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**FACTORS AFFECTING THE DATA WAREHOUSE  
IMPLEMENTATION SUCCESS:  
AN EXPLORATORY STUDY**

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**Summary:** The ultimate purpose of this paper is to investigate the adoption and/or implementation of Data Warehouse (DW) technology among firms in Poland. The factors which are expected to influence the mentioned processes were derived from previous studies in similar research areas. In this study a model of data warehousing implementation success was formulated based on an extensive literature review, previous studies, and own experience. This is initial investigation, therefore the results and findings will be published after collecting and analyzing the data in the authors' next separate supplementary paper.

**Keywords:** data warehouse implementation, literature review.

## **1. Introduction**

As the business environment is changing, companies rely more and more on changing technology. At the same time, those companies are likewise evolving. In this changing environment, companies are much more eager to get immediate and accurate information to make better decisions. Successful support of managerial decision-making has become critically dependent upon the availability of integrated and high quality information organized and presented to managers in a timely and easily understood manner (see for example: [2; 18; 41]). Furthermore, with the rapidly growing need for large amounts of information, traditional decision support systems (DSS) are futile [21]. This inability greatly impacts businesses in such a way that the decision-makers cannot utilize internal data efficiently and effectively to assist reliable decision-making in a timely manner [21; 33; 42].

However, the situation will be different if the firms implement Data Warehouse (DW) technology which has emerged as a key source and powerful tool for delivering and accessing information for decision-makers [3; 18; 32; 39]. In such a case DWs have been an essential IT strategy component for medium and large sized global organizations [26; 30; 31]. Large organizations are facing significant chal-

allenges in maintaining an integrated view of their business. In an ever more complex and competitive world, the complexity of the organizational context and the management task involving decision-making and assessment of information has increased. Decision-making in those environments involves large data volumes and includes a wide variety of decision tasks. In such environments it is important to assure decision-makers of the quality of data they use. Therefore DW systems are perceived to be important tools in the modelling of that complexity, however, reports of high failure of DW systems are common [4; 19; 24; 40].

Despite the recognition of data warehousing as an important area of practice and research, there is little empirical research about implementation of DW in general and critical success factors in particular [18; 19; 21; 27; 46]. Similar variations also exist among studies that measured implementation factors: when different factors are examined in different studies, "how are the results to be compared across studies?" Hwang and Xu [21] argue that it is very difficult to compare research findings to pin down the exact implementation factors and their impact on data warehousing success, and even the fundamental question of what constitutes data warehousing success has not been resolved. Therefore, there is a need for a study to investigate data warehousing success. Although many studies to data warehousing have been published, they have been concerned with technical issues. Overall, there is a scarcity of empirical studies that examine the data warehousing success within an integrative model [19]. The study intends to focus on the effect of the system support factors on the data warehousing success. It aims at providing empirical evidence that identifies the system support factors that influence successful adoption and/or implementation of data warehousing.

## 2. Literature review

Most previous research, studies, and scientific works into successful DW implementations have focused on many aspects of DW technology [1]. Many studies (for example: [34; 44; 46]) on critical success or failure factors of DW projects have been published. Most studies comprise *technical issues*, *organizational issues*, *project issues*, *environmental issues*, *managerial perspective*, *human factors*, and how the data warehouse facilitates corporate strategy (see for example: [4; 21; 29]).

It has been found that issues like management support, resources, user participation, project team, development technology and other are mentioned (for example: [12; 46]). Many researchers have investigated the success of ISs in numerous ways, such as by measuring the users' satisfaction, service quality, and the perceived usefulness of specific applications. DeLone and McLean [9; 10; 37] identified six major categories of IS success: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. They assume that the system and consequent information quality affect both the system use and user

satisfaction, which have an impact on user performance [9; 10]. Since DW is a special type of IS, these categories are applicable. According to Seddon [36] high data and system quality can provide net benefits for various stakeholders. System quality is one of the most important advantages for data warehousing because a warehouse provides the infrastructure that integrates data from multiple sources and flexibly supports current and future users and applications. It can give users a better understanding of the decision context, increase decision-making productivity, and change the way people perform tasks [5; 6; 7; 46].

A DW significantly affects how decision-making for end-users is supported in the organization because IT professionals no longer have to extract data and run queries for users as in the past. When supplied with appropriate data access tools and applications, users can perform decision-making tasks faster and more comprehensively. Shaw [38] examined the category of IS implementation success factors that had been identified in implementation research studies and organized them into an IS implementation hierarchy. Shaw suggested that in order to achieve implementation success, organizations must pay attention to, and successfully manage, the lower level technical factors listed in the hierarchy before tackling the higher level organizational factors.

Empirical studies have found that those three dimensions are related to one another. A laboratory experiment conducted by Park [32] shows that the adoption and use of a fully capable DW improved DSS users' decision performance. This result is consistent with the fundamental idea of the IS success model: improving system and/or information quality will improve individual performance. In addition the experiment indicated that improving system quality did indeed enhance decision maker performance. Shin [39] studied the effect of variables pertaining to system quality, information quality, and service quality on user satisfaction. The results showed that user satisfaction with the DW was significantly affected by such system quality factors. Wixom and Watson [46] found that the high level of data and system quality is associated with the high level of perceived net benefits. Rudra and Yeo [35] found that the data quality of DW is influenced by its data captured, the degree of heterogeneity of system integration, and the level of policy and planning. The research effort to investigate a model of DW success by Hayen et al. [18] showed a significant relationship among the system quality, data quality, and perceived net benefits. The implementation's success with organizational and project issues, in turn, influences the system quality of the DW. Another study by Iivari [22] shows that perceived system quality and perceived information quality are significant predictors of user satisfaction with the system, perceived system quality was also a significant predictor of system use.

On the basis of their work, which posits the selection of several success measures, taking into consideration the potential relationships among the success dimensions when building a research model, it remains the most influential model in

conducting research on ISs success factors and therefore became a conceptual framework for identifying influencing factors of DW success. Moreover, since the DW integrates the information provided by data sources, it is also crucial to take those sources into account throughout the development process to obtain a consistent reconciliation of data sources and information needs. Watson and Haley [45] argue that data quality is frequently discussed in the data warehousing literature. Therefore, providing high-quality data to decision-makers is the primary reason for building a DW. According to Viktor and Motha [43] it is important to ensure that the DW includes high quality data. Hence, poor quality data often hinders managers from reaching decisions. In today's global market it follows that poor quality data has a serious detrimental effect on the quality of the information and the resultant decisions made, and may lead to incorrect decisions, which in turn has a detrimental effect on the organizational performance.

In building a DW, a wide variety of business, technical, and organizational issues and challenges that affect the success or failure of its implementation will arise [30]. Managers of large data warehousing projects often attribute project failure to the organizational resistance. Technical requirements are usually not considered to be crucial for project success. However, the precise nature of those issues and challenges, and their impact on the success or failure of DW implementations, are not yet fully understood. According to Herrmann [20] the organizational domain of DW systems still lacks attention of DW researchers compared to technical aspects. Although those researches are rich in content, there is hardly any consolidation of results, nor an understanding of how those results interrelate, and no identification of the cumulative knowledge that has been gained [17]. As a consequence, a comprehensive framework or method for the introduction of a DW is still missing [23, p. 46]. Little and Gibson [25] conducted an exploratory factor analysis to identify factors affecting the successful implementation of DWs. They found that understanding the organization's environment is critical for successful implementation. A study by Hwang and Xu [21] showed that environmental variables are most strongly correlated with organizational impact. The keys to achieving high system quality appear to be high-quality project management and successful acceptance of and integration of the DW into the organization. The factors associated with achieving high data quality in a data warehousing environment, however, are still a research issue [46].

Previous literature suggests that various factors play crucial roles in the adoption of an IS; however, there is little empirical research about the factors affecting adoption of DW technology. Prior studies on DWs have focused mainly on the success of their implementation, rather than their effects on the performance of DSS users. Thus, little empirical evidence of the effectiveness of DW has been reported [28]. This calls for empirical studies to help organizations understand the benefits of DW. Watson and Haley [45] found that DW was used throughout the

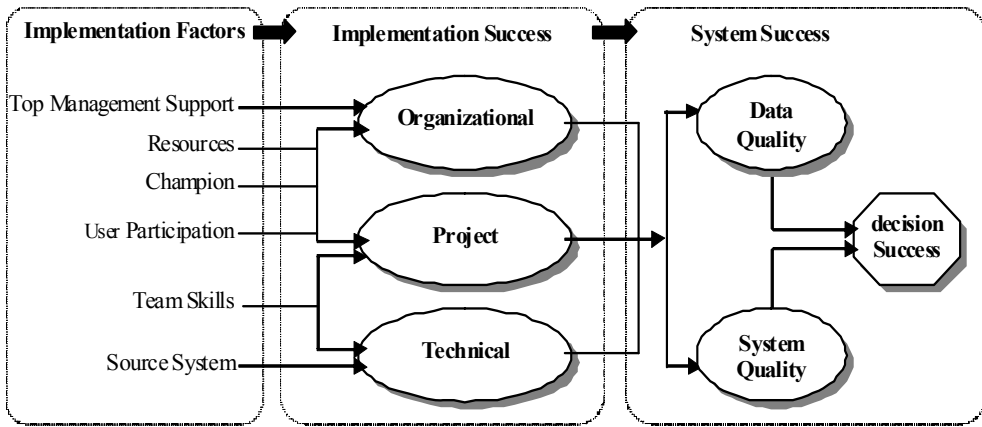
organization and also supported executive information systems (EIS); see also [8]. Applying this argument to data warehousing suggests that the adoption and use of a DW in a DSS can improve decision performance. The consolidation of dependent measures into an IS success model is very useful and is now being widely used to help researchers and practitioners select and use categories of success measures. Even though both implementation factors and system success have received a fair amount of attention in the data warehousing literature, as mentioned previously, they rarely are examined in the same study [14; 15; 21].

Based on the literature review, the above mentioned argument, and for the manageability sake, in this study, data quality and system quality were used in the research model as the two dimensions of data warehousing success. Additional success dimensions were not included because they were considered less appropriate for this study than the selected constructs. As illustrated in Figure 1 the implementation factors impact the DW implementation success, those successes influence the data quality and system quality, which guide the system success culminating in the decision success, the implementation success in turn affects the system success, and this impacts the decision success from the deployment of the DW in business decision-making. The research problem of this study can be described as follows: what is the effect of DW adoption and/or implementation on decision success in Polish firms? The actual survey questions were: How do firms assess the success of their DWs? What are the factors which influence the success of DW technology in Polish firms? How does the existence of a DW influence the users' decision? Furthermore, the research objectives include the following items:

1. To identify the reasons for the implementation of DW technology by Polish business firms.
2. To study the factors which influence the success/failure of DW technology in Polish firms.
3. To identify the critical factors which influence the adoption of DW technology in Polish firms.

### **3. Research model and structure**

The IT implementation literature suggests that various implementation factors play critical roles in the success of an IS; however, there is little empirical research on the implementation of data warehousing projects [18; 21; 46]. In the data warehousing literature and the initial survey, three facets of warehousing implementation success were identified: success with organizational issues, success with project issues, and success with technical issues. Those factors were believed to affect the ultimate success of the DW technology. Figure 1 presents the resulting research model. The rationale for the factors and the relationships among the factors are described as follows:



**Figure 1.** A model of data warehouse implementation success

Source: own elaboration.

### 3.1. Implementation success

In an environment with dynamic changes, organizations must try their best to measure and reduce uncertainties in the surrounding environment, and hence create competitive advantages by actively adopting newer information technology. As a result, the environment itself has a great influence on the utilization of new information technology. Most enterprises will be affected by such competition as raising the operational productivity and efficiency by adopting new information technology. Also, the selection of a vendor can be a factor that affects the adoption of data warehouse technology [21].

**Project-planning dimension** – according to Hwang and Xu [21] – is an important dimension in adoption of data warehousing technology. A good plan can help identify and accommodate the end users' needs better. It can also reduce the dissatisfaction and discrepancy to manage and use the data gathered from different sources [21]. Most prior research measured the project-planning factor using the following four variables: skills of the project team, the degree of coordination of the organizational resources, the participation of end-users, and the assistance from information consultants.

An implementation is not successful unless the system it produces is **accepted into the organization** [46]. The findings of a study by Ramamurthy et al. stressed the importance of paying attention to both organizational and technology factors when examining a major, infrastructure type innovation that has consequences for the entire enterprise [34].

*The technical complexity* of data warehousing is high because of the large number of diverse and disparate systems that typically need to be understood, reconciled, and coordinated; the large volume of data that must be extracted, transformed, loaded, and maintained; and the complicated analytics that often are applied to the data [46].

### 3.2. Implementation factors overview

Six implementation factors were included in the research model because of their potential importance to data warehousing success: management support, champion, resources, user participation, team skills, and source systems. Each factor is hypothesized to affect one or more of the implementation success factors.

Top *management support* affects the adoption of DW technology [11; 16] for instance, and has been identified as a key factor influencing the success of IT implementation. This study builds on the first hypothesis by assuming that top management support affects the decision to adopt DW technology and its success.

Studies have shown that the existence of a *champion* is one of the most important factors of the success and adoption of DW technology [16; 45; 46]. Champions often support and promote the adoption of new technology in an organization and usually help staffs to meet their project goals and support their ideas. This study believes that the existence of champions is one of the key factors, which will affect the adoption of DW technology in Polish firms. Therefore, this study builds on the second hypothesis by assuming that the existence of champion affects the decision to adopt DW technology and its success.

*Resources* are likely to be important to data warehousing projects [21; 34] because DWs are expensive, time consuming, and resource intensive. Providing adequate resources can also help project teams meet their project milestones. Therefore, this study builds on the third hypothesis by assuming that resources affect the decision to adopt DW technology and its success.

*User involvement* is an important factor influence the success (see: [18]). When users participate in data warehousing projects, they have a better understanding of what the warehouse will provide, and hence are more likely to accept and less resistant to the warehouse when it is delivered. As a result, this study builds on the fourth hypothesis by assuming that user participation affects the decision to adopt DW technology and its success.

The *skills of project team* affect the adoption and success of DW technology. To ensure successful adoption of the DW technology, a project team should be much better equipped to manage and solve technical problems and must be continuously informed and aware of the status and latest developments of the project [21]. Therefore, this study builds on the fifth hypothesis by assuming that team skills affect the decision to adopt DW technology and its success.

A primary purpose of data warehousing is to integrate data throughout the organization. However, data often resides in heterogeneous sources, therefore making it challenging for the project team to reconcile and load into the warehouse properly. Thus, the quality of *data sources* depends on the standardization of their technology and data [46]. Therefore, this study builds on the sixth hypothesis by assuming that source system affects the decision to adopt DW technology and its success.

#### 4. Research methodology

To develop the research model and build the hypotheses, the DW implementation, and success literature were reviewed to identify factors that affect data warehousing success. After the literature review, survey data is going to be collected from firms listed in WSE via a mail questionnaire. The objectives of the questionnaire are to collect appropriate data for testing the significance of hypotheses proposed and for reporting the current status of DW technology implementation in Polish firms. The quantitative data will be processed by using a SPSS program leading to appropriate descriptive and inferential statistical analysis.

#### 5. Conclusion

Many studies showed that the successful implementation of DW is affected by several factors. Therefore, this theoretical framework proposes a research model and related hypotheses about those important factors based on the literature review, previous studies, and own experience. The research model includes the following three dimensions as mentioned earlier: the organizational dimension, technical dimension, and project dimension as shown in Figure 1, and shows all the relationships and proposed hypotheses based on the findings of prior research discussed in sections 2 and 3. A survey was designed to collect relevant information from DW users at medium to large sizes Polish firms. The qualitative field study will be undertaken shortly by the authors.

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## **CZYNNIKI WPLYWAJĄCE NA POWODZENIE WDROŻENIA HURTOWNI DANYCH: STUDIUM BADAWCZE**

**Streszczenie:** Celem artykułu jest zbadanie możliwości adopcji i/lub wdrożenia technologii wykorzystującej hurtownię danych w polskich firmach. Czynniki, które mają wpływ na omawiany proces, są wyprowadzone z prac badawczych realizowanych w podobnych obszarach. Model skutecznego wdrożenia sformułowano w niniejszym artykule na podstawie intensywnych badań literaturowych, innych prac studialnych oraz na podstawie własnego doświadczenia. Jest to wstępne studium, zatem właściwie rezultaty badań wraz z wnioskami zostaną opublikowane po zebraniu i przeanalizowaniu materiałów w kolejnym artykule.