Journal of Sustainable Technology and Applied Science (JSTAS)
Vol.5 No. 1, May 2024, pp. 24-31
ISSN: 2722-2403 (online)

DESIGN FOR SIX SIGMA METHOD APPLICATION FOR CONCEPTUAL DESIGN OF MINING INFORMATION SYSTEM PT. KIDECO JAYA AGUNG

Boy Parulian[1*], R.V Hari Ginardi[2], Maranatha Wijayaningtyas[3]
[1,2,3]Project Management, Magister Management Technology, Sepuluh November Institute of Technology
[1*]PT. Kideco Jaya Agung, Indonesia

E-mail: [1]boyparulianhutapea@gmail.com,

ABSTRACT: Although coal mining business provide a large economic contribution, coal mining operational can have negative impacts if that business don't implement good mining practice. Therefore, companies need to optimize technology to minimize negative impacts and increase productivity. The problems that have occurred at PT. Kideco Jaya Agung is an information system that is currently implemented is not yet relevant according to the stakeholders expectation. Data error, bugs, and mistake found, so there will be potential for dualism point of view which can impact to fault in decision making. So strategic planning in information system is needed with the aim that the company designs a concept which is effective and has the best quality in accordance with stakeholder needs to support the company's business. The application of Design For Six Sigma (DFSS) is to analyze planning based on stakeholder needs, then the used tools is Software Quality Function Development (SQFD). SQFD tool quantifies user needs and then prioritizes the digitalization project portfolio by mapping all user needs involved in the business process. Design For Six Sigma analysis produces output analysis of stakeholder needs. Based on stakeholder needs, the business processes required to be digitized include Coordination Meetings, Data Analysis, Daily/Weekly/Monthly Reports, Contractor/Subcont Management, and Decision Making which then become a reference in designing data flow diagrams as conceptual design.

Keywords: technology, information system, stakeholder, design for six sigma, conceptual design

1. Introduction

PT. Kideco Jaya Agung main business is in coal mining sector. This company has business partnerships in Indonesia, and export to Asia and Europe. In operate this business, there are still business processes that are still manual and not yet integrated, thus affecting the length of the information management process which has implications for late decision making. Along with the industrial transformation towards Industry 4.0, validity and processing time have become new challenge for company. In this case, the information system digitization project is very significant. Company hoped that information system digitalization plan can help the company's business processes. By using IT, business performance can be improved by providing accurate information, especially in increasing the effectiveness of computerized processes in operational activities [1]

In Kepmen ESDM No. 1827 K/30/MEM/2018, state that one of the responsibilities of the Coal Mining Owner is to monitor and optimize resources in the entire series of mining activities. In accordance with UU No. 3 year 2020, concerning Mineral and Coal mining has mandated Mining Owner with IUJP (Izin Usaha Jasa Pertambangan) holders to implement GMP (Good Mining Practice), one of which is implementing mineral and coal conservation. Mineral and Coal Conservation is the one of optimization and efficiency processes for the management and utilization of coal mineral resources in a measurable, efficient, responsible and sustainable manner. To supporting this program, company are required to develop digital transformation so that all processes can be carried out quickly, concisely, effectively, synchronized in a database, so that they are valid and fast, especially in terms of reporting.

As reference journal, previous research has been published regarding Design For Six Sigma on the conceptual development of an integrated information system for case studies at the Wholesale X and Retail store in Cianjur [2]. The

rapid development of information–communication technologies and the rapid distribution of information, the application of information systems is developing a key role when it comes to conducting business [3]. The objective of this research include:

1. Make a Design For Six Sigma analysis on information system planning.
2. Design a DFD (Data Flow Diagram) for each business process in the mining report.

2. Methodology

2.1 Design For Six Sigma

The development of the digitalization in mining industry from year to year is increasingly rapid, in line with advances in supporting technology industry 4.0. Nowadays the progress and development of the times is able to change the way consumers look at choosing a desired product [4]. Design For Six Sigma (DFSS) is a methodology used to develop products or processes quickly, effectively, at low cost. Design For Six Sigma outcome is to design products, services and process from the development stages to avoid failure risk at operational stage. The fundamental difference between Classic Six Sigma and Design For Six Sigma is the implementation phase, where "classic" Six Sigma is perform in the production or implementation stage, while Design For Six Sigma is perform in the research, design, and product development stage. This research is a type of quantitative and observational research. Sampling using random techniques. The types of data used in this study are quantitative data, polymer data and secondary data. while for data collection techniques by means of interviews and observations [5].

Design For Six Sigma method is completely different from the Classic Six Sigma. Classic Six Sigma uses DMAIC (define, measure, analyze, improve, control) stages. Meanwhile Design For Six Sigma uses a different method, contains of DMADV (define, measure, analyze, design, verify). Define is the stage of defining the project to be develop. Measure is determining customer needs or expectations. Analyze is the stage of identifying functions and elaborating thinking concepts. Design is the stage of developing procedure and checking the overall design concept. Verify is the stage of verifying the design results.

DFSS in software development is a tools for integrating Software Engineering with Six Sigma such as object-oriented design, predictive models, and simulation techniques. This methodology can be used as a measuring tool in analyzing the quality attributes of software products so that these products must have quality standards in accordance with consumer desires **[6]**.

2.2 Software Quality Function Deployment

In information systems, Software Quality Function Deployment (SQFD) is a requirements mapping technique or technical method required by software development. Software Quality Function Deployment is a development of Quality Function Deployment which is specifically for software development. With Software Quality Function Deployment, software development can be measured quantitatively and can determine priority user needs **[7]**. Software Quality Function Deployment is an adaptation of the matrix in House Of Quality (HOQ) which is commonly used in the "classic" Quality Function Deployment method. Barnett and Raja created the Software Quality Function Deployment model which can be used in software development to support operational performance that occurs as part of organizational processes [8]. With using Software Quality Function Deployment, the software must provide process support for stakeholders to add value to organizational processes. Software Quality Function Deployment can facilitate business process needs and information technology development projects.

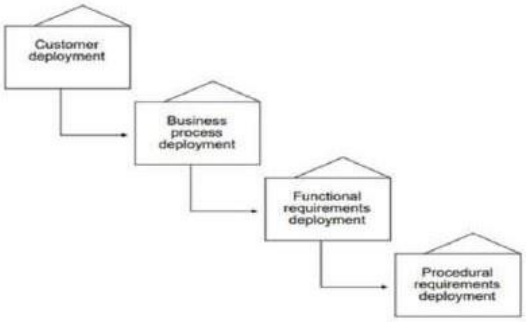


Figure 1 SQFD Concept adapt from Barnett [8]

Each stage of Software Quality Function Deployment use House Of Quality as a tool. House Of Quality is divided into 6 parts [9] such as; customer requirement, technical measurement, planning matrix, correlation matrix, relationship matrix, and weighted target/benchmark. Based on the House Of Quality structure adapted from A

Conceptual Quality Function Deployment Planning Model [10] the stages in creating House Of Quality include:

1. Identify the Voice of Customer which will then become the "what" or vertical part of the House Of Quality. This can be done with focus group discussion or brainstorming with customers or stakeholders.
2. Develop Design Requirements & Technical Response which will then become the "how" or horizontal part of the House Of Quality. This can be done with focus group discussion or brainstorming with customers or stakeholders.
3. Determine the Correlation Matrix or the relationship between variables that are part of the horizontal House Of Quality. This is done by using the symbol (+) if there is a positive relationship between the variables. This can be done with focus group discussion or brainstorming with customers or stakeholders.
4. Determining the Relationship Matrix is to identify the level of customer interest in existing products or services. At this stage, scoring is carried out using a questionnaire with the following scoring categories:

   ● = Indicates a strong relationship and occurs when the response is very close and meets the customer's needs. In weight calculations, if there is a relationship it will be given a value of 9

   ○ = Indicates a moderate relationship and occurs when the response meets customer needs. In weight calculations, if there is a relationship it will be given a value of 3

   Δ = Indicates a weak relationship and occurs when the response does not really affect the customer's needs. In weight calculations, if there is a relationship it will be given a value of 1

5. Evaluate Competitive Analysis, namely carrying out comparisons if there are other products, so you can find out the product's advantages or disadvantages compared to competitors' products in order to be able to compete. This can be done using a questionnaire or brainstorming method with customers or stakeholders.
6. Evaluate Design Targets and select technical response priorities. The aim is to evaluate technical responses which are priorities based on customer needs.

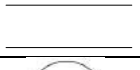
2.3 Data Flow Diagram

Data Flow Diagram (DFD) is a chart that depicts the flow of data in a company, which is described with a certain number of symbols for shows the data transfer that occurred in the processes of a business system [11]. Data Flow Diagram can describe input, processing and output flow of a system. This diagram describe relationship input/output between the system and the world outside [12]. Data Flow Diagram can help user for understand business process logic, structured, and systematic [13]. This research carried out basic design related to the database, in the form of modelling that is easy to understand by developer and users [14]. The stages in drawing a Data Flow Diagram start from the Context Diagram, Level 0 Diagram, and Level 1 Diagram. Stages in designing a Data Flow Diagram contains of :

1. Identification of external entity.
2. Identify the original input and output involved in the unity.
3. Draw a complete context diagram first. The top level of the context diagram always includes one process and only one process.
4. Draw a hierarchical chart for prepares a lower level Data Flow.
5. Draw a Data Flow Diagram level 0.
6. Draw a Data Flow Diagram for the ultimate levels (1,2, etc.).
7. Draw a combined Data Flow Diagram at all levels.

Data Flow Diagram uses standard symbols which are used as references in the process of designing data flows. The table below represents the symbols used in Data Flow Diagram versions adapt from Bagir [15].

Table 1 Data Flow Diagram Code

Code	Remarks
	External entity, boundary
	Data Storage
	Process
	System Boundary
	Data Flow

3. Result and Discussion

3.1. Data Collection

The research was conducted in-house at PT Kideco Jaya Agung mine site, with considering that Information Systems and Information Technology strategies can be quickly applied and provide optimal benefits. This research was start from January 2023 until February 2024 with consideration of the need for thorough preparation in designing strategic planning for digitalization projects. Author observe on each business process with 40 respondents at 13 Departments In Charge using questionnaires, observation and focus group discussion methods.

Table 2 Respondent List

No	Department	Management in Charge	Person In Charge
1	Production	TM Production	1x production ss manager 1x production analyst
2	Coal Hauling	TM Coal hauling	1x coal hauling ass manager 1x coal hauling supervisonr
3	Planning	TM Planning	1x Planning ass manager
4	Development	TM Development	1x blasting ass manager 1x Development ass
5	Geotech	TM Geotech	1x geotech manager 1x geotech engineer
6	Geosurvey	TM Geosurvey	1x geology ass manager 1x survey ass manager
7	Marketing	TM Marketing	1x manager marketing manager 1x marketing analyst
8	Quality Control	TM Quality Control	1x QC ass manager 1x QC supervisor
9	FPM	TM FPM	1X FPM ass manager 1x FPM supervisor
10	Mine Facility	TM Mine Facility	1 x mine Facility ass manager 1x mine facility supervisor
11	MID	TM MID	1x MID Supervisor 1x data scientist 1x MID staff 1x Contractor Management 1x data scientist
12	ESG	TM ESG	1X corporate strategic manager 1x ESG Supervisor
13	BPIT	TM BPIT	1X IT Manager 1x IT Supervisor

Table 3 Data Collection

No	Instrument	Data Collection
1	1Observation/FGD	Company Business Process, Correlation Matrix
2	Questionnaires	Scoring Relationship matrix

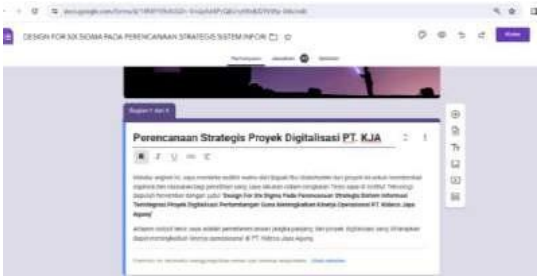


Figure 2 Questionnaires using google form

3.1 Validity & Reliability Data Test

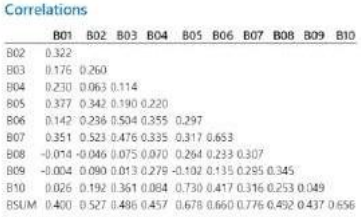
Before analysis Design For Six Sigma, validity test is needed to determine the results, suitability and validity of the questionnaire results for the theory used and a reliability test for the consistency of the questionnaire results at the time, place, and researcher in the various tests themselves. This test was carried out on 40 respondents with 29 questionnaire data which had been distributed using the Minitab tool.

Validity test uses the Pearson Correlation approach with a significance level of 0.05. The R table for $\alpha = 0.05$ and $N = 40$ is 0.312. The Reliability Test uses the Cronbach's Alpha approach with an α value > 0.7.


Correlations

	A01	A02	A03	A04	A05	A06	A07
A02	0.331						
A03	0.382	0.230					
A04	0.621	0.328	0.800				
A05	0.289	0.268	0.666	0.670			
A06	0.284	0.361	0.301	0.378	0.451		
A07	0.521	0.172	0.379	0.426	0.377	0.486	
SUM	0.704	0.529	0.759	0.858	0.757	0.647	0.688

Figure 3 Business Process Data Validity Test


Correlations

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10
B02	0.322									
B03	0.176	0.260								
B04	0.230	0.063	0.114							
B05	0.377	0.342	0.190	0.220						
B06	0.142	0.236	0.504	0.355	0.297					
B07	0.351	0.523	0.476	0.335	0.317	0.653				
B08	-0.014	-0.046	0.075	0.070	0.264	0.233	0.307			
B09	-0.004	0.090	0.013	0.279	-0.102	0.135	0.295	0.345		
B10	0.026	0.192	0.361	0.084	0.730	0.417	0.316	0.253	0.049	
BSUM	0.400	0.527	0.486	0.457	0.678	0.660	0.776	0.492	0.437	0.656

Figure 4 Functional Requirement Data Validity Test

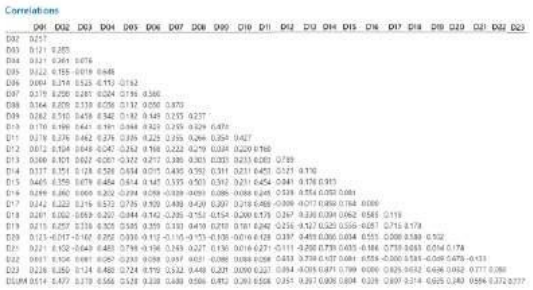


Figure 5 Procedural Requirement Data Validity Test

Based on the results of the analysis using Minitab tool, Business Process Data, Functional Requirement Data, and Procedural Requirements Data Validity Test analysis in the image above, it is known that all R values for each factor are greater than 0.312. Then all data is valid.

Figure 6 Business Process Data Reliability Test

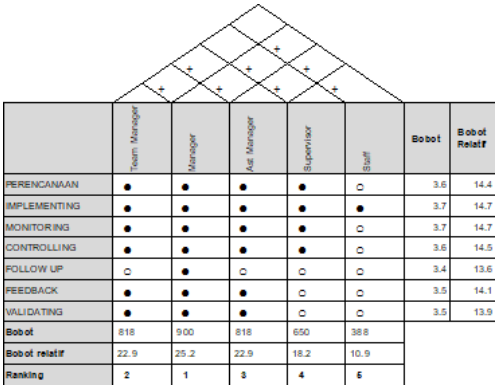
Figure 7 Functional Requirement Data Reliability Test

Figure 8 Procedural Requirement Data Reliability Test

Based on the results of the analysis using the Minitab tool, Business Process Data, Functional Requirement Data, and Procedural Requirements Data Reliability Test analysis in the picture above, it is known that Cronbach's Alpha is 0.8789 or greater than 0.7, so all data is reliable.

3.2 Define Stage

At define stage, author identifies customer deployment in each department stakeholder as CTQ (Critical to Quality) by conducting interviews with Management In Charge in 13 departments who focus on stakeholder relationships with business processes to determine the needs that must be met to provide the best support to improve the company's operational performance and then continue analyze business process using HOQ Customer Deployment.



	Team Manager	Manager	Ast. Manager	Supervisor	Staff	Bobot	Bobot Relatif
PERENCANAAN	●	●	●	●	○	3.6	14.4
IMPLEMENTING	●	●	●	●	●	3.7	14.7
MONITORING	●	●	●	●	○	3.7	14.7
CONTROLLING	●	●	●	●	○	3.6	14.5
FOLLOW UP	○	●	○	○	○	3.4	13.6
FEEDBACK	●	●	●	○	○	3.5	14.1
VALIDATING	●	●	●	○	○	3.5	13.9
Bobot	818	900	818	650	388		
Bobot relatif	22.9	25.2	22.9	18.2	10.9		
Ranking	2	1	3	4	5		

Figure 9 HOQ Customer Deployment From

the HOQ Customer Deployment above, it can be concluded that the stakeholders who contribute the most to the implementation of mining digitalization projects include Managers and Team Managers, followed by Assistant Managers, Supervisors and Staff.

3.3 Measure Stage

At measure stage, author identifies business process priorities using HOQ Business Process Deployment in the Software Quality Function Ddeployment model. Based on the results in the House Of Quality at define stage, stakeholders will be divided into 2 segments, namely Manager Up and Non Manager. The results can focus on stakeholder segments that make a high contribution to the digitalization project. The weighted value from House Of Quality become a reference in determining business process priorities that will improve the company's operational performance.

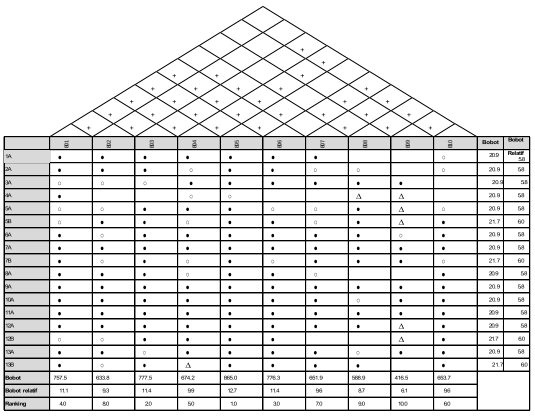


Figure 10 HOQ Business Process Deployment

From the HOQ Business Process Deployment above, Business Process which is a critical area in implementing mining digitalization projects includes Decision Making, Coordination Meetings, Daily/Weekly/Monthly Reports, Partner and Subcont Management, and Data Analysis.

3.4 Analyze Stage

At analyze stage, the author identifies priority functional requirements using HOQ: Functional Requirements Deployment in the Software Quality Function Deployment model. Business processes in the digitalization plan are linked to the functional requirements of the system being designed. The weighted value from House Of Quality become a reference of functional requirements that can improve the company's operational performance.

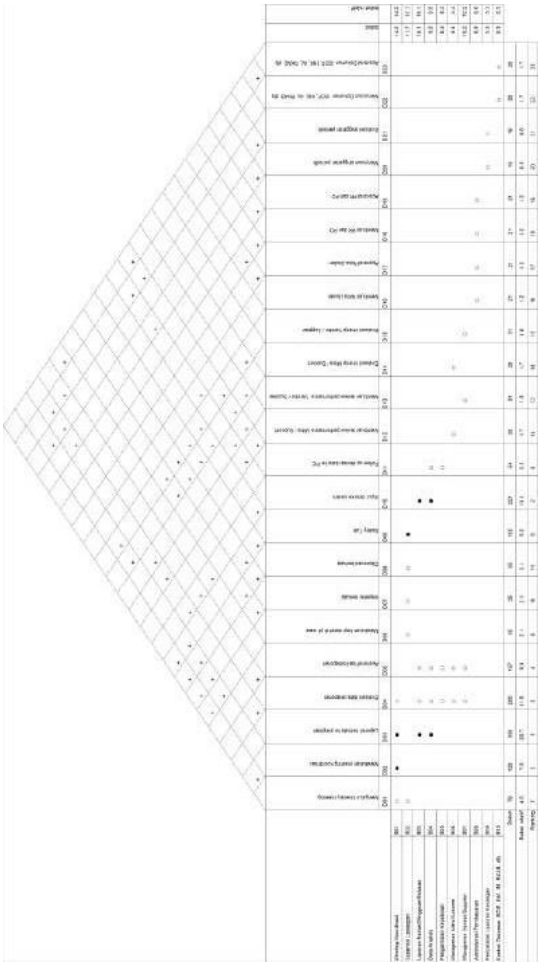
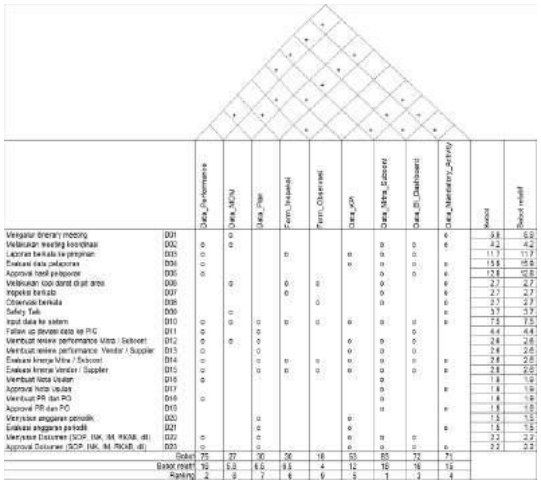


Figure 11 HOQ Functional Requirement Deployment

From the HOQ Functional Requirement Deployment analysis above, Functional requirements that are priorities in implementing mining digitalization projects are periodic reports to superior, input data into system, data evaluation, approval superior, and coordination meetings.

3.5 Design Stage

At design stage, the author identifies priority procedural requirements using HOQ: Procedural Requirements Deployment in the Software Quality Function Deployment model. Functional requirements are detailed into procedural requirements. Technical data needed to fulfill stakeholder procedural functions. This stage provides a more detailed concept design regarding technical procedures that are priorities in supporting business processes that will improve the company's operational performance.



		Data_Performance	Data_MOM	Data_Plan	Form_Inspeksi	Form_Observasi	Data_KPI	Data_Mitra_Subcont	Data_BI_Dashboard	Data_Maintenance_Activity	Bobot	Bobot relatif
Mengelar breifing meeting	D01		○	○						○	9.8	9.8
Melakukan meeting koordinasi	D02	○	○					○	○	○	4.2	4.2
Laporan berkala ke pimpinan	D03	○		○			○	○	○		11.7	11.7
Evaluasi data pelaporan	D04	○	○				○	○		○	15.8	15.8
Approval hasil pelaporan	D05	○						○	○	○	12.8	12.8
Melakukan loop darat di pit area	D06		○		○	○		○		○	2.7	2.7
Inspeksi berkala	D07				○			○		○	2.7	2.7
Observasi berkala	D08					○		○		○	2.7	2.7
Safety Talk	D09									○	3.7	3.7
Input data ke sistem	D10	○	○	○	○	○	○	○	○	○	7.5	7.5
Follow up temuan data ke PIC	D11	○	○	○	○			○	○		4.4	4.4
Membuat review performance Mitra / Subcont	D12	○	○	○	○		○	○	○		2.8	2.8
Membuat review performance Vendor / Supplier	D13	○		○	○		○	○	○		2.8	2.8
Evaluasi kinerja Mitra / Subcont	D14	○		○	○	○	○	○	○	○	2.8	2.8
Evaluasi kinerja Vendor / Supplier	D15	○		○	○	○	○	○	○	○	2.8	2.8
Membuat Nota Usulan	D16	○					○				1.9	1.9
Approval Nota Usulan	D17						○			○	1.9	1.9
Membuat PR dan PO	D18	○					○				1.9	1.9
Approval PR dan PO	D19						○			○	1.9	1.9
Menyusun anggaran periodik	D20			○			○				1.5	1.5
Evaluasi anggaran periodik	D21			○			○			○	1.5	1.5
Membuat Dokumen (SOP, IMK, IM, RKAB, dll)	D22	○		○			○	○	○		2.2	2.2
Approval Dokumen (SOP, IMK, IM, RKAB, dll)	D23	○		○			○	○	○	○	2.2	2.2
	Bobot	75	37	30	24	18	93	85	72	71		
	Bobot relatif	10	5.0	4.0	3.3	2	12	10	10	10		
	Ranking	2	6	7	8	9	1	3	4	5		

Figure 12 HOQ Procedural Requirement Deployment

3.6 Verify Stage

At verify stage, The author made conceptual design obtained from the results of the House Of Quality which has been analyzed in the previous 4 stages. The previous 4 stages provide input and output for the conceptual design. The conceptual design uses a Data Flow Diagram (DFD) to determine the data process flow in the planned information system. Data Flow Diagram consist of Context Diagram, Level 0 Diagram, and Level 1 Diagram.

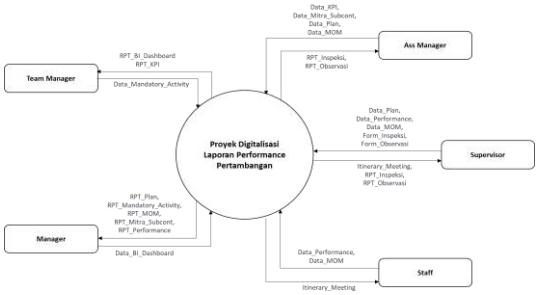


Figure 13 Context Diagram

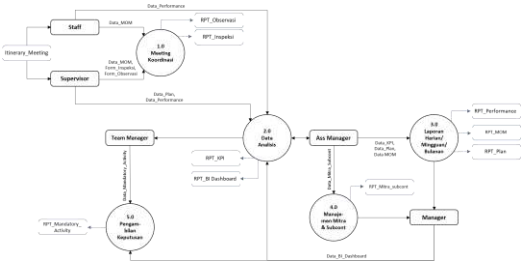


Figure 14 Lvl 0 Diagram

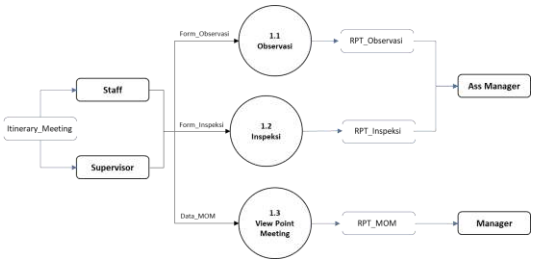


Figure 15 Lvl 1 Diagram Business Process 1.0

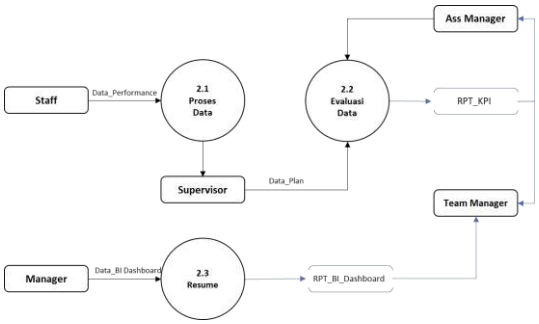


Figure 16 Lvl 1 Diagram Business Process 2.0

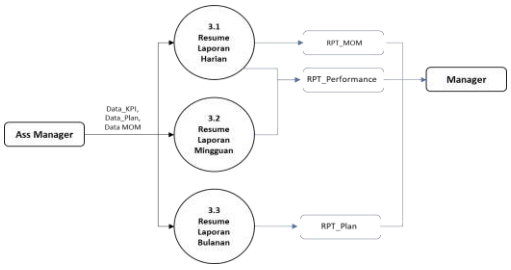


Figure 17 Lvl 1 Diagram Business Process 3.0

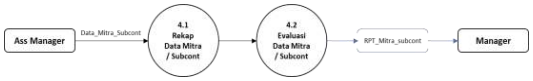


Figure 18 Lvl 1 Diagram Business Process 4.0

Figure 19 Lvl 1 Diagram Business Process 5.0

4. Conclusions

1. Design For Six Sigma output is an analysis of stakeholder requirement which then becomes a reference in designing data flow diagrams.

   a. Based on House Of Quality Customer Deployment, stakeholders who contribute the most to the implementation of mining digitalization projects include: Managers and Team Managers, followed by Assistant Managers, Supervisors and Staff.
   b. Based on House Of Quality Business Process Deployment, Business processes required to be digitized include; Coordination Meetings, Data Analysis, Daily/ Weekly/ Monthly Reports, Contractor/ Subcont Management, and Decision Making.
   c. Based on House Of Quality Functional Requirement Deployment, Functional requirements that are priorities in implementing mining digitalization projects are periodic reports to superior, input data into system, data evaluation, approval superior, and coordination meetings.
   d. Based on House Of Quality Procedural Requirement Deployment, All procedural data is needed to make Data Flow Diagram

2. Conceptual design obtained from the results of the House Of Quality which has been analyzed in the previous 4 stages. The previous 4 stages provide input and output for the conceptual design. The conceptual design uses a Data Flow Diagram (DFD) to determine the data process flow in the planned information system. Data Flow Diagram consist of Context Diagram, Level 0 Diagram, and Level 1 Diagram. Companies can use the results of this research as reference for analyzing stakeholder needs of digitalization in mining operational data reports.

Acknowledgement

Special thanks to management PT. Kideco Jaya Agung for facilitating this research.

References

[1] H.-T. S. &. H.-P. Fu, "Information Technology Adoption Models in Retailing Industry.," *International Journal of Management, Economics and Social Sciences,* pp. Vol. 4(1), ISSN 2304 – 1366, 2015.

[2] T. A. Triadi, "Design For Six Sigma Pada Pengembangan Konseptual Sistem Informasi Terintegrasi Studi Kasus Pada Toko X Grosir dan Eceran Cianjur," *Prosiding SENIATI,* pp. 4(1), 140-152, 2018.

[3] N. M. B. M. E. Z. Djalic N, "Modeling the Influence of Information Systems on Sustainable Business Performance and Competitiveness.," *Sustainability,* vol. 13(17):9619, p. 2, 2021.

[4] H. W. H. Ghani IA, "Analisis Metode Six Sigma dalam Pengendalian Kualitas Produk Rokok SKM PR," Gagak Hitam, Bondowoso, 2016.

[5] D. G. D. I. L. Muhammad Husen, "Product Quality Control Using Six Sigma (DMAIC) Method to Minimize Wast In Bima Mandiri Cigarette Company Rembang, Pasuruan Regency," *Journal of Sustainable Technology and Applied Science (JSTAS),* Vols. Vol. 2, No. 2, p. 2, 2021.

[6] d. N. D. L. A. K. K. Laricha Salomon L, "Strategi Peningkatan Mutu Part Bening Menggunakan Pendekatan Metode Six Sigma (Studi Kasus: Department Injection Di Pt. Kg)," J Ilm Tek Ind 3, 2015.

[7] S. R. M. &. S. L. L. Haag, "Quality function deployment usage in software development.," in *Quality function deployment usage in software development.*, Communications of the ACM, 1996, pp. 39(1), 41-49.

[8] W. D. &. R. M. Barnett, "Application of QFD to The Software Development Process.," *International Journal of Quality & Reliability Managament, Vol. 12,* 1995.

[9] R. R. d. S. A. Singh, "A Literature Review on Quality Function Deployment (QFD)," *IAETSD JOURNAL FOR ADVANCED RESEARCH IN APPLIED SCIENCES,* vol. 2018, pp. 245-250, 2018.

[10] S. B. C. S. K. E. M. &. S. M. S. Han, "A conceptual QFD planning model.," *International Journal of Quality & Reliability Management,* pp. 18(8), 796-812., 2001.

[11] Surono, "Data Flow Diagram (DFD) Pada Apotek Candra Kota Jambi," *Jurnal Ilmiah Universitas Batanghari Jambi ,* vol. Vol. 14 No. 4, 2014.

[12] W. Kusumawardani, "Analisis dan Perancangan Sistem Informasi Hotel Graha Prima Pacitan," *Journal Speed Sentra Penelitian dan Edukasi,* vol. Vol 6 No 3, 2014.

[13] F. Soufitri, "Perancangan Data Flow Diagram untuk Sistem Informasi Sekolah (Studi Kasus pada SMP Plus Terpadu)," *Regional Development Industry & Healthy Science, Technology and Art of Life,* vol. Vol 2 No 1, pp. pp. 240-246, 2019.

[14] L. M. W. H. P. D. N. &. R. K. Satyaninggrat, "Analisis Pemodelan Data Flow Diagram pada Sistem Basis Data Wisata Kuliner di Kota Balikpapan: Analysis of Data Flow Diagram on Culinary Tourism Database System in Balikpapan City," *MALCOM: Indonesian Journal of Machine Learning and Computer Science,* vol. 3(2), pp. 236-246, 2023.

[15] H. &. P. B. E. Bagir, "Analisis Perancangan Sistem Informasi Pergudangan di CV. Karya Nugraha.," *Jurnal Media Teknik Dan Sistem Industri,* vol. 2(1), pp. 30-38, 2018.