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QUANTIFYING INFORMATION QUALITY

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In the knowledge based information society, to which the modern world is moving, in order to enhance their global business performance, organizations must be careful with the quality of their information since it is one of their main assets. But what are the main dimensions of information quality (IQ), how to ensure the desired quality etc.?

The purpose of this paper is to demonstrate the importance of the business information quality assessment, in according to analysis of scientific literature, and to perform a summary of principal dimensions, ways and possibilities for IQ management.

Keywords: *data quality, information quality, quality management.*

CUANTIFICAREA CALITĂŢII INFORMAŢIEI

În societatea informaţională globală bazată pe cunoaştere, spre care tinde lumea modernă, pentru a-şi îmbunătăţi performanţa de afaceri la nivel mondial, organizaţiile sunt nevoite să se preocupe de calitatea informaţiilor, care constituie unul dintre activele lor principale. Dar care sunt principalele dimensiuni ale calităţii informaţiei, cum să se asigure calitatea dorită etc.?

Scopul lucrării este de a demonstra, în baza analizei literaturii ştiinţifice, importanţa evaluării calităţii informaţiilor de afaceri şi de a efectua o sinteză a principalelor dimensiuni, componente, metode şi posibilităţi de management al calităţii informaţiilor.

Cuvinte-cheie: *calitatea datelor, calitatea informaţiilor, managementul calităţii.*

Introduction

According to experts, Quality of Information (IQ) can be achieved through management by integrating some corresponding management activities into the organizational processes [1] and quantifying and assessment of IQ is a key determinant of IQ management [2-3].

Nowadays, when our current society is in transition of historical stage from large industrial era to the information age (also known as the *Computer age, Digital age* or *New media age,* based on information computerization), we all use information systems and the internet (International Interconnected Networks) [4]. For example, most of our society use google and other kinds of searching engines, get important data about the bank transactions, get work assignments and even set appointments with a doctor through the internet. We cannot imagine modern society without information. The quality and timing of information determine the degree of success of any business organization. So organizations that want to gain competitive advantage should treat information not only as subsidiary business element, but also as a product that quality may differ and that should be managed efficiently using appropriate methods, principles and means of quality management [5].

In this article, we review the general concept of information quality, and look for the basic elements that exist in the literature and research to assess the quality of the information. We indicate the relationship between *data* and *information quality* and we make a comparison between the two main models and highlighting the common between them in order to develop a better measure of the quality of information as the basis for a better assessment.

1. The relationship between data and information

Information is defined as data processed to be useful and either defined as data that represents the results of a computational process, such as statistical analysis, for assigning meanings to the data, or translation of the meaning given by people usually by using software tools like Information Systems (IS) [6]. Data are numbers, words or images that have yet to be organized or analyzed to answer a specific question [7]. It represents real world objects, in a format that can be stored, retrieved and elaborated by a software procedure [8]. In the computing literature, some of the studies use data and information terms interchangeably. Although there is still an ambiguity around their definitions, a consensus is also available that they are not the same thing. But the relationship between data and information is an interconnected one, data is raw facts such as phone numbers or addresses, and information is the organization of these raw facts into a meaningful manner. From the quality point of view it is important to consider both of them due to the dependences between *input accuracy* and *output accuracy* [9,10]. The implications of data quality are partly determined by the relationship between the quality of the input data and the quality of the information that an information system outputs. This is because data often passing various processing before any actual use, such that quality may change. However, the relationship between an information system's data accuracy and its output information accuracy is hard to assess. The popular belief is reflected by the saying *"garbage in garbage out"*, namely, the accuracy of the output of an information system is positively and tightly linked to the accuracy of its input. Yet, this belief has not been validated [11].

Information is generated through the transformation of data. According to O.Brien & Marakas [12], Information as data that have been converted into a meaningful and useful context for specific end user's needs.

Figure 1 explains how the Data is transformed into Information [10, 13].

Figure 1. Transforming Data into Information

2. Quality management

The definition of quality sometimes depends on the role of people who describes it; there is no single, universal definition of quality. Some people view quality as *"performance to standards."* Others view it as *"meeting the customer's needs"* or *"satisfying the customer"* [14] p.151. Therefore, different definitions of quality are available. According to Oxford dictionary, quality means "*the standard of something as measured against other things of a similar kind; the degree of excellence of something" [15].*

In manufacturing, *"a measure of excellence or a state of being free from defects, deficiencies, and significant variations, brought about by the strict and consistent adherence to measurable and verifiable standards to achieve uniformity of output that satisfies specific customer or user requirements".* ISO 8402-1986 standard defines quality as *"the totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs"* [16]. There are a lot of approaches to handle quality, each one of the specialists of quality is probably convinced that his method of assuring and measuring quality is the best. The PMBOK (Project Management Body of Knowledge) Guide [17] describes three elements of quality management: *quality planning, quality assurance,* and *quality control*. The Juran Trilogy describes three slightly different elements: *quality planning, quality control, and quality improvement* [18]. (Joseph M. Juran holds degrees in electrical engineering and law. Juran worked at the Hawthorne Electric Plant in Chicago in the 1920`s (as did Deming) and also taught at New York University. He is also well known in Japan for his contributions to the practice of total quality control after the Second World War). Juran's view includes assurance and control activities within quality control, but also adds the essential element of quality improvement.

ISO describe eight quality management principles on which the quality management system standards of the ISO 9000 series are based [19]: (1) Customer focus, (2) Leadership, (3) Involvement of people, (4) Process approach, (5) System approach to management, (6) Continual improvement, (7) Factual approach to decision making, (8) Mutually beneficial supplier relationships.

The PMBOK Guide points that quality management processes: *"include all the activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken".* This description is sufficiently general to include the needs of the project in terms of *time, cost, and scope* and the needs of the product of the project or customers of the project in terms of the defined requirements. Project quality management is connected to all organizational quality management activities in terms of processes and costs [20, p.41].

Other approach is to combine the better of these views to include *quality planning, quality assurance, quality control* and *quality improvement*. We want to determine the most suitable quality dimensions, mainly from the point of views of the users, and find what the key dimensions to satisfy the users are, that will used as a basis for the quality evaluation.

3. Data quality management

Impact of Data Quality (DQ) on Organizational Performance Madnick et al. (2009) [21] note that there are technical and nontechnical issues that may cause data and information quality problems: "*Organizations have increasingly invested in technology to collect, store, and process vast quantities of data. Even so, they often find themselves stymied in their efforts to translate this data into meaningful knowledge that they can use to improve business processes, make smart decisions, and create strategic advantages. Issues surrounding the quality of data and information that cause these difficulties range in nature from the technical (e.g., integration of data from different sources) to the nontechnical (e.g., lack of a strategy across an organization ensuring the right stakeholders have the right information in the right format at the right place and time*)" [22].

Data Quality Management (DQM) is a combination of the collection, organization, storage, processing, and presentation of high-quality data. In addition, it deals with organizational issues that must be addressed, such as maintaining sponsorship, managing expectation, avoiding scope creep, and handling political issues [23-26]. However, responsibility for improving data quality and managing corporate data is often assigned to IT departments [27]. Also, many companies try to cope with Data Quality (DQ) issues by simply implementing data management or data warehouse systems. Surveys on data warehousing failures reveal that organizational rather than technical issues are more critical to their success [28-30]. Figure 2 shows the scope of DQM within the context of IT and quality management.

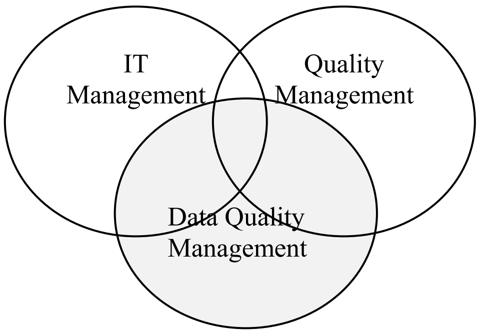

Figure 2. Data quality management in the context of IT and quality management [30]

4. Total data quality management

Total Data Quality Management (TDQM) was initially introduced at the Massachusetts Institute of Technology (MIT) in 1990s as an extension of Total Quality Management, while its main purpose is to develop a theoretical foundation for data quality. TDQM uses the Information Product (IP) approach inspired by the resemblance between manufacturing product of TQM and data. Wang summarizes the purpose of TDQM as "*delivering high quality information products to information consumers*" [31]. TDQM adopts Deming's *"Plan, Do, Check and Act"* from the TQM literature and creates its own *"Define, Measure, Analyze, and Improve"* cycle as a continuous process [2]. Table 1 shows a comparison between Product vs. Information Manufacturing [31], with the emphasis on the partial similarities between the manufacture and information product used by the TDQM [32].

Table 1

Product vs. Information manufacturing [31]

	Product Manufacturing	Information Manufacturing
Input	Raw Materials	Raw Data
Process	Assembly Line	Information System
Output	Physical Products	Information Products

5. Total information quality management

Total Information Quality Management (TIQM) methodology (formerly known as Total Quality Data Methodology – TQDM) is inspired by quality management concepts analogous to those of TDQM. Deming Management Method and Keizen had an especially big influence while establishing the basis of the methodology. It has been initially designed to support data warehouse projects where data from different sources is consolidated into a common integrated database [24]. TIQM mainly concentrates on management activities that should be performed during the integration of those data sources, in order to make choices best fitting the organization. A detailed classification of costs and benefits is provided as part of the methodology. The main goal of the cost-benefit analysis is finding out the most useful and effective quality improvement activities; such that once they are performed, their benefit should exceed their cost.

TIQM consist of six process steps [33]: (1) Assess data definition and information architecture quality, (2) Assess information quality, (3) Measure non-quality information costs and risks, (4) Reengineer and correct data, (5) Improve information process quality, (6) Establish the information quality environment.

6. Information quality

Information Quality (IQ) has become a critical concern of organizations and an active area of Management Information Systems (MIS) research. The growth of data warehouses and the direct access of information from various sources by managers and information users have increased the need for, and awareness of, high-quality information in organizations [34].

Information quality is one of the key determinants of information system success. When information quality is poor, it can cause a variety of risks in an organization [35]. Information quality is the desirable characteristics of the system outputs [10]. Information quality is either the sum of information quality characteristics that satisfy the information consumers' (knowledge workers') expectations and needs. Only high quality information enables to make reasonable business decisions. Consequently, this is information that is delivered to the right person at the right time and place. Topical modern business problems are as follows: how to pick right information from its abundance, how to decide which information is correct, and which one is useless, finally, how to assess the quality of information [5].

After an extensive review of the literature, an agreed definition of information quality also seems to be an elusive concept and difficult to define in a way that is conceptually satisfying. There are a number of theoretical frameworks for understanding data and information quality. *Levis et al* [36], summarized the main points of some important models. Redman, Orr and others [37-39] present a cybernetic model of information quality that views organizations as made up of closely interacting feedback systems linking quality of information to its use, in a feedback cycle where the actions of each system are continuously modified by the actions, changes and outputs of other systems. Data and information are of high quality "*if it is fit for its intended use*" (also *"fit-for purpose"*). Wang&Strong (1996) propose a DQ/IQ framework that includes the categories of *intrinsic* data quality, *accessibility* data quality, *contextual* and *representational* data quality from the perspectives of those who used the information [40, 41]. Information quality, just as a material product has quality dimensions associated with it, an IP has IQ dimensions. IQ has been viewed as fitness for use by information consumers, with four IQ categories and fifteen dimensions identified [31], [40]. As shown in Table 2.

Table 2

Categorized of IQ/DQ and dimensions [40]

IQ Category	IQ Dimensions
Intrinsic IQ	Accuracy, Objectivity, Believability, Reputation
Accessibility IQ	Access, Security
Contextual IQ	Relevancy, Value-Added, Timeliness,Completeness, Amount of data
Representational IQ	Interpretability, Ease of understanding, Concise representation, Consistent representation

The goal of Information Quality Management (IQM) introduced in the 1990sis to increase the value of high quality information assets. Most researchers and practitioners agree, that the key to understanding information quality is to understand the processes that generate, use, and store data. High quality information is a critical enabler to TQM and, serves as a key to quality success. Better quality and productivity may not be the issue, but rather better information quality. Information is critical to all functions and all functions need to be integrated by information. Organizational knowledge is based on exchange of information between customers, employees, information suppliers, and the public [42].

7. Quantifying information quality

Information Quality (IQ) is a measure of how fit information is for a purpose. Sometimes called Quality of Information (QoI) by analogy with Quality of Service (QoS), it quantifies whether the correct information is being used to make a decision or take an action. Not understanding when information is of adequate quality can lead to bad decisions and catastrophic effects, including system outages, increased costs, lost revenue and worse. Quantifying information quality can help improve decision-making, but the ultimate goal should be to select or construct information producers that have the appropriate balance between information quality and the cost of providing it [43]. Pipino et al. (2002) categorizes DQ/IQ assessment into objective and subjective assessment. Objective assessments reveal quality problems in databases while subjective assessments reflect the needs and experiences of data consumers [44]. Objective IQ, assessment measures the extent to which information conforms to quality specifications and references. Subjective IQ, assessment measures the extent to which information is fitness for use by information consumers [45]. Table 3 indicates the differences between objective and subjective IQ assessment.

Table 3

Comparison of objective and subjective IQ assessment [45]

Method / Feature	Objective assessment	Subjective assessment
Tool	Software	Survey
Measuring Object	Data	Information
Standard	Rules, Patterns	User Satisfaction
Process	Automated	User Involved
Result	Single	Multiple

8. Measuring information quality model

An Information Quality Model structure the IQ measurable concept by defining the relationship between attributes of information products and information needs.

Generic modules determine that, the same relationships always hold; e.g. a generic model might say that, no matter what process is being performed. The relevance, timeliness, completeness and reliability or the information product are important factors in the satisfaction of information need. Targeted models, on the other hand, state that, in a particular context and when performing a particular process, the satisfaction of the information need will depend on a specific set of information product attributes. A targeted model may include weights for each attribute so that their relative importance can be brought into the algorithm that calculates the indicator for identifying the best opportunities for improvement [46].

Information quality is an assessment of whether information is suited for the purposes to which it is put, and IQ metrics provide quantitative data to make this assessment. The metrics can be divided into three categories: standalone, composite, and context-dependent IQ metrics. Table 4 represent the classification of IQ metrics, by Keeton et al 2009 [43].

Table 4

Keeton, Mehra & Wilkes classification of IQ metrics

Standalone IQ metrics	Standalone IQ metrics are independent of the use the information is put to, and can be directly measured by the information producer. They include: how recent is the data? How complete is it? How accurate is it? How representative is it?
Composite IQ metrics	Composite IQ metrics are measured across multiple producers. For example: is this data producer unique, or is there a duplicate copy obtainable elsewhere? Do these two producers agree (e.g., the strength of correlations or duplicate coverage between them)? Do we know the information's provenance? Is it auditable? Which producer should be trusted more for the desired purpose?
Context-dependent IQ metrics	Context-dependent IQ metrics can only be calculated relative to the context and needs of the information consumer. They generally cannot be evaluated by looking solely at a single information producer

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9. Data quality dimensions

Another data quality classification is provided by Wand and Wang [47]. They limit their focus to intrinsic data qualities, of which they define four intrinsic dimensions: completeness, unambiguousness, meaningfulness and correctness. Wand and Wang take as their basis a paper, which features a review of cited data quality dimensions, i.e. the comprehensive literature review of Wang et al. [48]. Based on the comprehensive literature review, Wand and Wang summarize the 26 most often cited data quality dimensions as shown in Table 5.

Table 5

Cited data quality dimensions Source: Wand and Wang

Quality dimensions	Frequency	Quality dimensions	Frequency	Quality dimensions	Frequency
Accuracy	25	Format	4	Comparability	2
Reliability	22	Interpretability	4	Conciseness	2
Timeliness	19	Content	3	Freedom from bias	2
Relevance	16	Efficiency	3	Informativeness	2
Completeness	15	Importance	3	Level of detail	2
Currency	9	Sufficiency	3	Quantitativeness	2
Consistency	8	Usableness	3	Scope	2
Flexibility	5	Usefulness	3	Understandability	2
Precision	5	Clarity	2		

As mentioned, Wang and Strong [40] propose a DQ/IQ classification which divides data quality into four categories*: intrinsic, contextual, representational,* and *accessibility*. For each category, they define a set of dimensions. The definition by Wang and Strong is discussed by Haug et al [49] who argues that "representational data quality" can be perceived as a form of "accessibility data quality" instead of a category of its own.

Thus, Haug et al. define three data quality categories: intrinsic, accessibility and usefulness. Levitin and Redman [50] provide another perspective by arguing that since processes to produce data have many similarities to processes that produce physical products, data producing processes could be viewed as producing data products for data consumers. With a basis in this view of data as resources, Levitin and Redman discuss how thirteen basic properties of organizational resources may be translated into properties for data [51].

10. Information quality dimensions

Information quality is commonly thought of as a multi-dimensional concept with varying attributed characteristics depending on a quality view-point.Each organization or the information consumer (the customer or the user) has a different view of the dimensions of information quality. Determine information quality dimensions for the information quality can be used to add structure and instrumental to this inherent complexity. Table 6 provides a summary of the 20 most common dimensions and the frequency with which they are included in the comparison Information Quality Frameworks of Shirlee-ann Knight and Janice Burn (2005) [52]. Definitions of the Common Dimensions are in Table 8.

Table 6

The common dimensions of IQ/DQ [52]

Quality dimensions	Frequency	Quality dimensions	Frequency	Quality dimensions	Frequency
Accuracy	8	Understandability	5	Believability	3
Consistency	7	Accessibility	4	Navigation	3
Security	7	Availability	4	Reputation	3
Timeliness	7	Objectivity	4	Useful	3
Completeness	5	Relevancy	4	Efficiency	3
Concise	5	Usability	4	Value-Added	3
Reliability	5	Amount of data	3		

Confusingly enough, quality dimensions are named and approached differently in different frameworks. As we can see, some dimensions are common and used by the two frameworks. In order to merge the two frameworks for assessing data and information quality, we propose a scale to determine the scores of the frequency weighted of each of the quality dimension measurements. For the scoring calculation, we sum the number of occurrences from the two frameworks (from Table 5 and Table 6) and determine the highest score with the greatest value, namely, rank the dimensions. These ranks will be used as the basis for calculating the score scale between 0 and 10, with 10 –the highest score. In Table 7 we show the frequency score of the 36 quality dimensions based on the two frameworks, so that made for each of the quality dimensions, the weighting of their grades according to the number of occurrences. This provides us a measurement scale for the quality dimensions with the frequency score.

Table 7

Quality dimensions and the frequency score

Quality dimensions	Frequency score	Quality dimensions	Frequency score	Quality dimensions	Frequency score
Accuracy	10	Usability	2.50	Interpretability	0.80
Timeliness	8.18	Efficiency	2.48	Content	0.60
Reliability	7.53	Useful	2.48	Importance	0.60
Completeness	6.13	Amount of data	1.88	Sufficiency	0.60
Consistency	5.98	Believability	1.88	Usableness	0.60
Relevancy	5.70	Navigation	1.88	Clarity	0.40
Security	4.38	Reputation	1.88	Comparability	0.40
Concise	3.53	Value-Added	1.88	Freedom from bias	0.40
Understandability	3.53	Currency	1.80	Informativeness	0.40
Accessibility	2.50	Flexibility	1.00	Level of detail	0.40
Availability	2.50	Precision	1.00	Quantitativeness	0.40
Objectivity	2.50	Format	0.80	Scope	0.40

Table 8

Common Quality Dimensions Definitions of DQ\IQ [40], [52]

	Dimension	**Definition**
1.	Accessibility	Extent to which information is available, or easily and quickly retrievable.
2.	Accuracy	The extent to which data are correct, reliable and certified free of error.
3.	Amount of data	Extent to which the quantity or volume of available data is appropriate.
4.	Availability	Extent to which information is physically accessible.
5.	Believability	Extent to which information is regarded as true and credible.
6.	Completeness	Extent to which information is not missing and is of sufficient breadth and depth for the task at hand.
7.	Concise	Extent to which information is compactly represented without being overwhelming (i.e. brief in presentation, yet complete and to the point).
8.	Consistency	Extent to which information is presented in the same format and compatible with previous data.
9.	Efficiency	Extent to which data are able to quickly meet the information needs for the task at hand.
10.	Navigation	Extent to which data are easily found and linked to.
11.	Objectivity	Extent to which information is unbiased, unprejudiced and impartial.
12.	Relevancy	Extent to which information is applicable and helpful for the task at hand.
13.	Reliability	Extent to which information is correct and reliable.
14.	Reputation	Extent to which information is highly regarded in terms of source or content.
15.	Security	Extent to which access to information is restricted appropriately to maintain its security.

	Dimension	Definition
16.	Timeliness	Extent to which the information is sufficiently up-to-date for the task at hand.
17.	Understandability	Extent to which information is clear without ambiguity and easily comprehended.
18.	Usability	Extent to which information is clear and easily used.
19.	Useful	Extent to which information is applicable and helpful for the task at hand.
20.	Value-Added	Extent to which information is beneficial, provides advantages from its use.

In Figure 4, the graph represents only the 10 quality dimensions which are common and shared in the two frameworks, for measuring data quality and information quality.

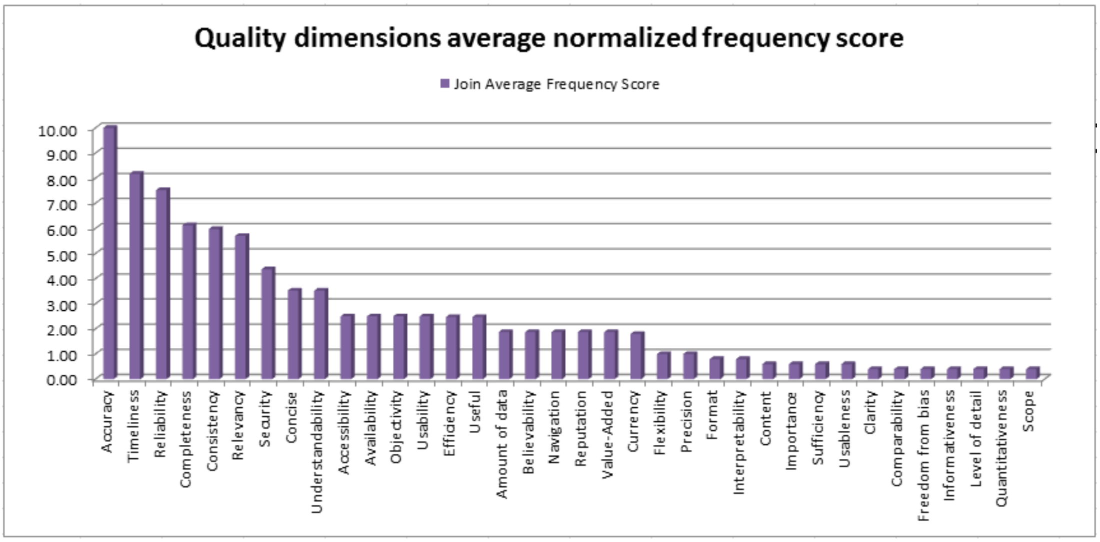

Figure 3. DQ/IQdimensionsaverage normalized frequency score

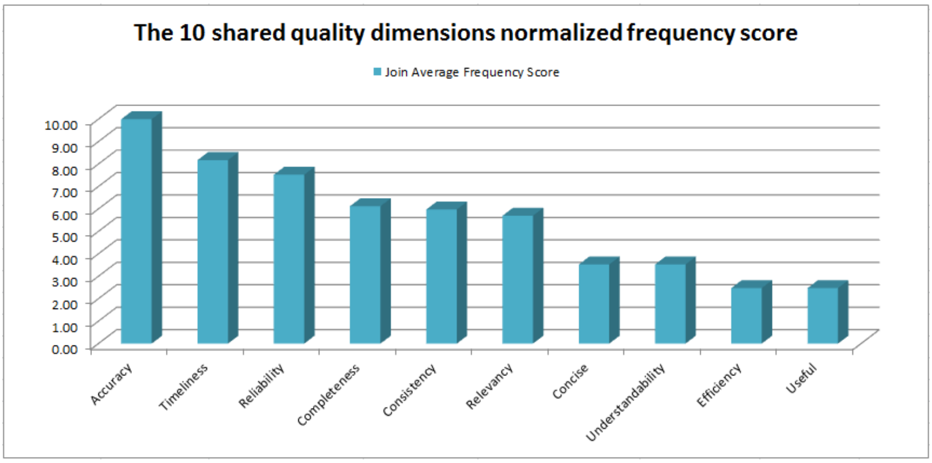

Figure 4. The 10 DQ/IQ shared quality dimension normalized frequency score

11. Various methodologies of information quality assessment

More than two decades of research in the emerging field of IQ has developed useful theories, methodologies, and technologies for assessing, improving, and managing the quality of various types of information [21]. The concept of IQ goes beyond accuracy. It includes more than a dozen other dimensions such as timeliness, completeness, consistency, interpretability, accessibility, security, to name only a few [40]. These different dimensions can be grouped into different categories. Several IQ frameworks have been developed to define and categorize various IQ dimensions [2, 40, 53, 54]. Among various IQ management methodologies, the Total Data Quality Management methodology [55] is one of the most used in researches and practice. It suggests that information should be treated as a product (Information Product) and managed continuously by following the cycles of improving Quality through: Define, Measure, Analyze, and Improve (DMAIC) [23]. Existing research has attempted to identify a full spectrum of IQ issues, most users are only concerned with a very few IQ dimensions. In fact, research has shown that a user typically can only handle approximately seven concepts without being confused or to flooded with data [56].

Thus it is not effective to present too many IQ dimensions when informing users or occupy their inputs about quality. Therefore numerous machine-based IQ assessment methods have been developed. Depending on the type of the information (e.g., structured vs. structured, centrally produced vs. socially contributed, medical domain vs. IT domain), different sets of metrics are selected and automatically assessed using different input features. Functional dependency analysis [57] and statistical analysis [58] can be used to identify various quality problems in relational and other types of structured sources. Record linkage techniques [59] can be used to detect duplicates and inconsistencies. For textual data, various quality indicators can be used as a proxy for quality metrics. The indicators can be based on content (e.g., information-to-noise ratio), metadata (e.g., Web page's last update date), or other features (e.g., HTML syntactic correctness). Up to 26 such indicators have been used to assess the quality of online health information [60]. With the growth of social media such as Wikipedia and various discussion forums, there has been growing amount of research that focuses on assessing the quality of socially contributed contents. The algorithms are usually specific to a particular type of social media platform because they rely on certain features specific to the platform. Most machine-based methods are scalable and can produce IQ metadata useful for improving the effectiveness of Web search and information retrieval. However, automatic algorithms can, at best, estimate the overall quality. They cannot reliably generate ratings along quality dimensions because the relationship between selected features and quality dimensions are usually unknown or unreliable. For example, number of edits is mapped to authority and article length is mapped to completeness for Wikipedia articles [2]. It is debatable whether such mappings make sense. Ratings along quality dimensions are necessary for explication purposes and for the effective use of information (e.g., making trade-offs between dimensions). Furthermore, certain selected metrics may be irrelevant to users in their intended uses of the information.

More importantly, machine-based methods cannot capture users" perspectives about IQ. User-based assessment relies on user inputs collected using questionnaire surveys, ratings, or freeform comments. A systematic survey instrument [34] has been used in various organizations to assess IQ perceived by users of different roles in the information supply chain. The survey method requires significant user involvement and is often used to assess a collection of IP's as a whole, thus it is not scalable to obtain real-time IQ assessment at a fine-granularity. Minimalist approach to online voting (such as thumbs up/down and "has the article helped you") does not capture sufficient information for quality improvement purposes. Freeform feedback option is cumbersome and thus rarely used by users.

User-based methods can capture user's perspectives about IQ but are not scalable. They also lack the necessary granularity and specificity in terms of the IP (in the case of the survey method) and the IQ metadata (in the case of the simple voting method). Furthermore, the lack of user incentives often results in scarcity of useful feedback and even leads to biased and malicious feedback. Hongwei Zhu, Yinghua Ma, Guiyang Surealized (2011) that these challenges require further research [61].

Conclusions

Information and its use is a very important resource for any kind of organization, not less important than other resources. To be better than the competitors, organizations have to get the best, the most updated and useful information, and for that purpose they have to know how to supply the best quality, monitoring and assessing of the information. Organizations who realize that information is a part of the organizational quality process will get superiority over the competitors [1]. Therefore, organizations should determine who is responsible for quality improvement and quality assessment of the information. Moreover, *it is important to determine the quality evaluation system, using machine-based methods and user-based assessment, to monitor and measure quality improvement over a time period and compare it to previous periods*.

To ensure information quality, organizations must comply in accordance with a clearly defined quality dimensions, like quality control in the manufacture of other products (goods and services), which are provided and are valued in accordance with the specific quality characteristics. As a result, the dimensions of IQ/DQ are the basis for assessing the quality of information.

Information Quality literature has provided a great amount of proposals for assessing the quality of information, but there is still a need to develop frameworks for assessing and improving the quality of information from the information consumer and the organizational point of view in the perspective of the information project classification. Moreover, for each dimension there must be set a clear definition what it represents, in order to be able to compare it for any type of Information Project (i.e. information system) throughout its life cycle.

In this paper, we prefer to base on the Data quality dimensions scale proposed initially by Wand and Wang [47]and the Information quality dimensions proposed by Shirlee-ann Knight and Janice Burn [52]. Both are strong and well validated. There are some basic differences in the theories of both models since data and information are not the same. However, most of the dimensions used, and especially the most frequent ones, are very similar. In this work, we tried to combine the two models and built a shared set of dimensions. Hopefully, this will give a starting point for the further research.

In order to prepare an assessment scale and give the appropriate weight for each of the quality indicator for certain project information, we revealed that quantifying information quality involves two main stages: first, identifying which dimensions are important and relevant to the information project and second, determining how these dimensions affect the customers' needs when they consume the information. This will enable to perform more accurate assessment of the quality, identifying discrepancies and determining the necessary actions for improvement.

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