INFORMATION QUALITY – WHAT GET MEASURED GET MANAGED
(LITERATURE REVIEW ON INFORMATION QUALITY)

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ABSTRACT

You can't manage what you don't measure is wisdom that attributed to Edwards Deming and Peter Drucker (McAfee & Brynjolfsson, 2012). This wisdom is the main background of this research. Many student's books in higher education explain the importance aspect of information but there is no universal understanding about how could we value the information. Many research conducted to define the indicators of information quality but, there are many varieties in the results. This paper is aimed to study the previous research in information quality and draw the conclusion in information characteristics. The first step in this research is collecting literatures in information quality and identified each indicator in the researches that examine information quality. After indicators identification, we categorized the indicators into few categories. For each category, we analyzed the frequency of each indicators used in research and the country of the authors. From the result, we identified, what quality of information that is the most important and the least important. The value of information will support the decision makers in assigning their resource by considering cost vs benefit.

Keywords: *information quality, accuracy, timeliness, completeness, relevancy, accessibility*

INTRODUCTION

You can't manage what you don't measure is wisdom that attributed to Edwards Deming and Peter Drucker (McAfee & Brynjolfsson, 2012). This quote was not dedicated only for information, but for all resource in the organization. Balanced scorecard, activity based costing and many other modern management accounting tools are used to measure resource and allocate those resource efficiently. In traditional business, resource involve: man, machine, money, material and method. But, in this modern era, information is become an important resource for an organization in doing their business. This need of information should be taken into account of the information overload possibilities.

Information overload occurs when the limit of human mind can absorb and process information are passed, resulting in a decline in decision making quality and increase in the cost of providing that information (Romney & Steinbart, 2012). In the information era right now, where information are available easily and inexpensive, decision makers tend to be hard to differ which information is valid and relevant with the decisions to be taken. (Jalal, 2017).

In this information era, there is no activities and decisions that can be made without information support. Information becomes an important resource in decision making. However, the acquisition of information requires sacrifice, therefore, taking into account efficiency, then decision-making needs to take into consideration the benefits of the information to be generated and the cost to obtain the information. When deal with resource constraints, decision makers must make decisions, which should be prioritized with existing resources. An information as far as possible to meet all the quality of information available. Sometimes, however, a decision maker must decide to focus on a certain quality and slightly disregard the quality of others. When it comes to deciding where to focus on which quality, a decision maker must have a guide, which quality will be prioritized.

Objective of this research is to analyze, which quality of information should be prioritized by conducting a literature study on previous studies in information quality to provide guidance on priority level of information quality. The benefit of this research is to provide support to decision makers to make the most efficient choice in utilizing existing resources in order to obtain the best benefits from information.

The research question from this study are: (1) What are the main indicators in the previous study related to information quality, (2) How is the classification of information quality that can be made from previous research and (3) What is the top five indicators of information quality derived from the information quality identified.

The remainder of the paper was structured as follows. The next sections review the theoretical background. The research method is described in the next section, followed by result discussed. Conclusion, limitations and suggestion for future research are presented in the last section.

LITERATURE REVIEW

Information is data that have been organized and processed to provide meaning and improve the decision-making process. As a rule, users make better decisions as the quantity and quality of information increase (Romney & Steinbart, Accounting Information Systems, 2015). Quality as a concept is quite difficult for many people to understand, and much confusion and myth surround it. In a linguistic sense, quality originates from the Latin word 'qualis' which means 'such as the thing really is'. There is an international definition of quality: 'the degree to which a set of inherent characteristics fulfils requirements' (ISO 9001, 2015). (Juran, 1988) also stated that quality consists of freedom from deficiencies.

According to (Kahn & Strong, 1998), information quality is the information characteristic and is also the indicator to measure if the users' expectations were met. Analysing the quality of information enables us to estimate the value that the information provides its user in order for him or her to take action. The value of information depends on the user's situation and on what kind of "problem" the information is supposed to

solve. Although there is no general agreement on the dimensions of information quality, in many studies, the same attributes are repeated (Jylhä & Suvanto, 2015).

One cannot manage information quality without first being able to measure it meaningfully and establishing a causal connection between the source of information quality change, the information quality problem types, the types of activities affected, and their implications (Stvilia, Gasser, Twidale, & Smith, 2007). (Bailey & Pearson, 1983) has identified the complexity of measuring information quality from the users' viewpoint; so in order to enable this measurement, they developed a tool to evaluate the satisfaction of information technology systems users through the use of information quality dimensions. However, the more dimensions are selected for information quality, the less comprehensible it is for the users and the more difficult the assessments will become (Naumann, 2002).

RESEARCH METHODOLOGY

This research is a literature review with the aim of: (1) identifying key indicators in previous study in information quality, (2) determining the classification of information quality, and (3) identifying information quality priorities. The results of this study are expected to answer the research questions mentioned in the previous section of this study.

This research is done by reviewing previous researchs based on these criterias: (1) researchs with the main analysis-unit were published researchs with the main topic about information quality and (2) time frame of the published journal is from 1983-2013. We collect research from 1983 to 2013 to find pattern in three eras, 80's, 90's, and 2000's.

RESULTS AND DISCUSSIONS

From the 44 previous researchs used in this research, we identified 62 information quality indicators that found from various countries, companies, data and its collection method as translated on the table in Appendix A. For some researchs among all, we could not identify where and how the researchs has been done.

From the 62 information quality indicators, we counted on the most indicators that have been found. Based on the countings, we found the top 5 information quality indicators. Based on the overall countings, we found that the top 5 information quality indicators were accuracy, timeliness, completeness, relevancy, and accessibility. It shows that most researchs we used found that a good information quality can be measured by looking those 5 indicators.

These previous researchs were done on various countries, such as US, Canada, Australia, and also European countries (which identified). 85% of them were come from Western. This shows that there was not much similar research done on Eastern, since there was only 15% of identified countries on the previous researchs used came from Eastern.

As identified, these 44 researchs were done on both profit and non-profit companies. We found that the results of the researchs were mostly done on profit companies. Profit companies as identified were come from various types (such as manufacturing and merchandising) and industries.

For the non-profit companies as identified, most companies were the government companies. This shows that the most information quality indicators found and measured from the researchs on profit companies. This information quality measurement seems not

that important for the non-profit companies since there was only a few researchs done on non-profit companies.

As identified, these 44 researchs used various data, such as primary data and secondary data. Those were also collected by various data collection methods, such as questionnaires, interviews, literature reviews, framework or model assessments, etc. Based on our analysis, most researchs used primary data collected by questionnaires.

To simplify the research, we divided the 62 information quality indicators that have been found into 11 categories. These categories were accessibility, accuracy, adequacy, completeness, conciseness, credibility, format, logical, relevancy, timeliness, and understandability. Each category were analysed on below parts, based on tables on Appendix B.

Security of access could be one of information quality for the company. It is because not everyone can get access to company's information. If the company gave their information to people who had no any business with it, it can be misused for wrong purposes. The table on Appendix B shows that most researchers finding is accessibility.

Based on research by (Goodhue & Thompson, 1995) about *Task-Technology Fit and Individual Performance*, aimed to find theoretical model between the relationship of information systems and individual performance. Accessibility used as one of indicator in information quality. This research shows that technologies in information systems can add value to individual performance.

A good information quality can be also measured by accuracy. It means that there is no errors or mistakes in the information. Information of the company often used to help stakeholders for decision making. The table on Appendix B shows that the most frequent indicator in information quality is accuracy.

Based on (Bailey & Pearson, 1983) about *Development of a Tool for Measuring and Analyzing Computer User Satisfaction*, it is measured to improve the productivity of information systems. They used measurement of accuracy and precision of the quality information. Through this research, computer user satisfaction has been developed with a valid measurement instrument.

When a company publishes some of their information, the table on Appendix B shows that adequacy of the information was also a critical thing to measure the quality of information. It is because if the information is not adequate for decision making, it will impact on stakeholder business life.

From (Forslund & Jonsson, 2007) journal about *The Impact of Forecast Information Quality on Supply Chain Performance*, it is aimed to describe of supplier access to customer forecast information and the information quality also to explain the impact of forecast information access and forecast information quality (FIQ) on supply chain performance. FIQ was measured by variable adequacy of information quality. Based on theoretical framework, measurement instrument for FIQ and supply chain performance were developed, but FIQ is lower further upstream in the supply chain in the empirical findings.

Completeness can determine whether the information can help stakeholder for decision making in their business or not. Because if stakeholder cannot find what they need in the information (incomplete), they cannot make a decision making for the business. The table on Appendix B shows that most researcher's findings were also about completeness.

Research by (Bovee, Srivastava, & Mak, 2003) about *A Conceptual Framework and Belief-Function Approach to Assessing Overall Information Quality*, aimed to assess information quality in online user and assurance provider. One of information quality indicator they used is completeness. Based on this, it was sum up that information quality support should be diminished by the presence of support for any major attribute of information quality being low.

Efficiency in information is really needed by the company. With efficiency, a few of resources, a company could give information which stakeholder need in a brief and clear way. A proper decision making could be made with efficiency by the stakeholder. From the table on Appendix B, it shows that most of researcher's finding in efficiency is conciseness.

Based on (Isik, Jones, & Sidorova, 2013) about *The Roles of Business Intelligence Capabilities and Decision Environments*, aimed to know the relationship and influence between BI capabilities and BI success. One of information quality indicator in this research is conciseness. This research sum up that data quality in BI capabilities appear to have reached an acceptable level, and further improvements to such capabilities may not support into grater BI success.

Information in the company must be credible to their stakeholder. Because when stakeholders can trust the company, it would be an asset for the company to support them to reach their goals. The table on Appendix B shows that previous research findings found that credibility also included as a critical indicator on a category of information quality.

Journal from (Li & Lin, 2006) about *Accessing Information Sharing and Information Quality in Supply Chain Management* shows impact of environmental uncertainty, intra-organizational facilitators, and inter-organizational relationships on information sharing and information quality in supply chain management. They used credibility as one of information quality indicator in this research. The results show that information quality is impacted by supplier uncertainty, trust in supply chain partners and shared vision between supply chain partners.

When the stakeholder got the information from the company, they often see their appearance of information. Appearance could affect stakeholder's interest to read the information, and also the speed to absorb it. The table on Appendix B shows that research findings also found that format was included in a critical indicator of information quality.

Based on (Miller, 2005), aimed to explore the relationship between information quality and market share for firms offering an information product. In this research, the researcher used appearance, format, and interpretability as information quality indicators. From the research, it was sum up that if the firm maintain information quality, tend to leads in accruing the market share.

All of components in information also must be logical from one part to the other, therefore the stakeholders could understand what the information means. A reason behind every information is also needed for the stakeholder to be more understand about information's meaning. The table on Appendix B shows that logical, meaning, and reasonable have proportional concern from researcher findings in US, Canada, and Spanish.

A research from (Roldán & Leal, 2003) about *A Validation Test of an Adaptation of the DeLone and McLean's Model in the Spanish Executive Information Systems Field* used logical as one of information quality indicator. Conclusion of the research is that the

researcher's adaptation of DeLone and McLean's model seems to have adequate predictive power to the EIS field in Spain for most implied variables.

All components of information from the company must be related to each other, that the stakeholders could understand what it means. If it is not related from one another, information that the company wants to share with will not be achieved, there will be possibility for misunderstanding between the stakeholder and the company. The table on Appendix B shows that research findings concluded that relevancy of information quality is the most critical on its category.

Journal by (Hussein, Mohamed, Karim, & Ahlan, 2007) about *The Influence of Organizational Factors on Information Systems Success in E-Government Agencies in Malaysia* aimed to investigate the influence of organizational factors on IS success in selected public sector. This research used relevancy as one of information quality indicator. Conclusion of this research is organizational factors can have significant impact on successful information systems of the public service sector.

Punctuality of information publication in the company also could affect decision making made by stakeholders. If the information not published at proper time, the stakeholder could make a decision at the wrong time. The table on Appendix B shows that most researcher's findings shows timeliness of information is critical on its category.

From journal (Bharati & Chaudhury, 2004) about *an Empirical Investigation of Decision-Making Satisfaction in Web-Based Decision Support Systems* aimed to understand factors that impact decision-making satisfaction in web based decision support systems. They used timeliness as the indicator of information quality. Based on statistical conclusions, system and information quality positively correlated with decision-making satisfaction, so an increase in system and information quality leads to an increase in decision-making satisfaction.

Company's information must be usable for the stakeholder. It means that all of information in their report could be understandable, so the stakeholder could take decision from the information. The table on Appendix B shows that most research findings in usability was understandability of an information.

From the journal (McKinney, Yoon, & Zahedi, 2002) about *The Measurement of Web-Customer Satisfaction* aimed to develop Web-customer satisfaction during the information phase. One of information quality indicator they used is understandability. This research summed up that with a model for Expectation-Disconfirmation Effects in Web-Customer Satisfaction (EDEWS) can provide strong support proposed metrics for measuring the key constructs of Web-Customer satisfaction.

CONCLUSION

75% of 80's research discussed accuracy, while 79% of 90's research discussed accuracy, whereas in the 2000s, 81% of the research discussed accuracy. It can be concluded that as information technology develops, more researchers include accuracy as one indicator of information quality in their research. This fact shows that the demand for accuracy is greater this day. The trend about this indicator is similar with relevance. There is an increasing trend of research that discusses relevance over time, from 29% in the 90s, to 54% in the 2000s. This is in line with the tendency of information overload where the current information is excessive, so the user of information is find it more difficult to distinguish which information is relevant or not with the decision that must be made.

Therefore, the researchers make relevancy as one of the indicator of discussion because this element is considered interesting to be studied.

Completeness is a consistent element used in research, both the 80s, 90s, and 2000s. This shows that completeness is one of the main needs of users of information.75% of 80's research discusses timeliness, while 71% of 90's research discusses timeliness, whereas in the 2000s, 65% of the studies discussed timeliness. There is a tendency to decrease the discussion of timeliness. This shows that with the development of information technology, time frame is no longer a competitive advantage but has become a competitive necessities. So the discussion about timeliness decreased in the research because it is no longer an interesting topic to be studied because it has become a necessity.

In the 80s, there was no research that matters about accessibility. In that era, information accessibility is still something that is difficult to obtain, so the researchers did not include the indicator in their research. However, in the 90s, accessibility, as part of information security, became one of the most studied elements. In this era, the internet began to grow and information accessibility became one of competitive advantage. While in the era of 2000s, information accessibility is no longer a competitive advantage but has become a competitive necessities. In this era, researchers do not consider accessibility to be an interesting element of information quality for research.

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Appendix A – Information Quality Indicators

Author	Country	Profit/Nonprofit Companies	Primary/Secondary Data	Statistical Tools
Bailey and Pearson (1983)	Not identified	Profit	Primary (questionnaires)	Critical incident analysis
Baroudi and Orlikowski (1988)	New York	Profit	Primary (questionnaires)	Cronbach's alpha
Bharati and Chaudhury (2004)	Not identified	Not identified	Primary (questionnaires)	GFI, Cronbach's alpha, Bentler Bonnet, Chi-square constrained and unconstrained model
Bovee et al (2003)	Not identified	Not identified	Secondary (literature review)	Not identified
Cao et al. (2005)	Not identified	Profit	Primary (questionnaires); Secondary (literature study)	Cronbach's alpha
Delone and mclean (2003)	Not identified	Profit	Secondary (studi literatur)	Not identified
Doll and Torkzadeh (1988)	Not identified	Not identified	Primary (questionnaires)	Correlation, Cronbach's alpha
Doll&Torkzadeh (1988)	Not identified	Profit	Primary (interview dan questionnaires)	Cronbach's Alpha
Folinas et al. (2006)	Canada	Profit	Primary (questionnaires)	Not identified
Forslund (2004)	Swedia	Profit	Primary (questionnaires)	(sample: 100 employees in four industries of Swedish manufacturing companies)
Forslund and Jonsson (2007)	Swedia	Profit	Primary (questionnaires)	T-test
Foshay et al (2007)	North America	Profit & non-profit	Primary (questionnaires)	R square value

Author	Country	Profit/Nonprofit Companies	Primary/Secondary Data	Statistical Tools
Goodhue (1995)	US	Profit	Primary (questionnaires)	Cronbach's alpha
Hussein., et al 2007	Malaysia	Non-profit	Primary (questionnaires)	Cronbach's alpha; multiple regression analysis
Isik, et al (2013)	US	Profit	Primary (questionnaires)	PLS, Cronbach's alpha
Jarke and Vassiliou (1997)	Not identified	Not identified	Not identified	Not identified
Lee et al (2002)	Not identified	Profit	Primary (questionnaires)	Cronbach'a alpha, descriptive statistics, dimension-level correlations, quadrant-level correlations
Li (1997)	North America	Not identified	Primary (questionnaires)	Chi-square
Li and Lin (2006)	Not identified	Not identified	Primary (questionnaires)	Multiple regression
Lindau (1995)	Swedia	Profit	Primary (questionnaires)	
Maltz (2000)	Not identified	Profit	Primary (questionnaires)	Squared regression
Mason-Jones and Towill (1997)	US	Profit	Not identified	Not identified
Mckinney et al. (2002)	Not identified	Profit	Primary (questionnaires dan observasi)	Cronbach's alpha; ANOVA
Menon and Varadarajan (1992)	Not identified	Profit	Primary (focus groups, personal interviews, other exploratory techniques)	Uji model

Author	Country	Profit/Nonprofit Companies	Primary/Secondary Data	Statistical Tools
Miller (1996)	Not identified	Profit	Not identified	Not identified
Miller (2005)	Not identified	Profit	Not identified	Excel-based - Monte Carlo model
Moberg et al. (2002)	US	Profit	Primary (interview, questionnaires)	Canonical correlation analysis (CCA)
Moenaert and Souder (1996)	Not identified	Profit	Primary (the critical incident technique, questionnaires)	Correlation matrix
Monczka et al. (1998)	US, Canada, Mexico, Western Europe, Australia	Profit	Primary (questionnaires)	Cronbach's alpha; regression
Pipino et al (2002)	Not identified	Profit	Not identified	Simple ratio, min or max operation, weighted average
Popovič et al (2009)	Slovenia	Not identified	Primary (questionnaires)	PLS, descriptive statistics
Raghunathan (1999)	Not identified	Profit	Secondary (literature review)	Shapely value
Raghunathan (1999)	Not identified	Profit	Secondary (literature review)	Shapely value
Rai et al. (2002)	Not identified	Not identified	Primary (questionnaires)	Descriptive statistics; t-values; cronbach's alpha; chi-square
Ramayah and Omar (2010)	Malaysia	Profit	Primary (questionnaires)	Cronbach's alpha; multiple regression
Roca et al (2006)	Not identified	Non-profit	Primary (questionnaires)	Cronbach's alpha

Author	Country	Profit/Nonprofit Companies	Primary/Secondary Data	Statistical Tools
Roldan and Leal (2003)	Spanish	Not identified	Primary (questionnaires)	Partial Least Squares (PLS); cronbach's alpha; t-statistics
Seddon and Kiew (1996)	Melbourne	Not identified	Primary (questionnaires)	Conventional ordinary least squares regression path analysis and structural equation modeling
Singh (1996)	European	Profit	Not identified	Not identified
Strong, Lee & Wang (1997)	Not identified	Profit	Primary (interview)	Not identified
Stvilia et al (2007)	Not identified	Not identified	Not identified	Descriptive statistics
Wang and Strong (1996)	Not identified	Not identified	Primary (questionnaires)	Descriptive statistics, Cronbach's alpha
Wangpipatwong et al. (2005)	Thailand	Non-profit	Primary (questionnaires)	Cronbach's alpha dan guttman split-half
Wixom and Watson (2001)	US, South Africa, Canada, Austria	Profit	Primary (questionnaires)	PLS (Partial Least Square), descriptive analysis, correlations
Yeoh and Koronios (2010)	Not identified	Profit	Primary (interview), Secondary (literature study)	Delphi study, case study

Source: processed authors on various sources

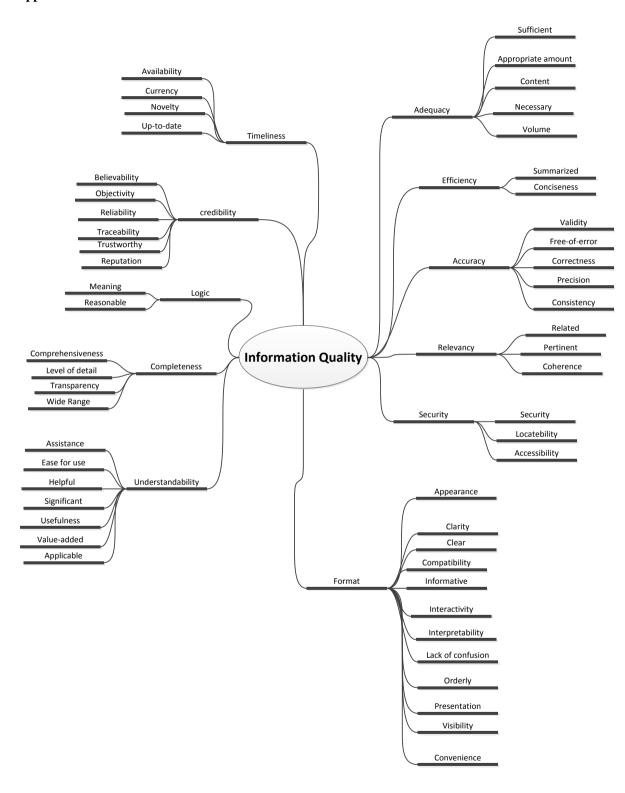**Appendix B – Categories of Information Quality Indicators**

Accessibility		Accuracy		Adequacy		Completeness	
Accessibility	**12**	**Accuracy**	**35**	**Adequacy**	**6**	**Completeness**	**23**
Locatebility	1	Consistency	11	Appropriate amount of data	4	Comprehensiveness	6
Security	7	Correctness	2	Content	3	Level of detail	1
		Free-of-error	2	Necessary	1	Transparency	1
		Precision	7	Sufficient	4	Wide Range	1
		Validity	3	Volume	1		

Conciseness		Credibility		Format		Logical	
Conciseness	6	Believability	6	Appearance	1	Logical	1
Summarized	1	**Credibility**	9	Clarity	1	Meaning	1
		Objectivity	4	Clear	4	Reasonable	1
		Reliability	8	Compatibility	2		
		Reputation	3	Convenience	2		
		Traceability	1	**Format**	7		
		Trustworthy	1	Informative	3		
				Interactivity	1		
				Interpretability	6		
				Lack of confusion	1		
				Orderly	1		
				Presentation	1		
				Visibility	1		

Relevancy		Timeliness		Understandability	
Coherence	1	Availability	2	Applicable	1
Pertinent	1	Currency	7	Assistance	1
Related	1	Novelty	1	Ease for use	4
Relevancy	20	**Timeliness**	30	Helpful	1
		Up-to-date	3	Significant	1
				Understandability	7
				Usefulness	4
				Value-added	3

Source: processed authors

Appendix C – Conclusion

Source: processed authors