

A Case Study of Success Factors for Data Warehouse Implementation and Adoption in Sales Planning

Abstract

We present the case of the successful implementation of a data warehouse for support of the sales planning process in an Austrian company. We investigate the factors that contributed to the success of the project. The key findings of this case study are as follows. First, highly-qualified external consultants may compensate insufficient qualification of internal staff. Of particular importance in that case is communication between internal staff and external consultants. Second, user training compensates a lack of (perceived) usability of the software. Resistance of initially overwhelmed users may be overcome through training sessions. Finally, rather than acquire functionality that is not required, companies should ensure customizability of the acquired software, which is often more important than a plethora of features.

Keywords

Business intelligence, critical success factor analysis

Introduction

A data warehouse organizes data from various operational sources in a central database using a representation format suitable for data analysis (Vaisman and Zimányi 2014). The data warehouse offers management a “single version of the truth” (Inmon 2005), containing cleansed and consolidated data of high quality from all across the company. The implementation of such systems in a corporate environment poses several technical and organizational challenges which have to be mastered in order to realize the full potential of a data warehouse system.

In this paper we present the successful implementation and adoption of a data warehouse for sales planning at the W&H Group, and we further identify the main factors that contributed to the success of this implementation project. The W&H Group is an Austrian family-run manufacturer of dental technology which has three production sites, two in Austria and one in Italy, and sells its products to more than a hundred countries worldwide. Product sales are managed by area managers and the local subsidiaries. The introduction of data warehouse technology in the sales planning process aimed at centrally providing employees at the group’s various subsidiaries and area managers with current and consolidated data as well as improving security through access rights management.

Prior to the implementation of a data warehouse system the sales planning process at the W&H Group involved the import of data from the ERP (Enterprise Resource Planning) system’s tables into spreadsheets and subsequent analysis using a pivot table add-in. These spreadsheets had to be synchronized manually in case of changes to the operational data after import, which made the sales planning process susceptible to a reliance on obsolete data. The finished sales plans were then distributed for approval via e-mail to various recipients with no single point of access, leading to redundant and potentially ambiguous versions of sales plans within the company.

The introduction of a data warehouse system for sales planning at the W&H Group saw the replacement of spreadsheet-based planning with sales planning in a web frontend backed by the data warehouse. The web frontend allows access to the data warehouse by providing forms for sales planning. The underlying data are read directly from the data warehouse, which is updated automatically and thus incorporates changes in the operational systems in a timely manner. Executives and other authorized employees have access to the sales plans stored in a central location.

The remainder of this paper is organized as follows. After a presentation of research problem and method as well as an investigation of related work, we briefly contrast the sales planning process at the W&H Group prior to and after the introduction of the data warehouse. We then describe the implementation and introduction of the data warehouse and identify critical success factors for this implementation project. We discuss the results with respect to IS theory and other empirical findings before concluding the paper with the main takeaway points for researchers and practitioners.

Research Problem

Over the years, industry professionals have established a multitude of guidelines that should pave the way for the successful implementation of a data warehouse system (Inmon 2005; Kimball and Ross 2013; Poe et al. 1997; Sherman 2015). Yet, many data warehousing projects fail due to various reasons (Poon and Wagner 2001; Ramamurthy et al. 2008). Literature has therefore long strived to identify the various success factors for data warehousing projects as well as their individual importance (Wixom and Watson 2001). Given the chance to observe first-hand a data warehouse implementation project in a company we set out to identify the success factors for this particular project and how the findings match up to the existing body of work in the field. Specifically, in this paper, we tackle the following research questions:

- 1. What were the main factors that contributed to the success of the implementation project of a data warehouse for sales planning in the case of the W&H Group?*
- 2. Despite the overall success of the project, what could have been done better?*
- 3. How do the success factors identified for the W&H Group's data warehouse implementation project compare to other findings in literature?*

Research Design

We follow a case research strategy (Benbasat et al. 1987) to study the case of data warehouse implementation for sales planning at the W&H Group. One of the authors participated directly in the data warehousing project at the W&H Group from January to May 2015, aiding the implementation of the data warehouse, building data cubes, and conducting training sessions with prospective users of the system. Through close interaction with technical staff and prospective users, a first intuition of the success factors of this particular project was established, which led to a formal survey about success factors among the project's stakeholders. The participating project stakeholders included technical and non-technical employees as well as external consultants working for the software vendor.

A survey about the project's success with respect to various factors was conducted as critical success factor analysis (Bullen and Rockart 1981; Heinrich and Pomberger 2001), in the variant as described in one of the European standard references on information management (Heinrich and Stelzer 2011). In this survey, participants had to rate performance and importance of 23 success factors. The success factors were adapted from literature by applying first-hand experience gained from direct collaboration in the project. Using the survey results, we are able to get an idea of the relative importance of the individual success factors and their contribution to overall project success. We compare the results with findings of related work dealing with the analysis of success factors for data warehousing and business intelligence.

Related Work

Critical success factors are those aspects of information systems that crucially contribute to the success of an information system (Bullen and Rockart 1981). Critical success factors of data warehousing projects are often categorized into organizational, project and technical factors (Wixom and Watson 2001). Factors that influence data warehousing success hence include management support and user participation, team

skills and resources, as well as source systems and development technology. Other factors relate to project management, data, and infrastructure (Yeoh and Koronios 2010; Yeoh and Popović 2016). These categories and factors often serve as a frame of reference for case research on success factors in data warehousing (Hawking and Sellitto 2010).

Among the top factors for data warehousing success are appropriate management, appropriate staff, and appropriate technology, along with the ability to overcome organizational resistance towards the new technology (Poon and Wagner 2001). Another study (Ramamurthy et al. 2008) stresses the importance of considering both technological and organizational aspects in data warehouse implementation. Similarly, in an adaptation of the Technology Acceptance Model, project management factors were proposed as drivers of implementation success (Bach et al. 2016)

Case studies from different industries in various regions report on critical success factors for data warehousing. A study of the banking industry in Taiwan (Hwang et al. 2004) identifies company size, support of top management, internal need to adopt a data warehouse as important success factors. A recent study of the banking industry in Vietnam (Pham et al. 2016), based on a well-established success factor framework (Yeoh and Koronios 2010), finds team composition, user orientation of change management as well as flexibility of the employed technology among the key factors. Similarly, a study in the financial sector of South Africa (Dawson and van Belle 2013) names organizational size, financial resources and IT capability as important success factors. Another study looks at various cases of data warehousing among small and medium-sized enterprises in Poland (Olszak and Ziemba 2012), thereby uncovering suitability of technology for business needs, ability of the system to further develop, and integration with operational systems among the factors determining success, with lack of know-how and management support, exceeding budgets, ineffective project management, and lack of user training among the inhibitors.

Sales Planning at the W&H Group

The W&H Group employs a number of area managers and local subsidiaries that are responsible for managing sales in different markets. Both the area managers and the local subsidiaries compile annual sales plans for particular areas and countries. The Controlling¹ department in the W&H headquarters advises the planners and collects the various sales plans which are subsequently approved or rejected by management. The sales plans serve as the basis for further planning by the Controlling department.

Initial Situation

The Controlling department used to dispatch spreadsheets with current and historical sales data to the area managers as the basis for sales planning. The data were extracted by the Controlling department from the relational tables of the ERP system using the spreadsheet software's advanced pivoting table add-in. The spreadsheets also contained the forms for sales planning. Each year these forms needed to be updated manually by the Controlling department along with the queries for importing the data from the source systems, which was error-prone and inefficient.

Spreadsheet transfer between the individuals that were involved in the planning process was conducted via e-mail. Error correction in spreadsheets entailed further e-mail communication. Rather than having a single point of truth, different versions of sales plans existed in various places of the company, leading to potential confusion and loss of data.

Although the spreadsheet software by default displayed only a limited amount of data to each planner – with data being hidden from area managers and other involved planners when irrelevant for their respective area – a simple change in settings of the spreadsheet software could reveal hidden information. The spreadsheet-based solution did not feature any more sophisticated mechanism for access rights management. Thus, restricting access of planners to only the necessary data was impossible.

¹Due to the lack of universally accepted translations we use the German pseudo-Anglicism “Controlling” to describe a management task that roughly corresponds to management accounting. Brühl (2016) employs the term “management control” as translation for “Controlling”.

Data-Warehouse-Backed Sales Planning

In the now data-warehouse-backed sales planning process, a web-based user interface provides area managers and planners at local subsidiaries with access to the required data as well as forms for sales planning. Automated ETL processes feed the data from the source tables into the data warehouse, ending the cumbersome manual adaptation of forms and data imports by Controlling department staff.

Sales plans now have a uniform appearance, at a more detailed granularity than before, and can be accessed easily by all individuals involved in the planning process, be it area managers, employees of the local subsidiaries, Controlling department staff, or executives. Error corrections are instantly available to all individuals without the need to exchange sales plans via e-mail. The data warehouse serves as a single point of truth, thereby eliminating the existence of different versions of sales plans in various places. The data

warehouse system, as opposed to the spreadsheet-based solution, allows for a flexible consideration of the area managers' individual preferences regarding the execution of the planning process. For example, some area managers prefer planning by countries first, others prefer planning by items first, which in the past required area managers to individually adapt their planning forms and later feed the data into the standard forms. The Controlling department could not cater for individual preferences in the spreadsheet-based solution as this would have multiplied the effort required by Controlling department staff. The data warehouse with its support for online analytical processing (OLAP) queries and filtering rules facilitates the customization of the planning forms. Furthermore, area managers and employees at the subsidiaries may define simple ad hoc reports to gain additional information. The data warehouse

incorporates access rights management which allows for effective restriction of access to individual data items. Each individual now has access only to precisely defined partitions of the data. Unauthorized access to the data is prevented by the data warehouse itself. An integrated workflow

management system provides the Controlling department as well as management with information about the progress of the planning process. Confirmation and approval of sales plans is managed using the workflow management system. The integrated rights management allows for the definition of responsibilities in the sales planning process. Overall, the sales planning process, due to the introduction of a data warehouse system, is now more structured and uniform without losing the ability for customization of individual aspects of the planning process.

Data Warehouse Implementation at the W&H Group

Requirements analysis involved managers, Controlling and IT staff as well as prospective users. Among the key requirements for the W&H Group's data warehouse system were the following: Ability to cope with relational data sources, enterprise resource planning (ERP) system connectivity, customizability of the software suite, user and access rights management, as well as web-based user interface.

Regarding the selection of data warehouse software, the W&H Group opted for a best-of-suite solution from an established enterprise computing company, choosing a single vendor for all aspects of the data warehouse system. The W&H Group invited companies to submit bids for the implementation project, requiring presentation of their system as well as the implementation of a given use case chosen by the W&H Group. Besides costs and fulfillment of formal requirements, human factors had a major influence on the selection process. The people in charge of the implementation project at the W&H Group deemed important a good relationship between internal employees and external consultants. Following the analysis of

requirements and the selection of a software suite, the project members analyzed source systems to determine the amount and quality of data that have to be loaded into the data warehouse. Text files and tables are among the data sources that need to be integrated. Furthermore, having the ETL process in mind, the project members determined frequency of updates depending on the data sources. Based on the analysis of the data sources the project members chose to streamline the planning process and introduce additional analyses for planners.

The design phase commenced with the definition of the sales data cube, which was later adapted during the implementation of the system, followed by a first definition of forms to be used during the sales planning process. Closely connected to the definition of forms, the design phase also included a definition of the workflow along with process roles.

Following the design phase, cube implementation and definition of extraction, transformation, and load (ETL) process dominated the agenda. The definition of the mappings between data sources and data cubes was tool-supported, leading to a semi-automated generation of ETL routines. A script language allowed for the fine-tuning of ETL routines and more detailed regulation of the data imports.

Originally, area managers as well as local subsidiaries were supposed to use the data warehouse for compiling their sales plans for fiscal year 2016. The data-warehouse-backed solution was set to completely replace spreadsheet-based sales planning beginning with sales planning for 2016. Due to unexpected delays and a more complex planning process at local subsidiaries, the company opted for a partial roll-out of the data-warehouse-backed solution with only area managers using the live system for their planning activities for the fiscal year 2016, thus serving as a test audience for the full roll-out. At that time, the development of additional data cubes for tasks other than sales planning, e.g., financial planning, service planning, logistics planning, was planned.

Training sessions for prospective users were an important part of the introduction of the data-warehouse-backed sales planning process. Training sessions were either on-site or over video conference. Most training sessions were individual sessions with only a single user at a time. Larger groups were trained in cases of teams that conducted sales planning collaboratively.

Initially, users adopted the new data warehouse system reluctantly. Without being able to state concrete points of criticism, employees seemed to oppose the introduction of a new data warehouse system on the grounds of a disruption of their familiar work processes. Area managers and Controlling staff, however, have adjusted, with area managers now praising the flexibility of the data warehouse system, which allows area managers to customize their individual planning, and Controlling staff welcoming the possibility of conducting additional analyses due to the analytical capabilities of the data warehouse. Furthermore, handling an unfamiliar data warehouse system initially overburdened many users.

Critical Success Factor Analysis

In this section we present the design and results of a critical success factor analysis (Bullen and Rockart 1981; Heinrich and Pomberger 2001; Heinrich and Stelzer 2011) for the evaluation of the success of the W&H Group's implementation and adoption of a data warehouse for sales planning. We first propose a set of success factors to be considered in a survey by stakeholders of the W&H Group's data warehousing project. We then present the results of the survey.

Identification of Success Factors

The success factors considered in this analysis derive from a list of general success factors for information systems (Heinrich and Stelzer 2011) and from the experiences of a recent case study (Kempinger 2013), preselected and further adapted in order to take into account the peculiarities of data warehouse technology and the specifics of this particular project. The considered success factors (Figure 1) are organized into four broad categories: service, personnel, security, and communication. The service category comprises success factors concerning functional and non-functional aspects of the software as well as services rendered by the software vendor. The personnel category comprises success factors concerning qualification and attitude of internal staff and external consultants. The security category comprises success factors concerning authorization and confidentiality of data access. The communication category comprises success factors concerning user training and communication between project stakeholders.

Project management has often been proposed as a success factor for data warehousing projects (Bach et al. 2016). Closely related to project management are effort and evaluation complexity thereof as success factors similar to the previously proposed factor of risk management support (Işık et al. 2013). Since exceeded implementation budgets often inhibit adoption of data warehouse technology (Olszak and Ziemba 2012), it seems appropriate to consider effort and its evaluation complexity as a success factor. In general, employing the appropriate technology is crucial to data warehousing success (Poon and Wagner 2001). The considered success factors for customizing and functionality of the software reflect the factor of having a "business-driven, scalable and flexible technical framework" (Yeoh and Koronios 2010) previously identified as a success factor for data warehousing. Other research (Işık et al. 2013) has likewise suggested flexibility, in the sense of adjustment to specific needs of individuals and organizations, as

Service	
Pre-Sales Service	The extent and quality of the services offered by vendor prior to purchase decision.
Project Management	The software solution's transition process from the vendor to the W&H Group.
Implementation	The process of the technical implementation of the new system.
Systems Integration	The quality of the merger between new system and existing software systems.
Effort	The amount of time, material, and human resources will be assessed.
Evaluation Complexity of Effort	The possibility of estimating beforehand the effort that arises during the implementation of the new system.
Availability of the BI Tool	The downtime, e.g., due to hardware or software failure, in proportion to the period of use of the tool.
Availability of Results	Temporal aspects during the delivery of reports or during the accessing of reports.
Usability	Simplicity, understandability, and safe handling of the BI system.
Functionality of the Software	The software's feature of providing the necessary functions to fulfill the task.
Customizing	The possibility to adapt the software to in-house processes of the W&H Group.
Further Development of the Software	The possibility to independently expand the data warehouse and build reports for employees of the W&H Group.
Personnel	
Qualification of Consultants	Knowledge and skills of consultants from the software provider regarding the particularities of processes and requirements at the W&H Group.
Qualification of IT Staff	Skills of IT staff regarding the BI solution and the introduction of data warehouse systems as well as knowledge about process and tasks of the departments.
Qualification of Controlling Staff	Knowledge and skills of Controlling staff regarding the BI solution as well as the use of the BI tool for reporting.
Qualification of Users	IT-related skills of prospective users, e.g., area managers, employees at subsidiaries,
	regarding the BI solution.
	Openness of users towards new tools for reporting.
User Acceptance	IT-related knowledge of the W&H Group's management regarding the BI solution and introduction of a data warehouse system.
Qualification of Management	
Security	
Authorization Concept	The system's ability to administer different users along with access rights.
Confidentiality	Protection of data from unauthorized access.
Communication	
User Training	Extent and quality of training sessions for users along with the teaching methods.
Cooperation between employees and consultants	Communication between employees of the W&H Group and external consultants, for example, availability of consultants, atmosphere of talks, conduct.
In-House Communication	Communication between users and project members from the W&H Group.

Figure 1. The success factors considered in the critical success factor analysis

a success factor for data warehouse and business intelligence systems. Aggregated empirical evidence from several case studies also suggests a lack of flexibility as a barrier to data warehouse adoption (Olszak and Ziembra 2012).

Systems integration has been established as an important success factor for data warehouse introduction (Işık et al. 2013; Olszak and Ziembra 2012). The data warehouse system must integrate well with the operational systems in order to realize the full potential of business intelligence technology. “Team skills” have long been identified as a success factor for data warehousing projects (Wixom and Watson 2001). The personnel category breaks down team skills into several success factors that reflect the composition of this particular project’s key stakeholders, namely external consultants, IT staff, Controlling staff, prospective users, and management. The social component of team skills is captured in the communication category as in-house communication. Another critical success factor suggested by literature is “user-oriented change management” (Yeoh and Koronios 2010), reflected in our list of considered success factors by user training and in-house communication. Other case studies have likewise identified a lack of know-how as inhibitors to data warehouse adoption (Olszak and Ziembra 2012).

Security aspects were important for the project, with the data warehouse providing a remedy to the lack of authorization concept and confidentiality associated with the spreadsheet-based planning process. Thus, we include the two factors for security in the success factor analysis. The security factor is often neglected in research on critical success factors in data warehousing, even though it can be considered an elementary factor of general information systems success (Heinrich and Stelzer 2011).

Participants of the Survey

The survey was conducted online with W&H Group employees and external consultants that had been involved in the project. Eight of these participants worked for the W&H Group, two participants were consultants of the software vendor. Among the eight W&H Group employees, four participants worked at the W&H headquarters whereas the other four participants worked for one of the subsidiaries. More precisely, the four participants from the subsidiaries worked in sales and distribution, one participant from the W&H headquarters worked in the IT department, and the other three participants from the W&H headquarters worked in the Controlling department.

Survey Results

Participants of the survey had to rate performance and priority of each factor in the context of the project on a 7-point Likert scale with the option to provide no rating for a factor. Figure 2 shows success rating as well as average performance and importance for each factor. The success rating of a factor was derived by the factor’s performance weighted with its importance; only answers with a rating for both performance and importance were considered for calculating the success rating. All answers counted towards the calculation of average performance and importance.

A separate question asked for overall project success on a 7-point Likert scale. Overall project success was rated highly by survey participants with a 6.1 average score.

The difference between priority and performance of a success factor serves as an indicator of the project’s efficiency regarding the respective success factor. Elevated differences are recorded for availability of tool and results, usability, qualification of IT staff, and user acceptance, to some extent also customizing. Success

factors are further classified into the following categories (Heinrich and Stelzer 2011): *Success*, *OK*, *Waste*, and *Killer*. This classification is an indicator of the project’s effectiveness and efficiency with respect to a particular success factor. Hence, performance and importance of a *Success*-classified factor are above average. In that case, resources were efficiently put to use, the effort justified. Performance and importance of an *OK*-classified factor are below average. Resources were only scarcely afforded to a relatively unimportant success factor. Performance of a *Waste*-classified factor is above average whereas importance is below average. In that case, excess performance is a waste of effort in a success factor deemed rather unimportant in the context of the project. Performance of a *Killer*-classified factor is below average whereas importance is above average. In that case, future projects should dedicate additional resources to this success factor as past performance was not matching the relative importance of this factor.

F	S(F)	P(F)	I(F)	D(F)	Classification(F)
Pre-Sales Service	5.89	5.83	5.90	0.07	Success
Project Management	6.08	6.00	6.00	0.00	Success
Implementation	6.00	6.00	6.10	0.10	Success
Systems Integration	6.14	6.14	6.22	0.08	Success
Effort	5.25	5.17	4.80	-0.37	OK
Evaluation Complexity of Effort	5.00	5.00	4.90	-0.10	OK
Availability of the BI Tool	4.93	4.90	6.00	1.10	Killer
Availability of Results	4.61	4.60	5.70	1.10	OK
Usability	4.88	4.90	5.90	1.00	Killer
Functionality of the Software	5.69	5.67	5.60	-0.07	Waste
Customizing	5.24	5.17	5.90	0.73	Killer
Further Development of the Software	6.18	6.17	6.25	0.08	Success
Qualification of Consultants	7.00	7.00	6.90	0.10	Success
Qualification of IT Staff	5.11	5.11	6.10	0.99	Killer
Qualification of Controlling Staff	5.45	5.40	5.80	0.40	Killer
Qualification of Users	4.58	4.56	4.20	-0.36	OK
User Acceptance	4.18	4.13	5.60	1.47	OK
Qualification of Management	3.45	3.00	3.10	0.10	OK
Authorization Concept	6.73	6.71	6.80	0.09	Success
Confidentiality	6.80	6.78	6.60	-0.18	Success
User Training	6.02	5.89	6.10	0.21	Success
Cooperation between employees and consultants	7.00	7.00	6.70	-0.30	Success
In-House Communication	5.15	5.14	5.44	0.30	OK
Average	5.54	5.49	5.77		

Figure 2. The survey results for the factors in Figure 1. The table includes for each factor F the success S(F), the performance P(F), the importance/priority I(F), the difference D(F) between importance/priority and performance, and a classification.

Regarding personnel, the qualification of IT staff and Controlling staff were considered important success factors which the project failed to accurately address. The external consultants were held in high esteem with performance and importance of the qualification of external consultants being rated exceptionally high. Qualification of users and qualification of management, on the other hand, were deemed rather irrelevant to project success.

Importance of user acceptance of the implemented system for project success was rated below average over all factors. Performance of this factor was likewise not rated highly. More concerning, though, was the rating of usability as a *Killer* factor. This low rating is consistent with impression from personal contact with prospective users who showed initial resistance. User training, on the other hand, was rated an above-average important factor with performance in the project closely trailing importance. The impression from personal contact suggests a vital role of user training in overcoming initial user resistance.

Customizing was rated an important factor, where performance trails importance; the factor was classified *Killer*. Importance of the functionality of the software, in turn, was rated below average. More crucially for the project, though, the ability to further develop the software was rated a resounding success by the survey participants.

Availability of the BI tool was rated *Killer*, a rating that almost certainly stems from initial problems with system outages that have been rectified rather quickly. So, in this respect, the *Killer* rating does not give cause for worry.

Discussion

In the W&H Group case, performance with respect to user acceptance, usability, and user qualification was rated relatively low. Still, the project was considered an overall success. But, the relatively low survey results concerning performance of user acceptance and usability at the W&H Group must be seen in relation to the employed training measures which positively contributed to project success. This is consistent with literature, where a lack of support from users for the data warehousing project must be compensated through appropriate intervention (Chenoweth et al. 2006). Similarly, user training is viewed as the appropriate intervention in cases where users lack sufficient comprehension of the software and analytical task (Chenoweth et al. 2006). That was certainly the case in this survey, where a lack of user qualification was not perceived as major concern since it could apparently be compensated for by user training.

Case studies have been characterized as “exploratory in nature” (Benbasat et al. 1987). The small sample size of ten participants in an observation of a single case somewhat limits theory building at the end of the presented case study. Yet, the obtained results are mostly consistent with literature while providing some interesting thoughts for future research concerning the relationship between user training and usability, qualification and involvement of external consultants, as well as the trade-off between functionality and customizability.

Conclusions

We consider the findings of the presented case study useful for practitioners and researchers alike. The case research strategy best suits “the exploration, classification and hypothesis development stages of the knowledge building process” (Benbasat et al. 1987). In this spirit, in the following, we summarize the case study’s key findings which we propose as the starting point (hypotheses) for further theory development in future research. Likewise, for practitioners, the following statements may serve as loose guidelines for implementation projects:

- A lack of qualification of internal staff can be offset by highly-qualified external consultants. In this case, communication between internal staff and external consultants is vital to the success of a project.
- User training can offset a lack of (perceived) usability of the implemented software. In the beginning, many users are overwhelmed by new technology. Training sessions are an effective means to overcome initial user resistance against new technology.
- Rather than acquire functionality that is not required, companies should ensure customizability of the acquired software, which is often more important than a plethora of features.