# Workload Analysis Using Work Sampling and NASA-TLX for Employee of Private University in Surabaya

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**Abstract.** *Employees are a valuable asset in an organization. The organization can be defined as two types, namely a profit or nonprofit company, and government institution. Employees as a capital human for these organizations have big roles for performance measurement. Performance measurement of the employee is used to determine whether the worker has been working efficiently or not. Workload analysis is defined as an analysis of a set or number of activities that must be completed by an organizational unit or position holder within a certain period of time. In this research, it will show employee workload analysis using two approaches in order to complete each other. Firstly, the work sampling method was used to determine the workload physically. Secondly, NASA-TLX was utilized to analyze workload in mentally. Pareto method will also take apart for analysis the research result to be more comprehensive. This research was conducted in East Java's University-Indonesia. The respondents are employees who have each job description to do their work in each position. The employee's workload will be calculated both physical and mental. From 25 position observed, show the job position who has strategic characteristic mostly have very high mental workload, whereas the job position who has operational characteristic mostly have high physical workload.*

**Keywords.** *Employee, workload analysis, work sampling, NASA-TLX*

## I. INTRODUCTION

Each organization, both companies and institutions, profit and non-profit, are faced with increasing development in any field. Organizations or companies that are aimed at profit or non-profit are required to participate in enhancing the development, especially about the welfare of the people (Novera, 2010).

According to Arsi et al. (2012), with the effectiveness, efficiency, and productivity, the company can find out how to optimize the resources used and can support the achievement of targets that have been carried out by a company. Related to the optimization of these resources, which is often done by a company both in the service and manufacturing industries is efficiency in terms of human resources. The efficiency of the human resources field is related to the workload analysis that must be done in an organization. By doing efficiency in the human resources field, it can be done in various ways, such as by making an appropriate analysis of the activities that occurred. The workload analysis also has the intention of optimizing the number of employees to carry out their work activities appropriately.

In line with Arsi et al. (2012), Singgih and Dewita (2008) also talk about the importance and how to enhance efficiency in the human resources field. The efficiency in the human resources field is related to work activities and the time needed by employees to complete their tasks in accordance with the job description that has been required by the management. The method that can be used in measuring efficiency and work effectiveness is called by workload analysis. Workload analysis is a description of the workload needed in an organization. With this method, it is also an effective way of providing information about the allocation of employee resources in an organizational unit. The workload is a consequence of activities given to workers. Workers' activities can basically be distinguished between physical activity and mental activity. In practice, the workload analysis is encountered a combination of physical workload and mental workload (Simanjuntak & Situmorang, 2010).

This research will be conducted in a university which placed in East Java, Indonesia. This university

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has a tagline that is empowering and networking. For empowering the University's resources, it is necessary to know about employee the workload at first. During this time, this university had never conducted the study. Therefore, on this occasion, there was a study or analysis of employee workload on organizational units in this university.

The preliminary study that has been carried out is by interviewing employees. Employees who work structurally on related units at this university do work based on the job description that has been determined. Twenty-five positions have observed in this study. The job description that had been determined is still typically strategic and only shows physical activity. If the assessment of workload is based only on the job description that has been formulated, this causes an assessment imbalance. To provide a solution to the existence of the assessment imbalance, it is necessary to make another assessment instrument that is able to show a mental workload. Because according to (Simanjuntak et al., 2010), workers' activities can basically be distinguished between physical activity and mental activity. Hence, this research will be utilized two methods that are work sampling and NASA TLX to see the workload analysis both physically and mentally.

## II. RESEARCH METHOD

Figure 1 has shown how to conduct this research. The research runs with 5 steps, namely step 1 about object observation, literature study, and generate an objective function of this research, step 2 about the works sampling method, step 3 about NASA TLX approaches, step 4 about result analysis, and step 5 about conclusion and recommendation.

There are two methods for measuring workload directly. They are stopwatch time study and work sampling. Each method has different provisions on the nature of the type of work. In this research, it uses work sampling to observe an employee's workload directly. The use of the work sampling method is very suitable for the type of work that will be carried out in this study, namely work that is not repetitive (not repetitive) and has a relatively long cycle (Santoso & Supriyadi, 2010). As for the
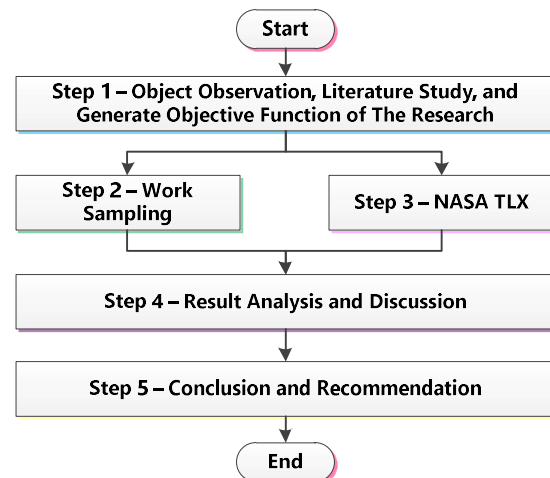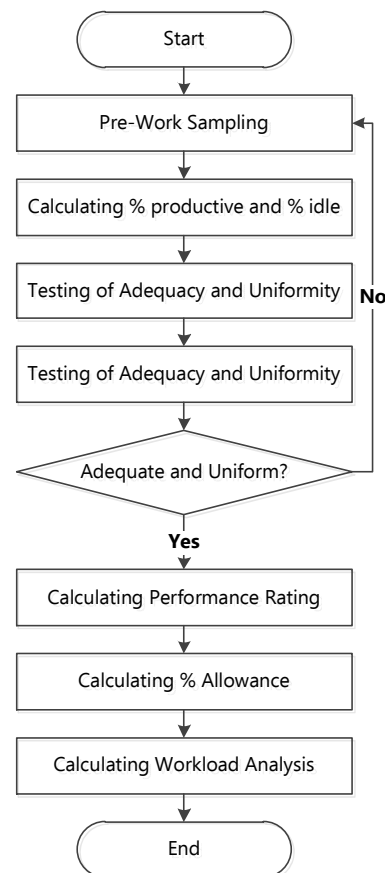


**Figure 1.** Research Methodology



**Figure 2.** The procedure of Work Sampling

work sampling, when indicated in the flowchart in Figure 2.

Figure 2 is a procedure of work sampling that we used and based on (Widiasih & Nuha, 2018a) as previous research has been done. Work

**Table 1.** Qualification of Workload Component, Scale, and Definition

| Workload Component | Scale | Definition |
|---|---|---|
| Mental Needs (KM) | Low - High | The mental activity and perception needed to do a task |
| Physical Needs (KF) | Low - High | Physical activity needed to do a task |
| Time Needs (KW) | Low - High | The time needed to do a task |
| Frustration Level (TF) | Low - High | The mental and physical activity needed to do a task at a certain level |
| Performance (PF) | Good - Poor | Overall stress and or satisfaction related to the complexity of the task |
| Effort (U) | Low - High | The level of success or satisfaction and the level of completion of the assignment given |

sampling is a way of measuring time directly using random time. There are types of work that can use method, including: (1) work that is only carried out by an employee in a permanent position or position, (2) work that will be changed periodically as a result of changes in customer systems or requests, and (3) work with a relatively small output value.

Based on several descriptions of the above provisions, it can be ascertained that the study is appropriate using the work sampling method. This random work observation, preceded by pre-work sampling. That is to do random job data retrieval at certain frequencies. Then the results of the pre-work sampling from each position are done by calculating the percentage (%) of productive and idle. Both parameters are used as data testing, data adequacy, and uniformity of data. So if the data meets the test data, it can be done by setting performance rating and percentage of allowance followed by the calculation of Work Load Analysis (WLA).

According to (Hidayat et al., 2013) and (Widiasih & Nuha, 2018b), the NASA-TLX method (National Aeronautics and Space Administration Task Load Index) is a method used to analyze the mental workload faced by workers who must perform various activities in their work. The NASA-TLX method was developed by Sandra G. from NASA's research center and Lowell E. Staveland from San Jose State University in 1981. This method was developed based on the emergence of subjective measurement needs consisting of scales nine factors (they are task difficulty, time pressure type of activity, physical effort, mental effort, performance, frustration, stress, and fatigue.

Of the nine factors, it is further simplified into 6, namely Mental demand (MD), Physical demand (PD), Temporal demand (TD), Performance (P), Frustration level (FR).

NASA - TLX is a subjective method that is often used in measuring mental workload on individuals in various industries. In the NASA-TLX method, there are six components that will be measured from each individual, namely mental needs, physical needs, time requirements, frustration levels, performance, and the last is the level of effort (Young, Zavelina, & Hooper, 2008). From each size of the workload, there is a scale that the respondent must later fill. This is the first step in measuring workload. In the components of mental needs, physical needs, time integrity, and level of frustration, the scale used is low to high. Whereas for performance measurement, good to bad scale is used. For more details, it will be shown in the following of Table 1.

After knowing the scale used to measure each component, the next step is data processing until the acquisition of workloads (Hart, 2006).

These steps are as follows:
1. Calculate the value of the product by multiplying the rating by the weighting factor for each descriptor, so that there are six product values for six descriptors (KF, KM, KW, PF, U, and TS).

Product = Ranking x Weight Factor     (1)

2. Calculating the value of WWL (Weighted Workload), which is the workload caused by each descriptor with the equation:

WWL = ∑ Products     (2)

3. Calculate the average WWL by dividing the WWL by the total number of weights of 15.

Average WWL = WWL / 15                    (3)

In this study, NASA-TLX will be used as a method to find out the optimal number of employees. The determination of this amount will be based on the average WWL value of each employee. There is a category of mental workload, which can later indicate whether a job is charged has a high or low load. The categorization, according to Rism U.S [4], is as follows in Table 2.

**Table 2.** Range of Value the Category of Workload

| Number | Range of Value | Category of Workload |
|---|---|---|
| 1 | 0% - 9% | Very Low |
| 2 | 10% - 29% | Low |
| 3 | 30% - 49% | Moderate |
| 4 | 50% - 79% | High |
| 5 | 80% - 100% | Very high |

## III.  RESULT AND DISCUSSION

At first, this research was conducted by step 1 is object observation. As we know, this research has the university's employees in East Java, Indonesia. The structure of this university was figured in Figure 3. This University was led by Rector, which is helping by two vice-rectors. They have three bureaus, namely Rector Bureau, Academic Bureau, and Non-Academic Bureau, which is every bureau that has each function and responsible. In each Bureau was conducted by the head of the bureau, then the head of the bureau

work with the head of the division. The head of each division also has subsection, then staff. Hence, this research will observe 25 positions in total in three bureaus as organization structural. In step 1, it has to search for some literature that was related to workload analysis and measurement sort of work sampling and NASA TLX. In step 1 was finished with the definition of the research's goals and aims.

Step 2 was done by the work sampling method (Widiasih & Nuha, 2018a). For calculating the workload analysis mentally, NASA TLX was completed in step 3 with a followed stage to do. Then, step 4 is the result analysis. From the work sampling method, as it shows in Figure 4, the highest rank is head of cooperation affair in the category of physically workload analysis, and the worst is the head of the rector bureau. Fact, the head of the rector bureau has many responsible for handling the activities of the rector and vice-rector as well.

Result analysis was conducted more comprehensive completely with Pareto analysis. The Pareto-Lorenz analysis is a very useful tool for this purpose, presenting visually and in a clear way, the result of the studies (Zasadzień, 2014). In this study, the 25 positions of observation were classified by its bureau in Figure 3. Figure 4 shows the position contributes about 78% of the Rector Bureau. They are head of the cooperation affair, head of rector secretary division, head of public
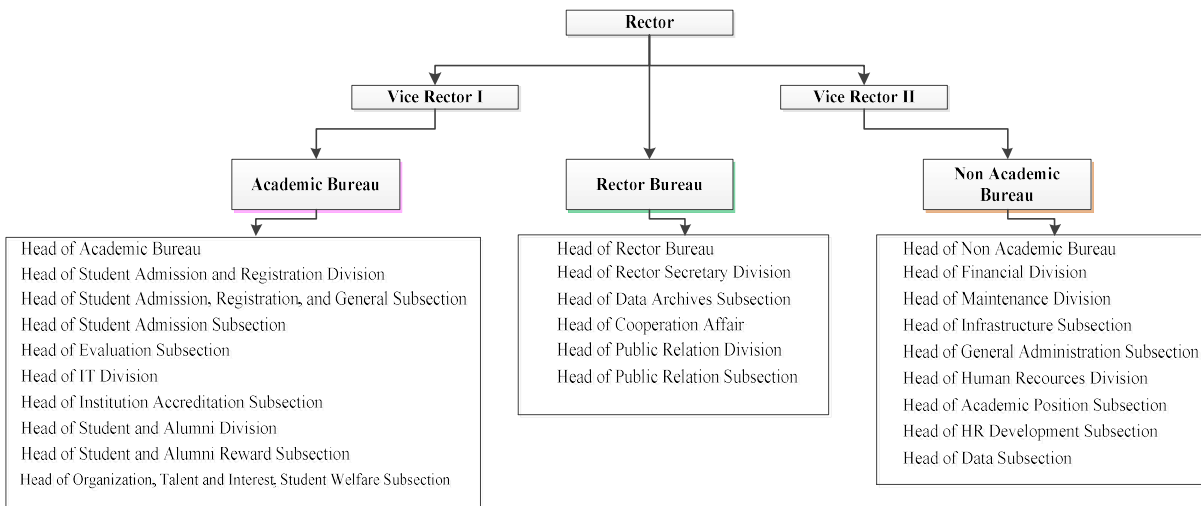
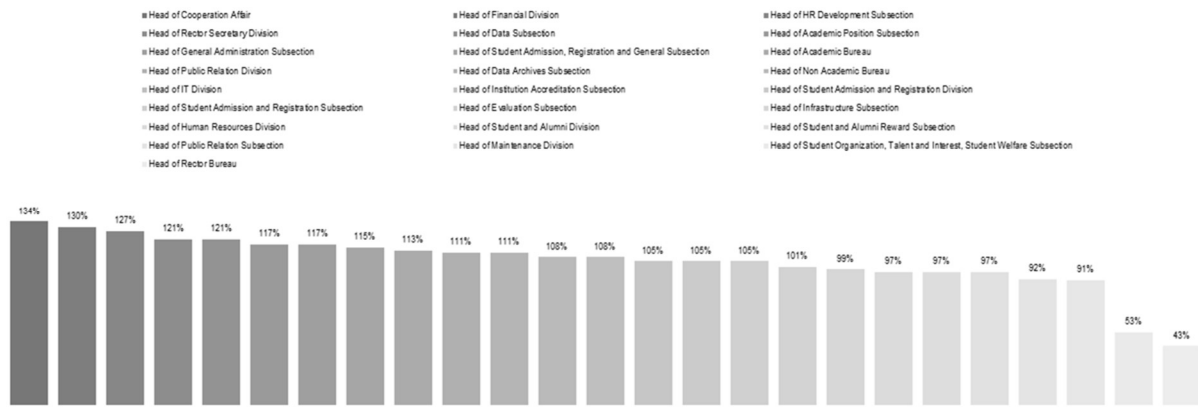**Figure 3.** The Organization Structural of University in Surabaya

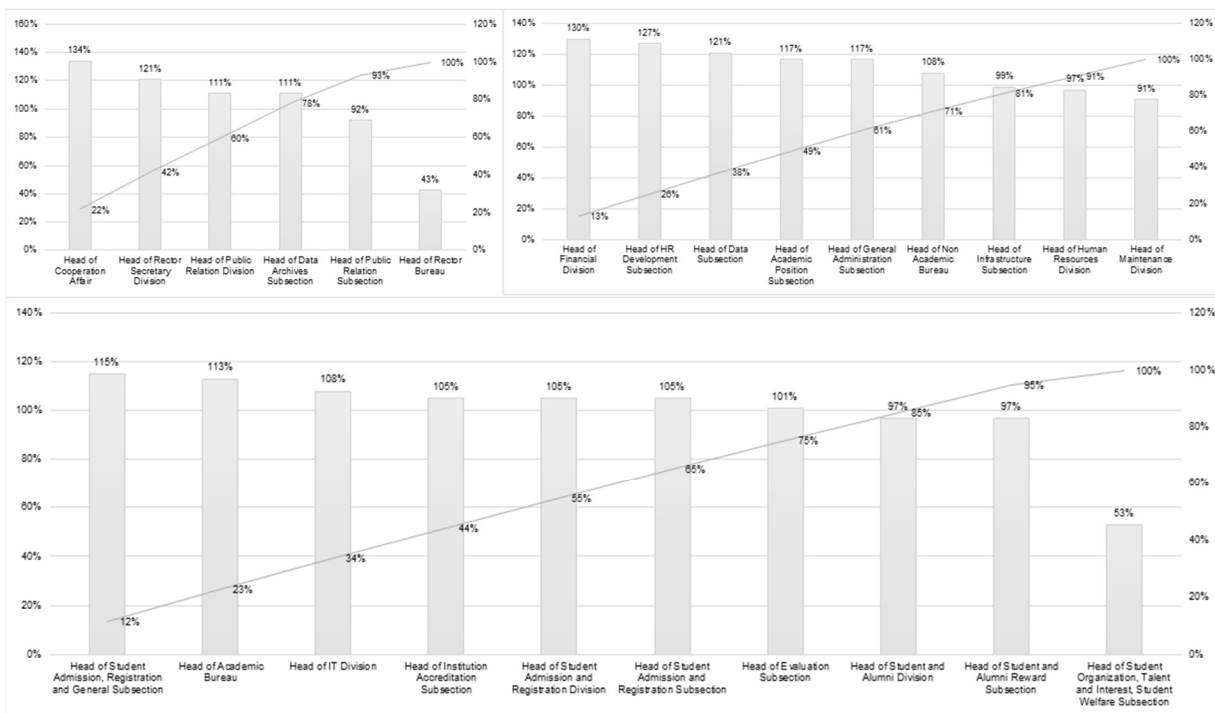**Figure 4.** Physical Workload Analysis Approach by Work Sampling Method



**Figure 5.** Physical Workload Analysis with Pareto Analysis

relation division, and head data of archives subsection with each cumulative of percentage 22%, 42%, 60%, and 78%.

Figure 5 also shows the position, which contributes to about 71% of the Non-academic Bureau. They are head of the financial division, head of HR development subsection, head of data subsection, head of academic position subsection, head of general administration subsection, and head of non-academic bureau with each cumulative of percentage 13%, 26%, 38%, 49%,

61%, and 71%. The same analysis shows the position, which contributes to about 75% of the academic bureau. They are head of the student admission, registration, and general subsection, head of academic bureau, head of institution accreditation subsection, head of student admission and registration division, head of the student admission and registration subsection, and head of evaluation subsection with each cumulative percentage 12%, 23%, 34%, 44%, 55%, 65%, and 75%.
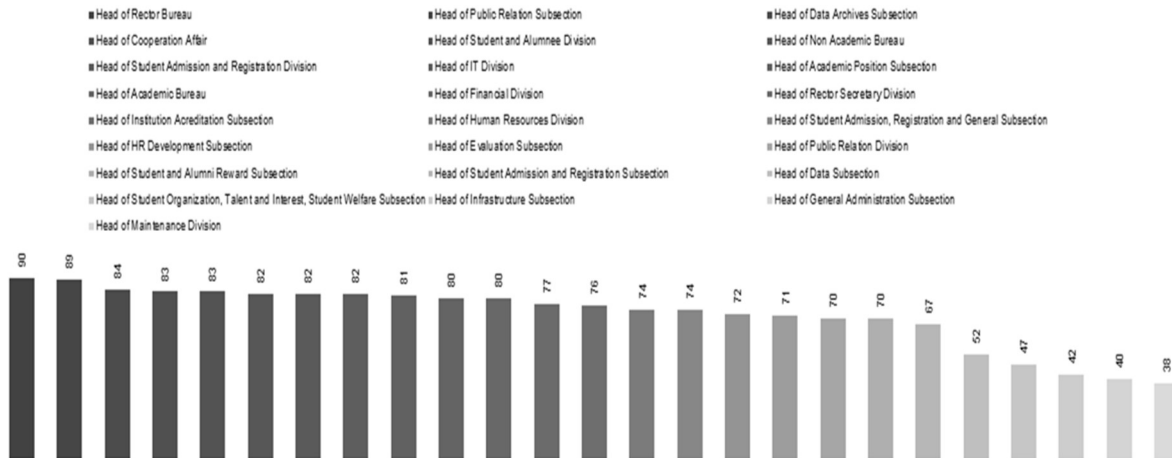
■ Head of Rector Bureau
■ Head of Public Relation Subsection
■ Head of Data Archives Subsection
■ Head of Cooperation Affair
■ Head of Student and Alumnee Division
■ Head of Non Academic Bureau
■ Head of Student Admission and Registration Division
■ Head of IT Division
■ Head of Academic Position Subsection
■ Head of Academic Bureau
■ Head of Financial Division
■ Head of Rector Secretary Division
■ Head of Institution Acreditation Subsection
■ Head of Human Resources Division
■ Head of Student Admission, Registration and General Subsection
■ Head of HR Development Subsection
■ Head of Evaluation Subsection
■ Head of Public Relation Division
■ Head of Student and Alumni Reward Subsection
■ Head of Student Admission and Registration Subsection
■ Head of Data Subsection
■ Head of Student Organization, Talent and Interest, Student Welfare Subsection
■ Head of Infrastructure Subsection
■ Head of General Administration Subsection
■ Head of Maintenance Division



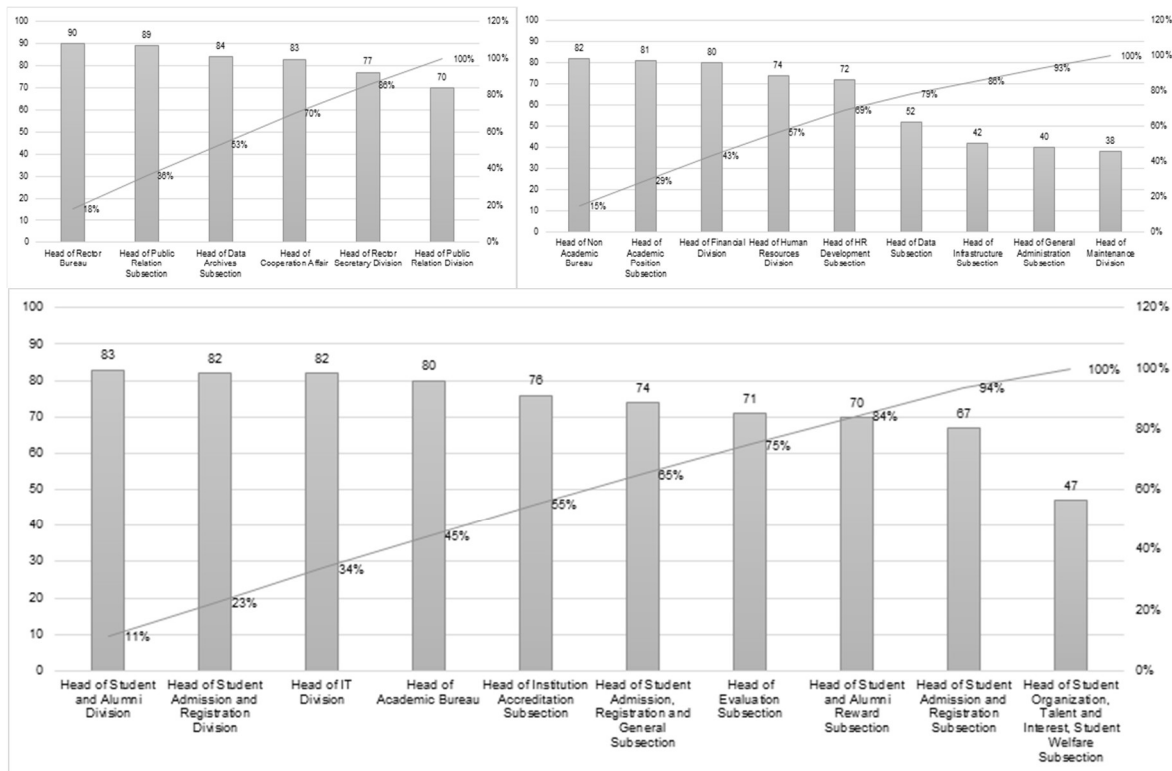**Figure 6.** Mental Workload Analysis with NASA-TLX



**Figure 7.** Mental Workload Analysis with Pareto Analysis

Figure 6 shows the result analysis of the mental workload that approached by NASA TLX. The highest rank of position is head of the rector bureau about score 90. It has means he has very high category mental workload. The head of the Bureau has a lot of jobs and functions sort of supporting and helping as the leader of the university, both technically and administrative field. He also has to provide a lot of data in order to make a suggestion for Rector-Vice Rector, who is making a decision with any policy. He also responded with the division under his monitor and evaluation; they are cooperation affairs, rector secretary division, and public relation division.

For making result analysis more comprehensive, then Figure 7 shows mental

workload analysis, which is approached by a Pareto diagram. It is the same with physical workload analysis because of this organization structural divided into three bureaus, so this Pareto diagram also consists of three parts. In Rector Bureau, the position who has contributed about 70% is head of a rector bureau, head of public relation subsection, head of data archives subsection, and head of a cooperation affair. They have each cumulative percentage of about 18%, 36%, 53%, and 70%. This is also in line with mental workload analysis using NASA TLX. These positions get into the very high category of mental workload analysis, about 90, 89, 84, and 83.

In Non-academic Bureau, the position who has contributed about 79% are head of a non-academic bureau, head of academic position subsection, head of a financial division, head of human resources division, head of human resources development subsection, and head of a data subsection. They have each cumulative percentage about 15%, 29%, 43%, 57%, 69%, and 79%. This phenomenon is also in line with mental workload analysis using NASA TLX. These positions get into the very high category of each mental workload analysis, about 82, 81, and 80. The rest of them are still getting into a high category of about 74, 72, and 52.

In Academic Bureau, the position who has contribute about 75% are head of student and alumni division, head of student admission and registration division, head of IT division, head of academic bureau, head of institution accreditation subsection, head of student admission, registration, and general subsection, and head of evaluation subsection. They have each cumulative percentage about 11%, 23%, 34%, 45%, 55%, 65%, and 75%. This phenomenon is also in line with mental workload analysis using NASA TLX. These positions get into the very high category of each mental workload analysis, about 83, 82, 82, and 80. The rest of them also still get into a high category of about 76, 74, and 71.

According to the result analysis above, it shows the general conclusion such as the job position who has strategic characteristic mostly have a very high mental workload whereas the job position who has operational characteristic mostly have high physical workload. This resulting study is able to be a recommendation for the university's management in order to revise job description, so that employee's workload, both physic and mental, be more standard and has a small deviation value in each position. This resulting study also can be used for the basis of an employee's payroll.

## IV. CONCLUSION

This research has successfully applied two methods for measuring workload, both physically and mentally, in each job position. Twenty-five positions in total to observe divided into three bureaus, they are rector bureau, the non-academic bureau, and the academic bureau. They have big roles in the university since they have to support the performance of the university's leader, namely rector-vice rector, to organize the university. Physical workload analysis was conducted by the work sampling method. Then, mental workload analysis was conducted by NASA TLX. Pareto diagram was utilized to complete them to make the result analysis more comprehensive. The result analysis of the Pareto diagram, which has an 80% 20% concept, is able to prove that the result analysis in line with the mental workload category. It happened in physical workload analysis, as well. In this study has answered the review of employee workload both physically and mentally. Then, we have some suggestions for this university to make their employee's work more productive and efficient. This study also provides suggestions to the university's management to review the job description in each position observed and needs to make delegation of authority in some part of the job description who has repetitively type. University's management can develop a framework to manage its human resources. Future research can attempt to make workload analysis by development simulation modeling based on the new framework. By simulation modeling, this research can be comprehensive to analyze. Another opportunity to develop mental workload analysis is a method that has a non-subjective measurement, then comparing with the existing method.

## ACKNOWLEDGMENTS

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