

# WORKLOAD MEASUREMENT USING DIARY SAMPLING METHOD FOR HUMAN RESOURCE REQUIREMENT PLANNING: CASE STUDY AT PT. JASA MARGA (PERSERO)

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## ABSTRACT

*PT. Jasa Marga is state-own company which conducting highway network and maintaining all highway in Indonesia. Since 1998, this company developed competence based human resource management (CB-HRM). To support implementing CB-HRM, PT. Jasa Marga also identify human resource requirement to make operations efficiently.*

*This research project use diary sampling method. Diary sampling is tool to collect data of employee activities during work-hours. Each employee was asked to fill in activity form by her/his self. After completing observation activities for ten days, these data was processed using workload analysis software. The result of this software is job workload for one year.*

*Job workload will be used to calculate number of employees requirement. And based on this calculation in this year, this data will be used to predict how many number of employees for each job is required for next five years.*

**KEY WORDS:** Workload, Diary Sampling, Human Resource Planning

## 1. Introduction

PT. Jasa Marga has designed integrated human resource management system (I-HRMS) since 1998. Integrated-HRMS have to be able to guide and improve developing human resource effectively. This company hope their employess have ability to create adding value. Employees have to give service excellent for their customers whom using highway in Indonesia.

Figure-1 show the concept of IHRMS. Using I-HRMS we can decide, for instance employee requirement, selection and recruitment plan, HR development plan, salary and incentive system, and performance assesment

Workload information is method to calculate employee quantity requirement. Workload is

important factor to determine policy on HRM system, e.g. employee requirement planning, together with job analysis to design salary system. Last but not least is to allocate job task and responsibility.

Workload terminolgy refer to time parameter. It's mean that percent of using working time effectively by employees during his/her work hour (Niebel, 1999). Workload not only calculate spending time for productive work but aslo included human aspects, e.g. fatigue, personal requirements, and unavoidable delay. This factors is called *allowances* (Barnes, 1989).

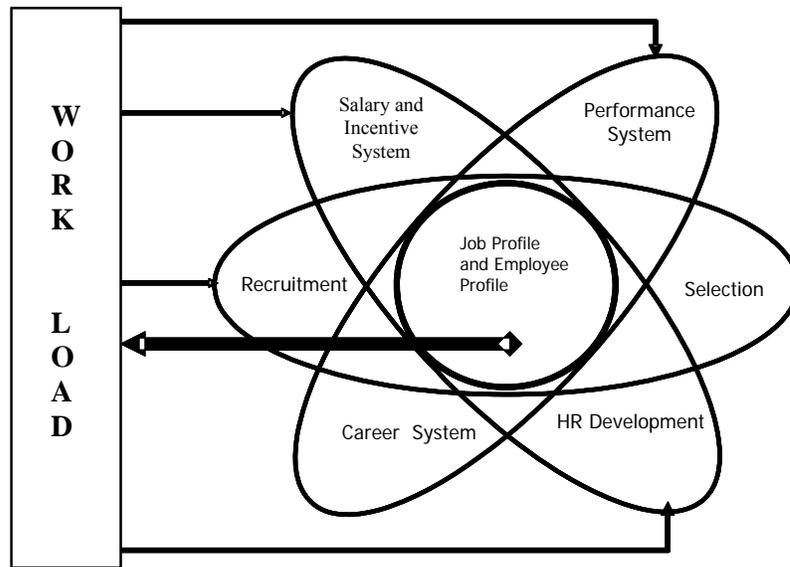


Figure-1: Concept of Integrated Human Resources Management

Source: Tjakraatmadja, J.H., Gustomo, A., Widyanti, A., Putro, U.S. (2004). Pengukuran Beban Kerja Karyawan PT Jasa Marga (Persero). LAPI – ITB Project Report.

## 2. Research Methodology

For non-routine job, e.g. office work, administration, managerial work, researcher, and engineer, is difficult to measure spending time for his/her work. The distribution of spending time for this job can be measured using observation while his/ her work hours for long time. However this method is not efficient for observer. To cover this problem, work sampling is efficient approach to measure workload for this job types.

Work sampling is method to measure and record job activities randomly with specific time interval for representative employee(s). Definition of work sampling contain two main articulation:

### 1. Choosing job holder sample

If there are only few job holder in one job, it's will be valid data if all job holder can be observed. But if not possible, we can take some job holder as sample data to be observed.

### 2. Choosing time interval for observation

Observation will be conducted based-on determination of time interval. As long as possible observation can be done for each this

time interval for employee sample. But usually maximum number of observation is not more than 2/3 possible observation frequent total.

Workload output have to be able to represent work load for one year. But in practice, its not possible to observe job activities over one year. So, workload which be resulted during observation days have to convert to one year workload using *load rating factor*.

One year workload output which be resulted based-on respondent measurement can generalize as job workload. This job workload will be used to calculate ideal number of employees. And based on this calculation in this year, this data will be used to predict how many number of employees for each job is required for next five years. Prediction model consider factors affected workload fluctuation.

### 2.1. Diary Sampling Method

This research use diary sampling method to observe job activities. In diary sampling method, each respondent be given trust to self fill-in observation sampling form on observation time. Respondent was asked to record and fill his/ her activities every 15 minutes during work hours.

Each respondent have been given diary book that contain all possible activities. So, each respondent only fill-in this diary book by using tally in appropriate activity at that observation time

This research aim to show how diary sampling method implemented. So, we will focus only for one job, is office administration in HR department at Jagorawi Branch Office of PT Jasa Marga.

## 2.2. Data Calculation

Number of office administration employees is six. This research take two employees as respondent. Work sampling was conducted for two weeks. Output of this observation is percent of productive ( $p$ ) for two weeks (ten work-days). Before continuing calculation until get job workload, this data have to pass on statistical tests. In work sampling method, they have two kind of statistical test, are homogeneity test and sufficient test.

### 2.2.1 Statistical Test

#### 2.2.1.1 Homogeneity Test

Control limit will be determined using formula:

$$BKA = p + 3 \sqrt{\frac{p(1-p)}{30}}$$

$$BKB = p - 3 \sqrt{\frac{p(1-p)}{30}}$$

with: BKA = upper limit  
BKB = lower limit  
 $p$  = % productive average

#### 2.2.1.2 Sufficient Test

Number of data requirement will be determined using formula:

$$N \geq \frac{400(1-p)}{p}$$

With: N = min. data requirement  
 $p$  = % productive average

This sufficient test use 10% for significant level and 95% for confidence level.

### 2.2.2. Job Workload Calculation

Steps to calculate workload in sampling method are:

1. Calculate percent of productive average

Formulation:

$$p = \frac{\text{percent\_of\_productive\_perday}}{\text{number\_of\_days}}$$

2. Calculate normal workload (Bk-n) for two weeks

Formulation:

$$BK_n[2 \text{ MINGGU}] = p \times r$$

with:

BK<sub>n</sub> = normal workload  
 $p$  = % productive average  
 $r$  = rating factor

rating factor is factor to convert respondent workload to be workload average. Workload average describe workload for employee who has average ability in skill and effort. Rating factor for each respondent was assessted by employee superordinat.

3. Calculate normal workload (Bk-n) for one month

Formulation:

$$BK_n [1 \text{ BULAN}] =$$

$$BK_n[2 \text{ MINGGU}] \times \{ (k_1 \times a) + (k_2 \times b) + (k_3 \times c) \}$$

with:

k<sub>1</sub> = conversion factor for daily high load  
K<sub>2</sub> = conversion factor for daily avg load  
k<sub>3</sub> = conversion factor for daily low load  
a = percent of high load in one month  
b = percent of avg load in one month  
c = percent of low load in one month

All parameter values above was determined by researcher through conducting interview with head of human resource department (employee super-ordinate).

4. Calculate normal workload (Bk-n) for one year

Formulation:

$$BK_n [1 \text{ TAHUN}] = BK_n [1 \text{ BULAN}] \times \{ (k_4 \times q) + (k_5 \times r) + (k_6 \times s) \}$$

with:

$k_4$  = conversion factor for monthly high load

$k_5$  = conversion factor for monthly avg load

$k_6$  = conversion factor for monthly low load

$q$  = percent of high load in one year

$r$  = percent of avg load in one year

$s$  = percent of low load in one year

All parameter values above was determined by researcher through conducting interview with head of human resource department (employee super-ordinate).

5. Calculate standard workload (BK) for one year

Formulation:

$$BK_i [1 \text{ TAHUN}] = BK_n [1 \text{ TAHUN}] \times (1 + L)$$

with:

$BK_i$  = workload/ year for employee- $i$

$L$  = allowances factor

6. Calculate job workload

Formula:

$$BK [JABATAN] = \sum BK_i [1 \text{ TAHUN}] / N$$

with:

$BK [JABATAN]$  = Job workload

$N$  = Number of respondent

### 2.2.3 Determining Employees Requirement

Formulation:

$$J_d = (J_0 \times BK) / t$$

with:

$J_d$  = ideal number of employees

$J_0$  = number of employees existing

$t$  = conversion factor to consider adding employee

to determine  $t$  parameter value, factors to consider is based-on benefit cost ratio calculation between adding or no adding employee. Based-on discussion with counterpart team of PT Jasa Marga,  $t$ -value was determined 1,20.

### 2.2.4 Prediction of Employee Requirement

First step to predict employee requirement is to find main factor(s) affected increasing workload. This research identify first factor will be attempted is traffic volume.

This hypothesis will be tested using correlation test between average workload in every office branch with traffic volume in every office branch. Table-1 below show that's data and figure-2 show plot data and correlation level for two variables.

This test show that regression coefficient,  $R^2 = 0.9268$ . Its mean that there is significant correlation between traffic volume with workload per branch office. So that way we can use traffic volume to predict number of employee requirement.

Using time-series model, traffic volume will be forecasted for next five years. Based-on forecast result, will be determined conversion factor to predict number of employee requirement.

For example :

Traffic volume at Jagorawi highway in 2003 = 290.000 cars

Forecast result for traffic volume at Jagorawi highway in 2005 = 300.000 cars

So, increasing workload conversion factor at 2005 =  $300.000/290.000 = 1,0344$

Finally, we can predict number of employee requirement using formula:

$$J_i = J_0 \times BK_0 \times K_i$$

with:  $J_i$  = number of employees year- $i$

$J_0$  = number of employees year-0

$BK_0$  = workload year-0

$K_i$  = conversion factor for year- $i$

Table-1 Average workload and traffic volume per office branch

No	Data Type	B-Type Branch Office			A-Type Branch Office					
		SEMA RANG	PALI KANCI	MEDAN	PADA LUENYI	SURA BAYA	TANGE RANG	JAGO RAWI	CIKAM PEK	CTC
1	Num of Employee (N)	124	169	237	484	525	587	815	774	943
2	Avg workload (avg BK)	91.35 %	85.80 %	93.03 %	81.23 %	81.50 %	88.08 %	82.33 %	89.47 %	88.17 %
3	N x avg BK	113.26 985	145.00 1255	220.49 173	393.14 402	427.85 766	517.00 758	670.98 5717	692.46 697	831.40 3821
4	Traffic Volume	58650	24532	39086	11293 0	15966 9	24389 4	28327 0	27921 4	45639 3

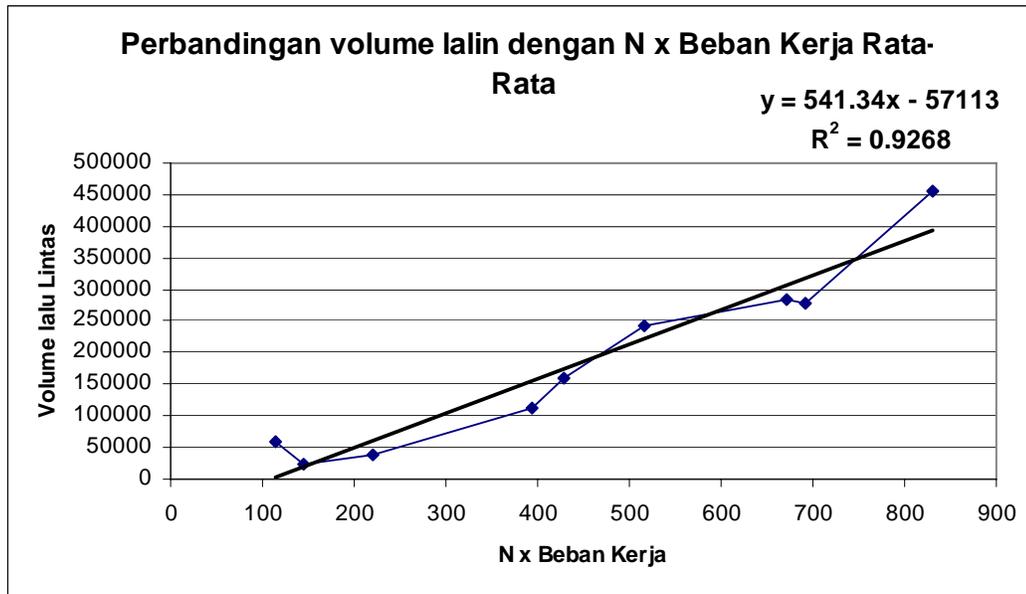


Figure-2 Graph of traffic volume vs workload for every branch office

### 3. Data Result and Analysis

#### 3.1 Data Result

Process of data calculation use software was created by Gustomo, Aurik (2003). Data calculation outputs are:

For respondent-1:

BKn[2 MINGGU] = 86,87%  
BKn[1 TAHUN] = 84,02%

and for respondent-2:

BKn[2 MINGGU] = 80,04%  
BKn[1 TAHUN] = 75,90%  
BK[JABATAN] = 76,55%

Its mean that workload for office administration job in HR Department of Jagorawi Office Branch at PT Jasa Marga is 76,55%.

### 3.2. Number Employees Calculation in 2003

Formulation:

$$J_d = \text{ROUNDUP} [(J_0 \times BK) / t]$$

With data:  $J_0 = 6$  employees  
 $BK = 76,55\%$   
 $t = 1,20$

so,  $J_d = 4$

Its mean that actually number of employee requirement for office administration job in HR Department of Jagorawi Office Branch at PT Jasa Marga is 4 employees only.

### 3.3. Prediction of Employee Requirement

#### 3.3.1 Forecasting of Traffic Volume

Figure-3 show graph of traffic volume in 1999 – 2002. Regression linier approach result the correlation coefficient is 0,9951 or there is strong correlation between two variable. So, function:  $y = 18.131x + 201.365$ , can be used to predict traffic volume for next years.

Table-3 show resulting of traffic volume prediction for 2004 – 2008.

Using this forecast and refer to example formulation to calculate increasing workload conversion factor in 2.2.4, the value of increasing workload conversion factor show in table-4 below.

Table-4 Workload conversion factor

Year	Conversion Factor
2004	1.0662
2005	1.1324
2006	1.1986
2007	1.26479
2008	1.33099

#### 3.3.2 Prediction of Employee Requirement

Finally, we can predict number of employee requirement using formula:  $J_i = J_0 \times BK_0 \times K_i$  (look at again in 2.2.4).

Table-5 below show resulting of employee requirement prediction for 2004 – 2008.

Table-5 Number of employees requirement for 2004 - 2008

Year	Workload	Number of Employyess
2004	81.62%	5
2005	86.69%	5
2006	91.76%	5
2007	96.82%	5
2008	101.89%	6

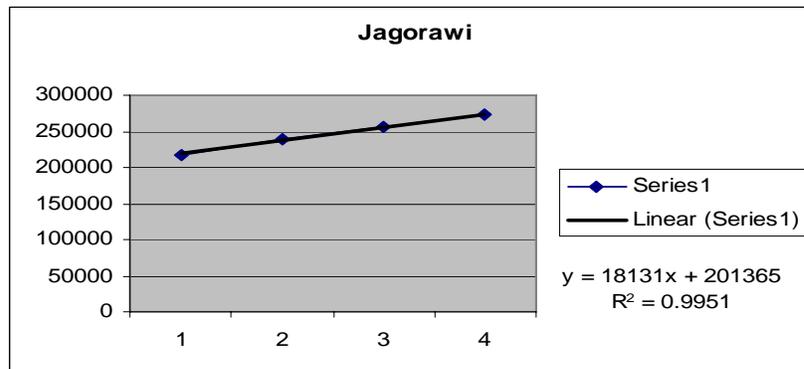


Figure-3 Data plot for increasing traffic volume at Jagorawi highway

Table-3 Prediction of traffic volume for 2004 - 2008

Cabang	Tahun				
	2004	2005	2006	2007	2008
Jagorawi	292020	310151	328282	346413	364544

#### 4. Conclusion

1. Using work sampling method, number of employees requirement for office administration job in HR Department of Jagorawi Office Branch at PT Jasa Marga is only four employees in 2003. Meanwhile, number of job holder in this job is six employees in 2003.
2. In this case, traffic volume variable can be used to predict increasing job workload.
3. Number of employees requirement for 2004 – 2008 show in table below.

Year	Number of Employess
2004	5
2005	5
2006	5
2007	5
2008	6

#### 5. References

- Barnes, Ralph M. (1980). Motion and Time Study: Design and Measurement of Work. John Wiley & Sons.
- Hidajat, T.J., Gustomo, A., Widyanti, A., Putro, U.S. (2004). Pengukuran Beban Kerja Pegawai PT. Jasa Marga (Persero). Laporan Proyek PT. LAPI – ITB.
- Niebel, B., Freivalds, A. (2002). Methods, Standards, and Work Design. (2002). 7<sup>th</sup> edition. John-Wiley & Sons. New York.