Workload Assessment with NASA-TLX and Work Satisfaction as the Basis of Improvement of Work Systems

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Abstract

Employee's workload of PT XYZ is predefined as relatively high if it takes into consideration manpower and the task amount. The exceeded workload can affect the job satisfaction of the employee. Hence, it is needed to do an assessment to measure the workload and its effect on job satisfaction. The workload was measured by NASA-TLX, which consists of mental demand, physical demand, temporal demand, performance, effort, and frustration. At the same time, job satisfaction is measured by a questionnaire that consists of remuneration, promotion, superior's assistance, and colleagues' assistance. The objects of this study are an employee of the Sustainability and Operation Department. The research result in workload is definitely high. Besides that, there is a correlation between workload and job satisfaction. There are two correlation models, positive and negative. A high workload can improve job satisfaction, but otherwise, it can decrease job satisfaction.

Keywords
Workload, Job Satisfaction, NASA-TLX, Correlation, Work Systems.

1. Introduction
Each department has its own responsibilities and job descriptions that may be related to other departments. The work in each department certainly has a different work weight. In theory, workloads must be able to be completed by employees. Workloads that are too heavy or light will result in an in-work efficiency. A workload that is too light means there is excess labour. This excess causes companies to have to pay employees more than expected productivity. Conversely, if there is a labour shortage or a lot of work with a small number of employees employed, it can cause physical and psychological fatigue for employees. Eventually, the employees became unproductive because they were too tired.

Based on observations, the current workload is felt to be out of balance with the number of human resources it has. For example, in the company's efforts to conduct early detection and prevention of land fires, the Sustainability Department was asked to identify PPE owned by the company and monitor hotspots in the company's area. The Sustainability Department assigns Safety Specialists for this matter (Hoonaker et al. 2011, Noy et al, 2011, Astianto et al. 2014, Widyanti et al. 2016). The employee contacted Regional Sustainability or directly contacted relevant employees at each farm to do the PPE recapitulation. At the same time, the Safety Specialist also monitors the hotspot distribution map and reports it to the farm if it requires follow-up. Safety Specialists also still need to prepare reports to report the results of their work to superiors. Another case with the Operation Department. Employees often come home late at night. Even Saturdays and Sundays still enter the office.

The workload that is too high can cause fatigue in employees. This can be feared will have an impact on employee job satisfaction. The potential for work errors by employees (human error) increases.

2. Research Method
NASA-TLX is a method of measuring mental workload developed by Hart (2006), a researcher at NASA's AMES Research Center. According to Hart (2006), this method measures the workload of the type of work, not the workload owned by each worker. NASA-TLX consists of 6 (six) scale or measurement dimensions, namely Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration. Behesthi et al. (2004) said that Mental Demand is a measurement of the mental burden that respondents receive in completing their work. Activities include

remembering and searching. Work is easy or difficult, simple or complex. Physical demand is a measurement of the physical load received as a result of doing work. Activities include pulling, pushing, typing, or moving to other departments. Temporal demand is the pressure felt by respondents regarding time. Is it in a hurry (must be resolved right now) or relaxed.

Still, according to Behesthi et al. (2004), performance is the perception of work success by respondents, whether respondents feel satisfied or consider the results of their work to be successful or even vice versa. The effort is a measure of effort that has been expended to complete the work, both physical and mental effort. Frustration is the pressure felt by respondents on safety matters at work, for example, feeling offended or even feeling comfortable. NASA-TLX consists of 2 (two) worksheets with the following pictures in Figure 1 and Figure 2:

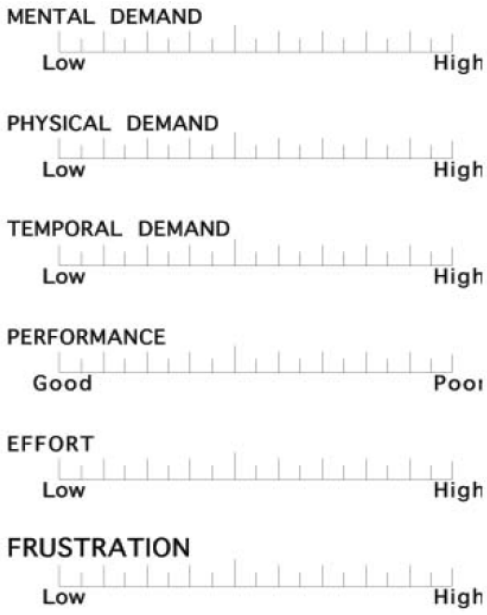

Figure 1. First sheet of NASA-TLX, Source: (Hart, 2006)

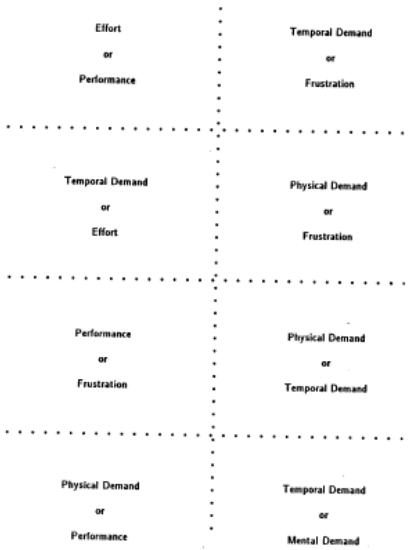

Figure 2. Second sheet NASA-TLX, Source: (Hart, 2006)

According to the Ames Research Center (Hart, 2006), in the first sheet, respondents were asked to rate the amount of workload they felt. The assessment consists of 6 (six) scales or dimensions of NASA-TLX, namely mental demand, physical demand, temporal demand, performance, and frustration. Each scale has 2 (two) endpoints, i.e., left to right. The leftmost scale is the worst, while the rightmost is the best. Except for the scale of performance, the opposite applies. Respondents give an X according to the workload they feel. The filling out of this sheet is purely subjective from the respondents. Whereas on the second sheet, the respondent is faced with 15 (fifteen) pairwise comparisons of the six NASA-TLX scales or dimensions. Respondents are required to choose one that feels more influential on the workload of respondents.

Ames Research Center (Hart, 2006) says that the next stage of NASA-TLX is to calculate scores based on questionnaires that have been filled out by respondents. The stages are as follows:

1. Calculate Product Value
   The product value is obtained by multiplying the weighting score with the rating.
2. Counting Weighted Workload (WWL)
   The next step is to calculate WWL. WWL is obtained from the sum of product values.
3. Calculate WWL average (workload score)
   Next WWL is divided by 15, and 15 is the total weight. The result of this division is the workload score.
4. Score Interpretation
   Existing workload scores compared to the table below are then interpreted into workload categories (Table 1).

Table 1. NASA-TLX category

Workload Category	Value
Low	0-9
Medium	10-29
Rather High	30-49
High	50-79
Very High	80-100

Source: Artadi (2015)

3. Results and Discussion

The first step is distributing the job satisfaction questionnaire to respondents. The following graph is the distribution of respondents' job satisfaction (Figure 3):

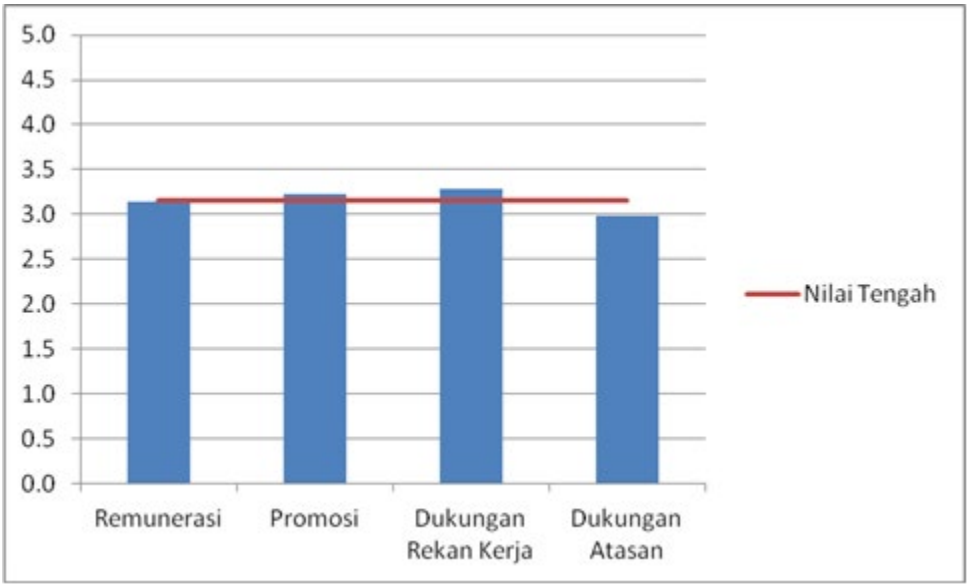

Figure 3. Employee job satisfaction factor graph, Source: Data processing 2017

Based on the table above, it can be concluded that employee job satisfaction is still below or slightly above the middle value. The remuneration factor and superiors' support are below the middle value. While the promotion and support factors of coworkers are slightly above the middle value. The highest factor of job satisfaction is the support of coworkers, with a value of 3.3. Meanwhile, the lowest satisfaction factor is superiors' support, with a value of 3.0.
The next questionnaire is NASA-TLX for workload measurement. Respondents were asked to rate the workload factors they currently feel. As mentioned before, there are 2 (two) worksheets that must be filled out by the respondent. The first sheet is weighing for workload factors. Whereas the second sheet gives a rating. The entries in the two questionnaire sheets are added up and multiplied to get the product value. The product value is then added to get the weighted workload. The average weighted workload value is translated into workload value. The value of the respondent's workload can be seen on the next page (Table 2).

Table 2. Value of respondent workload

Respondents	Average Weighted Workload	Load Category
1	51,33	High
2	69,33	High
3	69,33	High
4	58,67	High
5	58	High
6	61,33	High
7	59,33	High
8	65	High
9	60,33	High
10	53,33	High
11	54,67	High
12	57,33	High
13	63	High
14	54	High
15	75,33	High
16	51,33	High
17	45,33	Rather High
18	45,33	Rather High
19	76	High

Source: Data processing 2017

Based on Table 2, it can be concluded that as many as 89.47% of respondents have a high workload. While the remaining 10.52% have a rather high workload.

Based on the discussion above, it can be concluded that the respondent's job satisfaction is still around the middle value, meaning that it can be increased again, and the workload is included in the high category. Both of these, if left unchecked, can trigger employee inconvenience at work. Therefore, we need to find the root of the problem and the solution.

To find the root of the problem, we must know what factors are the causes. The first step is to do a correlation test. The correlation test aims to measure the relationship between variables, whether there is a strong relationship or not. The four factors of job satisfaction are tested for correlation with the six NASA-TLX scales or dimensions. A correlation test was performed using SPSS ver. 20 with a 95% confidence level. Here are the results of the test (Table 3):

Table 3. NASA-TLX scale correlation test results with job satisfaction factors

Test Factor	Significance Value
Efforts - Support of co-workers	0,330

Efforts - Support of superiors	0,309
Mental - Support of co-workers	-0,317
Mental - Promotion	-0,351
Test Factor	**Significance Value**
Temporal – Support of superiors	-0,371
Mental - Superior support	-0,379

Source: Data processing 2017

Based on Table 3, it can be concluded that there are 6 (six) factors that have a tendency to influence or be influenced. There are positive and negative correlated factors. Factors that are positively correlated are business factors with workforce support factors, with a correlation value of 0.330. Then, the business factor with the support factor of the boss with a correlation value of 0.309. Furthermore, the negatively correlated factors are mental factors with promotion factors with a correlation value of -0.351. Then, temporal factors with superiors' support factors with a correlation value of -0.371. And mental factors with superiors' support factors with a correlation value of -0,379.

The results also show that there is a relationship between workload and job satisfaction. The relationship is directly proportional to those that are inversely proportional. A relationship that is directly proportional is shown by a positive correlation value, while a relationship that is inversely shown is a negative correlation value. Low employee job satisfaction will affect his enthusiasm for working. Therefore, efforts should be made to reduce workload.

As explained earlier, the dimensions of the NASA-TLX workload consist of 6 (six) scales. For more optimal results, this research will only focus on 1 (one) NASA-TLX scale, which is the most dominant. To determine which scale is the most dominant, an analysis is done using Pareto diagrams. Here's the diagram (Figure 3):

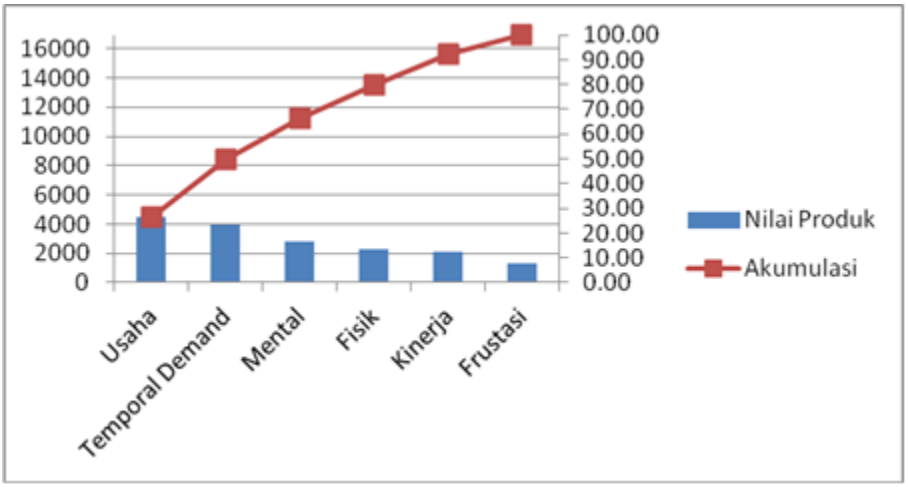

Figure 3. Pareto diagram of NASA-TLX workload dimensions, Source: Data processing 2017

Based on the Pareto diagram above, it can be concluded that the most dominant workload dimension is effort. Next, to find the root cause of the business dimension, a tool called fishbone diagram is used. Here's the diagram:

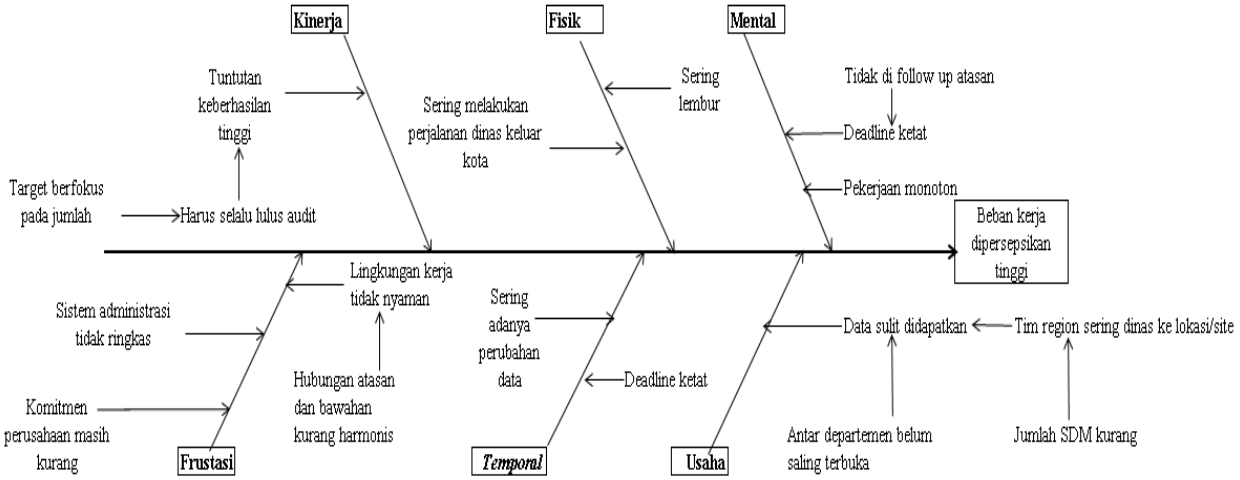

Figure 4. Fishbone diagram, Source: Data processing 2017

Based on Figure 4 above, it can be concluded that the root cause of the high workload is the difficulty in getting data. Based on the results of the interview, the difficulty in getting data is due to the fact that the departments have not been open to each other. Each department is still individualistic. The proposed improvement is to create a centralized database system. All data will be collected in 1 (one) place and managed by special officers. So, anyone who needs data is enough to communicate it with the centralized database system officer. The flow chart can be seen on the following Figure 5-7:

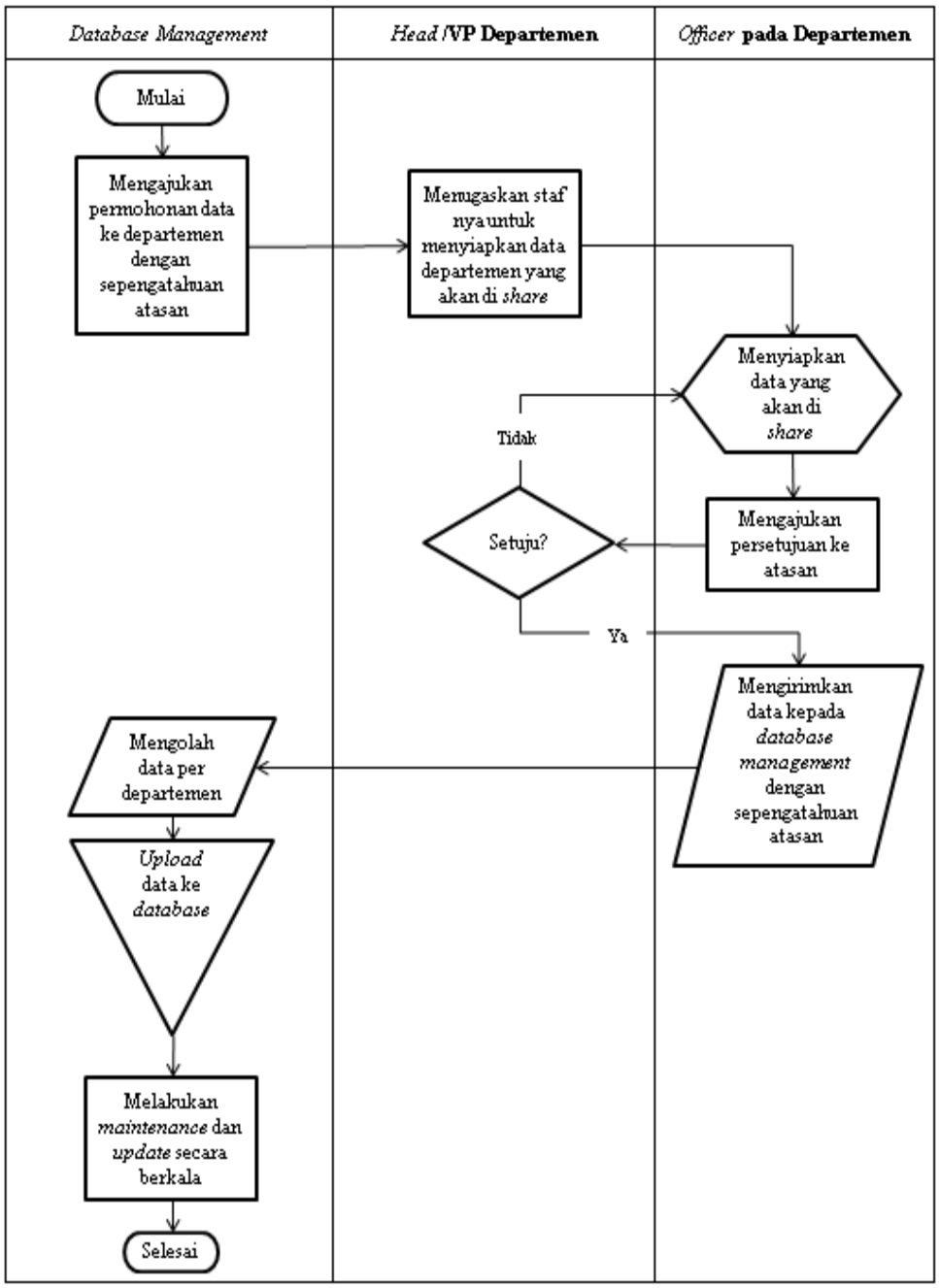

Figure 5. Proposed initial data collection flow chart for centralized database system
Source: Data processing 2017

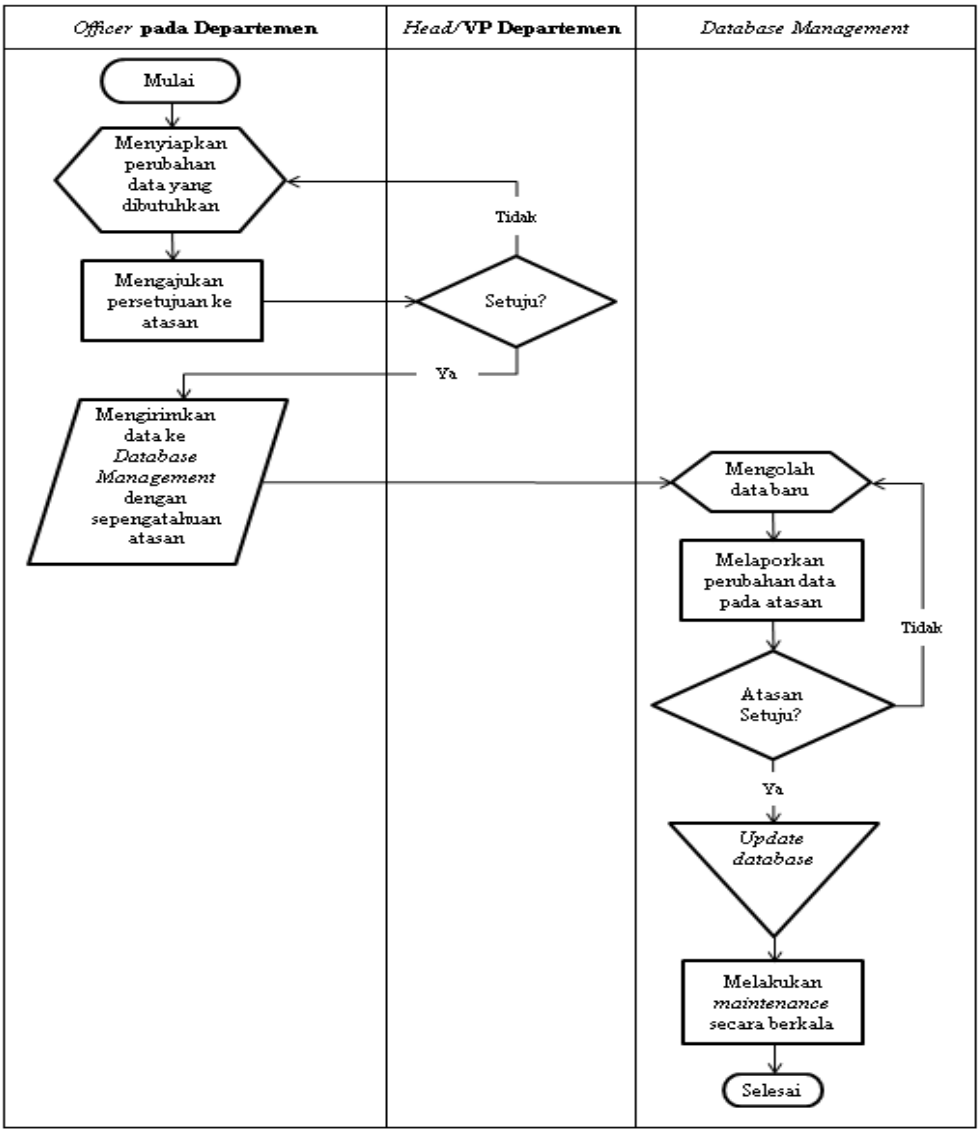

Figure 6. Proposed flow chart of data requests to a centralized database system, Source: Data processing 2017

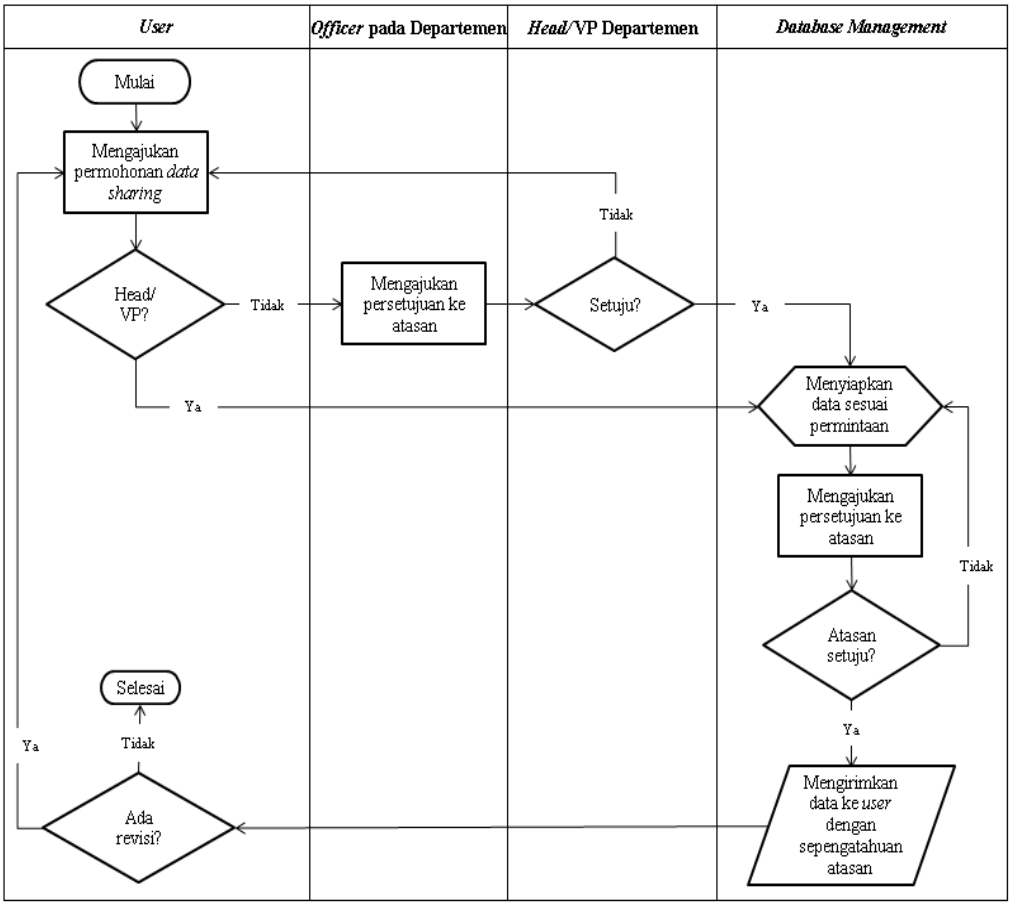

Figure 7. Proposed flow chart of data requests to a centralized database system, Source: Data processing 2017.

4. Conclusion and Suggestion

Based on research that has been done, it can be concluded several things as follows:

1. Perceived workload by Sustainability and Operations department employees at PT XYZ, in general, is high. A total of 10.52% perceived high, and 89.47% perceived high.
2. Workload received by employees can affect employee job satisfaction. There are positive and negative correlations. A positive correlation means that if the workload increases, job satisfaction also increases, such as the relationship between effort workload factors (effort) and support factors of superiors' support. A negative correlation means if the workload increases but job satisfaction actually decreases, for example, is the mental workload factor (mental demand) with the promotion job satisfaction factor.

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