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RE-LAYOUT SHOPFLOOR DEPARTMENT AT RETAIL COMPANY TO OPTIMIZE THE INITIAL LAYOUT, MATERIAL HANDLING REDUCTION, AND TRANSPORTATION WASTE MINIMIZATION USING BLOCPLAN ALGORITHM

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ABSTRAK

Starcorss shopfloor employee (receiving and warehousing department) at headquarter stated on very high level of mental workload while high season compared while low season. Based on this consideration, the business owner asked the author personally to develop a new layout for shopfloor department as mitigation for mental workload based on previous research recommendation. Most likely 3 month the author has direct observed and proposed am optimized shopfloor layout with BLOCPLAN Algorithm approach. The proposal also considers about how to reduce waste activities on the shopfloor regarding material handling

INTRODUCTION

Retail clothing business is affected by movement of people's activity in shopping, which previously shopping to many outlets and now shopping to the online shops. (Khairawati S., 2020). Due to people activity in shopping, company on the clothing sector have to ready to stock and aware with product trends, because the result from previous research work (Aditi, 2018) stated customer preference for choosing product based on brand, price, quality, and design. The customer reference makes clothing companies need concern about their products in production process phase. According to (Budiartami and Wijaya, 2019) the output of production process is products that in accordance with plan, price, quality, quantity, and time process. Waste is an important by product of human activity; it is also the outcome of inefficient manufacturing processes, resulting in a waste of essential resources (Asamsuomo and Baird, 2016). Then, waste activities possible to give an impact to material handling and cost. Movingthings from one production facility to another or from one department to another

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is what material handling is all about. Material handling can account for up to half of a company's overall production costs (Supriyadi, 2019).

Starcross is one of brand under retail company (PT. Lintas Bintang Mulia Nusantara) engaged on fashion industry in Yogyakarta, Indonesia. To support business process of production and distribution at Headquarter (main office), Starcross provide shopfloor and creative department for designer or research and development until distribution employee. According to Abrar (2020) in his undergraduate research, Starcorss's shopfloor employee (receiving and warehousing department) at headquarter stated on very high level of mental workload while high season compared while low season. Based on this consideration, the business owner asked the author personally to develop a new layout for shopfloor department as mitigation for mental workload based on previous research recommendation . Most likely 3 month the author has direct observed and proposed to company stakeholders to optimized shopfloor layout with BLOCPLAN Algorithm approach. The proposal also considers about waste activities on the shopfloor regarding material handling.

METHODS

The production system has several components that play an important role in supporting the operational processes of an industry (Eprida B., 2017). In essence, the production process in a company must have a waste, waste generally consists of seven types, namely overproduction, waiting, motion, transportation, unnecessary processes, inventory, and defects (Novitasari R., 2020). Due to identify the real-time issue on the shopfloor, according to Mario C. (2017) stated if fishbone diagram or known as Ishikawa Diagram is a precise visual representation of a phenomenon that involves investigating the various causal factors and how they relate to one another of Equipment, Process, Materials, People, Environment, and Management.

There are six classic categories on figure 1 which are categorized as the main cause of every business process problem. Namely people, equipment, materials, environment, management and processes. The analysis of these six variables that stated on Figure 1 reveals the reasons for a problem regardless of its type or severity (Ishikawa, 1986).

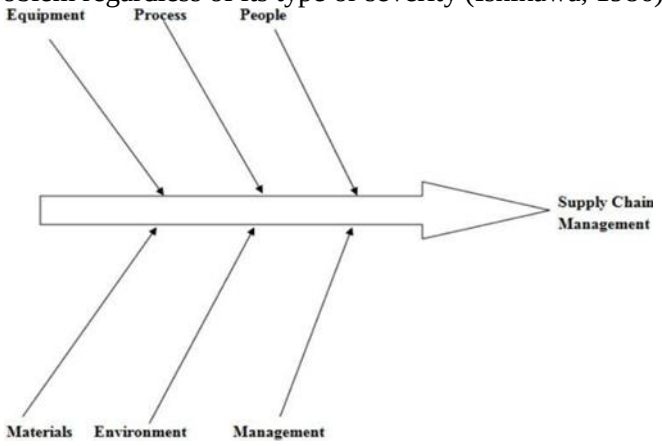

Figure 1. Ishikawa Diagram / Fishbone Diagram

One of the fundamental principles of lean manufacturing is to decrease or eliminate waste in the manufacturing process (Paramawardhani H., 2020). Manufacturing with Lean Principles There are nine different types of waste factors (waste), all of which are represented as E- Downtime. Here is a breakdown of each of these wastes (Baharudin I., 2021) such as

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Environmental Health and Safety (EHS), Defect, Over-Production, Waiting, Non- Utilizing Employee, Transportation, Inventory, Motion, and Excess Processing. The focus is on Transportation Waste which related to shopfloor issue because excessive transportation activities will lead to wasted costs, time, and energy.

Material handling strives to deliver materials to the appropriate place, at the right time, in the correct quantity, and in the right sequence according to the expected conditions in order to reduce production costs (Judha O.C., 2015) by using this formulation:

- The total material handling per meter (MHM) can be calculated by the following equation:

$$MHM = \sum MHC / \sum r \times hk$$

  Description:
  - MHM = material handling cost per meter
  - r = displacement distance (m)
  - hk = working days in a month
- The total material handling cost (MHC) can be calculated by the following equation:

$$\sum Total\ MHC = MCM \times \sum r \times f$$

  Description:
  - MHC = material handling cost
  - MHM = material handling cost per meter
  - r = total displacement distance (m)
  - f = total displacement frequency

Monthly operating costs are calculated by add up depreciation expense with labor cost. Material flow system is divided into four types of layouts (Yulianti R, 2014):

1. Product Layout, in product layout, machines or tools are arranged according to the process order of a product. Products move continuously on the assembly line.
2. Process Layout, factory/process/functional industry's structure and all processes of the same sort are grouped in the same department.
3. Group Layout, this sort of arrangement groups components that are not identical into one group based on the shape of the components, machineries, or equipment used.
4. Fixed Layout, the product moves to the machine in the sequence in which the process is completed, thanks to a system based on product and process arrangement.

According to Heragu (1997) there are several ways that can be used for layout distance measurement, namely:

1. Euclidean, Euclidean matrix measures the straight line between the center of the facility.
   xi = x coordinate of facility centers i, yi = y coordinate of facility centers I, dij = distance between facility centers i and y.
   The following is the equation of the Euclidean matrix = $[(xi)2 + (yi)2]0.5$
2. Squared Euclidean, name implies (squared Euclidian), squaring gives greater weight to the distance of a pair of facilities as well as to their proximity.
   The equations used are: $dij = [(xi - xj)2 + (yi - yj)2]$
3. Square, the rectangle is the sum of the differences between the horizontal and vertical distances from the center point of the two facilities and has the following equation: $dij = |xi - xj| + |yi - yj|$

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4. Tchebychev, the time to reach the center of facility j from the center of facility i depends on the magnitude of the distance x and y. with the following equation: dij =max ($|xi - xj|$, $|yi - yj|$
5. Aisle Distance, Aisle distance is different from all formulas because it is a calculation of the distance that moves along the aisle (aisle) by means of material handling transportation.
6. Adjacency, another formula that indicates whether the facilities are adjacent. This is called the boundary or proximity matrix. The drawback of this formula does not distinguish facilities that are not next to each other or next to each other.

The distance, time, cost, and distance of material moving are all critical factors in manufacturing planning. The long-term efficiency of production is influenced by the form of the manufacturing facility (Pramesti M., 2019). Facility layout is the arrangement of available facilities on shop floor to get the maximum layout. The following are the parameters that wereused (Amri, 2014):

1. The process room's transport distance is kept to a minimum, reducing labor and material moving costs.
2. The material flow is smooth and does not obstruct the continuing production process.
3. Effective space use entails maintaining a spacing between equipment that is neither too large nor too small.
4. Flexibility refers to the design of the plan in such a way that, if necessary, alterations can be made in accordance with current developments (type of product, quantity, quality, etc.).
5. Transported items are guaranteed to be safe. These facilities may me machines, workers, rooms, etc.

Broadly speaking, the main purpose of factory layout according to Purnomo (2014), the basic goal of layout design is to maximize the value provided by the manufacturing industry by optimizing the arrangement of operating facilities (Triyono, 2014). According to Industrial engineering introductory teaching materials by Amri on 2014. The general purpose of the layout is simplifying the process, minimize material transfer, maintain flexibility, maintain the turnover of semi-finished goods, save the use of building space, provide convenience, safety and comfort for employees in doing their jobs.

ARC according to Ukurta Tarigan (2018) is created to determine the level of proximity and to find out why a product should be brought closer or farther away. Before the data is proceed on ARC, the researcher has to collect questionnaire data by related respondents to get the variables closeness. Down below is the example of variables questionnaire (Wahyukaton, 2019):

Table 1. ARC Assessment Sheet

	AD	LR1	LR2	MDB	IB	SIB	DC	PM	OR	T
Administration Desk (AD)										
Lecturer Room 1 (LR1)										
Lecturer Room 2 (LR2)										
Mark Display Board (MDB)										
Information Board (IB)										

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Seminar Information Board (SIB)										
Document Cabinet (DC)										
Photocopy/Printer Machine (PM)										
Officer Room (OR)										
Toilet (T)										

According to Tampubolon (2020,) he stated that ARC is used to convert quality into quantity. ARC consists of 15 work stations, and each section/station is assigned a grade of A, E, I, O, U, or X. Moreover, Prayogo (2020) stated if the reasons for proximity are divided into 3 criteria (Production Criteria, Employee Criteria and Information Criteria). Down below is table of Degree of Importance in Activity Relationship Chart:

Table 2. ARC Table

Code	Colour	Degree of Importance
A	Red	Absolute
E	Orange	Especially
I	Green	Important
O	Blue	Ordinary
U	White	Unimportant
X	Brown	Undesirable

The figure above provides a code that may be used to describe the level of relationship in each facility in a consistent and standardized manner. Down below is the example of Activity Relationship Chart implementation n (Wahyukaton, 2019):

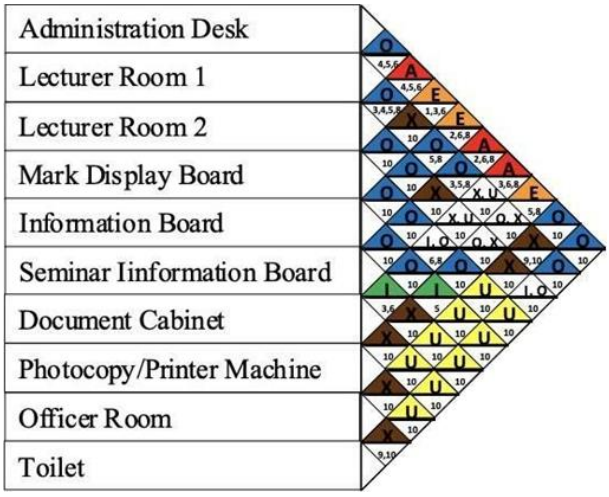

Figure 4. ARC

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In the Activity Relationship Chart that has been designed by, values that show the degree of relationship are recorded together with the underlying explanations (Wingnjosoebroto, Factory Layout and Material Transfer: Third Edition, 2003).

BLOCPLAN Algorithm (Block Layout Overview with Layout Planning) is a heuristic technique that provides both quantitative and qualitative data to create the design, which necessitates the use of an activity relationship chart. This process utilizes the Activity Relationship Chart (ARC), the From to Chart, and the Process Flow as inputs to create and test block type layouts (Widodo, 2006). BPLAN90 software is used to implement the BLOCPLAN algorithm (Setyawan D.T., 2017). According to Andri Nasution and Budi Anugrah (2020), BLOCPLAN Algorithm is one of method in Facility Layout Planning to minimize distance between departments or facilities based on quantitative or qualitative data. Requirements to use BLOCPLAN Algorithm is author must have data of ARC.

RESULT AND DISCUSSION

The business processes of the shopfloor (receiving and warehousing departments) at Starcross can be found in Appendix 1. When the goods from the vendor come to the Headquarter (HQ) at PT. Lintas Bintang Mulia Nusantara, a letter checking will be carried out in advance so that travel documents and goods brought is in accordance with the appropriate quantity. Then, if it is appropriate, the incoming goods will be moved or transported to the Goods Collection Area (GCA). The goods data comes and then entered into the Revota software to be adjusted to the type of goods and the price of the goods. Then, the result from Revota is in the form of a barcode which will be pasted when labelling. When the barcode and data have been entered, the incoming goods will be moved to the Labelling Area where later the goods will be rechecked for quality and put on a brand label using a string pin, brand card, and barcode. Finished goods (which have been labelled with the brand) and defective goods will be separated before being entered into the warehouse area. Then, the finished goods will be moved to the warehouse area and the defect goods will be moved to the Reject Goods Area.

Identification of waste is determining the category of waste that occurs in the receiving and warehousing department when the author is making observations at PT. Lintas Bintang Mulia Nusantara. There are 9 categories of this waste that can be found in Appendix 2, namely: Environmental Health and Safety (EHS), Defect, Over Production, Waiting, Non-Utilizing Employee, Transportation, Inventory,Motion, and Excess Processing.

Flow of material handling on receiving and warehousing department at PT. Lintas Bintang Mulia Nusantara can be found in Appendix 3. The production area is where the facility's initial layout, as well as the layout of proposals at reception and warehousing, are created. The entire accessible area is 202 m^2, which includes 112 m^2 for the reception department and 90 m^2 for the warehousing department. The reception department area measures 16.47 meters by 6.8 meters in length and width. The length and width of the departmental warehouse area are 18 meters long and 5 meters wide. Because the suggested area is in-agreement with the actual conditions, this size is used as a reference for refining the layout of the proposal so that the changes made can be implemented. PT. Lintas Bintang Mulia Nusantara is a company engaged in the clothing sector with an area of 2 departments is 202m^2, which is then divided into several sub-departments. The area of the sub-departments and the number of workers in each department were obtained based on direct observations and interviews can be found in Appendix 4. While the dimensions of each facility on receiving and warehousing departments at PT. Lintas Bintang Mulia Nusantara can be found in Appendix 5. The dimensions of the facilities obtained are used to carry out the preparation of the existing layout facilities as well as the proposed layout so that the dimensions of each facility can be known and arranged

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according to the actual dimensions. According to Pailin (2013), The shape of the area and its appropriateness with the dimensions and facilities contained therein can be considered as evidence of the feasibility of this layout upgrade, which can then be used to recalculate the moment of displacement and material handling costs

Initial Layout of Receiving and Warehousing Departments

Based on the observations that have been made at PT. Lintas Bintang Mulia Nusantara. Receiving and warehousing department is obtained the layout of the room that is currently used by PT. Lintas Bintang Mulia Nusantara can be found in Appendix 6. The interaction between activities on the shop floor of any industry is referred to as an activity relationship. Machines, departments, offices, storage, and other industry activities are examples of activities. To develop an activity connection map, relationships between activities and resources must be identified. You can get this information via conducting surveys or conducting interviews. the form to chart of Activity Relationship Chart (Sharma P., 2018) can be found in Appendix 7.

The distance between departments is visible from the existing layout. To use the cube of the distance, the distance between departments is computed. (Tompkins, White, & Tanchoco, 1996). The results of the departmental rectilinear distance calculation that can be placed in a layout based on the coordinates of the reference point can be found in Appendix 8.

The results of direct observations and interviews at PT. Lintas Bintang Mulia Nusantara became the basic material for data processing. Data processing requires information such as weighting on Activity Relationship Chart (ARC), distance between sub-departments, waste identification, material handling cost, area of sub-departments, initial layout, and total area. Then, the data will be processed using the BLOCPLAN algorithms to get optimal layout results

According to Kriswanto (2021), there are 6 fundamental or principle of Fishbone Diagram to dig some problem identification. Down blow is the principle of Fishbone Diagram:

1. Manpower (Labor), manpower associated to a lack of information, fundamental mental and physical skills, tiredness, tension, indifference, and so on.
2. Machines (Machinery or Equipment), due to the lack of a preventative maintenance system for manufacturing machines, as well as other facilities and equipment, not adhering to task specifications, not being calibrated, being too complicated, being too hot, etc.
3. Methods (Work Methods), work procedures and methods that are incorrect, confusing, unknown, unstandardized, improper, and so on.
4. Materials (Raw Materials and Auxiliary Materials), quality criteria and supporting raw materials are already in place in the sector, ensuring that there are no roadblocks during the manufacturing process and the processing of raw materials and auxiliary materials, for example.
5. Environment, cleanliness, health, work safety, a pleasant work environment, lack of lighting, insufficient ventilation, excessive noise, and other factors are ignored while discussing the location and time of work.
6. Measurement, the action of systematically determining numbers for an object is referred to as measurement.

To conduct the Fishbone Diagram, only a related principle that use according to the main problem. For the case study, author only use 4 principle such as Manpower, Machines, Materials, and Environment. The Fishbone diagram on departments of receiving and warehousing at PT. Lintas Bintang Mulia Nusantara can be found in Appendix 9.

The company struggles significant losses as a result of the waste problem, enhancing production line efficiency is the key to generating earnings (Purnomo D.H., 2020). According

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to data collection process of waste activity identification on receiving and warehousing departments at PT. Lintas Bintang Mulia Nusantara, the waste activity that related with case study and give a significance impact for the company is waste transportation. Meanwhile, waste transportation is the process of transporting waste from the collection point to the integrated waste processing site or final processing site, minimize the distance between departments is one of the ways to reduce the transportation waste (Priambodo B., 2020).

Transfer of material handling distance at PT. Lintas Bintang Mulia Nusantara, especially in the receiving and warehousing departments, was based on the initial layout. The frequency of movement of workers and the cost of material handling per meter are the quantities for calculating the total material handling costs. Labor work hour/days is 5,5 because at Saturdays only a half day. The amount of frequency is multiplied by 3 because every day there is 3 cars from supplier or third party come to the Headquarter (HQ), The table of initial layout of Material Handling Cost (MHC) at receiving and warehousing departments can be found in Appendix 10.

Distance calculations based on business processes that occur in the receiving and warehouse departments are used for comparison and to find out the total distance gap before being converted into a finished layout at PT. Lintas Bintang Mulia Nusantara. In this case the author uses rectilinear distance as tools measurement, the initial layout distance calculation can be found in Appendix 11.

Activity Relationship Chart Measurement

The Activity Relationship Chart (ARC) was created based on considerations of the object of study, process flow, and the number of reasons for proximity based on observations of current work areas and interviews conducted in accordance with the business process flow. owned. The ARC from PT. Lintas Bintang Mulia Nusantara's working area can be found in Appendix 12.

Total Closeness Ratings Measurement

The Total Closeness Rating (TCR) is calculated utilizing the results of filling in the ARC can be found in Appendix 13. The following are the steps involved in performing calculations using the BLOCPLAN algorithm

1. Fill the amount of department, sub-department, or facility. In this case, there are 8 sub department for the input
2. Fill the Activity Relationship Chart (ARC) value data
3. Adjust the layout and select the best proposed layout iteration from 10 iteration:
4. The final-result using BLOCPLAN Algorithm as follows:
5.

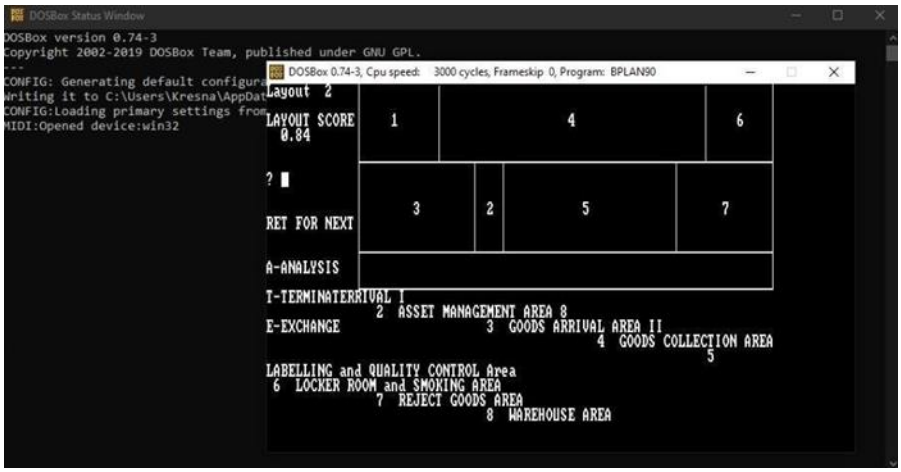

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Figure 5. BLOCPLAN Final Result

The proposed layout according to BLOCPLAN Algorithm result and Adjusted Form according to the available space can be found in Appendix 14 and 15. After the proposed layout is adjusted, then author have to re-calculate the coordinate and rectilinear distance of proposed layout that changed that shown on Appendix 16 and 17. After the proposed layout is adjusted, then author have to re-calculate the Material Handling Cost (MHC) of proposed layout that changed that shown on the on Appendix 18.

ANALYSIS

Basically, the essential of fishbone diagram is a tool in first stage to identify cause and effect regarding to the problem, six parameters of fishbone diagrams are manpower, machines, methods, materials, environment, and measurement. Problem of PT. Lintas Bintang Mulia Nusantara is when the company at High Season phase then it effects to the worker of receiving and warehousing department. The implementation of fishbone diagram regarding or related to is used 4 parameters, then fishbone diagram roots are Material, Manpower, Machines, and Environment. The main causes can be found on Appendix 19.

The information stated if there are 6 main causes regarding the effect which is "Mental workload is in high level at high season phase on receiving and warehousing department at PT. Lintas Bintang Mulia Nusantara". In this case, according to the cause on fishbone diagram the author is focusing on martial root cause such as X1 and X2 that related with waste activities. When distance is influenced material handling cost means it categorized as transportation waste. The process of moving materials or work in progress (WIP) from one work station to another is known as transportation (Jakfar, 2014). Although transportation isnecessary, it does not add value to a product

The total amount of workstation and Activity Relationship Chart (ARC) proximity are the main data input before use BLOCPLAN Algorithm as a tool for choosing the most optimum layout proposal. Base on the tools, in this case author choose 15 iterations from 20 iteration as maximum capacity. Thus, after the software run calculation for proposed layout, the most optimum iteration is iteration number 2 because it has the highest score of R-Score, Adjacency Score, and Rel-Dist Score. The display visualization of iteration 2 stated down on Appendix 20.

The iteration is used by the author as parameters to re-design the proposal layout for PT. Lintas Bintang Mulia Nusantara (Starcross). Based on the BLOCPLAN Algorithm analysis, final iteration that can be seen in iterations 2 (Figure 5.2). Then, author use Adobe Illustration as a tool for display visualization and Solidworks for calculate adjustment on proposed layout distance conditions of PT. Lintas Bintang Mulia Nusantara. Proposal layout is calculated based on rectilinear distance, material handling milage, and material handling cost. The result of proposal rectilinear distance is 1164.15 meters, proposal material handling milage is 144.44 meters, and proposal material handling cost is Rp 2.180.750.

After doing a comparison between the initial and proposed layouts, the author perform calculations to find out how much efficiency it gets in the receiving and warehousing departments after the facility displacement. The basic formula for calculating the percentage comparison can be presented as follows:

$$Total\ Initial\ Rectilinear\ Distance - Total\ Proposed\ Rectilinear\ distance$$

The final step of analyzation is comparison between initial layout with proposed layout. Down below is table comparison between both layout:

Table 1. Comparison between Initial Layout with Proposed Layout

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No	Variable Comparison	Total Rectilinear Distance (m)	Total Material Handling Milage (m)	Total Material Handling Cost (Rp)
1	Initial layout	1089,34	137,32	**Rp2.475.094**
2	Proposed Layout	1164,15	144,44	**Rp2.180.750**
3	Percentage (%)	**-7%**	**-5%**	**12%**

According to the Table 1, as we can see comparison analysis of Total; Rectilinear Distance, Material Handling Milage, and Material Handling Cost make a differentiation. Differentiation rectilinear distance between initial and proposed layout is -7%. Then, for the differentiation on material handling milage between initial and proposed layout is -5%. Moreover, the differentiation on material handling cost between initial and proposed layout is 12%.

CONCLUSIONS

In this research, researcher find a problem in this research based on fishbone diagram's root cause which is have to reduce material handling cost and waste transportation activities through re-design layout using BLOCPLAN Algorithm during High Season on receiving and warehousing departments at Starcross which means the output of this research is a new layout proposal for the company. Researcher use BLP99 Software as a support tool to figure out automatically which one is most optimum layout, then on the software researcher select 15 iterations to measured automatically. On BLP99 Software, there are three scoring parameters such as R-Score, Adjacency Score, and Rail Dist. Score. Based on those three scoring parameters, the most optimum data that shown is Iteration 2. Researcher use Iteration 2 for fundamental new layout. On the new layout, researcher also measure the new rectilinear distance, material handling millage, and material handling cost to differentiate with the initial data. The measurement result from proposal layout data is total rectilinear distance is -7%, total material handling milage is –5%, and total material handling cost is 12%. From the analysis comparison data above, researcher is failed to reduce the rectilinear distance and material handling milage from initial data then there still exist the transportation waste. But on the other side, researcher succeed to reduce the material handling cost in new layout proposal. It is concluded that this new layout still able to implemented for receiving and warehousing department Suggestions for company regarding to the problem that discussed through this report is explained as follows:

1. Proposal layout on receiving and warehousing is implemented, because one of the layout parameters which is material handling cost is reduced. Thus, it will give impact to production cost on High Season phase.
2. Although, this research still needs further research to find another variable that influenced layout facilities to give more advantage for the company. For instance, based on fishbone diagram result there are aspects such as Material, Machine, and Manpower that still need further research

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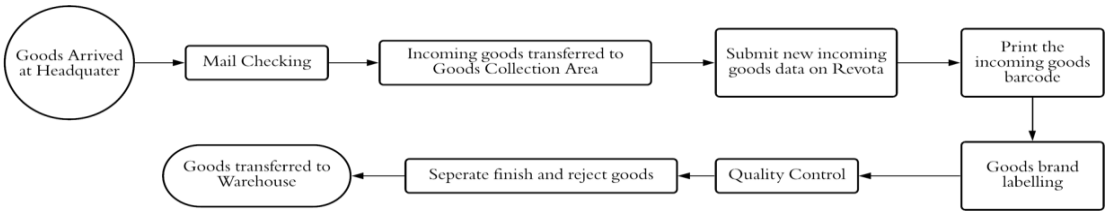
APPENDIX 1
BUSINESS PROCESS FLOW



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APPENDIX 2
Waste Activities

No.	Waste Categorization	Waste Description
1	Environmental Health and Safety	Receiving employee using sandals not shoes
2	Defect	Misaligned or incorrect stitching of clothes and improper placement of brand logos.
3	Over Production	Lack of space when in High Season position and an-overload incoming goods from third-party
4	Waiting	-
5	Non-Utilizing Employees	Freelancer not compatible
6	Transportation	Material handling distance have a long distance
7	Inventory	Full storage and uncategorized
8	Motion	The sitting position in labelling employee is not good because of the bent body posture and repetitive motions
9	Excess Processing	-

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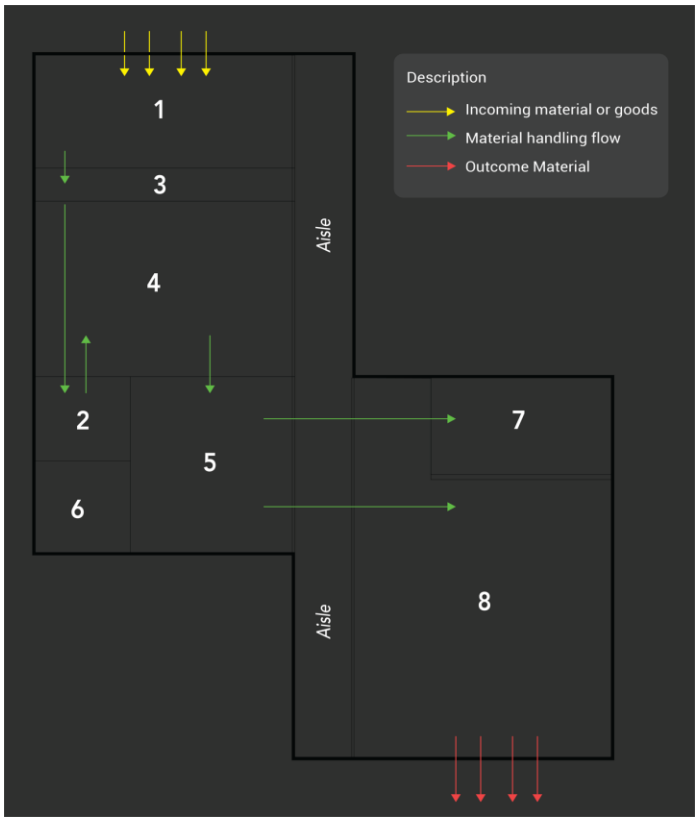
APPENDIX 3
Initial Material Handling Flow



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APPENDIX 4
Detail of Function and Capacity

No.	Facility Name	Area Function	Worker
1	Goods Arrival Area I	To carry out checking of travel documents and letters of conformity with the number of shipments ordered from vendors.	**7**
2	Asset Management Area	Entering incoming goods data in the receiving department into the Revota application to update data and create barcodes. Then, do barcode printing	
3	Goods Arrival Area II	As a place for goods to be unloaded from transportation and still random and untidy after checking the letter has been verified	
4	Goods Collection Area	Sorting incoming goods from Good Arrival II into 4 categories including clothing, pants, accessories, and footwear. And prepare equipment for labeling workers into baskets.	
5	Labelling and Quality Control Area	Checking the quality of the product, labelling Starcross brand, put on selected barcode. Thus, separate the finished goods and defect goods.	
6	Locker Room and Smoking Area	A place to store workers' personal belongings and as a place to chat while resting.	
7	Reject Goods Area	As a storage place for reject goods.	**0**
8	Warehouse Area	As a place to store finished goods and have been labelled and categorized	

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APPENDIX 5
Facility Dimensions

No.	Facility Name	Code	Size (m)		Total Area
			Length	Width	
1	Goods Arrival Area I	A	4,1	2,65	10,865
2	Asset Management Area	B	1,7	2,65	4,505
3	Goods Arrival Area II	C	6,8	2,65	18,02
4	Goods Collection Area	D	6,8	5,3	36,04
5	Labelling and Quality Control Area	E	6,8	3,975	27,03
6	Locker Room and Smoking Area	F	6,8	1,325	9,01
7	Reject Goods Area	G	5	3	15
8	Warehouse Area	H	5	15	75

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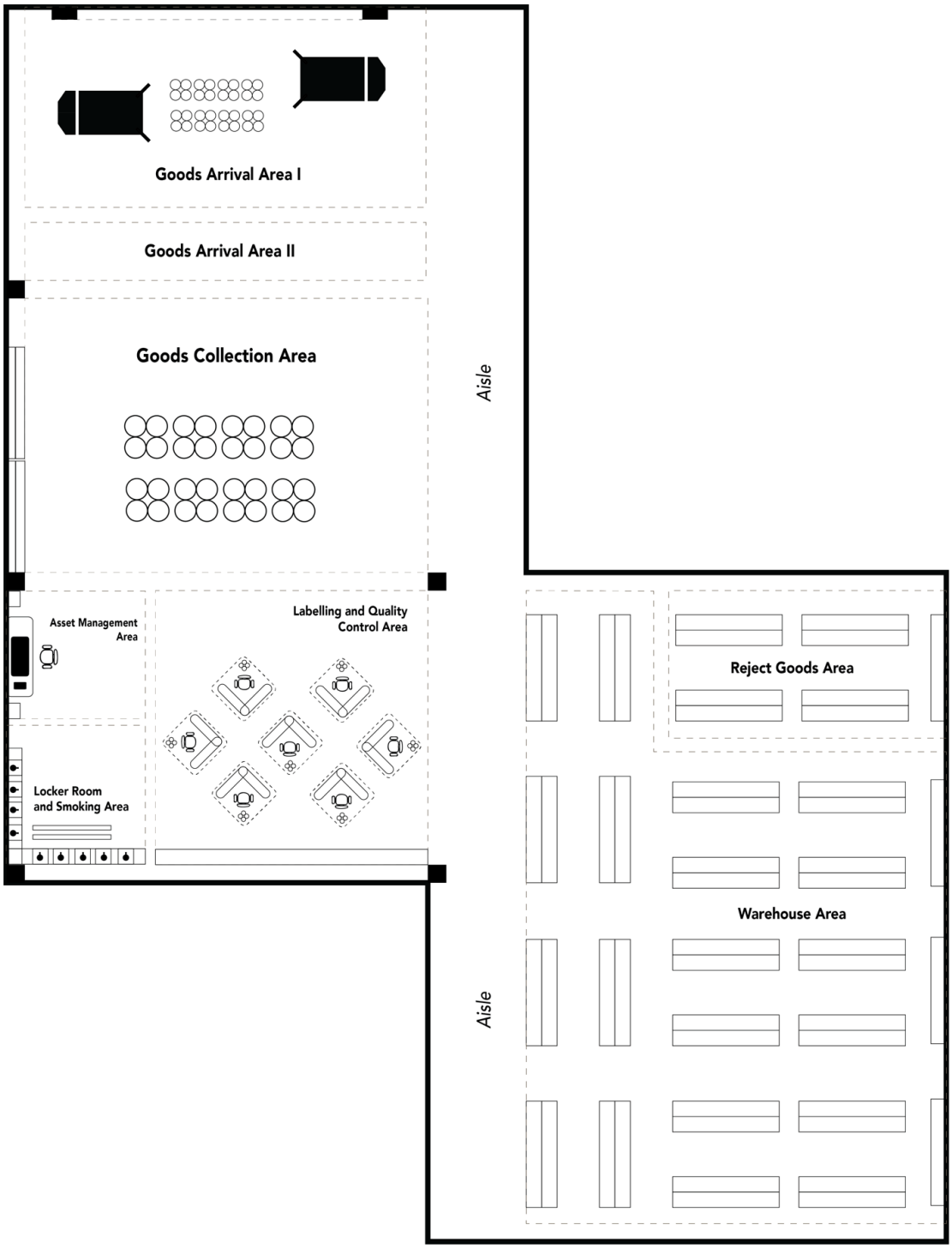
APPENDIX 6
Initial Layout and Initial Layout with Block Form



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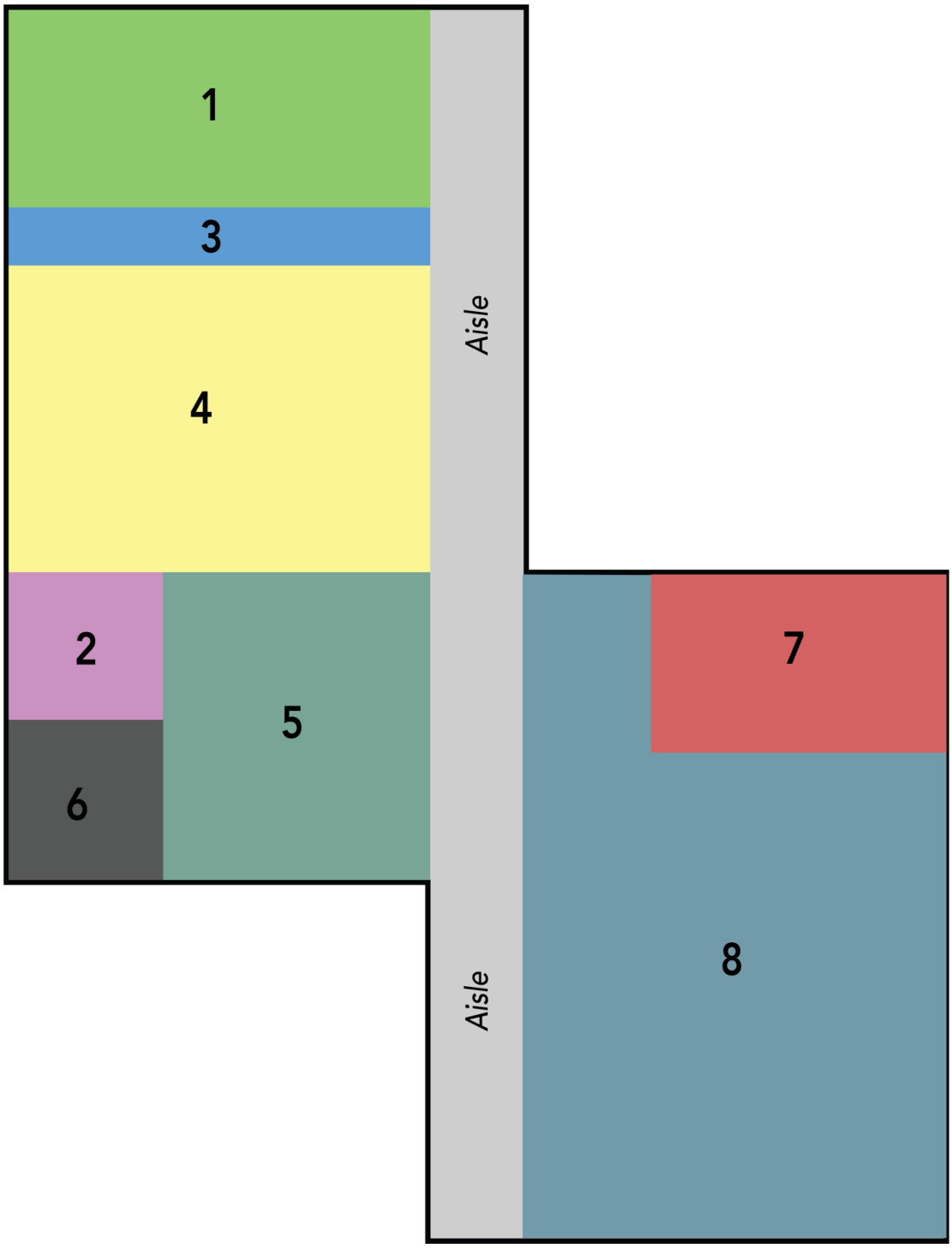

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APPENDIX 7
From to Chart ARC

No.	Facility	Code	A	B	C	D	E	F	G	H
1	Goods Arrival Area I	A		A	A	E	U	O	U	**U**
2	Asset Management Area	B	A		A	A	U	O	U	**A**
3	Goods Arrival Area II	C	A	A		A	U	O	I	**U**
4	Goods Collection Area	D	E	A	A		A	O	A	**A**
5	Labelling and Quality Control Area	E	U	U	U	A		O	A	**A**
6	Locker Room and Smoking Area	F	O	O	O	O	O		U	**U**
7	Reject Goods Area	G	U	U	U	U	A	U		**U**
8	**Warehouse Area**	**H**	**U**	**A**	**U**	**I**	**A**	**U**	**A**	

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APPENDIX 8
Facility Coordinates

No.	Facility Name	Code	Coordinates	
			X	Y
1	Goods Arrival Area I	A	23,38	14,38
2	Asset Management Area	B	21,8	4,09
3	Goods Arrival Area II	C	23,6	11,76
4	Goods Collection Area	D	23,6	8,24
5	Labelling and Quality Control Area	E	25,08	2,89
6	Locker Room and Smoking Area	F	21,82	1,56
7	Reject Goods Area	G	32,32	4,09
8	Warehouse Area	H	31,37	-3,46

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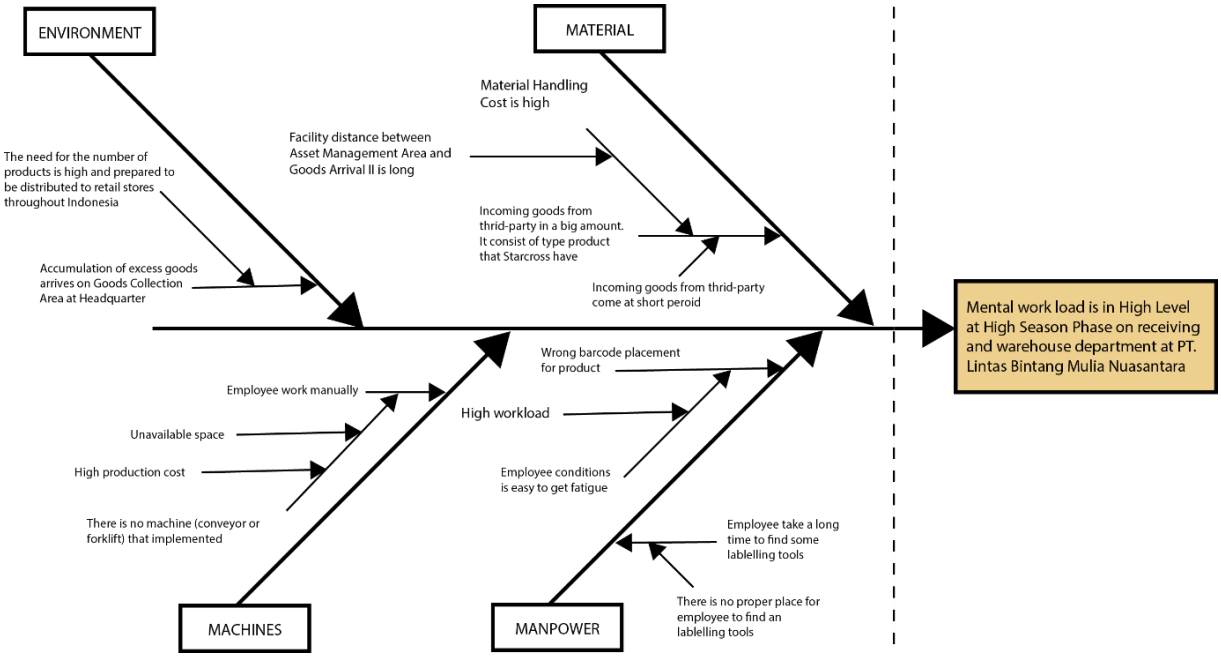
APPENDIX 9
FISHBONE DIAGRAM



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APPENDIX 10
Initial Rectiliner Distance

Code	Facility	From	To	Frequency	Distance (m)	MHC/m (Rp)	Total MHC (Rp)
A	Goods Arrival Area I	A	C	6	31,4	Rp175	Rp144.317
B	Asset Management Area	B	D	3	16,44	Rp335	Rp137.821
C	Goods Arrival Area II	C	B	6	31,84	Rp173	Rp142.323
D	Goods Collection Area	D	E	18	29,31	Rp188	Rp463.824
E	Labelling and Quality Control Area	E	G	18	14,94	Rp368	Rp909.952
		E	H	12	13,39	Rp411	Rp676.857
F	Locker Room and Smoking Area						
G	Reject Goods Area						
H	Warehouse Area						
		Total			**137,32**		**Rp2.475.094**

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APPENDIX 11
Initial Rectilinear Distance

No.	From	To	Coordinates From		Coordinates From		Rectilinear Distance (Dij= |xi-xj| + |yi-yj|)	Total
			X1	Y1	X2	Y2		
		B	23,38	14,38	0,22	2,62	34,92	
		C	23,38	14,38	0,22	6,14	31,4	
		D	23,38	14,38	1,56	10,29	25,91	
		E	23,38	14,38	1,56	12,82	23,38	
		F	23,38	14,38	1,64	11,49	24,63	
1	A	G	23,38	14,38	8,94	10,29	18,53	**170,69**
		H	23,38	14,38	7,99	17,85	11,92	
		A	21,8	4,09	0,22	2,62	23,05	
		C	21,8	4,09	0	3,52	22,37	
		D	21,8	4,09	1,78	7,67	16,44	
		E	21,8	4,09	1,78	10,2	13,91	
		F	21,8	4,09	1,43	8,87	15,59	
2	B	G	21,8	4,09	8,72	7,67	9,5	**103,75**
		H	21,8	4,09	7,77	15,23	2,89	
		A	23,6	11,76	0,22	6,14	29	
		B	23,6	11,76	0	3,52	31,84	
		D	23,6	11,76	1,78	4,15	29,43	
		E	23,6	11,76	1,78	6,67	26,91	
3	C	F	23,6	11,76	1,43	5,35	28,58	**184,13**

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		G	23,6	11,76	8,72	4,15	22,49	
		H	23,6	11,76	7,77	11,71	15,88	
4	D	A	23,6	8,24	1,56	10,29	19,99	**161,11**
		B	23,6	8,24	1,78	7,67	22,39	
		C	23,6	8,24	1,78	4,15	25,91	
		E	23,6	8,24	0	2,53	29,31	
		F	23,6	8,24	3,2	1,2	27,44	
		G	23,6	8,24	10,5	0	21,34	
		H	23,6	8,24	9,55	7,56	14,73	
5	E	A	25,08	2,89	1,56	12,82	13,59	**126,32**
		B	25,08	2,89	1,78	10,2	15,99	
		C	25,08	2,89	1,78	6,67	20	
		D	25,08	2,89	0	2,53	25,44	
		F	25,08	2,89	3,2	1,32	23,45	
		G	25,08	2,89	10,5	2,53	14,94	
		H	25,08	2,89	9,55	5,03	13,39	
6	F	A	21,82	1,56	1,64	11,49	10,25	**103,34**
		B	21,82	1,56	1,43	8,87	13,08	
		C	21,82	1,56	1,43	5,35	16,6	
		D	21,82	1,56	3,2	1,2	18,98	
		E	21,82	1,56	3,2	1,32	18,86	
		G	21,82	1,56	7,29	1,2	14,89	
		H	21,82	1,56	6,34	6,36	10,68	

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7	G	A	32,32	4,09	8,94	10,29	17,18	**165,85**
		B	32,32	4,09	8,72	7,67	20,02	
		C	32,32	4,09	8,72	4,15	23,54	
		D	32,32	4,09	10,5	0	25,91	
		E	32,32	4,09	10,5	2,53	23,38	
		F	32,32	4,09	7,29	1,2	27,92	
		H	32,32	4,09	0,95	7,56	27,9	
8	H	A	31,37	-3,46	7,99	17,85	2,07	**74,15**
		B	31,37	-3,46	7,77	15,23	4,91	
		C	31,37	-3,46	7,77	11,71	8,43	
		D	31,37	-3,46	9,55	7,56	10,8	
		E	31,37	-3,46	9,55	5,03	13,33	
		F	31,37	-3,46	6,34	6,36	15,21	
		G	**31,37**	**-3,46**	**0,95**	**7,56**	**19,4**	

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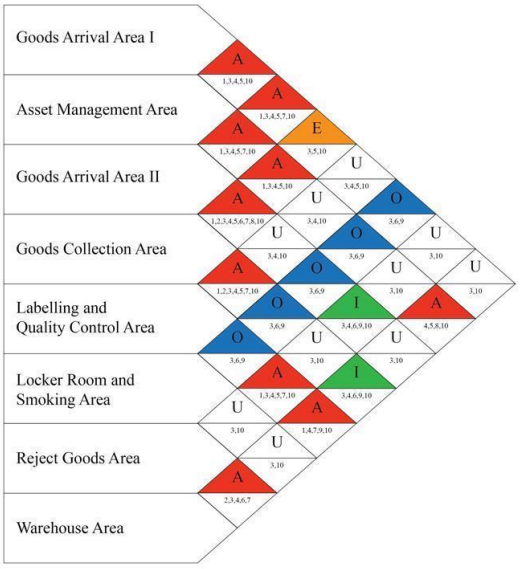
APPENDIX 12
ACTIVITY RELATIONSHIP CHART

Code	Explanation
1	Follow the work flow
2	Using the same work equipment
3	Using the same room
4	Ease of Supervisor in conducting inspections
5	Using the same notes
6	Using the same employee
7	Easy to move goods
8	Doing a similar job
9	Employee transfer
10	The importance of connecting/communicating between employees
11	Not following the work flow

No.	Level of Importance	Code	Color
1	Absolutely Necessary	A	
2	Especially Important	E	
3	Important	I	
4	Ok	O	
5	Unimportant	U	
6	Not Desired	X	



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APPENDIX 13
TOTAL CLOSNESS RATING (TCR)

No.	Sub-Department	Code	A	B	C	D	E	F	G	H	A	E	I	O	U	X	Total	TCR
											5	4	3	2	1	0		
1	Goods Arrival Area I	A		A	A	E	U	O	U	U	2	1	0	1	3	0	7	19
2	Asset Management Area	B	A		A	A	U	O	U	A	4	0	0	1	2	0	7	24
3	Goods Arrival Area II	C	A	A		A	U	O	I	U	3	0	1	1	2	0	7	22
4	Goods Collection Area	D	E	A	A		A	O	A	A	1	0	1	1	4	0	7	14
5	Labelling and Quality Control Area	E	U	U	U	A		O	A	A	3	0	0	1	3	0	7	20
6	Locker Room and Smoking Area	F	O	O	O	O	O		U	U	0	0	0	5	2	0	7	12
7	Reject Goods Area	G	U	U	U	U	A	U		U	2	0	1	0	4	0	7	17
8	Warehouse Area	H	U	A	U	I	A	U	A		3	0	1	0	3	0	7	21

A	2	4	3	1	3	0	2	3
E	1	0	0	0	0	0	0	0
I	0	0	1	1	0	0	1	1
O	1	1	1	1	1	5	0	0
U	3	2	2	4	3	2	4	3
X	0	0	0	0	0	0	0	0

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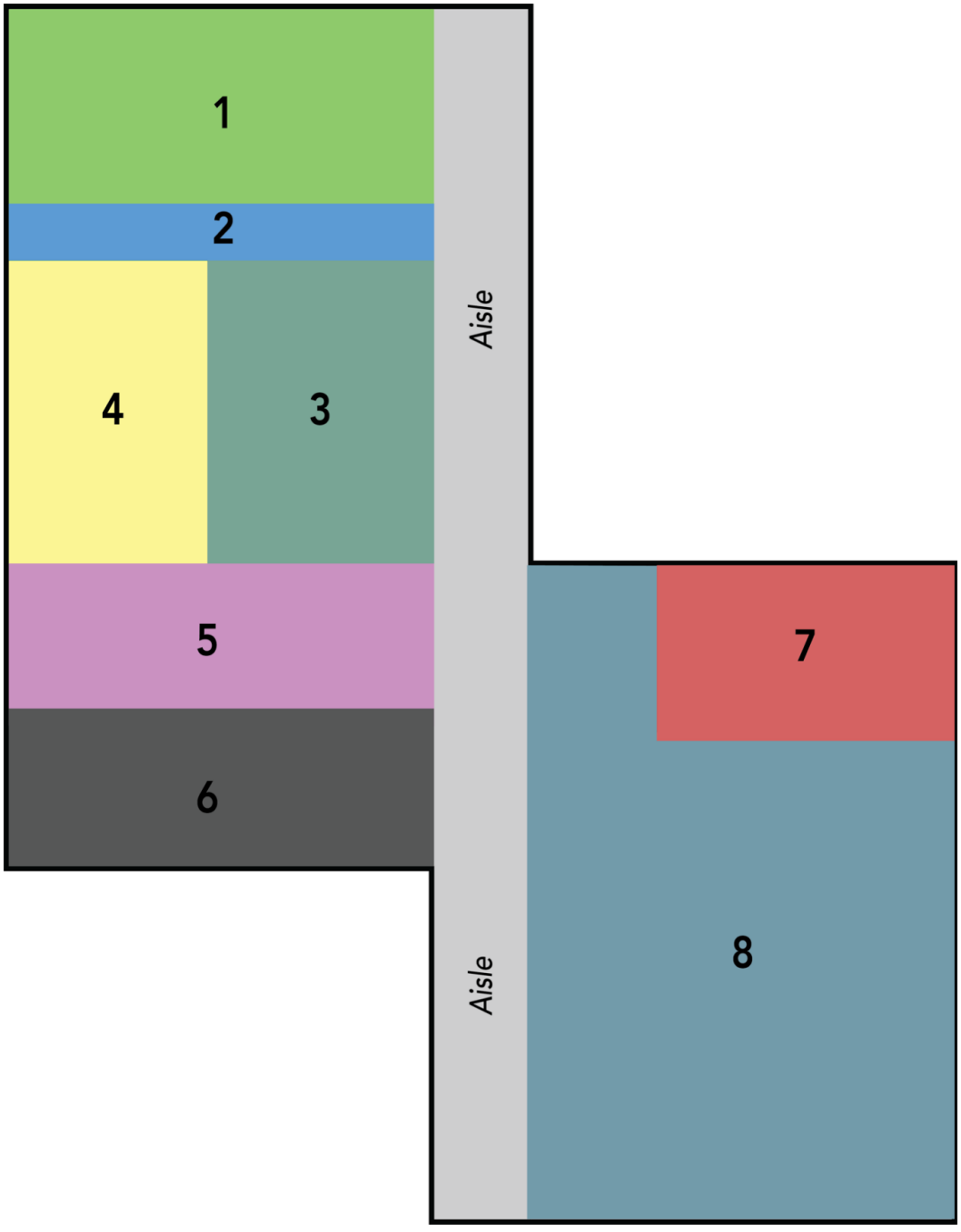
APPENDIX 14
PROPOSED LAYOUT (BLOCK FORM)



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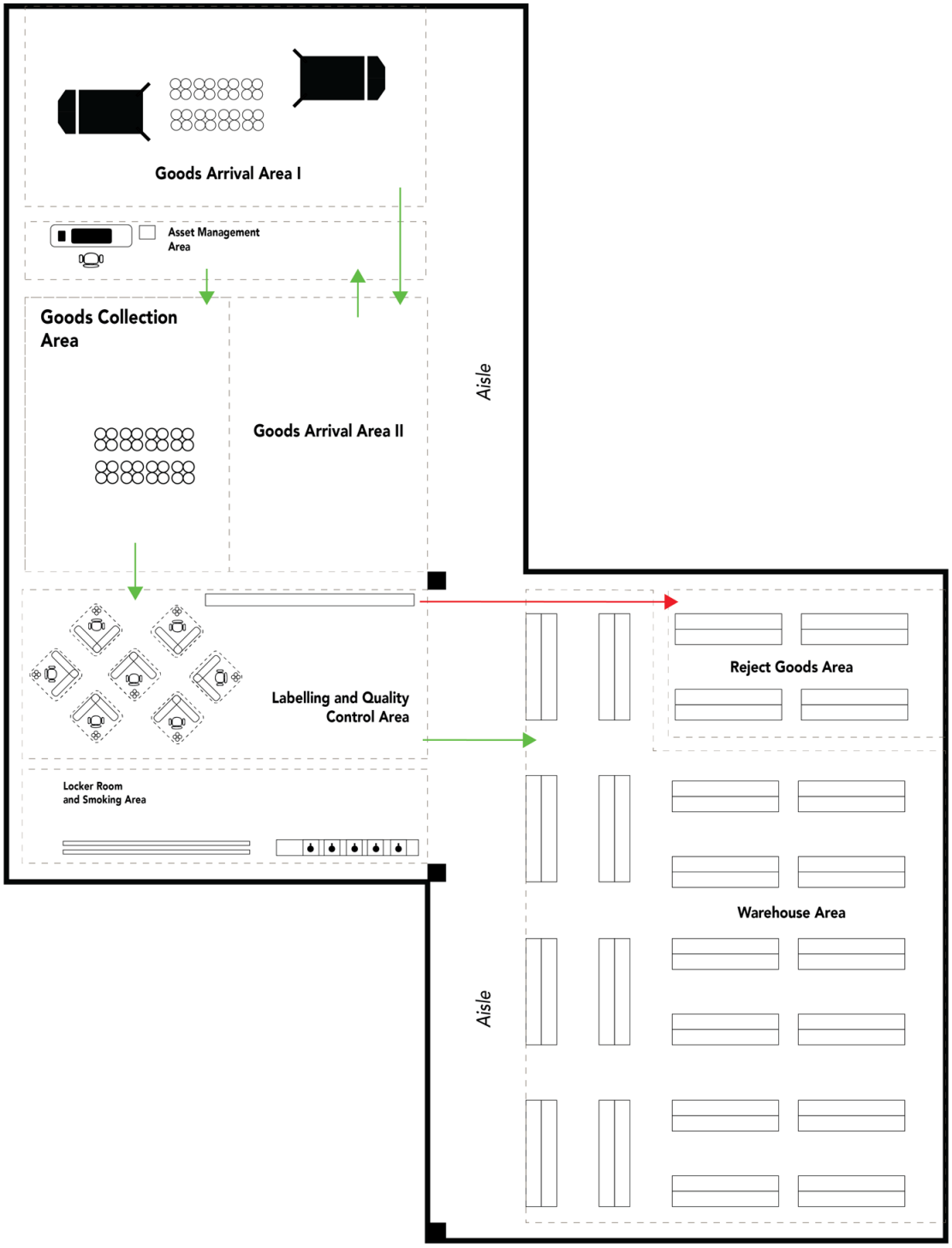
APPENDIX 15.
PROPOSED LAYOUT (ADJUSTED FORM)



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APPENDIX 16
PROPOSED LAYOUT (COORDINATE)

New Coordinate

No.	Facility Name	Code	Coordinate	
			X	Y
1	Goods Arrival Area I	A	23,38	**14,38**
2	Asset Management Area	B	23,6	**11,76**
3	Goods Arrival Area II	C	25,15	**8,24**
4	Goods Collection Area	D	22,05	**8,24**
5	Labelling and Quality Control Area	E	23,6	**4,15**
6	Locker Room and Smoking Area	F	23,6	**1,62**
7	Reject Goods Area	G	32,32	**4,09**
8	Warehouse Area	H	31,37	**-3,46**

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APPENDIX 17
PROPOSED LAYOUT (RECTILINEAR DISTANCE)

No.	*From*	*To*	*Coordinates From*		*Coordinates From*		*Rectilinear Distance*	*Total*
			X1	**Y1**	**X2**	**Y2**		
1	A	B	23,38	14,38	0,22	2,62	34,92	177,61
		C	23,38	14,38	1,77	6,14	29,85	
		D	23,38	14,38	1,33	6,14	30,29	
		E	23,38	14,38	0,22	10,23	27,31	
		F	23,38	14,38	0,22	12,75	24,79	
		G	23,38	14,38	8,94	10,29	18,53	
		H	23,38	14,38	7,99	17,85	11,92	
2	B	A	23,6	11,76	0,22	2,62	32,52	177,4
		C	23,6	11,76	1,55	3,52	30,29	
		D	23,6	11,76	1,55	3,52	30,29	
		E	23,6	11,76	0	7,61	27,75	
		F	23,6	11,76	0	10,14	25,22	
		G	23,6	11,76	8,72	7,67	18,97	
		H	23,6	11,76	7,77	15,23	12,36	
3	C	A	25,15	8,24	1,77	6,14	25,48	174,6
		B	25,15	8,24	1,55	3,52	28,32	
		D	25,15	8,24	3,1	0	30,29	
		E	25,15	8,24	1,55	4,09	27,75	
		F	25,15	8,24	1,55	6,61	25,23	
		G	25,15	8,24	7,17	4,15	22,07	
		H	25,15	8,24	6,22	11,71	15,46	

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No.	*From*	*To*	*Coordinates From*		*Coordinates From*		*Rectilinear Distance*	*Total*
			X1	**Y1**	**X2**	**Y2**		
4	D	A	22,05	8,24	1,33	6,14	22,82	147,14
		B	22,05	8,24	1,55	3,52	25,22	
		C	22,05	8,24	3,1	0	27,19	
		E	22,05	8,24	1,55	4,09	24,65	
		F	22,05	8,24	1,55	6,61	22,13	
		G	22,05	8,24	10,27	4,15	15,87	
		H	22,05	8,24	9,32	11,71	9,26	
5	E	A	23,6	4,15	0,22	10,23	17,3	138,21
		B	23,6	4,15	0	7,61	20,14	
		C	23,6	4,15	1,55	4,09	22	
		D	23,6	4,15	1,55	4,09	22,11	
		F	23,6	4,15	0	2,53	25,22	
		G	23,6	4,15	8,72	0,06	18,97	
		H	23,6	4,15	7,77	7,62	12,36	
6	F	A	23,6	1,62	0,22	12,75	12,25	119,34
		B	23,6	1,62	0	10,14	15,08	
		C	23,6	1,62	1,15	6,61	17,46	
		D	23,6	1,62	1,15	6,61	17,46	
		E	23,6	1,62	0	2,53	22,69	
		G	23,6	1,62	0,72	2,46	22,04	
		H	23,6	1,62	7,77	5,09	12,36	
		A	32,32	4,09	8,94	10,29	17,18	159,04

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No.	*From*	*To*	*Coordinates From*		*Coordinates From*		*Rectilinear Distance*	*Total*
			X1	**Y1**	**X2**	**Y2**		
7	G	B	32,32	4,09	8,72	7,67	20,02	
		C	32,32	4,09	7,17	4,15	25,09	
		D	32,32	4,09	10,27	4,15	21,99	
		E	32,32	4,09	8,72	0,06	27,63	
		F	32,32	4,09	8,72	2,46	25,23	
		H	32,32	4,09	6,95	7,56	21,9	
8	H	A	31,37	-3,46	7,99	17,85	2,07	70,81
		B	31,37	-3,46	7,77	15,23	4,91	
		C	31,37	-3,46	6,22	11,71	9,98	
		D	31,37	-3,46	9,32	11,71	6,88	
		E	31,37	-3,46	7,77	7,62	12,52	
		F	31,37	-3,46	7,77	5,09	15,05	
		G	31,37	-3,46	0,95	7,56	19,4	

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APPENDIX 18
PROPOSED LAYOUT MHC

Code	Facility	From	To	Frequency	Distance (m)	MHC/m (Rp)	Total MHC (Rp)
A	Goods Arrival Area I	A	C	3	29,85	Rp184	**Rp79.841**
B	Asset Management Area	B	D	3	30,29	Rp182	**Rp78.681**
C	Goods Arrival Area II	C	B	6	28,32	Rp194	**Rp168.309**
D	Goods Collection Area	D	E	18	24,65	Rp223	**Rp580.104**
E	Labelling and Quality Control Area	E	G	12	18,97	Rp290	**Rp502.532**
		E	H	12	12,36	Rp445	**Rp771.282**
F	Locker Room and Smoking Area						
G	Reject Goods Area						
H	Warehouse Area						
	Total				**144,44**		**Rp2.140.829**

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APPENDIX 19
FISH BONE TABLE

Code	Root Cause
X1	Material Handling Cost is high
X2	Facility distance between Asset Management Area and Goods Arrival II is long
X3	Employee conditions is easy to get fatigue
X4	There is no proper place for employee to find a labelling tool
X5	High production cost
X6	There is no machine (conveyor, or forklift that implemented)

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APPENDIX 20
MOST OPTIMUM LAYOUT PROPOSAL