeitungsbereich, Serienbriefe, Excel-Kalkulationen ist das eine Grundvoraussetzung.

A [00:12:09]: Um die Frage 10 zu beantworten, der Fokus muss aus meiner Sicht der sein, dass man Standardschnittstellen verwendet und nicht direkt in der Datenbank herumschraubt. Nur so kann man aus meiner Sicht nachhaltige Schnittstellen gewährleisten.

DS [00:12:38]: Und die letzte Frage in Hinblick auf Integration bezieht sich auf Workflows - inwiefern können aus deiner Sicht Workflows das Zusammenspiel und die Kommunikation verschiedener betrieblicher Informationssysteme optimieren und verbessern?

A: Meinst du da jetzt Workflows innerhalb eines Systems oder zwischen verschiedenen Systemen?

DS: Ich meine hier Workflows zwischen verschiedenen Systemen

A: Naja Workflows zwischen verschiedenen Systemen in einer Workflow-Engine abzubilden, da kenne ich nicht viel Tools, die das unterstützen.

DS: Ok, ich frage deswegen, weil Microsoft baut gerade ein Tool, dass in diese Richtung geht.

A: Ok, und das soll dann das Navision und das CRM ansprechen können oder wie?

DS: Unter anderem, das kann sehr viele Lösungen, auch zum Beispiel ein SharePoint oder die DropBox ansprechen.

A: Naja, ich würde sagen, dass schauen wir uns dann an wenn es so weit ist (lacht).

DS: Ja, das ist noch in den Startlöchern, aber in diese Richtung soll es gehen.

A: Da bin ich gespannt. Ich mein es gibt schon Workflow-Engines die über Webservices Fremdsysteme antrödeln, nur dann muss das Fremdsystem auch die Möglichkeit haben das entsprechend zurückzuliefern, sonst hat das keinen Sinn. Und an dem scheitert es derzeit.

DS [00:15:06]: OK das waren die Fragen zur Integration. Danke mal. Und jetzt noch ein paar Fragen zur Cloud. Die erste Frage ist, wie sieht der Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme deiner Meinung nach aus?

A: Es gibt Ansätze in diese Richtung, wir haben auch einige Kunden die so arbeiten, wobei man sehr starken sagen muss, das hängt sehr stark ab von der Region, wo der Kunde ist. Das hängt sehr stark vom betrieblichen Umfeld und von der Unternehmensgröße ab. Unsere Erfahrung ist speziell kleine Unternehmen, 1, 2 User, tendieren zur Cloud. Unsere Erfahrung ist auch, dass es Branchen gibt da geht es gar nicht. Ich spreche da von Branchen, die mit hochsensiblen Daten hantieren und wir haben die Erfahrung es gibt Gebiete, zum Beispiel die Schweizer tendieren sehr stark in die Cloud oder auch die

Benelux-Länder tendieren sehr stark in die Cloud, die Österreicher und Deutschen sind da eher zurückhaltend. Vor fünf Jahren hätte ich gesagt ja es geht alles in Richtung Cloud, mittlerweile haben wir auch Gegentendenzen, weil halt in der Cloud doch nicht alles so komfortabel ist, sprich zum Beispiel Connectivity, Telefon, Anbindung an andere Systeme, auch das Lizenzierungsmodell ist wieder ganz ein anderes, sprich Office-Produkte etc., also da gibt es schon einige Punkte wo sich die Kunden dann doch wehren in die Cloud zu wechseln.

DS [00:17:10]: OK und welche betriebliche Informationssysteme sind aus deiner Sicht noch besser und welche schlechter für die Verlagerung in die Cloud geeignet?

A: Im CRM haben wir mehr den Trend zur Cloud wie im ERP Bereich. Und vor allem wenn ein Unternehmen dezentral organisiert ist.

DS [00:17:52]: Und welche Voraussetzungen muss aus deiner Sicht ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das Cloud Model besonders geeignet?

A: Wenn ich eine Unternehmensstruktur habe, die nicht sehr ortsgebunden ist. Wenn ich zum Beispiel ein Unternehmensberater bin und ich haben einen Briefkasten als Büro und Mitarbeiter die auf jeden Schreibtisch arbeiten, dann ist die Cloud eine tolle Geschichte.

DS [00:18:42]: Nächste Frage ist, welche potentiellen Herausforderungen und Risiken siehst du in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

A: Ich persönlich sehe das Risiko nicht viel höher als wenn das On-Demand ist, weil das größere Risiko in der Realität, dass aber niemand sieht, sind die Mitarbeiter. Aber natürlich gibt es auch Hacker-Zugriffe, aber die Cloud-Systeme sind in der Regel mittlerweile schon sehr gut abgesichert, in der Regel besser als jede On-Demand Lösung.

DS [00:19:38]: Gibt es aus deiner Sicht Einschränkungen bzgl. der Funktionalität von Cloud-basierten betrieblichen Informationssystemen im Vergleich zu den On-Premise Varianten?

A: Ja klar gibt es Einschränkungen. Die Cloud-Lösungen sind funktional, aus meiner Sicht, alle nicht so weit wie die OnDemand-Lösungen. Wenn ich das vergleiche dieselbe Lösung OnDemand und dieselbe Lösung in der Cloud, dann gibt es einfach von der Bedienung, vom Handling, von der Bediengeschwindigkeit, Integration, Telefon, Fremdsysteme, gewisse Vorteile, die ich mit der Cloud derzeit nicht realisieren kann.

DS [00:20:25]: Und die nächste Frage ist ähnlich, in Hinblick auf Customizing, inwiefern unterscheiden sich die Möglichkeiten bzgl. Customizing und Konfiguration zwischen Cloud-basierten und On-Premise betrieblichen Informationssystemen?

A: Klar, mach mal eine Anpassungsprogrammierung in einer cloud-basierenden Lösung. Ist, wenn überhaupt möglich, mit viel höherem Aufwand. Neue Fenster, neue Felder, das können sie alle recht gut. Aber wenn du dann eine Logik drinnen hast, dann wird es schwierig. Hat aber mit WinLine oder GenesisWorld nichts zu tun, sondern scheint ein flächendeckendes Problem zu sein.

DS [00:21:29]: Bzgl. der Upgrade-Fähigkeit von betrieblichen Informationssystemen durch die Anwendung in der Cloud – siehst du da Vorteile oder auch Nachteile?

A: Naja, nachdem man weniger Anpassungsmöglichkeiten hat, ist die Upgradefähigkeit verbessert (lacht).

DS: Ja stimmt, das ergibt sich daraus.

A: Das ist eine Folgeerscheinung, die durchaus auch was Positives hat. Wo ich immer wieder Schwierigkeiten sehe ist die Datenmigration von einer bestehenden Cloud-Lösung in ein anderes System. Also wenn jemand mal in einer Cloud-Lösung ist, diese Daten dann in ein anderes System zu bekommen ist dann nicht mehr ganz so einfach.

DS [00:22:39]: Alles klar, und dann sind wir schon bei der letzten Frage: Welche Auswirkungen hat die Einführung Cloud-basierter betrieblicher Informationssysteme auf die Implementierungsdauer im Vergleich zur On-Premise Variante?

A: Ist in der Regel kürzer, und zwar einfach darum, weil man sich auf den Standard beschränkt.

DS [00:23:13]: Gut, dann sind wir mit den Fragen durch. Ich bedanke mich nochmals sehr herzlich für deine Zeit und deine wertvollen Inputs.

A: Bitte, sehr gerne, ich hoffe ich konnte dir helfen.

Transcript of Expert Interview B – German

Name of the interviewee: Peter von Zimmermann
Company: Alta Via Consulting GmbH
Industry: IT Consulting
Position: CEO
Date, Place: 2018-02-21, Telephone
Recording of the interview allowed: X Yes No
Publishing of the name of the interviewee allowed: X Yes No

DS[60] [00:00:00]: Die erste Frage ist inwiefern haben die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben (sowohl technisch als auch organisatorisch)?

B[61]: Das hängt von Fall zu Fall ab. Ob man schon ein integriertes System hat, die bestehende Landschaft. Unternehmen haben eine bestimmte Problematik, dafür gibt es spezifische Lösungen. Die sind entweder alle in einem System drinnen, dann hat man von Hause die Integration. Oder man hat verschiedene Tools, die man zusammenführen muss. Da brauch ich die Integration verschiedener Systeme. Wenn man NetSuite einsetzt, ist man auf der sicheren Seite, da man ein ziemlich integriertes System hat und man muss wenige Schnittstellen innerhalb dieses ERP- und CRM-Systems erstellen. Das ist die Integration innerhalb der Systemlandschaft. Auf der anderen Seite arbeiten wir oft zusammen mit anderen Firmen, wir haben ganz oft die Integration zu Third-Party Logistik Firmen, externe Services die ich ansprechen muss, da habe ich auch ein Integrationsthema

DS: Das heißt zusammengefasst kann man sagen, dass die Integration einen sehr hohen Einfluss hat.

B: Ja genau, das muss funktionieren, es muss eine vollständige Integration geben.

DS [00:03:12]: Die zweite Frage wäre, welche Anforderungen bzgl. Integration von betrieblichen Informationssystemen haben Unternehmen aus Sicht des Managements und welche aus Sicht der Anwender? Angenommen man hat verschiedene Systeme, ein getrenntes ERP-System, ein getrenntes CRM-System zum Beispiel.

B: Da kann ich Ihnen keine Erfahrungen beisteuern, weil wir haben kein getrenntes CRM System. Das Thema das wir oft haben ist das die Firmen eigene Front-End-Systeme haben, zum Beispiel irgendein Front-End für das Internet, wo sie ihre Services anbieten, und das man da eine Integration braucht. Dann die Integration zum 3CL, der Webshop ist oft integriert und typischer als die Integration zwischen ERP und CRM. Aber egal welche Integration, sie muss stabil sein, sie muss ein Fehlerhandling haben, sie muss monitorbar sein, das ist die größte Problematik die wir immer sehen. Das man Integrationen baut, die im Normalfall schön laufen, aber im Fehlerfall haben sie überhaupt kein Handling. Das muss getracked und monitored werden. Es ist ja keine Option, dass so eine Integration nicht funktioniert, vor allem wenn es firmenkritisch ist. Zum Beispiel die Beauftragung eines 3CL um darauf zu liefern. Oder die Anbindung eines Webshops, der Anschluss des Kassensystems. Wenn das nicht funktioniert, dann seht die ganze Firma.

DS [00:05:19]: OK danke, zur nächsten Frage. Was sind die Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben, zum Beispiel die Organisationsstruktur oder die betrieblichen Prozesse etc.?

[60] DS = Dominik Scheuringer (Interviewer)
[61] B = Interviewee of Interview B

B: Das sind die betrieblichen Prozesse. Wir malen das auf immer ab, da schreiben wir die Prozesse auf. Den Order-to-Cash oder den Lead-to-Cash-Prozess, oder auch Einkaufsprozesse. Und dann stellt sich halt die Frage, welche Prozesse passieren in welchem System. Ich nehme als Beispiel einen Verkaufsprozess. Wir bekommen einen Auftrag vom Webshop rein, der muss rein gehen in das ERP System, die müssen den Auftrag annehmen, verarbeiten. Dann geht es zur Third-Party-Logistik, die bekommen den Auftrag das Ding auszuliefern, der muss zurückmelden die Tracking-Nummer über das was ausgeliefert wurde und das muss wieder zum Webshop hoch. Wenn man diesen Prozess aufmalt, dann kann man Swimlanes aufmalen, da sieht man dann dort kommt der Auftrag rein, da kommt er rüber über das Interface, dort muss er verarbeitet werden, dann geht es in das 3CL, dort wieder geliefert und es geht wieder an den Webshop, sodass der Kunde dann die Trackingnummer sieht. Kann man sich einfach vorstellen, dass da drei Systeme sind und der Prozess das entscheidende ist.

DS [00:06:47]: Danke für die ausführliche Antwort, die nächste Frage ist, was sind aus ihrer Sicht die größten Herausforderungen bzgl. der Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

B: Ich denke, dass das die verschiedenen Techniken von den Anbietern der Lösungen sind, vernünftige APIs und Schnittstellen. Als Beispiel, eine Webshop-Integration, das können die Webshops in den meisten Fällen, das ist deren täglich Brot. Hingegen schwieriger ist es in der Regel eine 3CL, die haben eine IT Abteilung, die hat halt bestimmte Vorstellungen, wie das aussieht und da haben wir eigentlich die größten Herausforderungen, mit denen zu diskutieren, welche Technologie man überhaupt verwendet. Da gibt es einen starken technologischen Wandel, die Klassiker wie z.B. File-basiert, dann gibt es SOAP-Technologie, die neue REST-Technologie, unterschiedliche Autorisierungsmethoden. Und gerade in der Cloud da ist die Vorstellung halt oft der Leute dass sie noch immer on-Premise eine Maschine irgendwo haben, auf die sie auf die Datenbank zugreifen wollen um Files zu hantieren und dann ist ein Webshop halt anders, da kann ich mit Webservices arbeiten, und da auch in der Regel eher mit REST als mit SOAP. Da gibt es einen starken Wandel.

DS [00:08:41]: Die nächste Frage ist, welche Probleme und Schwachstellen verursachen isolierte Applikationen, also Insellösungen, in Produktionsbetrieben?

B: Das geht eigentlich gar nicht, weil das bedeutet immer manuelle Prozesse. Die Integration gibt es immer. Der betriebliche Prozess funktioniert so. Wenn ich an dem Beispiel bleibe. Der 3CL lässt sich nicht anschließen, der kann das nicht, und ich muss jeden Auftrag telefonisch oder per Mail zuschicken dann ist das eine gewisse Schwachstelle. Der Prozess nimmt keine Rücksicht auf die Applikation.

DS: Das heißt das gibt der Geschäftsprozess schon so vor oder?

B: Ja, der Geschäftsprozess ist eben so und ich habe jetzt verschiedene Tools, die miteinander arbeiten müssen.

DS [00:09:59]: OK, die nächste ist dann wahrscheinlich gegen das Gegenteil, inwiefern können Produktionsprozesse, z.B. Einzelfertigungsprozesse, in Unternehmen optimiert werden durch die Integration betrieblicher Informationssysteme?

B: Ja genau, wenn man die Probleme vermeidet, die sich durch Insellösungen ergeben, schafft man die Grundlagen um Prozesse auch wirklich zu optimieren.

DS [00:10:14]: Alles klar und gibt es aus ihrer Sicht bestimmte Abteilungen in Produktionsbetrieben, die am meisten von der Integration von betrieblichen Informationssystemen profitieren?

B: Also, die IT-Abteilung hat das Problem meistens. Aber in dem Tunnel wo wir meistens sind die haben meistens eine Backoffice-Abteilung, die muss die Aufträge die reinkommen bearbeiten, die muss sie dann weiterreichen, bearbeiten was zurückkommt, also die würde ich sagen profitiert am meisten, weil die eigentlich die Verantwortung für den gesamten Prozess haben.

DS [00:11:03]: OK, die nächste Frage können wir wahrscheinlich ignorieren, weil ja bei NetSuite das CRM im ERP-System integriert ist. Die Frage wäre für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen und vice versa sinnvoll und vorteilhaft für Produktionsbetriebe?

B: Ja, aber, wenn man annimmt man hat ein externes CRM System, was wir ja auch manchmal haben, dann ist es wenig was das CRM-System an Echtdaten braucht. ERP-Daten müssen irgendwann die Aufträge kriegen. Das CRM-System sollte wissen, wenn ein Kunde nicht gezahlt hat bzw. generell Informationen zum Kunden, was er gekauft hat. Ob das jetzt Echtzeit ist, ist eine andere Frage. Echtzeit ist immer so eine Sache, das kann in Mikrosekunden sein. Zwischen ERP und CRM-System würde ich Echtzeit innerhalb einem Tag sehen. Wobei das stimmt nicht ganz. Wenn das CRM-System den Verkauf machen soll, das fällt mir jetzt noch ein, aber das ist die Frage was Sie mit einem CRM-System meinen, dann ist natürlich der Lagerbestand das Entscheidende. Die Verfügbarkeit ist also noch ein Punkt. Wobei das ist weit hergeholt, in der Regel ist das ja nicht das CRM-System, sondern der Webshop, das System muss natürlich wissen ob ein Artikel noch auf Lager ist und verkauft werden kann oder aber ob er ausverkauft ist. Und das relativ kurzfristig. Da haben wir oft ein Problem, wenn die Firmen unterschiedliche Channels haben, wie z.B. Web-Shop, Amazon und was es da nicht alles gibt, und da muss diese Information, wenn ein Artikel nicht mehr verfügbar ist an alle Channels. Wenn der Artikel dann nicht verfügbar ist, dann habe ich dann nur Ärger. Das ist dann ein Echtzeitthema, dass wir mal hatten bei einer Modefirma.

DS [00:13:44]: Bei der nächsten Frage geht es um die Integration von betrieblichen Informationssystemen wie z.B. ERP- und CRM-System innerhalb von Office-Produkte wie Outlook, Word oder Excel. Welche Potentiale sehen Sie da darin?

B: Ich denke, dass ist jetzt sehr unterschiedlich was Integration bedeutet. Excel-Integration mit ERP-Systemen sollte vorhanden sein. Wenn das das ERP-System nicht kann ist es schwach. Die andere Integration, aber das habe ich noch nie wen benutzen gesehen, ist ein Excel-AddIn, das ein CRM-System fortschreibt. Also ich habe so eine Excel-Tabelle und arbeite an der Excel-Oberfläche aber hintendran werden dann die Aufträge angelegt. Halte ich jetzt für weniger wichtig. Ist zwar theoretisch eine schöne Sache, aber in der Realität weniger relevant. Oder ein Excel was die Daten im Hintergrund dynamisch holt, das ist jetzt schon ein bisschen flexibler als ein Download. Und sonst. Was machen wir jetzt mit Word. Da schreiben wir jetzt eher Romane. Ist jetzt die Frage machen wir das wirklich mit den ERP-Systemen, Serienbriefe oder sowas gibt's da vielleicht, Marketingaktionen im CRM. Oder halt dann Kalender und Mails. Das ist schwieriger aber auch wichtiger. Kriege ich also eine Antwort auf ein Mail im CRM-System zu sehen. Das muss miteinander verbunden werden. Ich schicke ein Mail an den Kunden und häng das dann bitte ins CRM-System an den Kunden dran. Der 4. Punkt sind Kalenderfunktionalitäten, klassische CRM-Funktionalitäten, die in meinem Kalender integriert werden sollten. Wenn ich also einen CRM Task habe, ich muss einen Kunden anrufen, dann sollte das auch im Kalender ersichtlich sein. Oder CSV-Upload, da gibt es sehr viele unterschiedliche Funktionen, die aber ganz andere Anforderungen haben. Im Prinzip, wenn ich von NetSuite spreche, dann ist alles was gebraucht wird auch da.

DS [00:16:56]: Die Frage 10 ist, auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades von betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

B: Ja das mit den Versionsupgrades, zumindest, wenn ich eine Cloud-Lösung habe, kommt das immer. Ich kriege die Upgrades automatisch, d.h. das Thema Upgrade ist eigentlich keines mehr. So eine Integration ist ja immer irgendwie eine AddOn-Entwicklung, das das upgradefähig ist, das muss das System zulassen. Das ist das was NetSuite eigentlich auszeichnet, das die Erweiterbarkeit gegeben ist, ohne das es irgendwelche Auswirkungen auf die Upgradefähigkeit hat.

DS [00:17:59]: Und die letzte Frage zur Integration, ich weiß jetzt nicht inwiefern eine Workflow-Engine in NetSuite integriert ist, aber inwiefern können aus ihrer Sicht Workflows das Zusammenspiel und die Kommunikation verschiedener betrieblicher Informationssysteme optimieren und verbessern?

B: Die Erfahrung die ich da habe ist das es Workflow-Lösungen gibt, mit der man Prozesse beschreiben kann und die auch häufig Steps haben die rausgehen. Also zurück zum Vertriebsprozess. Der Auftrag kommt rein, muss genehmigt werden, können wir den überhaupt liefern, dann mache ich die Lieferung und dann schicke ich die Lieferung automatisch raus zum 3CL. Und dann kriegt der Kunde 3CL zurück und dann geht der Workflow weiter und sagt jetzt muss ich den Webshop informieren. Der Workflow steuert das alles. Da kann ich auch einzelne Skriptteile einbauen. Der Workflow kann dann auch Calls in Richtung eines externen Systems triggern.

DS [00:20:30]: Danke, das war mal zum ersten Fragenblock. Und jetzt habe ich noch ein paar Fragen zum Thema Cloud. Die erste allgemeine Frage ist, wie sieht der Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme ihrer Meinung nach aus?

B: Ja das ist so, dass wir halt nur Cloud anbieten, also born in the Cloud (lacht). Wir leben also mit dem Trend. Ich mache das jetzt seit 9 Jahren. Und vor 9 Jahren war es schon noch so, dass viele Teil des deutschen Mittelstands gesagt haben das geht gar nicht. Wir haben uns also dann auf kleine StartUps, auf junge Unternehmen konzentriert. Irgendwelche Internetfirmen die gesagt haben, das geht nur damit. Das ist ja stark gewachsen. Heute haben wir selbst Kunden, zum Beispiel schwäbischer Produktionsmittelstand, wo du denkst, die kommen nie auf die Idee, die dann Cloud-Lösungen wollen. Somit ist der Trend ungebrochen. Und das sehen auch die meisten Standard-Hersteller. Der entscheidende Punkt ist eben die Upgrade-Fähigkeit.

DS [00:22:51]: Ok danke. Gibt es aus ihrer Sicht betriebliche Informationssysteme die besser und welche die schlechter für die Verlagerung in die Cloud geeignet sind?

B: Also wir haben jetzt ein ganz aktuelles Beispiel. Ein StartUp, die machen so Möbel im Internet, Tische die man bestellen kann, die haben ein großes Lager in Polen wo die Fertigung ist und von wo geliefert wird, und die haben auch mit NetSuite angefangen, alles wunderbar mit NetSuite, die hatten dann auch die Lagerhaltung mit NetSuite, und die haben diese Lagerverwaltung jetzt wieder On-Premise geholt, weil das einfach zu weit war, zu langsam, zu unsicher. Die reine Lagerführung, z.B. mit Hochregal, das ist auch das wo es um Echtzeit geht. Oder Kassensysteme. Wenn das ausfällt dann geht gar nichts mehr. Da sehe ich die größten Schwierigkeiten bei der Cloud.

DS [00:24:10]: Danke, das bringt mich gleich zur nächsten Frage. Welche Voraussetzungen muss ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das

Cloud Model besonders geeignet? Sprich welche Unternehmen tendieren noch am meisten zur Cloud?

B: Bzgl. Voraussetzungen, aus meiner Sicht kann jedes Unternehmen ein ERP in der Cloud betreiben, da keine wirklichen Voraussetzungen da sind. Bei Firmen, die sowieso schon eine riesige IT-Abteilung haben da ist es vielleicht naheliegend, dass sie auch das ERP-System mitbetreiben. Ansonsten ist es vor allem dann besonders geeignet, wenn Firmen international aufgestellt sind, wenn sie stark wachsen bzw. sich einfach nicht für eine On-Premise-Anwendung binden wollen, dann ist das besonders geeignet. Ich mache mal einen ganz konkreten Fall, den wir bei NetSuite ganz oft haben. Ein erfolgreicher Markt für NetSuite ist Afrika, z.B. Nigeria oder Kenia. Und zwar deswegen, weil da nichts gestohlen werden kann. Das Rechenzentrum steht in Kalifornien, und solange ich Internet habe kann ich arbeiten. Und da kann niemand reinkommen, die Maschine stehen, abbrennen oder sonst was. Für die ist das natürlich die perfekte Lösung, die Daten in einem völlig sicheren Rechenzentrum zu haben und nicht vor Ort in Nigeria. Das ist ein Beispiel, was das halt klar machen sollte.

DS: Ja danke, sehr gutes Beispiel.

DS [00:26:12]: Welche potentiellen Herausforderungen und Risiken sehen Sie in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

B: Das sind aus meiner Sicht unterschiedliche Themen. Die Security, also die Sicherheit, das ist immer die Diskussion die wir führen, dass Firmen die Bereitschaft haben, die Daten in die Cloud zu geben, und nicht auf ihrem Schreibtisch. Wie sicher sind die Daten, wie ist die Verfügbarkeit, das ist das eine. Wobei man sagen muss, dass die Daten ja sehr sicher sind in den DataCenters, da sehe ich keine Gefahr. Der Datenschutz ist natürlich immer eine Diskussion bzgl. US-Unternehmen, US DataCenters, da sind Risiken, die muss man einfach hinnehmen. Da kann ich jetzt auch nicht mehr dazu sagen. Die erste Frage, die war daher immer stellen ist, wir sagen, dass unser DataCenter zwar in Amsterdam steht, das Unternehmen aber immer noch ein US-Unternehmen ist, passt das, oder passt das nicht? Bzgl. der Compliance sehe ich keinen Unterschied.

DS [00:27:51]: Die nächste Frage ist, gibt es aus ihrer Sicht Einschränkungen bzgl. der Funktionalität von Cloud-basierten betrieblichen Informationssystemen im Vergleich zu den On-Premise Varianten?

B: Also die cloud-basierte Lösung kann natürlich nicht auf die Datenbank runter, sie kann nicht auf die Datenbank zugreifen, muss immer über die cloud-basierte Schnittstelle gehen. Das ist natürlich eine gewisse Einschränkung, gibt aber auch Sicherheit, dass man die Datenbank nicht kaputt machen kann. Ansonsten gibt es an vielen Stellen große Unterschiede, weil man eben die cloud-basierte Lösung nicht anpassen können. Wenn Sie also eine on-Premise-Lösung kaufen, dann installieren sie die und fangen dann an, die Lösung anzupassen. Dann können Sie das zwar irgendwann nicht mehr vernünftig upgraden, weil sie es geändert haben. Wenn Sie aber eine cloud-basierte Lösung haben, dann bieten Sie das als Standard an und wir können das als Kunde gar nicht so viel ändern, wir müssen den Standard so nehmen. Das ist für mich aber, aufgrund meiner Erfahrungen, eigentlich ein No-Go, weil keine Firma hat gleiche Prozesse wie andere, und daher brauche ich, und das ist was NetSuite liefert, eine Entwicklungsumgebung, die Teil der Cloud ist. Da kann ich in der cloud-basierten Lösung mein System erweitern, indem ich Tabellen, Felder, Logik dazu bauen kann, die aufwärtskompatibel ist bei Upgrades, und damit habe ich eigentlich keine Einschränkungen mehr. Und da möchte ich auch sagen, dass NetSuite flexibler und mächtiger ist als jede On-Premise-Lösung.

DS [00:27:51]: Ich denke die nächste Frage haben Sie damit auch schon beantwortet, inwiefern unterscheiden sich die Möglichkeiten bzgl. Customizing und Konfiguration zwischen Cloud-basierten und On-Premise betrieblichen Informationssystemen?

B: Ja genau, wobei bei Hersteller, die beides Anbieten, da ist die cloud-basierte Lösung meist stark eingeschränkt, was das Customizing angeht. NetSuite hat halt nur cloud-basierte Lösungen, und das Customizing ist in der Cloud oder Teil der Cloud, und damit ist hier kein großer Unterschied mehr. Man ist natürlich an die Entwicklungsumgebung dieser cloud-basierten Lösung gebunden, und kann nicht ganz was anderes in der Datenbank machen, aber mit WebServices und anderen modernen Technologien bin ich da mindestens so flexibel wie ich das vorher war.

DS [00:30:15]: OK, alles klar. Welche Vorteile oder auch Nachteile sehen sich in der Upgrade-Fähigkeit von betrieblichen Informationssystemen durch die Anwendung in der Cloud?

B: Das ist eigentlich das gleiche. NetSuite ist upgradefähig, das machen die alle 2-6 Monate, ungefragt, alle Kunden gehen da einen Release hoch. Das funktioniert, egal wie viel sie angepasst haben. Wir haben bereits Lösungen gebaut, die wirklich massiv angepasst sind, aber das ist noch immer upgradefähig. On-Premise-Lösungen bleiben da oft viele Jahre am gleichen Stand und müssen dann mit sehr hohem Aufwand das Upgrade hochziehen, das ist bei NetSuite nicht so.

DS [00:31:18]: Gut, dann wären wir schon bei der letzten Frage. Welche Auswirkungen hat die Einführung Cloud-basierter betrieblicher Informationssysteme auf die Implementierungsdauer im Vergleich zur On-Premise Variante?

B: Ich glaube ehrlich gesagt keine. Wenn ich sage, die cloud-basierte Lösung muss ich so nehmen wie sie ist, weil es gar nicht anders geht, dann habe ich natürlich eine kürzere Anpassungsdauer. Ich sehe also keinen Unterschied, das hängt nicht von diesem Thema ab. Es hängt davon ab, inwiefern passt die Lösung, kann ich meine Prozesse darin abbilden, das hat also nichts mit Cloud oder On-Premise zu tun.

DS [00:32:10]: Gut, dann sind wir mit den Fragen durch, ich bedanke mich für ihre Zeit und ihre sehr ausführlichen Antworten.

B: Bitte gerne, ich hoffe ich konnte Ihnen weiterhelfen und wünsche Ihnen noch viel Erfolg bei ihrer Masterarbeit.

Transcript of Expert Interview C – German

Name of the interviewee: DI Peter Weiss
Company: FULCRUM Consulting GmbH
Industry: IT Consulting
Position: CEO
Date, Place: 2018-02-22, Telephone
Recording of the interview allowed: X Yes ☐ No
Publishing of the name of the interviewee allowed: X Yes ☐ No

DS[62] [00:02:30]: Dann möchte ich jetzt mit dem Interview beginnen. Die erste Frage ist, inwiefern haben die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben (sowohl technisch als auch organisatorisch)?

C[63]: Leider nur hohen Einfluss, und nicht sehr hohen Einfluss. Es gibt leider viele Unternehmen, die nicht verstehen, wie wichtig das wäre. Die Integration hat eine sehr hohe Wichtigkeit, die Kunden, die auswählen, sind sich dieser Wichtigkeit aber leider nicht immer in voller Breite bewusst.

DS: OK, und warum ist das so aus ihrer Sicht?

C: Weil viele Unternehmen sich nicht bewusst sind, wie teuer und aufwändig die Integration werden kann in einem Worst-Case-Szenario.

DS [00:03:52]: Die zweite Frage ist, welche Anforderungen bzgl. Integration von betrieblichen Informationssystemen haben Unternehmen aus Sicht des Managements und welche aus Sicht der Anwender?

C: Der Chef will geringe Total Cost of Ownership, der Endanwender möchte mit einem Doppelklick die Informationen haben, die er braucht, die halt oft in einem anderen System sind, das heißt wir brauchen eine Schnittstelle.

DS [00:04:44]: Die nächste Frage ist, was sind die Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

C: OK, die Frage ist was ist die Auswahl?

DS: Zum Beispiel im Hinblick auf die Organisationsstruktur, oder auf die Prozesse.

C: Die meisten schauen eigentlich viel zu sehr in die Funktionen, und sollten aber viel mehr schauen auf die Prozesse.

DS [00:05:24]: OK, und was sind die größten Herausforderungen bzgl. der Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

C: Die üblichen Schnittstellenprobleme. Wie integriere ich es wirklich. Gibt es ein API, das passt, oder muss ich mir eines schreiben. Oder man könnte sagen, die größte Herausforderung ist, gibt es was im Standard, oder muss ich was basteln, und wenn ich es basteln muss, wie sehr unterstützt mich die Schnittstellenarchitektur beim Basteln. Wenn ich ein API habe, dann ist das Basteln leicht, wenn ich mir eines bauen muss, dann ist es mittelschwer, wenn ich mir nicht mal ein API bauen kann, dann ist es schmerzhaft.

DS [00:06:48]: Wenn man jetzt keine Integration hat, welche Probleme und Schwachstellen verursachen dann isolierte Applikationen, also Insellösungen, in Produktionsbetrieben?

[62] DS = Dominik Scheuringer (Interviewer)
[63] C = Interviewee of Interview C

C: Datenschiefstände, Overheadkosten, Doppelerfassung heißt ja auch, dass hier irgendwer Zeit investiert, und das kostet. Informationsverluste, weil ja auch mein Report nicht optimal funktioniert, oder nur sehr mühsam, nicht real-time, z.B. nur einmal im Monat. Das also in Kombination, Kosten, schlechte Prozesse, schlechte Daten, schlechte Reports, schlechte Entscheidungsgrundlagen.

DS [00:07:56]: Die nächste Frage ist, gibt es aus ihrer Sicht bestimmte Abteilungen oder Bereiche in Produktionsbetrieben, welche am meisten von der Integration von betrieblichen Informationssystemen profitieren?

C: Controlling und Rechnungswesen. Weil die sitzen am Ende des End-to-End-Prozess, und wollen dann auf Knopfdruck die ganze Kette.

DS [00:08:35]: Die nächste Frage zielt auf die Integration zwischen ERP- und CRM-System, falls es dafür getrennte System gibt. Für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen (und vice versa) sinnvoll und vorteilhaft für Produktionsbetriebe?

C: Klassiker sind die unbezahlten Rechnungen, weil wenn ich als Vertriebler zum Kunden gehe wegen Folgeaufträgen, dann kann ich ja dann auch höflich fragen, was mit den Rechnungen ist, ob es da ein Problem gibt, und das sind ja Daten, die direkt aus der Buchhaltung kommen. Was anderes im CRM würde ich ja gerne alle Kunden sehen, die letztes Jahr was gekauft haben, und heuer nicht, in einer Zielgruppe zusammenfassen, und die besonders einladen für irgendein Event. Und damit habe ich auch eine Verknüpfung von meinem Verkaufssystem zu meinen Target Groups im CRM. Und natürlich alle Personendaten. Das wären typische Beispiele.

DS [00:10:06]: Welche Potentiale sehen Sie in der Integration von betrieblichen Informationssystemen (ERP- und CRM-System) innerhalb Office-Produkte wie Outlook, Word oder Excel?

C: Outlook ist immer dann gut, wenn ich ein E-Mail bekomme vom Kunden, und ich möchte es zu Dokumentationszwecken ins CRM hängen. Outbound, da schicke ich es meistens direkt aus dem CRM raus, ist nicht so spannend. Spannend hingegen ist die Integration von Adressdaten, also Personen und Telefonnummern, damit ich weiß wann mich wer anruft, wer mich anruft. Das andere, gewisse Dinge sind halt im Excel sehr schön, zum Beispiel, wenn ich einen Sales-Target-Frame habe, den kann ich dann im Unternehmen über mehrere Hierarchien hinweg verschicken, dann ist es schön, wenn ich mir aus dem CRM-System ein XML herunterlade, das XML in den Kreis schicke, und dann wieder rauflade. Und zwar mit einem Excel-Plug-In. Damit kann ich auch automatisch im Hintergrund die Daten im CRM updaten und ich kann es trotzdem schön herumschicken.

DS [00:11:53]: Die nächste Frage zielt auf Versions-Upgrades hin. Auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades von betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

C: Das ist ganz leicht. Das kann man sich anschauen, wie das SAP macht. Die Release-Wechsel sind in den Lizenzpreisen integriert. Ich drücke auf den Knopf, und der Releasewechsel passiert, wobei bei SAP die SAP halt an einem gewissen Datum auf den Knopf drückt. Und von Freitag auf Samstag ist der Release da, und die Schnittstelle funktioniert, wenn ich es nach den SAP-Regeln gemacht habe, ansonsten sie die SAP dafür verantwortlich, dass nach dem Release-Wechsel die Schnittstelle wieder funktioniert. Und somit Total Cost of Ownersip 0, außer das, was schon im Lizenzpreis enthalten ist. Es gibt andere Produkte, da ist der Release-Wechsel halt eine Überraschung, da kann der Release-Wechsel mehrere 10.000 Euro kosten. Je nachdem wie viel ich programmiert habe, je nachdem wie viel Schnittstellen ich habe. Und das ich auch das Wichtige an

einem Cloud-System, da macht die Cloud erst so richtig Sinn, wenn ich sage, ich habe meine Objekte so standardisiert, dass ich Release-Wechsel einfach machen kann, und alles was ich dazu programmiert habe, habe ich als Bolt-On mit einem WebService, und das WebService ist selber aber wieder release-sicher, weil ich es mit dem SDK des Herstellers gemacht habe. Und damit geht das auf Knopfdruck. Das ist eigentlich die hohe Kunst in einer modernen IT-Architektur.

DS [00:13:51]: Die letzte Frage zum Thema Integration ist, inwiefern können aus ihrer Sicht Workflows das Zusammenspiel und die Kommunikation verschiedener betrieblicher Informationssysteme optimieren und verbessern?

C: Ja, schon sehr. Beim Workflow über die Systemgrenzen hinweg habe ich halt manchmal das Problem, ob die Systeme voneinander gut wissen, wer der Vorgesetzte ist, daher funktioniert der Workflow über die Systemgrenzen oft nur sehr dürftig. Aber wichtig wäre es schon.

DS [00:14:30]: OK, dann wären das die Fragen zum Thema Integration. Dann hätte ich jetzt noch ein paar Fragen zum Thema Cloud. Die erste Frage ist, wie sieht der Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme ihrer Meinung nach aus?

C: Es geht eindeutig in Richtung Cloud. Alle großen Hersteller, egal mit welchen Produkten, gehen in Richtung Cloud. Für den Kunden gibt es geringere TCO, und die Hersteller radieren eigentlich die Rechenzentren ein bisschen aus und der Lock-In der eigenen Lösung beim Kunden, es ist weniger austauschbar, somit machen sie mehr Geld und haben weniger Risiko. Und da das alle gleichzeitig machen, kommt der Kunde nicht aus. Ich habe gestern mit der VOEST telefoniert, die überlegen nicht ob Cloud oder nicht, die überlegen nur, wann sie dem Druck nachgehen aller Hersteller. Man könnte sagen, On-Premise ist definitiv tot. Weil wenn alle in Richtung Cloud gehen, wer soll denn dann On-Premise bleiben.

DS [00:16:12]: Gibt es aus ihrer Sicht gewisse betriebliche Informationssysteme die besser und welche die schlechter für die Verlagerung in die Cloud geeignet sind?

C: Das ist eigentlich egal. Von der Architektur her muss das System für die Cloud designed sein, siehe meinen Spruch bzgl. Objekte und Stabilität für den Releasewechsel. Der Rest ist egal. Außer ich bin jetzt in irgendeiner Prozesssteuerung, wo es auf jede Millisekunde ankommt, dann habe ich in der Cloud schon noch ein Problem wegen der Latenzzeiten. Aber in der normalen Businesssoftware gibt es da keine Unterschiede.

DS [00:16:53]: Welche Voraussetzungen muss ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das Cloud Model besonders geeignet?

C: Die mittelgroßen, und vor allem die verteilten, die 3 oder mehr Standorte haben. Weil mit einer OnPremise-Lösung müssen sie sich irgendwas überlegen, wie sie kommunizieren, also VPN, Remote-Zugriff, Firewall. Mit einer Cloud-Lösung ist das kein Thema. Jeder IT-Administrator ist da sehr happy über eine Cloud-Lösung.

DS [00:17:56]: Welche potentiellen Herausforderungen und Risiken sehen Sie in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

C: Nicht mehr als bei anderen. Die meisten Cloud-Systeme habe ja eine verschlüsselte Kommunikation und sind damit jedenfalls sicherer als Outlook. Das Rechenzentrum eines Cloud-Anbieter ist auch mit Sicherheit sicherer als ein privater PC, der im Keller steht.

DS [00:18:50]: OK danke, und gibt es aus ihrer Sicht Einschränkungen bzgl. der Funktionalität von Cloud-basierten betrieblichen Informationssystemen im Vergleich zu den On-Premise Varianten?

C: Das ist von Hersteller zu Hersteller unterschiedlich. Bei SAP sieht man, dass die on-Premise S4/Hana kann noch mehr als die Cloud S4/Hana. Aber das CRM-System und das KMU SAP Business ByDesign gibt es nur in der Cloud, da gibt es alle Varianten. Bei Oracle ist es ähnlich. Bei SAP wurde in Österreich letztes Jahr noch immer mehr On-Premise verkauft als in der Cloud. Unterschiede kann man also allgemein nicht sagen.

DS [00:19:59]: Und sehen Sie Unterschiede im Customizing, sprich inwiefern unterscheiden sich die Möglichkeiten bzgl. Customizing und Konfiguration zwischen Cloud-basierten und On-Premise betrieblichen Informationssystemen?

C: Auf jeden Fall. Auf OnPremise, da habe ich den Source-Code, den ich komplett ändern kann, was mir bei Release-Wechsel wieder auf den Kopf fällt. Das geht bei Cloud-Systemen nicht mehr, da brauche ich eine API, da brauche ich WebServices, Bolt-Ons und da kann ich nicht alles komplett modifizieren.

DS [00:20:40]: Die nächste Frage haben Sie mir ja im Endeffekt schon beantwortet, welche Vorteile (oder auch Nachteile) ergeben sich in der Upgrade-Fähigkeit von betrieblichen Informationssystemen durch die Anwendung in der Cloud?

C: Ja sehr große Vorteile, und da spielt eigentlich die Musik in den Total Cost of Ownerships. Und da bin ich in einem guten Cloud-System, auf 5 Jahre, obwohl die Lizenzkosten am ersten Blick viel teurer sind als On-Premise, bin ich trotzdem oft um 50.000 Euro billiger, wenn ich den Release-Wechsel richtig kalkuliere.

DS [00:21:15]: Zur letzten Fragen, welche Auswirkungen hat die Einführung Cloud-basierter betrieblicher Informationssysteme auf die Implementierungsdauer im Vergleich zur On-Premise Variante?

C: Viel schneller, und zwar um Faktor 2-3. Wir implementieren ja noch immer S4/Hana on-Premise, wenn ich das vergleiche mit Business ByDesign, dann haben wir einen Faktor 3. Hängt aber nicht nur mit der Cloud zusammen, sondern auch, weil im Finetuning, im Customizing viel mehr Automatismus, viel mehr Logik ist, da sind auch mehr BestPractise drinnen. Ich brauche aber auch keine Datenbank aufsetzen, keine Hardware kaufen. In einem On-Premise-Projekt dauert es oft ein Monat, bis die Datenbank mal funktioniert. Und bei der Cloud Variante haben wir halt nach 3 Tagen ein Testsystem, das fix und fertig ist und auf jeden Laptop läuft.

DS [00:22:40]: Gut, dann sind wir durch mit dem Interview, nochmals vielen Dank!

C: Gerne, freut mich, dass ich helfen konnte und noch viel Erfolg.

Transcript of Expert Interview D – German

Name of the interviewee: Anonymous
Company: Anonymous
Industry: Machine Engineering (Hydraulics)
Position: CEO / CIO
Date, Place: 2018-02-23, Unterweitersdorf
Recording of the interview allowed: X Yes □ No
Publishing of the name of the interviewee allowed: □ Yes X No

D[64] **[00:00:00]:** Herr Scheuringer, bevor wir mit den Interviewfragen beginnen, hätte ich noch eine Frage, und zwar wie Sie das Wort Integration definieren, was Sie darunter verstehen? Geht es hier nur um die Integration eines Systems? Oder schließt das auch die Kopplung von verschiedenen Systemen mit ein?

DS[65]**:** Es geht hauptsächlich darum, wenn man verschiedene Systeme hat. Also um das Zusammenwirken verschiedener Systeme.

D: Alles klar, dann können wir starten.

DS [00:01:17]: OK, die erste Frage wäre, welche betrieblichen Software-Informationssysteme haben Sie im Einsatz und welche Module decken ihre Software-Systeme ab?

D: Wir haben einmal ABAS als Kernsystem, das in einem breiten Umfeld im Einsatz ist. Von Vertrieb, Einkauf, Produktion und Finanzbuchhaltung. Dann haben wir noch 2 Ergänzungssysteme, zum einen Sage im HR-Bereich, die ganze Lohnabrechnung etc. Da gibt es keine enge Verzahnung von Sage mit ABAS, es werden nur Buchungssätze von Sage nach ABAS hinübergeschoben, damit man die Löhne und Gehälter anweist. Im Sage machen wir auch die Personalzeiterfassung und Reisekostenerfassung. Und dann gibt es noch ein drittes wichtiges System, das ist unser Warehouse. Durch das, dass wir automatisierte Läger haben, wird die Lagerverwaltung nicht in ABAS gemacht, sondern in der PowerPick, das ist von der Firma Kardex. Und was dann an ABAS noch dran hängt ist ein Dokumentenmanagementsystem von der Firma Habel, wo halt alle Belege reinwandern. Habel ist der DMS-Partner von ABAS. Das ist praktisch in ABAS integriert, wir haben in den ABAS-Masken Zugriff auf die Dokumente. Ja das sind alle unsere Business Applikationen, alles andere geht in die technische Richtung

DS [00:03:20]: Gut, die Frage der unterschiedlichen Anbieter ist damit auch beantwortet – ja haben wir. Wir haben ABAS, wir haben Sage, Habel und Kardex.

DS [00:03:39]: Welche Systeme hängen dabei aktuell am meisten voneinander ab?

D: Das ist ABAS und PowerPick. Dort ist eine ganz eine enge Verzahnung. Wenn ich beim Wareneingang beginne, wir erfassen im ABAS den Wareneingang, dort wird schon bei der Erfassung mitgeteilt, in welche Behältnisse die Ware gegeben wird, und dieser Datensatz wird dann PowerPick übergeben, und PowerPick sucht dann die Lagerplätze, der Mitarbeiter im Lager wird dann schon systemgeführt, meldet dann zurück, dass er es jetzt platziert hat, dann werden die Waren im ABAS verbucht und umgekehrt wenn die Waren ausgehen ist es auch so, es werden Kommissionsaufträge übergeben von ABAS nach PowerPick und jede einzelne Position wird sofort wieder in ABAS rückgemeldet und in ABAS verbucht. Das heißt wir haben Bestand-Synchronität, es ist nicht so dass wir nur den Bestand im Warehouse haben, sonders es wird eben synchron gehalten im ABAS, und

[64] D = Interviewee of Interview D
[65] DS = Dominik Scheuringer (Interviewer)

das ist schon eine heftige Schnittstelle, da die Systeme grundsätzlich nichts miteinander zum tun haben. Das kam erst später, wir haben 2008 ABAS eingeführt und 2014 haben wir ein automatisiertes Lager bekommen und da haben wir uns getrennt von der Lagerwirtschaft in ABAS und haben die Bestandsführung an PowerPick übertragen und führen das nur in ABAS mit.

DS: OK, da haben wir ja schon ein gutes Beispiel für eine starke Integration.

DS [00:06:11]: OK, und nachdem die Systeme standardmäßig ja nichts mit einander zum tun haben, nehme ich auch an, dass sie ein unterschiedliches User Interface haben, oder?

D: Ja genau, vollständig unterschiedliches User Interface. Laufen auch auf einer anderen Plattform, ABAS haben wir auf Linux und PowerPicks in Windows.

DS [00:06:50]: Gut, dann habe ich mal einen guten Systemüberblick. Die zweite Frage an Sie ist, welche Erfahrungen haben Sie in dem Integrationsprojekt in ihrem Unternehmen gemacht?

D: Wenn man jetzt 2 Anbieter am Tisch hat, jeder hat nur die Brille für sein System. Und die Klammerfunktion muss eine übergeordnete Person sein, die sich mit beiden Systemen eng auseinandersetzt und die auch dann das Pflichtensystem schreibt, sich mit den Funktionalitäten beider Systeme auseinandersetzt, nur so kann das Projekt zum Erfolg führen. Weil der Herr von Kardex interessiert sich nicht für ABAS, und der Herr von ABAS nicht für die PowerPick, das ist das Problem. Und die Verantwortung muss komplett im eigenen Haus sein, die sich wirklich auch mit allen Systemen auskennt. In dem Fall bin ich es, das ist auch historisch geprägt, aber das ist nicht immer so. Ich denke mir, wenn das ein Mitarbeiter in der IT unter der Geschäftsleitung macht, dann muss sich der voll mit dem Unternehmen identifizieren, weil der kann nach 3 Monaten nicht wieder weg sein, das ist ein lang andauerndes großes Projekt. Oder zumindest muss es gut dokumentiert werden und das Wissen übertragen werden. Und da haben viele Klein- und Mittelbetriebe sicher oft ein Problem, da die nicht eine IT-Abteilung mit 5 Mitarbeiter haben, sondern da gibt es nur einen im Haus, Unikatspersonen sind da extrem gefährlich.

DS [00:09:11]: Die dritte Frage ist, wie Sie damals die Systeme ausgewählt haben, da hatten die Integrationsmöglichkeiten wohl auch einen Einfluss bei der Auswahl der betrieblichen Informationssysteme, oder? Wenn ja, welche (technisch, organisatorisch, geschäftsorientiert)?

D: Genau, in Wahrheit waren am Ende 2 Systeme, die bzgl. Lagerhaltung zur Auswahl standen. Zum einen die Firma Hänel, das ist der Wettbewerber von Kardex und halt Kardex. Dann gingen wir in die Details der Technologie und sind darauf gekommen, dass das System von Hänel nicht die Offenheit zur vollständigen Integration hatte, und damit war das das Entscheidende warum wir uns dann für Kardex entschieden haben.

DS [00:10:20]: Die nächste Frage geht jetzt mehr in Richtung der Prozesse, welche ihrer Geschäftsprozesse betreffen mehr als ein betriebliches Informationssystem in ihrem Unternehmen?

D: Der Auftragsabwicklungsprozess bis zur Lieferung und auch der Wareneingangsprozess, bzw. auch in der Produktion. Also immer wenn Material im Spiel ist. Der Warenausgang kann sein Richtung Kunde, dass ein Auftrag bedient wird oder die eigene Produktion, dass der Materialanforderer der Meister einer Montageeinheit ist und der schickt seinen Betriebsauftrag mit PowerPicks. Und da spielt dann auch das DMS mit, beim Wareneingang bekommen alle Belege einen Barcode, der Barcode wird bei der Materialerfassung mit dem System verankert und dann werden die Belege gesammelt und gehen zu einer zentralen Scanstation, und dort werden sie eingescannt und verlinkt mit dem ERP-System und wenn man im ERP-System ist und will sich das Dokument ansehen,

dann geht im ERP-System das Dokument aus dem DMS auf, da ist ja auch schon wieder eine Integration. Das sind 3 Systeme, die stark miteinander integriert sind.

DS [00:12:49]: Führen Sie ERP- und CRM-Tätigkeiten in einem Software-System durch oder haben Sie dafür getrennte Software-Systeme?

D: Nein, diese Information wird auch im ABAS geführt. Man muss dazu ergänzen, wir stecken im klassischen B2B-Bereich und haben eine sehr geringe Anzahl an Kunden, die quasi Stammpartner sind. Wir machen also mit 25 Kunden 90% unseres Umsatzes.

DS: Ok, das heißt sie benötigen kein klassisches CRM-System, Adressverwaltung, Leadmanagement, etc.

D: Ja genau.

DS [00:13:34]: In welchem System erstellen Sie Analysen und Auswertungen ihrer ERP- und CRM-Daten? Haben Sie dafür ein separates BI-System im Einsatz?

D: Da ist ganz klar das federführende System der ABAS. Wir haben kein BI-System, sondern wir machen das direkt mit Queries und der sogenannten flexiblen Oberflächenprogrammiersprache damit wir auf den Datenstand von ABAS zugreifen, das ist nicht von einem externen System, wo mit ODBC externe Daten abgegriffen werden. Es werden alle Auswertungen im ABAS erstellt, wo entweder die normale Query-Sprache verwendet wird, oder man programmiert es aus. Die einzige Auswertung ist bei der Bestandsführung, dort gibt es schon von der PowerPick Auswertungen, und zwar gibt es eine Besonderheit, weil wir brauchen keine Inventur machen. Und zwar haben wir das so gelöst, wir haben ein strenges FIFO-Prinzip im Warehouse, das heißt jeder Platz geht immer auf 0, bevor ich dann auf den nächsten Platz zugreifen kann, und wenn ich auf 0 gehe, dann wird das ja quittiert. Jetzt könnte es sein, ich muss 5 kommissionieren und es liegen nur 4, dann wird eine Bestandskorrektur gemacht zu dem Zeitpunkt, aber immer wenn ich auf 0 gehe, dann quittiere ich die Null oder ich mache eine Bestandskorrektur. Und aufgrund dieser Tatsache, dass wir eine gleitende Nullbestandsinventur machen, brauchen wir keine Inventur machen. Und den Nachweis, dass dieses System insgesamt stabil ist und diese Bestandskorrektur nicht aus dem Ufer geraten, da muss ich einen Nachweis gegenüber der Wirtschaftsprüfung liefern, und das kommt direkt aus der PowerPick, wo ich dann halt sage, die Abweichungsquote 0,2 %. Und der Wirtschaftsprüfer begnügt sich eigentlich mit einem Wert wenn er kleiner als 3 % ist.

DS [00:16:31]: Gut, dann habe ich ein paar Fragen zum Realisierungsgrad bzgl. der Integration ihrer betrieblichen Informationssysteme. Die erste Frage dabei ist, was sind bzw. waren die Auslöser für eine notwendige Integration ihrer betrieblichen Informationssysteme (Organisationsstruktur, betriebliche Prozesse etc.)?

D: Weil wir damals die Bestandstreue nicht hatten und ein quasi nicht automatisiertes System. Der Mitarbeiter war nicht von einem System geführt, sondern er muss einen Platz selber suchen, kann sich vergreifen etc. Und so kommt es zu Fehlern im System, die falsch entnommene Ware wird gar nicht entdeck im Unternehmen, geht dann aber zum Kunden. Dann wird ein anderer Artikel nachbestellt etc. Das waren also Bestandsfehler in unserem System, die den Prozess unheimlich gestört haben und das wollten wir bereinigen mit einem starreren System, das nicht so viele Freiheiten zulässt, in sich abgeschlossen ist.

DS [00:18:12]: Was sind bzw. waren die größten Herausforderungen bzgl. der Integration ihrer Informationssysteme?

D: Das war die Umstellung zum Tag X, mitten eigentlich im Prozess. Und ich habe diesen Umstellungszeitpunkt noch einen Tag vorher noch gecancelled und nochmal um drei Tage verschoben, weil ich kein gutes Gefühl hatte und ich noch mehr Integrationstests wollte.

Wobei die Vertreter der beiden Firmen, ABAS und Kardex, die haben kein mulmiges Gefühl, denn ist das sozusagen egal. Und wenn du da Fehler in der Datenschnittstelle hast, dann fährst du die Firma an die Wand, da kannst alle Leute heimschicken.

DS [00:19:30]: Gibt es aus ihrer Sicht Verbesserungspotentiale aktuell in der Integration ihrer betrieblichen Informationssysteme (technisch / organisatorisch)? Wie können aus ihrer Sicht diese Verbesserungspotentiale umgesetzt werden?

D: Ja, wir denken über die Integration weiterer Systeme nach. Das eine ist Projektmanagement, wobei das sind AddOns zu ABAS. Es gäbe auch die Möglichkeit, komplette Fremdsysteme zu connecten, aber, wenn man sich das ansieht, dann wird man immer am meisten zufrieden, wenn man den Empfehlungsgrad von ABAS nimmt. Und das zweite ist APS, also ein Feinplanungssystem, da gibt es das Fremdsystem Etagis, da hat übrigens auch Navision schon angedockt, das ist nämlich gerade ein Projekt, und die zwei häufigsten Systeme sind ABAS und Navision. Wir haben uns aber noch andere Systeme auch angesehen, zum Beispiel die Industrie Informatik ist ja auch in dem Bereich tätig und da kommt man wieder zu dem Punkt, bleibt man in der ABAS Familie. Aber das sind halt auch wieder alles Projekte. Es bedarf einer Änderung von Stammdaten. Ev. müssen Stückliste und Arbeitspläne geändert werden. Das ist bei allen Integrationsprojekten der Fall, das ist die meiste Arbeit, dass man den Daten-Istzustand auf den Stand bringt, dass dann eine gute Integration gelingt.

DS [00:22:46]: Gibt es aus ihrer Sicht aktuell noch Insellösungen im Unternehmen?

D: Nein, die sind von mir verpönt. Access darf bei uns nicht installiert werden. Es gibt eine zentrale Datenbank und notfalls integrieren wir neue Anforderungen ins ABAS. Ich nehme als Beispiel Produkt-Datenbanken von einem Lieferanten oder Fehlermelde-Datenbanken, die ABAS nicht hatte, oder die Prüfaufzeichnungen kommen in eine Prüf-Datenbank. Man hat dann den Vorteil, dass alle anderen Beziehungen, die mit diesem Prüfobjekt stehen, sei es mit dem Artikelstamm oder auch mit dem Kundenauftrag, sofort abbildbar sind. Wir hatten z.B. bei meiner alten Firma SAP, und das war aber den Leuten in vielen Bereichen einfach zu komplex, und bestimmte Gruppen und Abteilungen haben sich entschieden eigene Access-Datenbanken zu erstellen, die hat sich dann über 10 Jahre gehalten und das Resultat war ein Datensalat, die nicht mehr mit SAP zusammenpasste. Wir mussten also ein eigenes Projekt starten, um all diese Fremdsysteme zu eliminieren.

DS [00:25:02]: Inwiefern sind Office- und Collaboration-Software-Systeme (Word, Excel, Outlook, SharePoint etc.) mit ihren betrieblichen Informationssystemen (ERP-/CRM-System) integriert?

D: Grundsätzlich ist bei uns Excel sehr stark im Einsatz, über den Druckgenerator von ABAS kann man die Excel ansteuern, das wird sehr häufig genutzt, wenn man z.B. den Kunden irgendwelche Daten bereitstellen muss, sei es Stücklisten oder Auftragsdaten. Und für diese Zwecke nutzen wir den Weg Richtung Excel sehr stark. Es gibt zwar auch den Weg nach Word zu exportieren, wobei es hier immer einer gewissen Nachjustierung bedarf. Es gibt zum Beispiel einen Vertreter, da machen wir das Basisangebot, und der möchte das nochmal weiteranbieten, dem liefern wir das zum Beispiel in einem Word, damit er das dann weiterbearbeiten kann.

DS [00:26:58]: Gibt es aus ihrer Sicht eine Abteilung, wo Sie sagen, die profitiert am meisten von der Integration ihrer betrieblichen Informationssysteme?

D: Da kann man keinen hervorheben. Es profitiert jede Abteilung davon. Wenn ich z.B. eine Abteilung nenne, die ich bisher noch gar nicht erwähnt habe, die Konstruktion. Es müssen alle Konstruktionsdaten zu einem Material im Artikelstamm verlinkt werden. Es gibt bei uns kein eigenes PDM, auch hier ist das ERP-System ABAS das Leitsystem für die

Daten der Konstruktion. Auch wenn die Daten auf File-Ebene irgendwo liegen, aber der Link zur Datei ist im ABAS abgebildet.

DS [00:28:29]: Aufgrund unseres bisherigen Gesprächs nehme ich an, dass Sie aktuell keine Doppelarbeiten machen müssen aufgrund isolierter Systeme oder?

D: Nein, das soll nicht sein. Fällt mir auch nichts ein.

DS [00:28:41]: OK, und gibt es aktuell einen Mangel an Echtzeit-Auswertungen und Reports aufgrund nicht integrierter, mehrfach überlappender Datenbanken?

D: Zwischen ABAS und PowerPick stecken halt 1-2 Minuten dahinter, aber sonst haben wir quasi alles in Echtzeit.

DS [00:29:15]: Werden von ABAS auch interaktive Dashboards unterstützt?

D: Es gibt ein System von ABAS, die das können. Wir haben aber dafür keine Notwendigkeit, das ist alles Nice-to-have, das bringt uns nicht nach vorne. Was aber ABAS hat sind sogenannte Business Apps, die auch Dashboards unterstützen. Und diese Dashboards werden auch im Standard immer mehr ausgeliefert. Z.B. haben wir ein App, da sieht man zum Auftrag, in welchen Beziehungen dieser Auftrag noch steht, wie viele Angebote noch offen sind, der offene Saldo zum Kunden und so weiter. Das kann man alles konfigurieren und somit ein Cockpit erstellen. Das kommt immer mehr, wir sind hier nicht Vorreiter, das kommt ja von den mobilen Geräten, und wir haben ja keine Verkäufer, die mobil unterwegs sind. Aber diese Technologie gäbe es.

DS [00:31:35]: Ich denke, die nächste Frage haben Sie auch schon beantwortet. Besitzen Sie aktuell eine einheitliche Datenbasis für Kundeninformationen? Wenn nicht, auf welche Systeme sind diese verteilt und ergeben sich daraus Probleme für ihr Unternehmen?

D: Ja so soll es sein. Wobei ich es nicht leugnen kann, ob die Leute auch in ihren Outlooks weitere Kontakte haben. Wobei dann, wenn ein Angebot erstellt wird, also wenn eine Geschäftsbeziehung eingegangen wird, dann landet das spätestens im ABAS.

DS [00:32:20]: Auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades ihrer betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

D: ABAS hat, finde ich, eine fürchterliche Upgrade-Strategie, weil es kommt im Endeffekt jede Woche was. Es gibt einmal im Jahr eine neue Version, und 4-mal im Jahr ein großes Update (R1, R2, R3 und R4) und dann gibt es die Nachträge, die kommen kontinuierlich, jede Woche. Auf jede Version, die nicht länger als 2 Jahre zurückliegt kann ich umstellen. Ich habe da eine Philosophie herausen, die Version musst mindestens 1 Jahr im Feld sein und ich steige nur auf die R4 um und von einem hohen Nachtragsstand, und das im Rhythmus von 2 Jahren. Jedes Jahr, da wäre der Kosten-Nutzen-Vorteil nicht gegeben, 3 Jahre wäre aber fast zu viel und daher ist 2 Jahre optimal.

DS: Und ist das dann eine große Challenge, der Upgrade?

D: Das ist ein Monatsprojekt. Also das wird auf einem Demomandanten installiert und dort werden die neuen Funktionen getestet, jeder Bereich muss seine Funktionen testen.

DS [00:35:29]: Dann hätte ich zum Block Integration noch eine Frage. Gibt es bei Ihnen Workflows zwischen ihren verschiedenen betrieblichen Informationssystemen implementiert?

D: Auch das ist in der Ankündigung bei ABAS, aktuell kann ich dazu noch nichts sagen. Momentan gibt es sowas wie ein POST-System, da gibt es Fragmente, die man nutzen könnte, das ist aber bei uns nicht im Einsatz. Zum Beispiel für automatische Benachrichtigungen. Und dann gibt es auch sowas wie Aktivitäten. Das sind mal so

Ansätze. Und jetzt soll aber ein vollständiges Workflow-System kommen, wo man die Prozesse designen kann.

DS [00:37:27]: Gut, dann hätte ich noch ein paar weniger Fragen zum Thema Cloud. Da würde mich mal generell interessieren, In welchem Ausmaß nutzt ihr Unternehmen aktuell Cloud-basierte betriebliche Informationssysteme (Software-as-a-Service)?

D: Es gibt momentan gar keine Cloud-Systeme. Aktuell völlig unvorstellbar, und zwar aus folgendem Grund. Und zwar weil die Datenleitungsinfrastruktur aktuell nicht gegeben ist in unserer Region. Sie müssen sich vorstellen wir haben da gestartet 2008 mit der Telekom Austria mit einer ISDN-Leitung. Ich wollte natürlich mehr, und die haben uns aber gesagt, dass wir uns selber eine Leitung bauen können. Da war ich natürlich geschockt. Dann habe ich ein Funksystem installiert und haben die Datenleitung praktisch über Richtfunk. Das ist mir aber nicht ausfallssicher genug. Das muss eine Verfügbarkeit zu 99,99 % haben und notfalls muss es ein Ausfallsystem geben. Wir haben jetzt den Richtfunk, und unser Ausfallsystem ist die billige Telekom-Leitung. Jetzt hat sich aber was getan, diese Region wird von der Linz Strom erschlossen, und bieten eine neue Lösung an. Das heißt, die Bandbreite wird jetzt erst so richtig zur Verfügung gestellt, wo ich über die Cloud nachdenken kann. Vorher denke ich hier gar nicht weiter. Ich kann noch nicht abschätzen, ob das für uns eine Relevanz bekommt. Momentan interessieren sie uns nicht die cloud-basierenden Systeme.

DS [00:40:30]: Welche Voraussetzungen müssten also erfüllt sein, damit Sie sich für eine Anwendung in der Cloud entscheiden würden?

D: Ja wie gesagt, wenn die Infrastruktur gegeben ist. Ich sehe, dass Amerika absoluter Vorreiter ist, die sind da ja 2-3 Jahre voraus. Ich sehe da auch in die ABAS rein, man hat die ABAS Amerika vollständig integriert, man hat den Regionalleiter einen Posten im Vorstand verschafft, um diese Denke der Cloud weiter in das Entwicklungskonzept einfließen zu lassen. Ich denke mir so, aktuell ist es so, dass wir immer mehr für die Kunden in deren Fremdsystemen arbeiten. Und da bin ich neugierig, wie sich das in der Cloud mit der Datenstruktur harmonisiert. Da fehlt mir noch die Vorstellung.

DS [00:43:36]: Das heißt, sie haben sich aktuell auch noch nicht überleg, inwiefern Cloud-Computing (insbesondere Software-as-a-Service) aus ihrer Sicht die Wertschöpfung in einem Produktionsunternehmen steigern kann (z.B: Prozessoptimierungen, Kostenreduktionen)?

D: Nein nicht wirklich. Nur die klassischen Microsoft Office-Pakete, die Leute nutzen ja Note, cloud-basierend. Selber da gibt es immer wieder Bedenken und die Mitarbeiter vertrauen dem noch nicht ganz. Aber da sind wir noch komplett auf der Basis.

DS [00:44:34]: Ist ein mobiler Zugriff auf ihre betrieblichen Informationssysteme (zu jeder Zeit, an jedem Ort) aktuell möglich?

D: Ja, über VPN.

DS [00:44:44]: Dann sind wir schon bei der letzten Frage, wie stehen Sie zum Thema Sicherheit und Datenschutz bei Cloud-basierten betrieblichen Informationssysteme? Welche Gefahren und Risiken sehen Sie darin?

D: Sie kennen ja diese DSVGO. Ich habe mit dem Gesetzestext ein Problem. Ein Aspekt, der mich besonders stört, ist diese Löschungsverpflichtung. Die Systeme sind aktuell nicht dafür gebaut. Die Firma hat auch nicht im Griff, wer mit welchen Daten abfahren kann. Und das dritte ist, hat man wirklich von allen Personen die Einwilligung, dass man deren personenbezogen Daten verarbeiten darf.

Transcript of Expert Interview E – German

Name of the interviewee: Marco Mülleder
Company: NAVAX Consulting GmbH
Industry: IT Consulting
Position: Head of Product Management
Date, Place: 2018-02-23, Linz
Recording of the interview allowed: X Yes ☐ No
Publishing of the name of the interviewee allowed: X Yes ☐ No

DS[66] [00:00:00]: Marco, die erste Frage ist, inwiefern haben aus deiner Sicht die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben (sowohl technisch als auch organisatorisch)?

E[67]: Da muss ich gleich mal eine Rückfrage stellen – Integration heißt für dich, dass ich ein integriertes System habe und alle Daten in einem Topf.

DS: Genau, aber ev. auch mehrere Systeme, dass ich diese miteinander integrieren kann. Ich habe z.B. ein eigenes ERP- und ein eigenes CRM-System. Oder halt auch noch ein Lagersystem etc.

E: OK, ja grundsätzlich ist das der Grund, warum Firmen auf uns zukommen, weil sie kein integriertes System haben und dann hier eine Problematik sehen. Die Problematik ist die Intransparenz ganz allgemein gesagt. Und da tut man sich ab einer gewissen Unternehmensgröße schwer, auch in der klassischen Abwicklung, weil der Aufwand zu hoch wird bei der Abwicklung.

DS [00:01:38]: Ok und was sind aus deiner Sicht hier die Anforderungen bzgl. Integration von betrieblichen Informationssystemen in Unternehmen, einerseits aus Sicht des Managements und andererseits aus Sicht der Anwender?

E: Das Management will konsistente Zahlen, und das bietet halt ein integriertes System besser, einfacher und vor allem genauer. Das ist die Sicht des Managements aus meinem Verständnis und die Sicht des Anwenders ist einfach eine effizientere Bedienbarkeit, Einmaleingabe usw., das sind so die Stichwörter. Damit er sich einfach unterstützt fühlt und die nötigen Informationen hat.

DS [00:02:24]: OK, und was sind die Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben, also z.B. die Organisationsstruktur, betriebliche Prozesse etc.?

E: Zum einen, weil sie oft gar keine genauen Zahlen haben oder in gewissen Abteilungen sind keine Zahlen verfügbar. Dadurch schwer steuerbar. In Produktionsbetrieben ist halt oft die Kapazität ein Thema, das sie perfekt planen wollen, um Kosten zu optimieren.

DS [00:03:16]: OK, und wenn es dann um die Umsetzung geht, was sind dann aus deiner Sicht die größten Herausforderungen bzgl. der Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

E: Ein integriertes System verlangt Genauigkeit, du kannst nicht einfach irgendwo einen Wert darüberschreiben oder so. Das ist oft ein Philosophiewechsel innerhalb eines Unternehmens, das ein bisschen in die Köpfe reingehört und auch gelebt werden muss, dass das was man macht auch Einfluss auf andere Abteilungen hat.

[66] DS = Dominik Scheuringer (Interviewer)
[67] E = Interviewee of Interview E

DS [00:03:53]: Und nun die Gegenfrage, wenn man doch isolierte Applikationen, also Insellösungen in Unternehmen hat, welche Probleme und Schwachstellen ergeben sich daraus in Produktionsbetrieben?

E: Erstens bekommt man die nötigen Daten oft schwer raus, und die Überprüfung, ob die Daten wirklich stimmen ist sehr aufwändig. Das Controlling muss unheimlich viel Zeit investieren, wenn man solche Dateninseln hat. Und natürlich auch in der Abwicklung ist man dort und da nicht so effizient.

DS [00:04:52]: Inwiefern können Produktionsprozesse (z.B. Einzelfertigungsprozesse) in Unternehmen optimiert werden durch die Integration betrieblicher Informationssysteme?

E: Ja, z.B. die Kapazitätsplanung, die wird ja aufgrund vieler Faktoren beeinflusst, wo der Anwender einfach Systemunterstützung braucht, und zwar aufgrund mehrerer unterschiedlicher Systeme. Habe ich die Maschine, habe ich das Material, ist gerade eine Wartungsarbeit, welche Rüstzeiten habe ich, was ist das nächste Produkt, welches Produkt sollte ich als nächstes produzieren, da brauche ich einen Überblick.

DS [00:05:45]: Die nächste Frage ist, welche Abteilungen in Produktionsbetrieben profitieren am meisten von der Integration von betrieblichen Informationssystemen?

E: Am meisten profitiert Finance und Controlling, die anderen Systeme haben ja die Systemunterstützung und haben daher oft nicht so viel von der Integration. Das Finance und Controlling hingegen benötigt aber konsolidierte Daten.

DS [00:06:17]: Wenn ein Unternehmen getrennte ERP- und CRM-Systeme hat. Für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen (und vice versa) sinnvoll und vorteilhaft für Produktionsbetriebe?

E: Aus der Hüfte heraus, bei Produktionsbetrieben, da hat man ja oft auch After-Sales-Services, da ist sicher mal interessant, was hat welcher Kunde gekauft, auf das man dann ein Marketing aufsetzen kann

DS [00:06:57]: OK und welche Potentiale siehst du in der Integration von betrieblichen Informationssystemen (ERP- und CRM-System) innerhalb Office-Produkte wie Outlook, Word oder Excel?

E: Office sind im Endeffekt unstrukturierte Daten, hat aber den Vorteil, dass man sehr flexibel ist, für Einmalaufgaben. Und da sehe ich es schon als gutes Werkzeug.

DS [00:07:33]: Auf was soll deiner Meinung nach der Fokus bei Versions-Upgrades von betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

E: Wichtig ist einmal eine Dokumentation der Infrastruktur als solche, und auch eine Dokumentation der Schnittstellen

DS [00:07:55]: OK, und dann noch eine Frage bzgl. Integration. Inwiefern können aus deiner Sicht Workflows das Zusammenspiel und die Kommunikation verschiedener betrieblicher Informationssysteme optimieren und verbessern?

E: Im Prinzip liefert dir das die Möglichkeit, dass der Anwender quasi sein optimales Tool hat, egal wo die Daten herkommen. Und je besser das Zusammenspiel ist, desto einfacher wird es. Dem Anwender interessiert das ja gar nicht, in welcher Anwendung er ist. Der will nur die Daten haben, die er braucht.

DS [00:09:07]: Gut, dann sind wir durch mit den Fragen bzgl. Integration. Dann hätte ich noch ein paar Fragen zum Thema Cloud. Wie siehst du allgemein den Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme?

E: Das eine ist, es gibt immer mehr Business Software, die ausschließlich in der Cloud verfügbar sind, da ist der Trend klar. Bei Produkten, wo beides verfügbar ist, ist der Schwerpunkt nach wie vor bei On-Premise-Anwendungen, jedoch merkt man ein vermehrtes Interesse an den Cloud Services, aber es ist nicht so hoch, wie man glaubt. Es geht also schon Richtung Cloud, aber verhalten. Bei Unternehmen mit über 20 Anwender, da spielt die Cloud immer weniger eine Rolle.

DS [00:10:17]: OK, und gibt es aus einer Sicht betriebliche Informationssysteme die besser und welche die schlechter für die Verlagerung in die Cloud geeignet sind?

E: Wenn ich ein hochverfügbares System brauche, zum Beispiel eine Kassalösung, wo der Kunde an der Kassa steht, dann will ich das nicht als Cloud-Service haben. Das zweite ist, wenn ich ein Unternehmen mit sensiblen Daten bin, dann werde ich auch nicht in die Cloud gehen.

DS [00:11:09]: Die nächste Frage ist, welche Voraussetzungen muss ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das Cloud Model besonders geeignet?

E: Also besonders geeignet ist ein Unternehmen, wenn es über das Jahr unterschiedliche Lastzustände hat, sprich unterschiedliche User-Anzahl bzw. unterschiedliche Performance-Anforderungen auf dem Server. Das ist eine klassische Cloud-Anwendung. Weil es dann eben besser skalierbar ist.

DS [00:11:46]: OK, und welche potentiellen Herausforderungen und Risiken siehst du in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

E: In der Praxis sind die Cloud-Services alle samt besser, als wie die lokalen Anwendungen. Potentielle Herausforderungen sind dann aber in vertrauensbildenden Maßnahmen und in Schulungsmaßnahmen für den Kunden.

DS [00:12:42]: Gibt es aus deiner Sicht Einschränkungen bzgl. der Funktionalität von Cloud-basierten betrieblichen Informationssystemen im Vergleich zu den On-Premise Varianten?

E: Ja, im Detail gibt es Einschränkungen, weil ich bei einer Cloud-Lösung im Browser bin, der nicht die Bedienbarkeit bietet, wie eine ausprogrammierte Applikation. Das ist aber eher noch ein technisches Thema. Und natürlich hast, wenn du eine Integration in eine andere Software suchst, dann muss die andere Software moderne Schnittstellenarchitektur unterstützen. Authentifizierungsmodelle etc.

DS [00:13:48]: OK und bzgl. den Möglichkeiten bei Customizing und Konfiguration, siehst du hier Unterschiede zwischen Cloud-basierten und On-Premise betrieblichen Informationssystemen?

E: im NAV ist das im Prinzip kein Unterschied, wir haben hier die gleichen Möglichkeiten. Wobei man hier unterscheiden muss, habe ich Cloud in einem externen Rechenzentrum oder Software-as-a-Service. Bei Software-as-a-Service bin ich in einem automatischen Upgrade-Zyklus, wo es wahrscheinlich dann auch entsprechende Einschränkungen in der Entwicklung und im Customizing gibt.

DS [00:14:40]: Welche Vorteile (oder auch Nachteile) ergeben sich in der Upgrade-Fähigkeit von betrieblichen Informationssystemen durch die Anwendung in der Cloud?

E: Erstens, es ist per-se upgrade-fähiger, das wird zum Teil auch abgenommen. Der Nachteil daraus ist natürlich, dass man das auch mögen muss, dass eine Business-Applikation über das Wochenende automatisch upgedated wird. Das ist meistens noch

nicht so in den Köpfen der Leute. Und es können kleine Änderungen große Auswirkungen haben.

DS [00:15:22]: Dann sind wir schon bei der letzten Frage. Welche Auswirkungen hat die Einführung Cloud-basierter betrieblicher Informationssysteme auf die Implementierungsdauer im Vergleich zur On-Premise Variante?

E: Diese sind marginal unterschiedlich zum Status Quo. Was eine Challenge werden kann ist, wenn du dir eine Cloud-Lösung mietest um 300 Euro im Monat, dann hast du irgendwie den Eindruck, dass du nicht 50.000 € für Dienstleistung ausgeben willst, weil ich zahle ja nur 300 Euro im Monat, das passt vom Verhältnis nicht mehr zusammen. Das heißt, die Bereitschaft wird abnehmen, hohe Summe für Dienstleistung auszugeben.

DS [00:17:02]: Gut, dann sage ich danke für das Interview, und ich beende jetzt die Aufzeichnung.

Transcript of Expert Interview F – German

Name of the interviewee: Ing. Roland König, BA
Company: König Engineering GmbH
Industry: IT Consulting
Position: CEO, Senior Consultant
Date, Place: 2018-02-23, Wolfsegg am Hausruck
Recording of the interview allowed: X Yes ☐ No
Publishing of the name of the interviewee allowed: X Yes ☐ No

DS[68] [00:00:00]: Die erste Frage ist, inwiefern haben die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben (sowohl technisch als auch organisatorisch)?

F[69]: Sie trennen da ja zwischen technisch und organisatorisch. Auf der technischen Seite geht es darum ein einheitliches System zu haben. Dieses CRM, dieses PPS, usw. alle getrennten Systeme zu einem einheitlichen System zusammenzufassen. Zum anderen technisch geht es auch darum eine gemeinsame verbundene Plattform zu haben. Nicht nur auf einen Gerätetyp, sondern über Plattformen hinweg das ganze betreiben zu können, sprich plattformübergreifend, egal ob Desktop-PC, Handy, Tablet. In organisatorischer Hinsicht geht es darum, dass diese Prozesse einfach durchgehend sind. Es gibt ja Prozesse im CRM, die auch ERP betreffen, das muss eingebunden werden, ein Managementinformationssystem, und wenn die getrennt werden voneinander, dann hat man keinen Prozess, der durchgehend ist. Wir bezeichnen das immer als Medienbrüche. Dann hat man das Problem, man hat zwar Daten, man kann im anderen System aber nichts anfangen damit. Damit einhergehend ist das Thema Workflow, dass da integriert werden kann, damit kann man die Prozesse, die innerhalb einer Firma laufen, in der IT abdecken.

DS [00:02:30]: OK, die 2. Frage haben Sie ja teilweise schon beantwortet. Welche Anforderungen bzgl. Integration von betrieblichen Informationssystemen haben Unternehmen aus Sicht des Managements und welche aus Sicht der Anwender?

F: Im Managementbereich sehe ich da, dass das Management die Unternehmensdaten, die geschäftlich wichtig sind oder wirtschaftlicher Erfolg des Unternehmens, online praktisch in Echtzeit zur Verfügung stehen. Das ist praktisch ein Abfallprodukt des ganzen Systems. Vom Management geht es natürlich auch darum, Kosten zu reduzieren, damit können Doppel-Gleisigkeiten, Mehr-Gleisigkeiten bei der Datenerfassung verhindert werden, die Verwaltung kann kostengünstiger verlaufen, es kann quasi alles online vorhanden sein, man hat eine Quelle, und dort hat man an sich die Daten. Aus Sicht des Anwenders würde ich sagen resultiert, dass es ein System für alles gibt, keine unterschiedlichen Programme, auch von den Schulungen her, ein System, das man einmal schult, und dann hat man eigentlich die unterschiedlichen Bereiche drinnen. Daher keine unterschiedlichen Software-Bereiche, einmal eine Datenerfassung, durchgängige Daten, die Erfassungszeiten reduzieren. Die Abteilungen können damit auch logischer verbunden werden. Wir sehen es öfter, dass z.B. Abläufe passieren von Unternehmen, die bisher an verschiedenen Stellen den Einkauf gemacht haben, dort plötzlich eine Art Zentraleinkauf gemacht wird durch eine zentrale Rechnungsprüfstelle. Bzw. die Aufgabenverteilung einfach strukturierter läuft.

[68] DS = Dominik Scheuringer (Interviewer)
[69] F = Interviewee of Interview F

DS [00:04:20]: Die dritte Frage ist, was sind die Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben (Organisationsstruktur, betriebliche Prozesse etc.)?

F: Es gibt ja kaum Neugründungen, wo eine Firma komplett von der grünen Wiese anfängt und sich ein System sucht. Meistens ist es ein Vertrennungswettbewerb, und da sieht man schon eines, wo ein neues System greifbar ist dann, wenn es im Altsystem keine Weiterentwicklung gibt, der Funktionsumfang ist zu gering, oder die Plattform ist einfach die falsche, die Datenbank ist zum Beispiel veraltet, wenn es zum Beispiel nicht auf dem SQL Server basiert, der Software-Hersteller wird aufgekauft, Support ist schlecht, nicht greifbar. Dann wechselt man praktisch. Es ist also mehr ein Vertrennungswettbewerb, als das jemand von neu anfängt. Wenn jemand ganz neu einsteigt, das muss man auch sagen, dann greift man vermehrt zur Cloud.

DS [00:05:46]: Die nächste Frage ist, wenn es dann um die Umsetzung geht, was sind die größten Herausforderungen bzgl. der Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

F: Das größte Problem ist eigentlich die Kommunikation Kunde und Software-Anbieter. Das heißt aus Kundensicht, was will ich. Dass der Kunde auch das vermittelt, was er auch haben will. Und das der Anbieter das versteht, was der Kunde eigentlich haben will. Die Software ist zum Teil schon sehr komplex, und zerschlagen den Kunden, das heißt man muss das so intuitiv darstellen, dass der Kunde erkennt, was er eigentlich auch an der Software hat. Und das ist oftmals nicht ganz so einfach, zu erkennen was er braucht und zu erkennen was er nicht braucht. Eine weitere Herausforderung ist die Mitarbeiter zu motivieren. Klingt vielleicht jetzt blöd, was wir jetzt auch gesehen haben ist, dass zwar das Management sehr schnell die Vorteile erkennt und diese einsetzen will, aber dass er viele Mitarbeiter hat, die ein System haben, dass zum Teil veraltet ist aber das sie halt kennen und zum Teil blockieren. Das heißt man muss auch den Mitarbeiter motivieren, dass er mitmacht, man muss sie umlernen, anlernen. Und das führt halt oft auch zu Problemen und hat oft auch schon dazu geführt, dass Unternehmen entschieden haben noch zu warten, und jetzt nicht mit der Umstellung starten. Eine weitere Herausforderung ist dann noch der Import der Alt-Daten. Wenn ein Bestand vorhanden ist, dann muss man natürlich auch die Daten übernehmen.

DS [00:07:35]: Die fünfte Frage ist, wenn ich keine Integration habe, welche Probleme und Schwachstellen verursachen dann isolierte Applikationen (Insellösungen) in Produktionsbetrieben?

F: Insellösungen haben meistens eine Mehrgleisigkeit von Datenerfassungen. Das Problem ist man muss das dann so erklären und strukturieren, dass sie organisatorisch nur an einer Stelle eingegeben werden. Natürlich kann man in einem neuen ERP-System an verschiedenen Stellen Daten eingeben, aber das muss man dann so erklären, dass man organisatorisch die Struktur innerhalb der Firma schafft, das man sagt, dort werden diese Daten eingegeben, dort werden diese Daten eingegeben. Dann sehe ich bei den isolierten Systemen eine Plattformbeschränkung, es läuft also z.B. ein Programm auf Windows-Systemen, und plötzlich hat der Anwender aber die Möglichkeit, das auch auf anderen Plattformen, Macs, Handys usw. zu benützen, und dieses Umdenken, dass das eigentlich möglich ist, und was da möglich ist, das ist man von Insellösungen eigentlich nicht gewohnt und da muss auch der Anwender ein bisschen umdenken.

DS [00:09:01]: Die nächste Frage ist, inwiefern können Produktionsprozesse (z.B. Einzelfertigungsprozesse) in Unternehmen optimiert werden durch die Integration betrieblicher Informationssysteme?

F: Zum Beispiel die Möglichkeit des Zentraleinkaufs, einer zentralen Rechnungsstelle, was man früher einfach an verschiedenen Stellen gehabt hat. Und das kann man nun an einer Stelle, und damit kostengünstiger machen. Da gehört die Datenerfassung genauso dazu. Aber man kann auch eine Struktur durch Workflows hineinbringen, die klar erkennbar sind. Man kann viel rascher auf Probleme reagieren, weil man sie im System leichter verteilen kann. Bei der Lagerhaltung erhält man ein strukturiertes Lager und kein chaotisches Lager mehr und dadurch reduziert man natürlich auch Lagerkosten. Da fällt die Inventur natürlich auch genauso hinein. Wir haben den Effekt, dass der Kunde dann feststellt, dass er irgendwo Teile hat, die entsprechende Preise haben, die einfach liegen geblieben sind, nie erfasst worden sind.

DS [00:10:38]: Die nächste Frage ist, welche Abteilungen in Produktionsbetrieben profitieren am meisten von der Integration von betrieblichen Informationssystemen?

F: Das ist die Geschäftsleitung und die Geschäftsführung, weil man bezeichnet das als Management Informationssystem, wenn der Datenfluss unten funktionieren muss und die Daten da sind und eingetragen werden, dann erhält der Unternehmer an sich Zugänge und Informationen, die er sonst normal nur aus der Buchhaltung zum Teil erhält. Und da ist es vielleicht schon zu spät. Das heißt er kann viel früher eingreifen und hat dieses Management-Informationssystem praktisch als Abfallprodukt und hat seine Unternehmensdaten in Echtzeit. Das finde ist einer der größten Vorteile und wird daher so vom Management gewünscht.

DS [00:11:41]: Für den Fall, dass ich getrennte ERP- und CRM-Systeme habe. Für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen (und vice versa) sinnvoll und vorteilhaft für Produktionsbetriebe?

F: Ich sehe da mal den Kundenstamm. CRM ist ja an sich Marketing, die Kundenakquise oder auch Support. Das heißt, das greift eigentlich mehr ineinander. Ich sehe da eigentlich schon einen großen Vorteil, und die meisten CRM-Systeme heutzutage trennen das ja nicht mehr, die verbinden das miteinander, weil ja gerade die Datenbasis Kundenstammdaten das wichtigste eigentlich sind, und da greifen beide zu. Und wenn man die getrennt hat, dann habe ich wieder 2mal Datenanlage etc. Und das ist ja nicht sinnvoll.

DS [00:12:58]: Welche Potentiale sehen Sie in der Integration von betrieblichen Informationssystemen (ERP- und CRM-System) innerhalb Office-Produkte wie Outlook, Word oder Excel?

F: Ich sehe hier eher einen Verdrängungswettbewerb. Ich sehe da eher, wenn ein wirklich durchgehendes ERP- / CRM-System kommt dann kann das CRM-System Outlook komplett ersetzen, Outlook also gar nicht mehr notwendig macht. Ganz im Gegenteil, diese CRM-Systeme haben ja oft schon Groupware-Funktionen, die man in Outlook ja nur mit Exchange realisieren kann, shared Kalender, oder Ressourcen für Besprechungsräume, Beamer oder dergleichen, die man gemeinsam nutzt. Auch Word und Excel wird durch die ERP-Systeme, wenn das Beleglayout korrekt funktioniert, kaum mehr notwendig. Da sehe ich eher, dass die verdrängt werden durch z.B. Microsoft PowerBI oder ClickQiew, so extrem schnelle Auswertetools, die direkt auf die Daten zugreifen und mit denen man dann entsprechend auswertet. Also ich sehe da keine Integration zwischen den beiden Systemen, sondern ich sehe da eher einen Verdrängungswettbewerb. Word wird man immer haben, das wird sich nicht ändern, aber ansonsten schaut das eher so aus, als würden sich die beiden verdrängen.

DS [00:14:35]: Auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades von betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

F: Ich kenne da mehrere Systeme, eines davon, dass wir früher hatten war Büroware, weiß nicht ob Sie das kennen? Firma SoftEngine, ein deutsches Software-Haus.

DS: Ja, Büroware kenne ich vom Namen.

F: Da war eines, da waren die Updates extrem groß, das heißt einerseits hat man die Datenbank reorganisieren müssen, dann hat man das Update gemacht, und ein normales Update war ein Aufwand von 3-4 Stunden. Die heutigen modernen Systeme machen das anders, da sind die Updates klein, das heißt man tauscht wirklich nur die Programme aus, die auch notwendig sind für das Update. Damit erhöht man einerseits die Updatesicherheit, das heißt Zusatzentwicklungen, die gemacht wurden, werden davon nicht berührt, sondern nur die Standardkomponenten werden ausgetauscht, und das ist wesentlich schneller, diese Updates passieren jetzt in ein paar Minuten, ist damit kostengünstiger und das ist aus meiner Sicht am wichtigsten für diese Systeme.

DS [00:15:47]: Und die letzte Frage zum Thema Integration ist, inwiefern können aus ihrer Sicht Workflows das Zusammenspiel und die Kommunikation verschiedener betrieblicher Informationssysteme optimieren und verbessern?

F: Wen man wirklich ein durchgängiges System CRM, ERP, PPS, Management Informationssystem hat, wenn das System wirklich das alles inkludiert, dann gibt ja die Software zum Teil schon einen gewissen Workflow vor oder legt zumindest mal eine gewisse Richtschnur. Unternehmen unterscheiden sich aber grundsätzlich, von ihren Abläufen, von ihren Prozessen. Wichtig ist dabei, dass trotzdem über Workflow-Skripts, wenn man es so bezeichnen möchte, oder Aufgabenverteilungen eben bereits trotzdem eingesessene Prozesse innerhalb der Firma abbilden lassen in der Integration der Software.

DS [00:17:10]: Dann habe ich jetzt noch ein paar Fragen zum Thema Cloud. Frage vorweg, das System, das Sie anbieten, MyFactory, ist das eine reine Cloud-Lösung?

F: Nein, das gibt es als Public Cloud, Private Cloud und Lizenzlösung.

DS [00:17:35]: OK und wie sieht der Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme ihrer Meinung nach aus?

F: Das ist getrennt zu betrachten. Die Kunden, die wir haben, die schon ERP-Systeme im Einsatz haben, sind von Cloud-Technologie eher nicht sehr angetan. Die scheuen sich eher davon und wollen trotzdem eine Kauflizenz. Das heißt, die wollen die Software In-House haben. Neukunden sind, zu ca. 95 % Cloud-Kunden. Und daher sehe ich auch, dass der Trend klar zur Cloud geht, weil sie einfach die Infrastruktur, die es braucht für eine In-House-Lösung nicht notwendig ist, weil sie plattformübergreifend ist, weil das Service ausgelagert ist, und das gesamte Unternehmen nur auf die Kernkompetenzen konzentrieren kann und muss und nicht auf die ganzen anderen Kosten. Daher sehe ich schon den Trend in Richtung Cloud gehen, aber alte Kunden sehen da noch eher Unsicherheit und Ausfälle und dergleichen.

DS [00:19:05]: Gibt es aus ihrer Sicht betriebliche Informationssysteme die besser und welche die schlechter für die Verlagerung in die Cloud geeignet sind?

F: Ich sehe da schon Unterschiede. Ein Cloud-Programm muss von der Datenstruktur und Programmstruktur einfach anders aussehen. Eine In-House-Lösung hat ja entsprechende Bandbreiten zur Verfügung, das heißt da hat man ein Gigabyte Netzwerk, das ist ja überhaupt kein Problem, ob da jetzt eine Abfrage mehrere Daten über das Kabel herholt ist relativ irrelevant, weil es einfach zeitlich kein Problem macht. Bei einer Cloud-Lösung hingegen ist die Internetgeschwindigkeit, die der Kunde hat, entsprechend wichtig. Genauso bei mobilen Geräten, mit denen man arbeitet. Wenn man da nur 3G oder 2G hat, dann hat man hier nur entsprechend geringere Bandbreiten und da muss man auch

schauen, dass eine Abfrage in einem gewissen Zeitraum wieder zurückkommt. D.h. ein Cloud-Produkt muss im Endeffekt so programmiert sein, dass es an sich auch mit geringeren Bandbreiten umgehen kann. Das heißt zum Beispiel bei Massendaten, da dürfen nur jene Daten geschickt werden, die sich geändert haben und die Selektion der Daten muss wirklich serverbasierend passieren wo nur mehr die gefilterten Daten über das Kabel kommen, weil sonst geht das ganze System in die Knie, und der Kunde wäre komplett unzufrieden.

DS [00:20:46]: Welche Voraussetzungen muss ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das Cloud Model besonders geeignet?

F: Größere Firmen gehen weniger in die Cloud, weil sie einfach leichter die Kosten schlucken für einen In-House-Server, weil da sind die EDV- und Hardware-Kosten ein kleiner Teil. Eine kleine Firma oder eine neu gegründete Firma, die am Anfang Kosten sparen will, die geht leichter in die Cloud, weil sie einfach nur mehr monatliche Kosten hat und keine anfänglichen Kosten in entsprechender Höhe. Ein Vorteil von Cloud sehe ich aber auch, wenn es mehrere Filialen gibt, wenn ich also ein Unternehmen bin, dass von sich aus schon mehrere Filialen hat, oder wenn ich ein Unternehmen bin, das Home-Office anbieten möchte, weil das einfach in einer Cloud-Lösung viel einfacher machbar ist und ich natürlich auch unterschiedliche Plattformen habe, weil dann kann ich mich in der Cloud auch viel leichter bewegen.

DS [00:22:05]: Welche potentiellen Herausforderungen und Risiken sehen Sie in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

F: Das ist eine gute Frage. Ich sehe da eigentlich weniger Risiken. Zum Beispiel MyFactory setzt auf einen Hochsicherheitsserver in Köln, meine Daten über meine Kunden liegen in der Private Cloud in einem Hochsicherheitsserver in Klosterneuburg. Ich muss natürlich diesen Hochsicherheitszentren vertrauen, dass das Ganze funktioniert, aber das funktioniert über SSL-Verschlüsselung und ich sehe hier eigentlich kein Problem im Bereich Security. Beim Datenschutz eigentlich auch nicht. Die meisten Firmen haben ja, wenn sie eine In-House-Lösung haben eine VPN-Verbindung oder irgendeine Verbindung nach außen, weil sie ja trotzdem Vertreter, Außendienstmitarbeiter haben, die rein wollen. Also haben sie dann genau so ein Problem, ich finde es sogar noch viel schlimmer, weil man damit vielleicht wirklich auf das In-House-Netz kommt. In der Cloud hat das Hochsicherheitszentrum das Problem, aber wenn, dann kommt jemand auf die ERP-Daten aber auf sonst keine anderen Daten. Das Problem ist eher, dass das Internet ausfallen könnte. Das ist nach wie vor ein Argument, wo viele sagen, nein, ich nehme eine Kauflösung, weil ohne Internet kann ich dann nichts machen. Aber rein aus Security-, Datenschutz-Sicht sehe ich da eigentlich kein Problem.

DS [00:24:04]: Wenn man jetzt zum Beispiel bei MyFactory die On-Premise und die Cloud-Lösung vergleicht, gibt es da aus ihrer Sicht Einschränkungen bzgl. der Funktionalität von Cloud-basierten betrieblichen Informationssystemen im Vergleich zu der On-Premise Varianten?

F: Nein, gibt es keine. Es ist nur so, dass an sich die Cloud-Lösung im PPS-Bereich meistens nicht genommen wird, weil da einfach die Lizenzierung unterschiedlich funktioniert. Rein vom Funktionsumfang können beide eigentlich alles, da gibt es keinen Unterschied. Nur mehr dort, wo man im PPS Maschinen ansteuert usw., da wird oft doch auf eine In-House-Lösung gesetzt, weil die Schnittstellen einfach doch um eine Spur einfacher zu produzieren und fertig zu stellen sind, bzw. weil man ev. auch in-house Maschinen hat, die Treiber benötigen, die man einfach in der Cloud nicht zur Verfügung hat. Aber betrifft eigentlich nur PPS, alles andere macht keinen Unterschied.

DS [00:25:18]: OK, und inwiefern unterscheiden sich die Möglichkeiten bzgl. Customizing und Konfiguration zwischen Cloud-basierten und On-Premise betrieblichen Informationssystemen?

F: Ja schon. MyFactory macht es so: es gibt eine Public Cloud, dass ist die billigste Einstiegslösung, wo Unternehmen für 40 Euro im Monat schon ein ERP-System fahren können. Das ist aber so wie es ist, da kann man nichts anpassen. Der nächste Schritt ist die Private Cloud, die ist anpassungsfähig, und die ist im Grunde gleich wie die In-House-Lösung, da gibt es keinen Unterschied, bis halt dort, wo man Schnittstellen im PPS-Bereich hat, da gibt es schon einen Unterschied.

DS [00:26:10]: Die nächste Frage ist, ergeben sich aus ihrer Sicht Vorteile (oder auch Nachteile) in der Upgrade-Fähigkeit von betrieblichen Informationssystemen durch die Anwendung in der Cloud?

F: Seitens MyFactory gibt es da keine Unterschiede, die Updates sind völlig ident, ganz egal welche Version das man nutzt, da ist eine Basis, die man verwendet. Auch bezogen auf die nächste Frage, die Einführungsdauer, auch hier gibt es keine Unterschiede, weil die Software komplett gleich ist. Die Einführung, die Einschulung, die Inbetriebnahme ist im Grunde egal, ob sie in der Cloud oder am Server In-House ist. Und auch die Implementierungsdauer ist im Endeffekt völlig gleich, da gibt es wirklich keinen Unterschied.

DS [00:27:02]: OK, somit haben Sie auch schon die letzte Frage beantwortet, und wir sind mit den Interviewfragen durch. Vielen Dank für ihre Zeit und ihre ausführlichen Antworten!

Transcript of Expert Interview G – German

Name of the interviewee: DI (FH) Dominik Aigner
Company: NAVAX Consulting GmbH
Industry: IT Consulting
Position: Leader Competence Center Manufacturing, Senior Consultant
Date, Place: 2018-02-26, Linz
Recording of the interview allowed: X Yes ☐ No
Publishing of the name of the interviewee allowed: X Yes ☐ No

DS[70] [00:00:00]: Die erste Frage ist, inwiefern aus deiner Sicht die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben haben, sowohl technisch als auch organisatorisch?

G[71]: Ich glaube, dass es nicht das wichtigste Argument ist, aber ich habe schon die Erfahrung gemacht, dass immer wieder die Frage aufkommt. Wie kann man da eine Schnittstelle bauen? Oder welche Anbindungen haben wir schon realisiert? Also ich glaube schon, wenn die Leute mal von der Optik und von den Prozessen überzeugt sind, dass dann auch diese eher technischen Elemente schon auch berücksichtigt werden. Und ich würde es auch fragen, also wenn ich eine Software kaufen würde, würde ich es auch fragen, weil es eben nicht unwesentlich ist.

DS: OK passt. Bei ein paar meiner bereits durchgeführten Interviews kam z.B. auch die Aussage, dass die Integrationsmöglichkeiten oftmals viel zu wenig berücksichtigt werden, obwohl es eigentlich ganz wichtig wäre.

G: Ja, ist aber auch ein schwieriges Thema. Bis man mal dahin kommt, da muss man vorher die Prozesse, das Lizenzierungsmodell und tausend andere Themen betrachten, und dann will man das auch noch wissen. Ich stell mir das total schwierig vor, wenn ich das Produkt noch zu wenig in der Tiefe kenne, was will ich da fragen. Aber ich finde es mittelwichtig und glaube, dass alle modernen Systeme da mittlerweile schon ganz gut aufgestellt sind.

DS [00:02:52]: OK, was sind aus deiner Sicht die Anforderungen bzgl. Integration von betrieblichen Informationssystemen von Unternehmen aus Sicht des Managements und aus Sicht der Anwender?

G: Ich glaube, dass beide wollen, dass es so wirkt, als wäre es eine Software. Der Benutzer wünscht sich, dass dies einfach in der Handhabung ist, sprich es soll aus einem Guss sein bzw. eine Oberfläche sein. Und der Chef will haben, dass es einfach für die Benutzer ist. Das ist so, wie ich es wahrnehme am Markt, und ich sehe es eigentlich auch so. Weil wenn ich das schaffe, dass es in einer Oberfläche ist, dass es einfach ausschaut, dann ist auch das im Hintergrund wahrscheinlich einfach. Man muss vielleicht einen Kopfstand machen und viel Aufwand betreiben, dass es einfach wird. Aber dann ist auch der Prozess einfach. Der User soll nicht Programm wechseln müssen, sondern er arbeitet nur im führenden System, zumeist im ERP, und soll gar nicht merken, wo er eigentlich ist.

DS [00:04:28]: Was sind die Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben (Organisationsstruktur, betriebliche Prozesse etc.)?

[70] DS = Dominik Scheuringer (Interviewer)
[71] G = Interviewee of Interview G

G: Ich glaube, dass es um diese Zentralisierung geht, dass ich einen Schwerpunkt setze, dass ich ein führendes System habe, dass ich aber keine Inseln habe. In einem produzierenden Unternehmen brauche ich zum Beispiel ein CAD-System, das kann ich mit einem ERP nicht machen, das geht nicht. Aber im CAD-System entsteht die Stückliste, und die Stückliste will ich nicht abschreiben, sondern über die Schnittstelle ins ERP-Produkt übernehmen. Also Automatisierung, doppelte Datenerfassung vermeiden, Zeit und Geld einsparen, ev. Darstellung im Web, sprich Self-Service-gerechter. Ich glaube, dass das die Hauptthemen sind, warum ich was integrieren würde. Das heißt unter dem Strich, den Nutzen der speziellen Software nutzen, aber in meinem führenden System, und sehr oft ist es halt das ERP-System.

DS [00:05:57]: Was sind die größten Herausforderungen bzgl. der Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

G: Die größte Herausforderung ist eine gemeinsame Sprache zu finden zwischen die Software Dienstleister und auch die Kunden. Begriffe zu definieren, was versteht der eine unter einer Stückliste, was versteht der andere unter einer Stückliste. Ist es klar, warum die Stückliste im Autocad anders aussieht als im NAV. Das führende System zu bestimmen. Artikel und andere Stammdaten gleich zu nennen. Eigentlich geht es um den Prozess. Begriffsdefinitionen, Abgrenzungen, wer ist für was verantwortlich in der Implementierung. Die Reihenfolge der Umsetzungsschritte definieren. Und dann definieren, was ist das Benutzererlebnis. Wie muss die zeitlich Abfolge der Ereignisse sein, dass das dann in Summe wie gewünscht läuft.

DS [00:07:27]: Welche Probleme und Schwachstellen verursachen isolierte Applikationen (Insellösungen) in Produktionsbetrieben?

G: Doppelte Datenerfassung, Datenschiefstand. Asynchronität der Daten. Das eine System glaubt, es hat Lagerbestand 100, das andere System glaubt, es hat Lagerbestand 10. Nicht den Single Point of Truth zu haben, sprich ich habe irreführende Informationen, der eine schaut da rein, der andere schaut da rein. Es wirkt komplexer auf die Benutzer, wenn ich mehr Systeme habe, in die ich dann auch reinschauen muss, dann wirkt das alles sehr kompliziert, auch wenn es vielleicht gar nicht ist. Je mehr Oberflächen ich als User bedienen muss, desto aufwändiger und komplizierter wirkt es für mich als Benutzer. Der Informationsdurchfluss durch das gesamte Unternehmen ist ev. langsamer. Der Automatisierungsgrad ist mit Sicherheit ein anderer. Das sind sicher die Hauptpunkte. Kommen andere Leute auf dieselben Sachen?

DS: Ja genau, das sind die meist genannten Punkte. Also Doppelerfassung, Datenschiefstände, usw.

DS [00:09:23]: Inwiefern können Produktionsprozesse (z.B. Einzelfertigungsprozesse) in Unternehmen optimiert werden durch die Integration betrieblicher Informationssysteme?

G: Der Nutzen kann der sein, dass ich die Stärken der jeweiligen Software nutze. Weil halt ein ERP z.B. kein Feinplanungsmodul hat. Jetzt kauf ich mir die Software zu, und durch diese Integration, kann ich dann dieses Feature der Software nutzen und dadurch Mehrwert generieren, Automatisierung erreichen bzw. weniger Arbeit ist dadurch noch erforderlich. Plus halt das Gegenteil von der Frage davor. Sprich ich habe nur mehr einen Datenstand, ein System usw. Also meiner Meinung nach geht es schon stark um die Nutzung der Stärken, dass ich aus jedem System das Maximale heraushole, was es kann, aber trotzdem mit den Ergebnissen der anderen Systeme bestmöglich kombiniere.

DS [00:11:57]: Die nächste Frage ist, gibt es aus deiner Sicht bestimmte Abteilungen in Produktionsbetrieben, die am meisten von der Integration von betrieblichen Informationssystemen profitieren?

G: Das ist natürlich abhängig von den genutzten Systemen, von den integrierten Systemen. Aber ich glaube, dass es in jeder Abteilung Potentiale gibt. Im Verkauf fällt mir der Webshop ein. Dann gibt es in der Produktion Systeme, PLM-, PDM-Systeme, Autocad, Schnittstellenimporte, wovon die AV, welche ich der Produktion zuordne, profitieren kann. Um im Einkauf habe ich z.B. auch Lieferantenportale oder EDI-Anbindungen von Lieferanten, oder auch Entwicklungsabteilungen etc. D.h. ich glaube schon, dass es in der gesamten Wertschöpfungskette von produzierenden Unternehmen in jedem Bereich Software-Produkte gibt, wo eine Integration mit dem ERP-System zu Wettbewerbsvorteilen führen kann. Obwohl es natürlich stark unternehmens- und branchenabhängig ist. Aber ich bin mir sicher, dass für jeden was dabei sein kann.

DS [00:13:41]: Die nächste Frage betrifft nur die Integration von ERP und CRM. Für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen (und vice versa) sinnvoll und vorteilhaft für Produktionsbetriebe?

G: Debitoren, Kontakte, sprich Ansprechpersonen. Umsätze, in der Vergangenheit gekaufte Produkte, also was hat der Kunde schon bei mir gekauft, wichtig für den Außendienst. Was ist jetzt an Angeboten draußen, Auftragsstand, offene Posten, Rechnungen, die noch nicht bezahlt sind. Wie ist das Zahlungsverhalten. Also der Außendienstmitarbeiter soll wissen, der zahlt nicht gut, der zahlt meistens mit Skonto. Die Aktivitäten, die Korrespondenz hingegen würde ich eher nur im CRM-System sehen.

DS [00:15:46]: Welche Potentiale siehst du in der Integration von betrieblichen Informationssystemen (ERP- und CRM-System) innerhalb Office-Produkte wie Outlook, Word oder Excel?

G: Ich nehme es so wahr, dass es immer mehr wird. Und auch vom Hersteller, also in unserem Fall von Microsoft, immer besser wird. In meinem Umfeld wird es relativ gut genutzt, also diese Outlook-Anbindung, dass ich Sachen sofort per Mail verschicken kann, dass ich Inhalte ins Word oder Excel exportieren kann. Da sehe ich schon Potentiale, die auch genutzt werden. Wobei es stark abhängig ist vom Berater, aber auch vom Kunden, wie die Personen das annehmen bzw. auch wie technikaffin sie sind. Im Excel brauch ich ja die Daten, wenn ich sie irgendwie weiterbearbeiten will oder AdHoc-Auswertungen erstellen will. Wenn jedoch ein User keine guten Kenntnisse über Excel hat, zum Beispiel nicht weiß, was eine Pivot-Tabelle ist, dann wird er es wahrscheinlich auch nicht nutzen bzw. auch den Sinn und Zweck darin nicht erkennen. Aber aus meiner Sicht kann man schon Vorteile daraus erzielen.

DS [00:17:35]: Auf was soll deiner Meinung nach der Fokus bei Versions-Upgrades von betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

G: Hier kann ich dir leider keine Antwort geben. Wobei, ich kann mir vorstellen, dass, wenn man z.B. auf Tabellenebene die Daten austauscht, ich habe also 2-3 Tabellen, wo ich alles zusammenfasse, dann habe ich einen Punkt, nämlich diese Tabellen, wo sich alles abspielt. Sprich wenn ich das so aufbaue, dass die Daten auf ein paar wenige Tabellen zusammengezogen werden, dann habe ich da einen guten Überblick. Und wenn sich dann in der Systemstruktur was ändert, dann muss ich es nur in diesen paar Tabellen ändern. Und ich glaube, dass das hilft, weil ich dann nur einen Ankoppelungspunkt habe. Wenn sich jetzt im ERP-System die Logik ändern würde, und ich müsste einen Wert anders ermitteln, dann weiß ich immer noch, ich muss diesen Wert mit dieser Aussage in das Feld hineinschreiben. Und dann kann sich diese Daten das CRM-System wieder abholen. Und ich habe die Baustelle nur in einem System. Im BI wird das ja auch so gemacht, Data Warehouse auf Power BI zum Beispiel. Das Date Warehouse schaut immer gleich aus, nur das Berechnen davor, das Daten absaugen ändert sich vielleicht. Die hängen auf SAP, auf NAV und weiteren Systemen, aber die Cubes bleiben immer dieselben, und das BI

sowieso. Somit muss ich nur mehr die vorderste Schicht, also dieses Daten befüllen und vorkomprimieren, ändern. Und das finde ich gedanklich einfach. Da habe ich genau einen Punkt, den ich prüfen muss. Und der Rest dahinter funktioniert. D.h. wichtig ist, dass man einen Punkt zum ändern hat und wieder Eindeutigkeit bei der Verantwortung.

DS [00:20:42]: Letzte Frage zum Thema Integration. Frage gleich mal vorweg: Inwiefern hast du Erfahrungen mit Workflows?

G: Wenig bis gar nicht.

DS: OK, dann werden wir diese Frage ignorieren. Dann wären wir mit den Fragen zur Integration durch und ich hätte jetzt noch ein paar Fragen zum Thema Cloud.

DS [00:20:53]: Wie sieht der Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme deiner Meinung nach aus?

G: In meiner Wahrnehmung ist es so, dass der Trend zwar schon in Richtung Cloud geht, aber langsamer als die Hersteller wollen. Manchmal wird man durch Lizenzmodelle dahin gedrängt, gewisse Software-Produkte gibt es überhaupt nur mehr in der Cloud, auch bei ERP, das habe ich letztens gerade wieder gehört, wo ein relativ kleines Unternehmen in Linz überhaupt nicht abgeneigt war, dass das System in der Cloud läuft. Die haben auch Office 365 in der Cloud, aber die haben das System dann nicht ausgewählt, weil es nur irgendwo einen Telefonsupport gibt. Deswegen haben sie das Cloud-System nicht genommen, da war also die persönliche Beratung das ausschlaggebende, sonst hätte es ihnen gut gefallen. Aber es geht der Trend schon dahin. Und ich glaube gerade für kleine Unternehmen, wo das Thema Datensicherheit kein Problem ist, und das Vertrauen da ist, wo man dem Thema offen gegenübersteht, da ist das schon eine coole Sache. Weil ich brauche keine Hardware, ich habe weniger Administration. Die Kosten sind kalkulierbar. Wenn der Server bricht ist mir das egal, weil kümmert sich ja sofort wer darum. Es muss mir halt egal sein, dass die Daten nicht da sind. Und da glaube ich schon, dass der Trend dort hingeht.

DS [00:22:51]: OK und gibt es jetzt aus deiner Sicht betriebliche Informationssysteme die besser und welche die schlechter für die Verlagerung in die Cloud geeignet sind?

G: Ich sehe da wenig Unterschied. Weil es ist eher von den Daten abhängig. Wobei letztens hatte ich bei einem Kunden, bei Fuchs Metalltechnik, das Thema, dass für deren Manufacturing Execution System gewisse Aktionen auf SPS-Ebene gemacht werden müssen, weil alles andere zu langsam ist. Weil wenn der in der Sekunde eine sehr hohe Anzahl an Hüben macht, dann bekommt das ein normales Netzwerk gar nicht mehr mit. Der kann da nicht mehr mitzählen. Ich denke in solch einem Fall ist eine Cloud-Lösung wohl nicht die beste Alternative.

DS [00:24:52]: Welche Voraussetzungen muss ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das Cloud Model besonders geeignet?

G: Ich denke, kleine Unternehmen tendieren noch eher zur Cloud. Weil das halt am Anfang billiger ist. Zum Beispiel bei produzierende Unternehmen ein Meisterbetrieb mit 10 Mitarbeitern. Der braucht ein Programm zum Angebote und Rechnungen schreiben. Dem ist das wahrscheinlich egal, ob das in der Cloud läuft. Der öffnet den Browser, logged sich ein und hat alles. Egal wo, ob in der Werkstätte, zuhause, im Auto. Bei kleinen Unternehmen ist es auch noch besser skalierbar. Je größer das Unternehmen, umso eher wird es politisch. Im Konzernverbund gibt es dann ev. Konzernentscheidungen.

DS [00:27:05]: Gibt es aus deiner Sicht Einschränkungen bzgl. der Funktionalität von Cloud-basierten betrieblichen Informationssystemen im Vergleich zu den On-Premise Varianten?

G: Ich glaube nicht, dass es hier viele Einschränkungen gibt. Wobei ich hier noch zu wenig Erfahrungen habe. Wobei ich könnte mir vorstellen, dass es Einschränkungen zum Beispiel beim Excel-Export gibt. Das stelle ich mir schwierig vor. Ev. Spracheinstellungen, z.B. beim CSV-Export, wo es Probleme mit den Trennzeichen gibt. Wobei die Hersteller werden sicher hierzu Antworten liefern zu diesen Bedenken. Oder ob wirklich jede Software in einem Web-Browser läuft, z.B. eine CAD-Software, da wird ja eine sehr starke Grafikkarte benötigt.

DS [00:29:52]: Welche potentiellen Herausforderungen und Risiken siehst du in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

G: Meine Meinung ist die, dass ein kleines- oder mittelständisches Unternehmen selten die Daten so sicher halten kann, wie jetzt ein großes Rechenzentrum, wenn man das richtige Rechenzentrum wählt. Außer ich hätte einen Skandal, und das Rechenzentrum selber würde die Daten verkaufen. Aber das jetzt ein Dritter eindringt und die Daten stiehlt, obwohl das Rechenzentrum nach besten Wissen und Gewissen abgesichert hat, da mache ich mir weniger Sorgen. Weil das ist ja deren Hauptberuf, das zu sichern. Und die können das sicher um einiges besser, als irgendein 30 Mann-Unternehmen in Österreich. Ich glaube, dass die Leute nur viel zu viel Angst haben aktuell.

DS [00:31:27]: Letzte Frage, welche Auswirkungen hat die Einführung Cloud-basierter betrieblicher Informationssysteme auf die Implementierungsdauer im Vergleich zur On-Premise Variante?

G: Ich glaube, dass sich die Implementierungsdauer beschränkt, aber doch, verkürzen wird. Weil die Hersteller wohl alle in die Richtung Standardisierung lenken. Wenn ich jetzt ein paar Euro pro Benutzer pro Monat einwerfe, dann nehme ich das vielleicht auch emotional viel leichter so, als wie wenn da viele Berater über einen langen Zeitraum hinweg zu mir ins Unternehmen kommen, und meinen Sever einrichten. Dann weiß ich, das läuft in der Cloud, und da arbeiten 1000 andere Kunden auch damit, mit demselben. Da muss ich mir dann die Frage stellen, warum funktioniert es bei mir nicht. Da würden sich also die Kunden viel schneller hinterfragen. Die Hersteller werden sich viel mehr in Richtung Standardisierung aufstellen, was muss ich als Hersteller machen, dass ich meine Lösung administrativ einfach mache für tausende Kunden gleichzeitig.

DS [00:33:12]: Gut, dann sind wir fertig mit dem Interview. Vielen Dank für deine Zeit!

Transcript of Expert Interview H – English

Name of the interviewee: Thomas Boogert
Company: Secrid BV
Industry: Manufacturing of wallets
Position: IT Manager
Date, Place: 2018-02-28, Telephone
Recording of the interview allowed: X Yes ☐ No
Publishing of the name of the interviewee allowed: X Yes ☐ No

DS[72] [00:01:50]: The first questions deals about the IT landscape of your company, in order that I get an overview. So which business information systems are you using in your company and which modules are covered by your business information systems?

H[73]: The primary system is our ERP system, NetSuite. We use that for customer care, so CRM, order processing, manufacturing, financial management, supply chain management and warehouse management. Also the full financial suite, so invoicing, paying our bills. That's our main system. And then, on the outside, we have some integrated systems with NetSuite. There are some eCommerce systems. We use Shopify, which is a Canadian company for B2C eCommerce, we are almost live with CloudSuite, which is a Dutch software vendor for the B2B eCommerce. So after placing the order in that system, we put the order into NetSuite, process it and we have some integrations that tell the eCommerce-system that the shipment has been made and the customer gets the information required. That is basically the front-end site. We have some other software systems integrated, for example, we have in our warehouse a packing machine, this is a custom-made machine, which takes a picture of a box of wallets. I should explain, we sell 99 % of our goods business to business, to retailers or distributers directly. So continuing, after taking a picture, we analyze a data matrix from the gift shop and we register these goods are sent to these customers, thereby we have a logic which compares the box with what is ordered and store all this information in NetSuite as well. We don't use external CRM tools, we do not have BI yet, because we were good with NetSuite reporting tool, which is our BI tool basically.

DS: OK, thank you for the good overview. So the next sub-question is already answered, you have different software providers. Question 1.3., which systems depend on each other very much, I assume this is the ERP-system with the eCommerce-system, is not it?

H: Yes, exactly. For example, if you take the B2C process, we also have a third layered software, which is the payment information. The payment information is stored within a payment service provider. So we get the information, this order has been paid in the eCommerce system. We ship that order over to NetSuite, so that is highly dependent on each other. We get the track&trace information from another integration with our delivery partners, e.g. Fedex, and put this tracking information back to our eCommerce system. And we have another integration between our payment service provider and NetSuite, that once we process an order and it is completely shipped, the invoice is created automatically. So those three systems are highly dependent on each other.

DS: OK, and sub-question 1.4, I assume that these three systems have a different user interface as they are from different providers, is that correct?

H: Well, in my project, I try to keep the work always in NetSuite, so we have a backend for our eCommerce-system for example. But due to the integration, nobody has to touch the

[72] DS = Dominik Scheuringer (Interviewer)
[73] H = Interviewee of Interview H

eCommerce-system. So as a goal of my integration projects, I try to keep the administration work as much as possible in the ERP system NetSuite. Of course, to the customer site it is a different system. We do have some digital guidelines therefore, so that it is only single brand experience. But internally, we try to keep it within the ERP as much as possible.

DS [00:10:15]: I assume, that you have already been involved in an integration project in your company. Which experiences have you made?

H: Well, I have been involved in all the major integration projects. I tell you the details and you can summarize them for your thesis (laughs). Basically, the first thing is, integration is very difficult in general. If you are lucky and both systems that you are integrating are perfectly documented, you have access to system A, e.g. Shopify, you have access to system B, e.g. NetSuite, you know the Shopify processes, you know the NetSuite processes and it is well documented. Then it is doable. But the thing is that most systems developed new capabilities, but the web services don't keep up. So internally you can do new actions, but if you wanna integrate you have to keep up. In most software development companies, it are two different departments. So one integration department but 16 product teams. So there is always a mismatch in the backend if you do it by hand and if you try to integrate those processes. Sometime it is a minor difference. For NetSuite, the primary process doesn't change very much, but we have experiences with other systems that sometimes there is a gap and also you can have a big gap between integrating a cloud system and a system that is used to having a server, or basically a server rack with system A, system B and an integration system below each other. That is another challenge to get that integration in the cloud environment. That is why we tried to select only cloud software. Basically I would describe integration in three different categories. The first category is the out-of-the-box integration, so you just fill in the credentials in some kind of middleware. For example the integration of Microsoft Outlook for your emails with NetSuite. That is called a single point-to-point out-of-the-box integration. If your business case fits that criteria, so let's say they support the linking of emails to the NetSuite customers and put them in communication, then it is perfect. The cheapest way how you can integrate a system. The downside of these integrations is that usually you have customized your business processes within your ERP or other system and the standard integration does not fit. So you must expand the standard integration, which is the second scenario. But the thing is, if they expand their standard integration, they won't be eager to do it for every single customer. So they usually don't want to do it. Or they have to build a separate branch, but then it is not a typical cloud platform anymore, because there are multiple software versions running in the cloud. So that usually does not work. Thus, you have to develop it by yourself, or you have to pay for it. And then the third option, that we actually mostly prefer, at least in our more critical business processes. We use Middleware software, we are a big fan of Dell Boomi, a middleware integration platform. What Boomi offers you is basically a full range of options, you can do whatever you want. You have to build it from scratch, you can use standard blocks and you have a standard NetSuite connector. Comparing to script engines, you have better logins, it is more uniform. I have a complete overview of all the different data transactions going on. So those are for me the three types of integration. We did one completely custom, but what we see is that the maintenance is much higher than with the Boomi integration and the initial investment is more for the project. But on the other side you also have Boomi with a licensing, you have to pay initially more, because you have to buy the platform, but you win it back in flexibility and maintenance

DS [00:17:47]: So then we can go on with the next question. Did the integration capabilities have an influence at the selection of your business information systems? If yes, which one? (technical, organizational)?

H: Yes, always. Well, when we implemented the ERP, we had no experiences yet with integrations. So we could basically theorize what would need to be possible and write some use cases with eCommerce systems, which we hadn't. So yes, they did have an influence on the decision on which system to pick, but basically every system will tell you that they can integrate. It is too hard to say that we did a good job on that, because NetSuite has some limitations because it is a cloud platform for. For example, you have to pay more if you want more performance. But for example if we would take in 5 or more years another ERP system, we would try to find harder how the integration would look like. But in my experience, sales people can tell you anything. You can look in the documentation, e.g. do they use the newest type of web services, do they only support EDI. You can scout out some red flags, but it is still a process of getting to work and seeing if it works for you. It is almost impossible to see upfront if the integration possibilities are good enough.

DS [00:20:15]: Which of your business processes affect more than one business information system in your company?

H: Yes, that is correct, our whole ordering process. And actually, we want to add one more system, which we want to integrate. We want to integrate with a product management information system. Especially for all the eCommerce systems that we have live. This system allows us to store all the master data of our items in a separated system. Our transactional data will remain in the ERP, but we have the product management system for the product names, the descriptions, the images and also the translations. So we want to expand our integrations even more.

DS [00:21:30]: So I think we can skip the next question, because you have no separated ERP- and CRM system, is that correct.

H: Yes that is correct.

DS [00:21:45]: In which system do you create analysis and reports of your ERP- and CRM-data? Do you have a separated BI-system therefore?

H: No, we have no separated BI system. We are creating the reports within NetSuite.

DS [00:22:02]: What are or were the triggers for a necessary integration of your business information systems (organizational structure, business processes, etc.)?

H: Well, we are a quickly growing company. But if we can do it with less people, it is also good. So a task which I always give to myself when we start a software project is how much administration workload is this gonna produce for my colleagues. Let's go back to the eCommerce system. We started selling B2B in the United States in November 2016 and one of the main goals of that project was to see how much we could automate of that processes. If we would get the market penetration as we have it here in the Netherlands, we would triple in size. And the other point is, that for the consumers, they expect more business. You get more margin, of course, so you have more room to play with, but they expect much more. So my goal was let's see how much we can automate this process in order to keep the workload low and to keep it scalable, because right now, if you grow let's say factor thirty, most of the systems are still in place, the only thing, that needs to happen is that somebody in our warehouse needs to pick the wallets, put it in a box, check whether it's right and then print the shipping label. The rest is all automated. So that is acceptable for me. And that is usually the trigger to start an integration project, because you can always transfer data by hand, exporting in system A and importing in system B but this is always manual labor. So basically it is scalability, but also speed. So right now, as long as we don't have a B2B portal, we don't really know what the demand of our retailers is because we get emails and in the emails is the excel sheet with the order. And then it take some time to process this order. So from the time we put it in the system until we deliver it,

we know what the time is, on average. But in my opinion, that is not the real demand. You miss like the whole front end. So we are working on a system to fix that, to make it easier to order, that also needs to be completely automated. So let's say one minute after the customer places the order from system A to B, and then we can make some real time reporting. So it is scalability, but it is also the rightness of your data, the more data you have, the better you can do your business.

DS [00:26:36]: OK, the next question is, what are / were the biggest challenges regarding the integration of your business information systems?

H: First of all, every integration is different. We have integrated I think 8 systems with NetSuite now. So I would say we know the NetSuite side, but there is always another system, which has new data. Every integration is in that sense a bit of a challenge. We have a very good integration partner, but it is still always challenge. Like there are always undocumented errors, there are always reasons that communication does not work. So it always come down to does the system perform as they said it. That is always the biggest challenge.

DS [00:27:53]: Which potentials for improvement do you currently see in the integration of your business information systems, both technically and organizationally? How can these improvement potentials be realized from your point of view?

H: I think the current integration work quite well. But one thing would be, that, we integrated so many primary processes now, basically every primary process step has some form of integration automation. Therefore, it becomes quite critical that the servers are on. Currently we host the systems on AWS but the problem is that it is a single point of failure structure. So if that server goes down we have a problem. It is actually on the roadmap for the next 2 months to start having the AWS servers running on different regions, with automatic failover. So basically, the main improvement potential would be the elimination of the single point of failure.

DS [00:31:08]: Do you currently see any isolated applications within your company and if yes, which problems and vulnerabilities cause possible existing isolated applications in your company?

H: At least in the primary process, so the operation part of the business and the finance, there is no silo application at all. Of course, we have different systems internally, so e.g. the graphics team has their own image software but there is no operational use to those. The primary process it is all linked and integrated.

DS [00:32:02]: To what extent are office- and collaboration software systems (Word, Excel, Outlook, SharePoint, etc.) integrated with your business information systems, so mainly with NetSuite?

H: Not really for Word and Excel. It is doable, but it would require a very high level of discipline of the departments to do it right in Excel. So we don't do that. Outlook, we are still looking into that. It would be nice to have some integration with our CRM. We integrated that, but it is not really used. So we have an integration for that, in my opinion the business could profit if they would use it more. But they don't use it really much. But generally NetSuite has an Outlook integration.

DS [00:33:58]: OK, then I have some questions regarding the process optimizations through the integration. The first question is, which departments benefit at most from the integration of your business information systems?

H: In the primary process, everybody benefits. The department, which is able to do more staff in less time is the order processing. By the way, NetSuite has some automation capabilities. So you can build custom workflows and integrate some processes. What I saw

was that we had a four men team in 2015 working on order processing all day. And the last 2 hours of the day were invoicing of the sales orders that were shipped on that day and sending those invoices to the customer via email. And it took a day to build a workflow to automate the billing of the sales orders, the creation of the invoices and then to email those invoices automatically to the right address of the customer. So in about one day of work, we took away four times two yours, so basically one FTE. I think the order processing right now they have two FTE in 2018, but we have grown about 400 % since 2015, but now with two people instead of four. So that is the biggest improvement by far. We gonna take that back even more if we launch our B2B eCommerce portal because that's gonna solve even more problems or get rid of more duplicate work because I think if a customer enters the order and we have to re-enter it in the system that is duplicate work. So there job will change, it's gonna more customer service than just data transfer. So the two people will do more meaningful works.

DS [00:37:19]: Is it currently necessary to make double works (e.g. double recording of data both in ERP- and CRM-system) due to isolated applications? If yes, which one?

H: No, I don't think so. Since we have a single source of truth in NetSuite, no double works are done anymore.

DS [00:37:55]: OK super, and do you currently have a lack of real-time reports due to not integrated, multiple overlapping databases?

H: No.

DS [00:38:14]: OK, and do you currently have dashboards, which analyze and report information from different business information systems and possible further data sources?

H: We have dashboards in NetSuite. They look simple, but you can do a lot with them if you dive a bit deeper into the reporting tools. So for example the finance team is the best power user for the dashboards. So I think they have three different dashboards. So yes, we use dashboards a lot. I also use them personally to keep track of what we built and I wanna see how many orders the US store processes

DS [00:39:37]: OK, I think the next question is also answered, as you have no separated ERP and CRM system, I assume that you have a consistent data basis of your customer information, do you?

H: Yes, exactly.

DS [00:39:57]: OK question 9 is, what should be the focus of versions upgrades of your business information systems in the future, mainly relating to the integration architecture in order to ensure sustainable systems in the future?

H: Maybe explain it with the consistent database for customer information. We have, as I told you, mostly B2B customers and our relationships last years and years. So we gather a lot of information. And currently, we are the only ones entering that information. With the launch of the retailer portal we wanna open that up to some extent so that customers tell us for example this is wrong or you should consider this. It is always tricky but we want to some extent empower our customers to update their own data if it is not correct and also to make it a bit more personal. Because not a customer record is like a business record, but we also want to know who are we dealing with. So is this a different person, because there is so much potential in knowing who you are in business with. To some extent, we have that, that is what we fill in for our most important customers. But the retailer portal is gonna help us to maintain that data more properly because 7.000 customers is a lot of data, we try to keep up but it is almost undoable, because the world and business changes so fast. So we want our customers to help us with that as well.

DS [00:42:56]: OK understand, so there is one last question regarding the integration, which is do you currently have workflows between your different business information systems implemented?

H: In my opinion, every integration, which we build with Boomi, is a Workflow. I think Boomi has some screenshots what's a process looks like in their software. But those are all workflows. For example, if you have a customer update in NetSuite, Boomi picks it up, take filter, customer update on this criteria need to be processed by retailer portal. So you have all kind of logic, which you need to keep your integrations mean.

DS [00:44:03]: OK, so now we have done all the questions regarding integration, thank you for the detailed answers. And now I have some questions relation to the Cloud. The first question is, to what extent does your company currently use cloud-based business information systems (Software-as-a-Service)?

H: All the systems already mentioned are cloud systems. NetSuite is a pure cloud solution, the eCommerce software as well. Of course, the packing machine is a machine, but the data are also stored in the cloud. The information flow is all on MySQL database, which is hosted on AWS. So we can access it quickly. So we use cloud as much as possible, but of course, for some applications, like file store, it is still better to have some servers. But we don't have some large servers running for business applications. Even the emails are stored in the cloud with Office 365. So as much as Cloud, yes.

DS [00:45:45]: OK, and which advantages and disadvantages do you see in cloud-based business information systems? Why did you decide to operate your business information systems in the cloud?

H: Well, there is a lot of advantages, in my opinion. First of all, I don't need a team of database experts internally. I like the model of having the best people working in the largest data centers. NetSuite has a team of very gifted experts on the database structure. Quickness of implementation is a factor with most cloud systems having just to activate your account which is done in about 30 Minutes. So this is a factor, also in test scenarios, copying test databases, it is all much easier. There is no maintenance cost directly for you. You don't have to worry about that. Most systems also have free updates, so NetSuite updates every six months for example. You get eight pages of release notes of new features. Some systems do that more often, some systems do that less often. But basically you don't have to spend money on the development of the system that much. It is just less worries for the business. To the disadvantages, there are some of course. For example for NetSuite, if you want to increase the performance, that is almost impossible. They know once you ask for it, it is necessary for you. So they have a good negotiation standpoint. For example, I told you, Boomi is hosted on AWS, and you have like control over your capacity. That is different, but then you also have to make sure that it is secure etc., so it is not pure cloud anymore. So you get those disadvantages. It is always like a balance, how much grip do I want to have on the performance of the platform, and also once a system is down, which does happen, because it is complicated, then you have no control. That is not necessarily a bad thing, because you don't want to have the control over your ERP system when you don't know the backend. But it gets very stressful. So for example, we had a period of 2 days where the performance was extremely slow, maybe ten percent of the user performance, and all what you can do, is to discuss with your account manager, what is happening, and they can also only say, that their guys are working on it. But usually they don't say what cost it. I think, it doesn't matter, because the problem will be solved faster as if you would solve it, because they have a bigger problem, because all of their customers are down then and most of them have service level agreements. However, it still feels like you are useless in that moment.

DS [00:51:15]: OK, the next question is, to what extent can Cloud Computing (mainly Software-as-a-Service) enhance the added value in a manufacturing company from your point of view (e.g. process optimizations, cost reductions)?

H: Well, to some extent, of course data is important in manufacturing companies, if you want to produce high quality goods. So you wanna get your moments of production, if something gets wrong, you want to know, where it came from. And I think if you have a supply chain than we have, with multiple vendors, that ship unfinished products to each other and finally we receive the final good. That is easier to track, if you don't have on-Premise environment. Because if you have on-Premise, you need to install everything with them as well. And with cloud you have the possibility of just saying if you have Internet, we build an app that has some automatization on the NetSuite side, and then you just press this button that the order is done, and then we have the data. That's a potential. But I think Manufacturing, it is often hard. Because we work with a lot of people, but most of them don't like computers. They like more to work with their hands and not with keyboards (laughs). So the education is a thing and the potential is huge.

DS [00:53:42]: OK, so then we have question 14, which is, do you have a mobile access to your business information systems within your company?

H: We made the decision to not allow mobile access to NetSuite. It would be a possibility, they have a native app on Android and iOS. But the thing is we control every laptop in terms of security, every employee gets a laptop and we know that it is secure, it is encrypted. We have end-point-protection etc. But for mobile phones, we don't have that control. And if you can't control the device, you don't know what is entering into the system. And based on that, and we also did not get very concrete use cases for the mobile app we decided to not allow mobile access to NetSuite. But if some user comes to us and has a great use case, we consider, but currently we say no.

DS [00:55:00]: Understand. So then we are at the last question. What is your opinion about the topics security and data protection with cloud-based business information systems? Which threats and risks do you see?

H: There are two sides to this. On-Premise, you need to focus on security by yourself. It is not so much that it is hard to do, but you have to have different net applications, you always have to consider the security by yourself. I think it is generally possible, some organizations are doing that very well. But if you are in a development environment, that sometimes gets left out, and you focus on other things that security, then you have a problem. That is one side. The other side is, that for the cloud providers. So if I would be a hacker, I would try to get access to those data centers, because then I would have access to a lot more data than just one as for on-premise. So the gain is a lot more if you succeed in hacking a cloud platform. So I think, there are two sides, and then, I think for us, as a relatively small company, we get better security with cloud applications if you choose the right platforms. So NetSuite for example has five billion dollar companies running on it and they have the same security for those companies in place as for us. So that is my opinion.

DS [00:58:02]: OK, so then we are finished with the questions and I'll stop now the recording. Thank you very much!

Transcript of Expert Interview I – German

Name of the interviewee: Mario Engleder
Company: Röchling LERIPA Papertech GmbH & Co. KG
Industry: Plastics industry
Position: CIO
Date, Place: 2018-02-28, Oepping
Recording of the interview allowed: X Yes □ No
Publishing of the name of the interviewee allowed: X Yes □ No

DS[74] [00:00:00]: Die erste Frage ist, damit ich einen Überblick über ihre Systemlandschaft bekomme, welche betrieblichen Software-Informationssysteme haben Sie im Einsatz und welche Module decken ihre Software-Systeme ab?

I[75]: OK, ich gehe davon aus, dass es hier nur um die Kern-Businesssystem geht, oder?

DS: Ja genau.

I: OK, also die klassischen Systeme sind natürlich einmal Dynamics NAV als ERP-System. Dann haben wir QlikView als BI-Lösung im Einsatz und Elo als Dokumentenmanagementsystem. Dann haben wir noch, wenn es um die Technik geht, eine sehr große Palette rund um die Konstruktionsprogramme im Einsatz, die natürlich auch beim ganzen Prozess mit dabei sind. Dabei verwenden wir als Haupt-Konstruktionssystem Autodesk Inventor, dann ist Mastercam die CNC Programmierumgebung, also wo die Bauteile programmiert werden für die Produktion und Meridian ist unser Zeichnungsverwaltungssystem. Und damit sich der Kreis schließt, in Richtung Lohn- und Gehaltsabrechnung, weil das haben wir nicht in Navision integriert, da verwenden LOGAVplus von der Firma Infoniqa. Das sind mal unsere Kernsysteme, wo ein Großteil unseres Tagesgeschäfts abgedeckt wird.

DS: Das heißt, die Frage 1.2., stammen die Systeme von unterschiedlichen Anbietern - Ja.

I: Genau.

DS: Welche Systeme sind aus ihrer Sicht jene, die am meisten voneinander abhängen?

I: Hängen eigentlich alle genannten Systeme zusammen.

DS: OK und inwiefern haben ihre unterschiedlichen betrieblichen Informationssysteme ein einheitliches User Interface?

I: Genau, die haben unterschiedliche User Interfaces.

DS [00:03:06]: Gut, danke für den Überblick. Die nächste Frage ist, waren Sie bereits in einem Integrationsprojekt in ihrem Unternehmen involviert und welche Erfahrungen haben Sie dabei gemacht?

I: Was immer problematisch ist sind einfach die Schnittstellen. Weil es einfach so heterogene Systeme sind und man diese Schnittstellenprobleme immer wieder hat. Das ist ein Thema. Das andere Thema ist wo es um die Richtung Versionskompatibilität geht. Weil wir eben nicht nur ein System im Einsatz haben, sondern verschiedene Anbieter. Dadurch ist ein Update auf einer Seite nicht so einfach durchführbar. Und was bei jedem Integrationsprojekt immer wieder Schwierigkeiten macht, das ist eher userbezogen, das ist sozusagen Altlasten von Systemen befreien. Jeder will noch immer das haben, was immer war, und das ist oft eine Schwierigkeit in solchen Projekten.

[74] DS = Dominik Scheuringer (Interviewer)
[75] I = Interviewee of Interview I

DS [00:05:02]: Hatten die Integrationsmöglichkeiten einen Einfluss bei der Auswahl ihrer betrieblichen Informationssysteme? Wenn ja, welche (technisch, organisatorisch, geschäftsorientiert)?

I: Natürlich, haben sie immer. Und bezogen auf ihre Punkte technisch, organisatorisch und geschäftsorientiert – der Hauptpunkt ist fast immer, wie sie organisatorisch eingegliedert werden können.

DS [00:05:31]: Die Frage vier ist, welche ihrer Geschäftsprozesse betreffen mehr als ein betriebliches Informationssystem in ihrem Unternehmen?

I: Ein Standard-Vertriebsprozess, wo ich von der Kontaktaufnahme vom Kunden, über Angebot, Auftragsbestätigung bis hin zur Abrechnung betrifft mehrere dieser Systeme. Da bleiben wir nicht nur in einem System.

DS [00:06:14]: OK bzgl. Frage 5 ist gleich mal vorweg die Frage, CRM-Tätigkeiten machen Sie im NAV, oder?

I: Aktuell noch im NAV genau. Aber es war gerade gestern ein Kollege von Ihnen bei uns im Haus, um das CRM-Modul vorzustellen (lacht).

DS: OK und was ist der Grund warum Sie gerne ein eigens CRM-System hätten?

I: Der Grund ist der, weil man die Sicht auf den Kunden bzw. die Aktivitäten auf den Kunden nur sehr schwer im ERP-System abbilden kann. Wir haben natürlich alle Informationen zum Kunden und zu den Kontakten und auch alle Rechnungswesen-relevanten Informationen in NAV, aber dieser Vertriebsblick auf den Kunden, wo Aktivitäten gesetzt sind, Besuche, Telefonate, Newsletter usw., diese Sicht fehlt aktuell im ERP-System.

DS [00:07:24]: Die nächste Frage - In welchem System erstellen Sie Analysen und Auswertungen ihrer ERP- und CRM-Daten, haben Sie dafür ein separates BI-System im Einsatz – haben Sie ja schon beantwortet. Das ist QlikView.

I: Genau. Da werden die Daten hauptsächlich vom ERP-System ausgewertet, aber auch von anderen Systemen aus der Produktion. Also Maschinendaten zum Beispiel. Aber natürlich auch Planungsdaten, die wir in einem Excel haben, Budgetplanung zum Beispiel, welcher Umsatz ist geplant in welchem Land.

DS [00:08:37]: Was sind bzw. waren die Auslöser für eine notwendige Integration ihrer betrieblichen Informationssysteme (Organisationsstruktur, betriebliche Prozesse etc.)?

I: Wir hatten nicht von Anfang an die Integration. Der Auslöser war dann das Nicht-Zusammenspiel einzelner Software-Lösungen, die es vorher im Haus gegeben hat, was dann ein Umdenken notwendig gemacht hat, dass man auf Systeme setzt, die einen gewissen Standard hat, Fokus ist bei uns einfach auf Microsoft, damit man gleich mal Schnittstellenproblematiken herausnimmt. Und weil eben auch die Nutzung und Komplexität der IT-Systeme so schnell gestiegen ist, konnten wir mit den Alt-Systemen einfach nicht mehr mit. Das war der Grund, warum wir vor sieben Jahren begonnen haben, alle Systeme neu zu integrieren und adaptieren.

DS [00:09:48]: OK und bei der Implementierung dieser Integrationen, was sind bzw. waren die größten Herausforderungen?

I: Die größten Herausforderungen waren natürlich Datenmigration und der Veränderungsprozess an sich. Mit der Integration der Software sind ja auch große Veränderungsprozesse verbunden, die wir mitmachen mussten.

DS [00:10:21]: Welche Verbesserungspotentiale sehen Sie aktuell in der Integration ihrer betrieblichen Informationssysteme (technisch / organisatorisch)? Wie können aus ihrer Sicht diese Verbesserungspotentiale umgesetzt werden?

I: Gibt es natürlich Verbesserungspotentiale. Und ein großes Projekt aktuell ist die Prozessoptimierung innerhalb der Business-Anwendungen. Das ist gerade ein Kernprojekt in diesem Jahr. Weil sich natürlich Organisationen, Tätigkeiten, Kunden, auch Produkte verändert haben, das System ist aber geblieben wie es implementiert worden ist, und damit man das wieder anpasst, wie es die Marktsituation erforderlich macht, dafür haben wir jetzt das Optimierungsprojekt.

DS [00:11:07]: Gibt es aus ihrer Sicht aktuell noch Insellösungen im Unternehmen?

I: Nein, es sind eigentlich durchwegs alle Lösungen, die irgendwie miteinander verknüpft sind, auch gut integriert.

DS [00:11:32]: Inwiefern sind Office- und Collaboration-Software-Systeme (Word, Excel, Outlook, SharePoint etc.) mit ihren betrieblichen Informationssystemen (ERP-/CRM-System) integriert?

I: Natürlich ist Excel und Outlook mit dem ERP-System verknüpft, von der Funktionalität, dass das Navision schon mitbringt. Und das zukünftige ERP-System wird natürlich auch komplett mit Outlook integriert sein. Speziell die Excel-Integration, aber auch Outlook, damit ich Maileingänge zum Beispiel auch im Navision habe, das wird auch wirklich genutzt.

DS [00:12:30]: Welche Abteilungen profitieren aus Ihrer Sicht am meisten von der Integration ihrer betrieblichen Informationssysteme?

I: Ich glaube, man kann keine Abteilung wirklich hervorheben, weil die Integration eigentlich immer alle Abteilungen betroffen hat und vorher, ohne die Integration, jede Abteilung eigentlich ähnliche Schwierigkeiten gehabt hat. Also ich würde jetzt keine Abteilung direkt hervorheben, wenn dann, die wirklich merkliche Vorteile haben, dann ist das der Vertrieb, die gegenüber der Vorversion noch mehr Vorteile bekommen haben, wie die anderen Abteilungen, die im gleichen Ausmaß Vorteile durch die Integration bekommen haben.

DS [00:13:25]: Müssen aktuell Doppelarbeiten, z.B. doppelte Datenerfassung, gemacht werden aufgrund isolierter Systeme? Wenn ja, welche?

I: Ja gibt es, und das ist auch ein Punkt in unserer aktuellen Prozessanalyse, dass man diese bereinigt. Auch wenn schon wo Schnittstellen vorhanden sind, typisches Beispiel ist die Anlage eines Kundenkontaktes. Meistens hat der Vertriebstechniker einen Kontakt, den er sich in seinem Outlook anlegt, aber wenn es dann irgendwie zu einer Geschäftsbeziehung kommt, dann muss dieser Kundenkontakt auch im ERP-System angelegt werden, obwohl eigentlich die Daten schon mal wo erfasst worden sind. Das ist ein klassischer Fall, wo das einfach passiert.

DS [00:14:15]: Gibt es aktuell einen Mangel an Echtzeit-Auswertungen und Reports aufgrund nicht integrierter, mehrfach überlappender Datenbanken?

I: Es gibt einen Mangel, und zwar da geht es wirklich um die Produktionsmaschinen, um die Auslastung der Maschinen, um generelle Maschinendaten, so hauptsächlich Auslastungsdaten. Dieses Projekt ist gerade auf Laufen, und wird erst Ende des Jahres fertig sein, sodass wir Maschinendaten aus der Produktion direkt einfließen können. Die Produktionsumgebung ist also noch nicht so direkt integriert in die Systeme.

DS [00:15:01]: Besitzen Sie aktuell Dashboards, welche Informationen von verschiedenen betrieblichen Informationssystemen und ev. weiteren Datenquellen auswerten?

I: Ja, Dashboards werden verwendet in QlikView.

DS [00:15:16]: Können ihre Verkäufer aktuell schnell auf Kundenanfragen reagieren ohne Informationen, z.B. die Artikelverfügbarkeit, Artikelpreise, Verkaufshistorie des Kunden, allgemeine Informationen zum Kunden, aus unterschiedlichen Systemen ermitteln zu müssen?

I: Wir produzieren ja nur auf Kundenwunsch und Kundenzeichnung, das heißt wir haben selbst ja nicht so klassische Artikel, die wir auf der ganzen Welt verkaufen. Sondern das ist immer eine individuelle Fertigung für eine bestimmte Kundenanforderung. Das heißt, dass der Kunde jetzt anruft und fragt, ob wir noch sieben Stück verfügbar haben, diese Anforderung gibt es eigentlich nicht.

DS [00:16:21]: Besitzen Sie aktuell eine einheitliche Datenbasis für Kundeninformationen? Wenn nicht, auf welche Systeme sind diese verteilt und ergeben sich daraus Probleme für ihr Unternehmen?

I: Gibt es eigentlich aktuell nicht die einheitliche Datenbasis, es gibt natürlich die Kunden-Stammdaten und Kontaktinformationen, die im ERP-System hinterlegt sind, aber das passiert halt erst, wenn es wirklich eine Geschäftsbeziehung gibt. Das heißt alles was vorher passiert, im richtigen Vertriebsprozess oder Marketingbereich, da gibt es diese zentrale Datenbasis nicht. Das liegt oft wirklich lokal im Outlook-Kontakt oder über das Newsletter-System irgendwie. Aber wirklich zentral haben wir aktuell die Information erst, wenn es eine Geschäftsbeziehung gibt.

DS [00:17:11]: Auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades ihrer betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

I: Der Fokus sollte sein, zumindest, wenn man zertifizierte Hersteller-Systeme verwendet, dass diese untereinander zusammenspielen. Also bei uns ist einfach Strategie, dass wir, wenn möglich Microsoft-Produkte verwenden und wenn nicht, dann zumindest zertifizierte Produkte, die Microsoft zertifiziert sind. Das hilft sehr, wenn es um Upgrades geht. Problematik haben wir zum Beispiel aktuell noch im Konstruktionsumfeld, weil unser zentrales Zeichnungsverwaltungssystem nicht direkt Autodesk zertifiziert ist. Wir können damit aktuell nicht ohne weiters auf die neueste Autodesk-Version in der Konstruktion switchen, weil unser Zeichnungsverwaltungsprogramm da noch nicht bereit ist. Wir hinken da also immer einen Versionssprung hinterher, nur wegen dem Anbieter, der das eben nicht hat bzw. nicht kann.

DS [00:18:45]: OK, und letzte Frage zum Thema Integration ist, sind aktuell Workflows zwischen ihren verschiedenen betrieblichen Informationssystemen implementiert?

I: Ja Workflows werden verwendet. Die aktuell verwendeten Workflows sind entweder im Elo, da geht es zum Beispiel um Rechnungsfreigabe, um Digitalisierung von Eingangsrechnungen, da gibt es Workflows. Und der zweite Bereich ist eher im Office-/Outlook-Bereich, wo es um Urlaubs- oder Dienstreiseanträge geht, da gibt es auch implementierte Workflows. Bzw. ein System, das ich vergessen habe, weil es ja eigentlich nicht zu den klassischen Business-Systemen gehört, ist unser Ticket-System, wo wir die IT-Instandhaltung, Forschungs- und Entwicklungsanträge alles in einem zentralen Ticketsystem erfassen, da gibt es natürlich auch Workflows. Wir haben da auch JIRA in Verwendung, das es auch bei der NAVAX gibt.

DS [00:20:07]: In welchem Ausmaß nutzt ihr Unternehmen aktuell Cloud-basierte betriebliche Informationssysteme (Software-as-a-Service)?

I: Aktuell noch gar nicht, zumindest wenn man es auf Services bezieht, da verwenden wir noch nichts aus der Cloud.

DS [00:20:51]: OK und aufgrund welcher Kriterien kommt eine Anwendung ihrer betrieblichen Informationssysteme in der Cloud (als Software-as-a-Service) aktuell nicht in Frage? Bzw. welche Voraussetzungen müssten erfüllt sein, damit Sie sich für eine Anwendung in der Cloud entscheiden würden?

I: Ich sag mal so, die Produkte, die für uns relevant sind, die haben noch die Marktreife zu dem Zeitpunkt gehabt, wo die Entscheidung getroffen worden ist. Das hat sich in den letzten zwei Jahren massiv verändert, und zukünftige Lösungen werden wahrscheinlich zu 90 % Cloud-Services sein, aber damals war es die Marktreife, und vor allem die Microsoft Cloud, die ist einfach noch nicht so lange bereit für einen wirklichen produktiven Einsatz. Früher hat es auch Konzernrichtlinien gegeben, das ist jetzt kein Thema mehr. Zum Beispiel das CRM-System, das kommen wird, das wird zu 100 % aus der Cloud kommen und es sind auch andere Projekte, zum Beispiel Exchange Server oder zentrales Active Directory, das wird alles cloudbasiert kommen. Das ist schon fixiert.

DS [00:22:40]: Inwiefern kann Cloud-Computing (insbesondere Software-as-a-Service) aus ihrer Sicht die Wertschöpfung in einem Produktionsunternehmen steigern, z.B: Prozessoptimierungen, Kostenreduktionen?

I: Einmal natürlich die weltweite Verfügbarkeit, die sonst mit Zugriff von extern auf on-Premise Installationen immer irgendwie bereitgestellt werden muss und gar nicht so einfach ist. Dann die Reduktion der lokalen Infrastruktur. Und das Services viel schneller verfügbar sind, bis das meine Installation vor Ort alles durchgeführt hat. Das sind sicher drei Hauptgründe, obwohl es sicher noch weitere Gründe geben wird. Wie es jetzt aussieht, entwickelt sich ja in der Cloud mehr Funktionalität, als was man on-Premise überhaupt zur Verfügung haben wird.

DS [00:23:34]: Ist ein mobiler Zugriff auf ihre betrieblichen Informationssysteme, zu jeder Zeit, an jedem Ort, aktuell möglich?

I: Ist theoretisch möglich, sofern es die Gegebenheiten vor Ort, zum Beispiel in China, es zulässt. Aktuell ist aber alles so umgesetzt, dass man, bis auf die Emails, für alles andere einen VPN-Zugang benötigt. E-Mails sind auf mobilen Geräten direkt verfügbar.

DS [00:24:12]: OK, und dann hätte ich noch eine letzte Frage. Wie stehen Sie zum Thema Sicherheit und Datenschutz bei Cloud-basierten betrieblichen Informationssysteme? Welche Gefahren und Risiken sehen Sie darin?

I: Nein, ich sehe mit Sicherheit keine höheren Gefahren, als wie wenn man das on-Premise installiert. Gefahren gibt es natürlich überall, aber ich stehe dem persönlich sehr gelassen gegenüber, vor allem wenn man schaut, wie Microsoft Cloud die höchste Zertifizierungsstufe weltweit hat, solche Sicherheitsmechanismen bringt man wahrscheinlich lokal gar nicht zusammen. Was natürlich mit den Daten im Hintergrund passiert, da sind wir natürlich sowieso schon recht gläsern, mit Mobiltelefon, Internet. Mit dem Thema müssen wir einfach leben. Das Risiko auf der sozialen Seite, also Social Engineering ist meiner Meinung nach ein viel höheres Risiko als die technische Sicherheit.

DS [00:25:10]: OK, dann sind wir mit den Fragen durch und ich bedanke mich recht herzlich für ihre detaillierten Antworten.

I: Bitte, sehr gerne.

Transcript of Expert Interview J – German

Name of the interviewee: Marcel Merz
Company: Full Speed Systems AG
Industry: IT Consulting
Position: CFO / Project leader
Date, Place: 2018-03-02, Telephone
Recording of the interview allowed: X Yes ☐ No
Publishing of the name of the interviewee allowed: X Yes ☐ No

J[76] **[00:00:00]:** Zur Ausgangslage, wir sind Oracle Partner und wir sind Spezialisten für mehrere Produkte von Oracle. Das ist JD Edwards, welches eine klassische on-Premise-Lösung ist, aber auch in der Cloud betrieben werden kann. Dann haben wir Oracle Cloud und NetSuite, und die beiden sind reine Cloud Lösungen. Und ich werde meine Antworten primär auf das NetSuite beziehen.

DS[77]: Ja das passt gut so, weil NetSuite spielt ja auch eine Rolle in meiner Masterarbeit.

DS [00:01:34]: Die erste Frage ist, inwiefern haben aus ihrer Sicht die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben, sowohl technisch als auch organisatorisch?

J: Es kommt immer darauf an, jetzt haben sie eine Firma, einen möglichen Kunden, der in der Evaluation ist, der eine möglichst einheitliche Lösung will, also nicht so große Integrationen, dann ist das absolut nicht relevant. Wenn sie aber einen möglichen Kunden haben, der da was sucht, irgendeine kleine Lösung in Mitten einer großen Landschaft, mit vielen Schnittstellen und Integrationen, dann wird das natürlich schon angeschaut. Das sind so technische Sachen, grundsätzlich für betriebliche Lösungen schauen die Kunden mehr auf die Funktionen, was ich übrigens nicht so gut finde, als auf wirklich die technischen Sachen. Also ich würde höchstens mittelwichtig sagen. Die Frage dabei ist ja auch, wer tut den überhaupt evaluieren für betriebliche Lösungen. Das sind in der Regel ja nicht die reinen IT-Leute, aber was wir hier diskutieren, Schnittstellenthemen, das ist dann auf der Stufe wirklicher IT. Also da habe ich zum Teil gar nicht die Leute am Tisch, die das fragen könnten.

DS [00:04:20]: Welche Anforderungen bzgl. Integration von betrieblichen Informationssystemen haben Unternehmen aus Sicht des Managements und welche aus Sicht der Anwender?

J: Das ist jetzt eher weniger Management und Endanwender. Das betrifft wirklich mehr die technischen Leute, die da Fragen stellen in diese Richtung. Und das sind dann meistens, welche Protokolle sind verfügbar, ist das abgesichert, gibt es XML oder ist das irgendwas moderneres usw.

DS [00:04:59]: OK und gibt es aus ihrer Sicht gewisse Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben, also zum Beispiel die Organisationsstruktur, die betrieblichen Prozesse etc.?

J: Absolut, wir haben in jedem Projekt Integrationen, wenn das nur schon Datenübernahme ist für den Start, da haben wir schon Integrationen. Und nachher haben wir halt Integrationen, das können legale Sachen sein, was gegen Ämter gemeldet werden muss, also Integration nach außen, oder dann halt auch intern, wenn der Kunde sagt, wir haben da schon ein Datenarchiv, wir wollen das integrieren. Oder die Rezepturen wollen

[76] J = Interviewee of Interview J
[77] DS = Dominik Scheuringer (Interviewer)

wir nicht in der ERP-Lösung, dafür haben wir speziell entwickelte Lösungen, also wir haben da immer solche Themen.

DS [00:05:45]: Bei der Implementierung, was sind hier die größten Herausforderungen bzgl. der Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

J: Es ist oft ein Thema, dass wir die richtigen Leute am Tisch haben, ich sage mal einfach Kommunikation. Weil ich brauche eine gute Person auf unserer Seite und ich brauche eine gute Person auf der anderen Seite. Und dann haben wir natürlich klare Anforderungen in Richtung Projektmanagement. Also hatte die andere Lösung auch eine Testumgebung wie wir, da haben wir oft Mühe, also die ganze Abstimmung. Oft wird auch berücksichtigt von den Kunden, habt ihr denn schon eine Standardschnittstelle in diesem und jenen System und das ist natürlich ein wichtiges Argument beim Vertrieb, weil der Kunde sich natürlich freut, wenn die schon eine Standard-Schnittstelle haben. Das Problem ist aber, dass diese Standard-Schnittstellen ganz oft gar nicht funktionieren, weil jeder Kunde ja anders funktioniert.

DS [00:06:57]: Die fünfte Frage ist, welche Probleme und Schwachstellen verursachen isolierte Applikationen (Insellösungen) in Produktionsbetrieben?

J: Das ist dann ja die perfekte Lösung. Eine Integration habe ich ja sowieso immer. Wenn das nur zum Beispiel die Logins der User sind, dann muss ich das immer schön parallel manuell pflegen. Keine Insellösung, keine parallele Pflege. Das ist der Nachteil, also zum Teil redundante Datenerfassung. Aber der ganz große Vorteil ist, dass die Systeme nicht abhängig sind. Sehr oft ist es das Problem, es sollte für irgendeine Lösung ein Release-Wechsel gemacht werden, kann aber nicht, weil es abhängig ist von der anderen Lösung, die da nicht mithält. Also die Abhängigkeit ist damit eliminiert, dafür manuelle und redundante Datenpflege.

DS [00:08:17]: Inwiefern können aus ihrer Sicht Produktionsprozesse in Unternehmen optimiert werden durch die Integration betrieblicher Informationssysteme?

J: Also grundsätzlich, wenn ich Systeme integrieren muss, dann ist das immer ein Zusatzaufwand. Ich muss immer schauen, was läuft wo, wer ist der Master für die Daten, ich habe gewisse Redundanz, jedes System hat gewisse Stammdaten. Also Systeme integrieren ist grundsätzlich negativ, aber für gewisse Firmen hat es Vorteile, dass sie einen Best of Breed nennen wir das, also sie können für jeden Bereich die beste Lösung wählen, und dann haben sie beste Lösungen eben, aber als Nachteil halt diese Integrationen. Wir versuchen, Integrationen bestmöglich zu eliminieren.

DS [00:09:13]: OK und Frage sieben ist, welche Abteilungen in Produktionsbetrieben profitieren am meisten von der Integration von betrieblichen Informationssystemen?

J: Ganz einfache Antwort. Alle Königreiche. Das ist sehr oft politisch. Also sehr oft bei Firmen sehe ich wenn die dann Insellösungen haben, das ist dann nicht eine zentral geführte Firma, sondern da darf jeder selber ein bisschen entscheiden. Und dann fängt das an mit so Insellösungen. Anders, jetzt schieße ich gegen die Konkurrenz, gegen SAP. Sie wissen ja was die drei Buchstaben SAP bedeuten. Suche andere Programme (lacht). Das ist jetzt ein Witz, aber ich habe das schon sehr oft gesehen, dass Kunden, wenn Sie SAP haben, beginnen, gewisse Teile in andere Software zu verlagern, weil in SAP das einfach viel zu schwerfällig ist. Und daher hat SAP ja so viele Schnittstellen im Standard. Also das ist schon eine Strategiefrage was man will als Firma. Will ich eine Lösung, die größtmöglich alles abdeckt, oder will ich diese Speziallösungen.

DS [00:11:21]: Für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen (und vice versa) sinnvoll und vorteilhaft für Produktionsbetriebe?

J: Also, wir machen keine Unterscheidung zwischen ERP und CRM. Aber wir haben auch Kunden, die zum Beispiel SalesForce nutzen, weil sie das schon hatten und entschieden haben, über eine Schnittstelle mit NetSuite zu verbinden. Es gibt alle Varianten.

DS: OK, und in solch einem Fall, welche Daten werden da aus ihrer Sicht oft ausgetauscht und synchronisiert?

J: Ja wobei die Frage ist vor allem, in welcher Periodizität die Daten hier hin und her verfügbar sind. Grundsätzlich muss ich sagen, wenn ich sowas habe, dann habe ich eine Parallelität, eine Redundanz von Daten, zum Beispiel Kundendaten. Die Frage ist dann, ob es reicht diese Daten über einen Batch über Nacht synchronisieren, oder brauchen wir dafür Web Services, um die Daten quasi online anzubinden oder andere Funktionalitäten. Das ist dann im Einzelfall zu prüfen.

DS [00:12:38]: Welche Potentiale sehen Sie in der Integration von betrieblichen Informationssystemen (ERP- und CRM-System) innerhalb Office-Produkte wie Outlook, Word oder Excel?

J: Ja die klassischen Office-Produkte, die verschmelzen ja mit den ERP-Produkten mehr und mehr. Also in NetSuite, habe ich zum Beispiel eine Outlook-Integration. Also wenn ich ein E-Mail an einen Kunden schreibe, dann sehe ich die direkt im Tab Kommunikation und kann damit nachvollziehen, was wer mit diesem Kunden kommuniziert hat. Excel ist natürlich in der Buchhaltung sehr oft gefragt. Also das verschmelzt mehr und mehr. Aber viele Firmen sagen auch, dass sie nicht wollen, dass die Leute zu viel in Excel arbeiten und sie wollen die Funktionen mehr ins ERP verlagern. Word in dem Fall ist ein bisschen weniger gefragt.

DS [00:14:15]: Auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades von betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

J: Gut, jetzt sprechen wir auch ein bisschen in Richtung Cloud und jetzt wird es spannend. Wenn wir von Releasewechsel sprechen, dann ist das NetSuite eine reine klare PaaS-Lösung. Jetzt wenn ich das JD Edwards nehme, und in der Cloud betreibe, es ist on-Premise gekauft, da sage ich wenn der Release-Wechsel gemacht wird als Kunde. Beim PaaS, NetSuite, habe ich als Kunde gar nichts zu sagen, da kommt einfach zweimal im Jahr ein Release-Wechsel, automatisch gemacht, alle meine Änderungen sind nachgezogen, perfekt. Das ist der große Vorteil, genau wegen dem wollen viele Kunden, und NetSuite ist übrigens ein absoluter Renner, und das ist von Anfang an so gebaut worden, dass das eben voll Release-automatisiert ist. Der Kunde kann zwar testen, er wird über die Neuerung informiert, er hat ein Zeitfenster wo er testen kann, wenn was nicht gut ist, dann kann er das melden. Aber irgendwann ist dann einfach der Upgrade gemacht. Die meisten Kunden testen gar nichts. D.h. jeder Kunde weltweit von NetSuite ist immer auf dem neuesten Stand. Das hat jetzt auch wieder Vor- und Nachteile. Ich habe Kunden, die lassen ihr on-Premise einfach laufen, die wollen gar nichts mit Änderungen zum tun haben, weil sich deren Business nicht so bewegt. Die meisten Kunden wollen aber immer von den neuesten Änderungen profitieren, das hat aber dann auch Einfluss auf die Schnittstellen. Also wenn ich viele Systeme angebunden habe, und das macht mir automatisch Upgrades, dann muss ich das auch dann kurz testen.

DS [00:16:26]: OK und noch eine letzte Frage zum Thema Integration. Inwiefern können aus ihrer Sicht Workflows das Zusammenspiel und die Kommunikation verschiedener betrieblicher Informationssysteme optimieren und verbessern?

J: NetSuite hat eine sehr starke Workflow Engine. Und wenn Sie einen Workflow haben jemand erfasst etwas, wer anderer muss das dann prüfen und freigeben, das ist einfach nur Standard. Aber Workflow in NetSuite geht weiter. Das brauchen wir sehr oft auch um

irgendwelche Modifikationen oder Spezialitäten einzubauen. Das geht bis runter auf Trigger-Funktionalität. Ich kann mit einem Workflow Felder vorbelegen, ich kann Prüfungen von Inhalten machen, ich kann nicht nur E-Mails klassisch verschicken, sondern auch ganze Prozesse anstoßen. Felder updaten usw. Das brauchen wir auch mit Integration. Zum Beispiel in einem anderen System wird etwas gemacht, das kommt in NetSuite rein und abhängig davon was es ist, tut es dann verschiedene Funktionen oder Nachrichten auslösen. Also sicherlich ein wichtiger Teil und oft im Einsatz.

DS [00:17:57]: OK danke. Dann hätte ich jetzt noch ein paar Fragen zum Thema Cloud. Erste Frage, wie sieht der Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme ihrer Meinung nach aus?

J: Ja, das wird immer wichtiger. Der Trend ist ganz klar Richtung Cloud. Es gibt zwar immer noch Firmen, die sind immer noch auf deren on-Premise-Strategie, das hat verschiedene Gründe, aber es ist ganz klar, das Eis ist durchbrochen mit den Cloud-Sachen, bei SAP mit HANA, bei NetSuite, das ist unglaublich was da momentan abläuft.

DS [00:18:50]: Gibt es betriebliche Informationssysteme die besser und welche die schlechter für die Verlagerung in die Cloud geeignet sind?

J: Doch, also auf dem Markt gibt es ja ungefähr ca. 500 verschiedene ERP Systeme. Und da gibt es ja schon ERP-Systeme, die sich überhaupt nicht für die Cloud eignen, weil die schlicht nicht dafür gebaut sind, das geht gar nicht. Also ein JD Edwards, was eine on-Premise-Lösung ist, die kann ich in die Cloud bringen, ich habe mehrere solcher Kunden. Das funktioniert einwandfrei, wogegen ein NetSuite, das eignet sich nicht für eine Verlagerung in der Cloud, weil das ist schon in der Cloud. Das ist reine PaaS-Cloud. Also ich habe mal gehört, es wäre möglich NetSuite on-Premise zu betreiben, aber das müsste dann schon wirklich ein kräftiger Kunde sein, so 1 Million Lizenzen pro Monat, irgend sowas, dann würde Oracle sich wohl die Mühe machen, dass nicht in einem DataCenter, Public Cloud, sondern privat bei jemanden zu installieren

DS [00:20:13]: Welche Voraussetzungen muss ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das Cloud Model besonders geeignet?

J: Ich sag mal so, grundsätzlich ist es immer sehr geeignet. Es gibt vielleicht ein paar Ausnahmen, wo es nicht geeignet ist. Bei Produktionen speziell ist es so, dass wir da von Rezepturen sprechen und es gibt Firmen, die sagen strategisch, ich will meine Rezepturen nicht in der Cloud veröffentlicht haben. Es gibt diese Firmen immer weniger, weil ob man das in der Cloud hat, oder ob man das privat on-Premise hat, das verliert immer mehr an Priorität. Das andere ist aber, es gibt verschiedene Fabrikstandorte, welche also nicht so in den Zentren der Städte sind, die ein bisschen außerhalb sind, vielleicht sogar in den Bergen, und da muss man halt prüfen, wie die Netzwerkanbindung ist. Mittlerweile ist das fast kein Thema mehr, weil mittlerweile alles überall sehr gut geschlossen ist, und auch die Software mit einer sehr geringen Bandbreite funktioniert, also ich habe in den letzten 2-3 Jahren da keine Probleme festgestellt. Funktionalität, da gibt es gar nichts zu sagen, ist alles in PaaS, ist alles in NetSuite verfügbar, und NetSuite hat einen ganz großen Vorteil, obwohl es eine Public Cloud PaaS-Lösung ist, das heißt man tut das ja nur mieten, aber man kann in dem auch programmieren, man kann scripten, man kann irgendwelche Workflows anpassen, das ist für mich die wirklich erste sensationelle PaaS-Lösung.

DS [00:22:08]: Welche potentiellen Herausforderungen und Risiken sehen Sie in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

J: Grundsätzlich ja, aber ich würde mal behaupten, wenn man es auf NetSuite hat, das ist eine Oracle Cloud-Lösung in den besten Rechenzentren, beste Performance, da haben wir

größere Datensicherheit, als wenn das jemand inhouse betreibt. Oder vielleicht, wenn das eine kleine IT-Firma ist, die das bei ihren Servern im Haus ein bisschen cloud-mäßig betreibt. Aber es ist immer ein Thema, man muss das anschauen. Es gibt verschiedene Modelle bei NetSuite, bei Oracle. Ich kann das hochverfügbare haben, in mehreren Datencentern, nur auf einem Ort, auf eine günstigere Art und Weiße, da gibt es verschiedene Modelle. Bis vor zwei Jahren hat NetSuite zwei Datencenter gehabt, in US und Holland, und mittlerweile sind sie zwar noch nicht in allen Länder der Welt, aber letztes Jahre kamen etwa zehn neue Datencenter hinzu, dieses Jahr sind etwa fünfzehn geplant, das wird jetzt ganz massiv in die Welt ausgerollt.

DS [00:23:40]: Gibt es aus ihrer Sicht Einschränkungen bzgl. der Funktionalität von Cloud-basierten betrieblichen Informationssystemen im Vergleich zu den On-Premise Varianten? Bzw. auch im Bereich Customizing und Konfiguration?

J: Nein, es gibt jetzt einen kleinen Unterschied, wenn ich jetzt NetSuite mit JDEdwards vergleiche. In NetSuite kann ich wirklich auch programmieren, in meiner Sicht ist das einzigartig und das große Verkaufsplus von NetSuite. Aber im on-Premise JD, da kann ich noch ein bisschen weiter und tiefergehend programmieren. Das NetSuite ist eine PaaS-Lösung und ich kann grundsätzlich alles machen und es tut mir NetSuite ja auch garantieren, dass das release-sicher ist, was ich da mache. Also das liegt dann auf der Hand, dass ich nicht ganz alles kaputt machen kann. Bei einer on-Premise-Lösung hingegen, die habe ich gekauft, die gehört mir, da kann ich wirklich alles kaputt programmieren. Aber das ist nur in Theorie so, sie können im NetSuite wirklich alles programmieren. Sonst von der Funktionalität, es gibt ja so Studien, die meisten Firmen schauen bei der Evaluation immer auf die Funktionalität. Ich bekomm manchmal so Excel, 1.500 Fragen könnt ihr das, könnt ihr dies, könnt ihr jenes usw. Und es ist ja so, dass die eine Software das ein bisschen besser kann, die andere kann das ein bisschen besser, aber grundsätzlich Funktionalitäten sind nicht much entscheidend, obwohl das die große Fragerunde ist. Es geht doch viel mehr um, wie kann ich das einführen, wie flexibel ist das, also mehr die Soft-Faktoren, also die nicht so klar messbaren Faktoren sind mehr entscheidend. Aber Funktionalität, ob on-Premise oder in der Cloud, ist genau gleich.

DS [00:26:01]: Welche Vorteile (oder auch Nachteile) ergeben sich in der Upgrade-Fähigkeit von betrieblichen Informationssystemen durch die Anwendung in der Cloud?

J: Ja, wie schon paar Mal erwähnt. Die Upgrade-Fähigkeit in der Cloud spielt null Rolle, es ist einzig und allein das Produkt selber. Wenn es NetSuite ist, das ist voll releasefähig, permanent, 2 mal pro Jahr automatisch gemacht. Wenn ich eine on-Premise-Lösung, ein JD oder ein SAP R/3 nehme, das klassische, dann entscheide ich, wann wie upgegraded wird. Als Lieferant, SAP oder Oracle, kann ich das vielleicht forcieren, indem ich sage, ja ihr müsst jetzt upgraden, weil sonst verfallen irgendwelche Wartungs- oder Supportmöglichkeiten. Aber technisch ist das absolut irrelevant, Cloud oder on-Premise.

DS [00:26:57]: Gut, und dann sind wir schon bei der letzten Frage. Welche Auswirkungen hat die Einführung Cloud-basierter betrieblicher Informationssysteme auf die Implementierungsdauer im Vergleich zur On-Premise Variante?

J: Absolut. Wenn ich jetzt von NetSuite denke, ich miete diese Software. Also wenn ich einen Vertrag unterschreibe mit NetSuite, dann kriege ich einen Vertrag von NetSuite, das ist DocuSign, ich tu das elektronisch unterschreiben, maximal 24 Stunden später habe ich meine Umgebung komplett verfügbar. Wenn ich on-Premise schaue, dann diskutieren wir zuerst mal, welche Hardware, dann muss diese beschafft werden, da gibt es Lieferzeiten, die Hardware muss installiert werden und erst dann kann ich dann mal die Software installieren. Also da habe ich mal 1-2 Monate Vorlaufzeit und auch Kosten.

DS [00:28:02]: Danke für ihre Antworten! Ich beende jetzt die Aufzeichnung.

Transcript of Expert Interview K – German

Name of the interviewee: Anonymous
Company: Anonymous
Industry: Manufacturing electronics company
Position: CIO
Date, Place: 2018-03-02, Engerwitzdorf
Recording of the interview allowed: X Yes No
Publishing of the name of the interviewee allowed: Yes X No

DS [00:00:00][78]: Welche betrieblichen Software-Informationssysteme haben Sie im Einsatz? Und welche Module decken ihre Software-Systeme ab?

K[79]: Der größte Part hier ist sicher Dynamics NAV, das setzen wir eigentlich voll umfänglich ein, also das heißt vom ganzen Bestellwesen, Stammdatenwesen logischerweise, bis hin zu Produktion, Vertrieb, Fakturierung, Lagerbewirtschaftung etc., also wirklich als ERP-System. Zusätzlich gibt es noch Dynamics CRM, was als reines CRM-System eingesetzt wird. Und ansonsten haben wir größtenteils individuell entwickelte Systeme, also Standardsysteme in dem Sinn gibt es dann keine mehr, das sind dann wirklich optimierte Produktionsunterstützungssysteme.

DS [00:02:38]: OK, und somit stammen die Standard-Systeme beide von Microsoft.

K: Ja genau.

DS [00:02:45]: OK, und ich nehme an, dass es eine Abhängigkeit zwischen den beiden Systemen gibt, oder?

K: Ja, es gibt eine Abhängigkeit, das ist ein Folgeprozess. Die Angebote entstehen im CRM-System und münden dann schlussendlich in Aufträge im ERP-System. Und das gleiche mit Kunden und Interessenten, die entstehen im CRM und münden halt dann hoffentlich als Kunden im ERP.

DS [00:03:15]: Waren Sie bereits in einem Integrationsprojekt in ihrem Unternehmen involviert und welche Erfahrungen haben Sie dabei gemacht?

K: Naja, im wesentlich die Erfahrungen, die man bei jedem Software-Projekt macht. Das eine ist, dass es eine sehr große Schwierigkeit gibt, die Erwartungshaltung und die Anforderungen der Fachbereiche zu ermitteln. Das zweite ist an einer Schnittstelle zu agieren hinsichtlich des Dienstleisters, dass der auch versteht, was man will. Und das dritte ist natürlich, das hängt davon ab, ob es dann ein neues System zum Einführen ist, oder ein bestehendes zum Ersetzen ist. Wenn was Bestehendes zum Ersetzen ist, dann hat man natürlich immer das Thema, dass das parallel zum Produktivbetrieb gehen muss.

DS [00:04:27]: Hatten die Integrationsmöglichkeiten einen Einfluss bei der Auswahl ihrer betrieblichen Informationssysteme? Wenn ja, welche (technisch, organisatorisch, geschäftsorientiert)?

K: Ja, das war einer der wichtigsten Punkte. Wie flexibel ist das System anpassbar und integrierbar. Also ja, hat einen hohen Stellenwert gehabt.

DS [00:04:51]: Welche ihrer Geschäftsprozesse betreffen mehr als ein betriebliches Informationssystem in ihrem Unternehmen?

K: Ja, das ist bei uns der gesamte Vertriebsprozess.

[78] DS = Dominik Scheuringer (Interviewer)
[79] K = Interviewee of Interview K

DS [00:05:12]: Die nächste Frage, führen Sie ERP- und CRM-Tätigkeiten in einem Software-System durch oder haben Sie dafür getrennte Software-Systeme – haben Sie ja bereits mit Ja, Sie haben getrennte Systeme, beantwortet.

K: Genau.

DS: OK, und auf welche ERP-Daten können Sie aktuell direkt im CRM-System zugreifen und umgekehrt?

K: Naja, im Wesentlichen sind es Kunden, statistische Informationen wie Umsätze, und natürlich auch der gesamte Artikelstamm bzw. auch zusätzliche Stammdaten, die man halt so braucht, wie Zahlungsbedingungen usw.

DS: Gibt es aktuell ERP- / CRM-Daten, auf die Sie nicht direkt vom CRM- / ERP-System zugreifen können, jedoch gerne möchten?

K: Nein, wir sind momentan glücklich damit. Mehr macht wenig Sinn momentan.

DS [00:05:58]: In welchem System erstellen Sie Analysen und Auswertungen ihrer ERP- und CRM-Daten? Haben Sie dafür ein separates BI-System im Einsatz?

K: Wir machen das selber auf Basis Microsoft Analysis Services und Microsoft Reporting Services und das ist selbst entwickelt. Und wir greifen da die Daten von NAV und CRM ab.

DS [00:06:35]: Was sind bzw. waren die Auslöser für eine notwendige Integration ihrer betrieblichen Informationssysteme, z.B. Organisationsstruktur, betriebliche Prozesse etc.?

K: Das war eigentlich Grundvoraussetzung, alleine, weil wir keine Daten redundant halten wollten bzw. auch um Fehleingaben von Daten, wenn diese von A nach B transferiert werden, zu vermeiden.

DS [00:07:02]: Was sind bzw. waren die größten Herausforderungen bzgl. der Integration ihrer Informationssysteme?

K: Wie vorher schon gesagt, die Kommunikation mit dem Software Dienstleister. Was da noch dazu kommt ist die derzeitige Produktpolitik von Microsoft. Weil gerade CRM ist sehr fehlerbehaftet, und die Politik, man kündigt Funktionen ab, hat aber noch keinen Ersatz für die Funktionen, ist nicht so gut. Wobei das ja weniger mit den Integrationen zum tun hat.

DS [00:07:55]: Welche Verbesserungspotentiale sehen Sie aktuell in der Integration ihrer betrieblichen Informationssysteme (technisch / organisatorisch)? Wie können aus ihrer Sicht diese Verbesserungspotentiale umgesetzt werden?

K: Im Prinzip genau das, was ich vorher bei Herausforderungen gesagt habe. Das hauptsächlich die Produktphilosophie und die damit verbundene Produktqualität von Microsoft eher nach unten geht, und die sollte sich wieder drastisch verbessern.

DS [00:08:30]: Welche Probleme und Schwachstellen verursachen ev. vorhandene isolierte Applikationen (Insellösungen) in ihrem Unternehmen?

K: Wir haben Insellösungen, aber das betrifft eher weniger den ERP- und CRM-Bereich, sondern das betrifft eher unsere eigen entwickelten Lösungen. Da geht es um Zentralisierung von Business-Logik, die derzeit mehrfach vorhanden sind und dementsprechend mehrfach gewartet werden müssen, da geht es natürlich auch um Stammdaten.

DS [00:09:02]: Inwiefern sind Office- und Collaboration-Software-Systeme (Word, Excel, Outlook, SharePoint etc.) mit ihren betrieblichen Informationssystemen sprich ERP- und CRM-System, integriert?

K: Wir haben SharePoint im Einsatz, SharePoint ist Voraussetzung für unser CRM, und da haben wir schon eine starke Integration. Die ganzen Angebote, die ganzen Dokumente vom CRM, die liegen alle in SharePoint.

DS [00:09:35]: Welche Abteilungen profitieren aus Ihrer Sicht am meisten von der Integration ihrer betrieblichen Informationssysteme?

K: Ja, ganz klar, das ist der Vertrieb.

DS [00:09:48]: Müssen aktuell Doppelarbeiten (z.B. doppelte Datenerfassung sowohl in ERP- als auch CRM-System) gemacht werden aufgrund isolierter Systeme? Wenn ja, welche?

K: Also CRM und NAV haben wir jetzt ziemlich alles durch, da gibt es so gut wie keine Doppelerfassungen mehr.

DS [00:10:10]: Gibt es aktuell einen Mangel an Echtzeit-Auswertungen und Reports aufgrund nicht integrierter, mehrfach überlappender Datenbanken?

K: Nein, dadurch das wir das selber machen, sind wir hier gut aufgestellt.

DS [00:10:25]: Besitzen Sie aktuell Dashboards, welche Informationen von verschiedenen betrieblichen Informationssystemen und ev. weiteren Datenquellen auswerten?

K: Ja, die haben wir, auch auf Basis unserer selbst entwickelten Lösung.

DS [00:10:35]: Können ihre Verkäufer aktuell schnell auf Kundenanfragen reagieren ohne Informationen (z.B. Artikelverfügbarkeit, Artikelpreise, Verkaufshistorie des Kunden, allgemeine Informationen zum Kunden) aus unterschiedlichen Systemen ermitteln zu müssen?

K: Wir haben gar kein B2C, nur B2B, da geht es nicht so sehr darum Sofort-Artikelverfügbarkeiten zu haben bzw. wir machen mehr individuelle Sachen, so dass dies nicht so relevant ist.

DS [00:11:03]: Besitzen Sie aktuell eine einheitliche Datenbasis für Kundeninformationen? Wenn nicht, auf welche Systeme sind diese verteilt und ergeben sich daraus Probleme für ihr Unternehmen?

K: Ja grundsätzlich gibt es 2 Quellen, NAV und CRM, aber die werden natürlich abgeglichen. Aber das liegt in der Natur der beiden Systeme, dass es da keine zentralisierte Datenhaltung gibt.

DS [00:11:28]: Auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades ihrer betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

K: Naja, in gewisser Weise eine gewisse Kompatibilität aufrecht zu erhalten, und nicht einfach Sachen abkündigen, wo es dann keinen Ersatz gibt. Bzw. wenn man Systeme integriert, dann ist man darauf angewiesen, dass die vorhandenen Schnittstellen danach noch funktionieren. Das heißt halt möglichst breit auf Standards zu setzen und diese auch wirklich gut unterstützen.

DS [00:12:10]: Sind aktuell Workflows zwischen ihren verschiedenen betrieblichen Informationssystemen implementiert?

K: Zwischen NAV und CRM jetzt nicht, was andere Systeme jetzt betrifft, da nutzen wir es schon ja.

DS [00:12:30]: Gut, dann waren das die Fragen zum Thema Integration, jetzt hätte ich noch paar Fragen zum Thema Cloud. Da hat mir mein Kollege, Herr Aigner ja schon gesagt, dass bei Ihnen die Cloud streng verboten ist.

K: Ja, genau (lacht).

DS: Ja, ist ja ganz interessant für meine Arbeit, damit man diese Meinung auch reinbringt.

DS [00:12:55]: Das heißt Frage 1, In welchem Ausmaß nutzt ihr Unternehmen aktuell Cloud-basierte betriebliche Informationssysteme (Software-as-a-Service), momentan gar nicht.

K: Ja, es gibt ein System, das wir nutzen, das ist WebEx, für Videokonferenzen und Kollaboration, aber das war es. Und das ist in dem Sinn ja keine Business Solution.

DS [00:13:31]: Aufgrund welcher Kriterien kommt eine Anwendung ihrer betrieblichen Informationssysteme in der Cloud (als Software-as-a-Service) aktuell nicht in Frage?

K: Das sind im wesentlichen Security-Themen, also sprich die ganze EU Datenschutzverordnung, und das zweite ist, weil es einfach Unternehmensphilosophie von unserem Mutterkonzern ist. Da gibt es eine goldene Regel, die heißt Company Data only on Company Devices.

DS [00:13:59]: OK, das heißt es gibt jetzt auch nicht irgendeine bestimmte Voraussetzung, die erfüllt sein müsste, damit Sie sich für eine Anwendung in der Cloud entscheiden würden, oder?

K: Nein, das entspricht einfach nicht der Unternehmensphilosophie, Punkt.

DS [00:14:14]: Und angenommen es wäre doch bei Ihnen möglich, inwiefern kann Cloud Computing (insbesondere Software-as-a-Service) aus ihrer Sicht die Wertschöpfung in einem Produktionsunternehmen steigern (z.B: Prozessoptimierungen, Kostenreduktionen)?

K: Naja, grundsätzlich schon, es gibt schon ein paar interessante Sachen. Also gerade, wenn es darum geht kleine Betriebe hochzuziehen, dann bräuchte man nicht in große Infrastruktur investieren, sondern könnte das einfach mal in der Cloud betreiben. Da wär für uns jetzt ein sehr hoher Nutzen drinnen. Und das zweite ist natürlich, dass immer mehr Software-Hersteller in die Cloud drängen, das heißt man hat mit der on-Premise-Lösung vielleicht sogar funktionelle Nachteile. Eigentlich wird man mehr oder weniger gezwungen.

DS [00:15:14]: Ist ein mobiler Zugriff auf ihre betrieblichen Informationssysteme (zu jeder Zeit, an jedem Ort) aktuell möglich?

K: Nur über unsere eigenen Sachen.

DS [00:15:35]: Wie stehen Sie zum Thema Sicherheit und Datenschutz bei Cloud-basierten betrieblichen Informationssysteme? Welche Gefahren und Risiken sehen Sie darin?

K: Natürlich sieht man ein Risiko. Das eine ist, man kann sich einfach nicht sicher sein, wer hat wirklich aller Zugriff, also zumindest ein Bauchgefühl bleibt halt immer. Und was wird alles aus diesen Daten in gewisser Weise generiert. Großes Thema mit dem Datenschutz ist natürlich so, man ist selber als Unternehmen verpflichtet, gewisse Regelungen einzuhalten, was da noch spannend wird ist, wenn es um die Nachweispflicht geht, wie organisiere ich das alles, wenn ich selber eine Datenschutzprüfung habe, dass das alles auch rechtmäßig ist. Und auch das ganze Thema Datenüberlassung ist ein riesiges Thema, weil die cloud-basierten Dienste bieten ja nicht an festzulegen, wo ihre Daten liegen, außer sie mieten sich zum Beispiel in der Azure Cloud ein. Das heißt, sie haben ein potentielles Datenschutzthema, wenn es darum geht, ist es jetzt eine Datenüberlassung oder nicht, weil wenn das ganze in Amerika gehostet wird, sie wissen es aber nicht, dann haben sie eine Datenüberlassung.

DS [00:17:02]: Gut, dann sind wir mit den Fragen durch, vielen Dank!

Transcript of Expert Interview L – German

Name of the interviewee: Raimund Scheuringer / Thomas Kaltseis
Company: Aspöck Systems GmbH
Industry: Car motif industry
Position: Team leader SCM and SAP Key user / CIO
Date, Place: 2018-03-02, Peuerbach
Recording of the interview allowed: X Yes No
Publishing of the name of the interviewee allowed: X Yes No

DS [00:00:00][80]: Welche betrieblichen Software-Informationssysteme habt ihr im Einsatz? Und welche Module decken eure Software-Systeme ab?

L[81]**:** Ja, wir haben im Prinzip mehrere verschiedene SAP Systeme. Das Große ist einmal ERP, SAP R/3, dann haben wir SAP EWM, also Extended Warehouse Management, für die Lagerverwaltung. Dann haben wir SAP ME, Manufacturing Execution, für die Produktionssteuerung, SAP BW, Business Warehouse, für Auswertungen. Dann haben wir SAP Business One für die Vertriebsniederlassungen in England. SAP HCM, Human Capital Management, für HR.

DS: OK, habt ihr auch ein eigenes CRM-System im Einsatz?

L: Nein, haben wir nicht.

DS: OK, ihr habt ja nur B2B-Kunden, also an Endkunden verkauft ihr nicht, oder?

L: Ja genau, nur Business to Business. Dann haben wir noch Talent Management im HR-Bereich und OrgManagement, damit wir die ganze Gruppe abbilden können. OrgManagement kommt von der Firma Ingentis und TalentManagement kommt von der Firma Infoniqa. Das wären dann die wichtigsten Business-Systeme.

DS [00:02:41]: Die Frage, stammen die Systeme von unterschiedlichen Anbietern, ist ja damit auch schon beantwortet. Wir haben hauptsächlich SAP, Infoniqa und Ingentis.

L: Ja, genau.

DS [00:03:10]: Gibt es Systeme, die sehr stark voneinander abhängen?

L: Ja, bis auf SAP Business One hängen alle Systeme stark zusammen. SAP Business One ist extra. SAP ERP, EWM und ME hängen extrem stark zusammen, da kann das eine nicht ohne dem anderen. Zum Beispiel die Lagerverwaltung, also das EWM, ist bestandsführend, also du kannst im ERP keinen Bestand ändern, das geht nicht. Alles was irgendwie mit Bestand zum tun hat muss im EWM geändert werden, und das wird dann über Schnittstellens ins ERP zurückgebucht.

DS [00:03:48]: Inwiefern haben eure unterschiedlichen betrieblichen Informationssysteme ein einheitliches User Interface?

L: Die Systeme haben alle samt unterschiedliche User Interfaces, wobei die SAP-Systeme natürlich ähnlich sind. SAP B1 sowieso, das ist komplett anders. EWM und R/3 sind ähnlich. ME ist komplett anders, das ist webbasierend großteils, und B1 ist wie gesagt auch anders, das ist ein bisschen moderner.

DS [00:04:36]: Seid ihr bereits in einem Integrationsprojekt in eurem Unternehmen involviert gewesen und welche Erfahrungen habt ihr dabei gemacht?

[80] DS = Dominik Scheuringer (Interviewer)
[81] L = Interviewee of Interview L

L: Also EWM und ME, also die Lagerverwaltung und die Produktionssteuerung, haben wir erst seit ca. 3 Jahren. Vorher haben wir Siloc von der TGW gehabt, da hatten wir eine selbstprogrammierte Schnittstelle, und da war einfach das Problem, dass gewisse Standardfunktionen nicht funktioniert haben. Weil am Anfang haben wir oft nicht gewusst was wir genau brauchen, und wir sind dann teilweise auch abgewichen von Standardprozessen in SAP. Als Beispiel haben wir den Versandprozess über einen Fertigungsauftrag gesteuert und das hat viele Probleme gemacht, zum Beispiel beim Controlling in anderen Modulen. Da hat das einfach nicht wirklich zusammengespielt. Das heißt, seitdem wir jetzt SAP EWM und ME haben ist das besser geworden, weil das alles SAP-Systeme sind, aber meiner Meinung nach gibt es trotzdem gewisse Funktionen, wo es noch immer nicht perfekt läuft. Also das Zusammenspiel zwischen den Systemen, obwohl es alles SAP Produkte sind, ist meiner Meinung nach von der SAP her verbesserungswürdig. Weil meiner Meinung nach müssen einfach die Funktionen, die es im SAP ERP gibt, auch in den anderen Systemen funktionieren. Was auch aus IT-Sicht noch eine große Schwierigkeit ist, ist das die Versionen gravierende unterschiedliche Funktionsunterschiede haben. Meistens fängt man mit einem ERP-System an, das ist dann gesetzt, auch die Version. Dann führt man ein neues EWM oder ME dazu, mit einer neueren Version, da nimmt man gleich das neueste, und dann passen die Schnittstellen nicht mehr zusammen. Und dann hat man immer einen Zusatzaufwand, dass man das bestehende zuerst nachziehen muss, damit die Standardfunktionalitäten funktionieren. Und wir waren auch die ersten, die EWM und ME gleichzeitig eingeführt haben, weil bei uns muss eigentlich das ERP mit dem EWM kommunizieren und mit dem ME und das ME und EWM müssen auch kommunizieren. Das ist also eine Art Dreiecksbeziehung kann man sagen. Was sich noch als Schwierigkeit darstellt um Drittsysteme anzubinden, ist das standardmäßig, wie von SAP, ein Enterprise Service Bus als Integrationsplattform zur Verfügung gestellt wird. Weil auch die SAP Systeme untereinander, also EWM, ME, ERP, immer unterschiedliche Schnittstellen und Möglichkeiten haben. Und auch die Schnittstelle zum BW ist ziemlich komplex. Also damit man überhaupt mal herausfindet, welches Feld im ERP-System überhaupt gemeint ist, das ist sehr schwierig herauszufinden.

DS: OK, also zusammengefasst kann man sagen, die Verwendung von Standardschnittstellen ist immer vorteilhaft laut eurer Erfahrung nach, richtig?

L: Ja schon, wobei ich es mir noch besser vorgestellt hätte muss ich ehrlich sagen.

DS [00:09:48]: Gut, dann gehen wir zur nächsten Fragen. Welche eurer Geschäftsprozesse betreffen mehr als ein betriebliches Informationssystem in eurem Unternehmen? Was ist hierfür ein typsicher Prozess bei euch?

L: Eigentlich ein normaler Verkaufsauftrag, wo was produziert werden muss. Beispiel Fertigungsprozess. Wir erstellen einen Fertigungsauftrag im ERP, das ist mal die Basis. Das wird dann ins ME verteilt, das heißt wenn der Auftrag freigegeben wird, dann wird er verteilt und ich kann im ERP nichts mehr machen und er wird dort gesperrt. Jetzt ist ME das führende System und ME muss aber immer mit dem EWM kommunizieren wegen der gesamten Materialbereitstellung bzw. auch für die Wareneingänge am Schluss, das wird alles über das EWM gemacht. Das heißt beim Fertigungsprozess sind alle drei Systeme betroffen. Das läuft grundsätzlich, mit ein paar Einschränkungen. Zum Beispiel es wurde im ERP ein Fertigungsauftrag erstellt und ans ME übergeben und im Nachhinein stellt sich heraus, dass im ERP was geändert werden muss. Das ist jetzt gerade ein Thema bei uns. Der Grund darin ist der, weil wir in Peuerbach keine Feinplanung haben. Also wir geben den Auftrag frei und dann wird der im Prinzip über das ME abgewickelt, also der vergibt dann die Reihenfolge der verschiedenen Vorgänge usw. In Portugal wollen sie aber auch eine Feinplanung haben und da haben wir jetzt folgendes Problem. Wenn ich den Auftrag verteile, dann kann der Auftrag dann nur im Anzeigemodus im ERP angesehen werden. In der Realität ist es dann aber so, dass sich was verschiebt oder es ändert sich was, dann

muss ich auch die Möglichkeit haben, etwas zu ändern. Und da wird gerade wegen Möglichkeiten diskutiert.

DS [00:12:30]: Die nächste Frage können wir skippen, weil ihr habt kein getrenntes ERP- und CRM-System.

L: Genau

DS [00:12:38]: OK, die Frage sieben ist dann, in welchem System erstellt ihr Analysen und Auswertungen eurer Unternehmensdaten? Habt ihr dafür ein separates BI-System im Einsatz?

L: Grundsätzlich das SAP BW, aber momentan ist das noch wenig im Einsatz. Das heißt momentan werden noch adhoc Auswertungen direkt aus der Datenbank erstellt. Und halt direkt die Standard-Auswertungen im ERP werden verwendet bzw. ein paar Auswertungen wurden für uns programmiert. Aber BW ist momentan noch wenig im Einsatz, da sind wir gerade im Aufbau.

DS [00:13:50]: Was sind bzw. waren die Auslöser für eine notwendige Integration eurer betrieblichen Informationssysteme (Organisationsstruktur, betriebliche Prozesse etc.)?

L: Wir haben eine Automatisierung in der Produktion und das ist halt nur möglich, indem die verschiedenen Systeme derart stark integriert sind. Sprich die Auslöser waren Prozessoptimierungen und Automatisierung. Anders würde es nicht gehen. Also als Beispiel mit einem SAP Business One, da könnte man unsere Produktionsprozesse nicht abbilden.

DS [00:15:13]: Welche Verbesserungspotentiale seht ihr aktuell in der Integration eurer betrieblichen Informationssysteme (technisch / organisatorisch)?

L: Ja das Thema von vorhin, das man nichts ändern kann. Dann die Integration zwischen SAP Business One und R/3, das ist momentan noch gar nicht verbunden, hier gäbe es aber auch Möglichkeiten. Also entweder klassisch über EDI, also quasi elektronisch Belege austauschen, oder man bindet es direkt an. Momentan werden die Daten halt manuell ausgetauscht zwischen den Systemen. Aber Ziel ist es, dass bei Anlage einer Bestellung in Business One automatisch ein Auftrag im R/3 angelegt wird.

DS [00:16:35]: Welche Probleme und Schwachstellen verursachen ev. vorhandene isolierte Applikationen (Insellösungen) bei euch im Unternehmen? Oder gibt es gar keine Inseln mehr?

L: Ja, die Lohnverrechnung, Reisekostenabrechnung, was auch geplant ist, dass das ins SAP HCM reinkommt. Aber sonst ist eigentlich alles schon im SAP integriert. Wir haben halt auch nach der Reihe SAP-Systeme mit dazu geholt. Ein anderes Thema haben wir noch. Wir sind gerade in der Evaluierung von einem Workflow-Managementsystem, K2 ist da in der engeren Auswahl, das ist ein Low-Code-Workflow Management System. Weil wir Probleme haben, dass wir durchgehend Prozesse abteilungsübergreifend bzw. sogar unternehmensübergreifend, über die ganze Gruppe, mit SAP nicht abbilden können.

DS [00:18:12]: Inwiefern sind Office- und Collaboration-Software-Systeme (Word, Excel, Outlook, SharePoint etc.) mit euren betrieblichen Informationssystemen integriert?

L: SharePoint wird gerade eingeführt, befindet sich gerade in der Testphase, im Intranet-Bereich, für Dokumentenmanagement und für den Informationsaustausch. Sprich Kollaboration. Ansonsten, Outlook ist zum Beispiel gar nicht integriert. Excel-Export geht natürlich schon aber sonst gibt es keine wirklichen Integrationen mit Office, nur das was halt SAP standardmäßig kann.

DS [00:19:25]: Welche Abteilungen profitieren aus eurer Sicht am meisten von der Integration eurer betrieblichen Informationssysteme?

L: Also eigentlich SCM würde ich sagen, weil da passiert jetzt viel automatisch. Dem Verkauf alleine ist es wahrscheinlich egal, wo wir die Daten eingeben. Aber alle anderen haben auch gewisse Vorteile. Kostenrechnung hat zum Beispiel schneller aktuelle Daten.

DS [00:20:57]: Müssen aktuell Doppelarbeiten, also doppelte Datenerfassungen, gemacht werden aufgrund isolierter Systeme? Wenn ja, welche?

L: Packvorschriften zum Beispiel. Wenn du also aktuell eine Packvorschrift im ERP pflegst, dann geht sie nichts automatisch ins EWM. Im EWM brauchen wir sie aber, das heißt dort müssen wir es nochmals eingeben. Dann HR, Lohnverrechnung. Der Personalstamm muss in der Lohnverrechnung und im ERP und im ME eingegeben werden.

DS [00:21:55]: Gibt es aktuell einen Mangel an Echtzeit-Auswertungen und Reports aufgrund nicht integrierter, mehrfach überlappender Datenbanken?

L: Es gibt aktuell eine Z-Transaktion, die von allen Bereiche gewisse Daten zusammenholt. Also von Verkauf, Logistik, Produktion. Da geht es um Verkaufsaufträge auf Positionsebene einerseits, mit Verknüpfung zur Produktion, Verknüpfung zu Auslieferungen, also Versand und Verknüpfung zu Faktura. Und man kann jeweils in die ganzen wichtigen Transaktionen abspringen. Und die hat halt teilweise Performanceprobleme. Die Daten werden immer mehr, und die kommen aus verschiedenen Bereichen, daher wird das immer langsamer. Aber das soll in Zukunft das Business Warehouse erledigen. Es gibt im ME Echtzeitauswertungen, die ziemlich gut funktionieren, auch mit einer Web-Oberfläche, da kann man mit SQL-Queries Auswertungen erstellen, auch mit Charts etc. Im SAP ERP sind meiner Meinung nach die Standardauswertungen ziemlich schwach.

DS [00:25:06]: Hab ihr aktuell eine einheitliche Datenbasis für Kundeninformationen? Wenn nicht, auf welche Systeme sind diese verteilt und ergeben sich daraus Probleme für das Unternehmen?

L: Ja, die haben wir alle im ERP und dort werden sie gezifft sagen wir ins EWM. Das heißt EWM brauch auch die Daten, gewissen Daten.

DS: OK, aber es gibt einen Single Point of Truth, wenn ich da reinschaue finde ich alle Kundenstammdaten, oder?

L: Ja genau im ERP.

DS [00:26:24]: Auf was soll eurer Meinung nach der Fokus bei Versions-Upgrades eurer betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

L: Ich möchte gerne einen Release-Zyklus haben, einmal im Jahr upgraden, ist aber aus mehreren Gründen schwierig bis nicht möglich. Wir machen es also, wenn es wirklich sein muss. Wenn Bugs behoben werden, wenn neue Funktionen dazu kommen. Aktuell sollten wir ein Upgrade von ME machen, aber hier warnen unsere Berater schon, dass es zu Problemen kommen könnte, weil sehr viele Z-Programmierungen enthalten sind. Das nächste große Update wird S4 sein, S/4 HANA. Das ist eigentlich eine neue Integration, da wird ein großes Projekt. Ansonsten, Hinweise sind schnell erledigt, maximal einen Tag, Service Packs muss man planen, wird meistens am Wochenende gemacht, kommt darauf an, so zwei bis drei Tage. Und dann natürlich testen.

DS [00:28:34]: Letzte Frage zum Thema Integration, wurde heute schon mal angesprochen. Sind aktuell Workflows zwischen euren verschiedenen betrieblichen Informationssystemen implementiert?

L: Ja, aber die basieren aktuell hauptsächlich nur auf E-Mail-Basis. Und wie gesagt, momentan ist aber ein Workflow-Management-System, K2, in der Evaluierung. K2 bietet extrem viel Schnittstellen zu verschiedenen Systemen, SAP, Office, SharePoint, etc. Und K2 ist dann praktisch das führende System für den Workflow.

DS [00:29:15]: OK danke, dann kommen wir jetzt zum zweiten Frageblock, wo es um das Thema Cloud geht. Erste Frage dabei ist, in welchem Ausmaß nutzt euer Unternehmen aktuell Cloud-basierte betriebliche Informationssysteme (Software-as-a-Service)?

L: Ja, aber nur im Office-Bereich, also Skype4Business, zusätzlich zur normalen Telefonalge, für Telefonkonferenzen, Bildschirm sharen etc. Inwieweit fasst du den Bereich Cloud-Services. Weil wir haben unsere SAP-Daten outgesourced in ein Rechenzentrum in Frankfurt.

DS: Mir geht es eher um Software-as-a-Service.

L: Ok, nein, da haben wir bis auf die Office-Anwendungen sonst nichts. Also Office 365.

DS [00:30:53]: Aufgrund welcher Kriterien kommt eine Anwendung in der Cloud nicht in Frage bzw. welche Voraussetzungen müssten erfüllt sein, damit die Cloud für euch ein Thema werden könnte?

L: Es gibt keine Konzernrichtline mehr, Cloud ist praktisch erlaubt, ist immer ein Kosten-Rechnungsthema. Aber es könnte ein Thema werden, zum Beispiel das Talent Management von HANA SAP, heißt SuccessFactors, das läuft nur in der Cloud, ist aber kostentechnisch zu teuer, deswegen haben wir uns für engage von Infoniqa entschieden. Oder damals, als wir SAP Business One angeschafft haben, stand auch SAP Business ByDesign zur Auswahl, ist ja auch eine reine Cloud-Lösung.

DS [00:32:19]: Ist ein mobiler Zugriff auf eure Systeme aktuell möglich?

L: Nur über VPN.

DS [00:32:40]: Dann sind wir schon bei der letzten Frage. Wie steht ihr generell zum Thema Sicherheit und Datenschutz bei Cloud-basierten betrieblichen Informationssysteme? Welche Gefahren und Risiken seht ihr darin?

L: Ja, großes Thema ist jetzt die DSVGO. Es ist schwierig, zum Beispiel Microsoft habe ich mir jetzt angesehen, die Lizenzbestimmungen und die Online Service Terms zu verstehen. Mal schauen, was hier rauskommt. Die DSVGO ist schon viel Aufwand für uns, ist eigentlich ein eigenes Projekt für uns. Wir müssen Verträge mit den Töchtern machen, wir brauchen Verträge mit den Rechenzentren, weil wir ja die Microsoft Cloud für Office 365 verwenden. Wir setzen da auf das Rechenzentrum in Frankfurt, bzw. SAP B1 läuft in Salzburg bei der Conova, da brauchen wir jeweils Verträge. Also viel rechtlicher Aufwand. Auf der technischen Seite sind wir am Stand der Technik. Es wird dann schwierig, weil Microsoft in den Online Service Terms stehen hat, dass sie, obwohl das Rechenzentrum in Europa ist, trotzdem Daten nach Amerika oder Drittländer verlagern. Und da ist die Frage, wie wir damit umgehen. Aber technisch gesehen, glaube ich, dass die Daten in der Cloud am Besten überhaupt geschützt sind. Man muss sich halt die rechtlichen Themen ansehen. Was ist wenn wirklich mal wer kommt und sagt, er möchte seine personenbezogenen Daten sehen. Wo sind die, ich möchte sie löschen. Darauf muss man Antworten liefern können. Das das wird halt dann schwierig. Aber sonst, rein technisch gesehen, ist das schon sicher, egal ob Microsoft oder SAP. Das ist ja deren Geschäft.

DS [00:36:02]: Gut, dann sind wir fertig. Danke für eure Zeit!

Transcript of Expert Interview M – German

Name of the interviewee: Mag. Jürgen Salaböck
Company: NAVAX Consulting GmbH
Industry: IT Consulting
Position: Team Leader and Project Manager Microsoft Dynamics NAV
Date, Place: 2018-03-07, Linz
Recording of the interview allowed: X Yes □ No
Publishing of the name of the interviewee allowed: X Yes □ No

DS [00:00:00][82]: Inwiefern haben die Integrationsmöglichkeiten einen Einfluss bei der Auswahl von betrieblichen Informationssysteme in Produktionsbetrieben?

M[83]**:** Aus meiner Sicht ist das sehr wichtig bzw. dass es auch künftig immer wichtiger wird die Integration. Der Kunde will immer eine Gesamtlösung, am besten natürlich von einem Anbieter. Und somit werden natürlich die Anbieter, die Plattformen anbieten, wo man Integration abbilden kann, einen gewissen Wettbewerbsvorteil haben. Ich sehe das also schon sehr wichtig, und zukünftig noch wichtiger, weil diese Integration der Applikationen voranschreitet, und zwar nicht nur im ERP, sondern auch in anderen Bereichen.

DS [00:01:27]: Welche Anforderungen bzgl. Integration von betrieblichen Informationssystemen haben Unternehmen aus Sicht des Managements und welche aus Sicht der Anwender?

M: Der Endanwender möchte am liebsten nur seinen Arbeitsbereich sauber haben. Er will seine zwei Programme in einer Plattform bedienen. Aus Managementsicht wird es sicher wichtiger sein, die Integration zu schaffen, weil es auch um Weiterentwicklung und um Wartung der Systeme geht. So klassische Anforderungen, die wir in unserem Bereich immer wieder haben, ist die Integration zwischen ERP und Dokumentenmanagement, CRM und gegebenenfalls noch Drittsystemen, die der Kunde hat, damit die über ein führendes System gesteuert werden.

DS [00:02:29]: Was sind die Auslöser für eine notwendige Integration von betrieblichen Informationssystemen in Produktionsbetrieben (Organisationsstruktur, betriebliche Prozesse etc.)?

M: Das können aus meiner Sicht verschiedene Auslöser sein. Momentan wird da sicher immer wieder die Digital Transformation als Schlagwort verwendet. Man ist als Unternehmer auch in gewisser Weise gefordert, die Integration zu schaffen, weil die Systeme sich einfach so entwickeln. Ich kann da gewisse Sachen gar nicht mehr so kontrollieren. Weil wenn Microsoft, oder ein anderer großer, was entwickelt, dann ist das zum Teil vorgegeben und ich muss mich zum Teil arrangieren und darum ist die Integration immer wieder wichtig. Das heißt ich glaube, dass es zum einen technologisch gesteuert ist, dass man es integrieren muss, um am Puls der Zeit sein zu können. Darum ist ja auch das Cloud-Thema das interessante, weil ich da eine Ebene habe, wo die Integration unter Umständen einfacher ist. Von dem her glaube ich, dass das sicher technologisch gesteuert ist. Aber inner-organisatorisch geht es wahrscheinlich um Optimierung. Ich will halt meine Businessprozesse streamlinien und will halt nicht, dass meine Leute damit beschäftigt sind, irgendwelche Programme zu bedienen und Zeit dort zu verschwenden, sondern dass die Arbeit effizient durchläuft und auch die Prozesse transparent sind. Das schaffe ich halt nur durch Integration aus meiner Sicht. Wenn ich sehr viele Insellösungen habe und sehr viel Brüche zwischen einem System und einem anderen System habe, dann werde ich

[82] DS = Dominik Scheuringer (Interviewer)
[83] M = Interviewee of Interview M

immer einen gewissen Gap haben, den ich organisatorisch covern muss. Wobei ich auch dazu sagen muss, wie hoch mein persönlicher Anspruch an die Integration ist. Weil umso höher ich versuche das zu integrieren, umso höher ist auch der Aufwand, sowohl organisatorisch als auch auf der Kostenseite. Das ist immer eine gewisse Rechnung, die man machen muss und das ist zum Teil auch branchenabhängig, wie die Branche bzw. auch die handelnden Personen ticken. Es ist nicht jedes Unternehmen gleich gut aufgestellt für solche Themen.

DS [00:04:48]: Was sind die größten Herausforderungen bzgl. der Integration von betrieblichen Informationssystemen in Produktionsbetrieben?

M: Die größte Herausforderung ist hierbei an erster Stelle immer die Kommunikation aus meiner Sicht. Einfach aus dem heraus, weil meistens ist man mit sehr viel Partnern im Boot. Es kommt natürlich auch darauf an, welche Technologien im Hintergrund stehen und ob ich das aus einem Haus bedienen kann, wobei das sehr selten der Fall ist und stattdessen hat man sehr viele Partner, sehr viele unterschiedliche Player mit unterschiedlichen Vorstellungen und Erwartungshaltungen, und das ist die größte Herausforderung das irgendwie zu sammeln und alle in die gleiche Richtung denken zu lassen. Der eine sieht zum Beispiel nur sein Data Warehouse, der andere sein DMS-System, der dritte sein ERP-System usw. Da hat man aus meiner Sicht eine sehr große Herausforderung, gemeinsame Ziele zu formulieren und die Erwartungshaltung des Kunden abzuholen. Weil es ist schon auch so, dass der Kunde sehr oft auch mit der ganzen Integration überfordert ist und natürlich auf der Gegenseite jemanden braucht, der dieses Gesamtkonzept für ihn durchdenkt. Und das ist oft auch für uns, im täglichen Business, die größte Herausforderung um dieses Gesamtkonzept zu leben und zu denken. Weil jedes System hat so seine Herausforderungen und man kann nicht zu Beginn schon jedes technische Detail durchdenken, das ist nicht möglich und man wird während der Umsetzung immer wieder vor Probleme gestellt. Das heißt ich sehe hier die größte Herausforderung, dieses Gesamtkonzept am Anfang zu definieren und dann gemeinsam mit dem Kunden die Erwartungshaltung abzustimmen. Weil am Ende des Tages wird man wahrscheinlich nicht alles schaffen können und da ist die Kommunikation der handelnden Personen sicher entscheidend. Technologisch wird man es immer irgendwie lösen können, es wird über Wege gehen, sei es über Web Services oder über andere Technologien, um gewisse Systeme miteinander reden zu lassen. Aber am Ende des Tages ist eine Bereitschaft der handelnden Personen notwendig, damit das wirklich ein integriertes System wird.

DS: Ja, die Kommunikation wurde hier schon bei vielen anderen Interviews auch genannt.

M: Ja, ist es auch. Die Kostenseite ist natürlich dann immer der andere Faktor. Wenn ich ein Unternehmen mit ausreichend Budget habe, dann wird die Umsetzung immer leicht sein, das muss man klar sagen. Also es ist schon auch eine gewisse Kostenfrage. Weil dort, wo ich sehr starke Integration will, muss ich natürlich auch eine gewisse Bereitschaft haben zu investieren. Teilweise sogar auch bereit sein, in einem gewissen Prototyping Lösungen umsetzen, weil es noch nicht für alles zu 100 Prozent Lösungen gibt. Also da hängt schon auch sehr viel von der Bereitschaft des Kunden ab, einen gewissen Weg zu gehen. Und sehr oft ist es so, dass der anfängliche Plan ein bisschen zurückgeschraubt wird, weil man einfach sieht, dass es sowohl auf der Kostenseite als auch zeitmäßig nicht möglich ist.

DS [00:08:12]: Welche Probleme und Schwachstellen verursachen isolierte Applikationen (Insellösungen) in Produktionsbetrieben?

M: Jetzt wär natürlich die klassische Antwort die fehlende Integration (lacht). Die größten Probleme sind sicher innerorganisatorisch, ich muss verschiedenste Systeme bedienen und warten, das heißt ich habe zum einen den laufenden Betrieb der Applikationen auf der

IT-Seite, das Kosten verursacht, sprich verschiedene Infrastruktur, Wartungsverträge usw. Aus der organisatorischen Sicht habe ich natürlich unterschiedliche Stammdaten, die ich warten und pflegen muss. Auch das ist immer sehr viel Aufwand für die Organisationen. Ich habe Systembrüche, sprich wie bekomme ich Informationen von einem System zu einem anderen System, das heißt hier entsteht sicher Overhead und Zeitaufwand. Wobei man natürlich sagen muss, es gibt sicher kleinere Unternehmen, die mit gewissen spezifischen Inseln sehr gut leben. Weil der Zeitaufwand, diese Inseln zu bedienen, nicht all zu groß ist. Sprich die Insel funktioniert so gut, dass es nach wie vor effizient ist, diese Insel zu verwenden. Aber natürlich habe ich durch diese Systembrüche immer die Thematik, wie komme ich zu einer gewissen Transparenz, zum einen von meinen Prozessen und zum anderen auch von meinen Daten. Und da ist meistens halt ein Weg, dass ich auf einer Data Warehouse-Seite irgendwas versuche darüber zu legen, um dort was abzuziehen. Das machen ja die großen Firmen so. Also es ist ja jetzt nicht so, dass alle Unternehmen alles soweit integriert haben, dass man wirklich auf eine einheitliche Systemlandschaft schaut. Sondern es ist meistens ja immer so, dass man unterschiedliche Applikationen hat, auch historisch bedingt. Und somit habe ich immer einen Layer, den ich darüber legen kann, und das ist halt oft ein Data Warehouse, wo ich mir dann gewisse Informationen herausziehe. Aber es ist aus meiner Sicht ein bisschen von der Größe des Unternehmens abhängig. Wenn ich ein kleines Unternehmen bin, dann kann ich wahrscheinlich mit Inseln relativ leicht umgehen. Wenn ich größer bin, standortübergreifend, wo ich auch abhängig bin, dass gewisse Prozesse im System abgebildet sind und durchgängig sind, dann wird es mit Inseln wahrscheinlich schwierig sein. Also da sehe ich dann schon gewisse Nachteile, weil der Overhead dann irgendwann zu groß wird bzw. die Systembrüche es einfach nicht möglich machen, sinnvolle Auswertungen und eine sinnvolle Sicht auf die Daten zu haben.

DS [00:11:06]: OK, und inwiefern können Produktionsprozesse in Unternehmen optimiert werden durch die Integration betrieblicher Informationssysteme?

M: Ich habe auf alle Fälle mal den Vorteil, dass ich keine Systembrüche habe. Keine Übergänge, wo ich irgendwie Daten konvertieren muss, Daten mappen muss oder sonst irgendwas. Ich habe im Normalfall hoffentlich eine einheitliche Stammdatenlogik im Hintergrund, die mir das ganze natürlich erleichtert. Ich habe eine einheitliche Sicht der Dinge. Auch die handelnden Personen schauen auf dieselben Daten, das ja gerade bei den Inseln das große Problem ist, dass jeder mit irgendeiner anderen Auswertung kommt. Und am Ende des Tages bastelt sich dann jeder seine eigene Welt. Und das habe ich mit einem integrierten System vielleicht nicht in der Form. Gewisse organisatorische Schwächen treten vielleicht mehr hervor mit einem integrierten System, weil alleine, wenn ich mich damit befasse, diese ganze integrierte Landschaft abzubilden, werde ich organisatorisch, und das ist ja leider auch oft das Problem, das wir in den Projekten haben, einfach Probleme haben, die ich lösen muss. Weil die Organisation ist nicht so integriert aufgestellt, weil jeder hat wo seine Insel geschafft und das ist sicher auch die Herausforderung, dass ich meine Prozesse und meine Denkweise an die integrierte Landschaft mappen muss. Das heißt, ich werde es nicht überall schaffen, die gleichen Prozesse wie in der Vergangenheit zu leben, sondern ich muss gewisse neue Definitionen vornehmen, um den Benefit dann abzuholen. Weil ansonsten habe ich vielleicht, auch wenn ich ein integriertes System habe, genau gleich oder sogar mehr Aufwand um das integrierte System zu bedienen. Weil umso stärker die Integration ist, umso komplexer ist an sich normal die Anwendung, sprich ich muss zum Beispiel mehr Daten in das System reingeben als in der Vergangenheit, weil irgendein anderes integriertes System davon abhängig ist. Das sieht man alleine im ERP-Bereich schon. Wenn ich zum Beispiel vorher von irgendeiner Nicht-ERP-Lösung komme, sei es jetzt Excel oder was anderes, wo ich sehr frei war, und alles Mögliche ändern konnte, und dann plötzlich in einer sehr starren ERP-Welt bin, und muss einfach mal Artikel anlegen, Stammdaten pflegen, Dinge

eingeben, damit ich überhaupt den nächsten Schritt gehen kann, dann kann das durchaus aufwändiger werden. Und daher ist da aus meiner Sicht auch einiges zum tun, und auch die Organisation dementsprechend vorzubereiten, damit sie dann wirklich den Benefit hat. Weil sonst habe ich ev. genau den umgekehrten Fall, ich habe extrem viel investiert, habe aber eigentlich überhaupt keine Effizienz. Ich glaube jetzt nicht, dass man dadurch fünf Arbeitsplätze einsparen kann, aber die Effizienz kommt, dass ich schnellere Daten habe, schnellere Abwicklung, kann von mir aus Angebote schneller erstellen und solche Dinge. Und bin einfach in der Lage, weniger Papier zu haben.

DS [00:14:19]: Welche Abteilungen in Produktionsbetrieben profitieren am meisten von der Integration von betrieblichen Informationssystemen?

M: Das ist jetzt natürlich eine gute Frage, wer davon am meisten profitiert. Es wird wahrscheinlich am Ende des Tages davon abhängen, wie gut die Abteilung vorher aufgestellt war. Wenn die eine gut organisierte Insel in sich gehabt hat, dann wird wahrscheinlich der Benefit überschaubar sein, aber an sich glaube ich schon, dass die interne Organisation an sich am meisten profitiert. Also alles, wo ich intern gewisse Dinge durchschleusen muss. Und gerade in der Produktion glaube ich schon, dass die Produktionsleitung als Beispiel definitiv einen besseren Überblick hat. Aber das müsste man sich dann wirklich konkret ansehen.

DS [00:15:29]: Für welche ERP-Daten ist eine Echtzeit-Verfügbarkeit innerhalb von CRM-Systemen (und vice versa) sinnvoll und vorteilhaft für Produktionsbetriebe?

M: Ja, natürlich. Unbedingt. Gerade ERP und CRM sind zwei Systeme, die unbedingt miteinander leben sollten, weil sie auch sehr viele gemeinsame Daten haben. Also alles was Kontakte, Angebote betrifft sollte auf jeden Fall synchronisiert sein, wobei ich schon auch sage, dass im CRM auch schon sogenannte Project Services angeboten werden, die in die Richtung gehen, dass auch schon im CRM gewisse Dinge abgebildet werden, die früher im ERP zuhause waren. Also man sieht da klassisch gewisse Tendenzen und Trends, wo man sagt, vielleicht reicht mir in gewissen Bereichen das CRM und ich brauche das ERP gar nicht mehr. Und dort wo ich mit einem System auskomme, da habe ich immer einen gewissen Vorteil, weil ich einfach eine Schnittstelle weniger habe. Umgekehrt sind aber aus meiner Sicht die Schnittstellen ausgereifter als sie vor ein paar Jahren noch waren und auch da wird sich immer noch was weiter drehen. Das heißt es wird nicht mehr so die Challenge sein, die zwei Systeme miteinander reden zu lassen. Noch dazu, wenn ich vielleicht den gleichen Hersteller wie Microsoft im Hintergrund habe, wo ich dann auch noch gewisse Vorteile habe. Aber auch wäre es wieder so, dass wenn ich die beiden Systeme nicht integriere, dass ich dann unterschiedliche Prozesse lebe, und auch unterschiedliche Stammdaten etc. Das heißt, die Benefits habe ich nur dann, wenn die zwei Systeme miteinander können.

DS [00:17:45]: Welche Potentiale siehst du in der Integration von betrieblichen Informationssystemen (ERP- und CRM-System) innerhalb Office-Produkte wie Outlook, Word oder Excel?

M: Auf der Microsoft Seite ist es ja ohnehin so, dass dieser gesamte Stack miteinander kommuniziert und gerade in diesem Office 365 ohnehin sehr viel integriert ist, das heißt aus meiner Sicht ist das ja schon passiert, die Systeme reden schon miteinander. Die Herausforderung ist eher in der Organisation zu suchen, was brauche ich denn wirklich alles in meinem Unternehmen. Nicht alles was es gibt bringt mir ja Vorteile, das muss ich dann schon abwiegen. Zum Beispiel brauche ich überhaupt einen SharePoint, ist das was, mit dem ich intern überhaupt was anfangen kann. Jedes System lebt ja davon, was ich in das System reinbringe oder wie ich das System in der Organisation auch nutze. Einfach nur, ich nehme alles, was integriert ist, wird mir jetzt auch nicht einen Vorteil bringen, da muss ich schon auch wieder schauen, was brauche ich. Wobei mittlerweile gibt es sehr

gute Möglichkeiten, gewisse Packages zu schnüren. Das ist dann je nach Anforderung zu entscheiden. Aber natürlich ist es sinnvoll, und die Richtung ist ja gewisser Weiße schon vorgegeben, weil ich möchte ja immer relativ rasch zu meinen Daten kommen, egal von welcher Seite ich komme, sprich komme ich von einer mobilen Seite, komme ich von einer Office-Seite, ich möchte immer den Vorteil haben, dass ich auf meine Daten, auf meine Dokumente hinkomme. Und das Front-End soll nicht mehr das entscheidende sein aus meiner Sicht. Es ist eher die Plattformdenke, ich habe meinen Single Access Point, wo ich einsteige, und habe da meine ganze Landschaft zur Verfügung.

DS [00:20:28]: Auf was soll deiner Meinung nach der Fokus bei Versions-Upgrades von betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

M: Das ist wohl im Moment einer der größten Challenges, wie man mit dem ganzen Update-/Release-Management umgeht. Der Markt aus meiner Sicht gibt ganz klar vor, dass Updates am laufenden Band kommen. Die Software-Entwicklung hat einfach komplett auf diese iterative Software-Entwicklung umgeschwenkt, und es ist mittlerweile nicht mehr so entscheidend das fertige Produkt zu liefern, sondern zu sagen, wir liefern das Produkt schnell, und geben dann halt gewisse Updates oder auch Korrekturen raus, wenn irgendwas nicht funktionieren sollte. Und die Challenge, auch in Hinblick auf Integration, ist immer, aus der Unternehmenssicht sozusagen, kann ich diese Pace mitgehen, bin ich überhaupt in der Lage, diese ganzen Updates mitzugehen, bin ich dazu aufgestellt, das genau so rasch durchzuführen. Weil eines ist klar, und speziell wenn ich unterschiedliche Systeme habe, da bin ich unter Umständen in der Situation, dass ich immer auf dem neuesten Stand sein muss, weil sonst habe ich vielleicht die Situation, dass die zwei Systeme nicht miteinander können. Also klassisch, Outlook kommuniziert mit dem ERP-System. Und auch da sehen wir schon aus der Praxis, dass wir immer wieder gewisse Probleme mit Updates haben, die dann gewisse Probleme verursachen oder vielleicht ein Update auf der anderen Seite notwendig machen. Das heißt, es wird sicher ein ganz wichtiger Part sein, jetzt schon, und auch in Zukunft, zu schauen, dass ich mein Portfolio an Applikationen aktuell halte. Und aus meiner Sicht ist halt der Druck dahingehend gegeben, dass die großen Hersteller das aus meiner Sicht vorgeben. Und ich muss dann selbst entscheiden, ob ich diesen Weg mitgehen kann und will. Und leider Gottes ist es halt oft so, dass ich gar nicht die Wahl habe. Wenn ich also eine gewisse Funktion nutzen will, dann muss ich einfach auf der neuesten Version sein. Zusätzlich ist es einfach so, dass die Hersteller immer nur auf der aktuellsten Version entwickeln, testen, weiterentwickeln, das heißt das System lebt von Updates. Und das wird zukünftig sicher immer wichtiger und auch immer automatisierter. Man sieht auch in der ERP-Welt, dass es bis hin zu automatisierten Updates geht, wo man einfach gewisse Packages reinspielen kann. Auch da wird sich sicher in den nächsten Jahren noch sehr viel bewegen und es wird sicher auch wahrscheinlich einfacher werden, um am neuesten Stand zu bleiben.

DS [00:23:33]: Inwiefern können Workflows das Zusammenspiel und die Kommunikation verschiedener betrieblicher Informationssysteme optimieren und verbessern?

M: Also Workflows sind aus meiner Sicht so eine klassische Engine, die halt in der Lage ist, eine gewisse Systemplattform anzustoßen, also die einen Layer bietet, von dem aus ich gewisse Systeme anstoßen kann. Da gibt es auch einiges am Markt, was aus meiner Sicht eine gewisse Notwendigkeit ist, um wahrscheinlich vollintegriert sein zu können. Also irgendwo brauche ich Workflows, um gewisse Dinge anzustoßen, vor allem wenn ich über mehrere Systeme den Weg gehen muss, dann brauche ich irgendwo einen Workflow-Layer, der mir halt diese ganzen Systeme steuert und auf dem die Kommunikation läuft.

DS [00:24:50]: Wie sieht der Trend von On-Premise-Anwendungen hin zu Cloud-Services im Bereich betrieblicher Informationssysteme deiner Meinung nach aus?

M: Der Zug fährt seit längerem ganz stark in Richtung Cloud. Wir haben halt in Österreich, bzw. in Europa, was das betrifft, nicht so stark auf den Cloud-Zug aufgesprungen, wie das vielleicht in Amerika der Fall ist. Und dadurch sind wir hierzu ein bisschen hinten, und haben noch mehr on-Premise Themen. Wobei ich sehe schon, dass dies die Zukunft ist aus momentaner Sicht und dass man wahrscheinlich irgendwann einen gewissen Wettbewerbsvorteil haben wird, wenn man in solch einer Umgebung ist. Es ist, gerade im Produktionsumfeld, eine sehr große Herausforderung. Weil da immer wieder sehr viele Schnittstellen und Hardware, infrastrukturelle Themen sind, wo ich sage, das kann ich aktuell noch nicht so einfach in die Cloud heben, weil die Systeme einfach noch zu alt sind. Das wird hier einfach schon noch ein bisschen dauern, bis da die Angst ein bisschen weg ist. Vielleicht braucht es auch noch einen gewissen Generationswechsel im Management, die Jungen, die nachkommen, werden viel weniger Probleme sehen, etwas in die Cloud zu geben als gewisse Entscheider, die nicht unbedingt mit dem aufgewachsen sind. Von dem her glaube ich auch, dass das auch da noch eine gewisse Zeit brauchen wird. Aber wenn das dann passiert ist, wird es zum einen technologisch getrieben sein, dort kann ich mir die meisten Benefits holen, ich kann es skalieren, ich kann es monatlich verändern, ich habe Sicherheit gegeben usw. Also ich hole mir die Benefits der Cloud ab, habe aber gleichzeitig nicht irgendwie die Panik, dass meine Daten irgendwo verschwinden, gelesen oder gestohlen werden.

DS [00:27:05]: Gibt es betriebliche Informationssysteme die besser und welche die schlechter für die Verlagerung in die Cloud geeignet sind?

M: Es gibt gewisse komplexe Systeme, die wahrscheinlich nach wie vor noch nicht in der Cloud sein können, weil es eventuell noch an gewissen technischen Dingen scheitert. Aber ansonsten sehe ich momentan da kein Limit in dem Sinn. Die IT schreitet hier so stark voran, dass ich mittlerweile eigentlich, wenn ich sage, ich habe alles auf der Cloud gehostet, dann sehe ich den Unterschied nicht. Ich kann da genau so arbeiten, wie wenn ich das bei mir hätte, und durch die Mobilität sehe ich dann eher die Vorteile. Es wird also sicher noch Systeme geben, ja, aber das wird eher wiederum eine technologische Frage sein am Ende des Tages.

DS [00:28:12]: Welche Voraussetzungen muss ein Produktionsbetrieb erfüllen um dessen betriebliche Informationssysteme in der Cloud betreiben zu können bzw. in welchen Fällen ist das Cloud Model besonders geeignet?

M: Aus dem Dienstleistungsbereich würde ich mal sagen auf jeden Fall. Alle Firmen, die in Ballungszentrumsnähe sind, wo die Internetanbindung entsprechend gut ist. Überall dort, wo ich weit weg bin von einem Knotenpunkt und ich habe Produktionssysteme und irgendwelche externen Waagen, die ich ansteuert muss, da wird es aus meiner Sicht schwierig, das alles in die Cloud zu geben. Vor allem natürlich auch dort, wo ich kein entsprechendes Service Level auch für den Zugang zur Cloud habe, wo ich gewisse Angst habe, dass die Internetverbindung nicht ausreicht, da wird es aus meiner Sicht nach wie vor schwierig sein, das in die Cloud zu heben. Ich sehe also nach wie vor die Bau- und Produktionsthemen momentan schwierig, alles was Dienstleistung, Finanzdienstleistung betrifft, da ist es wohl einfacher möglich.

DS [00:29:48]: Welche potentiellen Herausforderungen und Risiken siehst du in Hinblick auf Security, Datenschutz und Compliance bei der Einführung Cloud-basierter betrieblicher Informationssysteme in Produktionsbetrieben?

M: Ja natürlich, wobei die aus meiner Sicht nicht unbedingt mit der Cloud im Zusammenhang stehen, weil selbst wenn ich jetzt nicht in der Cloud bin und meine

Systeme selbst gehostet habe, dann bin ich genau so angreifbar. Im Gegenteil, es gibt ja so Artikel, wenn man die liest, dass an sich die ganzen Cloud-Anbieter durchaus sicherer sind, weil da hier das ganze betreut wird und die Anbieter das auch als Dienstleistung anbieten und entsprechend verkaufen wollen, und somit sind die da immer gefordert, am Stand der Zeit zu bleiben. Die Gefahr, die da natürlich besteht, ist halt, dass so ein großer Cloud-Anbieter immer ein schönes Ziel ist für gewisse Attacken, und daher habe ich natürliche gewisse Risiken. Aber ich sehe es umgekehrt so, wenn ich meine eigenen Systeme habe, dann bin ich jetzt auch nicht davon gefeilt, dass ich irgendwelche Sicherheitslücken habe. Bzw. sehr oft sind die Sicherheitslücken ja innerorganisatorisch zu suchen, das heißt, das habe ich sowohl mit dem einen, als auch mit dem anderen.

DS [00:31:18]: Gibt es aus ihrer Sicht Einschränkungen bzgl. der Funktionalität bzw. auch der Anpassbarkeit von Cloud-basierten betrieblichen Informationssystemen?

M: Ja, aktuell gibt es schon noch Einschränkungen, weil die Funktionalität noch nicht alles bietet, was die OnPremise-Lösung bietet. Aber das wird sich jetzt alles schnell ändern. Bei Microsoft kommt jetzt eine neue Version raus, die komplett in der Cloud läuft, und da wird die Funktionsweise wohl schon sehr nahe an dem sein, was die On-Premise Lösung bietet. Also wenn man da ein bisschen vordenkt, ein bis drei Jahre, dann sehe ich da keinen Gap mehr. Es wird dann eher die Frage sein, ob der Hersteller überhaupt die gleichen Funktionen bieten will auf der On-Premise-Lösung. Ich sehe da also eher das Thema, dass die Cloud-Lösung wiederum gewisse neue Funktionen liefern wird, einfach durch die neue Technologie und die neue Umgebung, die die On-Premise-Lösung dann nie hatte und umgekehrt werden vielleicht gewisse Dinge wegfallen, weil man sie in der Cloud nicht braucht, weil es durch gewisse anderen Funktionen ohnehin schon abgedeckt ist, zum Beispiel weil es durch eine Integration mit einem anderen Produkt einfach gegeben ist und man das eigentlich im ERP gar nicht mehr braucht. Da sehe ich also schon Unterschiede, aber den Gap wird man relativ schnell geschlossen haben. Es geht wohl eher um die Entscheidung, ob ich bereit bin, in die Cloud zu gehen, oder möchte ich on-Premise bleiben. Aber auch da glaube ich werden wir durch die Hersteller getrieben, weil die Hersteller fokussieren sich dann wohl auf das Cloud-Geschäft.

DS [00:33:40]: Welche Vorteile (oder auch Nachteile) ergeben sich in der Upgrade-Fähigkeit von betrieblichen Informationssystemen durch die Anwendung in der Cloud?

M: Das ist wahrscheinlich einer der größten Benefits in der Cloud bzw. die Idee, dass man dort auch sehr standardisiert implementiert und mit Technologien implementiert, die Upgrades einfach machen. Und das ist aus meiner Sicht einer der größten Benefits, die ich mir erwartet würde, damit ich mir dann mit Upgrades leicht tue und einfach mitgehen kann.

DS [00:34:20]: OK, dann sind wir schon bei der letzten Frage. Welche Auswirkungen hat die Einführung Cloud-basierter betrieblicher Informationssysteme auf die Implementierungsdauer im Vergleich zur On-Premise Variante?

M: Die Unterschiede, die Probleme, die wir in der täglichen Abwicklung haben, liegen vielleicht in der Infrastrukturthematik, sprich ich habe halt die Systeme irgendwo gehostet, hab damit also noch einen Partner mehr im Boot. Sprich ich sehe da auch wieder Kommunikation, sehr stark. Sprich, ich muss die Partner koordinieren. Der Kunde hat damit sehr viel selber nicht mehr in der Hand, d.h. man benötigt immer den Partner, um gewisse Dinge zu implementieren, Zugriffe zu berechtigen. Wo wir, als Partner, gewisse Nachteile sehen ist, dass wir in diesen Cloud-Umgebungen nicht mehr mit den gleichen exklusiven Rechten ausgestattet sind wie auf den on-Premise-Lösungen, was die Abwicklungen schon komplexer macht, gerade in der Anfangsphase. Das kann man bei On-Premise oft auf kürzeren Weg lösen. Rein inhaltlich sehe ich keinen Unterschied.

DS [00:36:05]: Viele Dank!

Transcript of Expert Interview N – German

Name of the interviewee: Anonymous
Company: Anonymous
Industry: Car motif industry
Position: CEO
Date, Place: 2018-03-08, Waizenkirchen
Recording of the interview allowed: X Yes No
Publishing of the name of the interviewee allowed: Yes X No

DS [00:00:00][84]: Welche betrieblichen Software-Informationssysteme haben Sie im Einsatz? Welche Module decken ihre Software-Systeme ab und stammen die Systeme von unterschiedlichen Anbietern?

N[85]**:** Ja, da fange ich gleich mal an bei Microsoft Dynamics NAV, wo wir Buchhaltung, Zahlungsverkehr, Lohnverrechnung, Zeiterfassung, Produktionsplanung, die Produktion selber, also Stücklisten, Fertigungsaufträge usw., Lagerwirtschaft, Einkauf, Verkauf, CRM. Zusätzlich haben wir noch ein EDI- und Automotivmodul voll integriert in NAV und auch unsere Chemikalienmischanlage ist angebunden.

DS: OK, also CRM im NAV System?

N: Ja genau, im NAV. Dann haben wir noch ein Instandhaltungsmodul und ein Personalmanagement-Modul, sprich Schulungen, Weiterbildungen. Das ist mal vom NAV, das Ziel war klar, soweit wie möglich in einem System zu arbeiten. Dann haben wir im Einsatz SharePoint, mit dem wir unsere ganzen Besprechungen abwickeln, jeder Bereich ob Einkauf, Verkauf, Entwicklung, Produktion hat dort sein eigenes Portal, wird als Dokumentationstool für die Besprechungen herangezogen und auch für die Ablage der Aufgaben dann. Zusätzlich haben wir ein zweites Tool, was auch SharePoint-basierend ist, aber nur für Qualitätsmanagementzwecke angepasst worden ist, sprich da werden die ganzen Dokumente für die Qualitätsmanagement-Systeme verwaltet. Und was wir natürlich noch haben ist Microsoft Office 365, sprich Outlook, Word, Excel, Exchange etc.

DS: OK, das heißt, da haben wir ja schon eine Cloud-Anwendung?

N: Genau, richtig.

DS: Passt, das heißt, Sie haben hauptsächlich Microsoft-Produkte im Einsatz für die Business Systeme?

N: Richtig. Ich nutze es gerne, weil es einfach weltweit verbreitet ist, und man hat dadurch einfach die besten Steuerungsmöglichkeiten.

DS: OK, und es herrscht wohl eine starke Integration zwischen all diesen Systemen, oder?

N: Genau richtig, das eine ist Dynamics NAV, was ja schon sehr stark in sich integriert ist. Dynamics NAV greift zum Teil ja schon auf SharePoint zu. Wir haben ja auch das Ablagesystem, das machen wir mit ZetaDocs, sprich wir schieben die Dokumente auf den Artikel ins NAV und die liegen dann in SharePoint.

DS [00:02:43]: Waren Sie bereits in einem Integrationsprojekt in ihrem Unternehmen involviert und welche Erfahrungen haben Sie dabei gemacht?

N: Projektmanagement ist alles! Nicht die Software, nicht die Mitarbeiter. Weil die Mitarbeiter kann man so schulen, dass sie lernen mit dem Instrument umzugehen und es

[84] DS = Dominik Scheuringer (Interviewer)
[85] N = Interviewee of Interview N

auch verstehen bzw. motiviert nutzen. Das funktioniert nur mit einem perfekt organisierten Projektmanagement. Ansonsten ist es zum scheitern verurteilt. Das haben wir gelernt.

DS [00:03:23]: Hatten die Integrationsmöglichkeiten einen Einfluss bei der Auswahl ihrer betrieblichen Informationssysteme? Wenn ja, welche?

N: Zu 100 Prozent, würde ich jetzt mal sagen. Wir haben eine Entscheidung gehabt zwischen SAP und Dynamics NAV im Jahr 2010. Haben uns dann nach einem Jahr bewusst für Dynamics NAV aufgrund der Integration und der Programmierkosten entschieden, weil das Dynamics NAV einfach so offen ist und aufgrund der AddOn-Module relativ breit zu haben ist, im Vergleich zu SAP, wo wir alles selbst programmieren müssten. Das war die Entscheidung, hat also einen sehr hohen Einfluss gehabt. Zu fast 100 Prozent. Weil können tun ja die Systeme fast alles. OK, wenn ich vielleicht global aufgestellt bin, dann hat SAP im Intercompany schon noch Vorteile, das muss man so sagen.

DS [00:04:18]: Welche ihrer Geschäftsprozesse betreffen mehr als ein betriebliches Informationssystem in ihrem Unternehmen?

N: Die Entwicklung. Weil wir haben Entwicklungsstücklisten und Arbeitspläne im NAV und abbilden tun wir das Projektmanagement über SharePoint und MS Projects. Das heißt hier sind sowohl NAV als auch SharePoint betroffen.

DS [00:04:53]: Die nächste Frage, führen Sie ERP- und CRM-Tätigkeiten in einem Software-System durch oder haben Sie dafür getrennte Software-Systeme, haben Sie ja schon beantwortet. Das wird beides im NAV gemacht, oder?

N: Richtig, das eigene CRM-System von Microsoft wäre uns zu viel gewesen. Daher nutzen wir die CRM-Funktionen in NAV, wo wir uns noch ein paar Features programmieren lassen haben, was auch nicht billig war, aber es ist einfach voll integriert.

DS [00:05:12]: In welchem System erstellen Sie Analysen und Auswertungen ihrer ERP- und CRM-Daten? Haben Sie dafür ein separates BI-System im Einsatz?

N: Nein, das ist bis dato noch immer ein bisschen ein Steckenpferd, da gibt es leider bei uns in der Firma nur zwei bis drei Leute, die das intensiv nutzen. Die anderen nutzen das leider zu wenig, das steht aber bei uns auf der Agenda, das ein bisschen zu forcieren und die Daten, die war ja schon sammeln und die auch Sinn machen, so gut wie möglich zu nutzen und auszuwerten. Das ist leider momentan noch zu wenig verbreitet, da gibt es auf alle Fälle Potential. Wobei die Tools sind noch immer nicht optimal, wir verwenden da viel euer entwickeltes Tool, das NC Cube, das ist ein Traum, aber man kann es leider nicht so visualisiert aufbereiten, dass es jedem gleich was sagt. Und dann braucht man Pivot-Tabellen und man muss dann Grafiken miteinfließen lassen und da muss man dann schon wirklich ein Hardcore-Excel-User sein, damit man da was rausbringt. Und da wäre es natürlich leichter, wenn man einfach Reports gestalten kann, dann würde das wahrscheinlich auch besser genutzt werden.

DS [00:06:33]: Was sind bzw. waren die Auslöser für eine notwendige Integration ihrer betrieblichen Informationssysteme (Organisationsstruktur, betriebliche Prozesse etc.)?

N: Ja, aufgrund unserer Qualitätsmanagement-Systeme, wo relativ viel dokumentiert werden muss, was man nachweisen muss, das kann ich ja im Dynamis NAV nicht machen. Daher haben wir entschieden, uns SharePoint anzuschaffen, für uns ist das zwar fast noch immer zu groß, aber man hat da einfach die Möglichkeit, dass man Meetings perfekt organisieren kann, die Aufgaben abarbeiten kann und die Abarbeitung dann entsprechend dokumentieren kann. Und da sind wir begeistert, das nutzt jeder Mitarbeiter mittlerweile. Also der Verkauf, der Einkauf, die Instandhaltung, der Produktionsleiter mit den Schichtleitern.

DS [00:08:10]: Was sind bzw. waren die größten Herausforderungen bzgl. der Integration ihrer Informationssysteme?

N: Ja wie schon erwähnt, das ganze Projektmanagement war sicher die größte Herausforderung. Natürlich gab es auch technische Probleme, aber dafür kann man ja fast immer eine Lösung finden.

DS [00:08:38]: Welche Verbesserungspotentiale sehen Sie aktuell in der Integration ihrer betrieblichen Informationssysteme? Wie können aus ihrer Sicht diese Verbesserungspotentiale umgesetzt werden?

N: Ja, das ist vor allem die Integration unserer Produktionsmaschinen. Wir waren sehr beeindruckt, seitdem wir das Personalmanagement integriert haben, sprich bei uns kommt ein neuer Mitarbeiter, der wird im Personalmanagement angelegt, wird automatisch in die Zeiterfassung übernommen, wird automatisch in die Lohnverrechnung übernommen und der Mitarbeiter wird automatisch in das Schulungssystem übernommen und ich kann ihm am ersten Tag zu Schulungen zuweisen. Das wird ausgedruckt, Schulungen werden gebucht und das hat für uns einen unheimlichen Mehrwert. Das war unheimlich kompliziert das zu implementieren. Aber jetzt bin ich total begeistert davon, habe ich mir nicht gedacht, dass das so toll in NAV zu integrieren ist.

DS: OK, das heißt, da fällt jetzt natürlich viel manuelle Arbeit weg, oder?

N: Ja genau, richtig.

DS [00:09:50]: Gibt es noch Insellösungen im Unternehmen?

N: Nein, kurz zur Geschichte, warum wir das nicht haben. Wir haben vor meiner Zeit noch, wie mein Vater noch im Unternehmen war, seit 1994, haben wir ein EDV-System gehabt, wo wir ein bisschen Warenwirtschaft-Buchungen gemacht haben und das war es, auf DOS-Ebene. Als ich dann 1998 in die Firma gekommen bin, war es meine Intention, das System wird irgendwann an seine Grenzen stoßen, bin doch ein relativ EDV-affiner, obwohl ich aus dem chemischen Bereich komme, und wir haben gesagt, wir machen nichts, bis es notwendig ist. Und dann machen wir es richtig. Wir haben also wirklich 14 Jahre lang mit diesem System mit allen Vor- und Nachteilen gearbeitet, aber nichts investiert. Und genau dieses Budget haben wir dann genommen, 2010, und entschieden, jetzt machen wir was Gescheites. Wichtig war uns ein offenes System, daher Dynamics NAV, zwei, drei Jahre vorher haben wir uns schon damit auseinandergesetzt. Und ganz wichtig war, wir wollen ein System, wo wir keine Insellösungen mehr schaffen. Und das ist uns bis jetzt, also seit 2010, gelungen und wir haben alle zwei Jahre ein neues AddOn-Modul integriert, und es ist aufgegangen.

DS [00:11:25]: Inwiefern sind Office- und Collaboration-Software-Systeme (Word, Excel, Outlook, SharePoint etc.) mit ihren betrieblichen Informationssystemen, also mit NAV, integriert?

N: Ja Excel ist ja ohnehin verheiratet mit NAV kann man sagen. Word machen wir gar nichts mit NAV. Outlook schon, da synchronisieren wir von NAV die Kontakte ins Outlook. Und halt SharePoint, das ist mit dem Projektmanagement integriert. Also wenn wir ein Projekt anlegen im SharePoint, dann wird das Projekt auch in NAV angelegt und wir können von NAV direkt ins SharePoint zugreifen.

DS [00:12:40]: Welche Abteilungen profitieren aus Ihrer Sicht am meisten von der Integration ihrer betrieblichen Informationssysteme?

N: Es profitiert jeder und es profitiert jeder sehr gut in seinem Bereich. Wenn ich also jetzt zum Beispiel sage, die Buchhaltung profitiert deswegen, weil die einfach 80 Prozent weniger Arbeit hat, weil sehr viel automatisch gebucht wird. In der Lagerwirtschaft, die

haben sicher nicht weniger Arbeit, weil sie noch immer alles buchen müssen, aber die haben eine Übersicht, die unbezahlbar ist. Genauso in der Produktion, da habe ich zwar auch den Aufwand, dass jeder Mitarbeiter seine Arbeitsgänge buchen muss, aber ich habe eine Echtzeit-Einstandspreiserfassung, ich weiß genau, wo stehe ich mit meinem Produkt, was kostet mir das Produkt zu diesem Stand, wann ist es fertig. Das heißt, jede Abteilung hat einen Mehrwert.

DS [00:13:49]: Müssen aktuell Doppelarbeiten, also doppelte Datenerfassung gemacht werden aufgrund isolierter Systeme? Wenn ja, welche?

N: Ich will nicht sagen, dass sie zu 100 Prozent ausgeschlossen sind. Aber zu 90 Prozent gibt es keine Doppelarbeiten mehr.

DS [00:14:09]: Und gibt es aktuell einen Mangel an Echtzeit-Auswertungen und Reports aufgrund nicht integrierter, mehrfach überlappender Datenbanken?

N: Nein, das Problem haben wir nicht. Da nach jedem fertigen Arbeitsgang die Informationen gebucht werden, sind die Daten immer sofort griffbereit. Und wir brauchen sie ja nicht auf die Sekunde, das heißt ich brauche sie erst, wenn der Arbeitsgang abgeschlossen ist. Wenn ich jetzt in der Früh komme um 6 Uhr und ich will wissen um 12 Uhr Mittag was wir produziert haben, dann kann ich mir das anschauen.

DS [00:14:48]: Besitzen Sie aktuell Dashboards, welche Informationen von verschiedenen betrieblichen Informationssystemen und ev. weiteren Datenquellen auswerten?

N: Da sind wir gerade dabei bei der Produktionsplanung. Aber da haben wir intern auch ein bisschen Umstellung, weil wir alleine schon vom System her die Produktionsplanung umstellen wollen. Wir haben das aufgeteilt gehabt auf verschiedene Abteilungen im Betrieb, und wir wollen jetzt eine Zentralplanung durchführen und das ist natürlich ein großer Aufwand das zu zentralisieren. Wir haben PlannerOne auch schon testweise im Einsatz, zum Probieren, Spielen. Ende 2019 ist der Plan, dass das dann im Einsatz ist.

DS [00:15:46]: Welche Prozesse konnten durch die Integration optimiert werden?

N: Zwei Beispiel dazu. Erstens, unsere Chemikalienmischanlage ist mit NAV integriert. Das heißt die Anlage bekommt die Basisdaten aus NAV, das sind die Fertigungsstücklisten in NAV, wo auch die Mischzeiten gespeichert sind. Nach der Herstellung in der Anlage erfolgt wieder die Rückmeldung ans NAV und dort werden automatisch Artikelverbräuche gebucht. Die Optimierungen daraus sind, dass viel weniger Korrekturbuchungen notwendig sind, eine viel genauere Lagerbestandsführung und eine höhere Prozesssicherheit. Zweites Beispiel ist unsere EDI-Anbindung. Unsere Kunden schicken Abrufe zu Rahmenaufträgen per EDI, der Rahmenauftrag wird dann automatisch in NAV angelegt. Daraus ergibt sich eine Prozessautomatisierung, weil neben dem Rahmenauftrag auch der Verkaufsauftrag, die Planung, Lieferung und Rechnung automatisch erstellt bzw. gebucht wird in NAV.

DS [00:16:48]: Auf was soll ihrer Meinung nach der Fokus bei Versions-Upgrades ihrer betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

N: Schlechte Frage (lacht). Fangen wir ganz klein an. Windows 10, das perfekt System. Es wird immer upgedated aber man merkt nichts davon. Das ist wunderschön. Genau so sollte das Microsoft in Zukunft bei allen Systemen machen. Der Upgrade von Dynamics NAV, ist die Höhle, die Höhle auf Erden. Wir haben vom 2009 auf 2016 upgedated, das hat so viel gekostet wie die Implementierung. Das kann nicht sein.

DS: Ja, genau da geht die Reise hin. Auch in Verbindung mit Cloud-Services und dem Stichwort „Extensions“; das heißt es wird nicht mehr direkt in den Source-Code

hineinprogrammiert, und der Standard-Code bleibt immer so wie er ist. OK, das heißt es gibt aktuell keinen Releasezyklus oder so?

N: Das ist ein wirtschaftliches Problem. Ich bin schon der Fan, dass ich immer die neueste Version habe. Aber das ist nicht leistbar, aktuell unter fünf Jahren geht da gar nichts.

DS [00:18:42]: Sind aktuell Workflows zwischen ihren verschiedenen betrieblichen Informationssystemen implementiert?

N: Ja, wir haben Workflows. Und zwar im Einkauf, Verkauf und in der Buchhaltung. Das heißt, da gibt es gewisse Beträge, in von einem Dritten abgesegnet werden müssen. Der Bekommt dann eine Freigabeanfrage und muss das dann freigeben.

DS: OK, damit hilft das auch noch zur Integration der Prozesse, oder?

N: Ganz wichtig. Wir sind noch klein, da ist das noch nicht ganz so wichtig. Aber in größerer Betrieben da wird das immer wichtiger, da hat man dann zwei bis drei Hierarchien.

DS [00:19:27]: In welchem Ausmaß nutzt ihr Unternehmen aktuell Cloud-basierte betriebliche Informationssysteme (Software-as-a-Service)?

N: Wir nutzen aktuell Office 365. Ich habe mich immer abschrecken lassen, weil es zu teuer ist. Im Endeffekt ist es nicht zu euer. Wir haben das jetzt umgestellt seit zwei Jahren und es ist einfach das Management so genial, dass die Kosten gar nicht dafür stehen. Vorher hatten wir CDs herumliegen gehabt, das musste man installieren, dann hat man es wieder deinstalliert, dann musste man Freigabecodes holen und so weiter. Jetzt macht man es online auf der Office 365 Homepage und es ist ein Traum. Ich möchte es nicht mehr missen und es hat jeder immer die gleiche Version. Das heißt ich schwör auf das mittlerweile.

DS [00:20:25]: Welche Vor- und Nachteile sehen Sie in Cloudbasierten betrieblichen Informationssystemen?

N: Das ist Auslagerung für mich. Ich nutze nur mehr das Tool an sich und das ist perfekt für mich. Zum Beispiel den Exchange Server, den hatten wir früher selber gehabt, den vermisse ich nicht. Der hat nur Geld gekostet.

DS [00:20:47]: Und wäre aus ihrer Sicht auch eine ERP-Anwendung in der Cloud möglich?

N: Ja, denkbar schon. Natürlich haben wir da eine andere Gefahr. Wir haben das heuer öfter gehabt mit unseren starken Unwettern. Wenn der Strom weg ist oder die EDV weg ist, dann steht die Firma. Wir können nicht mehr mal eine Palette aus dem Regal holen. Ich meine wir sind jetzt vier Jahre in diesem Standort und haben noch nicht einen Ausfall gehabt. Ich bin schon ein Fan. Das einzige, was ich fürchte ist ein bisschen die Verfügbarkeit, das ich wirklich mal in der laufenden Produktion stehen würde. Weil das wäre fatal, das sind Kosten, die kriegt man nicht mehr rein. Im Office 365 ist das nicht so das Problem, dann gehe ich mal 15 Minuten auf Kaffeepause. Aber wenn die Produktion steht, das wär echt fatal. Sonst wär ich, wenn das so funktioniert wie Office 365, dann würde ich es machen, Wir haben nur einen Fehler gemacht, beim SharePoint, da haben wir noch selbst eine Lösung installiert auf unserem Server und ein Jahr später haben sie die Cloud-Lösung angeboten. Das würde ich machen. Also ich würde mir keinen SharePoint-Server mehr ins Haus stellen. Also wenn wir da nochmal was neues brauchen, dann ist das in der Cloud. Wenn das bei Dynamics NAV so funktionieren würde und die Sicherheit und Verfügbarkeit gegeben ist, dann bin ich eigentlich ein Cloud-Fan.

DS [00:22:14]: OK, und dann bin ich schon bei der letzten Frage. Wie stehen Sie zum Thema Sicherheit und Datenschutz bei Cloud-basierten betrieblichen Informationssysteme? Welche Gefahren und Risiken sehen Sie darin?

N: Ich habe für unser Unternehmen den Datenschutzbeauftragten gemacht, obwohl wir ihn ja eigentlich nicht brauchen, weil wir nicht mit menschlichen Daten hantieren und nur B2B haben. Und was man da so hört, spielt es keine Rolle, ob sie jetzt mich angreifen oder Microsoft angreifen. Ich glaub sogar, dass die mehr Erfahrung haben als wir. Ich glaub also, dass wir hier mehr angreifbarer sind als Microsoft.

DS [00:23:39]: Dann haben wir nun alle Fragen durch und ich bedanke mich recht herzlich für das Interview mit Ihnen.

N: Gern geschehen.

Transcript of Expert Interview O – English

Name of the interviewee: Jana Lukic
Company: Microsoft Austria GmbH
Industry: IT
Position: Solution Sales Professional Microsoft Dynamics 365 Customer Engagement
Date, Place: 2018-03-13, Vienna
Recording of the interview allowed: X Yes ☐ No
Publishing of the name of the interviewee allowed: X Yes ☐ No

DS[86] [00:00:00]: The first question is to what extent have the integration possibilities an influence on the selection of business information systems in manufacturing companies (both technically and organizationally)?

O[87]: Out of the experiences we have been having from different conservations with different customers and especially in manufacturing companies, the technical integration possibilities are very important. Traditionally, the companies have been choosing the information systems based on the department. So for example, production department would use the best in-class software independent from the fact if it is possible to integrate this let's say with a finance tool or other back office tools. So nowadays, this has completely changed. The companies have realized that this is not an efficient way of working and especially if you look at the IoT and this digital trends, that are enforcing that the systems are integrated, the company are more aware of that, therefore they are choosing the systems that are technically connected. That's on the technical side. Organizationally, of course this push comes from the internal organizational side in terms of few work and how have people actually worked together on one hand, on the other hand if they are able to have transparency into other departments. So what does that mean. If I am a sales person inside a manufacturing company, and just looking at the outside you would say that I am not interested in the production processes. But if I cannot understand how my colleagues are working in the background I can't address certain paint points with the customer because I do not know if this is actually feasible. Back in the days you would just sell what ever needed to be sold, and then you would come back and have the internal discussion. You know, something is positive, something is negative. But you would try to let's say produce something based on what has already been sold. Nowadays we are looking at a trend that the sales process needs to be streamlined, so you wanna sell 80 % of the standard product and then the other 20 % would be something that is customizable. So as a sales person you need to be fully aware of what is going on in the background. For that reason, you also need an integrated system. Does that answer your question?

DS: Yes, perfectly, thank you.

DS [00:03:42]: Which requirements regarding the integration of business information systems have companies from the standpoint of the management and from the standpoint of the users?

O: The management is concerned with two things. The first thing is to be able to control who sees what and who does what, so we are talking about typical setup of the system. Just to make sure that information is not going in the wrong direction. But that is priority two. What management is concerned about is information that they get, at a single day. So they usually deal with reporting tools or what they want to see, and this is what they are communicating to us, I need to see a nice dashboard where all of the data is flying in that

[86] DS = Dominik Scheuringer (Interviewer)
[87] O = Interviewee of Interview O

is actually up to date on every single moment. They are not concerned about the systems but about the actual reporting that comes out of it.

DS [00:05:00]: What are the triggers of a necessary integration of business information systems in manufacturing companies with regard to the organizational structure, business processes, etc.?

O: What companies want to achieve and the reason why the choose integrated systems is the perceived increase in efficiency, better control of processes and information, so we do have business processes but also information in the background and also the actual increase in success factors. So they do have certain KPIs and KPIs are defined for departments but they all combine in some point and integrated systems simply helps to achieve all of those at the same time. It is kind of connected to efficiency, but efficiency in terms of the output.

DS [00:06:10]: What are the biggest challenges regarding the integration of business information systems in manufacturing companies?

O: The one is, let's say soft challenge. Often when we talk about integrated systems in a new implementation it is a change management process. It is not only about the system, it is not only about technology, it is about how people's daily work is impacted. So this is an emotional topic. So if there is not a proper change management in place, the implementation is going to fail, no matter how good the system is. That is the soft challenge. And then the actual hard challenge is the actual technology. So you will not find a manufacturing company that is working without the system. So what you will find often is an IT landscape of 50 plus systems, again they are not necessarily talking to each other, or they are integrated through complex integration tools. So the technical challenge is to move away from that approach to an integrated system. That is a technical challenge that might be very costly.

DS [00:07:30]: Which problems and vulnerabilities are caused by isolated applications in manufacturing companies?

O: Not having an integrated system also means that the company is not working efficiently, because as mentioned, there is no transparency, there is not a flow in the process, which at the end they have one single impact that anybody would care about which is profit. If your processes are not efficient internally you are going to influence your prices, your prices are going to influence your position on the market, it is gonna make you less attractive to your customers and which at the end of the day will be a loose of money.

DS [00:08:25]: To what extent can manufacturing business processes, e.g. the make-to-order process, in companies be optimized through the integration of business information systems?

O: What we often describe within Microsoft is the Prospect to Cash-Process. It is basically the full sales to invoice process. If you look at the situation where you have different systems, the production team is not going to necessarily know what the sales team is doing and the sales team is not knowing what the marketing team is doing. So if you integrate all of those you can kind imagine, there is certain marketing campaign and a prospect, a potential customer is being identified, according to preferences, online research, due to certain trade shows and so on. For a sales person having this information through an integrated system can basically speak to the need of the customer. On the other hand there are aware what is going on in the background, once the order is in, they can simply fast it along, the production team already knows what kind of customer this is, what their preferences are, they know what needs to be produced or what needs to be offered if it is not an individual customer product, and then, once this has been done, it can go back to the finance department. You have to imagine this is not a loop, this is not the

end of the process, because once the product has been sold, we are talking about services which goes back to the sales, marketing and so on. So if you optimize this, which is a full chain of simple smaller processes, you gonna have a prospect to cash optimization.

DS [00:10:34]: Which departments in manufacturing companies benefit most of all from the integration of business information systems?

O: I do think that each department gets certain benefits. I do also believe that certain departments get more benefits. So I think the benefits let's say that are obtained from an integrated system can be easily spotted in sales and customer service. So customer phasing departments. The visibility of the benefits is immediate in the customer phasing departments.

DS [00:11:20]: For which ERP-data is a real-time availability within CRM-systems (and vice versa) useful and beneficial for manufacturing companies?

O: Assume that ERP data is the main source of the Single point of truth data, what is necessary to be reflected in the CRM system is the purchase history of the customer, because this is how you can basically identify cross- and up-sell opportunities and also the customer ranking, so A, B, C. D. This is often connected to open invoices, number of cases that are being open and so on and so forth. So everything that is related with future sales. On the other hand when we flip it around, actually you wanna reflect CRM data in ERP system what is necessary to know is open opportunities, so which product could be sold in the next quarter, or year or whatever, number of open cases, so everything that can influence the cashflow, so forecast and cashflow and on the other hand open cases in terms of complaints. So anything, that can influence repairs, spare parts, anything that is going to be connected with the procurement process. This are the main data. And then of course you can expand this and say I need to see out of the ERP, the HR module, the number of professionals and their skills because I need this again in CRM for resource planning. So you can expand this.

DS [00:13:40]: Which potentials do you see in the integration of business information systems (ERP- and CRM-systems) within office- and collaboration-products like Outlook, Word or Excel?

O: Talking out of Microsoft perspective, and Dynamics 365 perspective, so this is for us a normal basic thing what needs to be included when we are talking about integrated systems. Because whether we like it or not, the first thing what we do in the morning is to look into Outlook. You can like or dislike Outlook, whatever, but this is what you do. And you spend most of the day with your emails and if this is not connected with ERP or CRM system it does not allow you to send automatically the important information, I have two decentralized systems, then we are not talking about efficiency. So this is like a basics.

DS [00:14:50]: What should be the focus of versions upgrades of business information systems in the future, mainly relating to the integration architecture in order to ensure sustainable systems in the future?

O: This is not an easy question. Because this is often connected with the actual architecture of the systems in terms of where is it hosted. Are we talking about cloud computing or are we talking about on-premises. I have to regard it to cloud systems because this is the future. This is the outlook which we are heading. So the advantage of a cloud system and the prerequisite of a cloud system is that a standard system remains, so you are not customizing, you are not changing the code of the system, which means that you are eligible for easy and seamless updates. I gonna give you an example. We are not talking about business applications, I'm gonna take Office 365 as an example. Right now, we do have over 250 upgrades and updates, and as an end user, as a company you don't necessarily know that. So if there is an update then it is nice and in the morning there is a

pop window saying there is a new feature, but you are not aware as it is gonna happen in the background. This is only possible because you are using standard versions of the software. In Business applications aspect this is a bit more complex. None of the customers are using standard systems so what you need to be aware of, you need to be able to upgrade at that speed, if it is twice a year of whatever, as soon as the updates are here, but this simply means that you have to be very careful with your customizations, that need to happen outside of the code, outside of the platform. Otherwise it is gonna mess up the whole system. If we are talking about the focus, the focus should be to always have the latest version. Because the latest version can have attractive features, because of the sustainability of the system. But on the other hand companies need to be aware of customizations and additional modules that influence the platform.

DS [00:17:18]: To what extent can workflows optimize and improve the integration and communication of different business information systems?

O: I think workflows have been regarded before as a tool within the system. So use workflows to connect, I am gonna be a bit more technical, different entities within ERP or within CRM. Nowadays we are looking at workflows that are connecting different systems. For example, I can get SMS whenever a new opportunity is created. Or a customer can get a notification if a package is approaching his location. They are getting more and more important because they increase the efficiency not only internally but also externally. So anything that can help you connect different systems in terms of the information flow it is gonna become crucial in the future.

DS [00:18:38]: OK, so these were the questions regarding integration. And then I have some more questions regarding the cloud. The first question here is how do you see the trend from on-premise applications towards cloud-services within business information systems?

O: There is an interesting shift happening. I am gonna give you an example. Four years ago, when I started working for Microsoft, most of the customers actually were against the cloud. This had many different reasons, some were emotional. I call it emotion-based fear of cloud and where the data is. And there was also fear of technical challenges. Nowadays I am only talking about cloud, big, small, manufacturers, banking, they are all talking about cloud technology, because of the additional intelligence that you can get out of it. So I think every move forward, I believe in the next 18 to 24 months I do not think that there will be focus on on-premise solutions, unless there are certain exceptions or requirements, which can't be placed in the cloud.

DS [00:20:16]: Are there business information systems, which are better, and business information systems, which are worse suitable for the deployment in the cloud?

O: I don't know if there is a better or worth. I would not put it like that. I think the ERP system in its function, its core function is a bit more challenging. Because it is often connected to many other systems. And these connections can actually influence the readiness to have it in the cloud or not. So even if I look in the market, I think the general willingness or readiness to use the cloud technology is better or greater in the CRM world. But again, this is more of a technical question. And also financial data is considered to be more sensible data, so ERP would be kind of a less favorable part of business applications going to the cloud.

DS [00:21:23]: Which prerequisites must a manufacturing company fulfill in order to be able to operate their business information systems in the cloud and in which cases is the cloud model most suitable, respectively?

O: So again it comes back to the question of the IT landscape. What manufacturing companies need to understand is that all the connected systems need to be cloud

versions. So even some small self-made systems. That is the one thing. And the other thing is basically the key decision what you want to achieve with your ERP system or your CRM system. If we are talking about a tool that is gonna help you to save data and let's say finish the process as it is then you need gonna have necessarily immediate benefits out of the cloud. But if we are talking about intelligence and you want that the systems gives you information that you don't have, then we are talking about cloud computing. I can give you an example, if you want to do predictive production, predictive maintenance, anything that is based on machine-learning modules, you are not be able to have this if you not move to the cloud technology. Those are questions of innovation, it is the question of how you want to approach your business processes and if they want to use that as a source of unique selling proposition. It sounds a bit glassy at the beginning, but actually that is what happening. And if you look at some manufacturing customers, that have chosen cloud technology vs on-premise technology, you just realize, that I can get insights that can make me more competitive. The prerequisite is the decision what you want to achieve and how important business processes are.

DS [00:23:34]: Which potential challenges and risks do you see in respect of security, data protection and compliance at the introduction of cloud-based business information systems in manufacturing companies?

O: I truly believe that if you choose the right provider, if you choose the right technology partner, risks can be decreased. Because large IT companies can definitely do a better job of protecting data than let's say a single company. In general public there is still fear of cloud in terms of protection, I understand it, but logically I think you are better of and these risks are minimized if you use cloud technology. Compliance, security, same thing, if you choose the right provider that is certified, then there is nothing to worry about.

DS: Yes, this was mostly the answer in my interviews.

O: Yes (laughs). It is true. I would not be comfortable if my data would be in some basement comparing to a data center where I know that not everybody can walk in and out.

DS [00:25:08]: The next question is are there any limitations regarding the functionality of cloud-based business information systems comparing to the on-premise variants from your point of view? E.g. if you compare Dynamics 365 with the on-Premise Dynamics NAV?

O: Yes, they are, but it is the other way round. So the way we develop a product, a cloud-based application is always more advanced than the on-premises. So there is a functionality gap, in right now it is perhaps 20 % but I do expect that it will be in the future mare larger. So the focus will be put on the cloud. Also in terms of available upgrades. On the CRM side you have it now twice a year and on-premise only once a year, and with NAV it is gonna something similar.

DS [00:26:16]: To what extents are there differences regarding the possibilities of customizing and configuration between cloud-based and on-premise business information systems?

O: Yes, the customization logic is different. If you want to customize the cloud system, as I mentioned before, you need to separate it from the platform, you cannot change the code itself. Or you should not do it. While on-premise you can get crazy, you can do whatever you want. It is not necessarily a good thing to do, but of course, once you are on-premise, you can separate yourself from the product strategy and the product release cycles. It needs to be clear what is being done.

DS: So this is a different philosophy to work more with the standard and just extend it and not change the standard code.

O: Yes, exactly.

DS [00:27:27]: Which advantages (or also disadvantages) result in the upgrade-capabilities of business information systems through the deployment in the cloud?

O: The advantage is of course that you get all of the updates more often. If I am honest, that you get the updates more often could also be a disadvantage. You can update at your own pace, but you have to update, this is often perceived also as pressure or disadvantage. It is more emotional, it is not necessary a rational disadvantage.

DS [00:28:21]: OK, then we are at the last question. Which effects has the introduction of cloud-based business information systems on the implementation duration in comparison to the on-premise variants?

O: The implementation process is much shorter in the cloud world. There are two basic reasons for that. First of all, you cannot customize so much, this saves a lot of time. And also, in the system setup, in the pre-implementation process, there is a different understanding of what my system could be. So it used to be that, you say, ok these are my processes, I am gonna get a system, and then, customize the system to fit the processes. Nowadays, you get a system and say, ok this covers 80 percent of my processes, and the other 20 can either be customized or I can make an internal decision, set the process to fit the system, which of course shortens the implementation time. And you only get this kind of thinking in the cloud world. So you are automatically efficient and faster with the Go-Live if you choose the cloud technology.

DS [00:29:36]: OK, so then, we are finished with the questions. Thank you very much!

O: You are welcome, if you have any more questions, just tell me.

Transcript of Expert Interview P – German

Name of the interviewee: Anonymous
Company: Anonymous
Industry: Telecommunication (including manufacturing)
Position: Project Manager & Process Management - Integrated Management Systems
Date, Place: 2018-03-15, Vienna
Recording of the interview allowed: X Yes No
Publishing of the name of the interviewee allowed: Yes X No

DS[88] [00:00:00]: Welche betrieblichen Software-Informationssysteme habt ihr im Einsatz und welche Module decken eure Software-Systeme ab?

P[89]: Ist das Fokus ERP oder weiter gefasst?

DS: Ja schon weiter gefasst, also generell um Business Software Systeme.

P: OK, ich zähl mal auf, und du kannst ja dann von der Liste streichen was für deine Arbeit nicht wichtig ist. Also wir haben natürlich Navision Dynamics im Einsatz, das kannst ja (lacht). Wir haben Dynamics CRM im Einsatz. Dann wir haben Cognos TM1 im Einsatz.

DS: OK, was ist Cognos TM1?

P: Das ist im Grunde genommen eine Business Intelligence-Lösung, das hat eine eigene Cube-Software. Dann kann ich noch SharePoint erwähnen, das haben wir auch im Einsatz. Dann noch Pro.File, ein Dokumentenmanagementsystem. Wir haben DocuWare im Einsatz, ebenfalls für Dokumentenmanagement. Ja das sind jetzt hier in der KCC die wichtigsten. In der ganzen Gruppe gibt es natürlich noch weitere Systeme.

DS [00:01:50]: OK danke, das heißt, wir haben auch unterschiedliche Anbieter im Spiel?

P: Ja genau, wir haben neben Microsoft auch Cognos und IBM als Software-Lieferanten.

DS [00:02:04]: Und sind diese Systeme stark voneinander abhängig?

P: Ja, es gibt gelegentlich Schnittstellen zwischen den Systemen. Vor allem ERP und unser Reporting. In unserem Fall Cognos TM1 und Navision.

DS [00:02:36]: Die zweite Frage ist, du warst doch sicher schon in einem Integrationsprojekt in deinem Unternehmen involviert, welche Erfahrungen hast du dabei gemacht? Sowohl positiver als auch negativer Natur.

P: Generell mal, dass Schnittstellen immer sehr heikel und sensible sind. Einer der größten Erfahrungen, die wir bei Integrationsprojekten gemacht haben, ist, dass die Auswirkungen, die eine Verknüpfung von Systemen bringt, oft mal nicht gleich erkannt werden im Scope. Dass es in der Regel auch einen Impact hat auf organisatorische Prozesse, die man auch mitunter nicht immer gleich erkennt. Ja und dass es mittlerweile schon sehr schwierig ist die technisch beste Lösung zu finden. Weil es mittlerweile ja schon sehr viele Lösungen gibt.

DS [00:04:15]: Hatten die Integrationsmöglichkeiten einen Einfluss bei der Auswahl eurer betrieblichen Informationssysteme? Wenn ja, welche (technisch, organisatorisch, geschäftsorientiert)?

P: Die Frage ist also, wenn wir Systeme evaluieren und ob das System gut integriert werden kann, ob das einen Einfluss hat, oder wie?

[88] DS = Dominik Scheuringer (Interviewer)
[89] P = Interviewee of Interview P

DS: Ja genau.

P: Ja, das hat natürlich einen Einfluss. Eine Stand-Alone-Lösung kannst eigentlich heutzutage nirgendswo mehr reinbringen.

DS [00:05:08]: Gibt es einen Geschäftsprozess bei euch, der mehr als ein betriebliches Informationssystem in eurem Unternehmen betrifft?

P: Ich überlege gerade was das beste Beispiel ist. Im Grunde genommen ja fast jeder. Wenn du den Projektmanagementprozess hernimmst, die Systeme, die dort zu betreuen sind, sind einerseits unser Reporting- und Planungssystem natürlich, wir haben Navision im jeden Fall, wir haben jetzt auch die Zeiterfassung mit Chronos drinnen, und wir haben auch das Ticketsystem, das KSMP, das zwar auf Navision basiert aber eine eigene Lösung ist. Das heißt im Projektmanagement, in der Projektimplementierung, da verwenden wir eigentlich mehrere Systeme.

DS [00:06:18]: Ihr habt ja auch ein getrenntes CRM –und ERP-System, oder?

P: Ja genau.

DS [00:06:25]: Auf welche ERP-Daten könnt ihr aktuell direkt im CRM-System zugreifen und umgekehrt?

P: Keine bei uns. Es gibt zwar grundsätzlich schon gleiche Daten, aber sie werden nicht ausgetauscht, die hängen nicht zusammen bei uns die beiden Systeme.

DS: OK, und es gibt auch nicht den Wunsch danach, oder?

P: Nein. Das hat aber mit unserem Geschäftsmodell zum tun. Wir haben nicht viele Kunden, weil unser Geschäft nicht viele Kunden hat, somit brauchen wir nicht unbedingt dieses Interface. In anderen Firmengruppen bei uns, da sieht das ganz anders aus. Die haben auch die Integration.

DS [00:07:28]: In welchem System erstellt ihr Analysen und Auswertungen ihrer ERP- und CRM-Daten? Dafür habt ihr ja ein eigenes BI-System im Einsatz, richtig?

P: Ja wobei das ist relativ. TM1 habe ich dir genannt für die Planung, sonst ist es aber normal die KISS, und das basiert auf den ganz normalen Microsoft Cubes in Wahrheit, SQL basierend. Das wird in ein Data Warehouse abgezogen und dort stehen dann Auswertungswürfel zur Verfügung, und zwar auf Basis Standard Microsoft Technologien.

DS: OK, aber im Data Warehouse habt ihr nicht nur Daten aus NAV, sondern auch aus anderen Datenquellen nehme ich an, oder?

P: Ja, das Planungssystem Cognos TM1, NAV, CRM, und halt diverse Excel-Uploads. Ansonsten haben wir da nicht mehr Systeme zusammengehängt.

DS [00:09:06]: OK verstehe. Die nächste Frage 7 hat ein paar Unterfragen. Die erste ist, was sind bzw. waren die Auslöser für eine notwendige Integration eurer betrieblichen Informationssysteme (Organisationsstruktur, betriebliche Prozesse etc.)?

P: Ich sehe da mal Änderungen im Geschäftsmodell. Das kann mal ein Auslöser sein, bzw. war auch mal bei unserem CRM so, weil die Erwartung war, dass es hier mehr Bewegung in diesem Gebiet gibt, also mehrere Opportunities und mehrere kleine Projekte. Und das andere Thema sind Technologiewechsel.

DS [00:10:08]: Was sind bzw. waren die größten Herausforderungen bzgl. der Integration eurer Informationssysteme?

P: Ja das ist die Doppelwartung der Systeme wenn du nicht integriert bist, und wir sind ja nicht voll integriert mit unseren Systemen.

DS [00:10:46]: OK, das heißt bezogen auf Frage 7.3., das wären dann auch Verbesserungspotentiale, oder?

P: Ja genau, einerseits, dass wir die Systeme voll integrieren, wobei das Problem hier ist natürlich immer, dass man auch die organisatorischen Prozesse voll mitbetrachten und eventuell anpassen muss.

DS [00:11:10]: Und welche Probleme und Schwachstellen verursachen diese vorhandenen isolierten Applikationen (Insellösungen) im Unternehmen?

P: Doppelte Wartung von Daten, ungleicher Datenstand mit all den negativen Konsequenzen daraus.

DS [00:11:27]: Inwiefern sind Office- und Collaboration-Software-Systeme (Word, Excel, Outlook, SharePoint etc.) mit euren betrieblichen Informationssystemen (ERP-/CRM-System) integriert?

P: In Wahrheit nicht wenn man sich ehrlich ist. Wir verwenden zwar Excel-Exports und solche Geschichten. Aber integriert ist es aktuell nicht, also zum Beispiel, dass du einen Brief in Navision schreibst, der in Wahrheit ins Word kommt. Integration ist es also nicht wirklich. SharePoint vielleicht ein bisschen, wo wir aktuell versuchen den NAVExplorer ins Laufen zu bringen und wo man halt Dokumentenablagen machen kann

DS [00:12:16]: OK, die nächste Frage hat auch wieder ein paar Unterfragen. Frage 8.1., gibt es auch deiner Sicht bestimmte Abteilungen, die am meisten von der Integration eurer betrieblichen Informationssysteme profitieren?

P: Das ist eine gute Frage. Naja, hauptsächlich die administrativen Abteilungen sage ich mal. Alles was bei uns Finance, Controlling, Supply Chain betrifft, je weniger Doppelarbeiten die machen müssen, umso besser ist es für die. Die profitieren eigentlich am meisten davon.

DS [00:13:00]: Das Thema Doppelarbeiten hatten wir schon. Was wären da aktuell Beispiele dafür?

P: Zum Beispiel User-Eintritt, oder Kostenstellenpflege. Wir haben dafür schon einige Integrationen gemacht, es gibt schon führende Systeme. Beim Artikel zum Beispiel, da gibt es einen Item Master, um hier eine Mehrfacherfassung zu vermeiden. Kunden im CRM-System könnte man sagen, wobei man bei uns das CRM-System eigentlich wieder fast vom Fokus herausnehmen muss.

DS [00:13:51]: Gibt es aktuell einen Mangel an Echtzeit-Auswertungen und Reports aufgrund nicht integrierter, mehrfach überlappender Datenbanken?

P: Eine einzige Auswertung, wo es einen Wunsch gibt, den wir aktuell nicht erfüllen können, ist der aktuelle Lagerbestand gruppenweit. Von einem und denselben Artikel. Das ist jetzt nicht kritisch, aber das können wir aktuell nicht erfüllen, weil ja auch Navision nicht übergreifend ist in Wahrheit. Und wir aber mehrere Datenbanken haben. Sonst werten wir eigentlich alles über das Data Warehouse aus, und da ist tagaktuell eigentlich alles verfügbar.

DS [00:14:54]: Besitzt ihr Dashboards, welche Informationen von verschiedenen betrieblichen Informationssystemen und ev. weiteren Datenquellen auswerten?

P: Momentan gar nicht. Wir versuchen es jetzt mal innerhalb Navision mit sowas zu beginnen. Dashboard ansonsten hat nur eine andere Firmengruppe. Die haben ein Cockpit.

DS [00:15:19]: Gibt es aktuell eine einheitliche Datenbasis für Kundeninformationen? Wenn nicht, auf welche Systeme sind diese verteilt und ergeben sich daraus Probleme für das Unternehmen?

P: Ja wobei im CRM aktuell eher wenig echte Informationen sind, das sind eher Kontaktinformationen. Im Navision ist alles wichtige, was operativ ist. Was getrennt ist, sind Verträge und ähnliche Dinge. Und auch gescannte Dokumente sind getrennt. Aber der grundsätzliche Kundenstamm, hier befindet sich im NAV die Wahrheit. Aber es gibt halt keine Kundenkontakthistorie, zum Beispiel.

DS [00:16:10]: Auf was soll deiner Meinung nach der Fokus bei Versions-Upgrades eurer betrieblichen Informationssysteme in Zukunft gelegt werden? Vor allem in Bezug auf die Integrationsarchitektur um nachhaltige Systeme in der Zukunft zu gewährleisten.

P: Ja Updatefähigkeit (lacht). Ein Großteil der Dinge, wie wir aktuell agieren, hat schon damit zum tun, dass wir uns eben nicht alles in Navision verbauen wollen, im Grunde genommen ist es bei 2 Mannjahren Investition bei der Geschichte, da sieht man das vielleicht nicht, aber wir haben sehr viele Dinge, die wir in der Vergangenheit gemacht haben, ja bewusst nicht ins neue Navision übernommen. Kernfunktionalitäten haben wir nicht unbedingt angegriffen, damit keiner später mehr die Buchungslogik versteht zum Beispiel. Was halt wichtig ist, dass man bei allen Customizingfähigkeiten sich eine gewisse Upgradefähigkeit und Supportfähigkeit noch hält. Ich brauche ja irgendwen noch in der NAVAX, der in 4 Jahren auch noch in der Lage ist zu verstehen, warum ein Lagerwert nicht mehr funktioniert. Und die Voraussetzung hier ist halt, dass die Software zumindest im Kern immer noch so bucht, wie halt ein Navision bucht.

DS [00:17:58]: Sind aktuell Workflows zwischen euren verschiedenen betrieblichen Informationssystemen implementiert?

P: Ist ein Thema, sind aber aktuell nicht implementiert.

DS [00:18:18]: OK, das waren mal die Fragen zum Thema Integration, jetzt hätte ich noch ein paar Fragen zum Thema Cloud. In welchem Ausmaß nutzt ihr im Unternehmen aktuell Cloud-basierte betriebliche Informationssysteme (Software-as-a-Service)?

P: Wir interfacen zu diversen Stellen, das kann man cloudbasierend nennen. Zum Beispiel, wenn du denkst RPS Interface und solche Sache. Das heißt in dem Sinne, wenn wir uns Informationen von anderen Unternehmen holen, dann nutzen wir es. Ansonsten nutzen wir die Cloud aktuell eigentlich nicht. Wobei die gesamte Firmengruppe jetzt bald mal Exchange umstellt auf cloud-basierend, ist aber das erste und meines Wissens nach das einzige große Thema, das wir cloud-basierend haben. Wir haben da immer noch das Thema der Information Security, das uns hier bremst.

DS [00:19:04]: Welche Vor- und Nachteile siehst du in Cloud-basierten betrieblichen Informationssystemen bzw. aufgrund welcher Kriterien kommt eine Anwendung euer betrieblichen Informationssysteme in der Cloud (als Software-as-a-Service) aktuell nicht in Frage?

P: Ja die gibt es. Die Kriterien kann man relativ gut beschreiben. Das erste ist immer, es muss immer im Einklang mit der Information Security Policy des Unternehmen stehen, das heißt, der Dienst, der zur Auswahl steht muss das entsprechend bieten, entweder durch Zertifikate, oder sonst irgendwie anders. Was dann auch noch wichtig ist, ist die Verfügbarkeit, die Möglichkeit, trotzdem zu customizen gegebenenfalls ist ein Kriterium. Und halt Kosten sind ein Kriterium, bis dato würden uns, interessanterweise, die cloud-basierten Microsoft-Produkte mehr kosten als die on-Premise Varianten. Anderes Kriterium ist natürlich auch die Möglichkeit, ob man solch ein derartiges System überhaupt warten kann. Eventuell kann ich sie gar nicht warten, weil ich die Technologie, die dahinter steht,

nicht führe. Wir werden nicht massig Oracle-Lösungen bei uns implementieren. Aber es könnte eine Option werden, ja.

DS [00:20:24]: Inwiefern kann Cloud-Computing, insbesondere Software-as-a-Service, aus ihrer Sicht die Wertschöpfung in einem Produktionsunternehmen steigern, z.B: Prozessoptimierungen, Kostenreduktionen?

P: Naja, das hatten wir noch zu wenig in der Praxis. Wie gesagt, ich sehe die großen Vorteile der Cloud nicht so für Unternehmen, das sehr wohl das eigentlich selbst hosten kann, aufgrund unserer Größe und vorhandenen Infrastruktur. Das Problem wird halt eher sein, dass die Cloud-Lösungen in der Regel eher kaum customizable sind, das geht aber nur bis zu einem gewissen Grad und ist in der Regel nicht akzeptabel für ein Unternehmen wie unseres. Die Frage ist natürlich dann auch, ob es gerade den Kernprozess trifft, den man halt so maßgeschneidert wie möglich braucht, oder trifft es halt irgendeinen Randprozess, wo Abstriche gemacht werden können.

DS [00:21:47]: Ist ein mobiler Zugriff auf eure betrieblichen Informationssysteme (zu jeder Zeit, an jedem Ort) aktuell möglich?

P: Derzeit ist es nicht möglich.

DS: Aber ist ein Thema, oder wie?

P: Naja, also erstens wenn der Web-Zugriff in den neuen Versionen wie gewünscht funktioniert, und zweitens unser Thema Information Security erfüllt ist, wenn das passt, dann können wir uns auch vorstellen, mobil was anzubieten. Der Wunsch ist also da.

DS [00:22:34]: OK, dann sind wir bei der letzten Frage. Und zwar wie stehst du generell zum Thema Sicherheit und Datenschutz bei Cloud-basierten betrieblichen Informationssysteme? Welche Gefahren und Risiken siehst du darin?

P: Das kommt jetzt wieder darauf an. Wenn du wie unser Konzern ein eigenes Infrastrukturunternehmen hast, dann kannst du dich selbst schützen. Das mag für dich dann ein geringeres Risiko sein, als wenn du die Daten in die Cloud packst. Bist du eine kleine Firma, die diese Möglichkeiten gar nicht hat, dann bist du in der Cloud wahrscheinlich besser aufgehoben, weil die Sicherheit dort eher gegeben ist. Also aus unserer Sicht ist es glaub ich ziemlich ähnlich zu bewerten, ich glaube wir können uns selbst ganz gut schützen, so wie auch die großen Cloud-Anbieter. Wenn halt jemand eine Cloud-Lösung hackt, dann hat er halt die Daten von sämtlichen Unternehmen, auch unseren.

DS [00:23:32]: OK ich verstehe. Damit sind wir am Ende des Interviews angelangt, und ich bedanke mich recht herzlich für die Teilnahme am Interview.

P: Gern geschehen, ich hoffe, ich konnte helfen.

Appendix C: Proof of concept implementation

This appendix describes the implementation of the proof of concepts. Thereby, the biggest focus and level of detail was put on the first prototype with Microsoft Dynamics 365.

1. Microsoft Dynamics 365

1.1. Installation

Before describing how the defined make-to-order process scenario (chapter 4.3.1.1) can be implemented within the Microsoft Dynamics 365 product family, an overview about the actual used software systems will be done. Actually, the author used exactly the business information systems from Microsoft as defined and described in chapter 4.3.1.3.1:

- First of all, the **cloud ERP solution Microsoft Dynamics 365 for Finance and Operations** (in the following abbreviated as "**Dynamics 365 FO**") was "installed" whereby the demo company "Contoso company" was used:

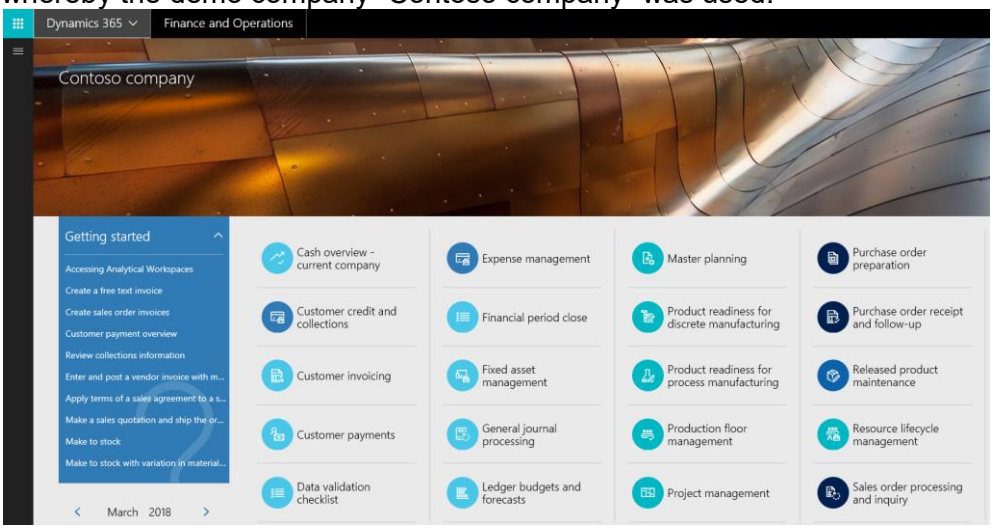

Figure 27: Microsoft Dynamics 365 FO start screen (Own screenshot by author)

- As a **cloud-based CRM system, Microsoft Dynamics 365 for Sales, Business Edition** (in the following "**Dynamics 365 Sales**") was applied:

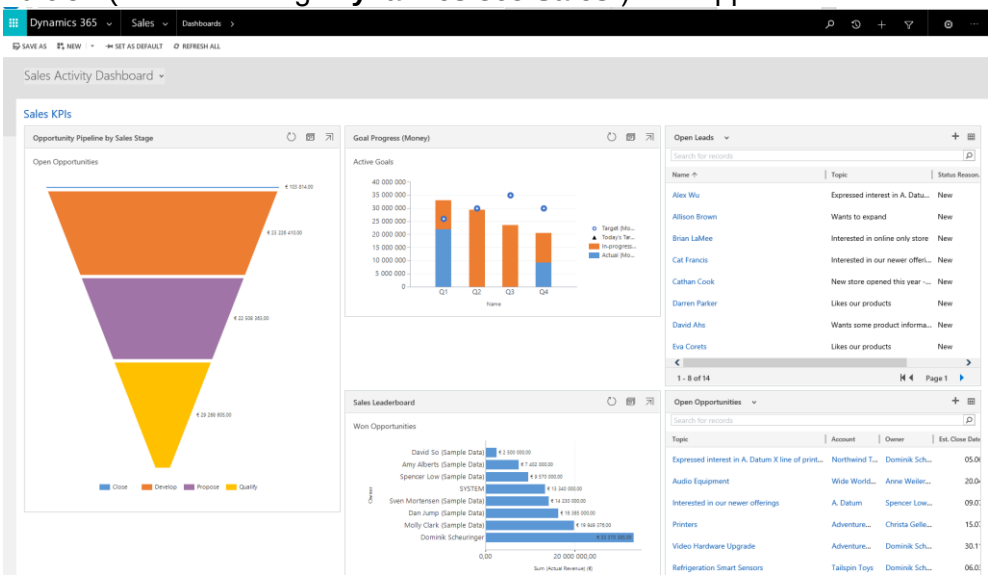

Figure 28: Microsoft Dynamics 365 for Sales start screen (Own screenshot by author)

- For the creation of BI analysis and dashboards, the **cloud-based solution Microsoft Power BI** (in the following "**Power BI**") was utilized:

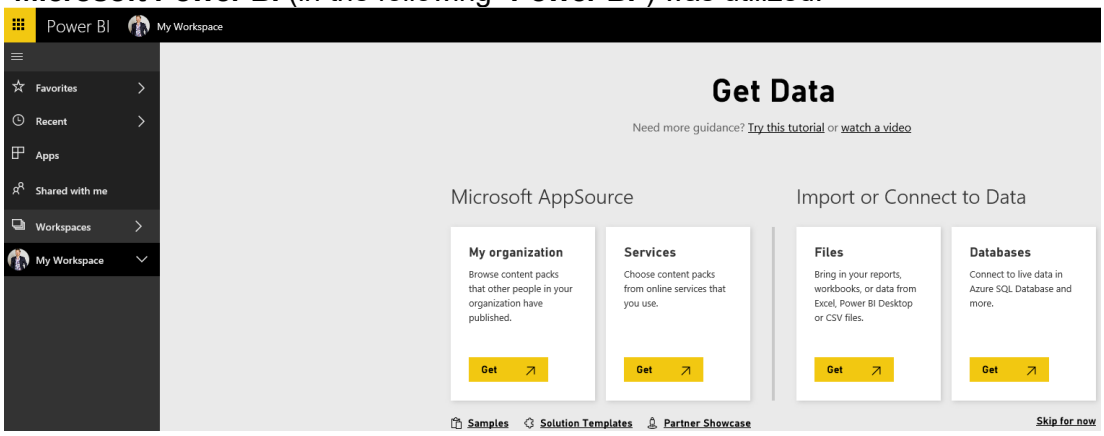

Figure 29: Microsoft Power BI start screen (Own screenshot by author)

- The **cloud-based collaboration environment**, which was used by the author for this proof of concept, was **Microsoft Office 365** (in the following "**Office 365**"):

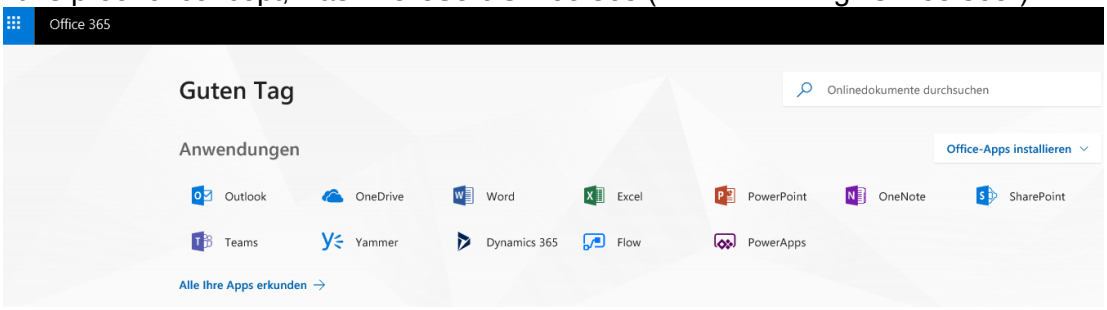

Figure 30: Microsoft Office 365 start screen (Own screenshot by author)

As you can see, beyond the Office products like Outlook, OneDrive, Word, Excel and SharePoint, also the aforementioned Dynamics 365 applications and the productivity services Microsoft Flow and Microsoft PowerApps can directly be started from Office 365. All of them play a role within this proof of concept.

These are the main four BIS, which were used for this prototype. In order to achieve the required level of integration between those four systems, the author additionally used the following **cloud-based productivity services** from Microsoft:

- **Microsoft Flow** as cloud service based on Microsoft Azure, which supports the automation of business processes between the aforementioned BIS:

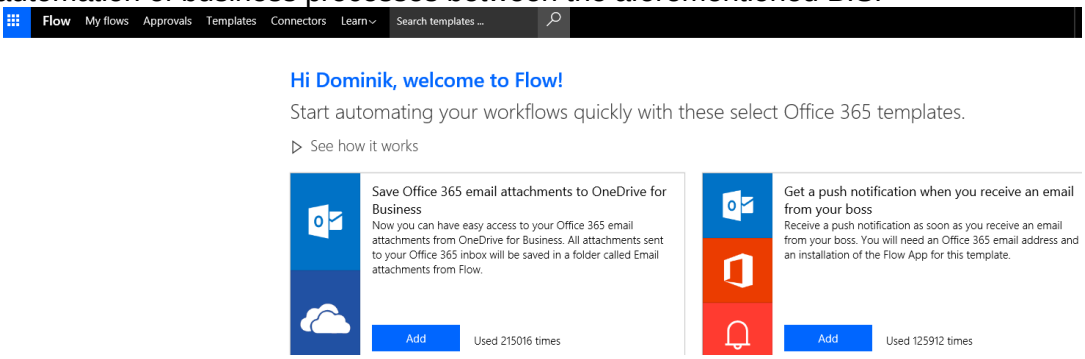

Figure 31: Microsoft Flow start screen (Own screenshot by author)

- **Microsoft PowerApps** which enables the creation of user-defined applications without programming knowledge, based on data from different BIS:

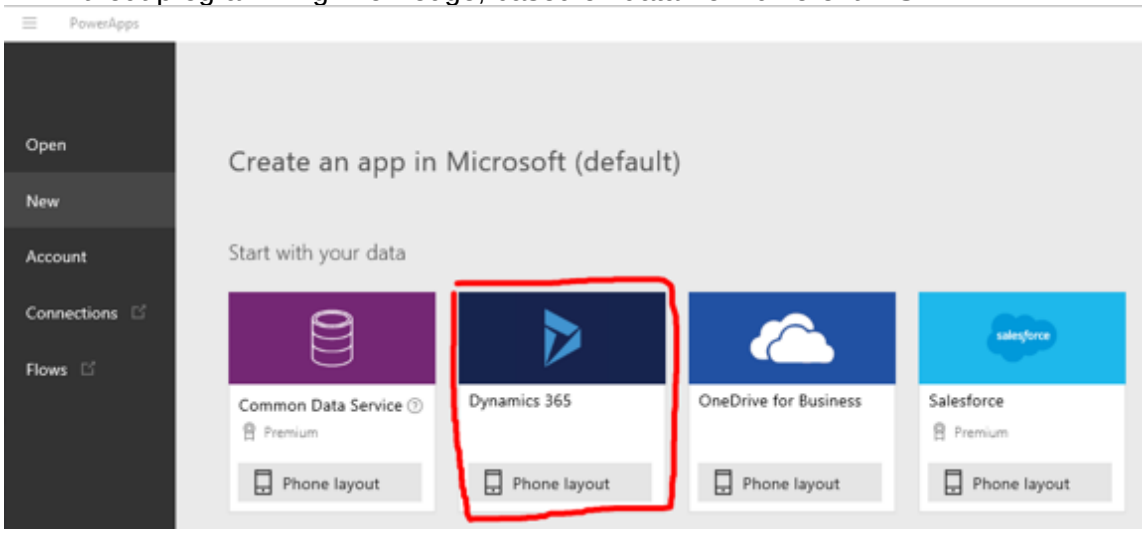

Figure 32: Microsoft PowerApps start screen (Own screenshot by author)

As can be seen above, within PowerApps also the setup and configuration of data integrations among multiple BIS using **Common Data Service** (in the following **CDS**) can be done, which enables to build apps that capture and organize business data using the **Common Data Model**. The Common Data Model facilitates the integration between different BIS by providing template integrations. The reason why CDS is used for the integration (and the data is not directly exchanged between the involved systems) is to allow business users to be able to create business applications more easily, based on Microsoft Power Apps. In this proof of concept for example, CDS enabled to easily transfer customer data between Dynamics 365 Sales and Dynamics 365 FO, without any developing. Finally, this enabled reporting across multiple systems. More details are described below.

As described in chapter 4.3.1.3.1, the foundation for all these cloud services is **Microsoft Azure**. For the monitoring and configuration of the applied cloud services during this proof of concept, Microsoft Azure Portal was used.

1.2. Setup

After “installing” the required systems (actually, there was no real installation necessary, as all of them are cloud services, thus it was more a registration for specific services), some setups and configurations had to be done in order to enable the implementation of the defined processes. As the focus of this thesis is put on the integration among multiple systems, only the **required setups for the integrations** (both data and process integrations) are explained and not all required setups within the individual systems as this would go beyond the scope. Even more, the described integration setups do not cover all details, as this would also extend the scope. Thus, only the main steps including some screenshots are explained.

Data integration

In order to achieve the required level of data integration between the involved systems, the author started by conceptually defining the **data flow** between the two main operating systems of this proof of concept, which are the CRM-system **Dynamics 365 Sales** and the ERP-system **Dynamics 365 FO**. The figure below depicts this data flow. The process

starts in Dynamics 365 Sales by creating a lead, an opportunity, a quote and hopefully a sales order (marked in blue). The order fulfillment and the invoicing, on the other hand, is only monitored within the CRM-system (marked in white). This data goes to the integration platform, which is **Common Data Service (CDS)** and which includes a punch of entities, both master data and document data. CDS makes sure that the required data for this scenario can flow between the two systems. You can see on the arrows in which direction the data is synchronized and the color of the entities defines if the data are editable (dark blue) or only readable (grey) within the individual systems. So for example, the contacts and customers will be synchronized both ways whereas product information can only be edited in Dynamics 365 FO; thus, this information is only synchronized from Dynamics 365 FO towards Dynamics 365 Sales. In Dynamics 365 FO, the quote from Dynamics 365 Sales can be picked up, a sales order can be created, fulfilled (manufactured), delivered and invoiced.

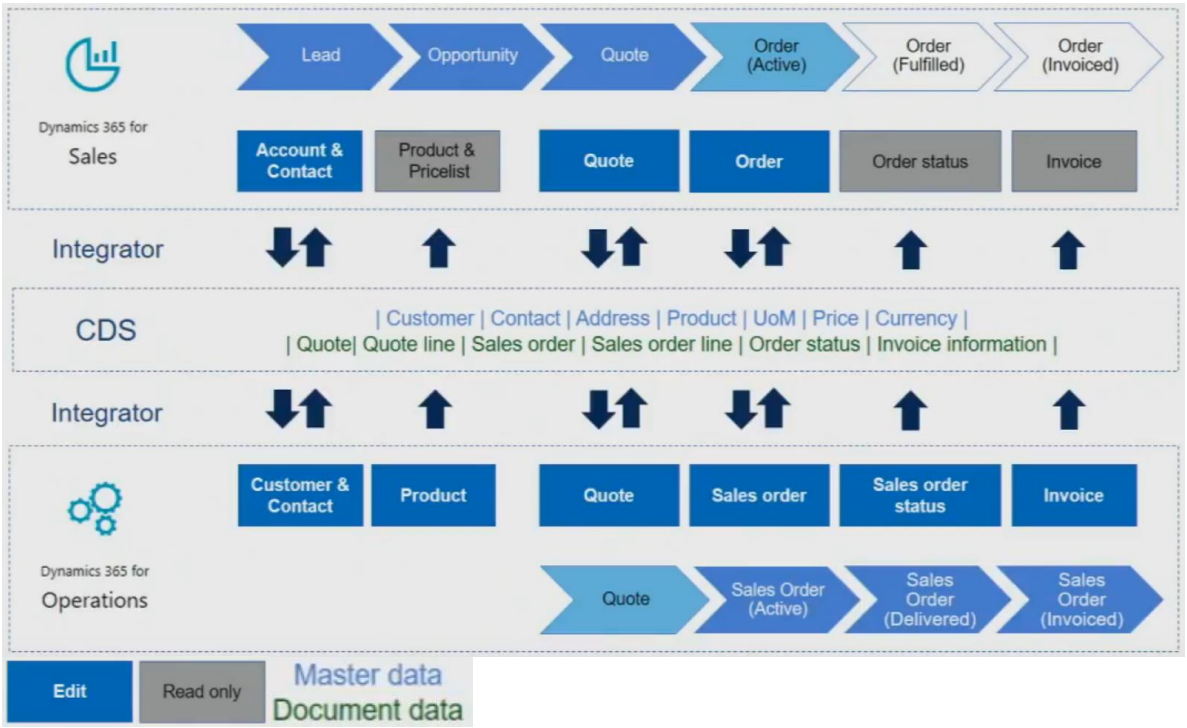

Figure 33: Make-to-order data flow in Microsoft Dynamics 365 (Own creation by author)

For the setup of the data flow as defined above, pre-defined **integration templates** within CDS were used, which include the mapping of the entities and fields between Dynamics 365 Sales, Common Data Service and Dynamics 365 FO. Thus, they enable an easy and fast setup of data integrations among different systems, without developing. Actually, the used integration template contains the **entity mappings** as shown in Figure 33. As can be seen, for example the Customer entity from Dynamics 365 FO must be mapped with both an Account and a Contact in Dynamics 365 Sales, as in Dynamics 365 Sales it is possible to sell both to an account and to a contact, whereas in Dynamics 365 FO it is only possible to sell to a customer. In case of products, not all products from Dynamics 365 FO are transferred to Dynamics 365 Sales, but only sellable released products (the finished bicycle) and not the raw materials needed for production.

Operations	CDS	Sales
Customer	Account	Account
Contact Person	Contact	Contact
Customer	Contact	Contact
Sellable Released Product	Product	Product + Pricelist
Sales Quotation Header	Sales Quote	Quote
Sales Quotation Line	Sales Quote Line	Quote Product
Sales Order Header	Sales Order	Order
Sales Order Line	Sales Order Line	Order Product
Sales Invoice Header	Sales Invoice	Invoice
Sales Invoice Line	Sales Invoice Line	Invoice Product

Figure 34: Microsoft Dynamics 365 Entity mapping (Own creation by author)

Within CDS, all the above-mentioned entities are administrated, which enables to securely store and manage the data within a set of **standard and custom entities** (which is like a table in a database). Even if it would be possible to create custom entities, this was not necessary for this proof of concept.

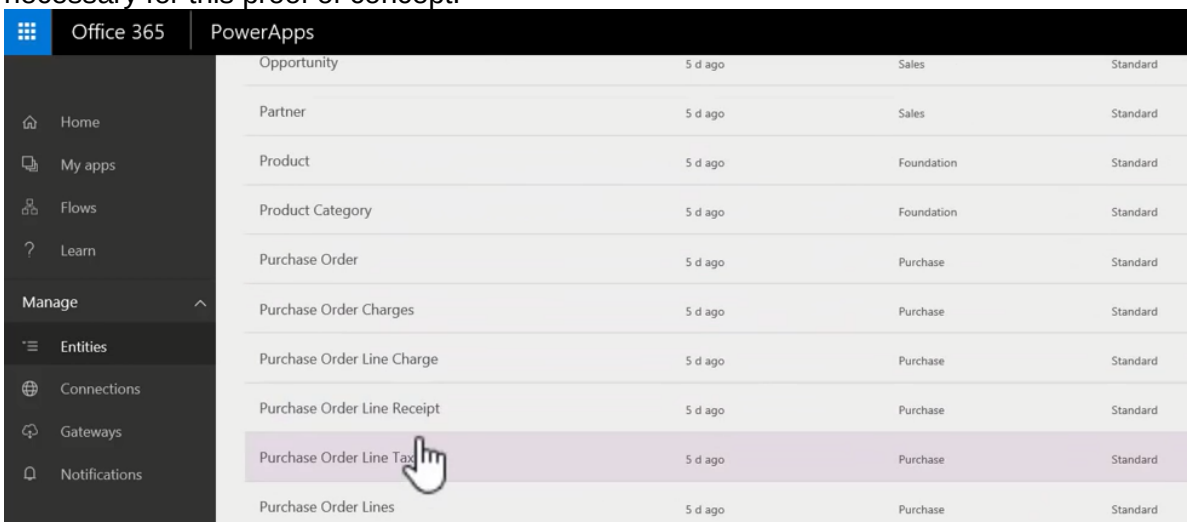

Figure 35: Common Data Services entities (Own screenshot by author)

Technically speaking, these **entity mappings** include detailed field and value mappings, which are not described within this Master Thesis in more detail, as this would go beyond the scope. Even if the integration templates already cover a wide range of functionality, the benefit at this point is that these integration templates are customizable, thus you could extend them or you could also create new templates. However, this was not done for this proof of concept, as it was not necessary.

Based on this integration template, the author created an **integration project** within the data integration admin center of Office 365 by selecting the integration template, a Dynamics 365 Sales connection, a Common Data Service connection and a Dynamics 365 FO connection. Before the integration project could be used, a **connection** for both systems was provided, which also needs to be done within Microsoft PowerApps Admin Center. Here you could also create connections for many other cloud-based systems.

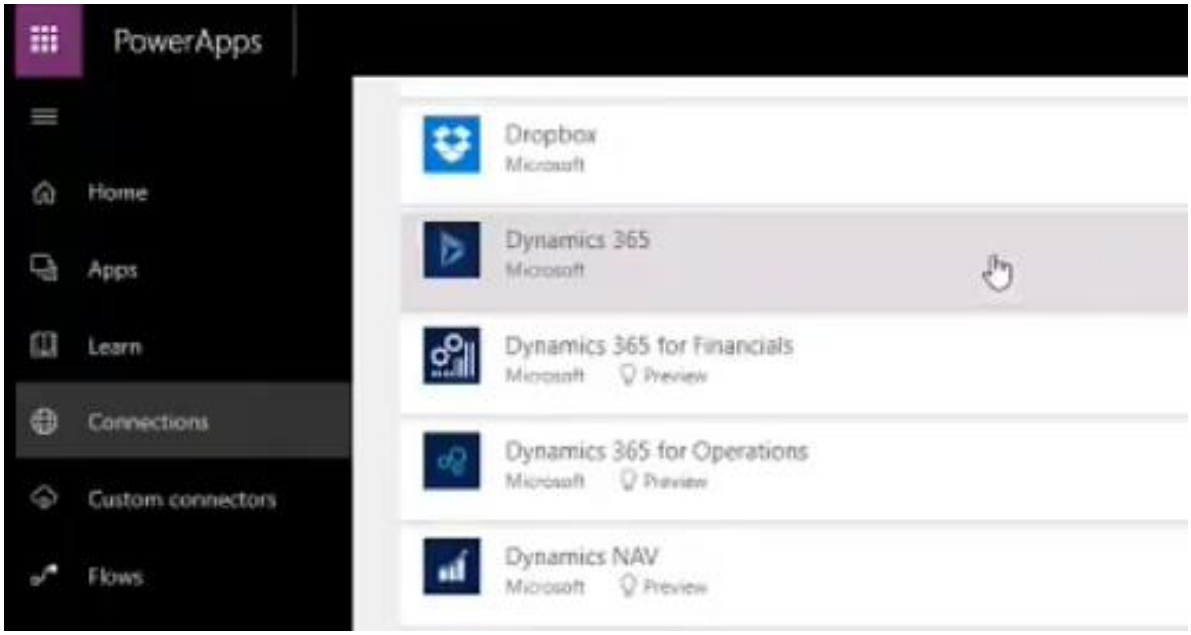

Figure 36: Common Data Service Connections (Own screenshot by author)

Afterwards the created connections for Dynamics 365 Sales and Dynamics 365 FO were used for the integration project together with the selected integration template:

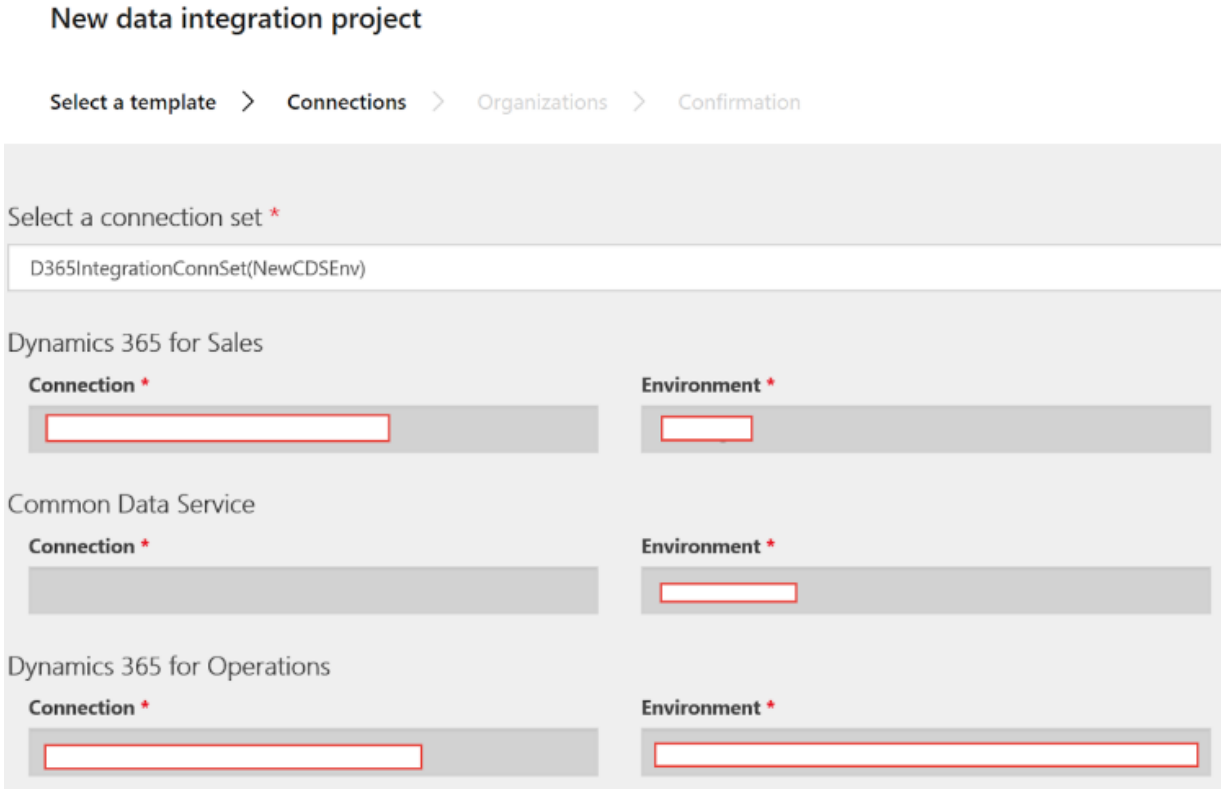

Figure 37: Data integration project (Own screenshot by author)

As a result, the following **data integration task** within CDS was created, which provides the integration between *accounts* in Dynamics 365 Sales (Source) and *customers* in Dynamics 365 FO (Destination). Thereby, the provided standard field- and value mapping already fulfilled the requirements of this scenario, thus no customization was necessary.

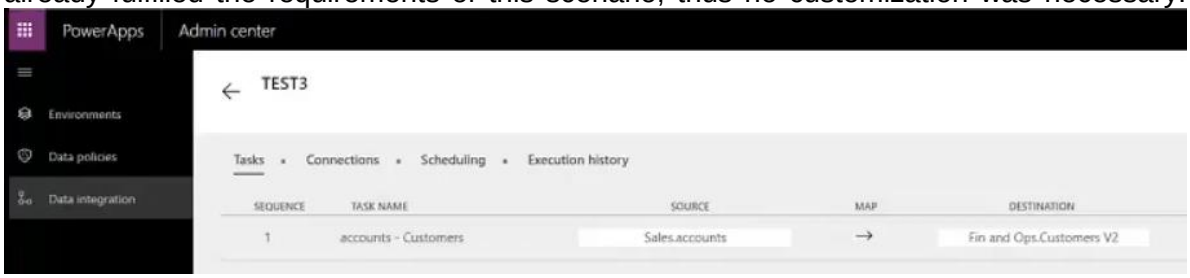

Figure 38: Data integration task in Common Data Service (Own screenshot by author)

Analogously, such an integration task was created for all required integrations, as defined in the data flow above, each time based on the already existing integration templates:

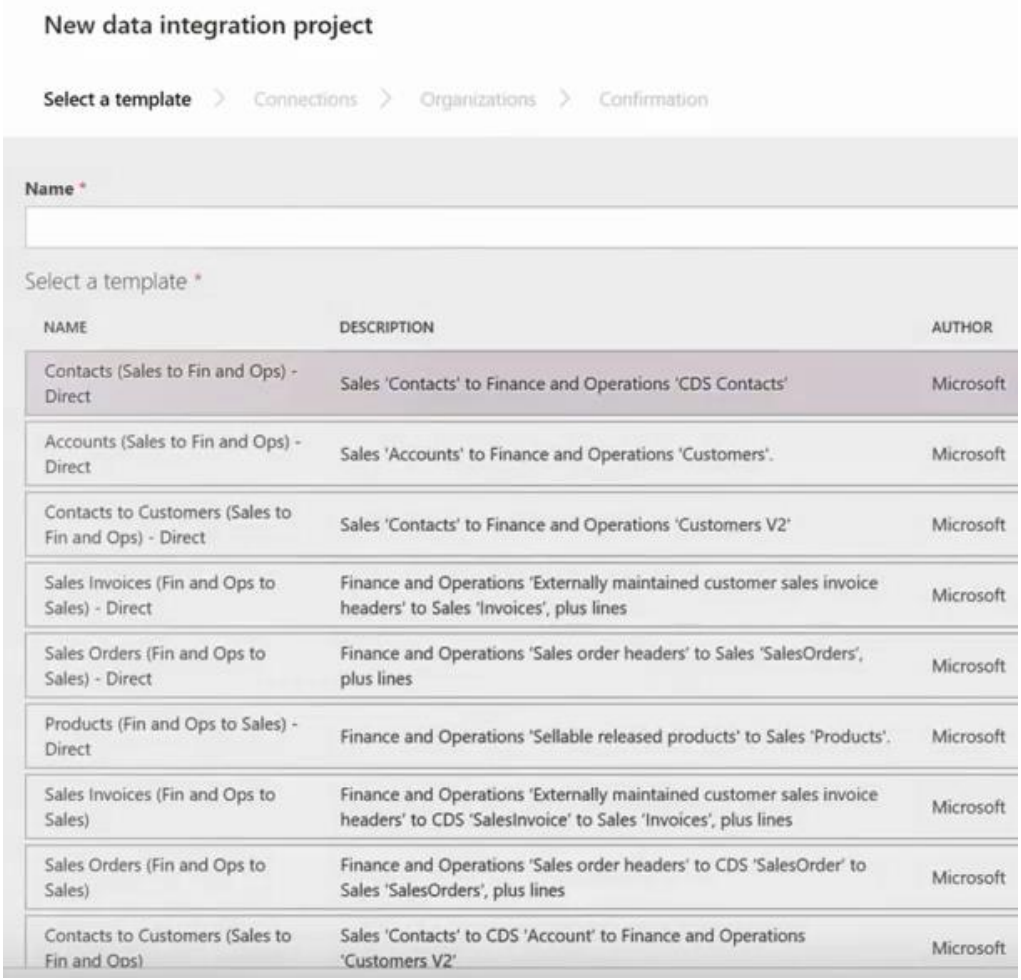

Figure 39: Standard data integration templates (Own screenshot by author)

In order to trigger the integration, for example, the integration between CRM accounts and ERP customers as defined above, there are two options. It is either possible to setup a schedule (e.g. hourly) or the integration should occur in real time after a specific event (e.g. after inserting or modifying one of the two records), which can be setup using **Microsoft Flow** in terms of a workflow and is explained below within the process integration section.

The CDS admin center also includes a **dashboard for the administration of the data integrations**, which enables easy scheduling and monitoring.

Process integration

Next to the data synchronization and integration, a definition and setup of the process integration must have been done. This mainly includes that as soon as specific data shows up in a specific system, a specific business process shall be triggered in terms of a workflow. For that purpose, the author mainly used **Microsoft Flow**.

In the make-to-order process scenario, the first **workflow** which shall be executed, is that when a new *contact* is created in Dynamics 365 Sales (via Outlook), a back-office employee shall be automatically notified via email, that the newly created *contact* must be completed. In order to achieve that workflow, the following steps must be accomplished:

1. New contact is created in Dynamics 365 Sales.
2. Microsoft Flow picks up the newly created contact record by using the standard Dynamics 365 connector. More details about the setup of this step are described below.
3. The new contact record is written into the Common Data Model through Microsoft Flow.
4. As an optional step, which is not required in this scenario, once the data is inside the Common Data Model it could be exposed by Microsoft Power Apps by providing a mobile app, which enables to browse contacts, also for users who are not Dynamics 365 users.

Consequently, in order to enable the process integration among multiple systems, a **combination and interaction of both CDS** (for the cloud-based data storage and data consolidation) and **Microsoft Flow** (for the automation), eventually supported by **PowerApps** (for mobile experiences) is required, which is summarized in Figure 40 below.

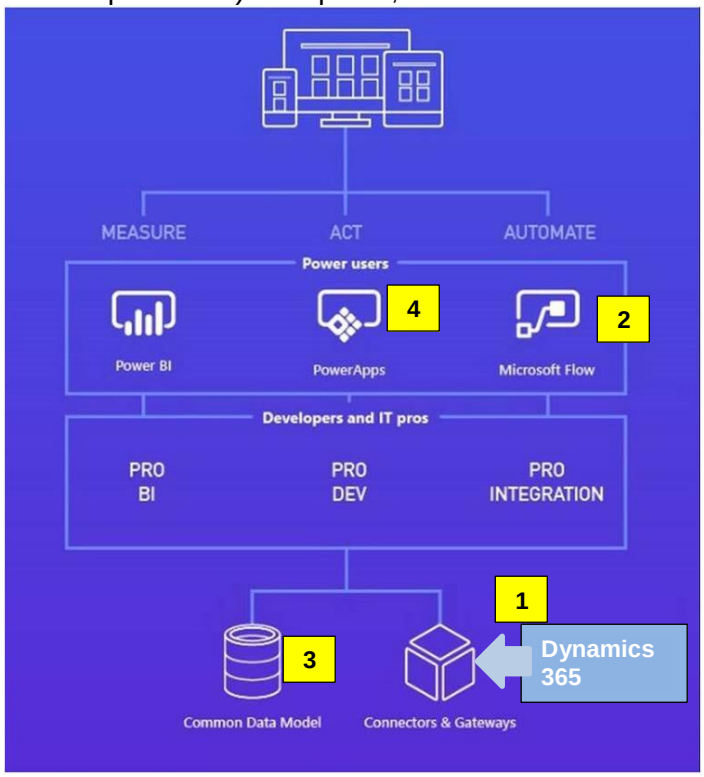

Figure 40: Process integration with CDM, Flow and PowerApps (Simens, 2017)

In order to setup the second step, i.e. the **automation part by means of Microsoft Flow**, the author logged into Flow (with the Office 365 account) and created a new Flow by using a template. The main benefit of Flow at this point is, that Microsoft already provides a great number of default flows, spanning across lots of different cloud-based BIS and services.

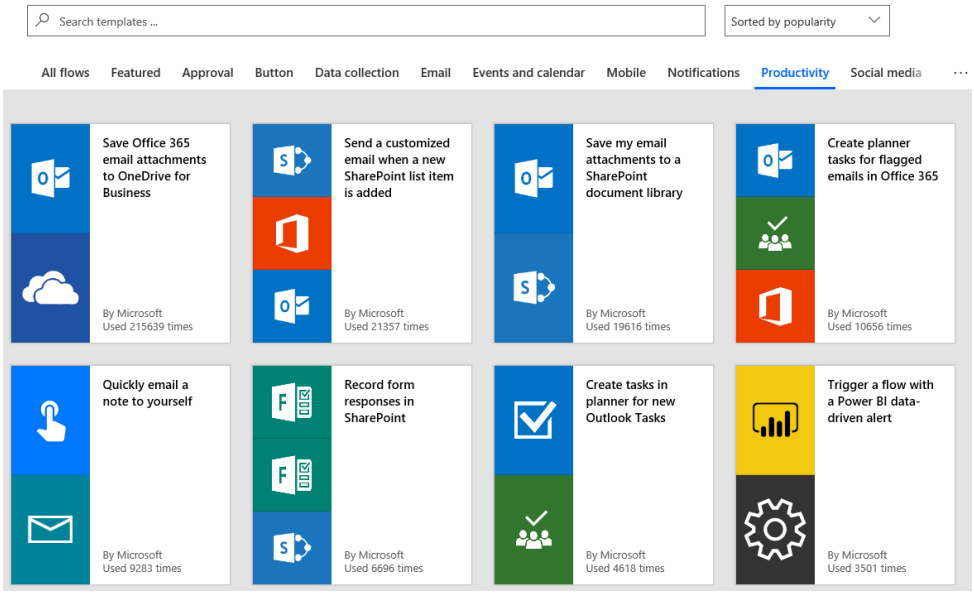

Figure 41: Microsoft Flow templates (Own screenshot by author)

Thereby, not only connectors for Dynamics 365 services, but also for other cloud-based Microsoft services (e.g. Microsoft translator) and for other third-party cloud services (e.g. for the cloud-based CRM-system Salesforce.com) exist, as can be seen in Figure 42. However, the author expects that this list will continue to grow more in the future.

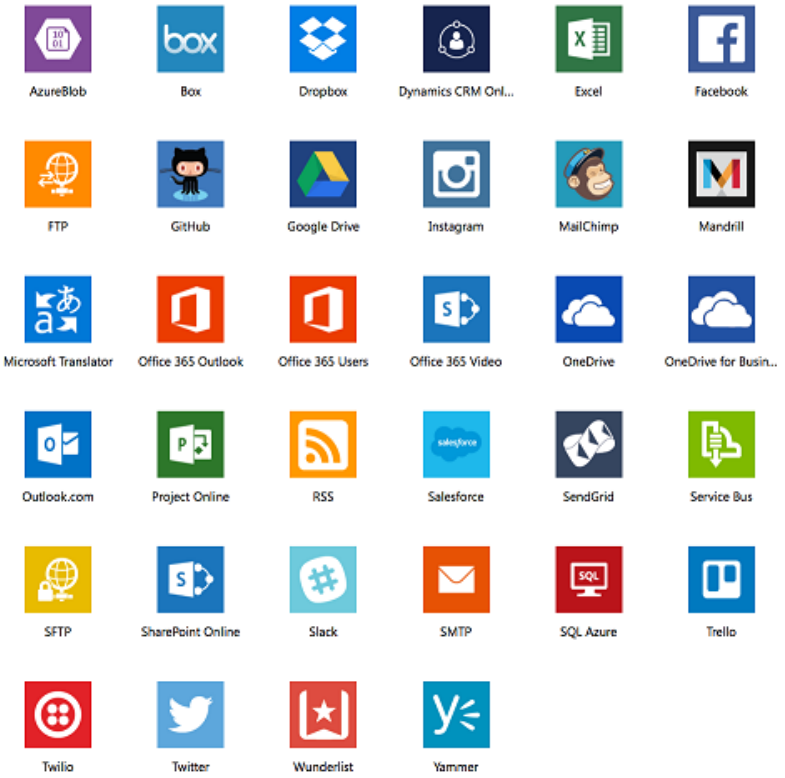

Figure 42: Supported services by Microsoft Flow (Own screenshot by author)

After selecting the service, which is *Dynamics 365* in this case, a **trigger** was selected. As the trigger of this workflow is a newly created contact, the trigger "*Dynamics 365 - When a record is created*" was chosen:

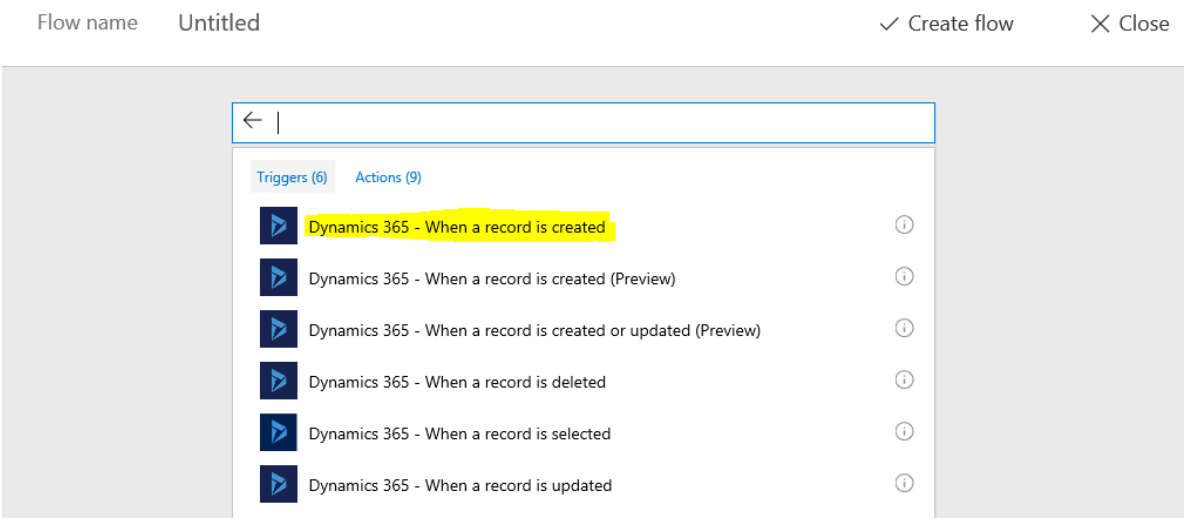

Figure 43: Trigger for a new Microsoft Flow (Own screenshot by author)

After selecting the related **organization** and **entity** (which was the *Contact* in that case), the next step was to define the Action.

Figure 44: Setup of new Microsoft Flow (Own screenshot by author)

For the definition of the **action**, a huge number of functionalities exists, like adding conditions, adding loops and so on. However, the author will not go in detail on that point. Actually, the action defined by the author implicated an automatic e-mail delivery to a specific e-mail address (for demo purposes the author's student e-mail address) about the newly created contact.

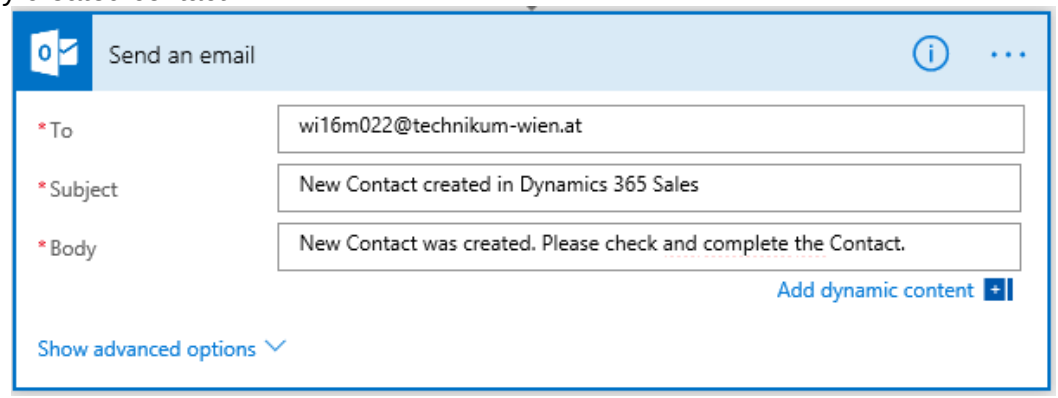

Figure 45: E-Mail Notification with Microsoft Flow (Own screenshot by author)

However, the action could also be an action within Dynamics 365, by retrieving, creating, updating or deleting any record in Dynamics 365 or within many other systems, as can be seen in Figure 46:

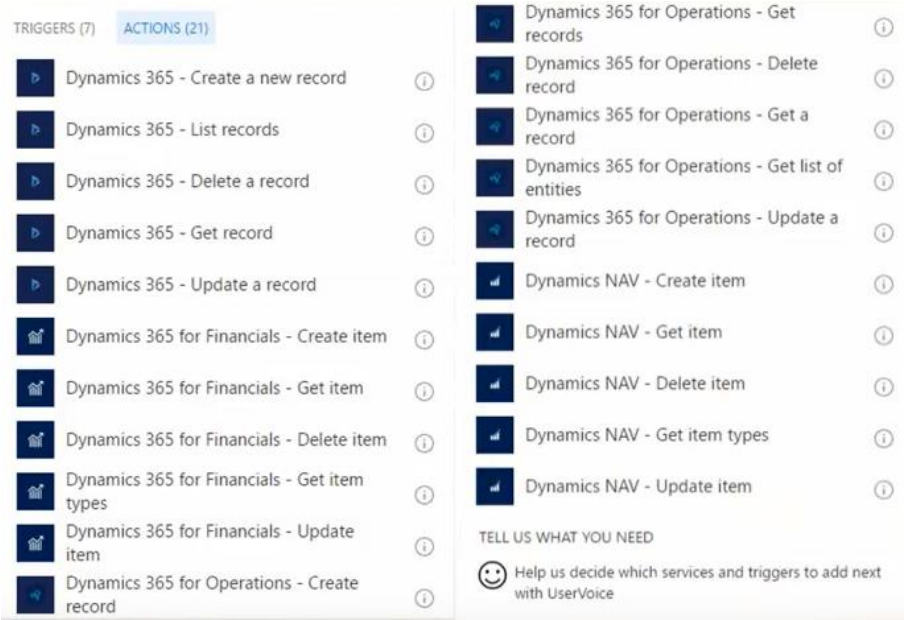

Figure 46: Microsoft Flow actions within Dynamics 365 (Own screenshot by author)

During the posting of the sales shipment, a further process integration should take place, this time with **Microsoft SharePoint**. Actually, based on the shipment of the finished bicycle to the customer, the creation of an order documentation and the storage of this documentation within a document management system (e.g. Microsoft SharePoint or OneDrive for Business) shall be triggered. For the setup of this workflow, the author used again Microsoft Flow. As the author could not find a proper template within Microsoft Flow, which fulfills this requirement, a new Flow was created from scratch. The main structure of the Flow can be seen in Figure 47. When a new record is created in Dynamics 365 FO (which was parametrized for a *posted sales shipment*), a new item shall be created within a parametrized SharePoint environment. Behind the "*Create Item*" activity, it was configured which document must be stored within which SharePoint site.

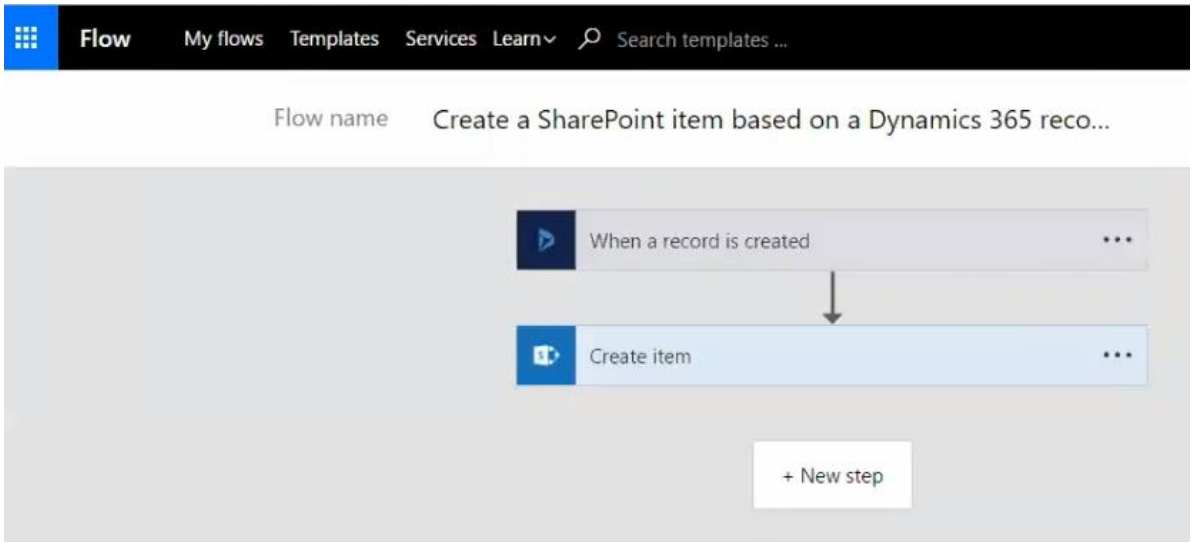

Figure 47: Microsoft Flow for integration between Dynamics 365 and SharePoint (Own screenshot by author)

However, independent of the usage of Microsoft Flow, there already exists a **standard integration between Dynamics 365 Sales and Microsoft SharePoint**. This only needs to be activated within the Dynamics 365 Settings:

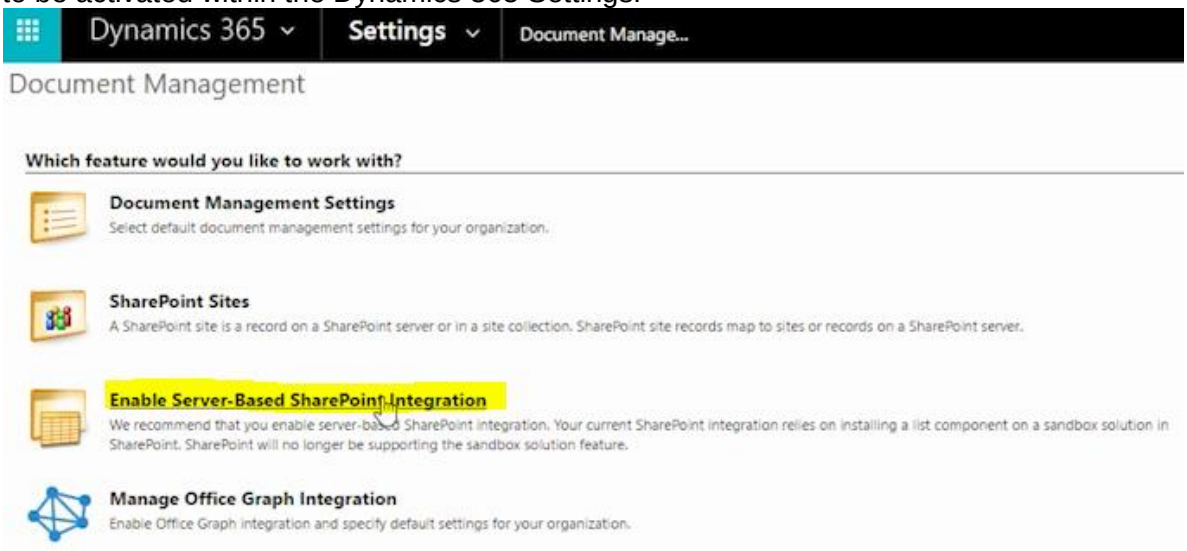

Figure 48: Enable standard integration between Microsoft Dynamics 365 and SharePoint (Own screenshot by author)

Afterwards you can also setup which **types of records** of Dynamics 365 Sales (e.g. accounts, contacts, leads, etc.) should have documents in SharePoint associated with them. The advantages and purposes of this standard integration are described in the demo (chapter 1.3) below.

Finally, the author would like to point out that, as soon as business data from multiple different data sources (so in that proof of concept mainly from the ERP- and CRM-system) is consolidated within the Common Data Model through CDS, **custom-made mobile apps** can be built by using **Microsoft Power Apps**. An example therefore would be an app for a customer success manager of a company, who needs to monitor the customer's usage and satisfaction from their products. This requires the matching up of data from multiple data sources, e.g. service activities from Dynamics 365 for Field Service (separated Dynamics 365 application specialized on service and maintenance activities), open sales orders from Dynamics 365 FO, marketing events from Dynamics 365 Sales and customer metrics from Power BI. The main benefit at this point is that the customer success managers get a **360-degree view of a customer within a single application**, without having to open and switch between the different applications. Even more, they can also access this data via mobile apps at any place. On the other hand, the creation of such PowerApps is very easy and straightforward and can be done without "real" programming knowledge, as a visual app designer exists for that (however, for advanced apps, some coding commands must be applied). Figure 49 shows how such a PowerApp for the just explained example could look like. Beyond this main screen, which enables a 360-degree view of customers, detailed analysis can be made by clicking on the drill down buttons of the app.

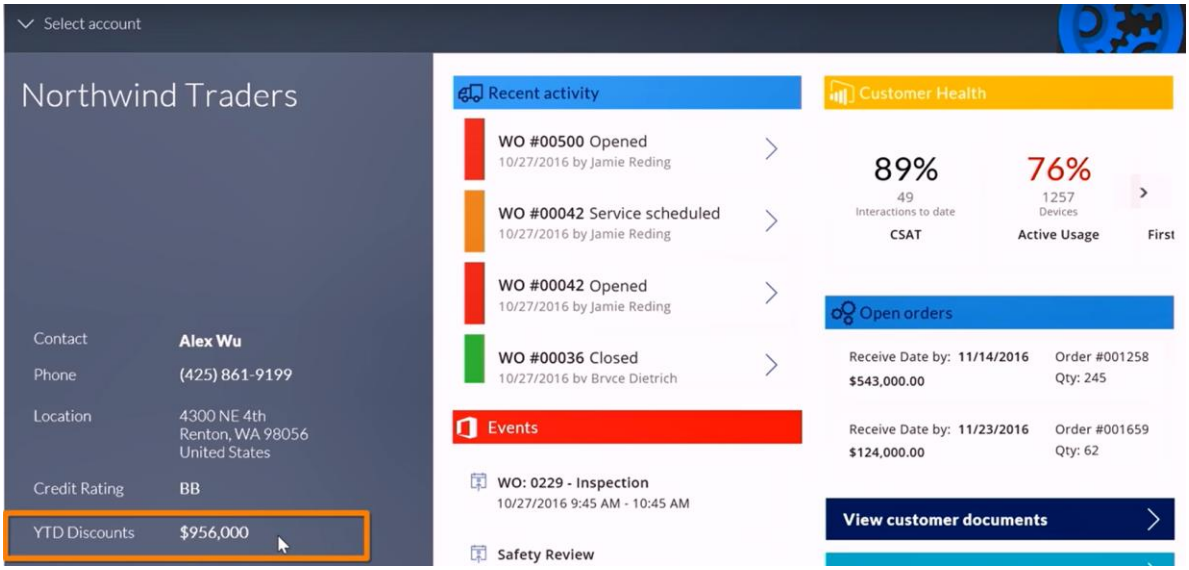

Figure 49: Example for a PowerApp (Own screenshot by author)

Finally, the following figure depicts a high-level overview about the relationships of the involved cloud-based services and systems of this proof of concept:

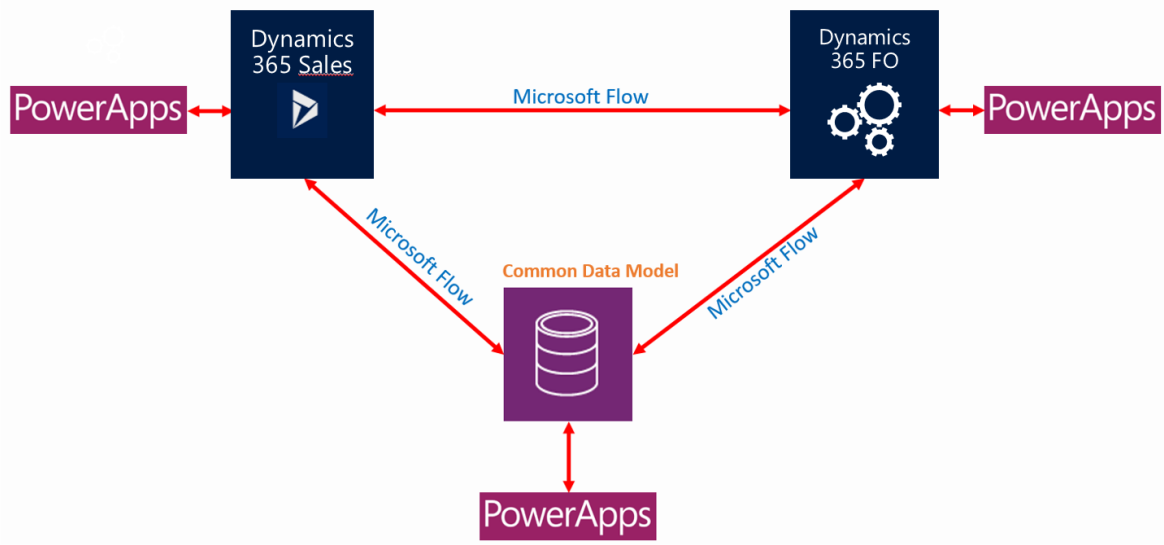

Figure 50: Service landscape Microsoft Dynamics 365 (Own creation by author)

1.3. Demo

After installing all the aforementioned systems (each time with a demo version) and setting up the data flow and process flow, it was possible to implement the defined make-to-order process scenario within the systems. This will be demonstrated with a rough iteration of the defined make-to-order process now.

Pre-Sales

A sales person of the demo company (author of this Master Thesis) receives an email from a prospect (Catherine Ryan from the company Northwind Traders) interested in a specific bicycle. Thereby, the sales person can directly see within **Office 365** within his/her **Outlook** application if a *contact* for that prospect already exists in Dynamics 365 Sales

(within the Dynamics 365 pane in Outlook). If not, Office 365 offers the possibility to directly **create the contact** in Dynamics 365 Sales out of Office 365 Outlook:

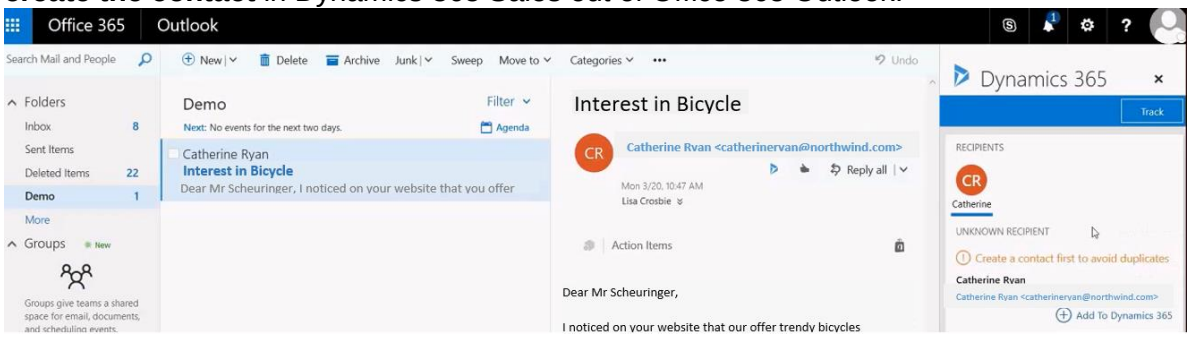

Figure 51: Dynamics 365 Connector in Office 365 Outlook (Own screenshot by author)

After clicking on "*Add to Dynamics 365*", a window opens which enables the sales person to enter contact data, whereby information like first name, last name or email address are automatically populated based on the email content. Additionally, the email is tracked as an activity against that contact which can be seen in Dynamics 365 Sales.

On the other hand, if the contact would already exist in Dynamics 365 Sales, the sales person could directly see in Outlook within the Dynamics 365 pane some **related information to the CRM contact**, including the possibility to directly open the contact card in Dynamics 365 Sales from Outlook:

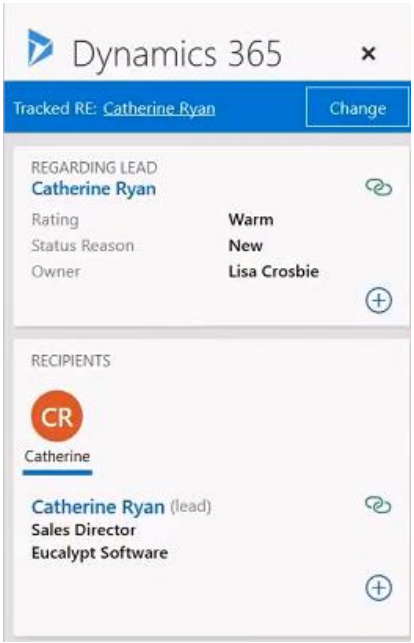

Figure 52: Show Dynamics 365 Sales contact in Outlook (Own screenshot by author)

In the opposite direction, it is also possible to **synchronize data from Dynamics 365 Sales into Office 365**. For example, after creating a new **appointment** for a contact in Dynamics 365 Sales, this is automatically added to the Outlook calendar of the relevant sales person. Equally, as shown above for the email, the sales person can directly see in the Outlook appointment within the Dynamics 365 pane some relevant information about the concerned contact coming from Dynamics 365 Sales.
Furthermore, the sales person can also directly **read and reply to emails** from a contact within Dynamics 365 Sales instead of Outlook, as can be seen in the following figure:

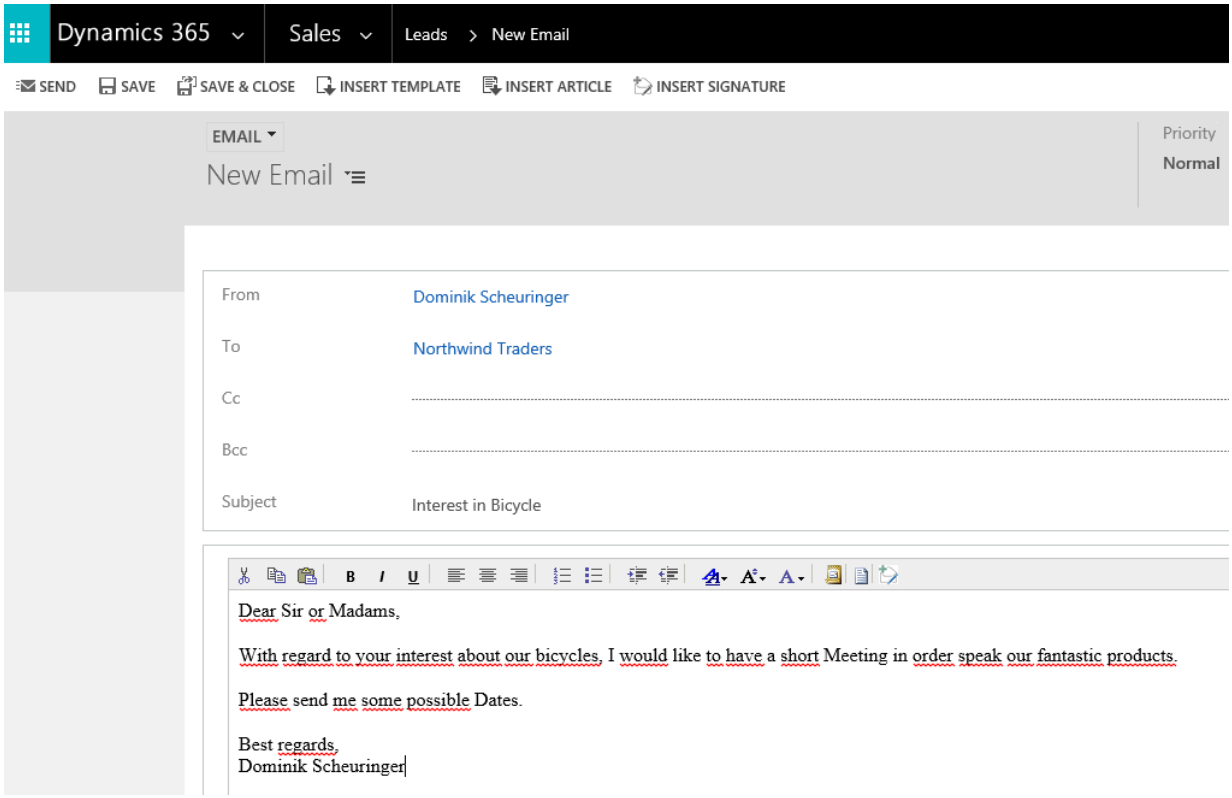

Figure 53: Send Email out of Dynamics 365 Sales (Own screenshot by author)

Consequently, the sales person can do both **CRM activities within Office but also Office activities within CRM**. Thereby, no additional setup and configuration is necessary.

Additionally to new contacts, the sales person can also create other CRM records directly out of Office 365 Outlook using the *quick create function* in the Dynamics 365 pane:

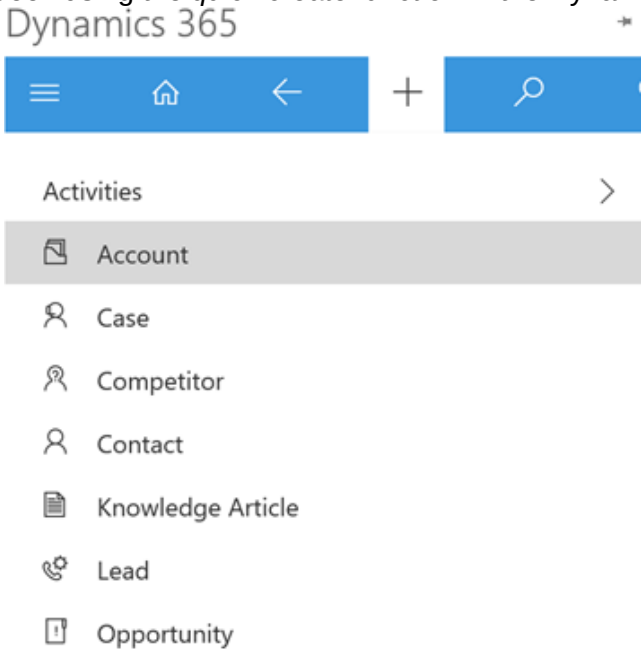

Figure 54: Creation of CRM records out of Outlook (Own screenshot by author)

Additionally, it can be searched for CRM data directly within Office 365 Outlook:

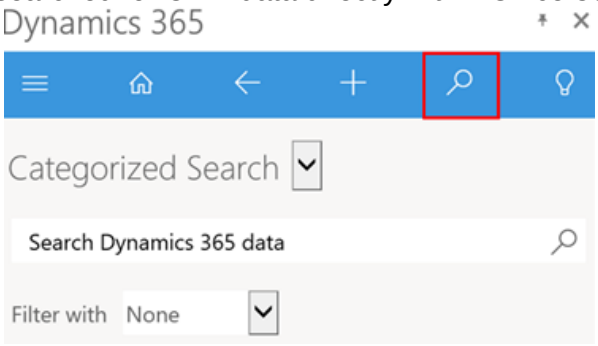

Figure 55: Search for CRM records out of Outlook (Own screenshot by author)

After the sales person creates a new contact out of Office 365, a specified back-office employee **automatically receives an email** about the newly created contact including a link to the contact in Dynamics 365 Sales. Thus, the back-office employee can directly open the affected contact card out of the email in Office 365 in order to fill out the contact card in Dynamics 365 Sales completely. This automatic email notification happens due to the established Microsoft Flow in chapter 1.2.

As a next step, a new **lead** in Dynamics 365 Sales was created and qualified, which can either be done directly out of Outlook in context of a specific email (as shown in Figure 54) or of course within Dynamics 365 Sales. Continuing, with the **opportunity** created from the lead in Dynamics 365 Sales, a new **customer** in Dynamics 365 FO was created automatically based on the account in Dynamics 365 Sales. This automatic creation of the customer was enabled due to the defined data integration task in chapter 1.2.
Thereby it is possible to open the created customer record of Dynamics 365 FO directly from Dynamics 365 Sales. For example, in order to see information like credit limits, which are only stored in the ERP-system:

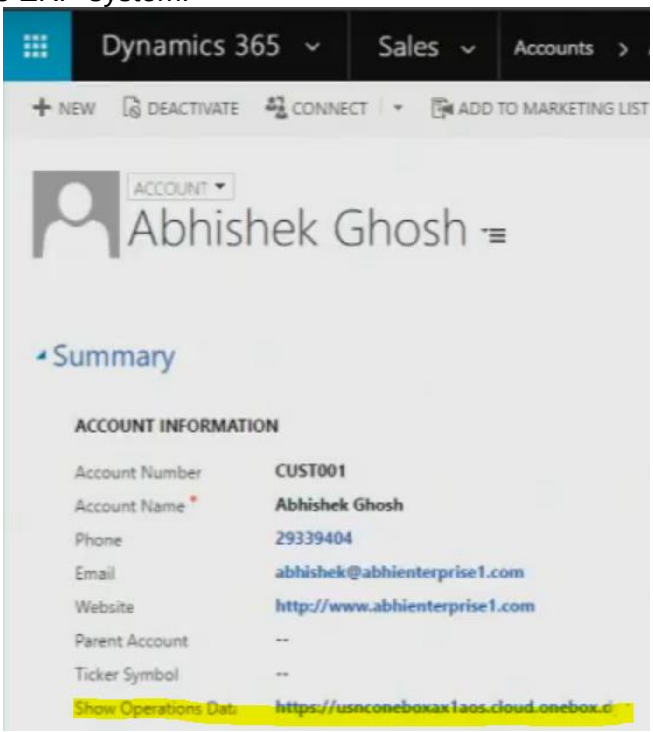

Figure 56: Open Dynamics 365 FO Customer from Dynamics 365 Sales (Own screenshot by author)

Afterwards, the desired **product** (bicycle) from the customer was added to the opportunity in Dynamics 365 Sales. The main benefit at this point is that the product information from Dynamics 365 FO are already synchronized into Dynamics 365 Sales, thanks to the pre-defined data integration task.

The next step in Dynamics 365 Sales was the creation and activation of the **sales quote** based on the opportunity. Thereby, as just mentioned, the product inventory from Dynamics 365 FO can directly be shown within Dynamics 365 Sales. In addition, the information about the current unit price, the price book and the inventory site, where the product is located, are coming from Dynamics 365 FO and are shown within Dynamics 365 Sales. This is also enabled due to the established data integration.

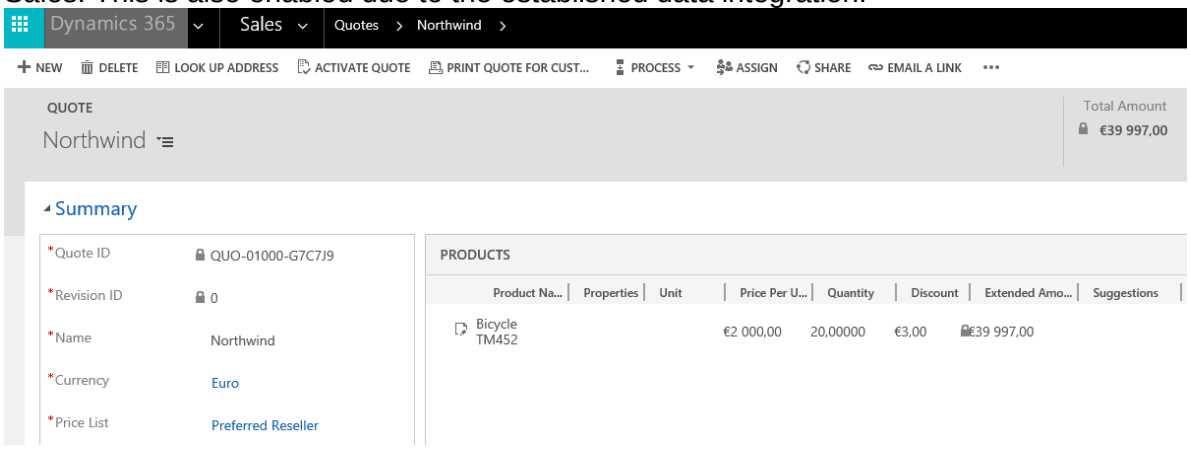

Figure 57: Sales Quote in Dynamics 365 Sales (Own screenshot by author)

Finally, the sales quote was sent to the customer's e-mail-address directly from Dynamics 365 Sales without switching to Outlook.

After the customer received the quote, **price negotiations** between the customer and the sales person were done, mainly by means of email communication. Thereby, due to the integration between Dynamics 365 Sales and Office 365, the sales person can directly consider all the **key facts about the sales quote within the email in Outlook** (product number, product description, quantity, price, discount, etc.), without switching to Dynamics 365 Sales.

Additionally, the sales person is supported by showing **customer statistical information** like open balance and information about the **sales history** directly in Office 365 Outlook:

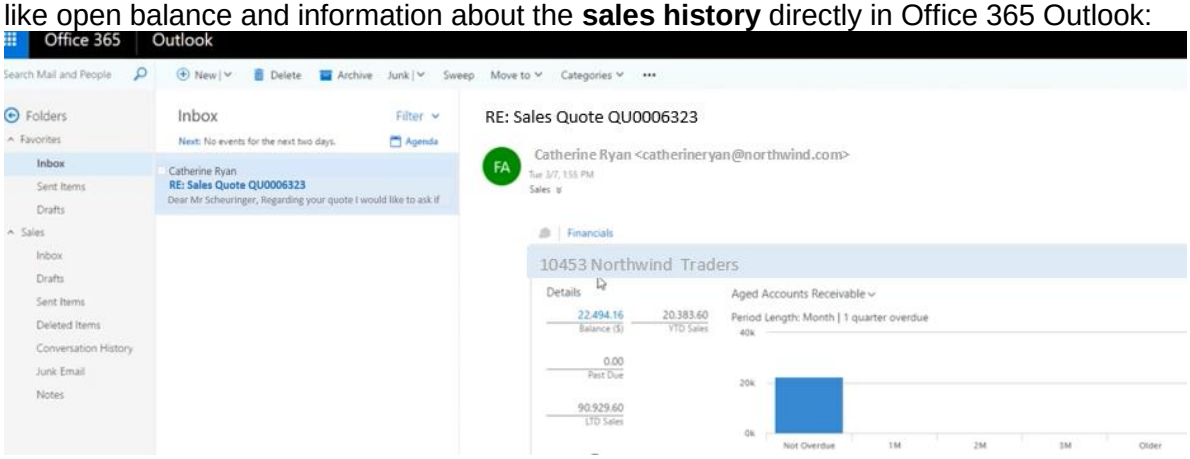

Figure 58: Visibility of customer sales history in Outlook (Own screenshot by author)

Finally, the customer accepted the quote and a **sales order** was created directly from the sales quote in Dynamics 365 Sales. Based on this and as defined in the dataflow at the beginning, the sales order was also automatically created within Dynamics 365 FO. In order to be consistent, the number of the sales quote from Dynamics 365 Sales is directly visible on the created sales order in Dynamics 365 FO, including the possibility to open the sales quote in Dynamics 365 Sales directly form Dynamics 365 FO.

During the whole pre-sales process, the sales person is supported by means of **BI sales dashboards**. These dashboards, containing information from multiple systems, were created in **Power BI**. For this scenario, the author created a dashboard named "*Sales Analytics for Dynamics 365*" in Power BI, which shall be added to Dynamics 365 Sales:

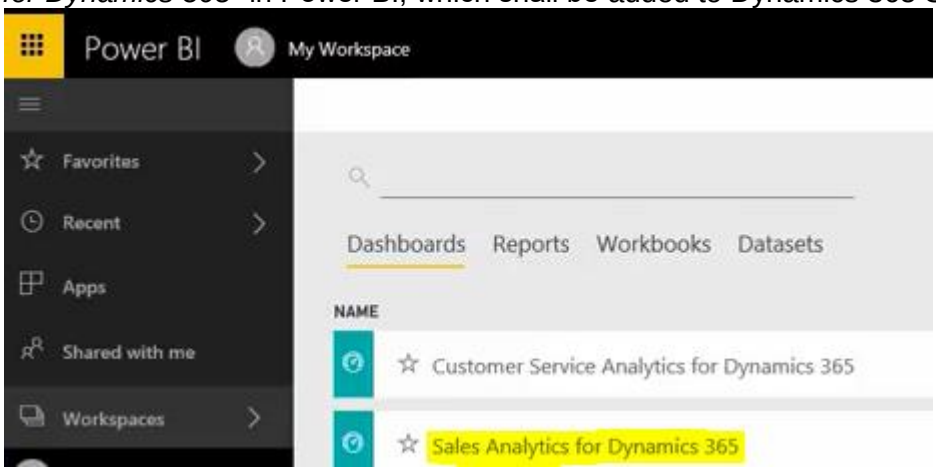

Figure 59: Power BI dashboard (Own screenshot by author)

Afterwards the created dashboard in Power BI was directly added in Dynamics 365 Sales:

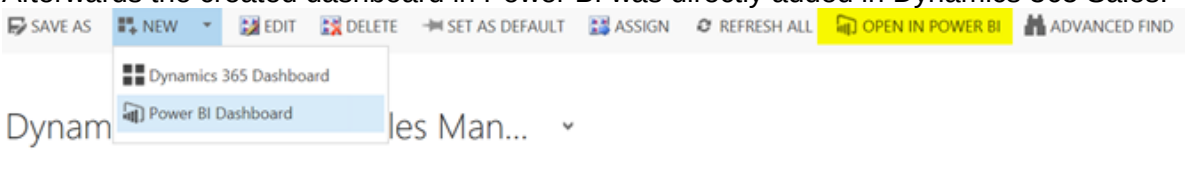

Figure 60: Add Power BI dashboard in Dynamics 365 Sales (Own screenshot by author)

Finally, the sales person can see the Power BI dashboard directly within Dynamics 365 Sales including the possibility to open the dashboard in Power BI for more detailed analysis:

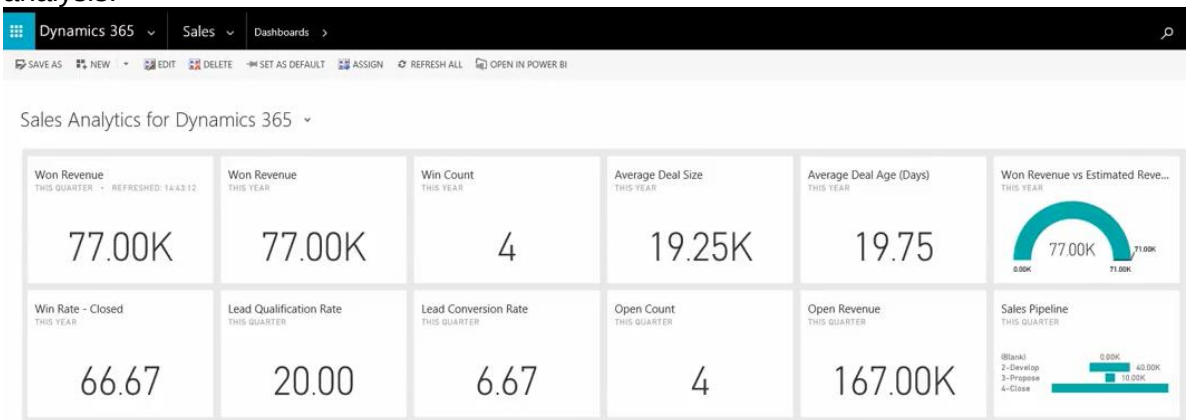

Figure 61: Power BI dashboard in Dynamics 365 Sales (Own screenshot by author)

Sales and manufacturing

Now, the sales order was processed in the ERP system (Dynamics 365 FO), starting with a planning process (**manufacturing resource planning**) within Dynamics 365 FO. Consequently the creation of the manufacturing order for the finished product (bicycle), the scheduling of the manufacturing order, the creation of the purchase orders for the semi-finished products and raw materials and the capacity and resource planning (work places etc.) was done within Dynamics 365 FO. As all these activities only concern one system (the ERP system Dynamics 365 FO), the author will not go into more detail regarding those steps, as this would go beyond the scope.

At the end of the **manufacturing process**, the quantities of the consumed semi-finished products and raw materials were entered into an excel-file by the manufacturing employees (who have no access to Dynamics 365 FO), which should directly be written back to Dynamics 365 FO. In order to make that possible the author exported the consumption journal out of Dynamics 365 to Office 365 Excel:

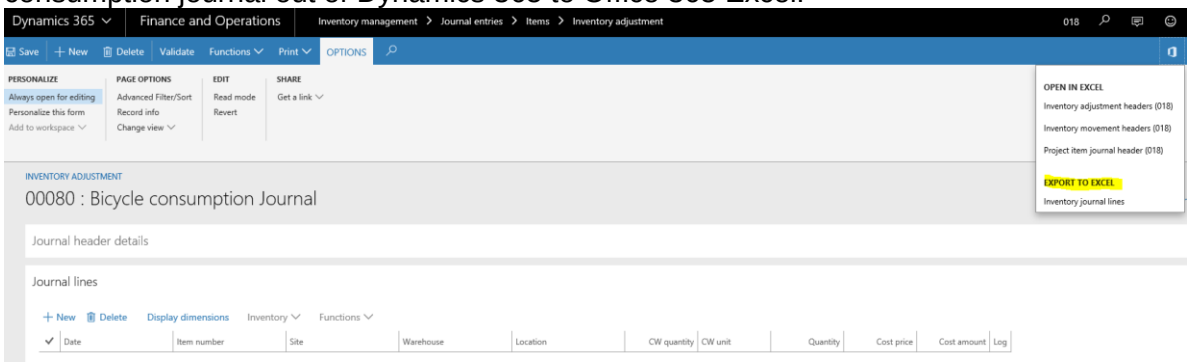

Figure 62: Excel-Export of Item journal in Dynamics 365 (Own screenshot by author)

The manufacturing employees get this Excel file and now have the possibility to enter the consumed quantities directly in Office 365 Excel. After completing the Excel file, by clicking on "*Publish*" the inserted data are imported back into Dynamics 365 FO. Thus, the manufacturing employees (who are logged into Excel with their Office 365 account) do not need to open and "learn" Dynamics 365 FO, as they only need to enter item consumptions. However, as the data is directly written back into the ERP system, no manual and double data recordings are necessary.

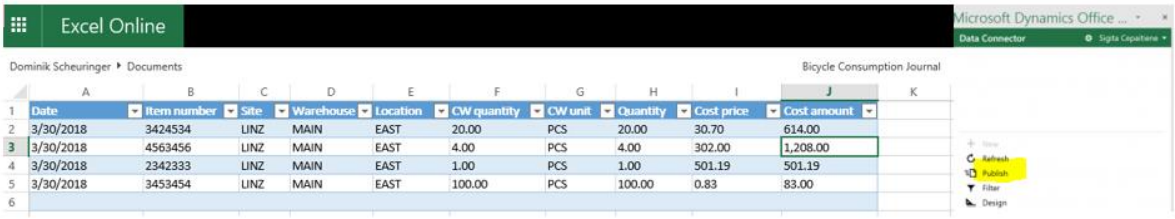

Figure 63: Item journal in Excel and publish to Dynamics 365 FO (Own screenshot by author)

For the top management, e.g. the COO, a **Power BI dashboard** was created which contains, on the one hand, forecast data from Dynamics 365 FO (left side) and sales data from Dynamics 365 Sales (right side) which enables an easy comparison and fast decisions. In both times, drill downs are possible to see more details. Based on this, decisions about the production programs and other important aspects can be taken. As both data sources are within the Common Data Service, this dashboard could have been created in less than 30 minutes by the author.

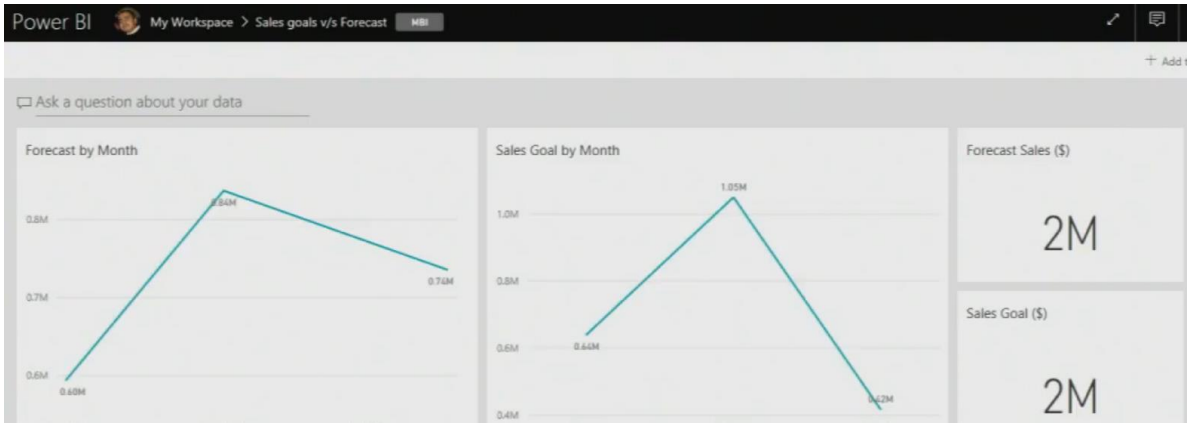

Figure 64: Power BI report sales goals vs. forecast (Own screenshot by author)

After **finishing the manufacturing of the bicycle** in Dynamics 365 FO, the production manager is automatically notified via E-Mail based on an established Microsoft Flow (in the same way as it was done above after creating a new contact in Dynamics 365 Sales). Afterwards, the **delivery** and **invoicing** process was done within Dynamics 365 FO, which is not explained in detail by the author. As a result, the sales order status both in Dynamics 365 FO but also in Dynamics 365 Sales was set to “Invoiced” (thanks to the integration).

Furthermore, the created **sales invoice document**, which was sent to the customer via Office 365, can also directly be opened within Dynamics 365 Sales, even if the invoice was posted in Dynamics 365 FO.

Based on the posting of the shipment of the finished bicycle to the customer, an automatic workflow is triggered which creates and stores an order documentation within **Microsoft SharePoint** (which is part of Office 365)**.** This was done based on the Microsoft Flow, which was defined above in chapter 1.2.

Furthermore, the author would like to point out that, thanks to the standard integration between Dynamics 365 Sales and SharePoint, which was also setup above in chapter 1.2, additional functionalities, which are helpful for make-to-order process scenarios, are provided. When the sales person works on an account, they can add a quote or a proposal without opening SharePoint. Depending on the permissions, the entire sales team can work on the same documents as they work towards the same goal, which is closing a sales deal. The result is a **document library structure** within SharePoint, which is composed of the core components of Dynamics 365 Sales, as can be seen in Figure 65. Now, the powerful capabilities of SharePoint together with all these documents from Dynamics 365 Sales can be used. For example, it would be possible to share CRM data with customers and enable them to submit requests, track status or view information.

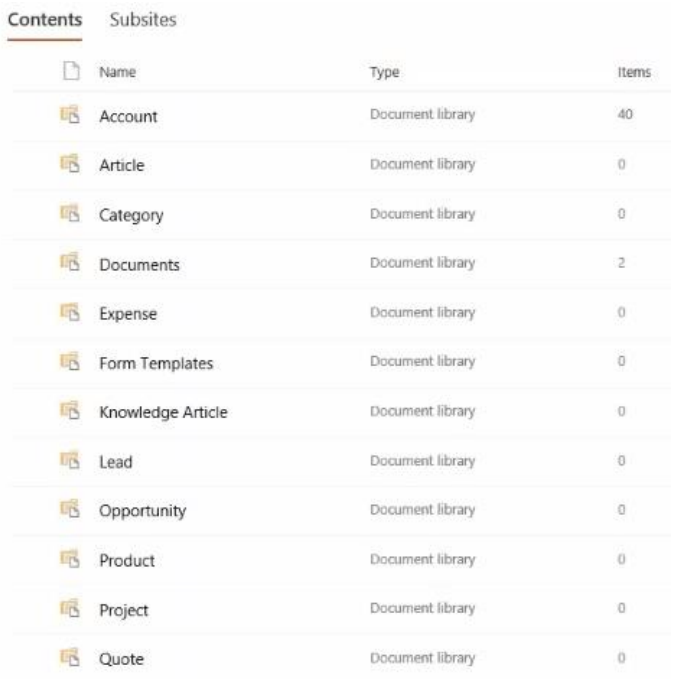

Figure 65: Microsoft SharePoint document library (Own screenshot by author)

In addition to the automatic storage of the order documentation, it was triggered another workflow at the posting of the sales shipment, which was the e-mail notification of the customers that they can expect the delivery of their bicycles. Again, this automatic e-mail notification was setup by means of Microsoft Flow.

In connection with **PowerApps**, another feature of Dynamics 365 FO is the direct integration of PowerApps in Workspaces and Forms of Dynamics 365 FO. An example therefore would be an App, which shows tracking information about the sales deliveries. This app is based on information from Dynamics 365 FO and other cloud-based data sources, consolidated into the common data model.

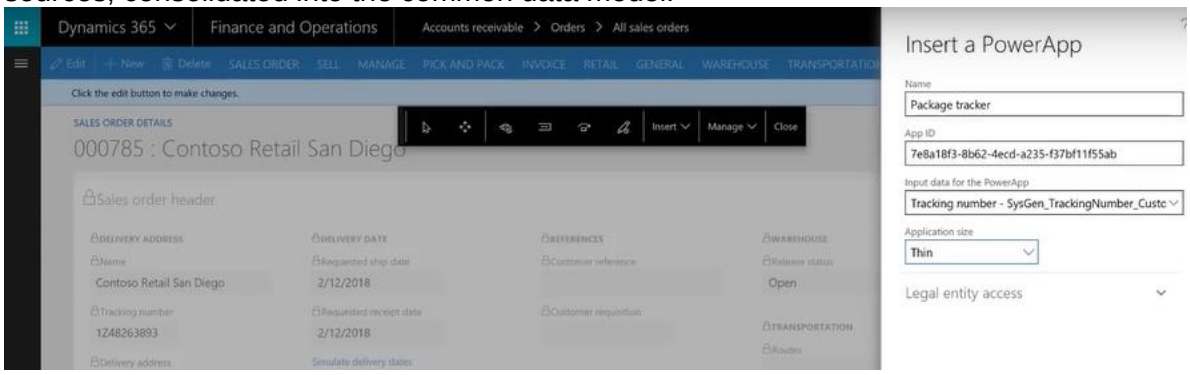

Figure 66: Insert a PowerApp into Dynamics 365 FO (Own screenshot by author)

Post-Sales

In order to enable a post calculation of the manufacturing order from the ERP system, the display of KPI's like contribution margins is required, which are calculated based on information from the CRM system (sales opportunities out of Dynamics 365 Sales) and from the ERP system (actual sales figures out of Dynamics 365 FO) on different levels (entire order, individual components and tasks). Equally as for the sales dashboard above, the required dashboard was created in Power BI (Figure 67) and was finally selected and

shown inside Dynamics 365 FO (Figure 68, Figure 69). Details about the created Power BI dashboards are not described by the author as this would go beyond the scope of this thesis. However, the author used standard templates from Microsoft, which were configured with the relevant systems of this proof of concept.

Figure 67: Post-sales Power BI dashboard (Own screenshot by author)

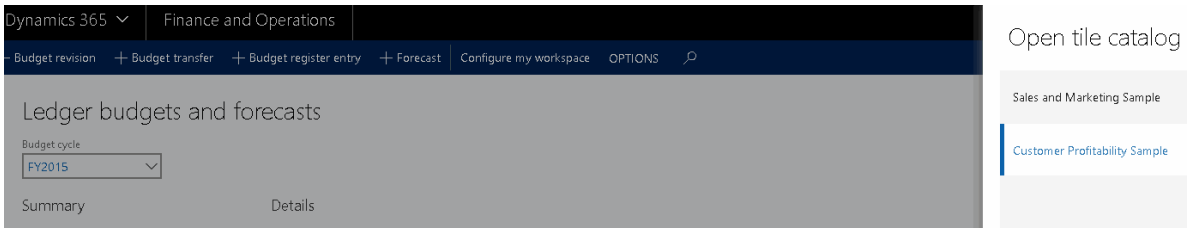

Figure 68: Add Power BI dashboard in Dynamics 365 FO (Own screenshot by author)

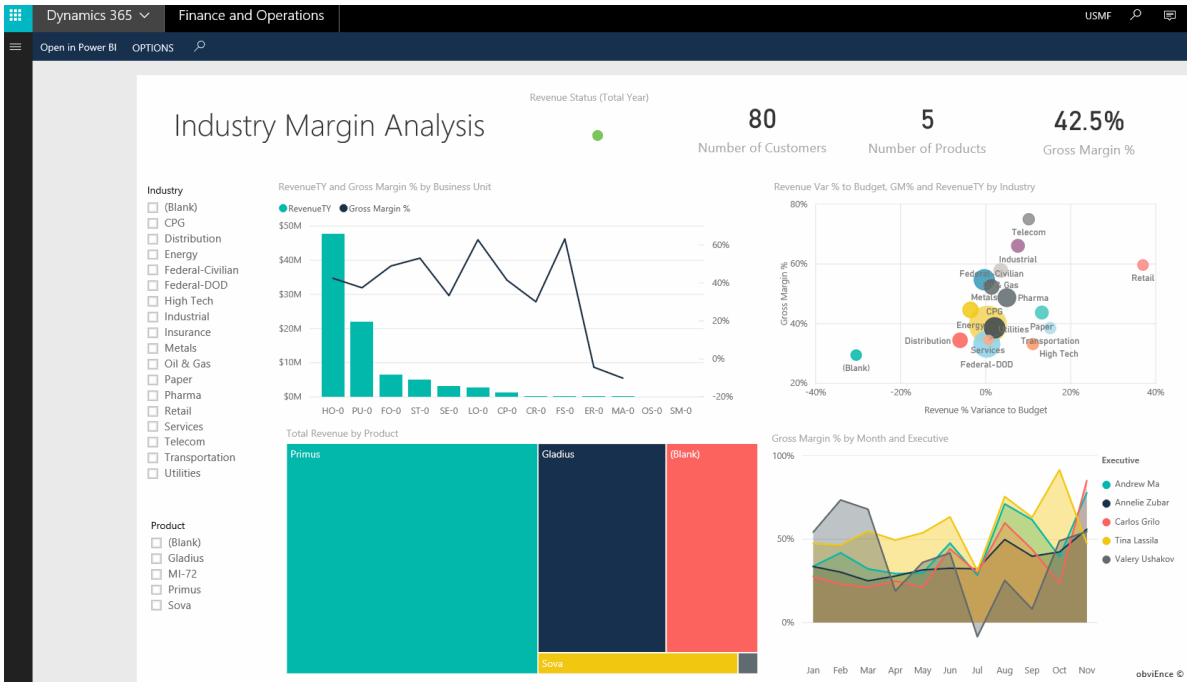

Figure 69: Show Power BI dashboard in Dynamics 365 FO (Own screenshot by author)

2. SAP Business ByDesign

2.1. Installation and setup

In order to implement the proof of concept with SAP Business ByDesign (in the following abbreviated as **SAP ByD**), the author registered for a 30-day trial version on the SAP homepage[90]. After some minutes, the author had access to this trial version.

Figure 70: SAP Business ByDesign start screen (Own screenshot by author)

In the following, it will be roughly explained how the pre-defined make-to-order process scenario could be implemented within SAP ByD. However, as already done for the implementation above within Microsoft Dynamics 365, the author will focus on the **main integration issues** and will skip the details. As the trial version only provides limited functionality (only specific guided tours can be reviewed), it was not possible for the author to implement the whole make-to-order process within this trial version. Thus, the author additionally checked some online documentation and, therefore, also included screenshots from the online documentation if necessary.

Comparing to the Microsoft Dynamics 365 prototype, SAP ByD has its own **CRM module** included and integrated, thus no additional CRM system is required. SAP ByD is a fully integrated solution, thus the product follows the strategy to run a business with a single solution ("**Suite-in-a-box**"). However, due to its open product architecture, there exist standard interfaces to many third-party systems like for example the CRM-system Salesforce.com.

For the integration with **Microsoft Excel and Outlook**, an Add-In must have been installed and afterwards it was possible to connect to SAP ByD from Excel and Outlook, but only with limited functionalities comparing to the integration between Microsoft Dynamics 365 and Microsoft Office 365. On the other hand, the author could not identify a standard integration between **SAP ByD and Microsoft SharePoint**.

[90] https://www.sap.com/austria/products/free-trials.html (Accessed 12 Apr. 2018)

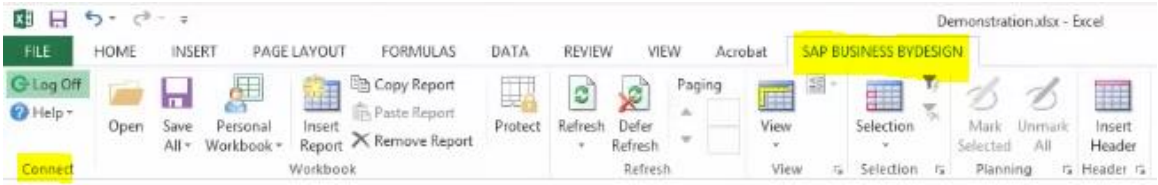

Figure 71: Connect to SAP ByD in Microsoft Excel (Own screenshot by author)

However, it would be generally possible to build and establish similar powerful integrations between SAP ByD and Office 365 via **SAP NetWeaver**. SAP NetWeaver, which is the foundation for all SAP applications, is an open integration and application platform and enables to connect heterogeneous applications. It consists of several tools and components, whereby one of them is **SAP NetWeaver Process Integration** (Zimmer, 2011, p.8).

The flexible setup of **automatic (email) notifications**, as it was possible with Microsoft Flow above, is currently not possible out-of-the-box within SAP ByD. However, insight driven alerts and notifications are included in the year 2018 roadmap of SAP ByD (SAP SE, 2018h).

2.2. Demo

Regarding the **integration with Microsoft Outlook**, which is demanded during the pre-sales phase of this make-to-order process scenario, the author could not identify the same level of powerful integration capabilities between the two systems. Equally as for Microsoft Excel, It exists a **SAP ByD Add-In for Microsoft Outlook**, which enables to connect to SAP ByD from Outlook:

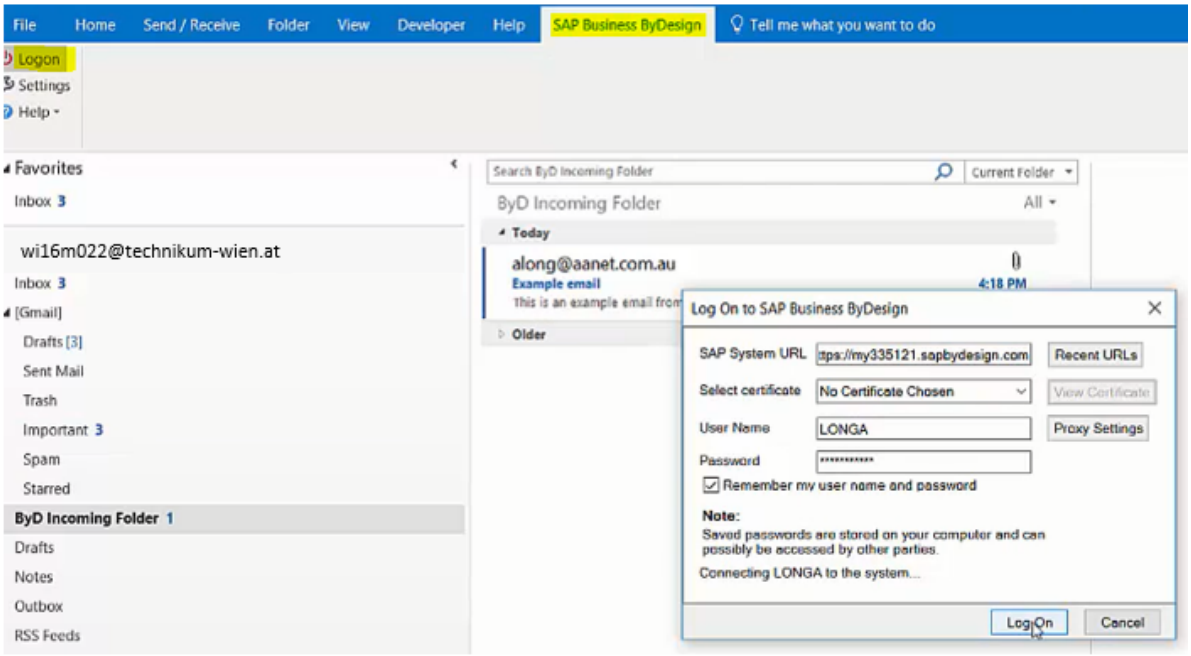

Figure 72: Connect to SAP ByD in Microsoft Outlook (Own screenshot by author)

Afterwards it enables users in Outlook to add emails to SAP ByD and associate them with specific records in SAP ByD. However, this must be done manually:

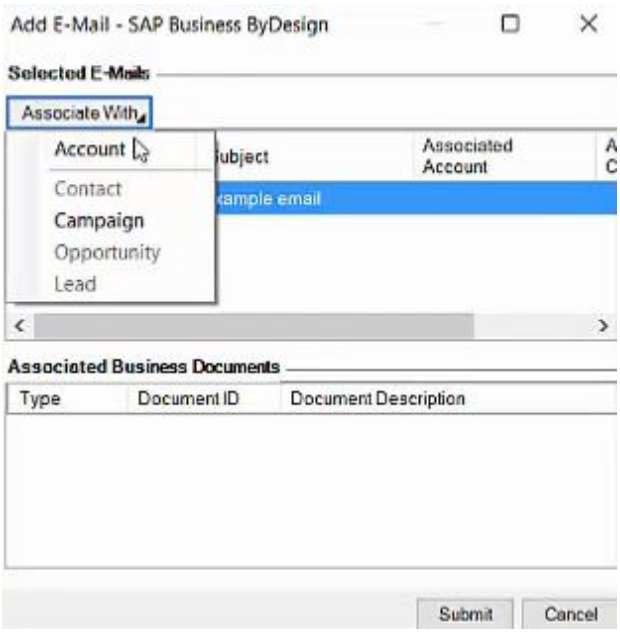

Figure 73: Add E-Mail from Outlook to SAP ByD (Own screenshot by author)

As a result, you can see this email as an **activity in SAP ByD**, including attachments, and you can also refer to them within follow-ups like sales quotes or orders within SAP ByD.

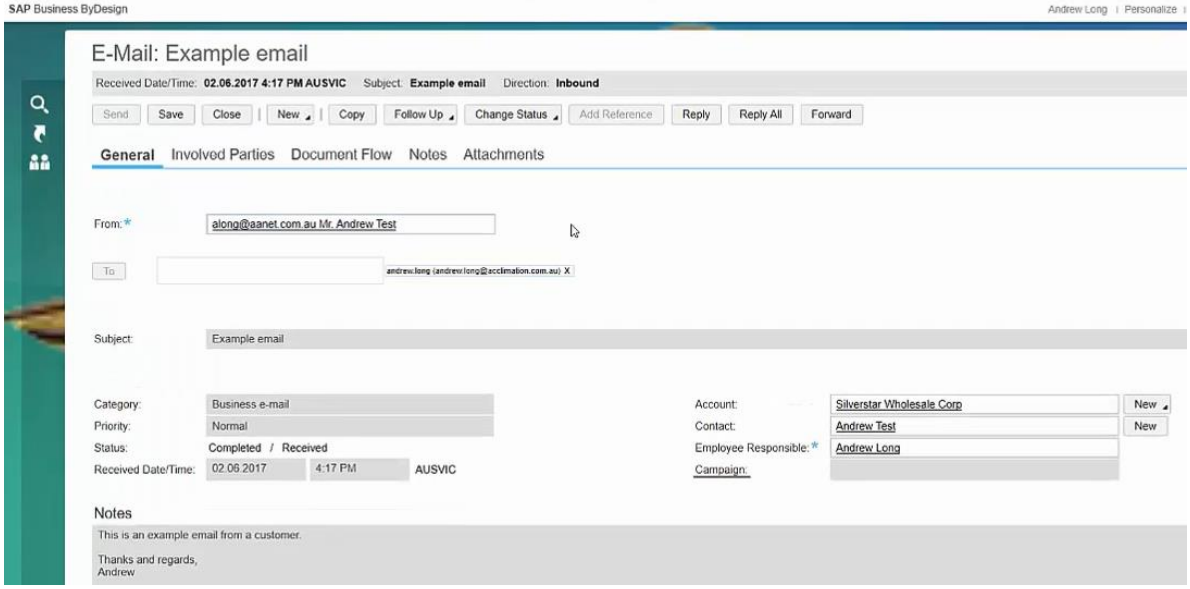

Figure 74: Show E-Mails in SAP Business ByDesign (SAP SE, 2018g)

Based on the email inquiry from the prospect, a **sales lead** was created in SAP ByD for the customer “Silverstart”. Afterwards, the lead was seamlessly converted to a follow-up **sales opportunity**. Thereby, the opportunity was automatically populated with all the relevant information from the sales lead, thus no double work was required.

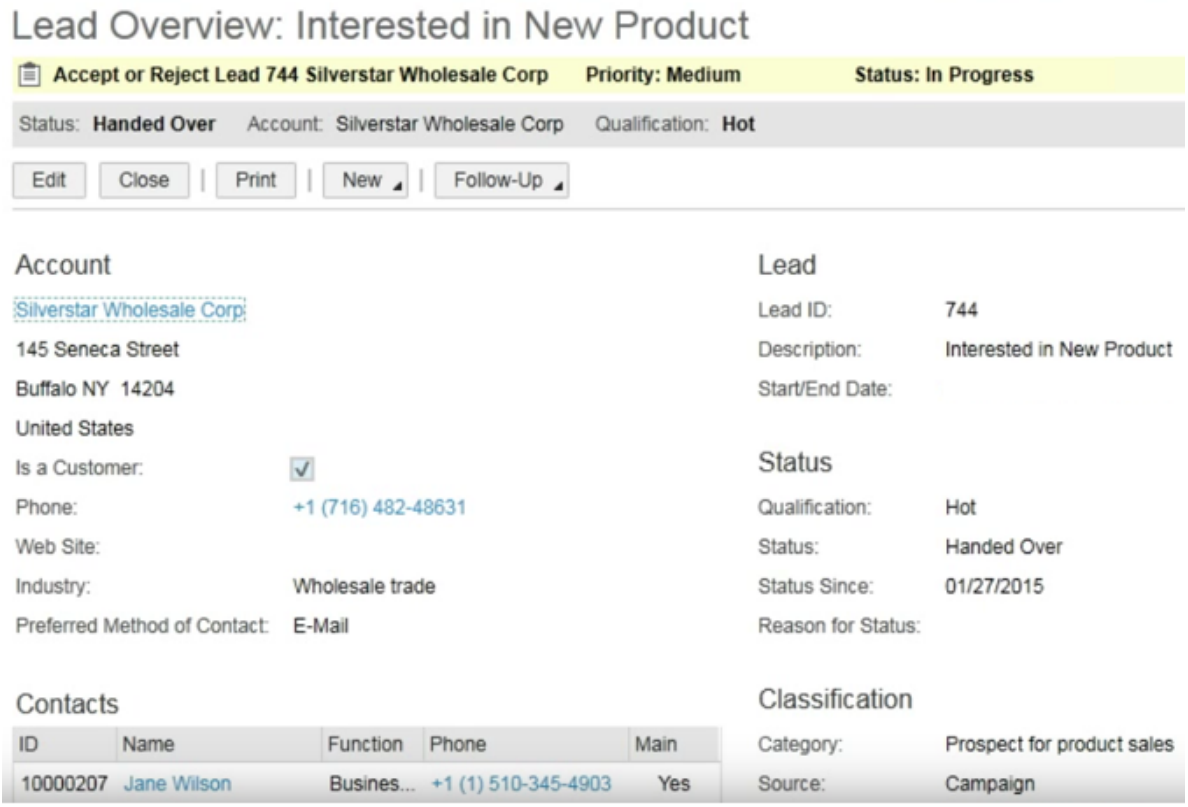

Figure 75: Sales lead in SAP Business ByDesign (Own screenshot by author)

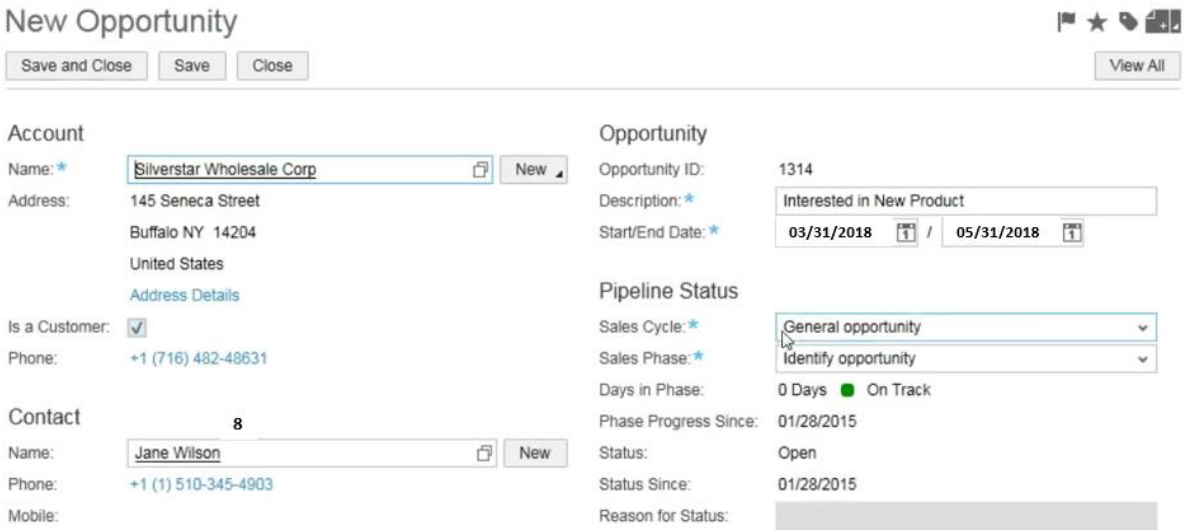

Figure 76: Sales opportunity in SAP Business ByDesign (Own screenshot by author)

Another possible feature regarding the integration with Microsoft Outlook in this context is that within SAP ByD it is possible to add pre-defined **sales activities** to the sales opportunity. As a result, these activities are also added to Microsoft Outlook if the Outlook integration is activated. Finally, any emails that come in related to that sales opportunity can be set over and attached to the opportunity.

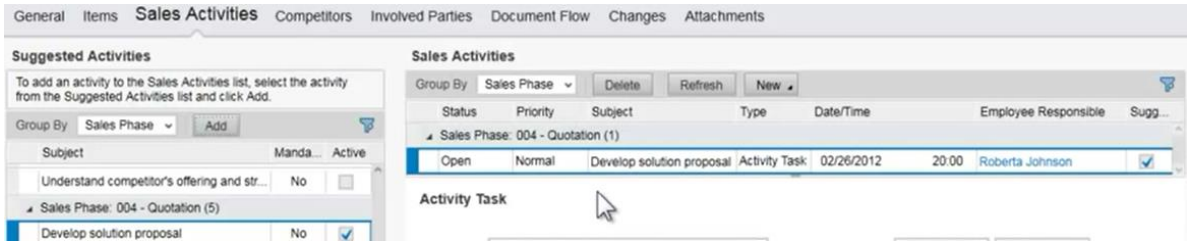

Figure 77: Sales activities in SAP Business ByDesign (SAP SE, 2018g)

Based on the sales opportunity the sales person can directly create a **sales quote** or also directly a **sales order** by means of follow-up actions. Again, the information flows seamlessly from the opportunity to the created sales quote or sales order.

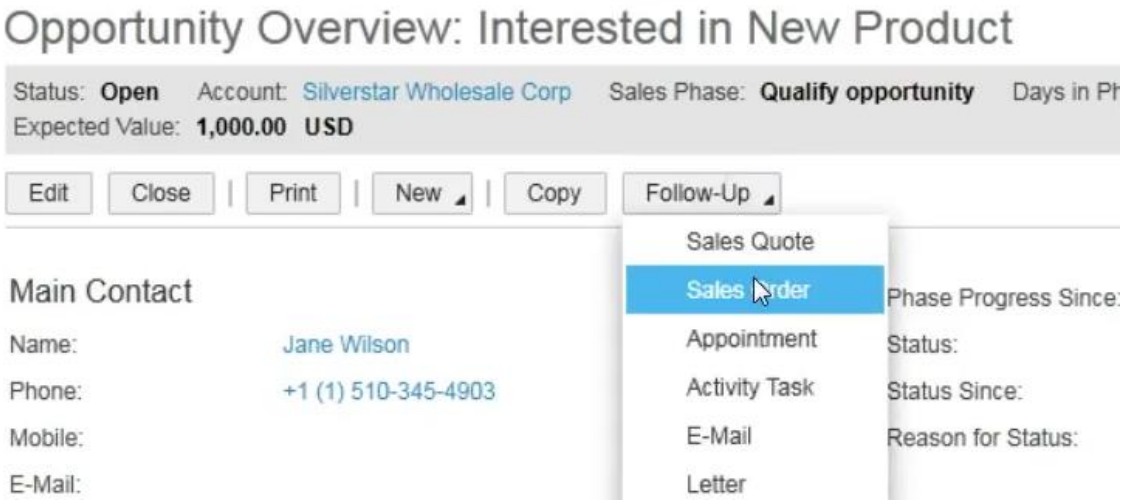

Figure 78: Follow-up for sales opportunity in SAP ByD (Own screenshot by author)

Before confirming the customer a specific delivery date, a **stock overview** can be displayed very fast within the system:

Figure 79: Stock overview in SAP ByD (Own screenshot by author)

The same applies during price negotiations. Thus, in case of changing quantities or delivery dates, the stock availability can be immediately checked within the sales order:

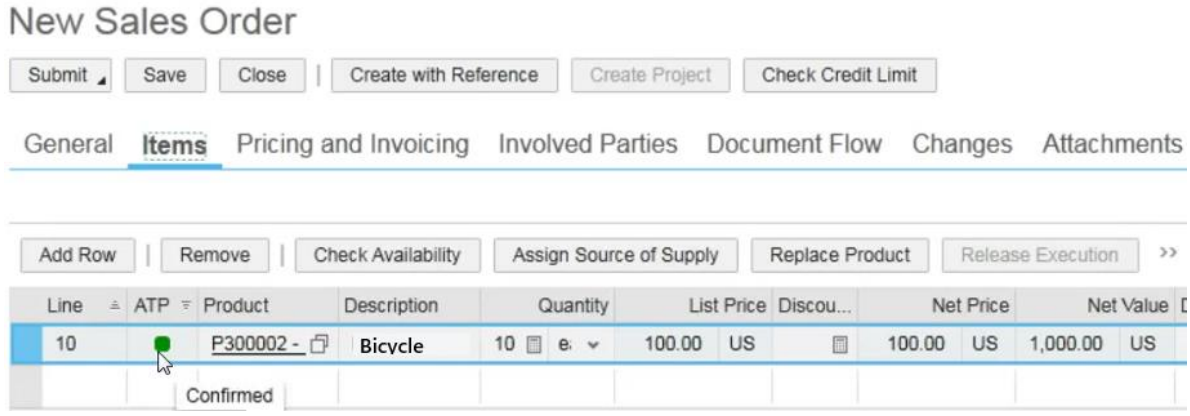

Figure 80: Check item availability in SAP ByD (Own screenshot by author)

Finally, when the customer accepts the sales quote, the **sales order confirmation** document (but also other documents like sales quotes) can be directly sent to the customer via email out of SAP ByD:

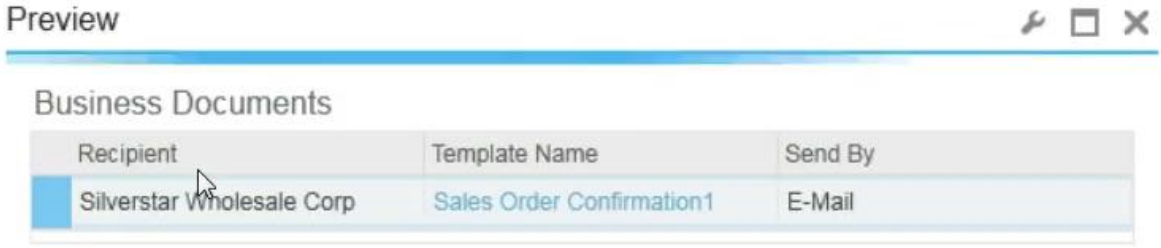

Figure 81: Send documents via email out of SAP ByD (Own screenshot by author)

As a basis for decision-making, the salesperson can immediately display the **sales history** of a customer in SAP ByD in order to get a **360-degree view** of the customer.

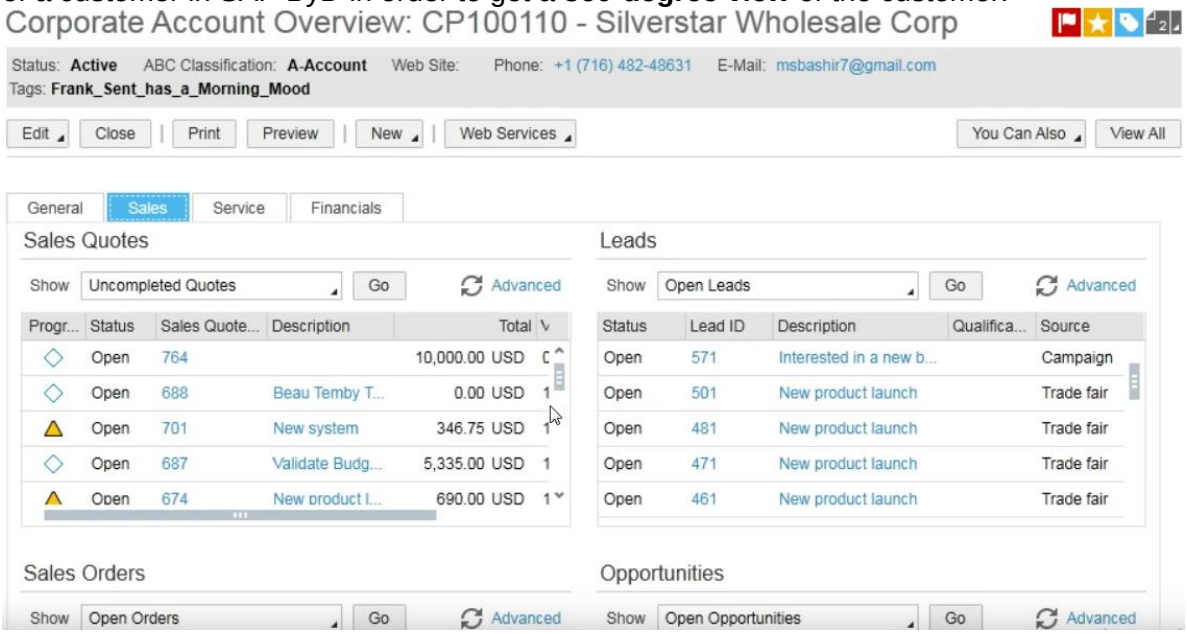

Figure 82: 360 degree view of customer in SAP ByD (Own screenshot by author)

Now the **demand planning** by means of MRP, afterwards the processing of the **production order** and finally the **delivery** and **invoicing** of the sales order is done within SAP ByD. As already for the implementation within Microsoft Dynamics 365, the author will not go into more details regarding those processes.

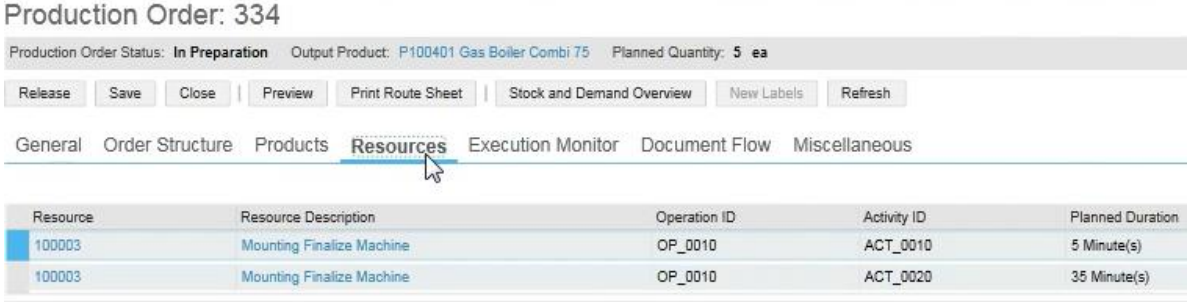

Figure 83: Production order in SAP ByD (Own screenshot by author)

For the delivery of the finished bicycle, the logistics employees are equipped with a **dashboard containing all the pending deliveries** whereby they get an automatic

notification as soon as a sales order was released for shipping in order to check this dashboard.

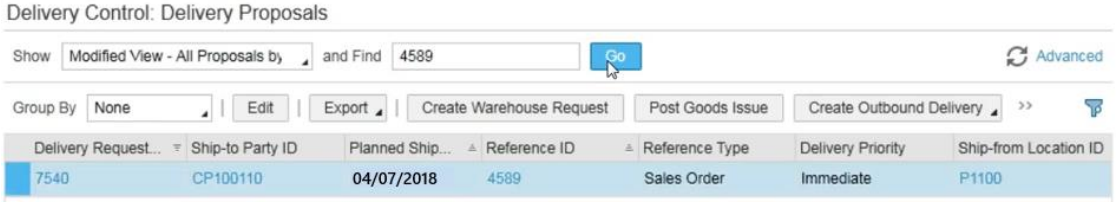

Figure 84: Delivery control dashboard in SAP ByD (Own screenshot by author)

During the whole make-to-order process, you can display the entire **document flow** and therefore also the seamless integration between sales, manufacturing and warehousing.

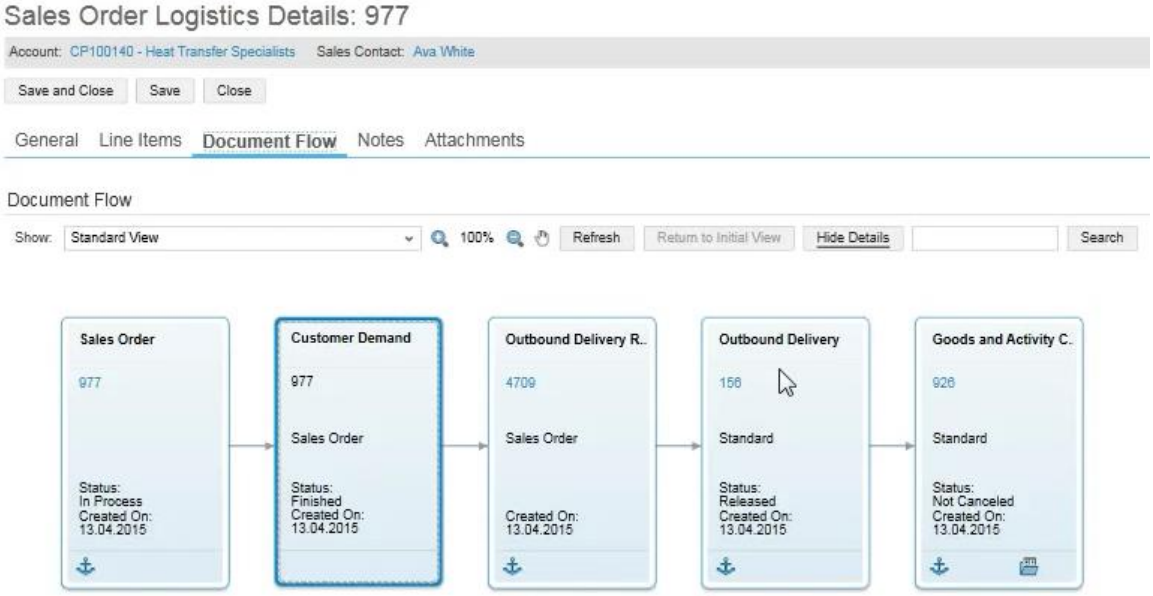

Figure 85: Document flow in SAP ByD (SAP SE, 2018g)

Additionally to an integrated CRM system, SAP ByD also provides **integrated analytics based on SAP HANA**, which is an in-memory computing platform, in order to gain real-time insights. Thereby, KPIs can be shown directly within dashboards of SAP ByD.

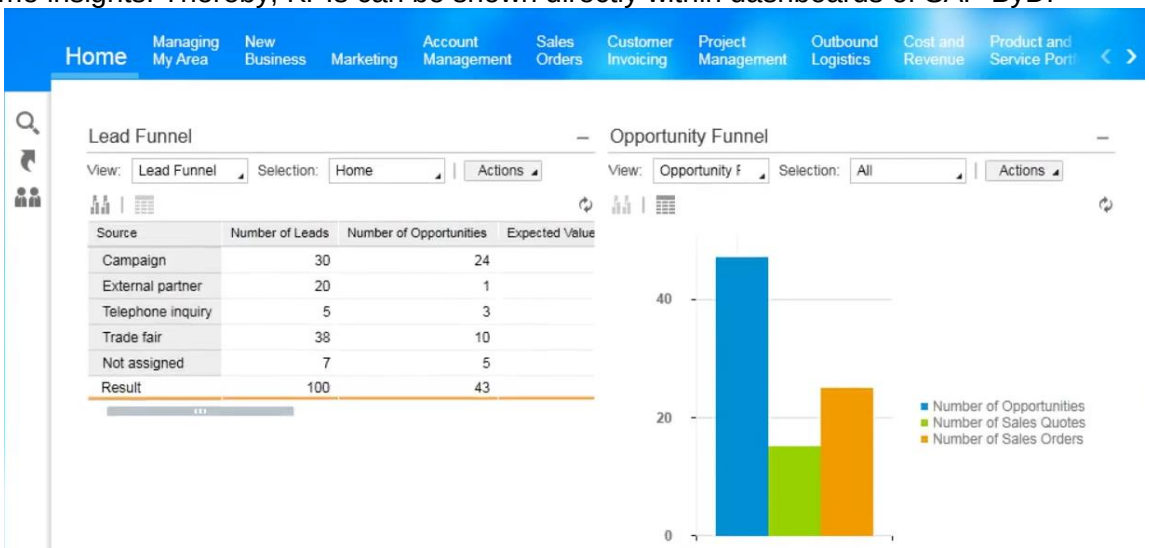

Figure 86: Dashboards in SAP Business ByDesign (Own screenshot by author)

Actually, the characteristics of those dashboards (e.g. filter criteria, display format) can be changed and adapted very quickly and easily by means of an **integrated BI designer**:

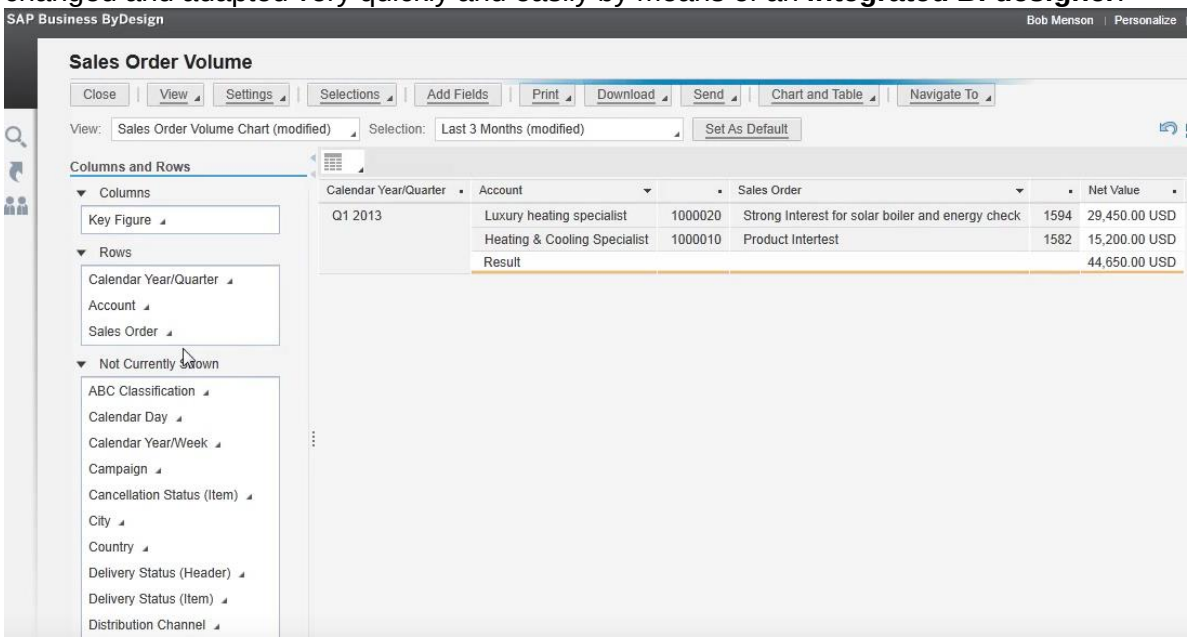

Figure 87: Integrated BI designer in SAP ByD (SAP SE, 2018g)

After creating SAP reports and dashboards, you can add them to specific screens (e.g. the Home Screen) by means of the **personalization-mode**, which enables the selection and configuration of created reports and dashboards within SAP ByD.

Next to the Microsoft Outlook integration, SAP ByD also provides an **integration with Microsoft Excel**, thus you can export business data into Excel, refreshing live data and write them back to SAP ByD.

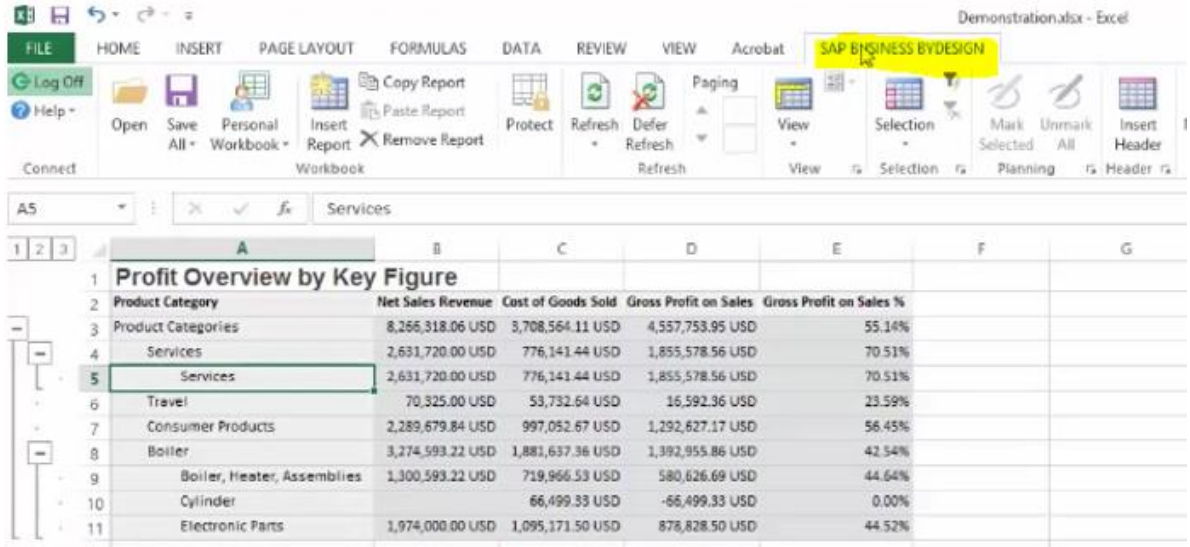

Figure 88: SAP ByD integration with Microsoft Excel (Own screenshot by author)

An interesting feature of SAP ByD supporting collaboration within the company is the **business task management**. It enables the ability to add sticky notes to a specific record in the system.

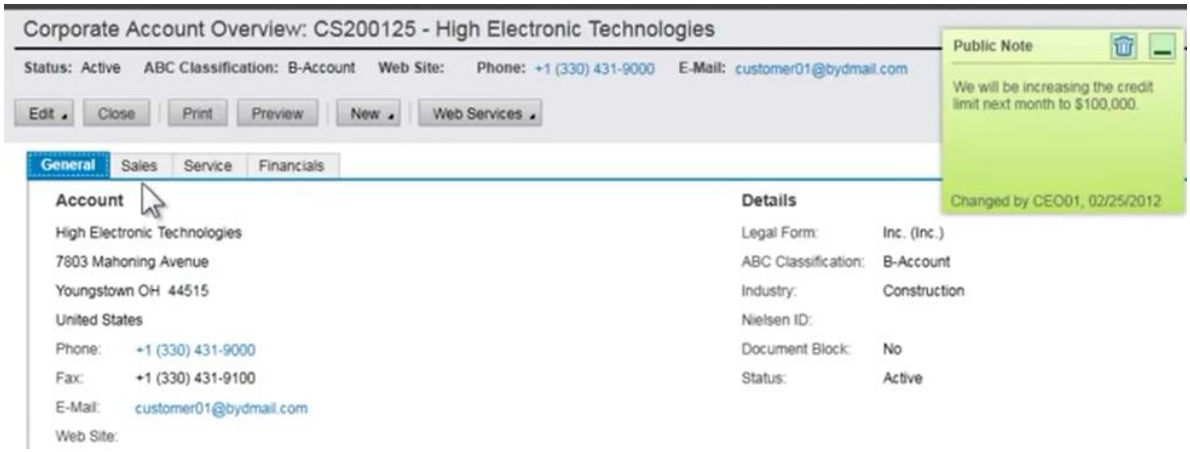

Figure 89: Business task management in SAP ByD (SAP SE, 2018g)

3. Oracle NetSuite

3.1. Installation and setup

Just like for the proof of concept with SAP Business ByDesign, the author registered for a 30-day **trial version** at the homepage of a NetSuite implementation partner[91]. Even if it was not as easy as for SAP Business ByD, after some days the author had access to the demo system. However, as this demo version only offers limited functionality, the author was not able to implement the entire pre-defined make-to-order process within this demo environment. Thus, as already done for the SAP Business ByD implementation, the author also included further online documentation and screenshots for this proof of concept.

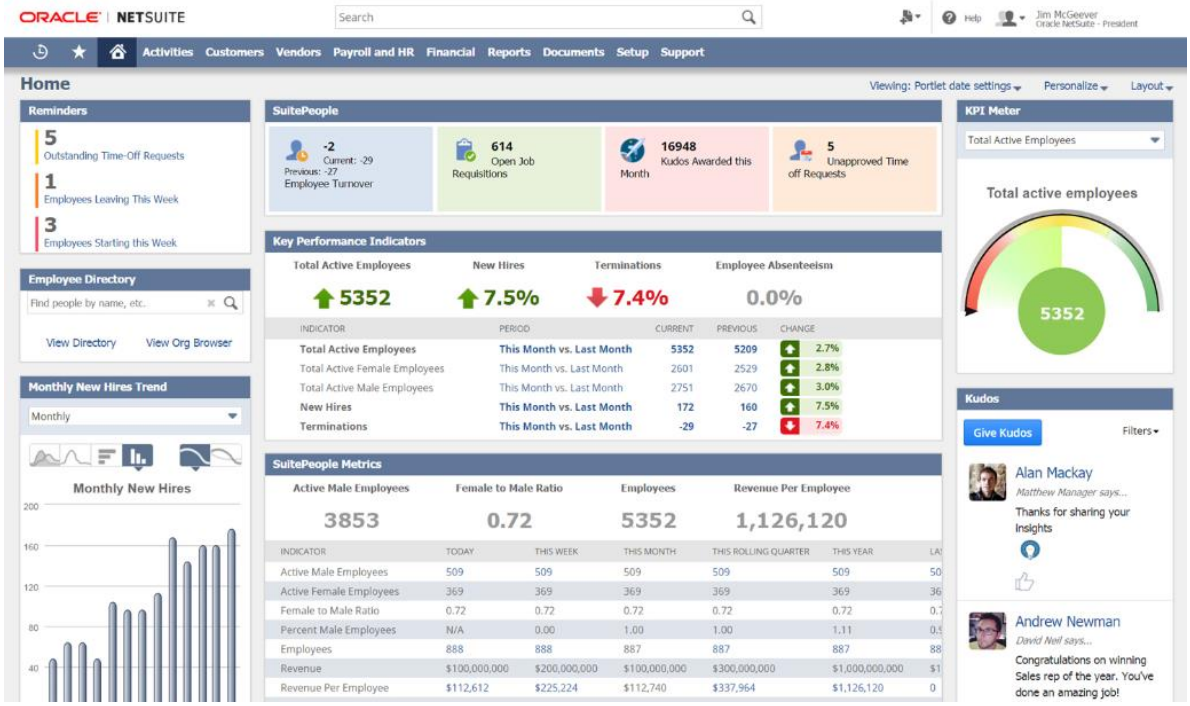

Figure 90: NetSuite start screen (Own screenshot by author)

For this proof of concept, the main BIS, which were used by the author, were **NetSuite ERP**- and **NetSuite CRM-system**, which are deeply integrated. Therefore, no additional

[91] http://go.frankrimermanconsulting.com/Try-Netsuite-with-a-No-Obligation-Product-Tour

setup was required in order to achieve the integration between ERP and CRM. Thus, equally as for SAP Business ByDesign, NetSuite is a **fully integrated system**.

For the setup of the required **workflows**, NetSuite's integrated workflow management suite called **SuiteFlow** was used. NetSuite offers a comprehensive range of built-in workflows and a powerful engine to customize these workflows and to build new workflows.

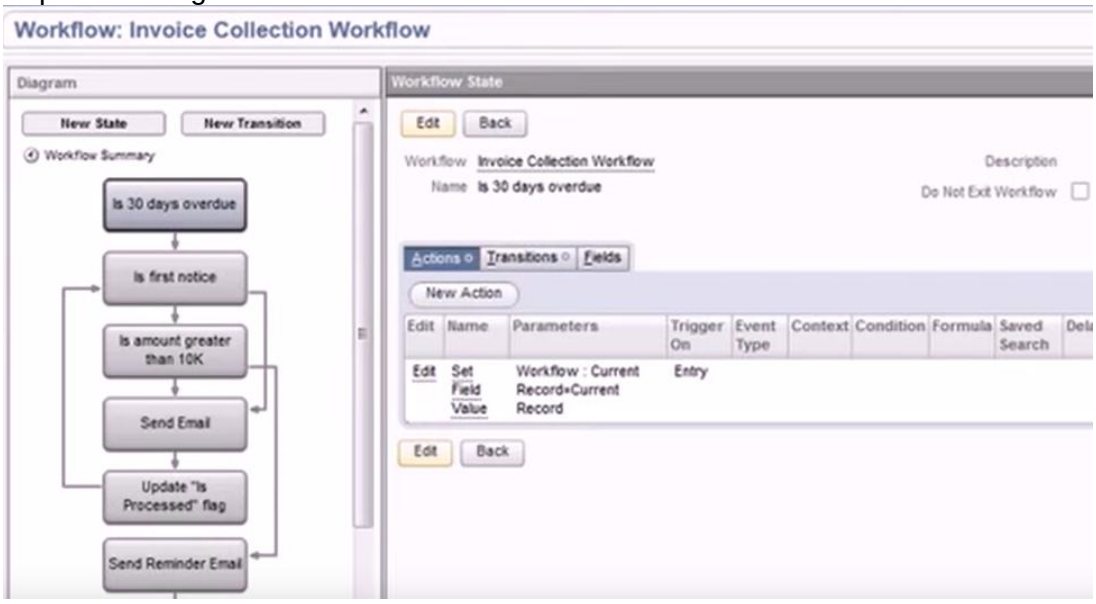

Figure 91: NetSuite Workflow management suite (Own screenshot by author)

Additionally you can also setup **alerts** to notify users via email of specific changes in the system, for example as required for new contacts, which have been created.

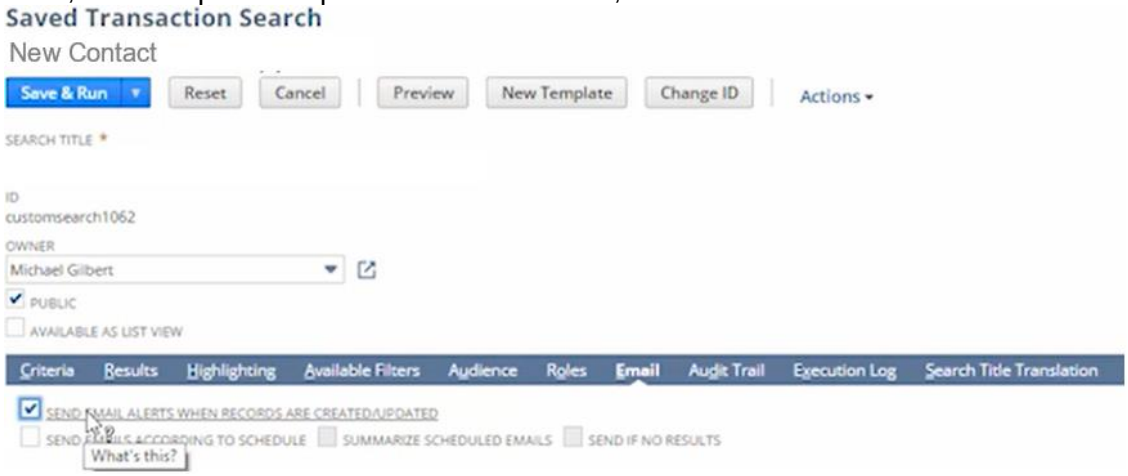

Figure 92: Setup of email alerts in NetSuite (Own screenshot by author)

Regarding **reporting** capabilities and the creation of the demanded **dashboards**, this could also be done directly within NetSuite and no additional BI tool was necessary. Due to the fully unified system, which means that all company data is within one place, widespread reporting capabilities and many existing built-in reports, all requirements could be fulfilled.

The last setup, which was necessary, was the integration between NetSuite and **Office 365**. Thereby NetSuite provides some basic standard integration features, which are demonstrated below. Additionally there is also a **SuiteApp** available for download that integrates Outlook and NetSuite even further. It is called "**NetSuite for Outlook**" and it

allows to fully synchronize data between the two applications like tasks, events, phone calls etc. (Jones et al., 2017). However, this additional SuiteApp was not installed for this implementation. The same applies for the integration between NetSuite and **Microsoft SharePoint**, which is also not possible out-of-the-box. Therefore, 3rd-party middleware integration platforms like for example StarfishETL[92] must be deployed which was not done for this proof of concept either.

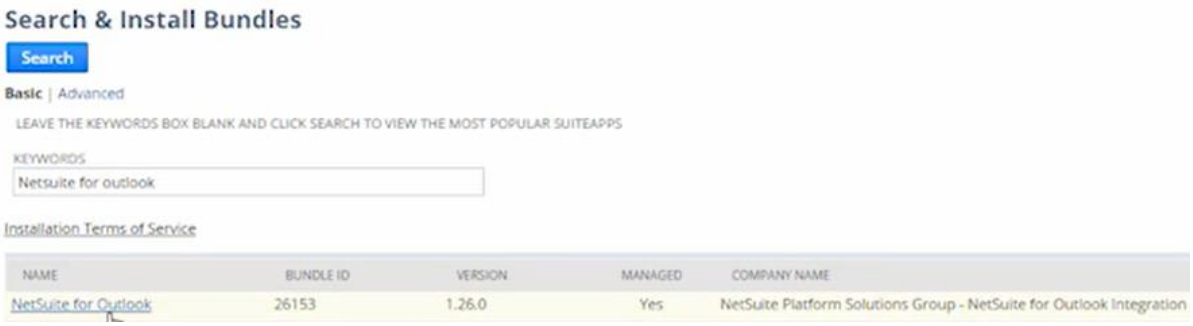

Figure 93: Install additional bundles in NetSuite (Own screenshot by author)

3.2. Demo

As the author only considered standard integrations between NetSuite and Office 365 and did not install the additional SuiteApp as described above, the author could not identify the same level of powerful integration capabilities between the two applications. However, there exists some capabilities regarding the integration between NetSuite and Microsoft Office. With regard to **Microsoft Excel**, you can export all lists in NetSuite to Excel. Regarding **Microsoft Outlook**, you can email any record directly from NetSuite. You can create and send emails directly out of NetSuite:

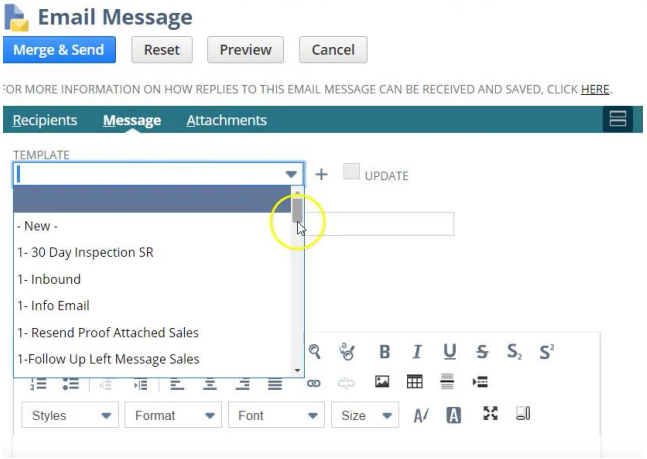

Figure 94: New email message out of NetSuite (Own screenshot by author)

However, based on the standard integration, it is not possible to show data out of NetSuite CRM directly in Outlook, as it is possible and it was demonstrated with Microsoft Dynamics 365.

Based on the email of the prospect (“Biker’s Delight”), a new **sales lead** is created within NetSuite. This lead could also be the result of a web page entry from a customer (e.g. within the “Contact Us” part on the company’s homepage), where NetSuite provides standard integrations, by means of so-called “**Online Customer Forms**”.

[92] https://www.starfishetl.com/crm-integration/Other/NetSuite/SharePoint (Accessed 18 Apr. 2018)

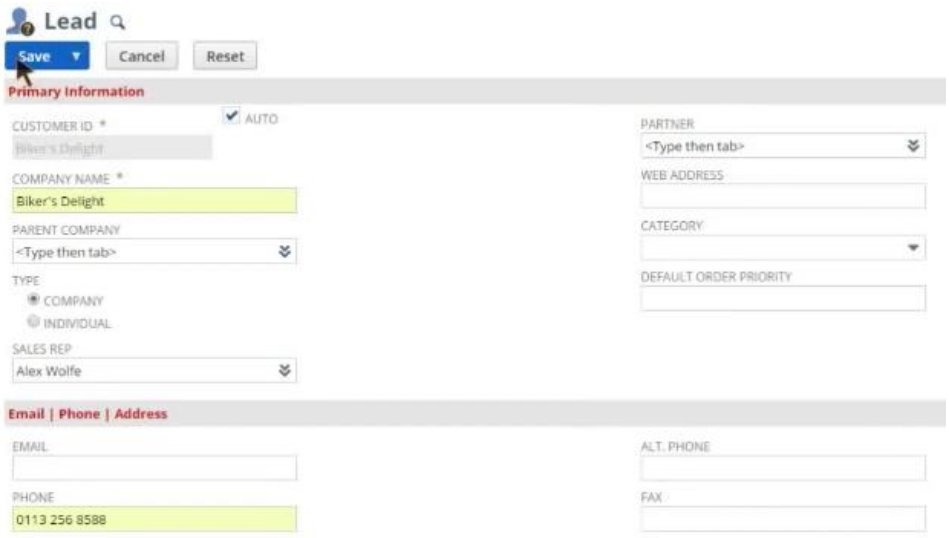

Figure 95: Sales lead in NetSuite (Own screenshot by author)

Based on the lead, a **calendar appointment** can be created directly within NetSuite, which can also be synchronized with the Microsoft Outlook calendar. Furthermore, an automatic e-mail reminder can also be setup.

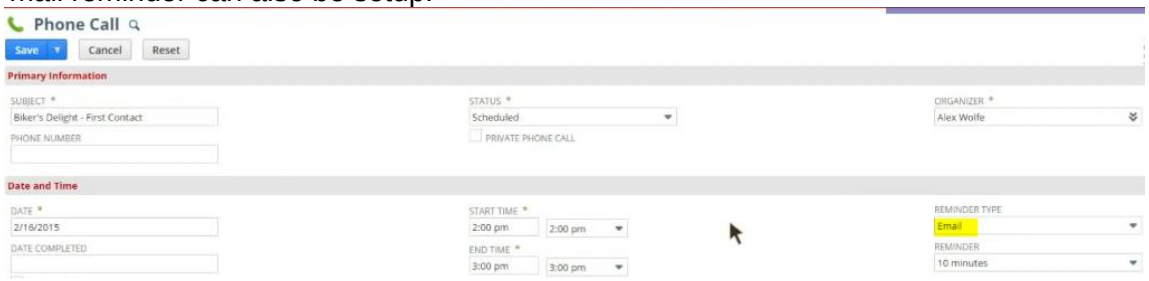

Figure 96: Microsoft Outlook activities in NetSuite (Own screenshot by author)

As the customer is definitely interested in some bicycles, a **sales quote** is created in NetSuite CRM. As NetSuite CRM is tightly integrated with NetSuite ERP, a sales person can quickly add new items and immediately see their price and availability, which comes from NetSuite ERP.

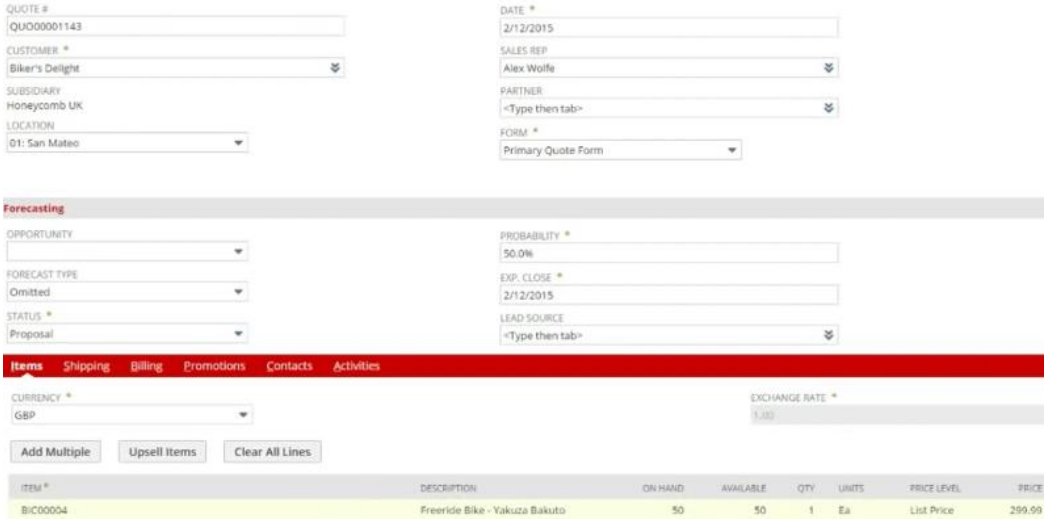

Figure 97: Sales quote in NetSuite (Own screenshot by author)

As can be seen in Figure 97, the **inventory status,** i.e. the available-to-promise (ATP) for the requested items from NetSuite ERP, can directly be seen within the sales quote in NetSuite CRM. If the items were out of stock, a warning would pop up. Also, the list price, which is defined in NetSuite ERP, is directly shown in the sales quote. Finally, the sales quote can be directly sent to the customer via email without switching to Outlook:

Figure 98: Send sales quote via email out of NetSuite (Own screenshot by author)

During the pre-sales phase, the sales person is supported with powerful **upsell- and cross-sell** management features. Based on them, when a salesperson has a customer on the line, this function shows a salesperson other items, which are associated with that sale. As already mentioned above, a **dashboard for the sales managers** could be created very quickly. As NetSuite ERP and NetSuite CRM are seamlessly integrated, a flexible and fully searchable **360-degree view** of the customer is possible. Thereby, also graphical charts can be created.

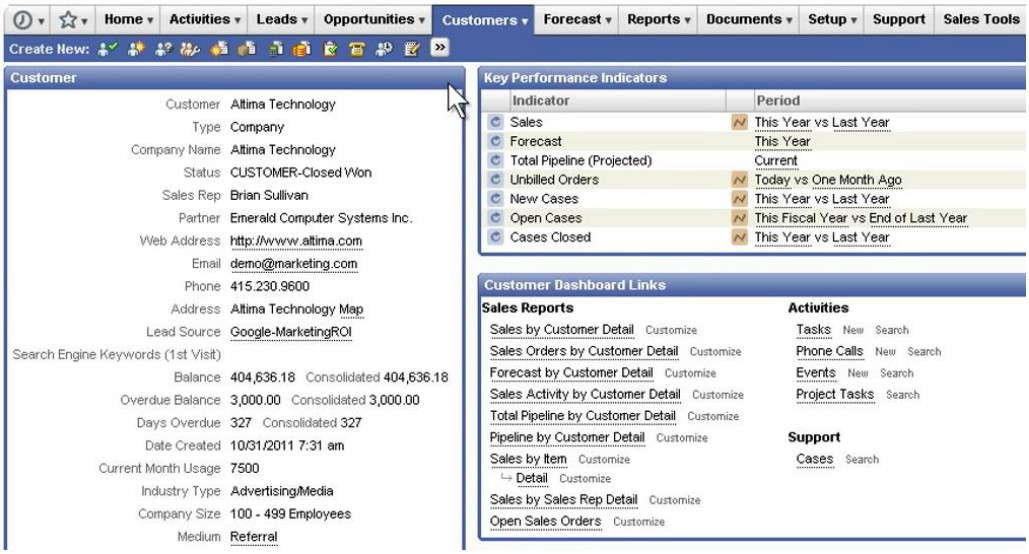

Figure 99: Customer dashboard in NetSuite (Own screenshot by author)

Out of the sales quote in NetSuite CRM, the **sales order** in NetSuite ERP can seamlessly be created, thus all the information flows through from the sales quote to the sales order.

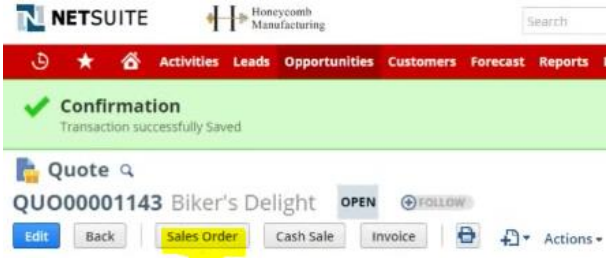

Figure 100: Create sales order in NetSuite (Own screenshot by author)

Now, the **demand planning** by means of MRP, afterwards the processing of the **production order** and finally the **delivery** and **invoicing** of the sales order is done within NetSuite ERP. As already for the implementation within Microsoft Dynamics 365, the author will not go into more details regarding those processes.

As soon as the sales order is approved in NetSuite ERP, it appears as an item for fulfillment on the **warehouse manager's dashboard** (which can be seen within the warehouse manager's role of NetSuite) where NetSuite's integration with UPS, FedEx and other delivery services help to automate the shipping process.

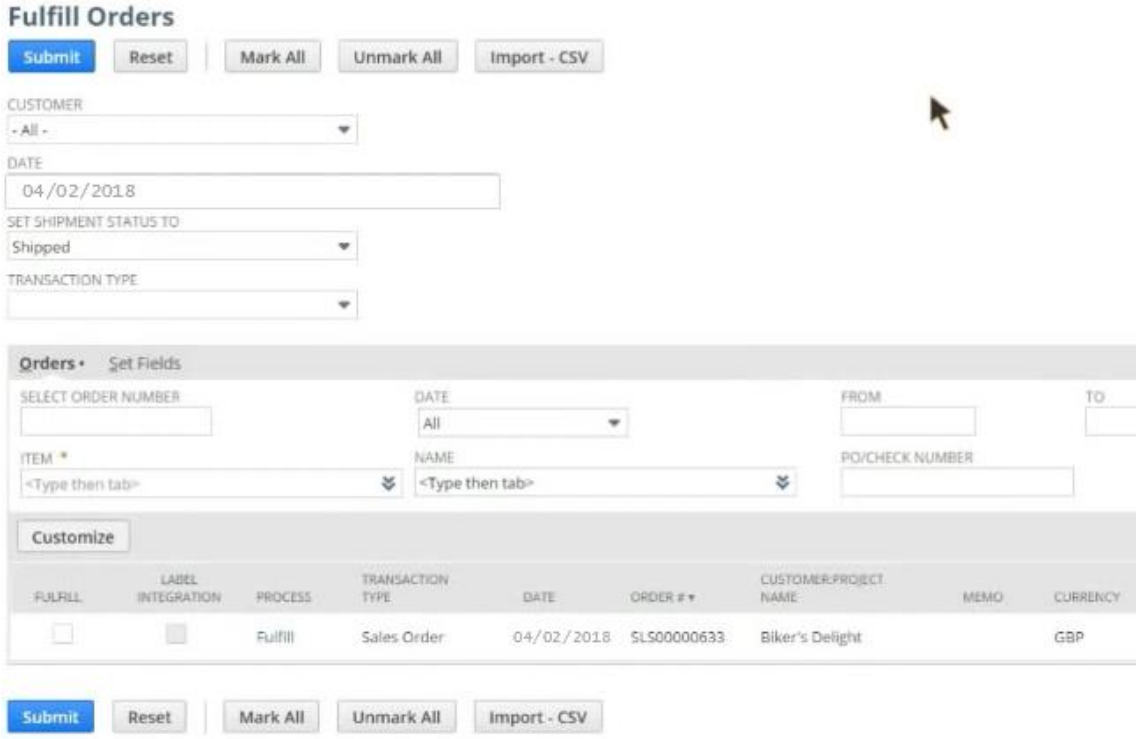

Figure 101: Shipment dashboard in NetSuite (Own screenshot by author)

After **delivering** the finished bicycle, the **billing** process completes the make-to-order process. Thereby, shipped orders have flown directly to the accounts receivable (A/R) dashboard, notifying them to invoice customers in time.

Figure 102: Accounts receivable dashboard in NetSuite (Own screenshot by author)

As result of invoicing the customer, the sales order status was set to billed.

Figure 103: Sales order status in NetSuite (Own screenshot by author)

The customer was automatically notified via email by means of an activated standard workflow within NetSuite:

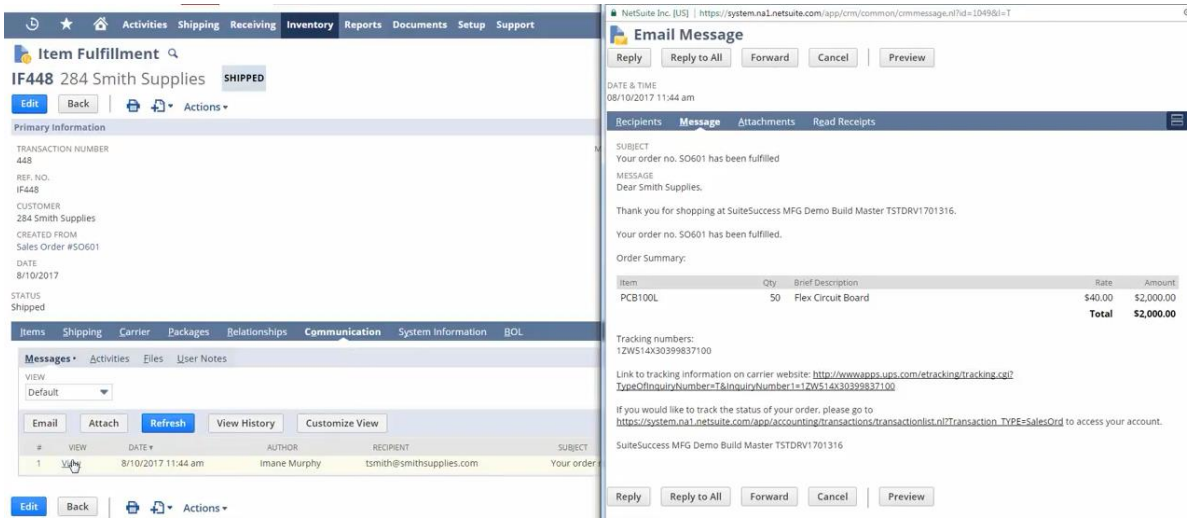

Figure 104: Automatic email notification of customer at item shipment (Own screenshot by author)

Finally, the **post calculation** of the sales order can be supported by means of KPIs shown in dashboards directly within NetSuite. In that case, ERP-data ("Sales") are compared with CRM-data ("New Leads"). As already mentioned, the creation of such KPIs and dashboards can be directly customized within NetSuite.

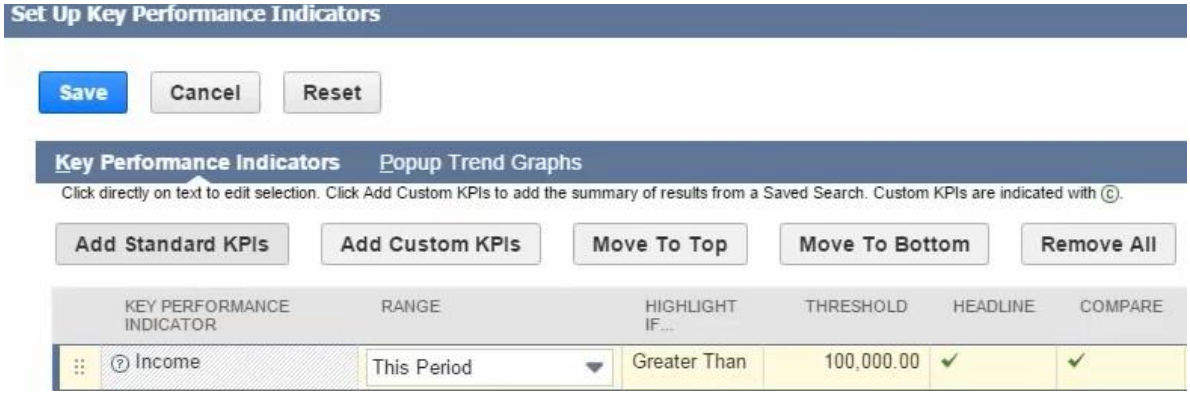

Figure 105: Setup of KPIs in NetSuite (Own screenshot by author)

Figure 106: Display of KPIs in NetSuite (Own screenshot by author)

Appendix D: Criteria catalogue evaluations of the author

For the evaluation of the three systems, additionally to the insights of the expert interviews and proof of concept, the author used some further literature and online documentation.

Criteria 	**Reasoning**	**Grad-ing**
FUNCTIONAL CRITERIA		
C1: Limitations of functionality comparing to the on-premise variants	This depends on the actual Microsoft Dynamics 365 product: Dynamics 365 FO Enterprise Edition has even some included features which are not available in the on-premise solution (Dynamics AX), as confirmed by Nair (Nair, 2017a; Nair, 2017b). Dynamics 365 FO Business Edition, on the other hand, has some limitations comparing to the on-premise solution (Dynamics NAV), as stated by Painchaud (Painchaud, 2017).	0.6
C2: Standard Interfaces	As demonstrated in the proof of concept, Dynamics 365 for Finance and Operations integrates seamlessly with other Microsoft cloud products such as Office 365, PowerBI and Dynamics CRM apps, as also confirmed by online documentation (Nigel Frank International, 2018).	1
C3: Mobile Access (Web-/Phone-/Tablet)	It is provided a cross-platform UI support based on a native HTML 5-browser based UI that can run on any device, any platform and any browser (Nair, 2017b).	1
C4: Dashboards based on information from different business information systems	As demonstrated in the proof of concept, dashboards and other BI reports can be created within PowerBI based on different data sources (e.g. Dynamics 365 FO and Dynamics 365 Sales). Dynamics 365 enables embedded Power BI reports where the created Power BI dashboards can be displayed in the ERP-/CRM-system.	1
C5: Office-/collaboration integration	As demonstrated in the proof of concept, Microsoft Office products and Microsoft Dynamics 365 applications are merging increasingly. Thus, all the described scenarios in the criteria description can be fulfilled completely.	1
C6: Limitations of customizability comparing to the on-premise variants	Customizations are only possible by means of so called “Extensions” and the source code of the system is not available anymore. Thus, the core system is not so highly customizable anymore comparing to the on-premise systems, as confirmed by interviews E, M and O.	0.4
C7: User friendliness	As determined in the proof of concept, all Dynamics 365 apps have a unified UI. Thus, each app can be accessed in the same way and user experience. However, the author could identify some slightly differences in the usability (e.g. regarding search- and filter functions).	0.8
C8: Integration / development platform	Based on the Common Data Services and supported with Microsoft PowerApps, as demonstrated in the proof of concept, powerful integrations, processes and apps can	1

	be established. No third-party integration tools like for example “Scribe”[93] are necessary.	
C9: Consistent availability of material information	As demonstrated in the proof of concept, by means of integration templates within Common Data Service, it was defined which type of products (only released sellable bicycles) shall be transferred from the ERP-system (Dynamics 365 FO) to the CRM-system (Dynamics 365 Sales) including the definition, which fields exactly need to be synchronized. Thus, the user in CRM has always access to up-to-date material information coming from the ERP-system when creating opportunities, quotes and other CRM activities.	1
C10: Direct conversion of sales offers into sales orders	As demonstrated in the proof of concept, pre-defined integration templates between Dynamics 365 FO and Dynamics 365 Sales support this scenario out of the box.	1
C11: Real time data visibility of information between ERP- and CRM-system	All scenarios outlined in the criteria description are demonstrated in the proof of concept. Beyond that, further required data, which eventually need to be exchanged between ERP- and CRM-system, could be setup within Common Data Service.	1
C12: 360-degree view of customers from different business information systems	In the proof of concept, it was demonstrated that customer information not only could be displayed within the ERP- and CRM-system (due to the configured data integrations, customer and contact information were synchronized in both directions) but also within Office 365 Outlook.	1
C13: Support of workflows	Microsoft Flow enables to automate workflows across different cloud-based systems and services (for notifications, file synchronization, data collection, approvals, etc.), as confirmed by interview O.	1
C14: Integration with document management system (DMS)	As demonstrated in the proof of concept, on the one hand, it exists a powerful standard integration between Microsoft SharePoint and Microsoft Dynamics 365 and on the other hand, within Microsoft Flow a number of different DMS systems can be seamlesssly integrated with Dynamics 365.	1
NON-FUNCTIONAL CRITERIA		
C15: Subscription fees	Dynamics 365 Plan (unlimited usage of all Dynamics 365 applications and services): 177,10 € per full user/month (Microsoft, 2018f).	0.5
C16: Online documentation	The author could identify a lot of different online documentation regarding Microsoft Dynamics 365. The official online documentation from Microsoft is “Microsoft Docs” (https://docs.microsoft.com/en-us/dynamics365/).	1
C17: Information security and data protection	The author could identify the following cornerstones of the security strategy from Microsoft: fully Microsoft managed cloud service; Microsoft managed data centers; Microsoft’s 5 levels of security; Microsoft Azure cloud occupies extensive certifications;	0.8

[93] https://www.scribesoft.com/

	all Dynamics 365 applications are developed based on a security development lifecycle (including identity management, encryption, etc.); German data centers (data trustees); Data policies in Common Data Services; different security levels (role-based, record-based, field-based) (Nair, 2017a; Microsoft, 2018g; Microsoft, 2018a; Microsoft, 2018c).	
C18: Performance and availability	99.9% uptime provision of the service-level agreement (SLA). If the service level falls below 99.9% for a given month, service credits are provided by Microsoft. Disaster recovery is included (Microsoft, 2018b). However, the author could also read about some performance problems in reference stories.	0.6
C19: Upgrade capability	Automatic update strategy, updates are provided in advance of the on-premises version (Nair, 2017). Due to the development/customization philosophy (no standard code changes are possible, just extensions) upgrades can be done seamlessly. IT administrators can decide when to install Dynamics 365 service updates for their companies, apart from mandatory updates (Holtzman, 2018).	1
C20: Implementation duration	Data migration tools; big network of Microsoft Dynamics implementation partners; average time to implementation in 2017: planned 21.6 months, actual 24.7 months (Panorama Consulting Solutions, 2017).	0.6
C21: Flexibility and scalability through integrated add-on apps	Microsoft provides an AppSource[94], where extensions created by Microsoft but also by implementation partner companies are provided. Companies can add these apps as extensions to their current Dynamics 365 implementation in order to gain additional functionality, e.g. specific industry solutions. Microsoft PowerApps enables to create and use custom business apps across different platforms.	1
C22: Data Lock-in	Lock-in through proprietary file formats. Shall be relieved through the upcoming general data protection regulation (GDPR), as confirmed by interview O.	0.6
SUM FUNCTIONAL CRITERIA		12.8
SUM NON-FUNCTIONAL CRITERIA		6.1
TOTAL SUM		**18.9**

Table 20: Author criteria catalogue evaluation Microsoft Dynamics 365

[94] https://appsource.microsoft.com/de-at/

Criteria 	Reasoning	Grad-ing
FUNCTIONAL CRITERIA		
C1: Limitations of functionality comparing to the on-premise variants	SAP Business ByD is a pure cloud solution. On-Premise solutions from SAP have either more (SAP S/4) or less (SAP Business One) functionality, as confirmed by interview C.	0.8
C2: Standard Interfaces	As SAP Business ByDesign includes ERP-, CRM- and BI-functionalities, no interfaces are necessary therefore. Beyond that, standard interfaces for Microsoft Word, Excel and Outlook exist, as confirmed by interview C.	1
C3: Mobile Access (Web-/Phone-/Tablet)	SAP Business ByDesign can be accessed via Internet browser, desktop PC and mobile devices like laptops, tablets and smartphones. SAP implementation partner companies can program their own mobile add-ons (SAP SE, 2018b).	1
C4: Dashboards based on information from different business information systems	Integrated analysis- and reporting tools based on SAP HANA are available. Thus, no additional external data warehouse system is needed. For advanced planning and Big data scenarios, it exists a standard integration between SAP ByD and SAP Cloud for analytics, as confirmed by interview C.	1
C5: Office-/collaboration integration	Integration with Microsoft Excel (free SAP Business ByDesign Excel plugin) is available. As determined in the proof of concept, even if integrations between SAP Business ByDesign and Microsoft Office products like Word, Excel and Outlook exists, it was not possible to implement all the required scenarios, especially not within Microsoft Outlook (e.g., execution of ERP-/CRM business transactions directly in Outlook is not possible).	0.5
C6: Limitations of customizability comparing to the on-premise variants	PaaS framework consisting of ByDesign Studio as development environment which enables to add new fields, create new business objects and whole new business scenarios, always in addition to the standard solution. The UI designer can be used to modify and create the UIs of the business applications (SAP SE, 2018a).	0.8
C7: User friendliness	The ERP-, CRM- and BI-modules of SAP Business ByDesign have a consistent user interface. However, there have been problems with the Silverlight presentation layer, which will be replaced with HTML5 clients in the upcoming releases.	0.6
C8: Integration / development platform	SAP HANA Cloud Platform Integration Service (HCI) provides out-of-the-box connectivity options supported with pre-defined integration templates and adapters. Thus, 70 integration scenarios are supported out-of-the-box (less than for Microsoft with Common Data Service). SAP NetWeaver as technology platform and SAP Solutions onDemand Studio as development environment (based on Microsoft Visual Studio) enable powerful non-	0.8

	coded extensions (SAP SE, 2018d).	
C9: Consistent availability of material information	As demonstrated in the proof of concept, SAP Business ByDesign covers ERP and CRM within one system. Thus, material information are always up-to-date between both systems and no further configuration is necessary.	1
C10: Direct conversion of sales offers into sales orders	As demonstrated in the proof of concept, follow-up-activities are possible throughout the whole system. One of them is the seamless creation of sales orders out of sales quotes.	1
C11: Real time data visibility of information between ERP- and CRM-system	As demonstrated in the proof of concept, SAP Business ByDesign covers ERP and CRM within one system. Thus, data are always up-to-date between both systems and no further configuration is necessary.	1
C12: 360-degree view of customers from different business information systems	As demonstrated in the proof of concept, a 360-degree view of customers is possible out of the box within ERP- and CRM-modules of SAP Business ByDesign, but not within Microsoft Outlook or other collaboration systems.	0.5
C13: Support of workflows	As demonstrated in the proof of concept, built-in workflow automation is supported: tasks can be assigned to users so that users receive work assignments automatically. However, it does not contain a real workflow engine in order to create and modify existing workflows.	0.5
C14: Integration with document management system (DMS)	Integration with Microsoft SharePoint or other DMS systems is only possible with workarounds (middleware platforms), like for example with Layer2[95].	0.5
NON-FUNCTIONAL CRITERIA		
C15: Subscription fees	Standard Enterprise-User: 133,00 € per full user/month (SAP SE, 2011).	1
C16: Online documentation	24/7 SAP support online[96] or per telephone.	1
C17: Information security and data protection	Fire-safe, flood-safe data centers protected by biometric security measures; data centers located in China, Germany, USA or Australia; regular backups are carried out over redundant hardware storage systems supported by multiple power connections; security features include multiple firewalls, an advanced intrusion detection system, a web dispatcher farm and state-of-the-art open cryptographic standards (Williams, 2017; SAP SE, 2018e).	1
C18: Performance and availability	Total end-to-end response time (E2E) 2.2 seconds to 2.8 seconds in average (SAP SE, 2018e). The author could read about some performance problems in reference stories (mainly due to the Microsoft Silverlight presentation layer). SLA for SAP cloud services: 99.5 % system availability percentage, 2 % credits of monthly subscription fees for each 1 % below system availability SLA (SAP SE, 2018i).	0.6
C19: Upgrade capability	Automatic upgrades (quarterly technology and feature updates). SAP sends pre-information for all upgrades.	1

[95] https://www.layer2solutions.com/
[96] https://help.sap.com/

C20: Implementation duration	Go-Live-Assistance from SAP support team; average time to implementation in 2017: planned 21.2 months, actual 23.1 months (Panorama Consulting Solutions, 2017).	1
C21: Flexibility and scalability through integrated add-on apps	SAP Cloud app store: in year 2017, SAP Business ByDesign had 3.172 available add-ons.	1
C22: Data Lock-in	Data within SAP Business ByDesign can be accessed by means of Web Services, as confirmed by interview C.	0.6
SUM FUNCTIONAL CRITERIA		11.0
SUM NON-FUNCTIONAL CRITERIA		7.2
TOTAL SUM		**18.2**

Table 21: Author criteria catalogue evaluation SAP Business ByDesign

Criteria ORACLE NETSUITE	**Reasoning**	**Grad-ing**
FUNCTIONAL CRITERIA		
C1: Limitations of functionality comparing to the on-premise variants	Fully integrated ERP & CRM system including reporting / analytics functionality. NetSuite is a pure cloud solution, thus there is no on-premise variant, as confirmed by interviews B and J.	1
C2: Standard Interfaces	As NetSuite includes ERP-, CRM- and BI-functionalities, no interfaces are necessary therefore. Beyond that, standard interfaces for Microsoft Word, Excel and Outlook exist, as confirmed by interviews B and J.	1
C3: Mobile Access (Web-/Phone-/Tablet)	NetSuite is generally applied within an Internet browser. Beyond that, mobile apps exist but they are providing only limited functionalities such as expense reporting, call logging, time tracking and mobile dashboards (Oracle, 2018a).	0.5
C4: Dashboards based on information from different business information systems	As demonstrated in the proof of concept, dashboards in NetSuite can be easily customized by end-users by means of native built-in reporting and analytics capabilities called SuiteAnalytics. However, only data within the NetSuite database can be analyzed with SuiteAnalytics.	0.5
C5: Office-/collaboration integration	Integrations with Microsoft Excel, Word and Outlook based on SuiteApps. As determined in the proof of concept, even if integrations between NetSuite and Microsoft Office products like Word, Excel and Outlook exist, it was not possible to implement all the required scenarios, especially not within Microsoft Outlook (e.g. the execution of ERP-/CRM business transactions directly in Outlook).	0.5
C6: Limitations of customizability comparing to the on-premise variants	“Click-not-code” configurations are possible (add fields, build custom workflows, create custom database tables). PaaS framework available, which means the	0.8

	development environment is also in the cloud, as confirmed by interviews B and J. However, the author could identify some limitations comparing to the Microsoft and SAP development environments.	
C7: User friendliness	The ERP-, CRM- and BI-modules of NetSuite have a consistent user interface based on HTML5; global quick add functionality and drag-and-drop capabilities are available (Oracle, 2018d).	0.8
C8: Integration / development platform	SuiteCloud platform enables to extend NetSuite and build apps. The platform includes "SuiteCloud developer tools" as development environment and "SuiteCloud Connect" as integration platform, which enables integrations with Salesforce.com, SAP and Google Apps. For further system integrations, NetSuite is cooperating with SaaS integration partners like Celigo, Dell Boomi, and many more (Oracle, 2017; Oracle, 2018c).	0.8
C9: Consistent availability of material information	As NetSuite ERP and NetSuite CRM are fully integrated, material information are always up-to-date between both systems and no further configuration is necessary, as confirmed by interviews B and J.	1
C10: Direct conversion of sales offers into sales orders	As demonstrated in the proof of concept, sales offers from NetSuite CRM can be seamlessly converted into sales orders within NetSuite ERP, as confirmed by interviews B and J.	1
C11: Real time data visibility of information between ERP- and CRM-system	As NetSuite ERP and NetSuite CRM are fully integrated, data are always up-to-date between both systems and no further configuration is necessary, as confirmed by interviews B and J.	1
C12: 360-degree view of customers from different business information systems	As demonstrated in the proof of concept, a 360-degree view of customers is possible out of the box within NetSuite ERP and NetSuite CRM, but not within Microsoft Outlook or other collaboration systems.	0.5
C13: Support of workflows	NetSuite provides a workflow engine called SuiteFlow, which enables to customize and automate business processes within NetSuite and between other business information systems (Oracle, 2017).	1
C14: Integration with document management system (DMS)	Integrations with Microsoft SharePoint or other DMS systems are only possible with workarounds (application of middleware platforms), like for example with StarfishETL as described in the proof of concept.	0.5
NON-FUNCTIONAL CRITERIA		
C15: Subscription fees	No official prices published by Oracle NetSuite, thus average grading.	0.5
C16: Online documentation	No comprehensive online user documentation comparing to Microsoft and SAP exists. Technical documentation about WebServices (SuiteTalk) and other technical resources is available[97].	0.5
C17: Information security and data protection	Five geographically separated data centers present in US and Europe (Amsterdam and Dublin) facilitated with	0.8

[97] http://www.netsuite.com/portal/developers/resources/suitetalk-documentation.shtml

	data mirroring, disaster recovery, failover capabilities, fire protection and backup power; application security including encryption using 128-bit SSL encryption, role-level access and robust password policies; operational security containing separation of duties and continuous monitoring, audited by well-known security certifications (Oracle, 2018b).	
C18: Performance and availability	High performance databases with maximum RAM configuration; scalable application architecture supporting multi-data center deployment. NetSuite's service level commitment (SLC) guarantees 99.5 % uptime, actual average uptime is 99.98 % (Oracle, 2018b).	0.6
C19: Upgrade capability	Automatic upgrades; customizations carry over automatically with each new release due to a single codebase without the need for any code retrofitting (Oracle, 2017).	1
C20: Implementation duration	Average time to implementation in 2017: planned 21.4 months, actual 24.5 months (Panorama Consulting Solutions, 2017).	0.8
C21: Flexibility and scalability through integrated add-on apps	SuiteApp[98] enables to extend NetSuite standard application, as confirmed by interviews B and J.	1
C22: Data Lock-in	The SuiteTalk Web Services tool provides a full complement of SOAP Web Services which enables integration with existing on-premise investments and third-party cloud applications (Oracle, 2017). As 100% of NetSuite customers are on the latest version of the software, it eliminates the version-lock problem associated with on-premise ERP systems (Misra, 2018).	0.8
SUM FUNCTIONAL CRITERIA		10.9
SUM NON-FUNCTIONAL CRITERIA		6.0
TOTAL SUM		**16.9**

Table 22: Author criteria catalogue evaluation Oracle NetSuite

[98] http://suiteapp.com/

Appendix E: Criteria catalogue evaluations of experts

In order to obtain an expert evaluation of the identified criteria for the three analyzed systems, the author sent the criteria catalogue including the description and evaluation criteria as defined in chapter 4.2.3 to three selected experts. In this appendix, the results of all three expert evaluations are described including the grading and reasoning for each criterion (but without the definition of each criterion as this can be found in chapter 4.2.3).

System validation Microsoft Dynamics 365

Name of the expert: Marco Mülleder
Company: NAVAX Consulting GmbH
Industry: IT consulting / consulting partner for Microsoft Dynamics solutions
Position: Head of Product Management
Date: 2018-05-17
Publishing of the system validation allowed: X Yes ☐ No
Publishing of the name of the expert allowed: X Yes ☐ No

Criteria	**Reasoning**	**Grading**
FUNCTIONAL CRITERIA		
C1: Limitations of functionality comparing to the on-premise variants	Depends on the product. Current limitations will be eliminated very soon.	0.6
C2: Standard Interfaces	Very powerful standard integrations. Hidden highlight: single sign-on, thus just one authentication required.	1
C3: Mobile Access (Web-/Phone-/Tablet)	Available, usability and functionality is continuously improving.	1
C4: Dashboards based on information from different business information systems	Thanks to Power BI.	1
C5: Office-/collaboration integration	The same reason as for C2.	1
C6: Limitations of customizability comparing to the on-premise variants	For developers nearly no limitations (even if the “extensions” are at the beginning), for end customers “In-App-Designer” exists.	0.6
C7: User friendliness	Consistent User Interface; some minor limitations due to Web Interface.	0.8
C8: Integration / development platform	CDS, Power Apps and Flow enable a huge number of integration scenarios.	1
C9: Consistent availability of material information	Thanks to the powerful integration capabilities in C8.	1
C10: Direct conversion of sales offers into sales orders	Standard functionality	1
C11: Real time data visibility of information between ERP- and CRM-system	Thanks to the powerful integration capabilities in C8.	1
C12: 360-degree view of customers from different business information systems	Within ERP and CRM already possible for many years (NAV-CRM connector); but since some releases also possibility within Outlook to show customer information.	1

C13: Support of workflows	In the past with 3rd party workflow modules. Now with Microsoft Flow a very powerful workflow engine.	1
C14: Integration with document management system (DMS)	Yes, deep integration with Microsoft SharePoint, but also with other well-known document management systems.	1
NON-FUNCTIONAL CRITERIA		
C15: Subscription fees	<No grading was done>	0.5
C16: Online documentation	Microsoft Docs	1
C17: Information security and data protection	Very high investments from Microsoft, but also high potential target for attacks.	0.8
C18: Performance and availability	Currently we (NAVAX) have about 5-6 customers who are working in the cloud, but mostly small customers. But there are for sure some improvement potentials for the next product releases.	0.6
C19: Upgrade capability	Automatic and seamless updates.	1
C20: Implementation duration	<No grading was done>	0.6
C21: Flexibility and scalability through integrated add-on apps	App Source available	1
C22: Data Lock in	Export functions for limited data volumes; differences to on-premise: no access to SQL database available, in the past companies often continued running their on-premise servers, now with cloud solutions they still have to pay licenses.	0.6
SUM FUNCTIONAL CRITERIA		13.0
SUM NON-FUNCTIONAL CRITERIA		6.1
TOTAL SUM		**19.1**

Table 23: Expert criteria catalogue evaluation Microsoft Dynamics 365

System validation SAP Business ByDesign

Name of the expert: DI Peter Weiss
Company: FULCRUM Consulting GmbH
Industry: IT consulting / consulting partner for SAP cloud solutions
Position: CEO
Date: 2018-05-16
Publishing of the system validation allowed: X Yes ☐ No
Publishing of the name of the expert allowed: X Yes ☐ No

Criteria	Reasoning	Grading
FUNCTIONAL CRITERIA		
C1: Limitations of functionality comparing to the on-premise variants	Some heavy modifications could be problematic during the project. With on premise systems the modifications only get problematic with the next release change.	0.8
C2: Standard Interfaces	Interfaces exist	1
C3: Mobile Access (Web-/Phone-/Tablet)	Both available	1
C4: Dashboards based on information from different business information systems	Based on SAP HANA	1
C5: Office-/collaboration integration	Generally available, but with limitations.	0.5
C6: Limitations of customizability comparing to the on-premise variants	Development is also part of the cloud.	0.8
C7: User friendliness	Currently some Silverlight problems	0.6
C8: Integration / development platform	SAP HCI	0.8
C9: Consistent availability of material information	ERP and CRM are 1 system.	1
C10: Direct conversion of sales offers into sales orders	Possible with follow-up actions.	1
C11: Real time data visibility of information between ERP- and CRM-system	ERP and CRM are 1 system.	1
C12: 360-degree view of customers from different business information systems	Some limitations with Outlook	0.5
C13: Support of workflows	Some limitations	0.5
C14: Integration with document management system (DMS)	Custom-made integrations available	0.5
NON-FUNCTIONAL CRITERIA		
C15: Subscription fees	<No grading was done>	1
C16: Online documentation	Available	1
C17: Information security and data protection	See www.sapdatacenter.com	1
C18: Performance and availability	Apart from some exceptions very good.	0.8

C19: Upgrade capability	One of the main strengths.	1
C20: Implementation duration	Very fast	1
C21: Flexibility and scalability through integrated add-on apps	SAP Cloud app store.	1
C22: Data Lock in	Exports are possible.	0.8
SUM FUNCTIONAL CRITERIA		11.0
SUM NON-FUNCTIONAL CRITERIA		7.6
TOTAL SUM		**18.6**

Table 24: Expert criteria catalogue evaluation SAP Business ByDesign

System validation Oracle NetSuite

Name of the expert: Peter von Zimmermann
Company: Alta Via Consulting GmbH
Industry: IT consulting / consulting partner for NetSuite solutions
Position: CEO
Date: 2018-05-14
Publishing of the system validation allowed: X Yes ☐ No
Publishing of the name of the expert allowed: X Yes ☐ No

Criteria ORACLE NETSUITE	**Reasoning**	**Grading**
FUNCTIONAL CRITERIA		
C1: Limitations of functionality comparing to the on-premise variants	There is no on-premise version of NetSuite, NetSuite has all needed functions like any comparable on-premise solution, there is nothing limiting due to the cloud.	1
C2: Standard Interfaces	There is no interface to any other ERP system out-of the-box. NetSuite also includes a CRM system and interfaces between CRM and ERP are always very custom-specific, BI integration is included as well as export to any office.	0.5
C3: Mobile Access (Web-/Phone-/Tablet)	Both are available.	1
C4: Dashboards based on information from different business information systems	NetSuite is a broad suite fulfilling the reporting requirements of all functions (ERP, CRM, …) but not a BI system integrating multiple other sources, for this data has to be included.	0.5
C5: Office-/collaboration integration	Most of our customers are not using Microsoft but Google, there is an outlook integration allowing to link e-mails to NetSuite data, create leads out of outlook or synchronizing the calendar with tasks and events; an-add-on exists to allow the direct change of data in NetSuite out of Excel via the NetSuite web service API, no integration with word other than mail-merge out of NetSuite.	0.5
C6: Limitations of customizability comparing to the on-premise variants	Due to the in-build development framework coming for free with every NetSuite license there are no limitations.	1
C7: User friendliness	There is always improvement potential.	0.8
C8: Integration / development platform	REST and SOAP interface, very easy to build any integration, SFTP as well.	0.8
C9: Consistent availability of material information	Actually, there is no difference between the ERP and the CRM system, NetSuite is one suite for the whole lead–to-cash process, as there are zero synchronization needs there is also nothing to parameterize.	1
C10: Direct conversion of sales offers into sales orders	By pressing a button.	1

C11: Real time data visibility of information between ERP- and CRM-system	It is very easy to make the NetSuite data available from outside as well as to read any data from a CRM system, also the integrated CRM functionalities are not limited in NetSuite.	1
C12: 360-degree view of customers from different business information systems	There is a 360-degree view for customers (and vendors) in NetSuite, Outlook data are if needed synchronized into NetSuite.	0.5
C13: Support of workflows	Strong workflow engine	1
C14: Integration with document management system (DMS)	There are integrations available for a lot of DMS systems.	0.5
NON-FUNCTIONAL CRITERIA		
C15: Subscription fees	<No grading was done>	0.5
C16: Online documentation	Available	1
C17: Information security and data protection	This is the major benefit of using an only-cloud solution like NetSuite that this is part of the basics in NetSuite, 40.000 customers worldwide including a lot of manufacturers rely on NetSuite.	1
C18: Performance and availability	This are actually 2 very different topics, NetSuite has 99.9 % availability history. The performance depends on multiple factors including client-side or wifi-related restrictions.	0.8
C19: Upgrade capability	This is again the basic feature in NetSuite, every 6 month a new release to all customers will be shipped guaranteeing upwards compatibility of all changes	1
C20: Implementation duration	Actually, there is not much difference as the implementation time is mostly depending on needs for customization and data-migration and not so much on deployment model.	0.8
C21: Flexibility and scalability through integrated add-on apps	See SuiteApps	1
C22: Data Lock in	There is an easy way to export all data	0.8
SUM FUNCTIONAL CRITERIA		11.1
SUM NON-FUNCTIONAL CRITERIA		6.9
TOTAL SUM		**18.0**

Table 25: Expert criteria catalogue evaluation Oracle NetSuite