STRATEGIC SLP APPLICATION FOR ENHANCED GRASS STOCKPILING: A BLOCK PLANT LAYOUT APPROACH IN THAILAND

Sittichai Pintuma[1], Komson Sommanawat[2], Martusorn Khaengkhan[3]
Nutthapat Kaewrattanapat[4], Jarumon Nookhong[5]
[1,2,3,4,5]Suan Sunandha Rajabhat University, Thailand
Email: sittichai.pi@ssru.ac.th[1]; komson.so@ssru.ac.th[2] ; martusorn.kh@ssru.ac.th[3]; nutthapat.ke@ssru.ac.th[4]; jarumon.no@ssru.ac.th[5]

ABSTRACT

This research addresses the challenges of inventory management and grass stockpiling efficiency in the context of grass broom production. While maintaining an inventory is crucial for business, it poses liquidity and cost concerns, particularly under inefficient logistics and long-distance management. The seasonal nature of grass harvesting further complicates the scenario, necessitating strategic storage and layout planning. The study explores the application of Systematic Layout Planning (SLP) principles to optimize the plant layout for grass stockpiling in Thailand. SLP is chosen for its proven effectiveness in enhancing operational efficiency, reducing costs, and improving workplace safety. The research involves a comprehensive methodology, integrating SLP principles, reviewing key plant layout considerations, and utilizing Arena Simulation for layout refinement. The proposed Block Plant Layout, derived from relationship analysis, becomes a valuable tool for designing a strategic and efficient plant layout. This research aims to provide insights into enhancing grass stockpiling efficiency, considering factors such as space utilization, cost-effectiveness, and responsiveness to customer demands. The Block Plant Layout serves as a practical guide for future layout considerations, optimizing workflow and efficiency within the grass broom production process.

Keywords: design of grass stockpiling, plant layout

INTRODUCTION

The necessity of having inventory, entrepreneur may not be necessary stock a huge amount of products because it’s known about affecting liquidity and cost of business but it’s under inefficient logistic management and distant management and delivery time. The product from supplier’s location and recipients has a distance, it causes the condition space of time to delivery products. When the longer distance, the longer delivery time as well included the cost occurred from purchasing product in the high price period lead to be necessary stock inventory for reduction the purchasing cost of numerous amount; therefore, it become the purchasing reduced but it has to stock these products in inventory only

Grass broom is necessary for cleaning houses of all houses and its life is not much so the demand in the market continuous increased also. It becomes the business making income for community in several provinces in North and Northeast; therefore, seeing from amount of grass broom producer groups have increased in that grass broom products then the raw materials for producing are also more too and it is also needed more by amount of grass broom producers increasingly. That is “GRASS” which is the key raw material to produce grass broom that yield only once a year seasonal. The harvesting period is from November to March. This period the grass is cheap because of the volume, entrepreneur has to storage the product as much as possible to have enough product to meet customers demand all year round and waiting for the yield of grass in the next year and in each year the demand of grass flower is growing as the result entrepreneurs have to buy the grass in high price also. Since entrepreneurs have not enough area to storage product for customers' demand from this problem entrepreneur need to provide insights into enhancing grass stockpiling efficiency, considering factors such as space utilization, cost-effectiveness, and responsiveness to customer demands.

The systematic layout planning (SLP) of industrial facilities holds significant importance, as it can greatly enhance operational efficiency in various aspects (Smith, 2023). This approach contributes to cost reduction in production by minimizing material or product movement distances, consequently reducing labor and energy consumption (Johnson et al., 2022). Furthermore, it improves production output by optimizing the flow of activities, enabling synergies between closely related tasks (Brown & White, 2021). SLP also plays a crucial role in enhancing product quality by minimizing the chances of material or product damage during transit (Jones, 2020).

In addition to improving efficiency and reducing costs, SLP contributes to workplace safety by minimizing the risk of accidents associated with material handling (Williams, 2019). Moreover, it enhances customer satisfaction by reducing waiting times for products or services (Miller, 2018). The flexibility inherent in the SLP design allows for easy adjustments to production processes or the introduction of new products, providing adaptability to changing needs (Anderson, 2017).

In the context of our research, we focus on the application of SLP principles to optimize the plant layout and adaptation strategies for grass stockpiling in Thailand (Brown et al., 2023). This case study aims to investigate how SLP can contribute to the efficiency and sustainability of grass stockpiling, considering factors such as space utilization, cost-effectiveness, and response to customer demands (Johnson & Smith, 2022). Through this research, we seek to provide valuable insights into the application of SLP methodologies in the context of agricultural and industrial practices.

RESEARCH OBJECTIVES

This research study was aimed to

1) To Analyze the Relationship Between Grass Flower Stockpiling Activities
2) To Propose Guidelines for Improving Grass Flower Storage Layout Using Systematic Layout Planning (SLP)

METHODOLOGY

To lay the groundwork for the design of the grass stockpile layout, this research conducts a comprehensive review of key principles and methods related to plant layout. Emphasis is placed on understanding design considerations, plant layout models, and factors influencing layout efficiency. Integration of Systematic Layout Planning (SLP): Drawing inspiration from successful applications of SLP in various industries, the study integrates the principles of Systematic Layout Planning. The works of researchers such as Mahawong, T., & Kummee, W. (2018), Perez et al.,(2020),Wisedsin, T. (2019)., as well as Yang, provide valuable insights into optimizing layout efficiency, increasing productivity, and reducing material transportation distances. Application of SLP in Grass Stockpile Layout: The research customizes SLP principles to suit the unique requirements of grass stockpiling. Considerations include the seasonal nature of grass harvesting, the need for efficient storage, and minimizing logistic activity costs. The objective is to design a layout that maximizes useful space, reduces material movement distances, and enhances overall efficiency in grass stockpiling. Utilization of Arena Simulation: Building on the approaches used Mahawong, T., & Kummee, W. (2018)., the research employs Arena Simulation to model and simulate the grass stockpile layout. This allows for a detailed analysis of material flow, production processes, and the effectiveness of the proposed layout. The simulation results contribute to refining the design for optimal performance.

This research is an application of warehouse design principle, warehouse management model. Starting from building warehouse, warehouse management, and using space included location of warehouse. Warehouse management contained key components as follow;

1). Location Design

2). Construction Design

3). Utility Design

4). Warehouse Facilities

5). Warehouse Personal

6). Layout of space area determined table in warehouse

7). Making space area code and installed fire protection equipment

From those principles would study to be the guidance and apply to warehouse design which had to consider related factors in many design factors the further establishing warehouse to get the appropriated warehouse and effectiveness

Systematic Layout Planning: SLP Theory, plant layout design or location to proper with producing work or storage product, material, working equipment or in front of shop for service provide from production process and service would been passed factors such as human, machine, material, and energy. Nice layout design would reduce cost of administration to be low, to increase working areas convenience and more efficiency by determined position of human, machine, material and other to support production in activity operation model, it was the key factors of production system taken the best value of production time and area. In addition, useful output in production low, save both of direct and indirect operation cost. Using area space effectively and economic advantage especially products in competitive market, plant layout design that had several design methods which each method would be designed difference so making plant layout or that new warehouse layout make sure that layout able to increase working efficiency and the best using space areas and most cost effective or called good performance

Layout means machine placement, material, human, facilities and supporting production in appropriated location for the most effective operation to meet the goals. Plant layout had six fundamental goals as follow;

1). Principle about all activities totally

Nice plant layout has been included human, material, machine, production supporting activities and other considerations affected the best combination. Plant layout still included all facilities in factory, machines, those were outside factory; beside, that still considered convenient work of labor to do any activities in factory, easy to access and inspected working process also.

2). Principle of shortest movement

A nice plant layout has to movement distance of loading material between activities and fewest during unit. Material handling, products or material can be saved cost by decreased distance movement and determined hierarchical unit of work. That any units or sections can be nearby and it can reduce delivery distance between those units and sections

3). Principle of material flow

A nice plant layout has to set up the working place of each unit or following of production process of product so that the flow of material has not circuitous or stop, the principle same as the reduction of shortest loading distance said that flow of material, products or materials have to through units not return or circuitous. Contrasting movement may cause congestion from barrier and cause error in operation. Hence, material flow, and products or material should flow in the same direction through all working process

4). Principle of using area

A nice plant layout has to highest useful of space area both of horizontal and vertical. In fact that the fundamental plant layout is the area management for human, machine, material, and product or raw material to highest useful of that space area

5). Principle of making workers satisfied and safe

A nice plant layout has to be plant layout which pleasant workplace, empower, creating the safety, and plant property because safety is the key component of plant layout another one it seen to creating morals for officers who have more power to work more too. The workplace for officer has not cause the dangerous of life and property. Officers are warmed to work and create benefit for organization and it is still able to decrease operation cost as well

6). Principle of flexibility

A nice plant layout can be improved or changed by minimum cost and easy in units or organization where related with main production factor such as material, worker, and machine in whole three factors moved in system such as in some production process had big size machine had to move human, raw material and equipment closely on the other hand small size machine had to move to work-piece that the worker staying on, it depended and produced situation in generally. Changing the qualify and components in each equipment model used different technique

The key fundamental for plant layout

Systematic Plant Layout is the management method plant layout has the components phases, pattern of procedures and plan conditions in each component in many areas related with plant layout proportionally and properly

Key fundamental for plant layout divided by 3 types as follow;

1). Relationship is the finding relationship of activities starting from more to less activity which more activities was closed

2). Space is consideration about any space whole of amount, type, and shape of area in any activities specified in plant layout

3). Adjustment was arrangement or adjustment activities position appropriately under any conditions

From key fundamental all 3 types said that they were the key of any layouts arrangement project that not considered the product type and production or project size in term of operation plan in plant layout would say next to apply after all main three types demonstration. The relationship chart is the table form showing the relationship to each activity needed to find the relationship

The relationship chart shows the relationship to each activity by the scoring which shows the relationship level how much each activity is related. Any activities had more relation giving high signification level at the same time there is the reason to support those relationship levels. Measuring relationship level of any activities, and relationship chart are appropriated method in practical more than other methods and they were useful tools for plant layout and office or service area that fewest flow of material

These charts tell the significant relationship for easily understand like activity on the sloping line number 1 cross to activity that is the represented on oblique line. Line 3 shows the relationship between activity 1 and activity 3, this is intersection which is the frame that shows relationship of each pair activities. This basic concept can show that any activity should be closeness or remoteness by specify score for showing the relationship level during that activities Scoring shows the relationship level value to specify as A, E, I, O, U and X. That relationship A shows the relationship level is necessary to most closely in part of relationship level X shows relationship level no need that activity close by and relationship level A, E, I, O and U that show the detail as follow;

A: Absolutely Necessary is the most completed relationship level, it must be adjacent or closest together may say that highest relationship level

E: Especially Important is the special relationship level but less than relationship level A or there is more relationship level

I: Important is less relationship level than relationship level E or there is relationship level

O: Ordinary is less relationship level than relationship level E or there is less relationship level

U: Unimportant is relationship level that not related, there is fewest relationship level or almost no relationship or independence. The fact that using X symbol might use wrong meaning but it shows negative relationship level. Any activities are specified the relationship level X that means no need that couple activities close by Relationship level A, E, I, O and U are the character that the most people remember easily so it is used scoring when specified relationship level value for that figure in this case it not select to use because it may give higher rating than reality. Furthermore, that figures were used as reasoning code and showing sequence of activities caused of confusing chart. Giving score for showing the relationship levels, any activities had more relationship that means it had reason to support. Each reason would use number code wrote it down on relationship chart at the same time it explained the reason frame on the bottom right of chart demonstrated to illustration.

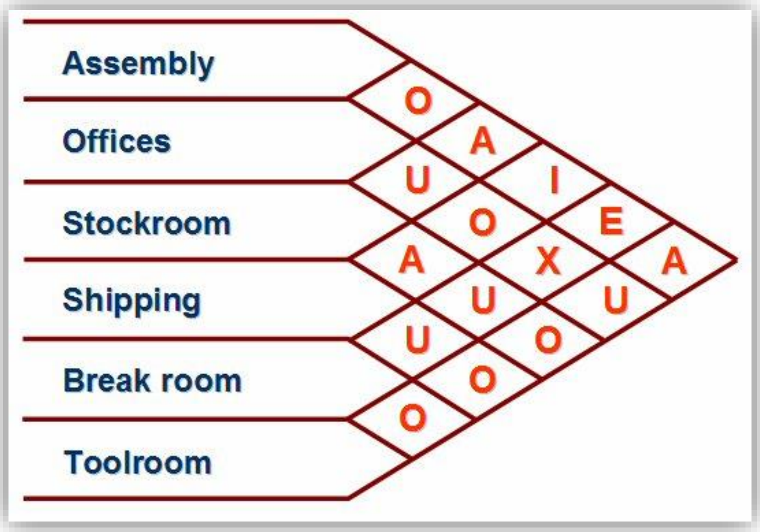

Figure 1 Relation Chart

RESULT

From all process related to inbound and outbound in warehouse, the related unit with all grass stockpile processes for seven parts consisted of 1). Office Section 2). Weight Section 3). Warehouse Grade Section AA 4). Warehouse Grade Section AB 5). Warehouse Grade Section F6). Separated products zone 7). Pouring product courtyard Section Relationship Chart

Creating a relationship diagram for showing relation of each section, relationship diagram shows the position of those relationship sections causes the high relationship level. Any relationship areas were high and close whereas any sections had less relationship might be considered apart

Plant layout design uses the degree of closeness, there are the processes starting from computing total closeness rating (TCR) by specifying each of relationship, it has score as

A=10,000, E = 1,000, I=100, U=0, and X=-10,000 TCRs value shows in Table 1 There are highest selection from TCRs Table to arrange position before. In case of there was the same score considering amount of relation as A, E, I, O, U respectively.

From relationship chart can be done by relationship diagram to propose relationship from relationship diagram computing Total Closeness Rating (TCR) that shows on Table 1 as follow;

Table 1 Showing Total Closeness Rating (TCR) of all seven parts work

Sec.	Section							Summary						TCRs
	1	2	3	4	5	6	7	A	E	I	O	U	X	
1	-	A	O	O	O	O	U	1	0	0	4	1	0	10,040
2	A	-	U	U	U	U	I	1	0	1	0	4	0	10,100
3	O	U	-	U	U	A	U	1	0	0	1	4	0	10,010
4	O	U	U	-	U	A	U	1	0	0	1	4	0	10,010
5	O	U	U	U	-	U	E	0	1	0	1	4	0	1,010
6	O	U	A	A	U	-	E	2	1	0	1	2	0	21,010
7	U	I	U	U	E	E	-	0	2	1	0	3	0	2,100

Based on above data in preliminary analysis involved the section in each part accordingly the requirement of entrepreneur for size around 64 square meters for convenience in the area office work in term of the weight sector of entrepreneur required the weight terminal able to weigh tow truck. Therefore, weight areas were required for 36 square meters or 3x12 meters which was the scale that could accumulate tow truck in term of grass stockpile in each grade. Entrepreneur had to separate grass stockpile in each grade for convenience to stock and grass grade from customer requirement. It said that in the lesson 1 have needed more. Last year, the average demand was 600 tons a year. Entrepreneur delivered to customer only 300 tons that need more areas to stock around 600 square meters from former warehouse, it had the size as 100 square meters that could keep grass only 50 tons. Entrepreneur would be each time of grass stock, it should been separated grass grade AA and AB around 200 tons for 400 square meters per warehouse, grass grade F had the size around 100 square meters because it was the grass which had the quantity about 100 square meters for packaging area, separate product grade only and courtyard product area where were the key of entrepreneur requirement due to those area was multipurpose space where was the grass courtyard, grass dried in during grass still wet included the car park of entrepreneur required the courtyard space around 1 rai or 1,600 square meters to support activities happened in warehouse included expansion in the future. It could be summarized the area size requirement using to build grass stockpile up but each part shows on Table 2 as;

Table 2 Summary the size requirement to use in creating grass storage

No.	Unit	Size W x L (meter)	Area (square meter)
1	Office	8x8	64
2	Checkpoint	3x12	36
3	Inventory Grad AA	20x20	400
4	Inventory Grad AB	20x20	400
5	Inventory Grad F	10x10	100
6	Pick out zone	10x10	100
7	Courtyard Product	50x32	1,600

In this section made the score close by the total, making the position of any sections related to the process starting from taking the section had highest score put before then other sector which had second score and put next position by following principles as;

1). Selecting the highest score from TRCs arranged first

2). Looking at the relationship considered relationship A first then E, I, O, U respectively. If it was A 2 ranks, it considered the relationship A which one had higher score put first

3). Position placement anti-clockwise by putting in the box which had the lowest level first had detail in each processes for putting grass stockpile shown as follow

Step 1. From Table TCRs section had highest score that was sector 6

Step 2. Separated grade and packing from sector 6 seem that sector 3 and 4 which were relation with sector 6 to be A but TCRs value of all two sectors had the same value and relation so it could select any sectors before then selected the sector 3 task down. The appropriated position with sector 3 had position at 1, 3, 5, and 7 distant during the point Centroid of sector 6 equally.

Step 1

8	7	6
1	6	5
2	3	4

Step 2

10	9	8	7
1	3	6	6
2	3	4	5

Step 3. Sector 4 was the next level and appropriated position where had fewest distant from sector 6 was position 4, 6 and 8

Step 4. There was not sectors relation to any sectors task down at level A and sector 6 so reduced the relationship level to level E which had the sector 7, appropriated position was position 6 and 4 which had the fewest distance from sector 6

Step 3

	10	9	8
12	11	4	7
1	3	6	6
2	3	4	5

Step 4

	12	11	10	
14	13	4	9	8
1	3	6	7	7
2	3	4	5	6

Step 5. Sector had relationship level E and sector 7 were sector 5 which was appropriated position to be position 5, 7, and 9

Step 6. From inspection about relationship not found that the relationship level E so it was reduced relationship level to level I found that sector 2 had relationship level I and sector 7 appropriated level was position 5 and 7

Step 5

	12	11	10	9
14	13	4	5	8
1	3	6	7	7
2	3	4	5	6

Step 6

	14	13	12	11
16	15	4	5	10
1	3	6	7	9
2	3	4	2	8
		5	6	7

Step 7. Last sector left was sector 1, it had relationship level A and sector 2, appropriated position as position 4 and 6

Step 7

	14	13	12	11
16	15	4	5	10
1	3	6	7	9
2	3	1	2	8
	4	5	6	7

The layout design serves as a practical guide for future plant layout considerations, offering insights into the spatial organization that aligns with the identified relationships and activities. This approach facilitates an organized and systematic plant layout that takes into account the intricate interdependencies observed during the relationship analysis.

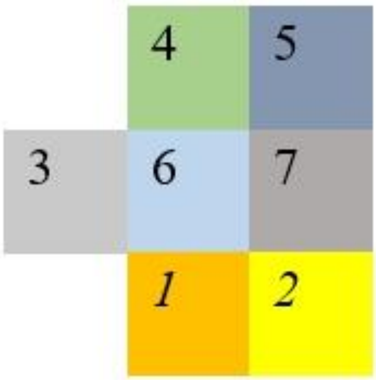

Figure 2 Block Plant Layout

CONCLUSION

The analysis of relationships and activities culminated in the creation of a Block Plant Layout to visually represent the interconnections between different sectors. The relationship diagram serves as a comprehensive illustration of the spatial arrangement of interrelated departments, depicting their proximity based on the level of association. In essence, departments with higher relational significance are positioned closer to each other. The Block Plant Layout provides a clear and concise overview of the spatial organization, emphasizing the proximity of interconnected departments. Conversely, departments with lower relational significance are strategically placed at a distance from each other. This intentional spatial arrangement aims to optimize workflow and efficiency based on the observed relationships and activities within the trading process. The layout design serves as a practical guide for future plant layout considerations, offering insights into the spatial organization that aligns with the identified relationships and activities. This approach facilitates an organized and systematic plant layout that takes into account the intricate interdependencies observed during the relationship analysis.

In conclusion, the Block Plant Layout generated from the relationship analysis becomes a valuable tool for designing the plant layout, offering a tangible representation of spatial relationships among different sectors. This strategic layout is intended to enhance operational efficiency and serve as a foundation for future plant layout designs.

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