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The Impact of System and Data Quality on Organizational Success in the Kingdom of Bahrain

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***Abstract*—**Data and system quality play a central role in organizational success, and the quality of any existing information system has a major influence on the effectiveness of overall system performance. Given the importance of system and data quality to an organization, it is relevant to highlight their importance on organizational performance in the Kingdom of Bahrain. This research aims to discover whether system quality and data quality are related, and to study the impact of system and data quality on organizational success. A theoretical model based on previous research is used to show the relationship between data and system quality, and organizational impact. We hypothesize, first, that system quality is positively associated with organizational impact, secondly that system quality is positively associated with data quality, and finally that data quality is positively associated with organizational impact. A questionnaire was conducted among public and private organizations in the Kingdom of Bahrain. The results show that there is a strong association between data and system quality, that affects organizational success.

***Keywords*—**Data quality, performance, system quality.

I. Introduction

THERE are many standards and regulations within organizations. Without such standards nothing and no one can live in an organized or civilized way, and society would lack quality and structure. Maintaining quality will help to build an organization and make it successful. This research will demonstrate the flexibility of system quality, why data quality is important in organizations, and how attributes such as accuracy, completeness and reliability will positively affect organizational success.

The quality of an existing information system is believed to have a significant effect on overall system performance [1].

Since the problem of data quality increases as the gathered data becomes more complicated, an acceptable level of management is required [2]. Reference [3] claims that "data resource management is the development and execution of architectures, policies, practices and procedures that properly manage the full data lifecycle needs of an enterprise". Therefore, the target of providing good management of data is to assure that it will be well defined, understandable, available, consistent, secure, and usable [4]. Data quality control requires the organization to appraise the level of the quality of its data in running systems and processes [5].

Reference [1] believe that the DeLone and McLean (D&M) Model of IS Success [6] is an appropriate measure of information system quality. The D&M model distinguishes two types of information system quality: system quality and data quality. Their different aspects and their impact on organizational success will be discussed below.

Our research problem is to investigate the impact of using system and data quality to highlight their importance in organizational performance. Therefore, the main objectives are: 1) to prove whether system quality and data quality are related; and 2) to study the impact of system quality and data quality on organizational success.

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II. Research Background

A. System Quality

Reference [7] reported that system quality is concerned with whether the system is free of errors, the consistency of the user interface, ease of use, quality of documentation, and quality and maintainability of program code. It has been proposed [8] that system quality replaces the significance of processing in an information system, which involves both software and data components. It is also an evaluation of the system's technical performance.

System quality was defined and validated in 2004 [9] by identifying certain features that make it special, such as making the system easy to use, making it easy to learn, meeting user requirements, and offering system features, system accuracy, flexibility, sophistication, integration and customization. It has also been claimed [6] that system quality is concerned with system functionality, ease of use, reliability, data quality and integration.

According to [10], when attempting to judge system quality it is important to begin with a plan. Software quality is the extent to which a certain type of software, used by the system, possesses a number of attributes. Hence, when we try to improve system quality it is important to set the rules based on the attributes of software quality. The most general and widely observed attributes in determining system quality are: agility, flexibility, sophistication, performance and security.

Ideally, all the given quality attributes are desirable, although this is impossible in practice and it is necessary to recognize trade-off points in any given system [11]. This is important because an understanding of a system's quality attributes and trade-off points helps in deciding which design to select.

Previous researchers have divided the features of system quality into two different categories; some are seen from the designer's point of view, called system flexibility, and others from the end user's point of view, system sophistication.

B. Data Quality

The ubiquity of electronic data means that its quality is significant in both business and government organizations. According to [12], "the quality of data is recognized as a relevant performance issue of operating processes, of decision-making activities, and of interorganizational cooperation requirements". This study also verified that data quality issues have become more complex and problematic with the evolution of the information systems themselves, since they have been moving from hierarchical/monolithic to the network-based structures, enlarging the size and scope of the possible data sources an organization could use. On the other hand, [13] believe that the importance of good management of organizational data results from two factors: first, the total amount of data produced by the organization, and second, the increasing number of data types and variety of sources.

Data quality is described [14] by two basic and related properties: first is the appraised quality depends on the user's needs; and second is the concept of "fitness for use", which is defined as its capability to fulfil the requirements of planned use in a particular situation. Hence, data quality can be found only in one case, "when information meets the user's expectations", which is considered as a significant evolution of the classical terminology of the data quality concept because it concentrates on a single aspect, "the absence of mistakes" [15].

According to [16], the idea of data quality depends on the amount of use that the user generates. The design of the system is an essential aspect in determining the quality of the data generated. The importance of measurable evaluation of the data has always been recognized, with two theoretical approaches: communication theory and information economics. Communication theory [17] handles the transmission and broadcasting of signals, while information economics [18] "looks to measure or evaluate information in amount of usage". Both theories offer formal action, although, neither reports the idea of data quality in the context of system design.

In the field of data quality, the quality of a product is measured by the process that the product undergoes through design and production. To create better production, it is important to comprehend what quality is and what it means. The attributes that define data quality are: accuracy [3], [4]; completeness [19], [20]; relevance [20]; timeliness [3], [20], [21]; validity [20]; and reliability [3], [20].

What measurement method should the organization consider in assessing data quality? Answering this question need a full awareness about the stages of incrementally setting data throughout all the units of the organization, because [12] nowadays the phenomenon of data quality is becoming more complicated and challenging as an effect of development and growth. Furthermore, it is very hard to assess and document the quality of data for every single element of the organization [3]. A potent measurement of data quality is required to produce a precise and authentic assessment and a guideline for enhancement [22]. Data quality assessment needs a strong basis of "data governance, ongoing monitoring and measuring of the state of the data, publication of data quality metrics, and a commitment to continuous improvement", to produce an adequate and healthy data quality programme [3].

As a base level for the assessment process, we must understand the meaning of the assessment, and then design the framework of the assessment process [22]. We have to build a mature data quality programme in order to specify trends and metrics; this is implemented by defining four major dimensions: "completeness, timeliness, validity and consistency" [3], as discussed earlier.

Both [12] and [22] demonstrated the steps of the assessment process, the latter in more detail demonstrating similarities and differences. This starts with the data analysis, which aims at an entire understanding of data meaning and management regulations by investigating data theories and conducting interviews. Then it comes to "data quality requirement analysis", which considers the views and assessment of frequent users to diagnose quality matters and identify new quality objectives. Thirdly, the "identification of critical areas" step chooses suitable data and databases for the quantitative assessment. This is followed by construction of a model for the processes producing or updating data. Last is measurement of the data quality by selection of the identical metrics and dimensions concerned with the quality matters identified in the second step, resulting in two types of measurement: "1) the objective, which is based on quantitative metrics, or 2) subjective, when it is based on qualitative evaluations by data administrators and users."

According to [2], data management is becoming more important nowadays since most organizations tend to handle increasing amounts of data, which introduces the risk of an increase in poor data quality. The research also identified four challenges facing the data quality concept: multiple data sources, subjective judgment in data production, security/accessibility trade-off, and changing data needs.

Reference [2] believed that multiple data sources result in producing variable values for that data; likewise, using multiple sources of data for various processes produces several values for the same piece of information. Information production using subjective judgment commonly produces one-sided information. Any piece of data in an organization's database is considered as a fact, and the process of collecting these facts or data might include subjective judgments, one of the main challenges. The challenge of security/accessibility trade-off occurs when "Easy access to information may conflict with requirements for security, privacy, and confidentiality. For data consumers, high-quality data must be easily accessible. However, ensuring privacy, confidentiality, and security of information requires barriers to access." The final challenge is changing data needs; as the information requirements change rapidly, according to the consumers or the organizational environment, the applicable and functional data might be useless.

Recently, several organizations have engaged in advanced technology to conduct their processes, including the aggregation and warehousing of enormous amounts of data;

even if they keep up with the arrival of data, there remains the problem of maintaining or converting it into information or knowledge to enhance business operations and procedures, ensure better decision making and establish strategic utilities [23]. There is also the realization that information and data quality has become increasingly important in our "data-intensive, knowledge-based economy" [5].

Another study [24] illustrated how depending on weak and poor data quality can be a major threat. Furthermore, according to [14], dealing with unqualified data can threaten the efficiency of an organization's techniques and planning. In terms of managing data quality, it requires the organization to appraise the quality in running systems and processes [23]. Decision makers need precise information if they are to work effectively [25].

Indeed, the impact of data quality on decision making is a crucial part of the management process, and several organizations employ computer systems to help and support decision-making functions. Studied and appropriate decisions result in more profitable activities, efficient problem solving actions and improved performance of the organization [26]. Thus, data quality affects organizational performance, and as [8] indicated, the advantages to an organization resulting from information system operations.

Like data quality, system quality also has an enormous effect on organizational success. A well-structured, established and implemented system is an essential pre-condition for acquiring organizational gains [8]. The gains that can be obtained from system quality consist of decreasing expense, increasing profits, and enhanced processing capacity [27]. In contrast, a system that is not well structured and developed will face system crashes and failures which will negatively affect business processes and raise product costs. A system that is easy to maintain and has a long life results in spreading the software costs over a longer period, and costing the organization less [28].

Data warehousing for system quality has a solid relationship with the observed net profits in term of qualified personnel and facilitating decision making [29]. In turn, it will raise the internal organizational efficiency [8]. System quality is also positively related to the organizational effect at the operational scale within the business context [30].

To generate business value for an organization through its information systems, the system features should include concern for documentation and usability [31]. According to [8], a system with efficient documentation will decrease the cost of software maintenance, and result in a competitive advantage for the organization [32].

Poor software quality increases costs, since it is not capable of reaching the planned objective; for example, it may not be modelled according to certain requirements, be easy to penetrate, ignore the strict application of security regulations, , and suffer from weak construction [33]. Moreover, poor software quality is the reason for poor information quality, due to inappropriate and insufficient information. Conversely, system flexibility eases the way to alteration to meet unstable user information requirements effectively; this enables the organization to deliver consistent and advanced output to the users, thus, higher information quality [8].

There is a reliable and steady relationship between the system and information quality; the more elastic the system, the more effective will be the information [8]. A system that is convenient to use, consolidated and employs up-to-date technologies, can facilitate user activities in terms of providing precise and integral information to conduct daily processes in a sufficient way, which leads to better decision making [8].

The organizational effects at the firm-level can be categorized as internal and external influences on the organization [8]. Two different categories of organizational performance were proposed by [34]: operating performance and market-based performance. Going back to [8], there are certain elements that shape the structure of organizational impact, such as "product cost control and internal organizational efficiency", which is related to the internal influences, and "product enhancements" which fall under external influences. Product cost control involves expense cutting of a novel product layout, extant product re-modelling, and product commerce, while internal organizational efficiency is concerned with aspects of decision making, internal communication, strategic planning and profit margin. The third element, product enhancements, clarifies the degree to which the information system enhances quality and provides the products and services to clients [8].

C. Theoretical Foundation

Relationships between the organizational impact of system quality, information quality, and service quality have been investigated by [8]. The three hypotheses in the research model (see Fig. 1) test the association between system quality and data quality and their indirect effect on organizational success. In the opinion of [8], "a well-designed, developed, and implemented system is a necessary pre-requisite to deriving organizational benefits", which include cost reduction, increased revenue and improved process efficiency concerning the system's flexibility and sophistication. Thus, we hypothesize:

H1a: System quality is positively associated with organizational impact.

Previous researchers have pointed out that "high flexibility of system quality (i.e., maintainability, useful features of system) leads to high information content (i.e., useful and relevant information)" [8], and that "a well-integrated system" supplies complete and accurate information; this feature will reflect positively on the information process of decision making and the users benefitting from it.

H1b: System quality is positively associated with data quality.

Poor data quality leads to a failing information system. [8], and high data quality concerning both content (i.e. accuracy, completeness and relevance to decision making) and format (i.e. appearance, outputs consistency, and understanding) can drive the organization to a high level of organizational efficiency and high-quality decision making. Thus, we hypothesize:

H2: Data quality is positively associated with organizational impact.

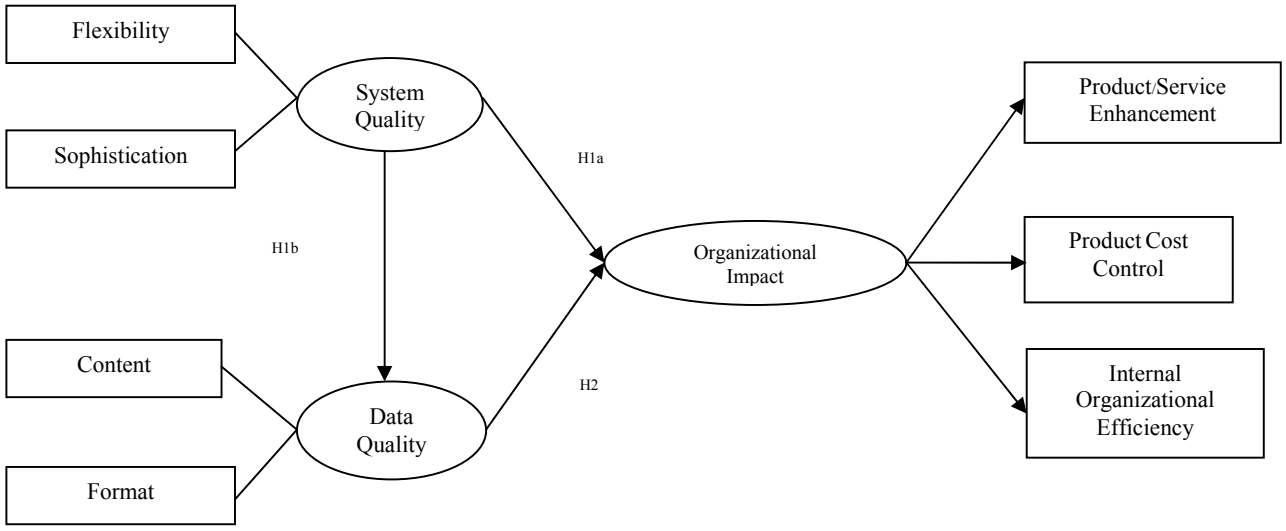

Fig. 1 Research model

III. Methodology

The data was empirically collected using standardized procedures so that every participant was asked the same questions in the same way. The questionnaire was distributed among different public and private organizations that are using information systems, to cover the impact of system and data quality in different sectors. Some of the respondents are employees involved in decision making, such as upper-level and middle-level managers, while others represent quality assurance; all are knowledgeable about IT and the overall business situation. In addition to personal information, the respondents were asked about several elements related to system quality, data quality, and organizational impact; their answers were recorded on a five-point scale (1 = strongly disagree, 5= strongly agree).

TABLE I
Research Measures

Latent Construct	Indicators	Number of Items
System Quality	Flexibility	3
	Sophistication	6
Information Quality	Content	5
	Format	3
Organizational Impact	Service\Product Enhancements	3
	Product Cost Control	4
	Internal Organizational Efficiency	8

IV. Results

The response was good, at 98%. We had difficulty in accessing some organizations, but in general most of the respondents were collaborative and cooperative. I In terms of measuring the accuracy of the results, we evaluated reliability and validity using SPSS:

Validity is the behavioral assumption that could be envisioned or predicted about whether the data is useful, meaningful and appropriate [35]. Validating the results is a core task to be done for any data analysis; we can consider a research model as a validated one once the validity exceeds the rate 0.5. Our research model was found to be valid.

Reliability has been defined as "the proportion of variance attributable to the true score of the latent variable" [36]. Thus, checking data reliability is as significant as the data validity for the data analysis process; we can consider a research data set as reliable if the reliability ratio is over 0.7. SPSS confirmed that the reliability for our research model was 0.97.

The sample size, N, is equal to 100 for all factors. We used it to measure the mean, standard deviation, and the variance between them. It appears that system quality has the largest variance, 0.786, and there is very little difference between data quality and organizational success.

Moreover, the descriptive analysis has a standard of minimum and maximum statistics, 1.50 and 5.00 respectively, for all factors. In terms of the mean statistics, organizational success has the highest rate, while system quality has the lowest.

Figs. 2 and 3 show the mean and standard deviation of each factor in public and private organizations respectively.

Fig. 2 shows that the private organizations have the highest ratios in terms of data and system quality, while Fig. 3 shows that the public organizations have the highest rates in all factors.

A t-test was used to differentiate between the statistics of the two organization types for each factor. The t-test results show that the organizational success factor mean in the public organizations had a smaller ratio than the private ones, but the standard deviation is greater in the public. The standard error mean has a larger ratio in the private organizations.

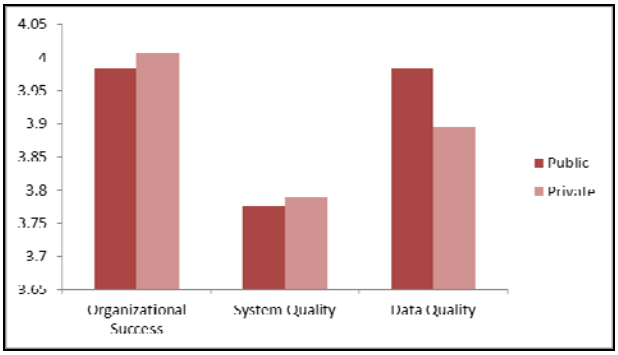

Fig. 2 Means of each factor in public and private organizations

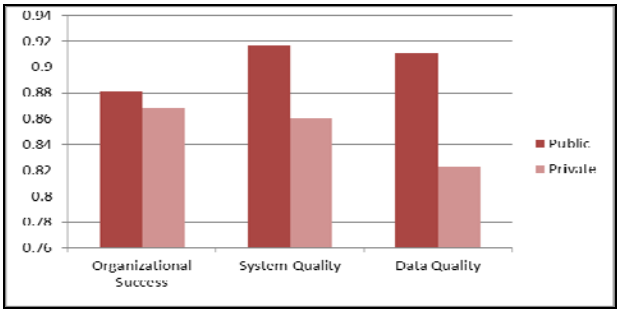

Fig. 3 Standard deviations of each factor in public and private organizations

Applying the t-test to the system quality factor, the private sector has a larger ratio of standard deviation and standard error mean, and the public organizations the larger rate for mean.

The data quality factors were tested by the different statistical methods; little difference was found between the rates in the public and private organizations, although the public had the largest ratios.

All hypothesized paths are significant, except the direct path from system quality to organizational impact (b = 0.70 for the path system quality → information quality, b = 0.01 for system quality → organizational impact, b = 0.27 for information quality → organizational impact, and b = 0.30 for the path service quality → organizational impact). However, there is an indirect effect of system quality (through information quality) on organizational impact. Overall, our hypothesized research model was supported. The total effects on organizational impact are 0.30 for service quality, 0.27 for information quality, and 0.20 for system quality (considering both direct and indirect effects). Furthermore, a total of 29% of the variance of organizational impact is explained by system quality, information quality, and service quality together; in addition, 49% of the variance of information quality is explained by system quality.

In this research, we hypothesized that there is a strong association between system quality and data quality and organizational impact. Data quality has a significant role in relation to system quality, integration, flexibility and sophistication, and to increasing the organizational success areas of effective performance and better decision making. The data from both private and public organizations validated the posited model and proved its reliability.

Our findings show a direct and indirect impact on organizational concerns. The first hypothesis (H1a), which identifies the relationship between system quality and organizational impact, shows no direct effect on organizational success, since the quality of data should be more efficient in processing the various actions and activities in the organization. Additionally, the potential purpose of the indirect effect of the system quality is that it concerns the aspects of being error-free, usable, secure and user-friendly.

In contrast, the second hypothesis (H1b) supports positively the relationship between data and system quality, because the data plays a major role in the whole organization. Poor data quality leads to poor system quality and vice versa. The poor data quality lowers the efficiency and effectiveness of the organizational and system performance, which in turn leads to high level of difficulty in making the right decision in critical cases, with the negative effect of poor outcomes. A system that uses advanced techniques, is well integrated and documented, and has various features, provides qualified data output in terms of the content and format. Moreover, it provides improved and efficient data, and thus a significant competitive advantage.

The last hypothesis in the model (H2), confirms the positive association between information quality and organizational impact, due to the influence of product/service enhancement, product cost control, and internal organizational efficiency, with the overall effect on the life cycle of organizational processes. Thus, the main implication is that data quality is a fundamental condition for system quality, with an actual impact on the organizational success.

V. Discussion and Conclusion

This paper has examined the concept of data management, as an introduction to the main objective, which is examining the organizational impact of system and data quality within Bahraini public and private organizations. We discussed data and system quality and their different aspects in detail, and their effects on organizational success. In general, the result of the analysis has shown that the high degree of data and system quality in public and private organizations affect positively their performance and the procedures of decision making, as a result of the high-quality data management. This leads to observing the obvious and strong association between data and system quality, and their effects on organizational success, which in turn results in product/service enhancement, better product cost control, and higher internal organizational efficiency.

The main limitation in our research is that it tests the research model in a Bahraini business environment, which cannot be considered as a standard. Besides, the targeted sample is comparatively small, with only 100 respondents. The questionnaire was distributed among upper-level and middle-level managers; this means the results might not be consistent and creditable or provide an accurate reflection, since managers would tend to give their own system and data

a good rating.

It is expected that the results of this study can be used by managers to structure their information system strategies to best benefit their businesses. Information system quality will increase by focusing on information quality and system quality, which in turn will enhance organizational performance; it considers the long-term and overall health of the structure. Information quality has a strong relationship with organizational impact, due to its role in coordinating the processes involved in constructing the organizational warehouse, with several consequences such as alignment among departments, effective cooperation between them in producing the output, and improved decision making.

Information quality influences product/service enhancement, product cost control, and internal organizational efficiency, affecting the whole life cycle of organizational processes. Also, it plays an intermediate role in the association between system quality and organizational impact, in which using relevant and accurate data will result in systems that are up-to-date, flexible, sophisticated, usable, well modelled and constructed on a strong basis, with capable and advanced technologies and features.

If the organization has a poor system quality, the reason is its poor data quality. The positive relationship between data and system quality increases organizational success, bringing the opportunity for competitive advantage, increased efficiency and effectiveness, and improved functionality of the information system.

Given the limitations discussed above, we would recommend distributing the same questionnaire to end users instead of managers, and to a larger sample, to guarantee greater accuracy of the results. Moreover, in future work, we would suggest testing this model on diverse environments with different cultures.

In order to improve data quality, which is considered as the basis of system quality, we would recommend following certain steps as explained by [12]. These steps involve the overall assessment of direct and indirect cost of data quality, with allocation for the data and process responsibilities, to specify personnel's roles; hence, this activity will facilitate the controlling and monitoring process to provide effective feedback. Further, the data should be evaluated to detect errors and find the best solutions to solve the problem and improve it [12].

There may be problems in assessing the quality of data, due to development and growth effects [12], and it is difficult to assess and document the quality of every single element of the organization's data [4]. Thus, a serious fault is indicating objectives in applying assessment of data quality, without realizing the importance of outlining a plan for the process to meet these objectives, because this is the key to maintaining a sufficient and competent assessment [22]. Therefore, we recommend designing an accurate plan, with a strong basis, that will result in meeting the main objectives. To have an effective assessment, there is a need for effective management which is concerned with the up-to-date evaluation and analysis of data, is well-documented, defines deliverables, and reaches the intended goals.

Meanwhile, the data quality aspect poses several challenges [5]. These challenges appear from the ever-changing business environment, regulatory requirements, increasing varieties of data forms/media, and Internet technologies; [2] summarized them in four main areas: multiple data sources, subjective judgment in data production, security/accessibility trade-off, and changing data needs. We would recommend these as the strongest approach to overcoming these challenges to better production and output, effective value of the processes, high-quality data and systems.

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