Raw Material Warehouse Layout Design Using Class-Based Storage Method with ProModel and FlexSim Simulation at Automotive Assembling Company

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Abstract

PT. XYZ is a company engaged in manufacturing that produces cargo boxes, flatbeds, and other types of equipment for transportation. Warehouse PT. XYZ uses a randomized storage policy. Frequently PT. XYZ was unable to reach its production capacity target because the workers were waiting to arrive at the materials. This material shortage occurs because the raw material warehouse is not optimally used, so there is little material storage space. The space for workers to walk becomes narrow because many raw materials are placed on the floor. Finding raw materials is long because workers have to unload the boxes first due to random placement and there is no name on the box. The proposed layout uses the Class-Based Storage method and is validated using ProModel and FlexSim. Validation with ProModel shows that the transfer time of raw materials is 6.33 minutes faster or more efficient in transferring raw materials increases by 16% from the initial layout. Validation with FlexSim shows that the total output increases by 202 units or 11.60%. The best-proposed layout results obtained with a total distance transfer of raw materials of 39698.39m or the efficiency of transfer raw materials increased by 38.34% and the total cost of material handling is more efficient by IDR 63,052,221 or costs decreased by 29.08%.

Keywords
Layout Design, Raw Material Warehouse Layout, Class-Based Storage, ProModel, FlexSim

1. Introduction
PT. XYZ. is a company engaged in manufacturing and producing cargo boxes, flatbeds, and tubs of transportation according to the needs and desires of consumers. Raw material warehouse at PT. XYZ still uses a randomized storage policy. This condition makes the capacity owned by the warehouse not used optimally and will cause a decrease in the actual warehouse capacity and cause the production capacity not to be fulfilled. Frequently PT. XYZ was unable to reach its production capacity target because the workers were waiting to arrive at the materials. This material shortage occurs because the raw material warehouse is not optimally used, so there is little material storage space. Many raw materials are placed on the floor so that the space for workers to walk becomes narrow. In addition, the result of this randomized storage policy is that it takes a long time to find raw materials for workers because workers have to unload the boxes first due to random placement and there is no name on the box.

1.1 Objectives
This study aims to redesign the layout of the raw material warehouse, which has the shortest Distance, the shortest Time, and the lowest material handling cost and performs ProModel and FlexSim simulations to validate the results of the proposed layout.

2. Literature Review
The literature reviews that are used in this research are:

2.1 Class-Based Storage Method

The Class-Based Storage method compromises the randomized storage and dedicated storage methods. This method divides existing products into three, four, or five classes based on the throughput (T) and storage ratio (S) ratio. This method arranges the place designed more flexible by dividing the storage area into several parts. Each of these places can be filled randomly by several types of goods that have been classified based on the type and size of the goods (Francis, et al., 1992).

2.2 ABC Analysis/ABC Classification

ABC classification is a classification of a group of materials in descending order based on the cost of using the material per period. Namely, the price per unit of the material multiplied by the volume of use of the material during a certain period, the period commonly used in ABC analysis is one year. ABC analysis can also be applied using other criteria, not only based on cost criteria but depending on the factors that determine the importance of a material (Gasper, 2005).

Generally, class A has a small number of goods but has a very high value. Three classes, namely A, B, and C, with the size of each class, determined as follows (Sutarman, 2003):

1. Class A: Represents units ranging from 15–20% of the total goods but representing 75–80% of the total value for money.
2. Class B: Represents units ranging from 20–25% of the total goods but representing 10–15% of the total value for money.
3. Class C: These are units ranging from 60–65% of the total goods but representing 5–10% of the total value for money.

2.3 Rectilinear Distance

Rectilinear Distance is measured following a steep path from one facility center point to another. The formula used in this measurement are (Heragu, 2008):

$dij = |\mathrm{x}i - xj| + |\mathrm{y}i - \mathrm{y}j|$ ……..(1)

which:

xi = x-coordinate at facility center i
yi = x-coordinate at the facility center j
dij = distance between facility center i and j

2.4 Material Handling Costs

Material handling costs result from the activity of material or raw materials to be transferred from one machine to another or from one department to another. Material handling planning aims to increase capacity, work better processes, better service to consumers, add equipment, use a room, and reduce costs. Calculation of material handling costs is obtained from the following formula (Wignjosoebroto, 2009):

$Material\ Handling\ Costs = Distance\ x\ Cost\ x\ Frequency$……...……..(2)

2.5 ProModel and FlexSim

ProModel is an application program used to simulate a system and analyze a production system. ProModel is a discrete simulation software that sees a production system as an arrangement of location processes, such as a machine or workstation where entities are processed according to the applied process logic (Harrell, et al., 2004). FlexSim is an easy-to-operate software for simulation. All simulation models are scaled and rendered using 3D visuals. FlexSim also provides decision makers with a tool that helps confirm their observations, with statistical reports.

3. Methods

The flowchart applied in this research can be seen in Figure 1 below.

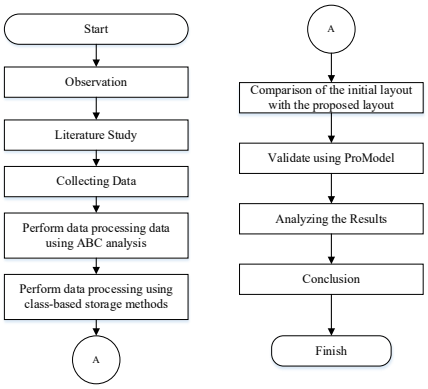

Figure 1. Research Methodology

4. Data Collection

The data used in this study are data of raw materials, initial raw material warehouse layout conditions, frequency of materials movement, a distance of materials movement, Time of materials movement, and data of raw material characteristics. The initial layout can be seen in Figure 2 below.

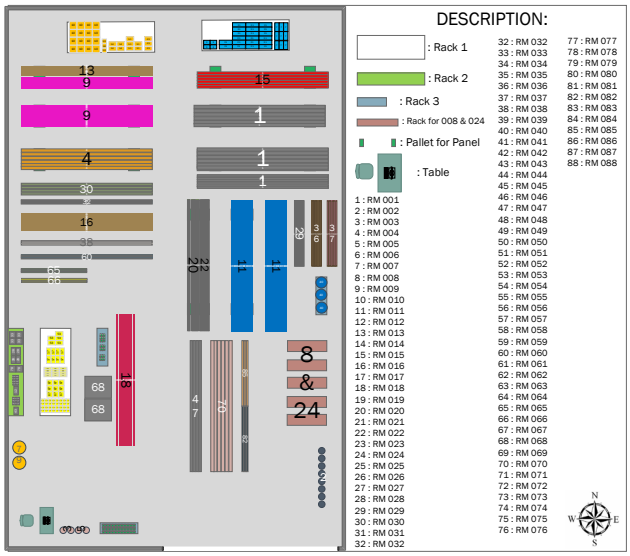

Figure 2. Initial Layout

5. Results and Discussion

5.1 Numerical Results

5.1.1 ABC Class Classification

ABC class classification can be seen in Table 1.

Table 1. ABC Class Classification

No.	Name of Materials	Unit	Quantity	Price	Value	% Quantity	% Value	∑%	Class	No.	Name of Materials	Unit	Quantity	Price	Value	% Quantity	% Value	∑%	Class
1	RM 001	Rod	5314	IDR 183.000	IDR 972.462.000	0,723	21,140	21,140		46	RM 046	Pcs	551	IDR 20.000	IDR 11.020.000	0,075	0,240	96,710	
2	RM 002	Pail	223	IDR 1.604.000	IDR 357.692.000	0,030	7,776	28,916		47	RM 047	Rod	96	IDR 112.500	IDR 10.800.000	0,013	0,235	96,944	
3	RM 003	Pcs	4032	IDR 67.500	IDR 272.160.000	0,549	5,916	34,832		48	RM 048	Pcs	14	IDR 720.000	IDR 10.080.000	0,002	0,219	97,163	
4	RM 004	Rod	1048	IDR 176.667	IDR 185.146.667	0,143	4,025	38,857		49	RM 049	Pcs	1300	IDR 7.500	IDR 9.750.000	0,177	0,212	97,375	
5	RM 005	Can	1644	IDR 110.000	IDR 180.840.000	0,224	3,931	42,788		50	RM 050	Pcs	152	IDR 60.000	IDR 9.120.000	0,021	0,198	97,574	
6	RM 006	Pcs	157028	IDR 1.100	IDR 172.697.151	21,379	3,754	46,543		51	RM 051	Pcs	104	IDR 87.000	IDR 9.048.000	0,014	0,197	97,770	
7	RM 007	Pcs	1970	IDR 82.500	IDR 162.525.000	0,268	3,533	50,076		52	RM 052	Pcs	1697	IDR 5.000	IDR 8.485.000	0,231	0,184	97,955	
8	RM 008	Pcs	3810	IDR 38.727	IDR 147.550.909	0,519	3,208	53,283		53	RM 053	Pcs	3963	IDR 2.100	IDR 8.322.300	0,540	0,181	98,136	
9	RM 009	Rod	1520	IDR 95.000	IDR 144.400.000	0,207	3,139	56,422		54	RM 054	Pcs	21250	IDR 386	IDR 8.204.625	2,893	0,178	98,314	
10	RM 010	Pcs	132045	IDR 1.006	IDR 132.897.791	17,977	2,889	59,311	A	55	RM 055	Can	61	IDR 130.000	IDR 7.930.000	0,008	0,172	98,486	
11	RM 011	Rod	1337	IDR 95.000	IDR 127.015.000	0,182	2,761	62,072		56	RM 056	Sheet	488	IDR 15.000	IDR 7.320.000	0,066	0,159	98,646	
12	RM 012	Pcs	1372	IDR 90.000	IDR 123.480.000	0,187	2,684	64,757		57	RM 057	Pcs	334	IDR 21.857	IDR 7.300.238	0,045	0,159	98,804	
13	RM 013	Rod	307	IDR 400.000	IDR 122.800.000	0,042	2,670	67,426		58	RM 058	Roll	7	IDR 950.000	IDR 6.650.000	0,001	0,145	98,949	
14	RM 014	Unit	166	IDR 692.667	IDR 114.982.667	0,023	2,500	69,926		59	RM 059	Pcs	224	IDR 25.000	IDR 5.600.000	0,030	0,122	99,071	
15	RM 015	Rod	1052	IDR 90.000	IDR 94.680.000	0,143	2,058	71,984		60	RM 060	Rod	50	IDR 100.000	IDR 5.000.000	0,007	0,109	99,179	
16	RM 016	Rod	830	IDR 110.000	IDR 91.300.000	0,113	1,985	73,969		61	RM 061	Roll	75	IDR 59.700	IDR 4.477.500	0,010	0,097	99,277	
17	RM 017	Pcs	294000	IDR 280	IDR 82.320.000	40,027	1,790	75,758		62	RM 062	Roll	480	IDR 8.800	IDR 4.224.000	0,065	0,092	99,368	
18	RM 018	Rod	784	IDR 99.000	IDR 77.616.000	0,107	1,687	77,446		63	RM 063	Pcs	16856	IDR 250	IDR 4.214.000	2,295	0,092	99,460	
19	RM 019	Kg	1530	IDR 50.500	IDR 77.265.000	0,208	1,680	79,125		64	RM 064	Pcs	425	IDR 9.405	IDR 3.997.125	0,058	0,087	99,547	
20	RM 020	Rod	727	IDR 105.000	IDR 76.335.000	0,099	1,659	80,785		65	RM 065	Rod	22	IDR 130.000	IDR 2.860.000	0,003	0,062	99,609	
21	RM 021	Pcs	154	IDR 465.000	IDR 71.610.000	0,021	1,557	82,341		66	RM 066	Rod	18	IDR 110.000	IDR 1.980.000	0,002	0,043	99,652	
22	RM 022	Rod	642	IDR 102.500	IDR 65.805.000	0,087	1,431	83,772		67	RM 067	Roll	14	IDR 134.999	IDR 1.889.986	0,002	0,041	99,693	C
23	RM 023	Pcs	3211	IDR 15.000	IDR 48.165.000	0,437	1,047	84,819		68	RM 068	Sheet	2	IDR 848.400	IDR 1.696.800	0,000	0,037	99,730	
24	RM 024	Pcs	3413	IDR 13.800	IDR 47.099.400	0,465	1,024	85,843		69	RM 069	Sheet	457	IDR 3.550	IDR 1.622.350	0,062	0,035	99,765	
25	RM 025	Pcs	1715	IDR 27.000	IDR 46.305.000	0,233	1,007	86,849		70	RM 070	Rod	16	IDR 95.000	IDR 1.520.000	0,002	0,033	99,798	
26	RM 026	Set	566	IDR 75.250	IDR 42.591.500	0,077	0,926	87,775		71	RM 071	Can	12	IDR 124.800	IDR 1.497.600	0,002	0,033	99,831	
27	RM 027	Pcs	9370	IDR 4.000	IDR 37.480.000	1,276	0,815	88,590		72	RM 072	Pcs	480	IDR 3.000	IDR 1.440.000	0,065	0,031	99,862	
28	RM 028	Pcs	1501	IDR 21.000	IDR 31.521.000	0,204	0,685	89,275		73	RM 073	Roll	109	IDR 6.000	IDR 654.000	0,015	0,014	99,877	
29	RM 029	Rod	235	IDR 125.000	IDR 29.375.000	0,032	0,639	89,914		74	RM 074	Pcs	17	IDR 38.000	IDR 646.000	0,002	0,014	99,891	
30	RM 030	Rod	273	IDR 105.000	IDR 28.665.000	0,037	0,623	90,537	B	75	RM 075	Pcs	15	IDR 42.500	IDR 637.500	0,002	0,014	99,904	
31	RM 031	Pcs	571	IDR 44.900	IDR 25.637.900	0,078	0,557	91,094		76	RM 076	Pcs	18	IDR 32.600	IDR 586.800	0,002	0,013	99,917	
32	RM 032	Rod	231	IDR 102.500	IDR 23.677.500	0,031	0,515	91,609		77	RM 077	Pcs	6	IDR 85.000	IDR 510.000	0,001	0,011	99,928	
33	RM 033	Roll	56	IDR 410.000	IDR 22.960.000	0,008	0,499	92,108		78	RM 078	Pcs	482	IDR 1.000	IDR 482.000	0,066	0,010	99,939	
34	RM 034	Pcs	3599	IDR 6.079	IDR 21.878.921	0,490	0,476	92,584		79	RM 079	Liter	33	IDR 14.250	IDR 470.250	0,004	0,010	99,949	
35	RM 035	Pail	20	IDR 990.000	IDR 19.800.000	0,003	0,430	93,014		80	RM 080	Pcs	4886	IDR 90	IDR 439.740	0,665	0,010	99,959	
36	RM 036	Rod	310	IDR 60.000	IDR 18.600.000	0,042	0,404	93,419		81	RM 081	Pcs	30	IDR 14.238	IDR 427.125	0,004	0,009	99,968	
37	RM 037	Rod	365	IDR 50.000	IDR 18.250.000	0,050	0,397	93,815		82	RM 082	Rod	6	IDR 70.000	IDR 420.000	0,001	0,009	99,977	
38	RM 038	Rod	171	IDR 102.500	IDR 17.527.500	0,023	0,381	94,196		83	RM 083	Can	8	IDR 46.000	IDR 368.000	0,001	0,008	99,985	
39	RM 039	Roll	18	IDR 950.000	IDR 17.100.000	0,002	0,372	94,568		84	RM 084	Pcs	283	IDR 992	IDR 280.642	0,039	0,006	99,991	
40	RM 040	Roll	44	IDR 380.000	IDR 16.720.000	0,006	0,363	94,932		85	RM 085	Rod	2	IDR 80.000	IDR 160.000	0,000	0,003	99,995	
41	RM 041	Pcs	38324	IDR 414	IDR 15.858.471	5,218	0,345	95,276		86	RM 086	Pcs	54	IDR 2.100	IDR 113.400	0,007	0,002	99,997	
42	RM 042	Pcs	1531	IDR 10.000	IDR 15.310.000	0,208	0,333	95,609		87	RM 087	Pcs	12	IDR 9.000	IDR 108.000	0,002	0,002	99,999	
43	RM 043	Pcs	177	IDR 78.500	IDR 13.894.500	0,024	0,302	95,911	C	88	RM 088	Pcs	15	IDR 2.000	IDR 30.000	0,002	0,001	100	
44	RM 044	Pcs	1849	IDR 7.500	IDR 13.867.500	0,252	0,301	96,213			Total		734505		IDR 4.600.087.357		100		
45	RM 045	Pcs	296	IDR 40.000	IDR 11.840.000	0,040	0,257	96,470											

Based on the classification carried out, there are 19 types of raw materials classified as class A raw materials, 21 types classified as class B, and 48 types of raw materials classified as class C raw materials.

5.1.2 Frequency of Raw Material Movement

The frequency of raw material movement can be seen in Table 2.

Table 2. Frequency of Raw Material Movement

No.	Name of Materials	Frequency of Incoming	Frequency of Outgoing	Total Frequency of Incoming & Outgoing	No.	Name of Materials	Frequency of Incoming	Frequency of Outgoing	Total Frequency of Incoming & Outgoing
1	RM 001	46	53	99	46	RM 046	7	21	28
2	RM 002	24	64	88	47	RM 047	12	33	45
3	RM 003	35	45	80	48	RM 048	2	7	9
4	RM 004	33	45	78	49	RM 049	8	11	19
5	RM 005	24	57	81	50	RM 050	0	2	2
6	RM 006	15	172	187	51	RM 051	1	1	2
7	RM 007	8	33	41	52	RM 052	6	18	24
8	RM 008	35	103	138	53	RM 053	6	21	27
9	RM 009	9	9	18	54	RM 054	3	21	24
10	RM 010	10	73	83	55	RM 055	2	6	8
11	RM 011	6	9	15	56	RM 056	3	6	9
12	RM 012	1	20	21	57	RM 057	9	69	78
13	RM 013	6	21	27	58	RM 058	1	2	3
14	RM 014	14	22	36	59	RM 059	6	7	13
15	RM 015	14	19	33	60	RM 060	4	14	18
16	RM 016	13	20	33	61	RM 061	0	4	4
17	RM 017	9	49	58	62	RM 062	4	21	25
18	RM 018	31	38	69	63	RM 063	1	6	7
19	RM 019	12	42	54	64	RM 064	10	15	25
20	RM 020	26	39	65	65	RM 065	1	7	8
21	RM 021	2	7	9	66	RM 066	3	5	8
22	RM 022	26	38	64	67	RM 067	0	6	6
23	RM 023	3	21	24	68	RM 068	0	1	1
24	RM 024	9	18	27	69	RM 069	5	21	26
25	RM 025	4	42	46	70	RM 070	3	1	4
26	RM 026	20	58	78	71	RM 071	2	10	12
27	RM 027	10	10	20	72	RM 072	3	38	41
28	RM 028	7	21	28	73	RM 073	4	21	25
29	RM 029	8	21	29	74	RM 074	3	9	12
30	RM 030	30	38	68	75	RM 075	0	3	3
31	RM 031	1	21	22	76	RM 076	5	6	11
32	RM 032	24	37	61	77	RM 077	0	2	2
33	RM 033	9	16	25	78	RM 078	13	15	28
34	RM 034	10	75	85	79	RM 079	9	15	24
35	RM 035	6	6	12	80	RM 080	1	12	13
36	RM 036	9	9	18	81	RM 081	2	3	5
37	RM 037	10	10	20	82	RM 082	2	1	3
38	RM 038	14	31	45	83	RM 083	2	8	10
39	RM 039	0	4	4	84	RM 084	3	21	24
40	RM 040	7	16	23	85	RM 085	1	1	2
41	RM 041	36	65	101	86	RM 086	2	16	18
42	RM 042	7	21	28	87	RM 087	3	6	9
43	RM 043	0	5	5	88	RM 088	3	6	9
44	RM 044	6	20	26	Total		784	2064	2848
45	RM 045	0	2	2					

The total frequency of raw materials movement is 2848 times in 6 months, with 784 incoming raw materials and 2064 outgoing raw materials.

5.1.3 Initial Area Requirement

The initial area requirement data is obtained from the maximum number of raw materials entering the raw material warehouse every month. The initial area requirement data can be seen in Table 3.

Table 3. Initial Area Requirement

No.	Name of Materials	Unit	Amount of Orders	Storage Capacity	Storage Needs	Stack	Storage Area Requirement	Rounding Results	Places	No.	Name of Materials	Unit	Amount of Orders	Storage Capacity	Storage Needs	Stack	Storage Area Requirement	Rounding Results	Places
1	RM 001	Rod	450	200	2,25	1	2,25	3	Panel Rack	45	RM 045	Pcs	10	12	0,83	2	0,42	1	Box
2	RM 002	Pail	25	9	2,78	3	0,93	1	Pallet	46	RM 046	Pcs	25	12	2,08	2	1,04	2	Box
3	RM 003	Pcs	350	50	7,00	2	3,50	4	Box	47	RM 047	Rod	40	200	0,20	1	0,20	1	Panel Rack
4	RM 004	Rod	170	200	0,85	1	0,85	1	Panel Rack	48	RM 048	Pcs	5	3	1,67	2	0,83	1	Rack Level
5	RM 005	Can	400	288	1,39	1	1,39	2	Black Rack	49	RM 049	Pcs	300	50	6,00	2	3,00	3	Box
6	RM 006	Pcs	80000	2000	40,00	2	20,00	20	Box	50	RM 050	Pcs	12	12	1,00	2	0,50	1	Box
7	RM 007	Pcs	500	20	25,00	2	12,50	13	Box	51	RM 051	Pcs	100	12	8,33	2	4,17	5	Box
8	RM 008	Pcs	750	130	5,77	1	5,77	6	Rack for 008 & 024	52	RM 052	Pcs	400	200	2,00	1	2,00	2	Box
9	RM 009	Rod	500	300	1,67	1	1,67	2	Panel Rack	53	RM 053	Pcs	10000	1000	10,00	2	5,00	5	Box
10	RM 010	Pcs	65000	2000	32,50	2	16,25	17	Box	54	RM 054	Pcs	8000	1000	8,00	2	4,00	4	Box
11	RM 011	Rod	570	300	1,90	1	1,90	2	Panel Rack	55	RM 055	Can	12	4	3,00	2	1,50	2	Rack
12	RM 012	Pcs	1000	1000	1,00	2	0,50	1	Box	56	RM 056	Sheet	300	200	1,50	2	0,75	1	Box
13	RM 013	Rod	50	150	0,33	1	0,33	1	Panel Rack	57	RM 057	Pcs	70	50	1,40	2	0,70	1	Box
14	RM 014	Unit	45	5	9,00	3	3,00	3	Box	58	RM 058	Roll	5	1	5,00	2	2,50	3	Box
15	RM 015	Rod	150	200	0,75	1	0,75	1	Panel Rack	59	RM 059	Pcs	200	200	1,00	2	0,50	1	Box
16	RM 016	Rod	150	200	0,75	1	0,75	1	Panel Rack	60	RM 060	Rod	20	200	0,10	1	0,10	1	Panel Rack
17	RM 017	Pcs	80000	5000	16,00	2	8,00	8	Box	61	RM 061	Roll	12	1	12,00	3	4,00	4	Box
18	RM 018	Rod	70	200	0,35	1	0,35	1	Panel Rack	62	RM 062	Roll	140	2	70,00	4	17,50	18	Box
19	RM 019	Kg	280	5	56,00	5	11,20	12	Box	63	RM 063	Pcs	13800	1000	13,80	3	4,60	5	Box
20	RM 020	Rod	100	200	0,50	1	0,50	1	Panel Rack	64	RM 064	Pcs	120	50	2,40	2	1,20	2	Box
21	RM 021	Pcs	200	2	100,00	5	20,00	20	Box	65	RM 065	Rod	20	200	0,10	1	0,10	1	Panel Rack
22	RM 022	Rod	85	200	0,43	1	0,43	1	Panel Rack	66	RM 066	Rod	20	200	0,10	1	0,10	1	Panel Rack
23	RM 023	Pcs	2000	100	20,00	2	10,00	10	Box	67	RM 067	Roll	12	1	12,00	4	3,00	3	Box
24	RM 024	Pcs	650	130	5,00	1	5,00	5	Rack for 008 & 024	68	RM 068	Sheet	10	1	10,00	5	2,00	2	Pallet
25	RM 025	Pcs	750	100	7,50	2	3,75	4	Box	69	RM 069	Sheet	200	200	1,00	2	0,50	1	Box
26	RM 026	Set	80	20	4,00	2	2,00	2	Box	70	RM 070	Rod	90	200	0,45	1	0,45	1	Panel Rack
27	RM 027	Pcs	2100	1000	2,10	2	1,05	2	Box	71	RM 071	Can	12	4	3,00	2	1,50	2	Rack
28	RM 028	Pcs	265	100	2,65	2	1,33	2	Box	72	RM 072	Pcs	200	1	200,00	4	50,00	50	Box
29	RM 029	Rod	80	200	0,40	1	0,40	1	Panel Rack	73	RM 073	Roll	40	1	40,00	10	4,00	4	Box
30	RM 030	Rod	60	200	0,30	1	0,30	1	Panel Rack	74	RM 074	Pcs	12	1	12,00	2	6,00	6	Box
31	RM 031	Pcs	400	200	2,00	2	1,00	1	Box	75	RM 075	Pcs	12	1	12,00	6	2,00	2	Box
32	RM 032	Rod	30	200	0,15	1	0,15	1	Panel Rack	76	RM 076	Pcs	12	100	0,12	2	0,06	1	Box
33	RM 033	Roll	12	1	12,00	3	4,00	4	Box	77	RM 077	Pcs	12	1	12,00	6	2,00	2	Box
34	RM 034	Pcs	1200	25	48,00	8	6,00	6	Box	78	RM 078	Pcs	300	100	3,00	2	1,50	2	Box
35	RM 035	Pail	5	8	0,63	2	0,31	1	Pallet	79	RM 079	Liter	4	2	1,00	1	1,00	1	Pallet
36	RM 036	Rod	170	200	0,85	1	0,85	1	Panel Rack	80	RM 080	Pcs	2000	500	4,00	2	2,00	2	Box
37	RM 037	Rod	170	200	0,85	1	0,85	1	Panel Rack	81	RM 081	Pcs	12	1	12,00	2	6,00	6	Box
38	RM 038	Rod	10	200	0,05	1	0,05	1	Panel Rack	82	RM 082	Rod	10	200	0,05	1	0,05	1	Panel Rack
39	RM 039	Roll	12	1	12,00	3	4,00	4	Box	83	RM 083	Can	12	1	12,00	2	6,00	6	Rack
40	RM 040	Roll	12	3	4,00	2	2,00	2	Rack Level	84	RM 084	Pcs	120	200	0,60	2	0,30	1	Box
41	RM 041	Pcs	6000	1000	6,00	2	3,00	3	Box	85	RM 085	Rod	12	200	0,06	1	0,06	1	Panel Rack
42	RM 042	Pcs	265	50	5,30	4	1,33	2	Rack Level	86	RM 086	Pcs	24	12	2,00	2	1,00	1	Box
43	RM 043	Pcs	12	12	1,00	2	0,50	1	Box	87	RM 087	Pcs	12	12	1,00	1	1,00	1	Box
44	RM 044	Pcs	500	200	2,50	2	1,25	2	Box	88	RM 088	Pcs	12	12	1,00	1	1,00	1	Box

Based on Table 3, it can be seen that the initial area requirements are 262 boxes, 26-panel racks, 11 racks for RM 008 & RM 024, 5 pallets, two racks for paint, and one rack for rubber.

5.1.4 Initial Raw Material Movement Distance

The distance data for the movement of raw materials in the initial layout can be seen in Table 4.

Table 4. Initial Layout Distance

No.	Name of Materials	Receiving			Delivering			No.	Name of Materials	Receiving			Delivering		
		Distance (m)	f	Total (m)	Distance (m)	f	Total (m)			Distance (m)	f	Total (m)	Distance (m)	f	Total (m)
1	RM 001	20,86	46	959,41	20,86	53	1105,41	46	RM 046	22,71	7	158,94	22,71	21	476,83
2	RM 002	3,72	24	89,33	3,72	64	238,22	47	RM 047	12,64	12	151,69	12,64	33	417,15
3	RM 003	28,65	35	1002,74	28,65	45	1289,23	48	RM 048	11,81	2	23,62	11,81	7	82,67
4	RM 004	28,94	33	954,89	28,94	45	1302,12	49	RM 049	31,53	8	252,20	31,53	11	346,78
5	RM 005	10,67	24	256,03	10,67	57	608,07	50	RM 050	21,70	0	0,00	21,70	2	43,39
6	RM 006	32,15	15	482,28	32,15	172	5530,15	51	RM 051	32,18	1	32,18	32,18	1	32,18
7	RM 007	25,78	8	206,28	25,78	33	850,89	52	RM 052	19,71	6	118,26	19,71	18	354,77
8	RM 008	8,73	35	305,45	8,73	103	898,90	53	RM 053	22,29	6	133,73	22,29	21	468,07
9	RM 009	31,03	9	279,30	31,03	9	279,30	54	RM 054	32,86	3	98,57	32,86	21	689,99
10	RM 010	34,74	10	347,44	34,74	73	2536,31	55	RM 055	19,26	2	38,52	19,26	6	115,56
11	RM 011	17,05	6	102,28	17,05	9	153,42	56	RM 056	22,23	3	66,69	22,23	6	133,39
12	RM 012	21,70	1	21,70	21,70	20	433,94	57	RM 057	23,64	9	212,77	23,64	69	1631,26
13	RM 013	33,10	6	198,62	33,10	21	695,16	58	RM 058	33,44	1	33,44	33,44	2	66,89
14	RM 014	23,13	14	323,84	23,13	22	508,89	59	RM 059	22,71	6	136,24	22,71	7	158,94
15	RM 015	24,75	14	346,44	24,75	19	470,16	60	RM 060	24,59	4	98,35	24,59	14	344,24
16	RM 016	26,27	13	341,56	26,27	20	525,47	61	RM 061	21,47	0	0,00	21,47	4	85,89
17	RM 017	21,50	9	193,48	21,50	49	1053,37	62	RM 062	34,38	4	137,53	34,38	21	722,05
18	RM 018	17,05	31	528,46	17,05	38	647,79	63	RM 063	22,09	1	22,09	22,09	6	132,51
19	RM 019	20,75	12	248,98	20,75	42	871,43	64	RM 064	19,21	10	192,08	19,21	15	288,13
20	RM 020	19,34	26	502,92	19,34	39	754,38	65	RM 065	25,46	1	25,46	25,46	7	178,21
21	RM 021	27,50	2	55,01	27,50	7	192,53	66	RM 066	25,00	3	74,99	25,00	5	124,99
22	RM 022	18,81	26	489,18	18,81	38	714,96	67	RM 067	19,99	0	0,00	19,99	6	119,93
23	RM 023	34,03	3	102,10	34,03	21	714,70	68	RM 068	17,58	0	0,00	17,58	1	17,58
24	RM 024	31,03	9	279,30	31,03	18	558,59	69	RM 069	22,23	5	111,16	22,23	21	466,86
25	RM 025	22,20	4	88,78	22,20	42	932,21	70	RM 070	11,58	3	34,75	11,58	1	11,58
26	RM 026	28,49	20	569,89	28,49	58	1652,69	71	RM 071	19,57	2	39,15	19,57	10	195,75
27	RM 027	23,64	10	236,41	23,64	10	236,41	72	RM 072	19,21	3	57,63	19,21	38	729,92
28	RM 028	23,13	7	161,92	23,13	21	485,76	73	RM 073	22,71	4	90,83	22,71	21	476,83
29	RM 029	15,78	8	126,28	15,78	21	331,48	74	RM 074	21,22	3	63,67	21,22	9	191,00
30	RM 030	27,69	30	830,70	27,69	38	1052,22	75	RM 075	24,22	0	0,00	24,22	3	72,66
31	RM 031	21,22	1	21,22	21,22	21	445,67	76	RM 076	21,70	5	108,49	21,70	6	130,18
32	RM 032	27,10	24	650,52	27,10	37	1002,88	77	RM 077	19,21	0	0,00	19,21	2	38,42
33	RM 033	23,93	9	215,38	23,93	16	382,90	78	RM 078	22,71	13	295,18	22,71	15	340,60
34	RM 034	20,75	10	207,48	20,75	75	1556,13	79	RM 079	18,60	9	167,37	18,60	15	278,96
35	RM 035	12,62	6	75,72	12,62	6	75,72	80	RM 080	24,22	1	24,22	24,22	12	290,66
36	RM 036	15,13	9	136,19	15,13	9	136,19	81	RM 081	21,22	2	42,44	21,22	3	63,67
37	RM 037	14,43	10	144,26	14,43	10	144,26	82	RM 082	9,01	2	18,02	9,01	1	9,01
38	RM 038	25,23	14	353,21	25,23	31	782,10	83	RM 083	20,20	2	40,41	20,20	8	161,64
39	RM 039	22,23	0	0,00	22,23	4	88,93	84	RM 084	20,77	3	62,32	20,77	21	436,22
40	RM 040	11,81	7	82,67	11,81	16	188,95	85	RM 085	12,01	1	12,01	12,01	1	12,01
41	RM 041	34,38	36	1237,81	34,38	65	2234,93	86	RM 086	23,64	2	47,28	23,64	16	378,26
42	RM 042	11,81	7	82,67	11,81	21	248,00	87	RM 087	21,22	3	63,67	21,22	6	127,33
43	RM 043	20,77	0	0,00	20,77	5	103,86	88	RM 088	24,22	3	72,66	24,22	6	145,33
44	RM 044	20,77	6	124,63	20,77	20	415,44	Total				17321,37			47059,98
45	RM 045	20,77	0	0,00	20,77	2	41,54	Total of Receiving and Delivering							64381,35

Based on Table 4, the initial raw material movement distance in the raw material warehouse is 64381.35 m.

5.1.5 Initial Material Handling Cost

The initial material handling costs can be seen in Table 5.

Table 5. Initial Material Handling Cost

No.	Name of Materials	Total Frequency of Incoming & Outgoing	Unit	Total Mileage	Material Handling Tools	Frequency of Displacement	Material Handling Cost (/m)	Total	No.	Name of Materials	Total Frequency of Incoming & Outgoing	Unit	Total Mileage	Material Handling Tools	Frequency of Displacement	Material Handling Cost (/m)	Total
1	RM 001	10509	Rod	41,71	Trolley	99	IDR 1.000	IDR 4.129.642	46	RM 046	1102	Pcs	45,4128	Manual	28	IDR 500	IDR 635.779
2	RM 002	422	Pail	7,44	Trolley	88	IDR 2.000	IDR 1.310.197	47	RM 047	247	Rod	25,2817	Trolley	45	IDR 1.000	IDR 1.137.676
3	RM 003	8623	Pcs	57,30	Manual	80	IDR 1.000	IDR 4.583.944	48	RM 048	23	Pcs	23,6191	Manual	9	IDR 250	IDR 53.143
4	RM 004	2322	Rod	57,87	Trolley	78	IDR 1.000	IDR 4.514.011	49	RM 049	2600	Pcs	63,0512	Manual	19	IDR 250	IDR 299.493
5	RM 005	3194	Can	21,34	Trolley	81	IDR 1.000	IDR 1.728.200	50	RM 050	152	Pcs	43,3943	Manual	2	IDR 500	IDR 43.394
6	RM 006	382516	Pcs	64,30	Manual	187	IDR 250	IDR 3.006.216	51	RM 051	208	Pcs	64,3626	Manual	2	IDR 500	IDR 64.363
7	RM 007	4230	Pcs	51,57	Manual	41	IDR 500	IDR 1.057.171	52	RM 052	3322	Pcs	39,4193	Manual	24	IDR 500	IDR 473.032
8	RM 008	7793	Pcs	17,45	Trolley	138	IDR 1.000	IDR 2.408.706	53	RM 053	7663	Pcs	44,5781	Manual	27	IDR 500	IDR 601.804
9	RM 009	3134	Rod	62,07	Trolley	18	IDR 1.000	IDR 1.117.188	54	RM 054	43250	Pcs	65,7138	Manual	24	IDR 250	IDR 394.283
10	RM 010	306536	Pcs	69,49	Manual	83	IDR 250	IDR 1.441.874	55	RM 055	83	Can	38,5199	Manual	8	IDR 1.500	IDR 462.239
11	RM 011	2797	Rod	34,09	Trolley	15	IDR 1.000	IDR 511.415	56	RM 056	1088	Sheet	44,4628	Manual	9	IDR 250	IDR 100.041
12	RM 012	75	Pcs	43,39	Manual	21	IDR 250	IDR 227.820	57	RM 057	654	Pcs	47,2828	Manual	78	IDR 250	IDR 922.015
13	RM 013	577	Rod	66,21	Trolley	27	IDR 2.000	IDR 3.575.131	58	RM 058	12	Roll	66,8896	Manual	3	IDR 1.500	IDR 301.003
14	RM 014	424	Unit	46,26	Trolley	36	IDR 1.000	IDR 1.665.461	59	RM 059	524	Pcs	45,4128	Manual	13	IDR 500	IDR 295.183
15	RM 015	2180	Rod	49,49	Trolley	33	IDR 1.000	IDR 1.633.201	60	RM 060	112	Rod	49,1771	Trolley	18	IDR 1.000	IDR 885.187
16	RM 016	1764	Rod	52,55	Trolley	33	IDR 1.000	IDR 1.734.049	61	RM 061	2372	Roll	42,9445	Manual	4	IDR 500	IDR 85.889
17	RM 017	569000	Pcs	42,99	Manual	58	IDR 250	IDR 623.421	62	RM 062	778	Roll	68,767	Manual	25	IDR 500	IDR 859.588
18	RM 018	26	Rod	34,09	Trolley	69	IDR 1.000	IDR 2.352.507	63	RM 063	30692	Pcs	44,1716	Manual	7	IDR 500	IDR 154.601
19	RM 019	3430	Kg	41,50	Trolley	54	IDR 1.000	IDR 2.240.826	64	RM 064	765	Pcs	38,4168	Manual	25	IDR 500	IDR 480.210
20	RM 020	1318	Rod	38,69	Trolley	65	IDR 1.000	IDR 2.514.608	65	RM 065	42	Rod	50,918	Trolley	8	IDR 1.000	IDR 407.344
21	RM 021	510	Pcs	55,01	Trolley	9	IDR 1.000	IDR 495.067	66	RM 066	48	Rod	49,9943	Trolley	8	IDR 1.000	IDR 399.954
22	RM 022	1364	Rod	37,63	Trolley	64	IDR 1.000	IDR 2.408.286	67	RM 067	14	Roll	39,9768	Manual	6	IDR 500	IDR 119.930
23	RM 023	7511	Pcs	68,07	Manual	24	IDR 500	IDR 816.804	68	RM 068	2	Sheet	35,1568	Trolley	1	IDR 2.000	IDR 70.314
24	RM 024	6750	Pcs	62,07	Manual	27	IDR 500	IDR 837.891	69	RM 069	983	Sheet	44,4628	Manual	26	IDR 250	IDR 289.008
25	RM 025	4965	Pcs	44,39	Manual	46	IDR 500	IDR 1.020.995	70	RM 070	110	Rod	23,1653	Trolley	4	IDR 1.000	IDR 92.661
26	RM 026	1291	Set	56,99	Trolley	78	IDR 1.000	IDR 4.445.165	71	RM 071	22	Can	39,1499	Manual	12	IDR 1.500	IDR 704.698
27	RM 027	19770	Pcs	47,28	Trolley	20	IDR 1.000	IDR 945.656	72	RM 072	879	Pcs	38,4168	Manual	41	IDR 500	IDR 787.544
28	RM 028	2766	Pcs	46,26	Manual	28	IDR 500	IDR 647.679	73	RM 073	224	Roll	45,4128	Manual	25	IDR 500	IDR 567.660
29	RM 029	484	Rod	31,57	Trolley	29	IDR 1.000	IDR 915.510	74	RM 074	37	Pcs	42,4443	Manual	12	IDR 500	IDR 254.666
30	RM 030	630	Rod	55,38	Trolley	68	IDR 1.000	IDR 3.765.841	75	RM 075	15	Pcs	48,4428	Manual	3	IDR 500	IDR 72.664
31	RM 031	971	Pcs	42,44	Manual	22	IDR 250	IDR 233.444	76	RM 076	58	Pcs	43,3943	Manual	11	IDR 500	IDR 238.669
32	RM 032	476	Rod	54,21	Trolley	61	IDR 1.000	IDR 3.306.808	77	RM 077	6	Pcs	38,4168	Manual	2	IDR 500	IDR 38.417
33	RM 033	121	Roll	47,86	Manual	25	IDR 500	IDR 598.285	78	RM 078	1236	Pcs	45,4128	Manual	28	IDR 250	IDR 317.890
34	RM 034	7115	Pcs	41,50	Manual	85	IDR 500	IDR 1.763.613	79	RM 079	67	Liter	37,1943	Trolley	24	IDR 2.000	IDR 1.785.326
35	RM 035	49	Pail	25,24	Trolley	12	IDR 2.000	IDR 605.758	80	RM 080	6886	Pcs	48,4428	Manual	13	IDR 250	IDR 157.439
36	RM 036	671	Rod	30,26	Trolley	18	IDR 1.000	IDR 544.765	81	RM 081	52	Pcs	42,4443	Manual	5	IDR 500	IDR 106.111
37	RM 037	837	Rod	28,85	Trolley	20	IDR 1.000	IDR 577.022	82	RM 082	26	Rod	18,0173	Trolley	3	IDR 1.000	IDR 54.052
38	RM 038	414	Rod	50,46	Trolley	45	IDR 1.000	IDR 2.270.609	83	RM 083	18	Can	40,4099	Manual	10	IDR 1.500	IDR 606.149
39	RM 039	18	Roll	44,46	Manual	4	IDR 500	IDR 88.926	84	RM 084	523	Pcs	41,5443	Manual	24	IDR 250	IDR 249.266
40	RM 040	82	Roll	23,62	Manual	23	IDR 500	IDR 271.620	85	RM 085	14	Rod	24,0143	Trolley	2	IDR 1.000	IDR 48.029
41	RM 041	74604	Pcs	68,77	Manual	101	IDR 250	IDR 1.736.367	86	RM 086	94	Pcs	47,2828	Manual	18	IDR 500	IDR 425.545
42	RM 042	2796	Pcs	23,62	Manual	28	IDR 500	IDR 330.668	87	RM 087	52	Pcs	42,4443	Manual	9	IDR 1.500	IDR 572.998
43	RM 043	177	Pcs	41,54	Manual	5	IDR 250	IDR 51.930	88	RM 088	2600	Pcs	48,4428	Manual	9	IDR 250	IDR 108.996
44	RM 044	3574	Pcs	41,54	Trolley	26	IDR 1.000	IDR 1.080.152	Total Material Handling Cost								IDR 88.900.244
45	RM 045	296	Pcs	41,54	Manual	2	IDR 500	IDR 41.544									

There are two ways in material handling tools: using the help of a trolley and manually (directly taken by humans). Based on Table 5, the total material handling cost in the initial layout is IDR. 88,900,243.87.

5.2 Graphical Results

The proposed layout design will use storage baskets and racks that are different from the initial layout and pallets for materials that are still placed on the floor. The proposed area requirements are 112 baskets, 53-panel racks, 11 racks

for RM 008 & RM 024, 5 pallets, two racks for paint and one rack for rubber. The proposed layout can be seen in Figure 3.

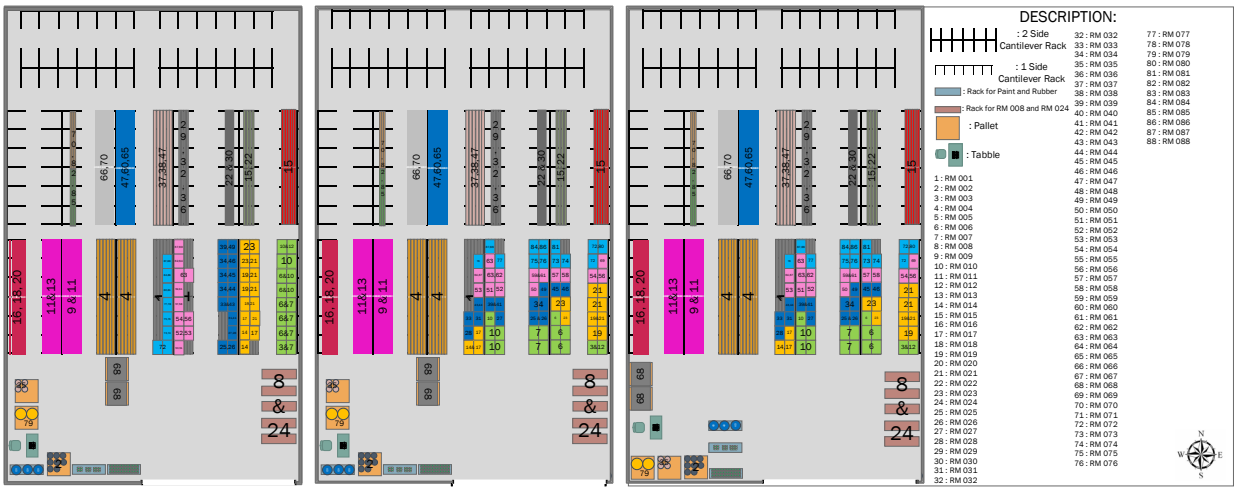

Figure 3. Proposed Layout

5.3 Proposed Improvements

5.3.1 Alternative Layout Selection

In the design of the proposed layout 1, materials that use storage in the form of baskets in class A to class C are placed at the top of the panel rack using the cantilever rack type so that the rack capacity can be used properly, placing the baskets in accordance with the class order, namely the left rack contains class A and the right rack contain class C baskets. The cantilever rack used will be placed in the middle of the back warehouse, while pallets, paint racks, rubber racks, and rack of RM 008 & RM 024 will be placed in the front to make it easier to group raw materials. In the proposed layout 2, the position of the class A baskets is placed closer to the door while the class B and C boxes will be placed behind the class A baskets so that it is divided into several different racks. In the proposed layout 3, the position of all storage areas for raw materials/baskets is still placed in accordance with the proposed layout 2, the difference in the proposed layout 3 is the change in the position of the pallet, paint rack, rubber rack, and rack of RM 008 & RM 024, but these four storage areas still be placed in the position of the front of the warehouse. After getting the three proposed design layouts, the Distance of raw materials movement and material handling costs were recalculated. The results of comparing the initial layout with the proposed layout can be seen in Table 6.

Table 6. Comparison of the Initial Layout with the Proposed Layout

Comparison	Total Distance of Raw Material Movement (m)	The efficiency of Distance (%)	Total Material Handling Cost (IDR)	The efficiency of Material Handling Cost (%)
Initial Layout	64381.35	-	IDR 88,900,243,87	-
Proposed Layout 1	40064.19	37.77	IDR 64,581,126	27.36
Proposed Layout 2	39964.8	37.92	IDR 63,897,921	28.12
Proposed Layout 3	39698.39	38.34	IDR 63,052,221	29.08

Based on Table 6, the proposed layout with the highest efficiency value for the Distance of raw materials movement and total material handling cost is the proposed layout no 3 with a total transfer of raw materials of 39698.39 m or the efficiency of raw materials movement increases by 38.34%. The total material handling costs are more efficient of IDR 63,052,221 or a decrease of 29.08%, then the proposed layout no three is selected.

5.3.2 ProModel Simulation

In the initial layout simulation, there is a combination of several materials located close together because the ProModel software used is the student version, so there is a limit in making locations, which is a maximum of 20 locations. Initial and final layout simulations with ProModel can be seen in Figure 4 – Figure 5.

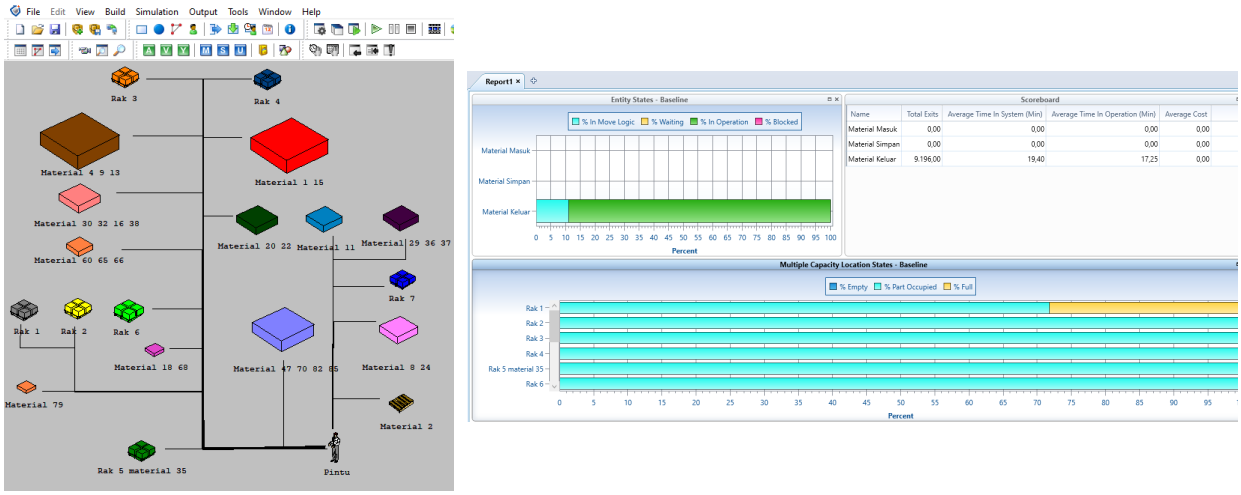

Figure 4. Initial Layout ProModel Simulation

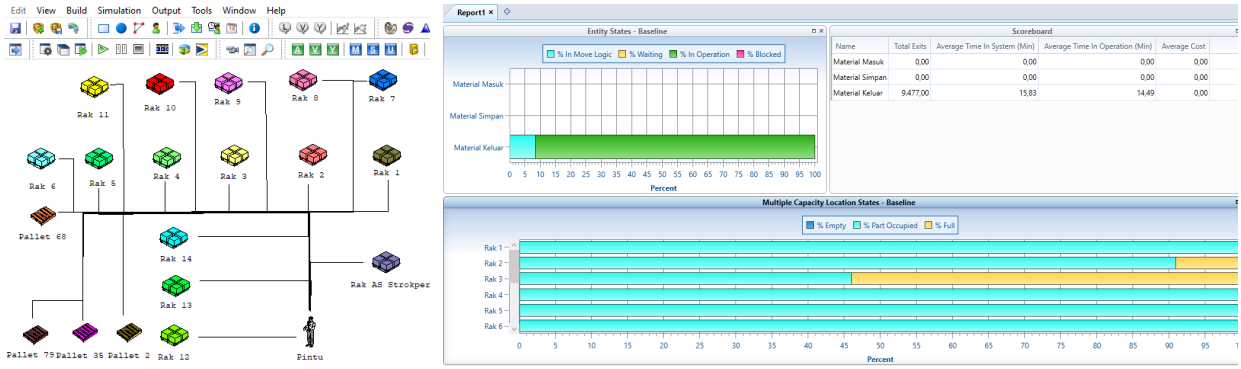

Figure 5. Proposed Layout ProModel Simulation

ProModel simulation results are determined by comparing total exits, the average Time in the system, and the average Time in operation. The results of comparing the initial layout simulation with the proposed layout can be seen in Table 7.

Table 7. Comparison Result of Initial Layout Simulation with Proposed Layout

Comparison	Total Exits	The efficiency of Total Exits (%)	Total Average Time in System (Minute)	Total Average Time in Operations (Minute)	Total Time (Minute)	The efficiency of Time (%)
Initial Layout	9196	-	19.4	17.25	36.65	-
Proposed Layout	9477	2.97	15.83	14.49	30.32	16

The total exits of the proposed layout increased by 281 materials or the efficiency increased by 2.97%, for the total Time the proposed layout had a difference of 6.33 minutes with the initial layout or the efficiency of the Time of raw materials movement increased by 16%.

5.3.3 FlexSim Simulation

The initial layout with the selected proposed layout will be simulated using FlexSim. This simulation aims to find out how much raw material enters the warehouse for 8 hours. Initial and final layout simulations with FlexSim can be seen in Figure 6 – Figure 7.

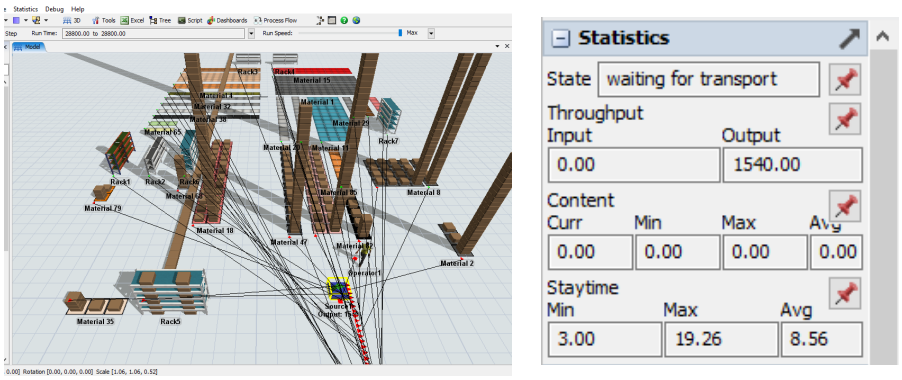

Figure 6. Initial Layout FlexSim Simulation

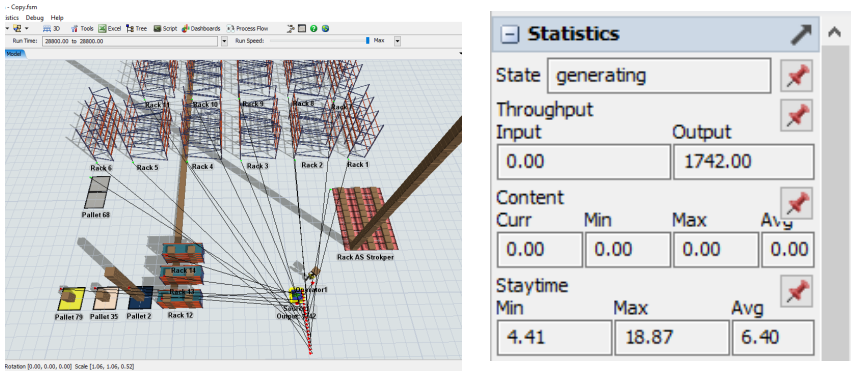

Figure 7. Proposed Layout FlexSim Simulation

The final result of the initial layout simulation is that in 8 hours workers can put in 1540 units of material, while the final result of the initial layout simulation is that in 8 hours workers can put in 1742 units of material. It was found that the total output of the proposed layout increased by 202 units or 11.60%.

5.4 Discussion

This research shows that the class-based storage method can produce the best layout proposals with the lowest displacement distance, displacement time, and material handling as in previous research. The differences on this research with previous research are in the main problems faced by the company. First, the raw materials data processing type, ABC analysis calculations using the number of materials used. In other studies, there are usually no proposed replacement of shelves, storage boxes, and adding pallets to the proposed layout, only moving raw materials' position. (Ramadhan et. al., 2020; Sudiarta et. al., 2020; Gozali et. al., 2020)

6. Conclusion

The design of the proposed layout of the raw material warehouse using the class-based storage method obtained three proposed layout designs with the mileage, the shortest time, and the lowest material handling costs from the initial layout. The proposed layout three was chosen because it has a total distance of 39698.39 m of raw material movement. The efficiency of raw material movement increased by 38.34%, with material handling costs of IDR 63,052,221 or saving more by 29.08% from the initial layout. In the proposed layout, there is also an empty room so that if the company wants to order more material when there is an increase in demand for cargo boxes, then the ordered material can be stored in the warehouse.

The total exits of the proposed layout in the ProModel simulation increased by 2.97% from the initial layout. For the total proposed layout time, there was a difference of 6.33 minutes with the initial layout or the time efficiency of moving raw materials increased by 16%. Validation with FlexSim shows that the total output increases by 202 units or 11.60%. Therefore, it can be validated that the proposed layout 3 is better than the initial layout.

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Biographies

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Lina Gozali

Lina Gozali is a lecturer at the Industrial Engineering Department of Universitas Tarumangara since 2006 and a freelance lecturer at Universitas Trisakti since 1995. She graduated with her Bachelor's degree at Trisakti University, Jakarta - Indonesia. She got her Master's Degree at STIE IBII, Jakarta – Indonesia, and she recently got her PhD at Universiti Teknologi Malaysia, Kuala Lumpur – Malaysia, in 2018. Her apprentice college experience was in the paper industry at Kertas Bekasi Teguh, shoe industry at PT Jaya Harapan Barutama and automotive chain drive industry at Federal Superior Chain Manufacturing. She teaches Production System and Supply Chain Management Subjects. She researched the Indonesian Business Incubator for her PhD. She has written almost 70 publications since 2008 in the Industrial Engineering research sector, such as Production Scheduling, Plant Layout, Maintenance, Line Balancing, Supply Chain Management, Production Planning, and Inventory Control. She had worked at PT. Astra Otoparts Tbk before she became a lecturer.

Frans Jusuf Daywin was born in Makasar, Indonesia on 24th November 1942. is a lecturer in the Department of Agricultural Engineering at Faculty of Agricultural Technology Bogor Agricultural University since 1964 conducted teaching, research, and extension work in the field of farm power and machinery and become a professor in Internal Combustion Engine and Farm Power directing and supervising undergraduate and graduate students thesis and dissertation and retired as a professor in 2007. In 1994 up to present as a professor in Internal Combustion Engine and Farm Power at Mechanical Engineering Program Study and Industrial Engineering Program Study Universitas Tarumanagara, directing and supervising undergraduate student's theses in Agricultural Engineering and Food Engineering Desain. In 2016 up to present teaching undergraduate courses of the introduction of concept technology, research methodology, and seminar, writing a scientific paper and scientific communication, and directing and supervising undergraduate student's theses in Industrial Engineering Program Study at the Faculty of Engineering Universitas Tarumanagara. He got his Ir degree in Agricultural Engineering, Bogor Agricultural University Indonesia in 1966, and finished the Master of Science in Agricultural Engineering at the University of Philippines, Los Banos, the Philippines 1981, and got the Doctor in Agricultural Engineering, Bogor Agricultural University Indonesia in 1991. He joined 4-month farm machinery training at ISEKI CO, AOTS, Japan in 1969 and 14 days agricultural

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Venny Vioren is an industrial engineering student at Universitas Tarumanagara. She was born in Malacca on August 17th, 2002. She graduated from St. Tarcisius Senior High School in 2020. She participated English Olympiad in 2018. She entered Universitas Tarumanagara in 2020 to gain an education and to be able to utilize it through life, especially to help her to achieve her goal of becoming a quality manager. She also wishes to gain a network of both friends and professional contacts that she can carry with her throughout the life span of her career.