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The Impact of Information Quality on Quality of Life: An Information Quality Oriented Framework

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SUMMARY Information affects almost all aspects of life, and thus the Quality of Information (IQ) plays a critical role in businesses and societies; It can have significant positive and negative impacts on the quality of life of citizens, employees and organizations. Over many years aspects and challenges of IQ have been studied within various contexts. As a result, the general approach to the study of IQ has offered numerous management and measurement approaches, IQ frameworks and list of IQ criteria. As the volume of data and information increases, IQ problems become pervasive. Whereas earlier studies investigated specific aspects of IQ, the next phase of IQ research will need to examine IQ in a wider context, thus its impact on the quality of life and societies. In this paper we apply an IQ oriented framework to two cases, cloud computing and lifelogging, illustrating the impact of IQ on the quality of life. The paper demonstrates the value of the framework, the impact IQ can have on the quality of life and in summary provides a foundation for further research.

key words: *Information Quality, ageing, cloud, social, lifelogging*

1. Introduction

Ensuring the quality of information has become an increasingly important factor in many aspects of the society, life and organizations [7], [11], [33], [34]. Recognizing the importance of Information Quality (IQ), practitioners and researchers have considered for many years approaches to study and improve its quality. Scientists have worked on management approaches as well as mathematical and statistical models to introduce mechanism to prevent data quality problems in data bases and information systems. Researchers have investigated the perception of IQ and tradeoffs between IQ criteria [22], [51]. Management of data flows and the management of Information Manufacturing Systems have also attracted many researchers [5], [15], [18].

With the increasing importance of IQ, much research in recent years has been focused on IQ assessments and improvement within organizations. Researchers have developed many frameworks, criteria lists and approaches for assessing and measuring IQ. Based on general quality management [17], IQ Management approaches have been suggested. IQ has often been defined as a measure for 'fitness for use' of information, following the seminal work from Wang and Strong [32]. The discussion follows the general quality literature by viewing quality as the capability to 'meet or exceed users' requirements.' Common examples of IQ dimensions are accuracy, completeness, consistency, timeliness, interpretability, and availability. Over the last two decades, many studies have confirmed that IQ is a multidimensional concept e.g. [3], [15], [26], [28], [31], [32] and its evaluation should consider different aspects [51]. The literature provides numerous definitions and taxonomies of IQ dimensions analyzing the problem in different contexts. The frameworks most widely used have been recently documented and adopted by the International Standards Organizations (ISO) [16].

In summary over the last two decades IQ research mainly focused on organizational contexts, whereas little research investigates the effects of information quality on societies and various aspects of life. However, as the volume of data and information increases, IQ problems become pervasive. The next phase of IQ research will need to examine not only IQ in an organization context, but also in a wider and societal context, thus examining and understanding its impact on the quality of life. Some documented examples of how IQ impacts on societies and quality of life, include for instance the lost the space shuttle Challenger at NASA with seven astronauts on board. The Presidential Commission investigated the Challenger accident and found that NASA's decision-making process was based on in-complete and misleading data. Just two years later the U.S. Navy Cruiser USS Vincennes shot accidentally an Iranian commercial aircraft with 290 passengers onboard. Officials who investigated the Vincennes accident admitted that poor quality information was a major factor [11]. Yet not only in the space and military industries but also in our daily life, certain data quality problems are found to be severe, for instance, Pirani [50] reported that one piece of wrong biopsy information caused a patient's death in an Australian hospital. Another example illustrates the negative effects of IQ on traffic management [6]. Examples such as these illustrate cases in which poor data quality have impact and significant costs, and may lead to irreversible damages in organizations and societies, thus impacting on the quality of life.

In this paper we apply an IQ oriented framework to two cases, cloud computing and lifelogging, illustrating the impact of IQ on the quality of life. The paper demonstrates the value of the framework and provides indications for further research. The paper is structured as follows. In Sect. 2 we reflect our work with related research propose in Sect. 3 some indications of poor IQ in form of costs and value. Based on Semiotic an IQ Framework is presented that subsequently is applied to two cases illustrating the impact of IQ on the Quality of Life. The paper concludes with a summary and indications for further research.

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2. Related Work

IQ has been investigated for many years and numerous frameworks and criteria lists have been proposed. Although claims are made to provide generic criteria lists [32], on closer examination most research has been focused on investigating IQ within a specific context, mostly geared towards an organizational context e.g. [1], [4], [10], [12], [13], [20], [23], [24]. Analyzing some popular IQ frameworks [18], [26], [32] we can observe a large number of dimensions and criteria associated with IQ. One of the seminal frameworks was proposed by Wang and Strong [32], and since then has been applied to many contexts and research. A critical element of any IQ assessment is to assign specific values for each IQ criteria through objective, repeatable and reliable measures. Over the years a plethora of IQ assessment methodologies have been proposed [2], [8], [14], [15], [19], [21], [22], [27], [28], [30]. On the one hand, IQ is often measured with subjective perceptions from information users. On the other hand, research has developed objective IQ measures on the basis of quality criteria (mostly for intrinsic IQ characteristics such as accuracy, completeness and correctness). But as of today no widely accepted IQ framework with generic, generally applicable measurements is available. This makes the understanding of IQ on aspects of life challenging. Based on our earlier research, in this paper we examine the application of IQ concepts to understand its impact on quality of life. In the following we use our work on IQ costs and value to illustrate the scope and extend of impacts of IQ.

3. Information Quality Costs and Value

In order to study the impact of IQ we first provide a definition and description of cost and value aspects of IQ. We define IQ cost as impacts caused by IQ problems. In order to identify IQ costs, we adopt a frequent citied IQ cost taxonomy from Eppler and Helfert [52]. Following the above definition, this taxonomy contains two types of major costs, (1) costs caused by low IQ and (2) costs of improving and assuring data duality. The costs caused by low IQ are divided into direct and indirect costs. Direct costs are those negative monetary effects that are raised directly out of low IQ, namely the costs of verifying data because it is of questionable credibility, the costs of re-entering data because it is inaccurate or incomplete, and the costs of compensation for damages to business based on the low-quality data. On the other hand, indirect costs are those negative monetary effects that arise, through intermediate effects, from low quality data. In terms of the costs resulted from improving IQ, Eppler and Helfert [52] distinguished among prevention, detection, and repair costs.

In order to reduce the costs of IQ, a number of studies have made efforts towards managing IQ. Many concepts from other domain are applied. For example total quality management, information management and knowledge management. From a total quality perspective, Wang [53] proposed a Total Data Quality Management (TDQM) framework and advocated the principle of "manage your information as a product". This framework consists of four stages, define, measure, analyze and improve, which are adapted from the Deming cycle. The objective of TDQM is to deliver high-quality information products to information consumers. From an information perspective, Eppler [9] proposed an information-focused framework that considers information integration, validation, contextualization and activation. The objective of this framework is to structure IQ handling and value adding activities. Huang et al. [15] proposed a framework that is used to transform high-quality data and information into knowledge. This framework contains three key processes: improve quality of information, make tacit knowledge explicit, and create organizational knowledge.

The second element to be considered when evaluating IQ is its impact and value. Many focusing on business aspects, value in relation to IS have been discussed in numerous papers. For instance, Gustafsson et al. [54] have presented a comprehensive model that aims to explain the business impact with three generic elements: IT, organizational impact, and business value. Although primarily used in a business context, this model can serve as background model for IQ impact on quality of life. The model is supported by strong evidence that IQ has a considerable effect on decision-making. For instance, Keller and Staelin [56] indicate that increasing information quantity impairs decision effectiveness and, in contrast, increasing IQ improves decision effectiveness. Jung et al. conduct a study to explore the impact of representational IQ (which comprises the IQ dimensions interpretability, easy to understand, and concise and consistent representation) on decision effectiveness in a laboratory experiment with two tasks with different levels of complexity [26]. Furthermore, Ge and Helfert [55] show that the improvement of IQ in the intrinsic category (e.g. accuracy) and the contextual category (e.g. completeness) can enhance decision quality.

4. An IQ Framework on Quality of Life

In order to develop our general IQ framework, we base our concept on two traditional and well established concepts. In order to structure characteristics of information, we follow the theory of semiotics. In addition, in order to provide different quality views, we follow general quality literature and structure quality along "quality of conformance" and "quality of design". Semiotic is a relatively widely established discipline, which has recently received increasing attention. Indeed, since the publication of Stamper [29] semiotic has revealed its relevance to information systems (IS) in many research. Stamper extended the traditional three layers of semiotics (syntax, semantics and pragmatics) with additional aspects (physical, empirical and social aspects) forming the "semiotic ladder" that consists of the views on signs from the perspective of physics, empirics, syntax, se-

Table 1 IQ framework based on semiotic [12].

Semiotic Level	Quality Aspects
Pragmatic	Relevance, completeness, Timeliness, actuality, efficiency
Semantic	Precise data definitions, easy to understand and objective data definitions. Interpretability, accuracy (free-of error), consistent data values, complete data values, , believability, reliability
Syntax	Consistent and adequate syntax Syntactical correctness, consistent representation, security, accessibility

mantic, pragmatics, and the social world [25].

Having established an IQ framework for relevant IQ dimensions (Table 1), it needs to be applied to a particular context

5. Cloud Computing and Quality of Life

The worlds' population as a whole is ageing as the increase in the number and proportion of elderly people in society demonstrates. This shifting of the global age profile will require significant economic and societal change to counteract the increasing cost of providing healthcare and the technology changes that provide new social and health possibilities. As there will be more elderly people worldwide than children for the first time by the year 2045 there will unfortunately be knock on negative outcomes such as higher costs of care [35], insufficient medical resources and scarcity of medical services in low population areas. Previously the healthcare industry attempted to address ageing issues using various approached such as Pervasive Healthcare Computing and Ambient Assisting Living (AAL) [36] and seeking to embrace the possibilities underpinned by new technology. Doctors and patients have reaped the benefit of round the clock access to medical information. Pervasive Healthcare computing promises a significant improvement in quality of life for the elderly [37] and provides personal services mapped to the requirements of the elderly person to assist in achieving successful and independent ageing. This concept of independent ageing links to the quality of life (QOL) of the elderly i.e. the degree to which a person enjoys the important possibilities of his or her life [38]. The QOL of the elderly person however is linked closely with their data quality in so far that using our IQ framework we can see completeness and timeliness form part of the Pragmatic Semiotic Level.

Apart from healthcare solutions for physical health, services vary across psychological health (mental and emotional) and social needs also. Cloud Based healthcare applications improve the quality of life of the elderly [37] because large scale compute, storage and networking resources facilitate the delivery of modern healthcare capabilities like mobile telemedicine, remote monitoring, individual health monitoring, social networking and pervasive access to medical data. Comprehensive health monitoring needs to be autonomous, context aware and provide [39] personalized health monitoring in a context aware environment. To improved correctness in medical decisions the cloud system must provide adaptive health monitoring to balance patient requirements with network traffic and utilize multi-point enhancements with devices and technologies to improve the end-to-end reliability. In terms of QOL it can be seen that the accuracy and reliability aspects of IQ form part of the Semantic Semiotic Level of our IQ framework.

Advances in sensor technology now allow meaningful remote health monitoring systems to be deployed. Typical approaches of traditional sensor-based monitoring system include "Smart Home" [41] and wearable sensing platforms. The Smart Homes solution uses sensors on walls and ceilings or in furniture and appliances. This means that different types of lifelog data can be acquired but such systems are expensive. Wearable sensing platforms [42] use sensors such as EEG and ECG which are attached to the body to measure brain activity and heart-rate and are cheap and light weight [43]. These technologies and devices described here, while contributing to QOL for the elderly have also contributed to the "Big-Data Tsunami". Specialized sensors, such as heart rate monitors, pedometers, or glucometers for diabetis, are in widespread use. Ubiquitous sensors can record eating habits, while mobility can be monitored using GPS and cameras. These sensors provide clinicians with solid facts as well as an insight into the habits of their patients. Unobtrusive monitoring can detect compliance with prescription taking and exercise regimes and proximity to high health-risk. This empirical measurement of life attributes particularly by sensors from a semantic level must supply accurate and consistent data about the person in real time so that decisions made on QOL criteria are well founded.

From the psychological perspective the proliferation of social network applications which are Cloud based has been instrumental in bringing individuals who are socially isolated, elderly or mobility challenged into the community. Studies have shown that healthcare service providers can develop strategies for reducing instances of depression by increasing social network support, especially with family members, among their elderly parents [40]. Such interactions are as important for the psychological and mental well-being of individuals as the new-age sensors are in monitoring physical well-being.

Data can be a mixed blessing, however. While pattern recognition and signal analysis, clustering, classification and data-mining algorithms exist to manipulate such information [44] that is only one step in moving ubiquitous sensor systems toward clinical practice. These data validation and quality assurance techniques must be provided with better end-user interfaces to allow medical professionals to better qualify the healthcare data. Standardized frameworks for ensuring Data Quality are fundamental to ensuring QOL improving methodologies are implemented in a consistent manner.

6. Lifelogging and Quality of Life

Another application example for this context-aware IQ framework is the new and emerging area of lifelogging [45]. Recent advances in sensing, search and user interaction technologies have each helped to bring us to the point where anybody with a cell-phone or a custom off-the-shelf device can engage in a process of lifelogging. Lifelogging uses sensors to record life activities in great detail and the resultant lifelogs can contain a comprehensive digital life diary or a surrogate memory. A lifelog can be gathered using digital sensing technologies, for example, GPS can log where a person goes, automatic periodic photos (or video) can log what is seen, microphones can log what is heard, accelerometers can log what movements are made, and so on. It is our belief that maintaining a lifelog will become a commonplace activity in the coming years, from birth to death. With the same ease that we execute a Google search, we will be able to locate any nugget of information from our lifelog, such as a phone number, a location, an entire event in great multimedia detail, or even perform an analysis of lifestyle trends over many years.

Although extreme lifelogging is still the domain of early adaptors, such as Steve Mann [47] and Gordon Bell [47], for reasons such as: 1) privacy and ethical concerns [48]; 2) overwhelming amounts of data [49]; and 3) limited sensing device availability, we can identify the key data quality factors for this context aware framework. In order to create an efficient and effective lifelog, we need to consider how such a lifelog will be accessed. The key reasons for accessing a lifelog can be categorized under the five headings; recollecting, reminiscing for sentimental reasons, retrieving specific knowledge, reflecting upon past experiences and remembering intentions (plans) [49].

At the pragmatic level, a lifelog that is truly useful needs to be operational in real-time and extract relevant information for a user based on the current user context. Hence, we are concerned with the relevance of delivered information, the timeliness of delivery and the completeness of the data. Since lifelogs are usually generated from sensed information, the semantic knowledge of this data needs to be accurate, be delivered consistently and be reliable. This is not as easy as it initially seems. The vast data quantities of lifelog archives provide real information quality challenges; the context aware framework can help to solve. Finally, with regard to syntax, lifelogs should be omnipresently accessible both the lifelog storage and lifelog access methodologies should be concerned with security and privacy of the data. The lifelog is a very personal and sensitive archive of all life experience. Indeed, since lifelogs will be captured automatically issues of security and privacy are especially relevant.

7. Conclusions and Further Research

For both case studies the semiotic level of syntax is critical to usability. Consistent representation is demanded when dealing with any medical data that has clinical outputs. The data derived from these systems must be both accessible and secure in order to meet the needs of both patient and practitioner. The varied nature of the data derived from the sensed and social environments occupied by the elderly in our society has massive potential for improving QOL both physically and mentally if the data utilized is of good quality. We are demonstrating here that semiotics is relevant to many types of information systems. The extension of the traditional three layers of semiotics to include physical, empirical and social aspects has applications across a wide range of new technologies which are making great improvements to QOL but can benefit from IQ Frameworks to ensure information quality. Future studies can use the framework to examine impacts of IQ in societies and the quality of life, and to develop IQ evaluation techniques.

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References

[1] J.E. Alexander and M.A. Tate, Web Wisdom: How to Evaluate and Create Information Quality on the Web, Lawrence Erlbaum, Mahwah, NJ., 1999.
[2] F.D. Amicis and C. Batini, "A methodology for data quality assessment on financial data," Studies in Communication Sciences, vol.4, no.2, pp.115–137, 2004.
[3] D.P. Ballou and H.L. Pazer, "Designing information systems to optimize the accuracy-timeliness tradeoff," Information Systems Research, vol.6, no.1, pp.51–72, 1995.
[4] D.P. Ballou and G.K. Tayi, "Enhancing data quality in data warehouse environments," Commun. ACM, vol.42, no.1, pp.73–78, 1999.
[5] D.P. Ballou, R. Wang, H. Pazer, and G.K. Tayi, "Modelling information manufacturing systems to determine information product quality," Management Science, vol.44, no.4, pp.462–484, April 1998.
[6] P. Chen, K. Srinivasan, and H. Mahmassani, "Effect of information quality on compliance behavior of commuters under real-time traffic information," Transportation Research Record, Journal of the Transportation Research Board, vol.1676, pp.53–60, 1999.
[7] I.N. Chengalur-Smith, D.P. Ballou, and H.L. Pazer, "The impact of data quality information on decision making: An exploratory analysis," IEEE Trans. Knowl. Data Eng., vol.11, no.6, pp.853–864, 1999.
[8] A. Dedeke, "A conceptual framework for developing quality measures for information systems," Proc. 5th International Conference on Information Quality, MIT, USA, 2000.
[9] M. Eppler Managing information quality, 2nd ed., Springer, Berlin, Germany, 2006.
[10] L. English, Improving Data Warehouse and Business Information Quality, John Wiley & Sons, New York, 1999.
[11] C.W. Fisher and B.R. Kingma, "Criticality of data quality as exemplified in two disasters," Information & Management, vol.39, no.2, pp.109–116, 2001.
[12] M. Helfert, "Managing and measuring data quality in data warehousing," Proc. World Multiconference on Systemics, Cybernetics and Informatics, 2001.
[13] M. Helfert and B. Heinrich, "Analyzing data quality investments in CRM: A model-based approach," 8th International Conference on Information Quality, MIT, USA, 2003.

[14] M. Helfert, O. Foley, M. Ge, and C. Cappiello, "Limitations of weighted sum measures for information quality," 15th Americas Conference on Information Systems, San Francisco, California, Aug. 2009.

[15] K.T. Huang, Y.W. Lee, and R.Y. Wang, Quality Information and Knowledge Management, Prentice Hall, 1999.

[16] ISO/IEC 25012 (2008) Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Data quality model, International Organization for Standardization.

[17] J.M. Juran, How to think about Quality, in Juran's quality handbook, 5th ed., ed. J.M. Juran and A.B. Godfrey, pp.2.1–2.18, McGraw-Hill, New York, 1998.

[18] B.K. Kahn and D.M. Strong, "Product and service performance model for information quality: An update," Proc. 1998 International Conference on Information Quality, MIT, USA, 1998.

[19] B. Kahn and D.M. Strong, "Information quality benchmarks: Product and service," Commun. ACM, vol.45, no.4, pp.184–192, 2002.

[20] P. Katerattanakul and K. Siau, "Measuring information quality of web sites: Development of instrument," Proc. 20th international conference on Information Systems, Charlotte, North Carolina, 1999.

[21] S. Knight and J. Burn, "Developing a framework for assessing information quality on the World Wide Web," Informing Science, vol.8, pp.159–172, 2005.

[22] Y. Lee, D. Strong, B. Kahn, and R.Y. Wang, "AIMQ: A methodology for information quality assessment," Information & Management, vol.40, no.2, pp.133–146, 2002.

[23] H.K.N. Leung, "Quality metrics for intranet applications," Information & Management, vol.38, pp.137–152, 2001.

[24] S. Li and B. Lin, "Accessing information sharing and information quality in supply chain management," Decision Support Systems, vol.42, no.3, pp.1641–1656, 2006.

[25] K. Liu, Semiotics in information systems engineering, Cambridge University Press., Cambridge, England, 2000.

[26] H. Miller, "The multiple dimensions of information quality," Information Systems Management, vol.13, no.2, pp.79–82, Spring 1996.

[27] L. Pipino, Y.W. Lee, and R.Y. Wang, "Data quality assessment," Commun. ACM, vol.45, no.4, pp.211–218, 2002.

[28] T. Redman, Data Quality For The Information Age, Artech House, 1996.

[29] R.K. Stamper, Information in Business and Administrative Systems, John Wiley & Sons, New York, 1973.

[30] B. Stvilia, L. Gasser, M.B. Twidale, and L.C. Smith, "A framework for information quality assessment," J. American Society for Information Science and Technology, vol.58, no.12, pp.1720–1733, 2007.

[31] Y. Wand and R.Y. Wang, "Anchoring data quality dimensions in ontological foundations," Commun. ACM, vol.39, no.11, pp.86–95, 1996.

[32] R.Y. Wang and D.M. Strong, "Beyond accuracy: What Data Quality Means to Data Consumers," J. Management Information System, vol.12, no.4, pp.5–34, 1996.

[33] H. Xu, and A. Koronios, "Understanding information quality in E-business," J. Computer Information Systems, vol.45, no.2, pp.73–82, 2004.

[34] H. Xu, J. Horn, N. Brown, and G.D. Nord, "Data quality issues in implementing an ERP," Industrial Management & Data Systems, vol.102, no.1/2, pp.47–59, 2002.

[35] K.A. Roberto, The Elderly Caregiver: Caring for Adults with Developmental Disabilities, SAGE, Newbury, 1993.

[36] AAL, Ambient Assisted Living Joint Programme, 2011, http://www.aal-europe.eu

[37] V. Stanford, "Using pervasive computing to deliver elder Care," IEEE Pervasive Computing, vol.1, pp.10–13, 2002.

[38] R.L. Schalock, Quality of Life for People with Intellectual and Other Developmental Disabilities: Applications Across Individuals, Organizations, Communities, and Systems, American Association on Intellectual and Developmental Disabilities, Washington, DC, 2007.

[39] Upkar Varshney, Pervasive healthcare and wireless health monitoring, Mob. Netw. Appl. 12, 2-3 DOI=10.1007/s11036-007-0017-1, 2007.

[40] B.J. Kim, C.C. Sangalang, and T. Kihl, "Effects of acculturation and social network support on depression among elderly Korean immigrants," Aging & Mental Health, vol.16, no.6, 2012.

[41] G. Virone, A. Wood, L. Selavo, Q. Cao, L. Fang, T. Doan, Z. He, R. Stoleru, S. Lin, and A. Stankovic, "An advanced wireless sensor network for health monitoring," Transdisciplinary Conference on Distributed Diagnosis and Home Healthcare (D2H2), pp.2–5, 2006.

[42] Harvard Sensor Networks Lab: Codeblue project: Wireless sensor networks for medical care, http://fiji.eecs.harvard.edu/CodeBlue

[43] C. Mundt, K. Montgomery, U. Udoh, V. Barker, G. Thonier, A. Tellier, R. Ricks, R. Darling, Y. Cagle, N. Cabrol, S. Ruoss, J. Swain, J. Hines, and G. Kovacs, "A multiparameter wearable physiologic monitoring system for space and terrestrial applications," IEEE Trans. Information Technology in Biomedicine, vol.9, no.3, pp.382–391, 2005.

[44] E.M. Berke, T. Choudhury, S. Ali, and M. Rabbi, "Objective measurement of sociability and activity: Mobile sensing in the community," Ann Fam Med., vol.9, no.4, pp.344–350, 2011.

[45] G. Bell and J. Gemmell, eds., Total Recall: How the E-Memory Revolution Will Change Everything, Penguin Books, 2009.

[46] S. Mann, "Wearable computing: A first step toward personal imaging," Computer, vol.30, no.2, pp.25–32, 1997.

[47] J. Gemmell, G. Bell, and R. Lueder, "MyLifeBits: A personal database for everything," Commun. ACM, vol.49, no.1, pp.88–95, 2006.

[48] D.D.H. Nguyen, G. Marcu, G.R. Hayes, K.N. Truong, J. Scott, M. Langheinrich, and C. Roduner, "Encountering sensecam: Personal recording technologies in everyday life," Ubicomp'09: Proc. 11th International Conference on Ubiquitous Computing, pp.165–174, New York, NY, USA, 2009. ACM.

[49] E.A.J. Sellen and S. Whittaker, "Beyond total capture: A constructive critique of lifelogging," Commun. ACM, vol.53, no.5, pp.70–77, 2010.

[50] C. Pirani, "How safe are your hospital?," The Weekend Australia, 2004.

[51] D.D. Fehrenbacher and M. Helfert, "Contextual factors influencing perceived importance and trade-offs of information quality," Comm. Asso. Info. Syst., vol.30, no.8, pp.111–126, 2012.

[52] M. Eppler and M. Helfert, "A classification and analysis of data quality costs," 9th MIT International Conference on Information Quality, Boston, USA, Nov. 2004.

[53] R.Y. Wang, A product perspective on total data quality management, Commun. ACM, vol.41, no.2, pp.58–65, 1998.

[54] P. Gustafsson, U. Franke, D. Höök, and P. Johnson, "Quantifying IT impacts on organizational structure and business value with Extended Influence Diagrams," The Practice of Enterprise Modeling, pp.138–152, 2009.

[55] M. Ge and M. Helfert, "Effects of information quality on inventory management," Int. J. Information Quality, vol.2, no.2, pp.176–191, 2008.

[56] K.L. Keller and R. Staelin, "Effects of quality and quantity of information on decision effectiveness," J. Consumer Research, vol.14, no.2, pp.200–213, 1987.

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