Advance Sustainable Science, Engineering and Technology (ASSET)
Vol. 6, No.4, October 2024, pp. 0240401-01 ~ 0240401-08
ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v6i4.675

Enhancing Bus Body Assembly Efficiency: Comparative Analysis of Ranked Positional Weight and Region Approach at PT. ABC

Herry Dwi Prasetyo*, Joumil Aidil SZS,

Department of Industrial Engineering, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya 60294, Indonesia

*prasetyaherry163@gmail.com

Abstract. In general line balancing problems occur in assembling industries compared to manufacturing industries. Problems that often occur on a production line can usually be seen from the presence of a high work in process bottleneck. The problem faced by the company in the production process is the level of efficiency of the workforce and production machines which are still less than optimal, due to the imbalance of the workload between work stations caused by delays in materials from the warehouse, then the operator usually waits for directions from the foreman first, then waits for the material processing process from other station. Therefore, in the bus body assembly process, it is necessary to make an analysis or calculation of the balance of the bus body assembly process so that it can run smoothly. In the line balancing study using the ranked positional weight and region approach methods, the results of the ranked positional weight method for the bus body assembly line efficiency were 78.43%, then for the balance delay of the bus body assembly 21.57% and idle time 1189.16 minutes. After data processing using the region approach method for the bus body assembly line efficiency, the results were 64.84%, then for the balance delay of the bus body assembly 35.16% and idle time 2344.75 minutes.

Keywords: Assembly Line Optimization, Manufacturing Productivity, Efficiency Metrics, Workstation Balancing.

(Received 2024-06-06, Accepted 2024-06-22, Available Online by 2024-08-16)

1. Introduction

In facing the problems of the industrial world and key factors for all manufacturing industries so that they can compete competitively (Pristi et al., 2020). One way to increase production capacity is to optimize resources to produce maximum products while still paying attention to aspects of product quality and quantity (Styawan et al., 2021). One factor that must be considered to achieve production efficiency is the production process time. One way to reduce the imbalance of the production line is through Line Balancing (Gunawan & Wirawati, 2023). In general, line balancing problems occur in assembling industries compared to manufacturing industries. Problems that often occur on a production line can usually be seen from the presence of a high work in process bottleneck (Sabardi et al., 2021). Therefore, companies need to increase the level of production efficiency by minimizing waste. Thus, in an effort to create smooth production, identification needs to be carried out for line balancing. PT. ABC is a company engaged in the field of bus body work. The problem faced by the company in the production process is the level of efficiency of the workforce and production machines which are still less than optimal, due to the imbalance of the workload between work stations caused by delays in materials from the warehouse, then the operator usually waits for directions from the foreman first, then waits for the material processing process from other station. Therefore, in the bus body assembly process, it is necessary to make an analysis or calculation of the balance of the bus body assembly process so that it can run smoothly. This aims to ensure that the company can produce optimal quantities and in accordance with the company's capacity, which is useful for obtaining maximum profits. In overcoming this problem, the researcher used the ranked positional weight (RPW) method and the region approach (RA) method. By focusing on track balance by making improvements, minimizing assembly time waste and efforts to make improvements, namely by finding the best results on the track. It is hoped that the ranked positional weight and region approach methods of line balancing can provide optimal solutions precisely and easily to these problems that can be used as evaluation material for the company.

2. Methods

Variables are objects that are the focus of the study. Related variables, namely the dependent variable in this study is the level of track efficiency in good track balance in the bus body assembly process. The independent variables in this study are assembly process flow diagram data, work element data, time data on each work element. Primary data collection was carried out by interviewing sources/operators, and conducting direct observations of the objects studied as well as secondary data obtained from the company's history and the literature used. The methods used in data processing in this study are the Ranked Positional Weight Method and the Region Approach Method. The flow diagram for solving the problem in this study is as follows:

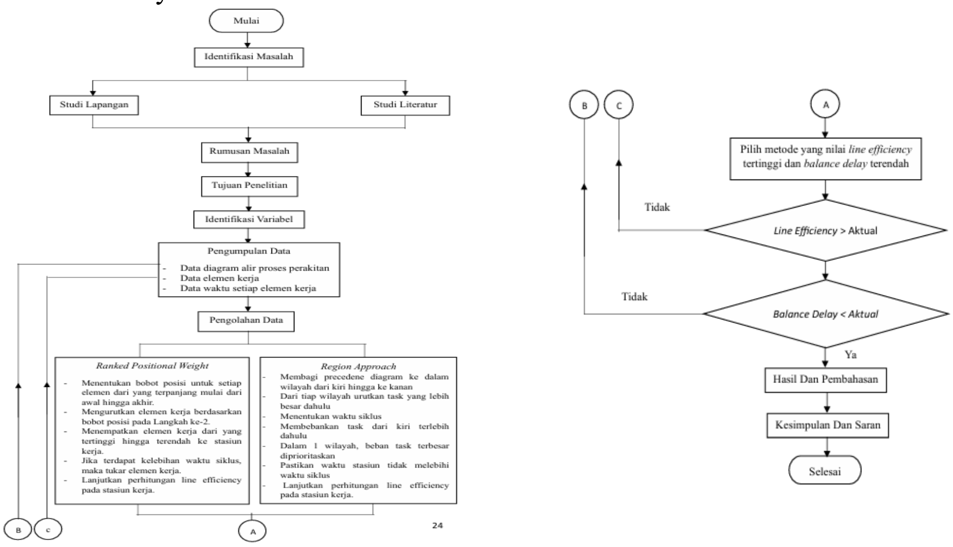


Figure 1. Research Methodology

3. Results and Discussion

In conducting this research, some data are needed to support the solution of the line balance problem. The data needed are work element data, time data for each work element, cycle time for each work element, and precedent diagram data.

Work Station	No	Process	Cycle Time	Normal Time	Standard Timr
	1	Installing the trunk floor	84,43	102,16	116,46
	2	Welding the trunk crank hinges	28,63	34,64	39,49
	3	Welding the trunk door	14,68	17,76	20,24
	5	Setting the aluminum fuel trunk	15,41	18,64	21,25

Stasiun 1	6	Setting the trunk lock	6,51	7,87	8,97
	7	Welding the wellhouse	7,56	9,14	10,42
	8	Tightening the trunk latch	10,38	12,55	14,31
	9	Setting the trunk flap	6,41	7,75	8,84
	12	Welding the trunk door lock	4,23	5,11	5,83
	13	Welding the trunk door lock	3,11	3,76	4,28
	14	Continuing to adjust the trunk	20	24,2	27,58
	15	Preparation for adjusting the trunk	11,16	13,50	15,39
	16	Tidying up the trunk door	15,33	18,54	21,14
	17	Adjusting the trunk lock	3,31	4,005	4,56
	18	Welding the trunk crank hinge	5,1	6,17	7,03
	19	Welding the trunk door	13,45	16,27	18,55
	20	Cutting the patch	25,06	30,32	34,56
	21	Patching the trunk flap	7,31	8,84	10,08
	22	Adjusting the trunk	30,26	36,61	41,74
	23	5R	20	24,2	27,58
	26	Cutting the patch of the trunk flap	9.28	11,22	12,8
	27	Patching the trunk flap	12,71	15,37	17,53
Stasiun 2	34	Sanding the trunk crank hinge	4	4,84	5,51
	35	Sanding the trunk door	7	8,47	9,65
	36	Tidying up the trunk lid	13	15,73	17,93
	37	Tidying up the trunk door	16	19,36	22,07
	38	Cutting the patch of the trunk flap	9	10,89	12,41
	39	Sliding the trunk leaf	20	24,2	27,58
	40	Sanding the trunk door	35	42,35	48,27
	41	Tidying up the wellhouse	13,53	16,37	18,66
	42	Taking the primer and mixing	7,58	9,17	10,45
	43	The operator works on applying the primer	34,01	41,15	46,91
Stasiun 3	44	Preparing to install the ceiling	24,2	29,28	33,38
	45	Grinding the ceiling	2,05	2,48	2,82
	46	Welding the ceiling	6	7,26	8,27
	47	Installing the ceiling	47,53	57,51	65,56
	48	Making Front Door Rubber Mount	15,68	18,97	21,62
	49	Grinding fiber	18,56	22,45	25,6
	50	Grinding driver's bottom dex	42,35	51,24	58,41
	51	Repairing and patching driver's door	35,23	42,62	48,59
	52	Installing plasma	8,28	10,01	11,42
	53	Working on the Rear Curve	47,16	57,06	65,05
	54	Working on the Front Curve	41,05	49,67	56,62
	55	Reaming the Front Curve	32,21	38,97	44,43
	56	Reaming the Rear Curve	39,16	47,38	54,01
	57	Cutting the Front Door to align with the Curve	11,56	13,98	15,94
	58	Installing Fiber	26,9	32,54	37,10
	59	Working on the Rear Door Curve	41,56	50,28	57,32
	60	Reaming the Door and Curve	29,35	35,51	40,48
	61	Repairing the Front Door Step	9,41	11,38	12,98
	62	Working on the Front Door Curve	35,6	43,07	49,10
	65	Reaming the trunk door	26,2	31,70	36,14
	66	Patching the trunk door gap	24,75	29,94	34,14
	69	Taking patch plate material	5,45	6,59	7,51
	74	Installing the trunk tire rubber	4,86	5,88	6,70
	75	Grinding the trunk gap	31,15	37,69	42,96
	76	Providing insulation for the trunk gap	3,16	3,82	4,35
	77	Patching the rear trunk flap	7,08	8,56	9,76
	78	Grinding the rear flap patch	2,93	3,54	4,04
	79	Moving the welding machine	1,96	2,37	2,7
	80	Welding the rear flap	7,38	8,92	10,17
	81	Providing insulation for the rear flap	1,86	2,25	2,56
	82	Patching the battery trunk	8,31	10,05	11,46
	83	Grinding the battery trunk	4,88	5,9	6,73

Stasiun 4	84	Moving the work tools	1,53	1,85	2,11
	85	Preparing the work tools	5,25	6,35	7,24
	86	Patching the rear radiator flap	12,31	14,89	16,98
	87	Replacing the grinding wheel	1,2	1,45	1,65
	88	Grinding the radiator flap patch	4	4,84	5,5176
	89	Tidying up the work tools	5,75	6,95	7,93
	91	Working on the Fuel Funnel	23,58	28,53	32,52
	95	Working on the Windshield Frame	22,23	26,89	30,66
	96	Working on the Battery Trunk	19,86	24,03	27,39
	97	Working on the Toilet Door	11,53	13,95	15,9
	98	Working on the Dead Hull Rear Plate	11,7	14,15	16,13
	99	Welding the Dex Trunk Pipe Cover	27,35	33,09	37,72
	100	Repairing the Rear Wheel Welhouse	7,53	9,11	10,38
	101	Welding the Battery Trunk Grille	3,58	4,33	4,93
	102	Repairing the Front Door Frame	15,7	18,99	21,65
	103	Making the Front Bumper Curve	12,58	15,22	17,35
	109	Working on the Side Glass Mold	22,11	26,75	30,49
	111	Welding the Headband Bracket	49,45	59,83	68,21
	114	Installing the Handrail Mount	11,16	13,50	15,39
	116	Installing the Dashboard Deck	14,7	17,78	20,27
	117	Making the stabilizer and snapring of the air intake trunk	20,53	24,84	28,31
	118	Taking the sealer	2,58	3,12	3,55
	120	Making the middle ladder get trap	10,28	12,43	14,18
	121	Grinding the driver's lower trunk	10,7	12,94	14,75
	122	Welding the ladder trap	10,51	12,71	14,49
	124	Making the front and rear door locks	20,58	24,9	28,38
	125	Tightening the trunk nut	12,43	15,04	17,14
	126	Grinding the front and rear doors	8,41	10,17	11,60
	127	Installing the mirror mount	10,3	12,46	14,20
	129	sanding and polishing the battery trunk	20,28	24,53	27,97
	130	Doing rear ladder sealer	9,51	11,5	13,11
	131	Sanding the unit aisle trunk box	12,58	15,22	17,35
	132	Sanding the rear body	10,43	12,62	14,38
	133	Sanding the right trunk door	4,28	5,17	5,9
	134	Sanding the emergency door	12,3	14,88	16,96
	135	Sanding the left front door	7,86	9,51	10,84
	136	Sanding the driver's door	14,21	17,19	19,6
	137	Sanding the windshield frame	7,4	8,95	10,2
	138	Welding the rear door	14,58	17,64	20,11
	139	Installing the battery trunk bolt	7,53	9,11	10,38
	140	Working on the bottom trunk sealer and dashboard dex	31,08	37,6	42,87
	141	Working on the trunk edge panel sealer	7,71	9,32	10,63
	142	Moving the plasma machine to	30,28	36,63	41,76
	143	Working on the trunk protector sealer	10,38	12,55	14,31
	144	Working on the driver's upper door pipe welding	10,25	12,4	14,13
	146	Working on the rear innelock flap sealer	35,58	43,05	49,07
	148	Making the machine dex	38,25	46,28	52,76
	149	Grinding the 2x4 pipe	4	4,84	5,51
	152	Patching the trunk pipe cover	3,68	4,45	5,07
	153	Patching the rear hull hole	23,2	28,07	32
	154	Patching the front hull hole	37,25	45,07	51,38
	155	Working on the battery trunk dex sealer	10,56	12,77	14,56
	156	Patching the driver's deck	25,23	30,52	34,8
	157	Patching the driver's seat	36,38	44,01	50,18
	159	Preparing to work on the driver's trunk bottom sealer	3,25	3,93	4,48
	160	Working on the stabilizer and air intake trunk snap ring	10,15	12,28	14
	164	Welding the driver's lock house	10	12,1	13,794
	165	Welding stair trap	10,53	12,74	14,52
	166	Sealing the front stair trap	15,35	18,57	21,17
	168	Sealing the right and left trunks	15,53	18,79	21,42

	169	Patching the upper spirit connector	11,71	14,16	16,15
	172	Patching the fuel trunk funnel	6,35	7,68	8,75
	173	5R	30	36,3	41,38
	174	Working on the Radiator Deck	25,11	30,38	34,63
	175	Welding the Bando Bracket	18,15	21,96	25,03
	176	Patching the Dashboard Deck	4,53	5,48	6,24
	177	Adding the Front Door Plate	22,53	27,26	31,07
	178	5R (Clean - Clean)	15	18,15	20,69
		Total	3136	3794,56	4325,8

A. Ranked Positional Weight Method

create a precedent diagram according to the actual, determine the position weight for each work element of an operation process that has a position weight value that has been obtained, then sorted from the highest position weight value to the lowest position weight value. The RPW method is used to determine the optimal number of work stations.

Stasiun Kerja	Elemen Kerja	Waktu Elemen	Bobot	Waktu Total (Menit)
Stasiun 1	1	116,46	4325,8	866,152
	2	39,49	4324,15	
	3	20,24	4323,69	
	4	42,002	4323,24	
	5	21,25	4323,1	
	6	8,97	4322,98	
	7	10,42	4322,83	
	8	14,31	4322,25	
	9	8,84	4321,76	
	10	26,84	4321,52	
	11	19,58	4321,45	
	12	5,83	4321,32	
	13	4,28	4321,24	
	14	27,58	4321,12	
	15	15,39	4320,87	
	16	21,14	4320,73	
	17	4,56	4320,29	
	18	7,03	4320,29	
	19	18,55	4320,282	
	20	34,56	4319,97	
	21	10,08	4319,9	
	22	41,74	4319,56	
	23	27,58	4319,1	
	24	7,11	4319,07	
	25	18,29	4318,77	
	26	12,8	4318,69	
	27	17,53	4318,62	
	28	46,14	4318,56	
	29	41,8	4318,29	
	30	8,82	4318,18	
	31	34,48	4318,07	
	32	124,73	4317,87	
	33	7,73	4317,53	
Stasiun 2	34	5,51	4317,18	219,44
	35	9,65	4317,05	
	36	17,93	4317,05	
	37	22,07	4316,98	
	38	12,41	4316,96	
	39	27,58	4316,83	
	40	48,27	4316,15	
	41	18,66	4316,15	
	42	10,45	4316,04	
	43	46,91	4315,72	
Stasiun 3	44	33,38	4315,63	1069,328
	45	2,82	4315,6	
	46	8,27	4315,58	
	47	65,56	4315,42	
	48	21,62	4315,42	
	49	25,6	4315,38	
	50	58,41	4315,35	
	51	48,59	4315,17	
	52	11,42	4314,96	
	53	65,05	4314,38	
	54	56,62	4314,38	
	55	44,43	4314,34	
	56	54,01	4314,25	
	57	15,94	4314,2	
	58	37,1	4313,39	
	59	57,32	4313	
	60	40,48	4312,82	
	61	12,98	4312,69	
	62	49,1	4312,01	
	63	21,21	4312,006	
	64	21,46	4311,8	
	65	36,14	4311,67	
	66	34,14	4311,62	
	67	28,56	4311,6	
	68	18,48	4311,49	
	69	7,51	4311,49	
	70	20,11	4311,42	
	71	13,79	4311,31	
	72	8,75	4311,28	
	73	7,62	4311,24	
	74	6,7	4311,05	
	75	42,96	4310,98	
	76	4,35	4310,41	
	77	9,76	4310,41	
	78	4,04	4309,9	
	79	2,7	4309,86	
	80	10,17	4309,67	
	81	2,56	4309,65	
	82	11,46	4309,17	
	83	6,73	4308,84	
	84	2,11	4308,82	
	85	7,24	4308,77	
	86	16,98	4308,66	
	87	1,65	4308,45	
	88	5,5176	4308,45	
	89	7,93	4308,27	
Stasiun 4	90	32,2	4307,87	1102,81
	91	32,52	4307,65	
	92	4,68	4307,51	
	93	43,28	4307,32	
	94	18,15	4307,25	
	95	30,66	4307,14	
	96	27,39	4306,22	
	97	15,9	4306,2	
	98	16,13	4306,18	
	99	37,72	4305,69	
	100	10,38	4305,69	
	101	4,93	4305,56	
	102	21,65	4305,53	
	103	17,35	4304,66	
	104	11,55	4304,63	
	105	59,52	4304,59	
	106	36,14	4304,55	
	107	34,89	4304,38	
	108	17,03	4304,34	
	109	30,49	4304,18	
	110	36,42	4304,15	
	111	68,21	4303,73	
	112	11,42	4302,96	
	113	42,08	4300,77	
	114	15,39	4300,2	
	115	8,62	4298,96	
	116	20,27	4298,41	
	117	28,31	4298,22	
	118	3,55	4298,22	
	119	125,7	4298,22	
	120	14,18	4297,93	
	121	14,75	4297,83	
	122	14,49	4297,49	
	123	62,63	4297,42	
	124	28,38	4297,24	
	125	17,14	4295,31	
	126	11,6	4295,14	
	127	14,2	4294,73	
	128	34,94	4293,8	
	129	27,97	4293,6	
Stasiun 5	130	13,11	4293,28	1067,164
	131	17,35	4292,42	
	132	14,38	4291,66	
	133	5,9	4291,32	
	134	16,96	4291,24	
	135	10,84	4291,17	
	136	19,6	4291	
	137	10,2	4290,91	
	138	20,11	4290,86	
	139	10,38	4289,66	
	140	42,87	4289,66	
	141	10,63	4289,38	
	142	41,76	4288,7	
	143	14,31	4288,08	
	144	14,13	4286,31	
	145	7,18	4285,32	
	146	49,07	4284,42	
	147	42,11	4284,06	
	148	52,76	4284,04	
	149	5,51	4284	
	150	16,63	4283,798	
	151	19,62	4283,72	
	152	5,07	4283,69	
	153	32	4282,93	
	154	51,38	4282,84	
	155	14,56	4282,52	
	156	34,8	4281,37	
	157	50,18	4279,66	
	158	2,97	4278,89	
	159	4,48	4277,53	
	160	14	4277,21	
	161	22,84	4276,73	
	162	9,65	4276,7	
	163	10,22	4275,62	
	164	13,794	4274,42	
	165	14,52	4273,04	
	166	21,17	4271,79	
	167	62,07	4269,18	
	168	21,42	4268,48	
	169	16,15	4267,39	
	170	27,87	4266,28	
	171	14,82	4263,73	
	172	8,75	4263,17	
	173	41,38	4260,75	
	174	34,63	4260,24	
	175	25,03	4257,59	
	176	6,24	4209,34	
	177	31,07	4201,07	
	178	20,69	4200,1	
Jumlah		4324,89		
Line Efficiency		78,43%		
Balance Delay		21,57%		
Idle Time		1189,16		

1. **Line Efficiency After Implementing the Ranked Positional Weight Method**

$$LE = \frac{Twc}{n.Tc} x\ 100\%$$

- Line Efficiency work station 1 : $LE = \frac{866,152}{33\ x\ 116,46} x\ 100\% = 22,53\%$
- Line Efficiency work station 2 : $LE = \frac{219,44}{10\ x\ 48,27} x\ 100\% = 45,46\%\%$
- Line Efficiency work station 3 : $LE = \frac{1069,33}{46\ x\ 65,56} x\ 100\% = 35,45\%$
- Line Efficiency work station 4 : $LE = \frac{1102,81}{40\ x\ 125,69} x\ 100\% = 21,94\%$
- Line Efficiency work station 5 : $LE = \frac{1067,16}{49\ x\ 52,76} x\ 100\% = 41,27\%$
- Line Efficiency work station Whole:

$$LE = \frac{4324,89}{5\ x\ 1102,81} x\ 100\%$$

LE = 78,43%

2. **Balance Delay After Implementing Ranked Positional Weight Method**

BD = 100% - LE

- Balance Delay work station 1 : BD = 100% - 22,53% = 77,47%
- Balance Delay work station 2 : BD = 100% - 45,46% = 54,54%
- Balance Delay work station 3 : BD = 100% - 35,45% = 64,55%
- Balance Delay work station 4 : BD = 100% - 21,94% = 78,06%
- Balance Delay work station 5 : BD = 100% - 41,27% = 58,73%
- Balance Delay work station Whole

BD = 100% - 78,43% = 21,57%

3. **Idle Time After Implementing Ranked Positional Weight Method**

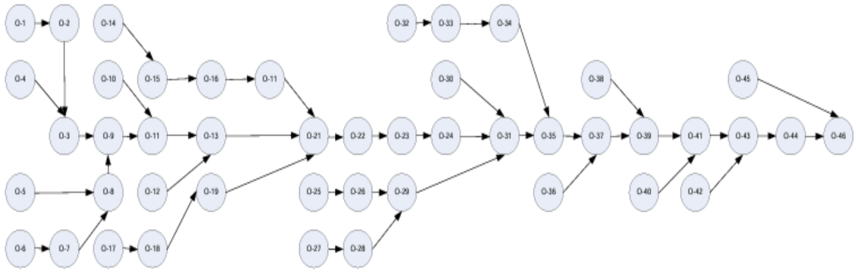
IT = *n.Tc – Twc*

IT = 5 x 1102,81 – 4324,89 = 1189,16 Menit

B. Region Approach Method

In this method, it is done by having a regional approach by dividing the work elements into the same region or area for each work element that works in parallel. This method killbridge method and the western/region approach begins by re-arranging the work network into regions from left to right by placing all work in the farthest possible area.

Stasiun Kerja	Elemen Kerja	Waktu Elemen	Bobot	Waktu Total (Menit)
	1	116,46	4325,8	
	2	39,49	4209,34	
	3	20,24	4286,31	
	4	42,002	4305,56	
	5	21,25	4283,798	
	6	8,97	4304,55	
	7	10,42	4316,83	
	8	14,31	4315,38	
	9	8,84	4311,49	
	10	26,84	4316,96	
	11	19,58	4298,96	
	12	5,83	4306,22	
	13	4,28	4319,97	
	14	27,58	4321,52	
	15	15,39	4298,22	
	16	21,14	4310,41	
Stasiun 1	17	4,56	4304,66	866,15
	18	7,03	4321,24	
	19	18,55	4318,77	
	20	34,56	4307,25	
	21	10,08	4291,24	
	22	41,74	4315,72	
	23	27,58	4284,06	
	24	7,11	4298,22	
	25	18,29	4318,69	
	26	12,8	4307,51	
	27	17,53	4313	
	28	46,14	4308,27	
	29	41,8	4279,66	
	30	8,82	4284	
	31	34,48	4316,98	
	32	124,73	4291,32	
	33	7,73	4201,07	
	34	5,51	4318,07	
	35	9,65	4320,29	
	36	17,93	4316,15	
	37	22,07	4307,87	
Stasiun 2	38	12,41	4303,73	
	39	27,58	4313,39	376,69
	40	48,27	4298,22	
	41	18,66	4277,53	
	42	10,45	4307,14	
	43	46,91	4315,35	
	44	33,38	4278,89	
	45	2,82	4292,42	
	46	8,27	4322,98	
	47	65,56	4317,53	
	48	21,62	4260,24	
	49	25,6	4304,18	
	50	58,41	4300,2	
	51	48,59	4267,39	
	52	11,42	4277,21	
	53	65,05	4314,38	
	54	56,62	4260,75	
	55	44,43	4269,18	
	56	54,01	4281,37	
	57	15,94	4271,79	
	58	37,1	4309,86	
	59	57,32	4288,7	
	60	40,48	4268,48	
	61	12,98	4285,32	
	62	49,1	4312,82	
	63	21,21	4276,7	
	64	21,46	4304,59	
	65	36,14	4304,34	
Stasiun 3	66	34,14	4289,66	1414,63
	67	28,56	4291,66	
	68	18,48	4297,24	
	69	7,51	4307,32	
	70	20,11	4318,29	
	71	13,79	4305,69	
	72	8,75	4312,01	
	73	7,62	4317,05	
	74	6,7	4318,18	
	75	42,96	4319,1	
	76	4,35	4282,84	
	77	9,76	4321,45	
	78	4,04	4316,04	
	79	2,7	4321,76	
	80	10,17	4323,1	
	81	2,56	4315,63	
	82	11,46	4323,24	
	83	6,73	4314,34	
	84	2,11	4319,07	
	85	7,24	4323,69	
	86	16,98	4318,56	
	87	1,65	4308,82	
	88	5,5176	4324,15	
	89	7,93	4320,282	
	90	32,2	4317,87	
	91	32,52	4293,6	
	92	4,68	4293,28	
	93	43,28	4321,12	
	94	18,15	4282,52	
	95	30,66	4307,65	
	96	27,39	4295,14	
	97	15,9	4298,41	
	98	16,13	4309,9	
	99	37,72	4309,67	
	100	10,38	4288,08	
	101	4,93	4315,42	
	102	21,65	4320,87	
	103	17,35	4304,15	
	104	11,55	4308,45	
	105	59,52	4314,25	
	106	36,14	4266,28	
	107	34,89	4289,66	
	108	17,03	4290,91	
	109	30,49	4308,77	
	110	36,42	4295,31	
	111	68,21	4289,38	
	112	11,42	4257,59	
	113	42,08	4314,38	
	114	15,39	4283,72	
	115	8,62	4310,41	
	116	20,27	4317,18	
	117	28,31	4305,53	
	118	3,55	4297,49	
	119	125,7	4322,25	
	120	14,18	4200,1	
	121	14,75	4311,62	
	122	14,49	4311,05	
	123	62,63	4311,31	
	124	28,38	4263,17	
	125	17,14	4297,42	
Stasiun 4	126	11,6	4308,66	
	127	14,2	4314,2	
	128	34,94	4311,6	
	129	27,97	4290,86	
	130	13,11	4297,83	
	131	17,35	4312,69	
	132	14,38	4308,45	
	133	5,9	4311,42	
	134	16,96	4319,9	
	135	10,84	4308,84	
	136	19,6	4314,96	
	137	10,2	4306,2	
	138	20,11	4315,6	
	139	10,38	4305,69	
	140	42,87	4315,42	
	141	10,63	4282,93	
	142	41,76	4315,17	
	143	14,31	4284,04	
	144	14,13	4311,49	
	145	7,18	4311,67	
	146	49,07	4318,62	
	147	42,11	4276,73	
	148	52,76	4283,69	
	149	5,51	4273,04	
	150	16,63	4320,29	
	151	19,62	4309,17	
	152	5,07	4306,18	
	153	32	4320,73	
	154	51,38	4293,8	
	155	14,56	4274,42	
	156	34,8	4311,24	
	157	50,18	4291	
	158	2,97	4275,62	1667,41
	159	4,48	4322,83	
	160	14	4321,32	
	161	22,84	4311,8	
	162	9,65	4302,96	
	163	10,22	4316,15	
	164	13,794	4315,58	
	165	14,52	4312,006	
	166	21,17	4311,28	
	167	62,07	4304,63	
	168	21,42	4263,73	
	169	16,15	4304,38	
	170	27,87	4309,65	
	171	14,82	4297,93	
	172	8,75	4310,98	
	173	41,38	4317,05	
	174	34,63	4284,42	
	175	25,03	4291,17	
	176	6,24	4300,77	
	177	31,07	4319,56	
	178	20,69	4294,73	
Jumlah		4324,89		
Line Efficiency		64,84%		
Balance Delay		35,16%		
Idle Time		2344,75		



1. **Line Efficiency After Implementing the Region Approach Method**

$$LE = \frac{Twc}{n.Tc} x\ 100\%$$

- Line Efficiency work station 1 : $LE = \frac{866,15}{33\ x\ 124,73} x\ 100\% = 21,04\%$
- Line Efficiency work station 2 : $LE = \frac{376,69}{16\ x\ 65,56} x\ 100\% = 35,91\%$
- Line Efficiency work station 3 : $LE = \frac{1414,63}{60\ x\ 59,52} x\ 100\% = 39,61\%$
- Line Efficiency work station 4 : $LE = \frac{1667,41}{69\ x\ 125,7} x\ 100\% = 19,22\%$
- Line Efficiency work station Whole:

$$LE = \frac{4324,89}{4\ x\ 1667,41} x\ 100\%$$

LE = 64,84%

2. **Balance Delay After Implementing Region Approach Method**

BD = 100% - LE

- Balance Delay work station 1 : BD = 100% - 21,04% = 78,96%
- Balance Delay work station 2 : BD = 100% - 35,91% = 64,09%
- Balance Delay work station 3 : BD = 100% - 39,61% = 60,39%
- Balance Delay work station 4 : BD = 100% - 19,22% = 80,78%
- Balance Delay work station Whole

BD = 100% - 64,84% = 35,16%

3. **Idle Time After Implementing Region Approach Method**

IT = n.Tc – Twc

IT = 4 x 1667,41 – 4324,89 = 2344,75 Menit

4. Conclusion

Based on data processing using two track balancing methods, namely ranked positional weight and region approach, there are differences in the results of bus body assembly before and after the application of the methods used. For the results of track efficiency, the balance delay of bus body assembly before using the ranked positional weight and region approach methods obtained a track efficiency of 50.67%, a balance delay of 49.33% and an idle time of 4314.08 minutes. After data processing using the ranked positional weight method, the efficiency of the bus body assembly track obtained a result of 78.43%, a balance delay of bus body assembly of 21.57% and an idle time of 1189.16 minutes. After data processing using the region approach method, the efficiency of the bus body assembly track obtained a result of 64.84%, a balance delay of bus body assembly of 35.16% and an idle time of 2344.75 minutes. To reduce waste in bus body assembly, data processing was carried out using the ranked positional weight and region approach methods. After measurement and processing, the optimal results were obtained in reducing waste on bus body assembly.

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