

Data Quality Management Evaluation: A Case Study at the BPS-Statistics of Kaur Regency Bengkulu Province

Rela SABTIANA^{1*}, Indra BUDI², and Yova RULDEVIYANI³

¹*rela@bps.go.id, BPS-Statistics of Kaur Regency Bengkulu Province, Indonesia*

²*indra@cs.ui.ac.id, Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia*

³*yova@cs.ui.ac.id, Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia*

**Corresponding author: rela@bps.go.id*

ABSTRACT

The BPS-Statistics of Kaur Regency is a work unit under the BPS-Statistics of the Republic of Indonesia which is responsible for carrying out statistical activities in the regency area and contributes a large role in the effort of improving data quality of each survey or census before being published to the public. In the implementation of the National Socio-Economic Survey conducted by the organization in the first semester of 2019, it was found incompleteness, inconsistency, and inaccuracy during data entry in the application. Likewise, post entries are still found inconsistencies and inaccuracies. To overcome this problem, an evaluation of the maturity level of data quality management using Loshin's Data Quality Management was done. The results obtained indicate that the maturity level is in the range of 2 to 3. Four out of eight dimensions have not met the expected targets, namely expectations of data quality, data quality protocols, data standards, and technology. In addition, to supplement the result, measurement using European Statistical System framework indicates that the total score achieved is 5.7 of the expected target of 9.4. Further, from the results of this study, the recommendation for improving data quality were compiled.

Keywords: *data, data quality, Data Quality Management, maturity*

INTRODUCTION

The Central Statistics Agency (BPS-Statistics) is a Non-Ministry Government Institution that provides data needs for the government and the community. BPS-Statistics has a vision that is "Pioneer of Reliable Statistical Data for All" as stated in BPS-Statistics's Strategic Plan Year 2015-2019. As a data provider, BPS-Statistics is demanded to always provide quality data. Quality means the resulting statistical data meets the dimensions of data quality that are relevant, accurate, timely, coherent, accessible, and interpretable [1].

In the context of fulfilling the wishes of data users for the availability of quality data, BPS-Statistics seeks to make fundamental changes to statistical activities by reforming the bureaucracy. One of the goals of the BPS-Statistics bureaucratic reform is to build the profile and behavior of BPS-Statistics officials who are professional, have high integrity, and carry out the mandate of providing excellent service for quality statistical data and information [2]. This is in line with the Performance Agreement of BPS-Statistics Year 2017 which states that one of the goals of BPS-Statistics is to improve quality statistical data [3].

Increasing quality statistical data is the first objective for BPS-Statistics of the Republic of Indonesia with no exception for all subunits working under it. BPS-Statistics in a regency is the smallest work unit that contributes a big role in achieving BPS-Statistics of the Republic of Indonesia's objectives to improve data quality. This is due

to its role in collecting data directly to respondents, as a data processor and at the same time as a place for disseminating data [4].

The BPS-Statistics of Kaur Regency is a work unit under the BPS-Statistics of the Republic of Indonesia which is responsible for carrying out statistical activities in the regency level, particularly Kaur Regency, Bengkulu Province. The main activities carried out by BPS-Statistics of Kaur Regency include conducting various surveys and censuses. Further, those activities produced various data such as social, agricultural, and economic data. For this study, the data samples used are social data that was taken from the National Socio-Economic Survey (Susenas) of March 2019. Susenas is a regular survey that provides development data in the socio-economic field at the national, provincial, and regency/municipality level. Susenas has the main support for meeting the needs of the government in implementing national development in line with international development goals. Susenas was conducted to provide a portrait of development progress. The portrait must be accurate and able to be trusted by the public at large [5].

To ensure the quality of Susenas data, the BPS-Statistics of Kaur Regency did some efforts initiated with training, supervising until checking documents to validate data entry. But in reality, the data still do not free of errors. In the core module data entry application, it was found 8,344 error records and in the expenditure consumption module, it was found 12,535 error records. The detail of errors is shown in Table 1.

Table 1. Lists of Errors

Error Types	Number of Records
Core Module	
Incompleteness	2.534 (30,3%)
Inconsistency	5.710 (68,4%)
Inaccuracy	107 (1,3%)
Expenditure Consumption Module	
Incompleteness	1.242 (9,9%)
Inconsistency	6.116 (48,8%)
Inaccuracy	5.176 (41,3%)

Besides those errors, errors were found also in post-entry data. This shows that the BPS-Statistics of Kaur Regency still does not meet the expected data quality standards. The errors found will affect the output data generated which will later be presented to the public. All this time, the assessment of the output results presented to the public could be known from the consumer satisfaction index. In 2018, the value of the consumer satisfaction index was 77.08. It was lower than average, left behind other regencies/municipalities. It indicates that BPS-Statistics of Kaur Regency needs some improvements in data quality management.

Based on the identification of the problems mentioned above, the basis of this research is the need for evaluation of data quality management. Furthermore, the research question for this study is "How is data quality management in BPS-Statistics of Kaur Regency?" The purpose of this study is to compile recommendations based on the result obtained.

THEORY

Data

According to Oxford Dictionary, in the mid-17th century (as a term in philosophy) in Latin, data are plural of datum which are defined as facts and statistics collected together for reference or analysis [6]. Meanwhile, according to [7], data are a representation of facts as text, numbers, graphics, images, sounds or videos. The data which are given context will become information and then the information will contribute to knowledge. Data have an important role in an organization. Data are required to have high quality in order to make a decision in an organization. [8] propose an initial conceptual framework for data quality that includes the following aspects: (1) Data must be accessible to data consumers. For instance, consumers know how to retrieve data; (2) Consumers must be able to interpret data. For example, the data are not represented in a foreign language; (3) Data must be relevant to consumers. For instance,

relevant and timely data are used by data consumers in the decision-making process; and (4) Consumers must find accurate data. For instance, data are correct, objective and comes from trusted sources. Furthermore, the conceptual framework of data quality is divided into four, namely intrinsic, contextual, representational, and accessibility, each of which has a data quality dimension that forms it.

Data Quality Management (DQM)

Data quality management is defined as a business process that ensures the integrity of organizational data during collection, applications (including aggregation), storage, and analysis. The main outcome of DQM is knowledge about data quality and its suitability for applicable usage for all intended purposes. The DQM function involves continuous quality improvement for data quality throughout the company and includes data applications, collection, analysis, and storage [9]. DQM plays an important role as a supporter in the management of changes in an organization. DQM is also a process that continuously defines the acceptable levels of data quality parameters to meet business needs [7].

Frameworks

To find out how data quality management in an organization requires a framework for measurement. From [10], there are many frameworks that can be used to measure data quality management. Based on extant literature/related studies, this study is limited to discuss Data Management Book of Knowledge (DMBOK), DQM of Loshin, and European Statistical System (ESS) framework. In DMBOK, DQM is the tenth function of ten data management functions. DQM is defined as planning, implementing, and controlling activities that implement quality management techniques to measure, assess, improve, and ensure data compatibility for use. There are six DQM of DMBOK activities [10] as follows: (1) Defining High Data Quality, (2) Defining a Data Quality

Strategy, (3) Defining Scope of Initial Assessment, (4) Conducting Assessment of Preliminary Data Quality, (5) Identifying and Prioritizing Improvement, and (6) Develop and Deploy Data Quality Operations. Different from DMBOK, in Loshin's DQM, [12] identified eight areas of data quality management, namely expectations for data quality, data quality dimensions, policies, data quality protocols/procedures, data governance, data standards, technology and performance management. Each dimension is composed of a number of indicators. In addition,

Loshin's DQM framework can be used to measure the maturity level of data quality. Within this framework, there are five maturity levels, namely initial, repeatable, defined, managed and optimized. Last but not least, compared to DMBOK and Loshin's DQM, ESS consists of three main areas namely institutional environment, statistical processes and statistical output [13]. From all the frameworks above, each framework has strengths and weaknesses respectively. To facilitate understanding, a comparison of those frameworks is shown in Table 2.

Table 2. Comparison of DQM Framework

Frameworks	Strengths	Weaknesses
DMBOK	<ol style="list-style-type: none"> 1. It has six data quality management activities [11]. 2. There have been previous studies using DMBOK. 3. It is able to be used for a research result mapping of DQM. For example, it was studied by [15] 	There is no instrument for assessing/ measuring the maturity level of data quality management.
Loshin's DQM	<ol style="list-style-type: none"> 1. It consists of eight data quality management dimensions. 2. There is a maturity level assessment/measurement instrument. 3. There have been previous studies using Loshin's DQM. For example, it was studied by [14] and particularly in government institutions, for example, it was studied by [15]. 4. It is more focused on data processing. 	Previous researches have not been carried out in statistical institutions.
ESS	<ol style="list-style-type: none"> 1. It consists of three areas and several dimensions. 2. There have been previous studies using ESS on statistical institutions. For example is study by [12]. 3. It is more focused on output data (which is presented to the public). 	There is no instrument for assessing/measuring the maturity level of data quality management.

Loshin's DQM and ESS frameworks were chosen for this study. The reasons for choosing them were as follows. First, Loshin's DQM framework was used to measure data quality management from the aspect of the process of data. Second, ESS was chosen to supplement Loshin's DQM framework particularly in making a recommendation for improving data quality management focusing on output.

METHODS

This study is a quantitative research conducted using a case study strategy in the BPS-Statistics of Kaur Regency Bengkulu Province. The samples of this study were 5 people. All of them were the heads of sections in the organization, Head of the

IPDS Section, Head of the Social Statistics Section, Head of Production Statistics Section, Head of Distribution Statistics Section, Head of Regional Balance Sheet Section and Statistical Analysis.

In order to respond to the research question, data were obtained from the distribution of questionnaires. There were two types of questionnaires. The first questionnaire was to measure the maturity level of the data quality management using Loshin's DQM framework. The questionnaire consisted of eight parts as shown in Table 3.

Table 3. Questionnaire 1 (Adopted from [12])

No.	Parts	Number of questions
1	Data Quality Expectation	16
2	Data Quality Dimension	12
3	Information Policies	11
4	Data Quality Protocols	16
5	Data Governance	14
6	Data Standards	15
7	Technology	12
8	Performance Management	13

The scales of answers for this questionnaire was ‘1’ if it was implemented in the organization and ‘0’ if it was not implemented in the organization. The second questionnaire was to supplement the first questionnaire in order to measure the data quality management from another side

namely institutional environment, statistical process, and statistical output using the ESS framework. The scale of answers for this questionnaire is 1 to 10. For more details, see [13]. This questionnaire consists of 10 dimensions and a number of questions as shown in Table 4.

Table 4. Questionnaire 2 (Adopted from [13])

Areas	Dimensions		Number of questions
Institutional Environment	D1	Professional independence of statistical authorities	3
	D2		2
	D3	Adequacy of resources	3
Statistical Processes	D4	Impartiality and integrity	5
	D5	Sound methodology and procedures	3
Statistical Output	D6	Relevance and completeness	2
	D7	Accuracy, errors, and omissions	2
	D8	Timeliness and punctuality	3
	D9	Consistency, coherence, comparability	3
	D10	Level of detail	4
		Accessibility and clarity	

The method used to process the data was process assessment model. The tool used was Ms. Excel.

RESULTS

Result Based on Loshin’s DQM framework

The results of this study based on DQM’s Loshin framework explained as follows.

Data Quality Expectation (DQE)

DQE consists of 16 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 1, 4 out of 16 characteristics are needed to be improved. They are (1) DQE1, the impact of a new data error is shown and recognized long after the event; (2) DQE2, characterization of areas that have an impact on poor data quality; (3) DQE3, data profiling is used to identify data errors in the process; and (4) DQE4, a framework for analyzing impacts is available.

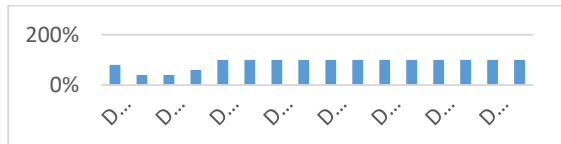


Figure 1. Data Quality Expectation Assessment

Data Dimension (DD)

DD consists of 12 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 2, 2 out of 12 characteristics are needed to be improved. They are (1) DD1, 1. There is no ability to measure data quality; and (2) DD2, data quality issues are not yet a concern.

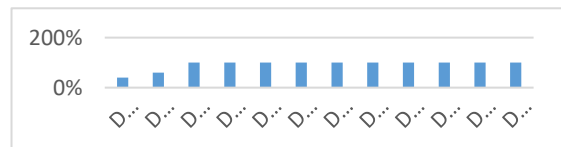


Figure 2. Data Dimension Expectation Assessment

Policy (P)

Policy consists of 16 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 3, 7 out of 16 characteristics are needed to be improved. They are (1) P1, policies are informal; (2) P2, policy not documented; (3) P3, corrective actions are taken by each staff without coordination; (4) P4, the organization tries to consolidate data in one source; (5) P5, a basic policy on the mechanism, if there are data problems have been established; (6) P9, data quality SLAs are used to see compliance with policies; and (7) P11, systems with self-management have been used.

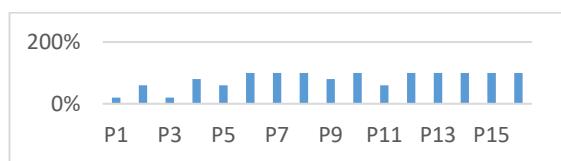


Figure 3. Policy Assessment

Data Quality Protocols (DQP)

DQP consists of 16 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 4, 12 out of 16 characteristics are needed to be improved. They are (1) DQP1, data errors are corrected without coordination with business processes; (2) DQP2, the root of the problem is not identified; (3) DQP3, the same mistakes are often repeated; (4) DQP4, the ability to trace errors due to incomplete data; (5) DQP5, the ability to trace errors due to data structure errors; (6) DQP6, analysis of the root of the problem is possible using simple data quality rules and validation; (7) DQP9, data validation is done automatically and only incorrect data is checked; (8) DQP11, control over data is done outside of business applications; (9) DQP12, data errors are identified as early as possible; (10) DQP13, data validation can be audited; (11) DQP15, measurement of data quality published by each participant; and (12) DQP16, data quality management is carried out transparently.

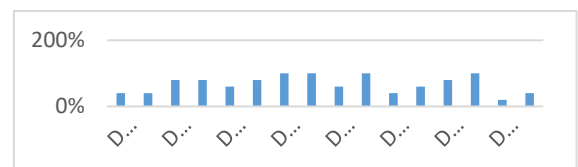


Figure 4. Data Quality Protocols Assessment

Data Governance (DG)

DG consists of 14 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 5, 3 out of 14 characteristics are needed to be improved. They are (1) DG1, communication-related to managing data quality is little or no; (2) DG2, all data problems are always regarded as IT problems; and (3) DG3, there is no data stewardship.

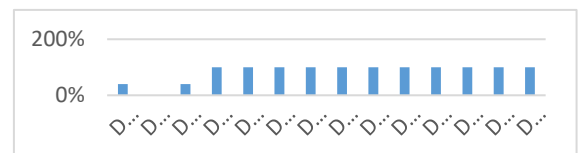


Figure 5. Data Governance Assessment

Data Standards (DS)

DS consists of 15 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 6, 10 out of 15 characteristics are needed to be improved. They are (1) DS1, there is no standardization of data; (2) DS2, similar data are displayed differently; (3) DS3, there is no data definition; (4) DS4, general data definition uses business terminology; (5) DS6, standard metadata is managed throughout the organization; (6) DS9, data exchange scheme has been established; (7) DS11, data exchange standards are managed through a standard data monitoring process; (8) DS12, already using certification of trusted data; (9) DS13, master data management has been truly implemented to manage master data; and (10) DS14, the data standardization process is done automatically through straight-through processing.

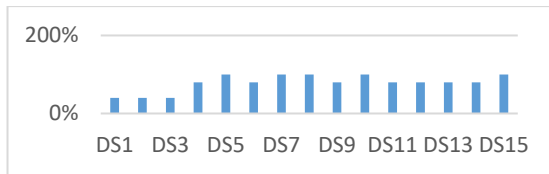


Figure 6. Data Standards Assessment

Technology (T)

Technology consists of 12 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 7, 4 out of 12 questions are needed to be improved. They are (1) T1, jobs ad-hoc jobs are routinely carried out; (2) T2, mentality avoids problems by saying the application was not developed there; and (3) T12, non-technical users can define and modify data quality rules and data dimensions dynamically.

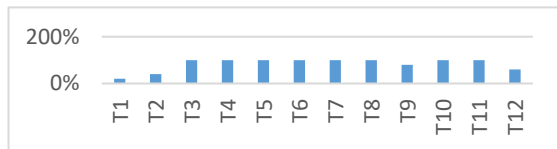


Figure 7. Technology Assessment

Performance Management (PM)

PM consists of 13 characteristics to measure the level of maturity from 1 to 5. As shown in Figure 8, 3 out of 13 characteristics are needed to be improved. They are (1) PM1, the impact of a new data error is shown and recognized long after the event; (2) PM2, characterization of areas that have an impact on poor data quality; and (3) PM13, overall organization performance can be improved through modification of data quality policies.

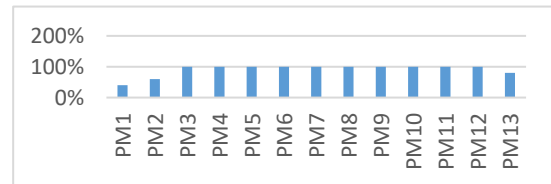


Figure 8. Performance Management Assessment

Data Quality Maturity Level Based on Loshin’s DQM Framework

In this study, the level of data quality maturity was measured using Loshin’s DQM framework. Within this framework, the results of maturity levels from eight dimensions is shown in Table 5.

Table 5. Maturity Levels

Dimensions	Current	Expected
Data Quality Expectation	2	3
Data Quality Dimension	3	3
Information Policies	3	3
Data Quality Protocols	2	3
Data Governance	3	3
Data Standards	2	3
Technology	2	3
Performance Management	3	3

The gap in the maturity level of the quality of data management in the BPS-Statistics of Kaur Regency is shown in Figure 9.

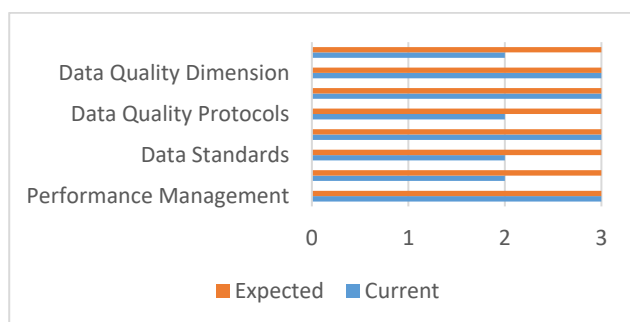


Figure 9. Maturity Levels Gap

Figure 9. informs that from the eight dimensions of data quality management, there are found maturity level gaps in four dimensions, namely data quality expectations, data quality protocols, data standards, and technology. The four dimensions reach maturity level 2 (repeatable). The other four dimensions have met the expected maturity level at level 3 (defined), namely data quality dimensions, information policy, governance, and performance management. To meet the expected maturity level targets, efforts need to be made to increase the quality of data on characteristics that are still not fulfilled.

Result Based on ESS Framework.

All current scores have not met the expected scores. The smallest score obtained is the adequacy of resources dimension and the biggest score obtained is impartiality and integrity dimension. The scores obtained for each dimension are shown in Figure 10.

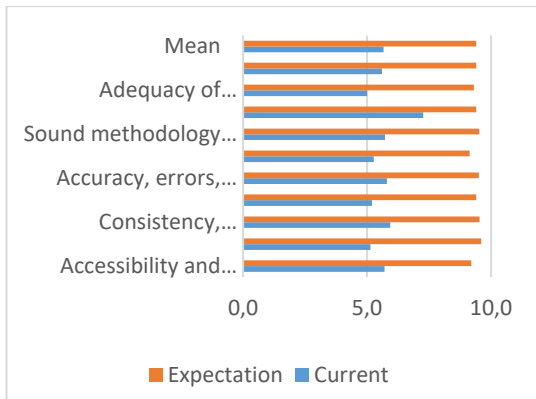


Figure 10. Current and Expected Scores

Recommendations for Improving Data Quality Based on Loshin’s DQM Framework.

The recommendations for improving the quality of data was based on the gap results of current and expected maturity levels. The details are shown in Table 6.

Table 6. Recommendations

Dimensions	Recommendations
DQE	<ul style="list-style-type: none"> • Dimensions of data quality have been partially identified in large-scale surveys such as Susenas but have not been documented. Therefore, the dimensions of the quality of survey data should be accommodated in all technical sections and provided a form for the required dimensions of data quality documentation. • Expectations regarding the dimensions of respondent data quality related to data values, formats and descriptions have been conveyed with data quality rules but are still limited. Therefore, it is best to hope that the data dimensions are conveyed according to the overall data quality rules in Susenas and other surveys. • The ability of data validation based on survey guidelines according to BPS-Statistics data quality rules already exists for Susenas but the validation rules in each semester often change due to changes in the questionnaire. In addition, data validation training is often not optimal. Therefore, the validation training should be optimal in accordance with established data quality rules, training in data validation ability should be increased.
DQP	<ul style="list-style-type: none"> • Automatic validation already exists with Susenas which is the responsibility of the Social Statistics Section but not yet in the Regional Balance Sheet and Statistical Analysis Section. In the Production Statistics Section, there is no automatic validation for routine surveys. Therefore, automatic validation should be available in all technical sections and includes all surveys. Data validation also checks thoroughly, not only the wrong data.
DS	<ul style="list-style-type: none"> • Data standards and metadata management do not yet exist. Therefore, data standards and metadata management should be accommodated in the IPDS Section. • Standard data structures and formats have not been assigned to all data, only part of it. Therefore, data structure and format standards should be set for all survey data managed in the organization. • Data exchange between the IPDS Section and other technical sections already exists. The current condition is that the data exchange scheme does not yet exist so that the data exchange is done informally between sections that need data from one to another. Therefore, it is better to formulate a data exchange scheme between the IPDS Section and other technical sections that are formal and binding.
T	<ul style="list-style-type: none"> • Specific applications for checking and improving data quality are not yet available except data entry applications. The standard procedure for using the application is already in the data processing manual. But for some web-based applications, there is no written standard procedure. Therefore, there should be a written standard procedure for using data entry applications both in the IPDS Section and other sections for improving data quality. • In the implementation of validation, there are still some rules that are not appropriate and need to be updated in the application. Thus, validation should be made based on the rules of the technical section which conducting the survey and reporting it to the BPS-Statistics for updates. • The technology component for data validation is already available in the form of a data entry application but data quality checking and reporting are not yet available. Thus, the data entry application should accommodate not only the validation results that can be reported but also the quality of the data.

Recommendations for Improving Data Quality Based on ESS framework

To complement the recommendations given based on Loshin's DQM framework, recommendations for improving the quality of Susenas data from the ESS framework are shown in Table 7. The recommendations

comprise institutional environment, statistical processes, and statistical output areas. The recommendations were based on the result score obtained and observation in the organization.

Table 7. Recommendations

Area	Recommendations
Institutional Environment	<ul style="list-style-type: none"> The current number of organic staff at the BPS-Statistics in Kaur Regency is still limited particularly in IPDS and Social Statistics Section. Based on the conditions, the addition of employees should be held in a balanced and ideal manner according to the mapping of employees who are supposed to achieve organizational goals.
Statistical Processes	<ul style="list-style-type: none"> Training for employees has so far focused on technical implementation in the field and data entry. Susenas data analytical skills training has not been given full attention to the regency level. Thus, skills training should be carried out up to the regency level continuously given because there are always changes in concepts and definitions in each semester, uncertain employee mutations and employee mapping that does not match employee's competency.
Statistical Output	<ul style="list-style-type: none"> During this time, a survey of user satisfaction data has been carried out on the overall data in general, not specifically for Susenas. Therefore, it is better to conduct a user satisfaction survey specifically for Susenas to find out the level of data user satisfaction with Susenas and future improvements. Susenas data dissemination is still conventional, especially microdata or data customization needed by users. If there are data users who need Susenas data, they can visit the library for data dissemination services. For ease of access, Susenas data should be displayed through modern communication technologies such as on the website or in the official mobile application of the organization if possible/available. Susenas data is not yet available dynamically on the organization's website. Therefore, the dynamic table should be presented in stages. And data should also be available on a complete office website from year to year making it easier for data users to access data. Some strategic indicators produced from Susenas have been displayed on the organization's website but are still limited. Considering this, it is better to add the data not only to upload organizational data but also to other regency/municipality data in Bengkulu Province so that data users can compare with other regencies/municipalities easily. Also, it is better for the data displayed on the website to be presented in the English version so that it can reach wider data users to foreign countries. Publication of Susenas in the form of published books is still limited and has not been done continuously from year to year for example consumption and expenditure publications. Therefore, it is better to do a continuous publication and the time lag between the reference date and the publication date is not too far away to keep the data up to date.

CONCLUSION

The results showed that the maturity level of the BPS-Statistics of Kaur Regency reached level 2 to 3 in each dimension of data quality management. Four dimensions obtained meet the expected level of data quality maturity at level 3, namely the dimensions of data quality, information policy, data governance, and performance management. The other four dimensions do not meet the expected level of maturity of data quality, namely data quality expectations, data quality protocols, data standards, and technology. While the total average current data quality score based on the ESS framework achieved by the BPS-Statistics of Kaur Regency is 5.7 out of the total expected average score of 9.4. To meet the expected data quality

targets, the BPS-Statistics of Kaur Regency needs to make efforts to improve data quality by implementing the recommendations given from the results of this study in the future. Next, for future research, there are three suggestions. First, data that were used as a sample in this study were only from one survey that was currently running. It would be better for further research can enter more survey data or census. Second, respondents in this study consisted of five section heads, further research could include all organic staffs in the organization. Third, this study is not only eligible for a statistical agency but also can be implemented in other public sectors/organizations.

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