An Exploration of Factors Influencing the Continuous Use of Business Intelligence Systems

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Abstract

Data Warehouse and Business Intelligence (DWH/BI) systems play an important role in the decision making process of organizations. DWH/BI systems address a heterogeneous group of users and therefore have to address a broad range of requirements. Only if these requirements and additional prerequisites are met by the DWH/BI systems, potential users will continuously use these systems for their daily work and thus justify the considerable cost of these systems. In this paper we present an exploratory analysis of factors that influence continuous use of DWH/BI systems. In total, we identified nine factors. Three address aspects related to the users and their interaction with the system. Another three focus on the DWH/BI system's characteristics and its development. The remaining three factors incorporate organizational, governance-related and peer influence factors with an effect on the users' continuous use behavior.

1 Introduction

The majority of information systems (IS) that can be found in an organization has a limited number of stakeholders and addresses specific operational processes or a specific topic area of the organization. As a result, such IS often are designed to fit the specific needs of one stakeholder group. Related theory is informed by, e.g., the IS success model [13, 14], the technology acceptance model (TAM) [10, 11, 42], the unified theory of acceptance and use of technology (UTAUT) [43] or the diffusion of innovation theory [9, 36].

A *Data Warehouse/Business Intelligence* (DWH/BI) system, however, often caters for a much broader, i.e., an enterprise-wide, perspective [24]. In the late 1980s the concept of *data warehousing* was developed with the aim of collecting and integrating any internal and external piece of data that is relevant for an organization's decision making into a central database—the data warehouse (DWH) [19, 22]. Based on a DWH, *Business Intelligence* (BI) systems aim at utilizing the data "to help its users make better decisions" [45, p. 14].

DWH/BI systems are based on an extensive technical and logical infrastructure that is necessary to make enterprise-wide data accessible to a broad range of stakeholders for analytical exploitation. As a result, DWH/BI systems are often centrally build and operated while their use is spread over large parts of an organization. The significant costs of such an enterprise-wide IS occur as a monolithic block while the benefits justifying these costs can only be realized by continuous and often decentralized use [3, 13, 17, 44]. Therefore it is crucial for building and managing DWH/BI systems to specifically address the *continuous use* of such systems in its manifold application scenarios in order to generate the accumulated value that justifies the costs [4].

The concept of continuous use is different from first-time acceptance, as intensively studied by Davis, Venkatesh et al., and others [10, 11, 43]. The corresponding research stream on first-time acceptance investigates the initial use behavior of IS users [10, 11, 43]. In contrast, continuous use has a long-term focus and studies a person's use behavior and interaction with the system over a longer period of time [4]. Taking the organizational distance of system deployment (centralized) and system use (in decentralized units) in the area of DWH/BI systems into account, it is crucial to understand which factors need to be adjusted in order to foster the continuous use behavior of DWH/BI users. Existing models investigating continuous use do not take the specific use scenarios of DWH/BI systems into account. Models are focused on specific IS with a defined purpose or on a homogeneous user group, e.g., online banking [4] or teenagers' (i.e., digital natives') continuous engagement in social virtual worlds [23]. In contrast DWH/BI systems are used by heterogeneous user groups with heterogeneous objectives.

Our research question therefore is: *Which factors influence the continuous use of DWH/BI systems?*

To answer the research question, we identified items that are discussed in literature on (continuous) use of IS, structured them based on the dimensions of a maturity model and triangulated these findings with qualitative empirical data from a case study. Based on the resulting items we collected data and used it in an exploratory factor analysis in order to identify latent factors influencing the continuous use of DWH/BI systems. Based on these factors, a cluster analysis was performed. We identified two clusters of organizations among the respondents that differ in their average factor means.

We proceed as follows: In the next section we describe the conceptual foundations of our research and discuss existing work in the area of continuous use in general and continuous use of DWH/BI systems in particular. In section three we describe our research approach and go on with presenting the results of the factor and cluster analysis in section four. The results are discussed in section five. We conclude with a section on future work.

2 Conceptual Foundations and Related Work

DWH/BI systems can be considered as enterprise-wide systems that integrate data from different units inside or outside of the respective organization [24]. As a result, users as well as the supported application scenarios of a DWH/BI system are very heterogeneous [38]. They range from strategic decision making by top level executives to supporting operational decisions [29] like vendor selection or justification of purchasing decisions. Thus, the benefits creation is distributed over all organizational layers of decision making [26]. One of the threats to DWH/BI systems is that although a central system is available, users still start decentralized development initiatives in order to create solutions that better fit their very specific needs. Such initiatives lead to growing overall complexity introduced by a number of local, decentralized systems with partially overlapping data and functionality. In such a situation inconsistency of functionality and data often is the consequence. Moreover, such situations represent an inefficient resource allocation from an enterprise-wide perspective. Therefore the actual and continuous use of DWH/BI systems by all relevant groups of users needs to be managed in a way that investments in DWH/BI systems can be justified.

Based on the IS acceptance (first-time use) research stream, that is itself based on the innovation diffusion theory [36], the technology acceptance model [11], the theory of planned behavior [1], and other models building upon these theories, continuous use has been researched with a general IS focus and also applied to specific IS domains [4]. The understanding of *continuous use* in the paper at hand follows Bhattacherjee [4] who defines continuous use as the long-term and ongoing (i.e., continued) use of an IS rather than the first-time use (i.e., acceptance).

Studies of continuous IS use in general conclude with different factors that influence continuous use on an abstract level. They usually build upon the mentioned research stream on IS acceptance, often reusing constructs from established IS acceptance models [e.g., 33]. Even though continuous use has been researched for various specific types of IS [23, 27, 37], to the best of our knowledge no study has addressed the specific characteristics, i.e., enterprise-wide perspective, heterogeneous user groups, and diverse use cases, that DWH/BI systems impose.

3 Research Approach

3.1 Item Development

In order to identify influence factors on continuous use of DWH/BI systems, we conducted an exploratory analysis. We designed a questionnaire that aims at incorporating items that allow for understanding the factors that influence the continuous use of DWH/BI systems. In order to cover the relevant dimensions of a DWH/BI system, we use the dimensions described by Raber et al.'s BI maturity model [35]. Their model consists of the dimensions strategy (S), organization (social system) (O), quality (Q), use/value (U) and technical system (information technology) (IT) [35]. The collection of items has been informed by literature from the areas of DWH/BI, acceptance, use and continuous use. Due to space restrictions the used items are only listed in section 4.1 (Table 2 to Table 10) where they are assigned to the identified factors. Literature that discusses respective items is also listed in these tables.

In order to assess the practical relevance of the extracted items, we triangulated [34] them with data from a case study lasting from October 2011 until July 2013 at a major financial organization in Switzerland. Two of the authors were involved in workshops with this organization on a regular basis (on average once a month). We closely worked with the head of the group analytics department, the head of the competence center DWH/BI services, a section head DWH/BI systems and a technical DWH/BI project manager. The workshops provided in-depth knowledge about the organization and the interconnection and communication processes between the different organizational units that are involved in development and operation of the organization’s DWH/BI landscape.

Based on the practitioners’ feedback, we added seven, practically motivated items to our questionnaire. At the case study organization use cases of DWH/BI systems and associated reports that users access are complex. Reports are related to customer risk calculation or the performance of client advisors. In addition it is difficult to verify their correctness beyond mere plausibility checks. Thus the users’ only choice is to establish trust or mistrust in the system. Only if they trust the numbers that they receive from the system, they will perceive the system as being useful for their daily work. Once this is achieved, they will potentially use it continuously. Thus items representing trust in the system and trustful use behavior (Q8, U8 and U10) were added.

The case study organization enforces its clearly defined DWH/BI governance regulations. The aim of the existing governance is to make sure that system changes are executed in a controlled and traceable way and that negative effects on the users are avoided. Each user can be sure that any system change that might have an impact on his or her interaction with the system in terms of response time, usability, reliability, correctness and/or availability is controlled and any interruption is limited to a minimum. Based on this feedback we added items O8, O9, O10 and O11 that represent the existence and enforcement of governance procedures.

3.2 Questionnaire Design

The resulting questionnaire consisted of three sections. The first section focused on demographic and background information regarding the participants and their work scenario as well as experience in the area of DWH/BI systems. The second part is comprised of items representing possible influences on the continuous use of DWH/BI systems. The third section is comprised of four items that measure the continuous use of DWH/BI systems. Ortiz de Guinea and Markus [31] suggest verbalizing questions in a way that the questionnaire can be filled in based on the respondents’ (DWH/BI managers and users) general observation within the organization and not based on their own use situation. Given the audience of the practitioner events where we distributed the questionnaire, we followed this suggestion. Thus the collected data is less likely to be biased by the respondent than self-reported data might be. The respondents were asked for each statement in the questionnaire to evaluate their organization on a five-point Likert scale, ranging from one (strongly disagree) to five (strongly agree).

We distributed the questionnaire at two major DWH/BI practitioner events in Switzerland in November 2012 and one DWH/BI workshop in Germany in January 2013. Participants came from German-speaking countries and the survey was conducted in German language only. In total 94 questionnaires were returned. The average return rate was 76 %. Based on the events’ list of participants we can state that none of the respondents attended more than one event. Thus all returned questionnaires are based on a different practitioner’s experience. Due to a significant number of missing values five questionnaires were discarded. Thus 89 datasets remained in the sample.

4 Results

4.1 Factor Analysis

In order to identify common factors influencing the continuous use of DWH/BI systems we conducted an explanatory factor analysis using the principal component analysis. The aim of the factor analysis is to extract a number of latent factors from the previously selected items. Before executing the factor analysis it is necessary to check the data set for its suitability for this kind of analysis. Therefore two criteria need to be met. The first test addresses the values of the anti-image covariance matrix. The percentage of non-diagonal non-zero values (> 0.09) should be less than 25% [15]. This requirement holds true for our dataset. The second criterion that should be evaluated before a dataset is used for a factor analysis is the Kaiser-Meyer-Olkin measure of sampling adequacy. For our dataset, the measure is 0.815. According to Kaiser and Rice [20] the measure‘s value for the dataset at hand is “meritorious.” Thus we conclude that our dataset is generally suitable for a factor analysis.

The factor analysis[1], using the principal component analysis based on a covariance matrix with Varimax rotation and Kaiser normalization, has led to nine factors, incorporating 39 items of the questionnaire. Missing values have been excluded pair-wise from the factor analysis. For the analysis, six items were excluded because they did not contribute to the factor identification [18]. The extracted nine factors explain 72.830% of the total variance.

For verifying the reliability of the factor scales, we calculated Cronbach’s Alpha. The calculated values for the identified factors are larger than 0.752. All values for Cronbach’s Alpha are listed in Table 1. The recommended threshold of 0.6 to 0.7 [18], which indicates adequate reliability, is exceeded for all factors. For assigning items to factors, the respective factor loadings must not be below 0.3 to 0.4 [18]. For an unambiguous assignment of an item to a factor, loadings of at least 0.5 are generally seen as the minimum threshold. Based on our dataset the requirement is fulfilled for the majority of the items. We identified the following nine factors:

[1] For our analysis we used SPSS 20.

Item ID	Fac. 1	Fac. 2	Fac. 3	Fac. 4	Fac. 5	Fac. 6	Fac. 7	Fac. 8	Fac. 9
U.1	.895	.169	.062	.053	-.131	.100	.033	.043	-.042
U.2	.875	.124	.038	.148	.099	.117	.045	.048	-.023
U.3	.857	.065	.001	.213	.086	.107	.065	.024	-.043
IT.2	.776	.127	-.022	.126	.198	.041	.033	-.026	.042
U.4	.692	-.025	.093	.296	.169	.126	.190	.172	.195
U.9	.519	.411	.049	.081	.430	-.059	-.009	-.197	.223
Q.1	.444	.142	.186	.146	.368	.019	.080	.112	.136
Q.7	.425	.175	-.008	-.012	.189	.244	.352	.036	.152
U.12	.051	.872	.080	.204	.071	.053	.109	.111	.034
U.6	.254	.828	.103	.070	.007	.170	.169	.162	.091
U.5	.083	.697	-.016	.166	.066	.238	.186	.156	.098
U.11	.192	.626	.020	.357	.124	.036	.159	.025	.067
U.13	.118	.615	.087	.146	.375	-.038	.264	.310	-.023
U.7	.191	.462	-.131	-.011	.338	.371	.352	.129	.152
U.14	.412	.448	.088	.037	.417	-.208	.052	-.167	.128
O.9	.091	-.042	.910	.139	.084	.092	.049	-.117	.124
O.10	-.015	.117	.906	.105	.054	.006	.116	.183	.043
O.11	.135	.075	.896	.069	.073	.116	.063	.062	.066
O.8	-.030	.037	.873	.225	.096	.000	.157	.026	.048
Q.11	.328	.091	.213	.674	.070	.072	-.087	-.088	.015
IT.1	.080	.160	.248	.653	.273	.282	.102	-.060	.219
Q.2	.220	.255	.223	.625	.142	-.074	.078	.331	.151
Q.3	.277	.227	.059	.606	.045	.191	.036	.060	.032
Q.9	.036	.240	.119	.446	.004	.287	.243	-.005	.098
O.1	.063	.204	.171	.008	.722	.170	.182	.060	.235
IT.3	.376	-.037	.085	.266	.618	.276	.068	.054	.057
O.2	.084	.282	.149	.270	.551	.266	.107	.399	-.178
Q.5	.297	.099	.009	.452	.500	.015	-.121	.277	.222
O.7	.220	.116	.253	.316	.392	.031	.422	-.403	.003
Q.10	.141	.160	.069	.274	.000	.821	.119	.032	.069
Q.6	.095	.054	.257	.024	.117	.811	-.060	.049	.144
Q.4	.206	.094	-.218	.220	.264	.625	.147	.146	.143
U.10	.051	.273	.222	.028	.022	.055	.826	.167	.013
U.8	.138	.249	.108	.072	.110	.030	.806	.186	.133
Q.8	.154	.263	.208	.411	.152	.338	.427	-.047	-.009
O.3	.147	.242	.034	.139	.064	.060	.138	.760	.212
O.4	-.013	.314	.155	-.111	.166	.157	.345	.665	.053
O.5	.030	.108	.165	.135	.233	.148	.001	.276	.808
O.6	.119	.189	.176	.225	.090	.298	.261	-.015	.697
Cronbach's Alpha	**.898**	**.886**	**.943**	**.804**	**.779**	**.809**	**.784**	**.785**	**.752**

Table 1: Factor loadings and scale reliability

Factor 1 comprises items (see Table 2) describing the user's interaction with the system and their use experience. In addition to the users' perception of the ease of use it also addresses aspects that are related to the direct interactions between the users and the system, when it comes to the interface of the system and the presentation of the information.

Item ID	Item Description
U.1	The users perceive learning to operate the DWH/BI system as easy. [1, 11, 12, 28, 39, 40, 43]
U.2	The users perceive the DWH/BI system as easy to use. [1, 11, 12, 28, 39, 40, 43]
U.3	The users think that it would be easy for them to become skillful at using the DWH/BI system. [11, 12, 28, 41, 43]
IT.2	The users perceive the access to the DWH/BI system as convenient. [13]
U.4	The users perceive their interaction with the DWH/BI system to be clear and understandable. [11, 12, 28, 43]
U.9	The users like using the DWH/BI system. [7, 8, 28, 43]
Q.1	The presentation (accuracy and currency) of the results within the DWH/BI system totally fulfills the users' expectations. [6, 13]
Q.7	The users perceive the information provided by the DWH/BI system as understandable. [6, 13]

Table 2: Factor 1 – Perceived ease of use

Factor 2 comprises items that are related to the benefits that users can draw from using the system. These items are related to the advantage the users can gain whenever they use the system. Such benefits include increased productivity, usefulness for the job and also cover effects that using the system has on their daily task. The corresponding items are listed and described in Table 3.

Item ID	Item Description
U.12	The users think that using the DWH/BI system would increase their productivity. [5, 11, 12, 28, 43]
U.6	The users think that using the DWH/BI system would enable them to accomplish their tasks more quickly. [11, 12, 43]
U.5	The users would find the DWH/BI system useful for their job. [11, 12, 43]
U.11	The users think that using the DWH/BI system would make their job easier. [11, 12, 28, 43]
U.13	The users perceive that using the DWH/BI system is a good idea. [11, 16, 39, 40, 43]
U.7	The users perceive the information provided by the DWH/BI system to be useful for their tasks. [11, 12, 43]
U.14	The users think that the DWH/BI system makes their tasks more interesting. [41, 43]

Table 3: Factor 2 – Perceived usefulness

Factor 3 comprises the governance-related items for system development and system operation (see Table 4). Within a DWH/BI system's lifecycle two main phases can be distinguished: system development and system operation. Both phases need to be appropriately addressed by well-defined governance regulations that need to be implemented and enforced.

Item ID	Item Description
O.9	The existing governance processes for DWH/BI system operation are enforced and followed.
O.10	Governance processes for DWH/BI system development exist.
O.11	The existing governance processes for DWH/BI system development are enforced and followed.
O.8	Governance processes for DWH/BI system operation exist.

Table 4: Factor 3 – Governance

Factor 4 comprises the items related to the user support mechanisms that are implemented for the DWH/BI system within the organization (see Table 5). Additionally it also covers aspects related to DWH/BI system use prerequisites. Users' skills and their equipment make sure that they are able to access the system and work with it. Additionally the existing support and helpdesk organization guarantees the timely assistance of users in case of any problem.

Item ID	Item Description
Q.11	The users think that they have the knowledge necessary to use the DWH/BI system. [1, 39, 40, 43]
IT.1	The users think that they have the resources necessary to use the DWH/BI system. [1, 5, 39, 40]
Q.2	The users perceive the DWH/BI helpdesk's operating hours as convenient. [6, 32]
Q.3	The DWH/BI system's service level is perceived to be high. [32]
Q.9	The DWH/BI system is perceived to be reliable. [13]

Table 5: Factor 4 – User support

Factor 5 is comprised of items addressing the users' requirements towards the DWH/BI systems functionality. In order to collect the users' requirements they need to be included in the development and design process of the system and need to be understood by the system designers and suppliers. Item O.7 shows almost equal positive values for factor 5 and factor 7 (0.392 vs. 0.422). Factor seven consolidates items that are related to trust the users have in the system (see later in this section). Thus a semantic fit of items O.1, IT.3, O.2 and Q.5 with O.7 can be recognized compared to the semantic difference that can be recognized between item O.7 and items U.10, U.8 and Q.8. Therefore item O.7 is assigned to factor 5. The items that are associated with factor 5 are described in Table 6.

Item ID	Item Description
O.1	The users' opinion is taken into account during the DWH/BI system development and design process. [2, 6, 21, 30]
IT.3	The DWH/BI system is compatible with other systems the users use. [1, 39, 40, 43]
O.2	A specific person (or group) is available for assistance with DWH/BI system difficulties. [41, 43]
Q.5	The providers (designers and suppliers) of the DWH/BI system understand the users' specific requirements and needs. [6, 14, 32]
O.7	The content of the DWH/BI system is regularly adapted to the users' requirements. [2, 21, 30]

Table 6: Factor 5 – Coverage of user requirements

Factor 6 is comprised of items related to the information quality of the DWH/BI system (see Table 7). It addresses aspects of data accuracy, data consistency, currency and timeliness. Presentation of information is the main purpose of the DWH/BI system and thus needs to be of high quality in order to motivate the users to work with the system.

Item ID	Item Description
Q.10	The information provided by the DWH/BI system is perceived to be accurate. [6, 13]
Q.6	The information provided by the DWH/BI system is perceived to be consistent and free from bias. [13]
Q.4	The information provided by the DWH/BI system is perceived to be current and timely. [6, 13]

Table 7: Factor 6 – Information quality

Factor 7 is comprised of items related to the users' level of trust in the DWH/BI system and trustful use behavior (see Table 8). Since users can only verify the information provided by the DWH/BI system for plausibility, it is important that they establish trust in the system including the whole organization that is designing and operating the system.

Item ID	Item Description
U.10	The users use the DWH/BI system for answering questions which are of high importance for the organization.
U.8	The users use the DWH/BI system for answering complex questions.
Q.8	The DWH/BI system as a whole is perceived by the users to be trustworthy.

Table 8: Factor 7 – Trust

Factors 8 and 9 both comprise items that are related to the external influence factors affecting the users and might change their use behavior. Factor 8 consists of items describing the influence of individuals and peers that affect the users. Thus we call the factor "influence of peers." The associated items are described in Table 9.

Item ID	Item Description
O.3	People who are important to the users think that they should use the DWH/BI system. [1, 11, 16, 25, 39, 40, 43]
O.4	People who influence the users' behavior think that they should use the DWH/BI system. [1, 11, 16, 25, 39, 40, 43]

Table 9: Factor 8 – Influence of peers

Factor 9 is comprised of items related to the influence of the organization in general on the use of DWH/BI systems. In addition to the influence of peers (see factor 8) the organization in general and the management have an influence on the use behavior of the users.

Item ID	Item Description
O.5	The senior management of this business has been helpful in the use of the DWH/BI system. [41, 43]
O.6	In general, the organization has supported the use of the DWH/BI system. [41, 43]

Table 10: Factor 9 – Influence of the organization

To summarize the results of the exploratory factor analysis, the identified factors can be distinguished into three groups, each consisting of three factors. Factors 1, 2 and 7 primarily address aspects related to the users and their direct interaction with the system. Factors 4, 5 and 6 focus on the system's characteristics and system development. Factors 3, 8 and 9 incorporate organizational, system governance-related and social influence factors that have an effect on the users and their use behavior.

4.2 Cluster Analysis

In order to identify different groups of respondents based on their perception of the DWH/BI system in each of the nine previously identified dimensions, we performed a cluster analysis. We used the total number of items as input variables in order to base the clusters on the data contained in the entire dataset. We applied a hierarchical cluster algorithm because it does not incorporate any ex-ante assumptions on the potential number of clusters [18], but determines all possible clusters. Due to missing values for individual items, 13 additional records were excluded. Thus, the cluster analysis is based on 76 complete records. We have used the average within-group linkage algorithm and the squared Euclidean distance measure. Based on the agglomeration schedule and the dendrogram, we identified two clusters. In order to characterize the clusters, we calculated the cluster centroids based on the mean factor values for each cluster. The net chart in Figure 1 visualizes both clusters based on the mean factor values.

Cluster 1 (54 cases) is characterized by very small means for all nine factors. The values for three factors attract special attention. An outlying small value has been measured for factor 6 the users' perception of the DWH/BI system's information quality in the respective organizations. In contrast the highest values have been measured for the users' perceived level of user support, including the availability of knowledge and resources necessary for using the system, and the influence of peers.

Cluster 2 (22 cases) is characterized by higher medium means for each factor value than cluster 1. The users' perception of the organization they work for shows below-average values for influence of peers, and user support. This is remarkable because these factors had above-average values in cluster 1. Additionally cluster 2 is characterized by very high values for the users' perception of the DWH/BI systems information quality and the perception of the system's ease of use—both of these factors had below-average means in cluster 1.

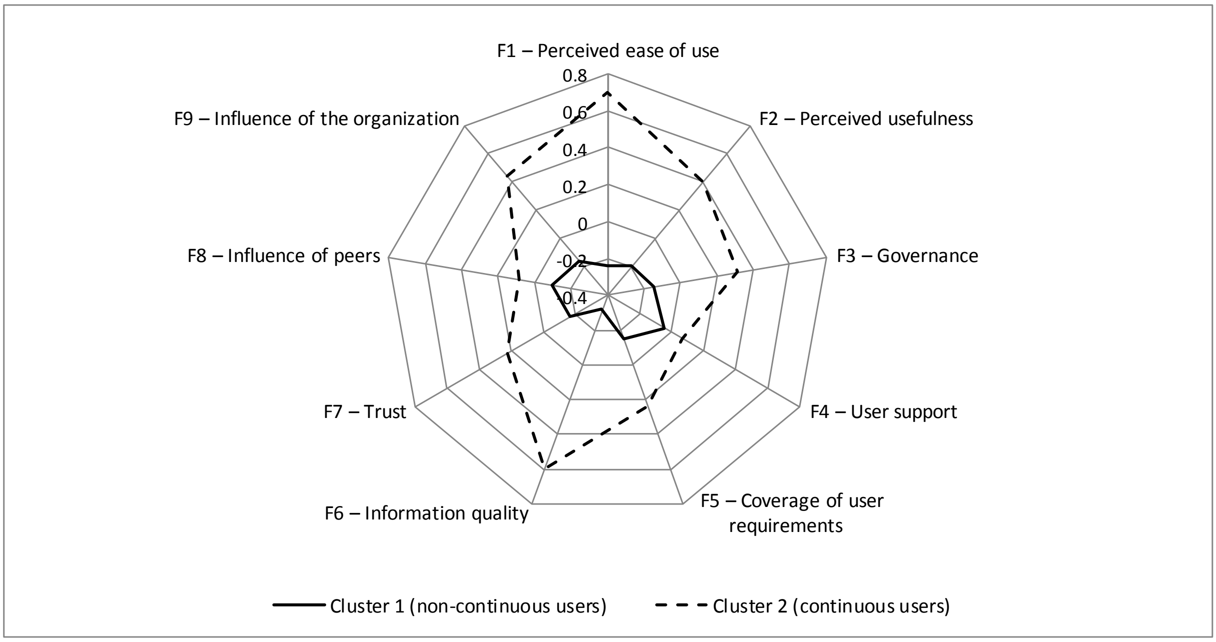

Figure 1: Mean factor values for each cluster

5 Discussion

Both clusters are characterized by contrary values for each factor. Cluster 1 shows smaller factor means for each factor compared to cluster 2. Both clusters show different values for the items that measure continuous use (CU). Table 11 lists the CU measurement items.

Item ID	Item Description
CU.1	The users continue using the DWH/BI system only if there is no alternative solution. (inverse) [4]
CU.2	The users also continue using the DWH/BI system if there are alternative solutions. [4]
CU.3	The users' satisfaction with the DWH/BI system is high.
CU.4	The users use the DWH/BI system as frequently as necessary for their tasks.

Table 11: Measurement items for continuous use

The reported continuous use behavior is higher for cluster 2 (4.375 compared to 3.52; average value of four measurement items). In order to test the significance of the difference of the item means between both clusters, we first conducted the Levene's test for equality of variances in order to determine whether our data is appropriate for using a 2-tailed t-test (if variances are equal) or if the Welch-test (if variances are not equal) needs to be used for testing significance. For all four items the Levene's test indicates that a 2-tailed t-test might be performed, comparing the differences of the mean values for each item per cluster. The test reveals a significant difference of the mean values for each CU measurement variable between both clusters within the 95% confidence interval [18] (all p-values are smaller than 0.003). Therefore we can conclude that the identified factors contribute to understanding the influence factors on continuous use of DWH/BI systems. Based on this analysis we characterize cluster 1 as non-continuous users and cluster 2 as continuous users.

The analysis of the collected descriptive data leads to additional conclusions. The data shows that cluster two is mostly comprised of very small (i.e., >250 employees) or very large organizations (i.e., >5000 employees). These results lead to the hypothesis that the size of an organization is also a factor that influences the continuous use of DWH/BI systems. Small organizations might have an advantage over medium sized organizations (i.e., 251–5000 employees) that are mainly part of cluster non-continuous users, due to the often simple DWH/BI system landscape. Small organizations tend to have one DWH/BI system that is used by selected users. Thus it can be specifically designed for their needs and fit their requirements perfectly. In medium sized organizations the DWH/BI landscape might be more complex and a higher number of users might lead to a smaller fit between the system functions and the individual employee requirements. Larger organizations tend to offer special services that allow them to offer fitted services for each employee, e.g., self-service solutions that increase the coverage of user expectations. These differences help to understand the advantages small and large organizations have over medium-sized ones when it comes to continuous use of DWH/BI systems.

Another characteristic that is notably different between the continuous use and the non-continuous use cluster is the duration of DWH/BI system use in the respective organizations. In organizations that show higher values for continuous use, the DWH/BI system has been used longer than in companies associated to cluster 1, where smaller values for continuous use were measured.

A second test for significance was conducted in order to analyze the differences of the factor means between both clusters. In this case Levene's test for equality of variances showed that for factor 5 the Welch-test needs to be used for testing the significance, the 2-tailed t-test could be used for all other items. The following p-values were computed: F1: 0.000; F2: 0.018; F3: 0.047; F4: 0.656; F5: 0.052 (Welch-test); F6: 0.000; F7: 0.115; F8: 0.489; F9: 0.016. Thus the differences of the factor means between both clusters are statistically significant within the 95% confidence interval for factors 1, 2, 3, 6 and 9. We conclude that these five factors directly have a significant influence on the continuous use of DWH/BI systems. Continuous use therefore significantly depends on a combination of the users' perception of the system's ease of use, its usefulness, existing and followed governance procedures, information quality and the organizational influence.

6 Conclusion and Future Work

Based on well-established items from the IS acceptance and DWH/BI literature that are expected to be important for the continuous use of DWH/BI systems, we conducted an exploratory factor analysis and identified nine latent factors. In addition a cluster analysis revealed two clusters in our data set. These two clusters can be distinguished based on the users' perception of the overall DWH/BI system and also the users' continuous use behavior. We expect a causal relationship between five of the identified factors and continuous use but it remains unclear how the exact relationships look like and whether these relationships are significant. Not all factors might be considered as independent variables, thus some of them might depend on others and jointly have an effect on continuous use. The next step towards a management method of DWH/BI continuous use and respective design principles for DWH/BI systems is to hypothesize the relationships between the identified factors and their influence on continuous use. These hypotheses lead to a testable research model.

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