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Application of The Hungarian Method and Software Quality Management (QM) testing in Determining Optimal Wage Costs at OneTop Frozen Food Stores

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Abstract: Linear programming that can be found in life around is an assignment problem. Common assignment problems include n tasks that must be assigned to m workers assuming each worker has different competencies in completing each task. One of the methods in solving this problem is the Hungarian method. The purpose of this research is to optimize the assignment of employees by looking at the cost of daily wages. The problems that occur at the OneTop Frozen Store are the ineffectiveness of the work process and the swelling of operational costs, especially at work, Order Sorting, Packing, Labeling, Delivery with 4 workers. The application of the Hungarian method and testing of Software Quality Management obtains optimal wage costs so that operational costs can be reduced to a minimum without reducing the quality of service to consumers. Based on data processing in the Hungarian method, an assignment that is in accordance with the work in preparing Frozen Food orders at the OneTop Store can cost a daily wage of Rp.130,000 (one hundred and thirty thousand) to be the optimal wage cost per day. when compared with the previous calculation without using the Hungarian method by paying wages of Rp. 175,000 (one hundred and seventy five) per day. Based on the application of the Hungarian method, it is effective in determining an assignment and placement of workers so that they can work more effectively on a better and optimal Frozen Food ordering process.

Keywords: Assignment,Hungarian, Quality Management, Cost Optimal, Frozen Food

INTRODUCTION

Errors in the work can actually be reduced, the reduction of errors in work is intended to increase work effectiveness and company efficiency (Dewanta & Sari, 2021). Assignment is one of the factors that affect profits in a company. The right assignment will maximize the performance results obtained (Husniati, 2017). Assignment problems often arise in many decision-making cases(Sofiyanurriyanti, 2018), usually related to the company's desire to get the optimal division or allocation of tasks, meaning that if the assignment involves profit then how the allocation of these tasks can provide maximum benefits, and vice versa if it involves cost or time then how the allocation of these tasks can minimize the cost or time used(Dewanta & Sari, 2021). Problems that are often faced in the business world and industry are problems related to the allocation of various resources (Prasetyo & Lubis, 2020). Problems that occur due to improper allocation of tasks are called assignment problemsn(Nurhidayati, 2021). The assignment problem is a problem regarding arrangements for individuals to carry out tasks, so that the costs or time used for carrying out these tasks can be minimized.(Rahman, 2021).

Wages are one of the things that encourage or motivate employees to work or fully serve the company (Lavinia, 2018). Wages are often also called salaries or vice versa, but the two designations have slight differences. With the categorization of permanent employees and contract employees in a company (Imbaruddin, 2020), then there is a difference in the compensation payment system between salaries and wages. The definition of difference between salary and wages can be seen as follows (Butar, 2021), Wages are defined as rewards for workers who do menial work and rely more on physical strength and the amount is usually set on a daily, unit or

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piece basis. Another opinion about wages which defines that, wages are given on the basis of daily performance(Lukman, 2022), usually this practice is found in factories. Wages are sometimes also based on units of product produced (Astuti, 2017).

The frozen food business is one of the most popular businesses and has good prospects. There have been many business actors who have made big profits from the frozen food business (Rudiatin, 2021). This is evidenced by the increasing number of frozen food businesses that are established from time to time and of course with their respective mainstay product offerings. However, there are also frozen food business actors who have gone out of business or went bankrupt, because the marketing strategy used is not appropriate and the service quality is less than optimal. This means that the success of a frozen food business in winning the competition is determined by the application of the right marketing strategy and good relations with consumers and also knowing the interests and concerns of consumers.

The assignment problem is a special case of the transportation problem. In the business world, for example, facing problems related to the optimal assignment of various productive sources that have different levels of efficiency for different tasks.(Hia, 2019). Assignment problems require each worker to only do one task so that one-on-one assignments are obtained in order to obtain maximum results (Sunandar, 2018).

The assignment problem can be a minimization or maximization problem (Hia, 2019). The goal is to schedule each task on an assignment so that minimal losses are generated, for example in the form of costs and time and maximum profits, such as income, profits, and the value of winnings. One of the methods used to solve assignment problems is the Hungarian method.

The research was conducted at the OneTop Frozen Food Store. The products from the OneTop Store are ready-to-eat frozen foods from various brands, such as Kanzler, Fiesta, Champ, SoGood and many more. As time has progressed and the Covid-19 pandemic has hit the world, especially in Indonesia, it has opened up great opportunities and increased sales. The problems that occur in the One Top Store are the ineffectiveness of the work process and the swelling of operational costs, especially at work, Order Sorting, Packing, Labeling, Delivery with 4 workers working on it. Referring to these problems, an effective calculation and analysis is needed to determine the level of employee work and cost-effectiveness, so analysis and calculations are made using the Hungarian method and testing using QM software for Research.

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LITERATURE REVIEW

Previous research that discussed the assignment problem with the application of the Hungarian method, as follows:

1. Research on production processes and performance obtained at CV. Exemplary Axis. The method used in this research is the Hungarian method which is a work operator assignment problem solving technique. Based on the calculations that have been carried out, with QM for Windows it is concluded that this method can minimize costs and optimize operator performance(Mardiani, 2020).
2. The research on the completion of sewing clothes at the Grand Sony Tailor is 39 hours, where there is a time efficiency of 4 hours when compared to the completion time before using the Hungarin method which is 43 hours. As for the production costs incurred by the company, judging from the placement of employee tasks with the optimum completion time of Rp. 4,925,50,00 with the company's profit of Rp 1,624,750,00 in completing 10 types of clothing(Ibnas, 2018).
3. The study used the Hungarian method to calculate the total delivery time of goods on CV. L&J Express Malang*) so that the optimal total delivery time is obtained. To solve assignment problems on CV. For L&J Express Malang, the data required includes the name of the employee, the destination location, and the time of delivery of the goods. Based on the results of calculations using the Hungarian method, the optimal total delivery time of goods is 105 minutes. Before using the Hungarian method, the total delivery time was 119 minutes. It can be seen that there is a time efficiency of 14 minutes(Harini, 2017).

Based on 3 previous studies, it becomes the author's reference to apply the Hungarian method to the assignment of employees at OneTop Stores so that the minimum and optimal wage costs are obtained.

METHOD

The method used in this study is the Hungarian method, in which the operator's performance assignment analysis is carried out due to the incompatibility of job placement for each operator. The method that is said to be optimal is the method that has a greater value which indicates the optimal amount of production(Mardiani, 2020).

Data collection techniques are carried out to obtain the information needed in order to achieve the research objectives, then the following types of data are used: (Rosmalasari, 2020):

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1. Primary data obtained is the result of direct observation or observation on the production floor. The results of these observations are in the form of data for 4 workers who produce glass aluminum frames, and data on the time of workers in producing these aluminum glass frames.
2. Secondary data is obtained from journals and ebooks to add information and strengthen the results of research conducted.
3. Assignment problems are problems regarding the arrangement of individuals (objects) to carry out tasks, so that the costs incurred for task problems can be minimized (Ibnas, 2018).

Assignment is a method that can be used for modes of transportation where workers are assigned to each activity. And can be defined as (i,j =1,2,3,4,5). Some things that must be learned in solving assignment problems are: the number of workers (m), the number of jobs to be completed (n), the assignment of workers to a job (Xij), assigned allocation parameters(Cij).

Xij= 1 If worker i is assigned to one of the machines.

Xij= 0 If worker i is not assigned to any machine.

The mathematical model in this case is based on the constraint function obtained and then entered into the assignment table. In general, the assignment problem can be written with the following formula: (Husniati, 2017):

Optimize Z :

$$\sum_{i=1}^{m} \quad \sum_{j=1}^{n} \qquad (1)$$

With constraints:

$$\sum_{i=1}^{m} ij = 1 \; ; j = 1,2 \ldots\ldots, m \qquad (2)$$

$$\sum_{j=1}^{n} ij = 1; i = 1,2, \ldots\ldots, n \qquad (3)$$

Information :

Z : The objective function is to find the optimal value (maximum or minimum).

N : Number of tasks to be completed.

Xij : Assignment from source (worker) i to destination (task) j.

Cij : Parameter allocation from source i to destination j

The Hungarian method is a method that modifies the rows and columns in the effectiveness matrix until a single zero component appears in each row or column that can be selected as an assignment allocation. The Hungarian method is usually used to solve assignment problems(Mardiani, 2020):

1. Step 1: Find the minimum element in each row of the max cost matrix. Construct a new matrix by subtracting from each minimum costs in the row. For this new matrix, find the minimum cost in each column. Construct a new matrix (called the reduced cost matrix) by subtracting from each cost the minimum costs in its column.
2. Step 2: Draw the minimum number of lines (horizontal, vertical, or both) required to cover all zeros in the reduced cost matrix. If m lines are required, then the optimal solution is available among the zeros included in the matrix. If it takes less than the m line, then proceed to step 3..
3. Step 3: Find the smallest nonzero element (call its value k) in the low-cost matrix opened by the lines taken in step 2. Now subtract k from each non-find element of the low-cost matrix and add k for each element covered by two lines. Back to step 2.

Testing With POM QM Software is a software designed to perform calculations needed by management to make decisions in the field of production and marketing (Putri, 2017). This software was designed by Howard J. Weiss in 1996 to help production managers, especially in preparing forecasts and budgets for the production of raw materials into finished or semi-finished products in the manufacturing process.

RESULT

The TopOne Frozzen Food store has four different jobs, namely order sorting, packing, labeling, delivery. TopOne Frozzen Food only has four employees, namely Diana, Ella, Lisa, Wati. The wages of an employee for each job are different. The steps in determining the assignment of an employee:

1. Compile a work time table in accordance with the data that has been obtained. In the following, data processing is carried out using the Hungarian method to determine the assignment to the OneTop Store as follows:

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Table 1. Employee Wage Data

EMPLOYEE TASK	EMPLOYEE WAGE			
	Diana	Ella	Lisa	Wati
Sort Order	35000	34000	33000	35000
Print Labels and Stamps	30000	27000	29000	31000
Sort Packaging and Packing	37000	38000	36000	35000
Delivery	37000	34000	38000	36000

In Table 1, the owner of TopOne Frozen Food wants to determine the optimal cost incurred by the store, with the condition that one job is only done by 1 (one) employee. It is also known that 4 employees as assigned resources will be allocated to 4 jobs which are tasks.

1. Specifies the smallest value in each row
   This shows row = column so there is no need for a dummy job, as follows: identification and simplification of problems into the assignment table. Objective: Finding the optimal cost is the same as the minimization case. The number of jobs is the same as the number of employees, which means the normal case.

Table 2. Identification of employee assignments

	Employee			
Job	I	II	III	IV
A	35	34	33	35
B	30	27	29	31
C	37	38	36	35
D	37	34	38	36

In Table 2, identification and simplification of problems into assignments with the aim of finding the optimal cost is the same as the minimization case and the number of jobs is the same as the number of employees, meaning the normal case.
Based on the assignment data above, there is the following information:
A = Sort Order
B = Print Labels and Stamps
C = Sort Packaging and Packing
D = Delivery

2. Subtracts the value in each row by the smallest value in each row

.Table 3. Smallest Value Reduction

	Employee			
Job	I	II	III	IV
A	2	1	0	2
B	3	0	2	4
C	2	3	1	0
D	3	0	4	2

In Table 3. In the third step, to find the smallest cost for each row, then use the smallest cost to subtract all costs in the same row.

3. If there is still a column that does not have the number 0, then iterate again by determining the smallest value in that column.

Table 4. Column Subtraction

	Employee			
Job	I	II	III	IV
A	1	1	0	2
B	2	0	2	4
C	1	3	1	0
D	0	0	4	2

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In Table 4. The results in the column that are not affected by the line, choose the smallest value then subtract other values in the same column with the small value.

4. Create assignment lines on rows and columns that contain the number 0.

Table 5. Line of Assignment

	Employee			
Job	I	II	III	IV
A	~~1~~	~~1~~	0	~~2~~
B	~~2~~	0	~~2~~	~~4~~
C	~~1~~	~~3~~	~~1~~	0
D	0	0	4	2

In Table 5, there are already zero values in each different row and column, so optimal results have been obtained.

Table 6. Optimal Cost Results

Profession	Employee	Cost	
Sort Order	Lisa	Rp	33.000,00
Print Labels and Stamps	Ella	Rp	27.000,00
Sort Packaging and Packing	Wati	Rp	35.000,00
Delivery	Diana	Rp	35.000,00
Total Wage Fee to be paid		**Rp**	**130.000,00**

Based on table 6, the calculation of the Top One Store optimal work results from each job including the allocation of work for each employee is as follows:

a. Work A, Sorting PO Orders is done by Lisa with a salary of Rp.300.000
b. Work B, Printing Labels and Stamps is done by Ella, with a salary of Rp. 27000
c. Work C, Sort Packaging and Packing is done by Wati, with a wage of Rp. 35000
d. Work D, Delivery of Goods is done by Diana, with a wage of Rp. 35000

Testing With POM QM Software

The test is carried out to determine whether the employee assignment input is valid or invalid. The test is carried out using the POM QM application for windows. The initial steps for calculating the Hungarian method using QM for Windows are as follows:

1. Run QM Program For Windows V.5

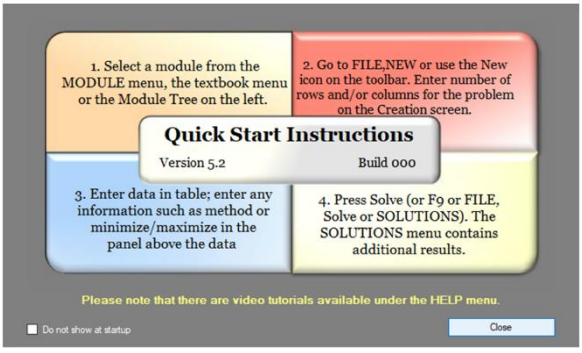

Figure 1. Display QM for Windows

In Figure 1, the Process of Running the QM software, with the results of the Initial Quick Start Instruction display.

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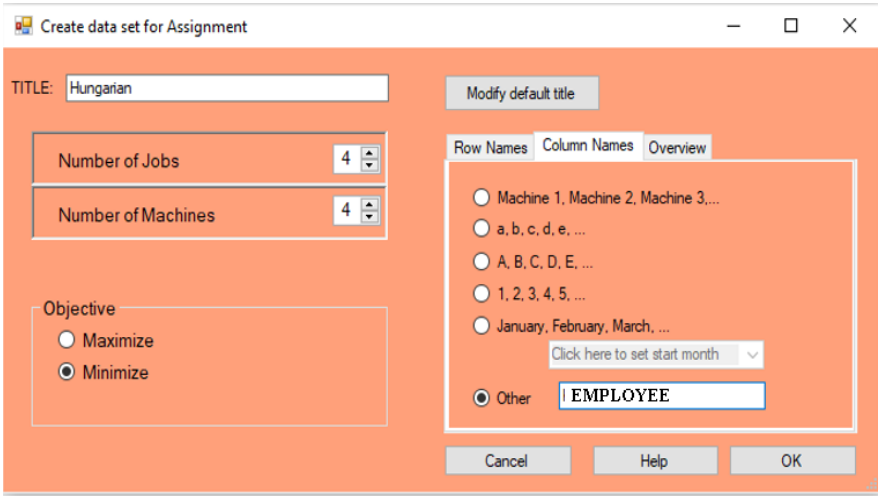
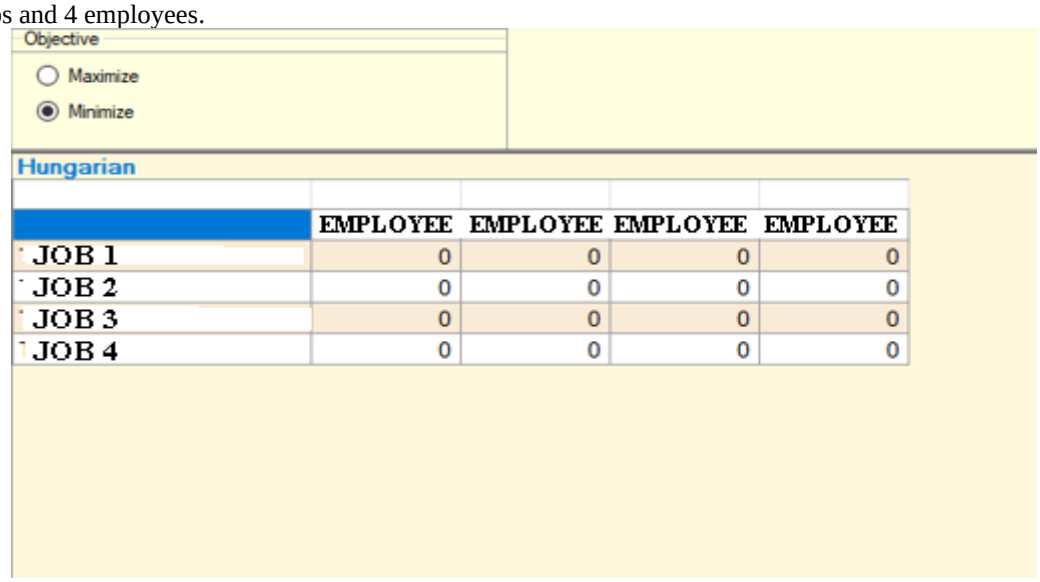


Figure 2. Tree Module

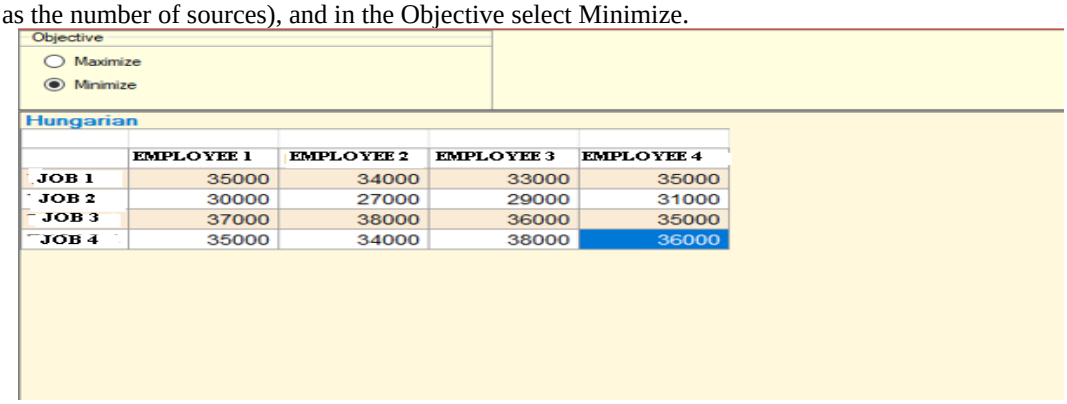
In Figure 2, select the module to determine the number of jobs and the number of employees, based on the data of 4 jobs and 4 employees.



	EMPLOYEE	EMPLOYEE	EMPLOYEE	EMPLOYEE
JOB 1	0	0	0	0
JOB 2	0	0	0	0
JOB 3	0	0	0	0
JOB 4	0	0	0	0

Figure 3. Display Create Data

In Figure 3, write in the Title section with the example title "Data 1", the Number of Sources section with 2 (as many as the number of sources), and in the Objective select Minimize.



	EMPLOYEE 1	EMPLOYEE 2	EMPLOYEE 3	EMPLOYEE 4
JOB 1	35000	34000	33000	35000
JOB 2	30000	27000	29000	31000
JOB 3	37000	38000	36000	35000
JOB 4	35000	34000	38000	36000

Figure 4. Display of input data

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In Figure 4, type the numbers from the distribution cost data in the cells provided. Then click the solve button located on the top right to see the solution results. From the create data table that has been filled in, click ok so that the image above appears.

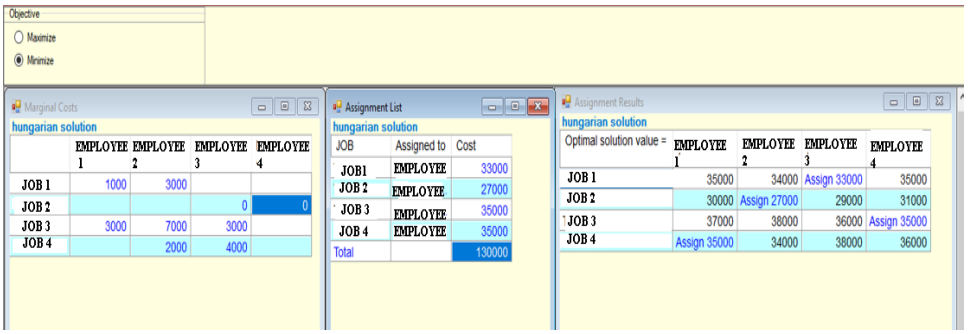

Figure 5. Assignment Results

In Figure 5, based on data processing in the Hungarian method, an assignment that is appropriate to the job has been obtained, the optimal wage fee paid is Rp.130,000 (One Hundred Thirty Thousand Rupiah).

DISCUSSIONS

Based on data processing in the Hungarian method, an assignment that is in accordance with the work in preparing Frozen Food orders at the OneTop Store can cost a daily wage of Rp.130,000 (one hundred and thirty thousand) to be the optimal wage cost per day. when compared with the previous calculation without using the Hungarian method by spending Rp. 175,000 (one hundred and seventy five) wages. Based on the application of the Hungarian method, it is effective in determining an assignment and placement of workers so that they can work more effectively on a better and optimal Frozen Food ordering process.

CONCLUSION

Based on data processing and analysis that has been done, it can be concluded that the best assignment at the TopOne Frozen Store with optimal cost expenditure is Work A, Sorting PO Orders is done by Lisa with a wage of Rp. 33000, Job B, Printing Labels and Stamps is done by Ella, with a salary of Rp. 27000, Job C, Sort Packaging and Packing is done by Wati, with a wage of Rp. 35000 Job D, Delivery of goods is done by Diana, with a wage of Rp. 35000, In finding the optimal value using the Hungarian method, it can be concluded that the optimal total cost incurred by OneTop Frozzen Store with the division of tasks is Rp. 130,000 (One Hundred Thirty Thousand Rupiah) and the placement or allocation of employees becomes more effective.

REFERENCES

Astuti, E. A. (2017). Pengaruh Upah dan Insentif Terhadap Produktivitas Kerja Karyawan. *Jurnal Manajemen Dan Kewirausahaan*, *2*(1), 33–43.

Butar, F. (2021). ANALISIS PEMBERIAN KOMPENSASI GURU SWASTA SMP PADA PERGURUAN ADVENT PASIR PUTIH DESA BARU KECAMATAN SIAK HULU KABUPATEN KAMPAR. *Wedana*, *VII*(2), 11–19.

Dewanta, A., & Sari, R. P. (2021). Analisa Optimalisasi Waktu Kerja Karyawan dengan Menggunakan Metode Hungarian. *Jurnal Ilmiah Mahasiswa Teknik Industri Universitas Kadiri (JURMATIS)*, *3*(2), 92–102.

Harini, D. (2017). Optimasi Penugasan Menggunakan Metode Hungarian. *Intensif*, *1*(2), 68. https://doi.org/10.29407/intensif.v1i2.797

Hia, O. (2019). Implementasi Metode Hungarian Dalam Penugasan Karyawan (Studi Kasus: PT. Jefrindo Consultant). *Jurnal Riset Komputer (JURIKOM)*, *6*(1), 85–92. Retrieved from http://ejurnal.stmik-budidarma.ac.id/index.php/jurikom

Husniati, N. (2017). Analisis Assigment Problem Berdasarkan Penilaian Kinerja karyawan Menggunakan Metode Hungarian (Hungarian Method) dan pohon keputusan (Decision Tree) Assigment analysis based on employee performance appraisal using hungarian method (Hungarian Method. *Jurnal MANAJEMEN*, *9*(1), 2. Retrieved from http://journal.feb.unmul.ac.id/index.php/JURNALMANAJEMEN/article/view/2432

Ibnas, R. (2018). OPTIMASI PEMBAGIAN TUGAS KARYAWAN MENGGUNAKAN METODE

*name of corresponding author

HUNGARIAN (Studi Kasus : Karyawan Grand Sony Tailor Makassar). *Jurnal MSA (Matematika Dan Statistika Serta Aplikasinya)*, *6*(1), 43. https://doi.org/10.24252/msa.v6i1.5279

Imbaruddin, A. Ar. (2020). Memahami Dasar Penetapan Upah Metode Syariah Dan Perbandingannya Terhadap Dasar Penetapan Upah Metode …. *Skripsi- Univ. Hasanudin*. Retrieved from http://repository.unhas.ac.id/id/eprint/82/4/A31116504_skripsi_12-11-2020(FILEminimizer).pdf

Lavinia, D. (2018). Pengaruh Kompensasi Terhadap Loyalitas Karyawan Melalui Motivasi Kerja Sebagai Variabel Intervening Pada Pt. Ehya Purwa Raharjo Gresik. *Agora*, *6*(1), 1–6.

Lukman. (2022). VARIABEL INTERVENING TERHADAP KINERJA PADA KANTOR. *Movere*, *4*(1), 1–10.

Mardiani, S. (2020). Penerapan Metode Hungarian dalam Optimasi Penugasan Karyawan CV. Paksi Teladan. *Bulletin of Applied Industrial Engineering Theory*, *1*(1), 1–2.

Nurhidayati, R. (2021). MANAJEMEN PENUGASAN WAKTU PRODUKSI HASTA KARSA BATIK DENGAN METODE HUNGARIAN HASTA KARYA BATIK PRODUCTION TIME ASSIGNMENT MANAGEMENT WITH HUNGARIAN METHOD Hasta Karsa Batik is an MSME that produces hand drawn batik . The problem of the production process. *SIGMA-Mu*, *13*, 1–6.

Prasetyo, B., & Lubis, A. M. (2020). Penyelesaian Masalah Penugasan pada Drafter Menggunakan Metode Hungarian dan Aplikasi POM-QM. *Bulletin of Applied Industrial Engineering Theory*, *1*(Maret), 21–27.

Putri, E. O. (2017). PENERAPAN METODE TRANSPORTASI VAM DAN MODI PADA PT. DOS NI ROHA SAMARINDA Eka Oktarina Putri, 2017 . *Jurnal Ilmu Manajemen MULAWARMAN*.

Rahman, L. N. (2021). Optimalisasi Penugasan Karyawan Jasa Ekspedisi Menggunakan Metode Hungarian (Studi Kasus CV. Anteraja Cabang Mekarmukti). *Jurnal Serambi Engineering*, *6*(3), 2120–2127. https://doi.org/10.32672/jse.v6i3.3245

Rosmalasari, T. D. (2020). Pengembangan E-Marketing Sebagai Sistem Informasi Layanan Pelanggan Pada Mega Florist Bandar Lampung. *Journal of Social Sciences and Technology for Community Service (JSSTCS)*, *1*(1), 27. https://doi.org/10.33365/jta.v1i1.671

Rudiatin, E. (2021). Building Brand in Digital Marketing Communication : Maintaining Business Sustainability in the Covid-19. *Prosiding PKM-CSR*, *4*, 1255–1261.

Sofiyanurriyanti. (2018). Analisis Penggunaan Metode Asiggnment dalam Mengoptimalkan Penugasan Karyawan untuk Setiap Departemen pada Proses Produksi Ikan Teri Cryspi. *Rekayasa*, *11*(2), 104. https://doi.org/10.21107/rekayasa.v11i2.4416

Sunandar, A. (2018). Meningkatkan Kesejahteraan Pemuda Desa. *ABDIMAS PEDAGOGI: Jurnal Ilmiah Pengabdian Kepada Masyarakat*, *1*(2), 114–121.

*name of corresponding author