

A STUDY IN IMPROVEMENT OF PRODUCTION PROCESS OF THE COMMUNITY ENTERPRISES IN PHAI CHUMPHON SUBDISTRICT, MUEANG DISTRICT, PHITSANULOK PROVINCE

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Submitted: 20 July 2025

Revision received: 15 August 2025

Accepted: 17 August 2025

Abstract

This research aims to improve the production process of the Housewives Farmers' Group of Ban Phai Chumphon, a community enterprise located in Mueang District, Phitsanulok Province, Thailand. The enterprise, established in 2015, processes various agricultural products into value-added goods such as butter-baked bananas, taro, pumpkin, and sweet potatoes, as well as salted and seasoned snacks. However, the group has faced significant challenges related to high production costs, inefficient workflows, and excessive material handling. The study applies principles of production process improvement, focusing on factory layout analysis, material flow theory, and transportation distance reduction to identify and address these issues. Data were collected through observations of current production processes, including workstations, raw material transport, and process flows. Tools such as flow process charts and systematic layout planning (SLP) were used to map activities and evaluate the spatial arrangement of the factory. The research also examined previous studies on similar production optimization techniques to guide the design of a new, more efficient factory layout.

The findings indicate that the original production system involved long material transport distances and unstructured workflow sequences, leading to increased time consumption and potential safety concerns. By redesigning the layout and optimizing the arrangement of production stations, the researchers achieved a substantial reduction in both material transport distance and time. Specifically, the average

transport distance per production cycle decreased from 38.54 meters to 27.94 meters, representing a 27.5% reduction. Additionally, the average time for material transportation was reduced from 93.22 minutes to 92.62 minutes per cycle, amounting to a 0.6% decrease. Although the time reduction appears modest, the significant decrease in distance contributes to lower labor fatigue, enhanced safety, and improved production efficiency. The study recommends further research incorporating tools such as Value Stream Mapping (VSM) to achieve even greater operational efficiency. The proposed layout design serves as a model for other community enterprises seeking to optimize their production processes, minimize costs, and promote sustainable local economic development.

Keywords: Community enterprise, Production process improvement, Factory layout

1. Introduction

Agriculture has historically been the foundation of Thailand's economic, cultural, and social identity, deeply embedded in the traditions and lifestyles of its people. For generations, the majority of Thai citizens have engaged in farming, relying on agricultural wisdom and self-sufficiency to sustain their livelihoods. This traditional approach integrated inherited skills and localized knowledge, creating resilient communities capable of adapting to environmental and social changes. However, in recent decades, Thailand's agricultural landscape has undergone a significant transformation, shifting from subsistence-based farming toward industrialized and production-oriented systems. Agriculture is now primarily focused on commercial output for competitive markets rather than household consumption, prompting rural communities to reorient their practices to sustain livelihoods in an era of globalization. One prominent strategy for strengthening rural resilience is the development of community enterprises, in which groups of local farmers pool resources, share knowledge, and work toward common goals. These enterprises optimize local resource use, foster collective well-being, and enhance economic independence, with housewives' community enterprise groups serving as a notable example of empowering women to add value to agricultural products.

In response to these socio-economic changes, the Thai government has established clear policies aimed at empowering rural populations, enhancing self-reliance, and improving the quality of life. These initiatives emphasize promoting occupational groups that can strengthen production capacity and market competitiveness. Government strategies typically follow two approaches: first, supporting individuals to produce goods for direct sale as a means of household income generation, and second, encouraging the formation of cooperative production groups functioning as community-based businesses. Such community enterprises contribute to grassroots development by fostering self-sufficiency, economic stability, and social cohesion. They operate on principles of utilizing local wisdom, managing natural resources sustainably, and creating income-generating opportunities that reflect the community's cultural identity. Collaboration with public and private stakeholders ensures these enterprises align with local lifestyles while integrating modern business practices. However, achieving sustainable outcomes remains challenging due to constraints in resources, market access, and operational efficiency. Overcoming these limitations requires strategic planning, effective resource management, and adaptive practices that balance economic growth with cultural preservation.

A case in point is the “Housewives Farmers’ Group of Ban Phai Chumphon,” founded in 2015 in Phitsanulok Province, which processes agricultural products into a variety of ‘One Tambon One Product’ (OTOP) items. The group’s portfolio includes butter-baked bananas, taro, pumpkin, and sweet potatoes, alongside salted fried variants and specialty products such as paprika bananas. Through collective operations, the group has aimed to improve members’ economic standing and create stable market channels. Nevertheless, high production costs have emerged as a persistent challenge, driven by expenses for raw materials, labor, and indirect overheads such as machinery maintenance and utilities. Outdated production methods and suboptimal workflows contribute to inefficiencies, limiting profitability and threatening long-term sustainability. Recognizing these issues, the group has identified cost reduction and process optimization as critical objectives. Streamlined operations, improved resource

allocation, and adoption of effective management practices are essential for enhancing production efficiency and ensuring the enterprise's resilience.

Research in related contexts offers practical solutions to these operational challenges. Mankongtham (2017) demonstrated that applying master production scheduling systems and advanced layout design techniques—such as Simulated Annealing and Robust Layout—can substantially reduce material handling distances and operational losses, even under variable demand conditions. Thongrak et al. (2017) illustrated how participatory action research and process standardization could transform household-level sweet potato production into a sustainable commercial-scale industry, yielding increased income and market presence over two years. Likewise, Bang-on (2016) emphasized the utility of Systematic Layout Planning (SLP) in designing efficient factory layouts by optimizing the arrangement of people, equipment, and materials to minimize waste and idle time. Coupled with Allan H. Mogensen's flow process analysis principles, these methods facilitate the identification of bottlenecks, the elimination of redundant steps, and the creation of smooth production flows. For the Housewives Farmers' Group of Ban Phai Chumphon, adopting such approaches could significantly improve material flow, reduce unnecessary handling, and lower both direct and indirect costs. These targeted interventions not only enhance productivity but also contribute to the broader goal of sustaining community enterprises as engines of rural economic development.

2. Research objectives

2.1 To improve the production process of the community enterprises in Phai Chumphon subdistrict, Mueang District, Phitsanulok Province

2.2 To make the guidelines for the community enterprises in Phai Chumphon subdistrict, Mueang District, Phitsanulok Province

3. Methodology

This research methodology section outlines the principles, theories, and systematic approaches used in conducting the study. The focus is on improving the

production process of a community enterprise that processes agricultural products. The methodology is divided into two main parts: data collection and data analysis.

3.1 Data Collection

The first phase involves an in-depth study of the products and production processes of the community enterprise. The enterprise produces nine main products: butter-baked bananas, butter-baked taro, butter-baked pumpkin, butter-baked sweet potatoes, salted fried bananas, salted fried taro sticks, salted fried sweet potatoes, baked sour bananas, and paprika bananas. Each product's production process is documented using process flow charts and flow diagrams to clearly illustrate the steps involved.

In addition, a detailed study of the workstation setup is conducted. This includes collecting data on the current factory layout, the arrangement of stations, the exact location of each workstation, and the distances between them. Understanding the spatial arrangement is essential for identifying inefficiencies in production flow.

Furthermore, data on the time and distance required for raw material transportation are collected. This involves measuring the time taken for each transportation activity and recording the corresponding distances. The results are systematically documented in the production process flow chart to ensure accuracy and traceability.

Lastly, the research team studies the overall material flow throughout the production process. This involves mapping each step, respectively, and evaluating the material movement to identify redundant or inefficient paths. The flow of materials is visualized through a comprehensive flow process diagram.

3.2 Data Analysis

The enterprise operates on a Make-to-Order (MTO) system, meaning products are manufactured based on specific customer orders. The analysis begins by examining the current workstation arrangement. Each workstation is equipped with specific tools and equipment, but discontinuity in the production sequence has been observed, resulting in process delays.

Next, the transport distance and time data are analyzed. Since the workstations are located in separate areas, the production process involves excessive

material movement, leading to longer transportation times and inefficiencies. Some routes are inconsistent and not aligned with the overall workflow, causing further delays.

Flow data is then analyzed by combining the transport time and distance information. This enables the researchers to design a new, more efficient production process. Finally, the researchers propose a new factory layout based on systematic layout planning principles. This redesigned layout aims to minimize material movement, optimize workflow, and improve space utilization, ultimately enhancing overall production efficiency.

4. Research results

Based on the study of factory layout theories and the analysis of the current operational data from the case study community enterprise, the production flow was examined using the prototype diagram presented in Figure 1 and the workstation distance diagram depicted in Figure 2. The findings indicate that the excessive distances between certain workstations are a significant factor contributing to reduced efficiency in material transfer within the production process.

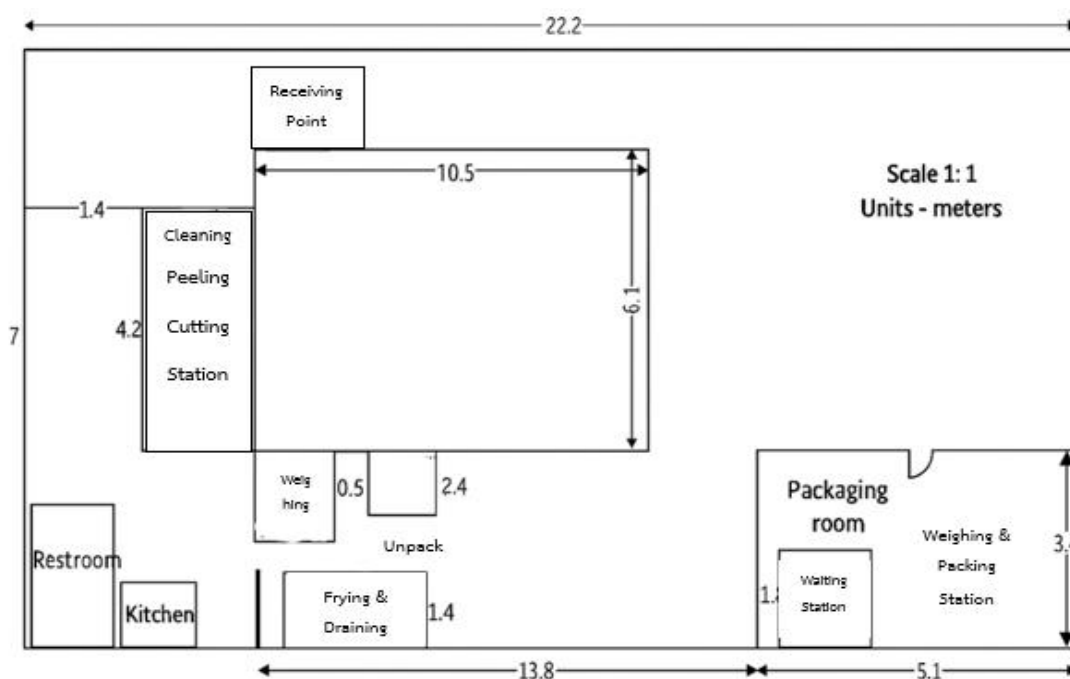


Figure 1 Current station layout

Figure 1 illustrates the current layout of the factory's production stations for the community enterprise. This diagram displays the sequence of workstations used in the production process of agricultural products, particularly focusing on processed banana products. The layout shows how workstations are scattered and not optimally arranged, resulting in long material transport distances between steps. The diagram highlights inefficiencies in the flow of materials, which lead to increased production time and unnecessary labor movement. The discontinuity between stations creates bottlenecks and affects the smoothness of operations. The current station arrangement does not fully support lean production principles or efficient resource utilization, prompting the need for improvement. This figure serves as the baseline for analyzing how workstation design impacts production flow, material handling time, and operational costs.

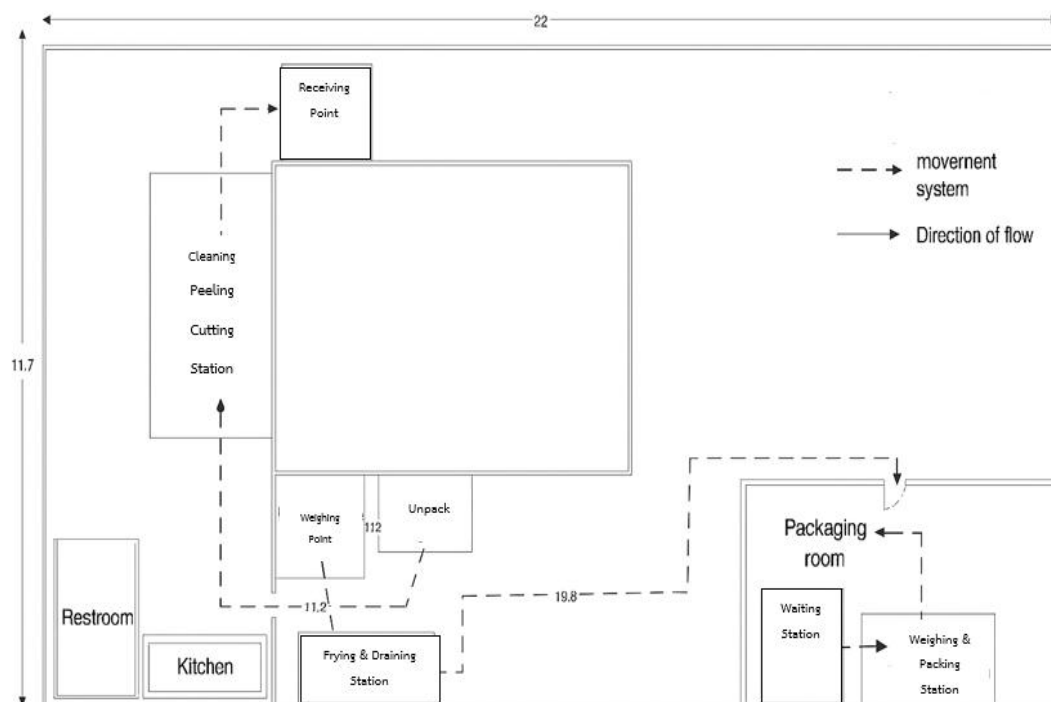


Figure 2 Current stations with details and distances

Figure 2 presents a detailed diagram of the current production stations, including specific measurements of the distances between each station. The figure provides a

clearer view of how raw materials move from one processing point to another, covering steps such as peeling, slicing, frying, and packaging. Each transportation step is marked with the exact distance in meters, allowing for precise calculation of total material movement throughout the factory. The figure reveals that some stations are located far apart, resulting in redundant transportation paths and inefficiencies in production flow. This arrangement increases production time and contributes to higher labor costs due to excessive material handling. Figure 2 also helps identify critical points where workflow interruptions occur, providing essential data for redesigning the factory layout. By documenting these details, the figure sets the foundation for proposing a new, optimized layout to minimize distances and improve production efficiency.

A revised diagram is designed, and taking into account the following guidelines:

1. Adjust and reduce the flow distance to the minimum, which will reduce the transfer time.
2. Adjust and reduce unproductive and inefficient work.
3. Adjust and reduce unusable space.

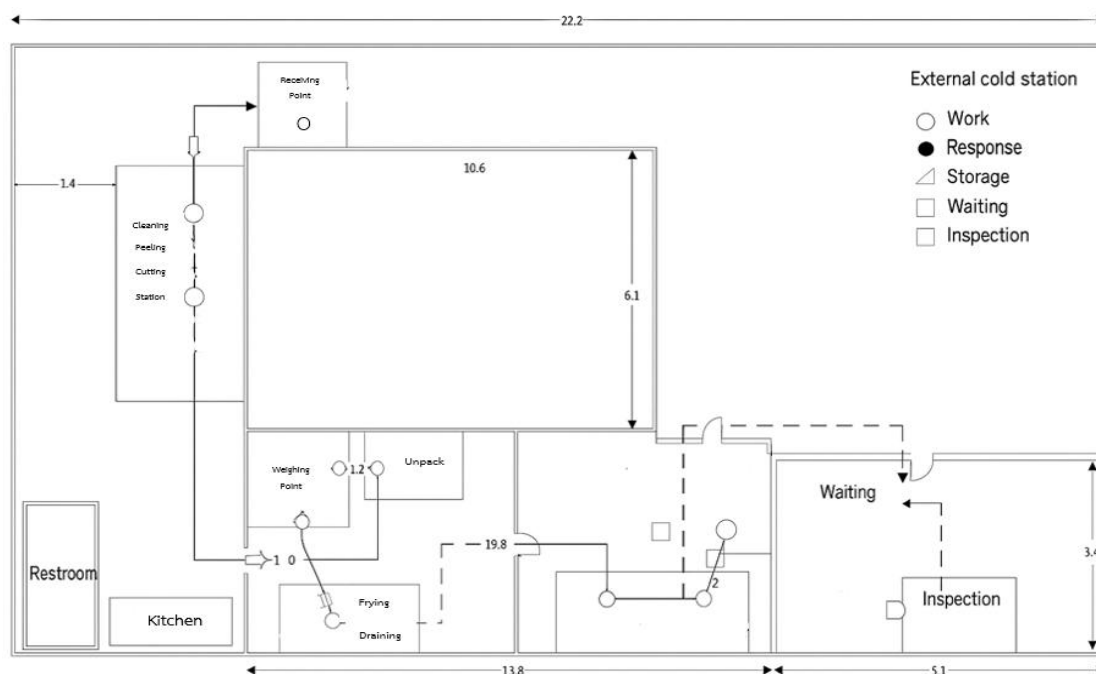


Figure 3 Improved factory layout

Figure 3 shows the revised factory diagram. Examples of some products are shown in Table 1. Flow chart of the production process of dried bananas before improvement and comparison of the material transfer distance of the prototype factory diagram with the revised factory diagram. Table 2 shows a comparison of the average material transfer time of all products of the prototype factory diagram before and after improvement. From the improved prototype factory layout shown in Figure 3, it can be concluded that the improved factory layout can reduce the distance used for material transfer from 38.54 meters per cycle to 27.94 meters per cycle, a distance reduction of 27.5%, and the time used for material transfer from 93.22 minutes per cycle to 92.62 minutes per cycle, or a reduction of 0.6%, respectively.

Table 1 presents the production process flow chart for butter-baked bananas before the process improvement. It details each production step, the associated distance of material movement (in meters), and the time taken (in minutes) for each task. The chart begins with purchasing raw materials from local farmers and proceeds through various stages such as transporting raw bananas to the peeling station, peeling, rinsing, slicing, weighing, seasoning with butter and sugar, frying, draining, packaging, and final inspection. In total, the production process consists of 9 working steps, 7 transportation steps, 1 waiting step, 3 inspection steps, and 1 storage step. The total distance for material movement within the original layout is 38.4 meters, while the total time required for the process is 91.56 minutes per production cycle. This table emphasizes key inefficiencies in the original production system, such as excessive distances between workstations, repetitive material handling, and time-consuming transportation. The detailed breakdown allows for a clear understanding of where time and space are consumed, providing a basis for identifying areas to improve production efficiency. This assessment is critical for community enterprises aiming to reduce operational costs, streamline workflows, and enhance productivity. The collected data in Table 1 was used as a benchmark to design a new factory layout that minimizes distance, reduces material handling time, and eliminates unnecessary processes.

Table 1 Production process flow chart

Production process flow chart					
☒ Previous method ☐ Work by men ☐ Proposed method ☒ Raw material			Summary of results		
			Before	After	Difference
Name/ Production process with the previous method	Working ☐		9	-	-
Products: Banana chips with butter	Transportation ⇨		7	-	-
Chart number	Waiting ☐		1	-	-
Page 1	Inspecting ☐		3	-	-
Recorded by: Niratcha	Storage ▽		1	-	-
October 5 th , 2024	Distance (meter)		38.4	-	-

Working process	Path	Distance (m.)	Time (min.)	Remark
1. Buy raw materials from farmers	○ → □ ▽			
2. Transport raw bananas to peeling point	○ → □ ▽	3.9	0.25	
3. Peeling the bananas	● → □ ▽		15.76	
4. Soak in water and rinse them	● → □ ▽		2.75	
5. Slice the bananas into slices	● → □ ▽		11.56	
6. Take banana sheets to stripping point	○ → □ ▽	11	0.45	
7. Peel off the banana slices	● → □ ▽		8.83	
8. Take to the weighing point	○ → □ ▽	1.2	0.15	
9. Take the banana slices and weigh	● → □ ▽		1.20	
10. Toss banana slices with sugar/butter.	● → □ ▽		4.38	
11. Take to the frying point	○ → □ ▽	1.3	0.17	
12. Fry the bananas golden brown crispy	● → □ ▽		12.50	
13. Scoop and put on an absorbent sheet	○ → □ ▽		1.88	
14. Move to the draining point	○ → □ ▽		0.13	
15. Drain the oil and let the temperature drop	○ → □ ▽		10.50	
16. Take the fried to the packaging room	○ → □ ▽	19.8	0.93	
17. Weighing	● → □ ▽		10.90	
18. Bagging	● → □ ▽		7.90	
19. Move to the cargo hold	○ → □ ▽	1.2	0.13	
20. Perform packaging inspection	○ → □ ▽		1.19	
21. Place at the finished product storage point awaiting delivery	○ → □ ▽			
Total	9 7 1 3 1	38.4	91.56	

Table 2 Comparison of average total material handling distance and time between the current prototype plant layout and the modified plant layout

Product	Time (min.)		Percentage of time decreased	Distance (m.)		Percentage of distance reduced
	Current	Modified		Current	Modified	
Baked Banana with Butter	91.56	91.05	0.07	38.4	27.8	27.60
Baked Taro with Butter	91.76	91.32	0.48	38.4	27.8	27.60
Baked Pumpkin with Butter	91.72	91.20	0.57	38.4	27.8	27.60
Baked Sweet Potato	91.78	91.15	0.69	38.4	27.8	27.60
Salted Banana	97.31	96.74	0.59	38.4	27.8	27.60
Salted Taro	97.31	96.83	0.49	38.4	27.8	27.60
Salted Sweet Potato	97.55	96.82	0.75	38.4	27.8	27.60
Baked sour Banana	87.22	86.78	0.50	38.4	27.8	27.60
Paprika Banana	92.81	91.69	1.21	39.7	29.1	26.70
Average	93.22	92.62	0.59	38.54	27.94	27.50

Table 2 presents a comparative analysis of the average total material handling distance and time between the current (prototype) factory layout and the newly modified factory layout for nine different agricultural processed products produced by the community enterprise. The primary focus of this comparison is to evaluate how the new layout design impacts production efficiency by reducing both the distance of raw material transportation and the time required for the production process.

For each product, including butter-baked bananas, butter-baked taro, butter-baked pumpkin, butter-baked sweet potatoes, salted bananas, salted taro sticks, salted sweet potatoes, broken sour bananas, and paprika bananas, both time (in minutes) and distance (in meters) are recorded before and after the improvement. The results show a consistent reduction in material transfer distance across all products. For most products, the distance was reduced from 38.4 meters in the current layout to 27.8 meters in the modified layout, resulting in a 27.6% reduction. The paprika banana process saw a slightly different reduction, from 39.7 meters to 29.1 meters, achieving a 26.7% decrease.

In terms of time, the improvements also show positive results, although the reductions are less significant than the distance reductions. For butter-baked bananas, the average time decreased from 91.56 minutes to 91.05 minutes, which is a 0.07% reduction. Similar slight reductions in time were observed across all products, with the largest time decrease recorded for paprika bananas at 1.21%, reducing the process time from 92.81 minutes to 91.69 minutes.

On average, the time taken per production cycle dropped from 93.22 minutes to 92.62 minutes, a 0.59% reduction. The average distance of material handling per cycle was reduced from 38.54 meters to 27.94 meters, achieving a 27.5% decrease in transport distance.

These results demonstrate that the new factory layout significantly reduces the physical distance of material movement, making the production process more efficient. While the time savings are relatively modest, the substantial reduction in transportation distance leads to lower labor fatigue, reduced production costs, and improved workflow continuity, aligning with the study's objective of increasing production efficiency.

5. Conclusion and Recommendations

5.1 Conclusion

The findings from the data collection conducted in the case study of the community enterprise revealed significant inefficiencies in the transportation of raw materials. Specifically, the material handling routes were unnecessarily long, and the transportation paths were reversed, leading to operational difficulties and potential safety concerns. In response to these issues, the research team conducted an extensive review of relevant literature, including theories on production process layout, material .

The primary objective of the research was to enhance the production process by designing and implementing an improved factory layout that minimizes transportation distances and streamlines material flow. As a result of the proposed improvements, the average distance for raw material transportation was reduced from 38.54 meters per production cycle to 27.94 meters, representing a 27.5% decrease.

Additionally, the time required for material transportation decreased from 93.22 minutes per cycle to 92.62 m..

5.2 Recommendations

Based on the results of this study, the following recommendations are proposed to further improve production efficiency and support the implementation of the new layout:

5.2.1 This research presents a conceptual framework for the systematic design and selection of an optimized production process layout. However, the proposed layout has not yet been implemented in a real-world setting. Therefore, it is recommended that additional data collection be conducted before practical application. This should include an assessment of cost implications, raw material flow logistics, and projections of potential productivity gains to ensure the feasibility and effectiveness of the proposed system.

5.2.2 The present study did not incorporate the application of Value Stream Mapping (VSM) in the analysis of production flow data. For future research, it is recommended that VSM and other lean management tools be employed to provide a more comprehensive evaluation of production efficiency. Future studies should ensure that their findings align with the research objectives, particularly in terms of reducing waste, improving workflow, and enhancing overall operational performance.

5.2.3 To enhance the robustness of the production process improvement, it is recommended that multiple alternative factory layout designs be developed and evaluated by Systematic Layout Planning (SLP) principles. Each alternative should be compared using clear performance metrics such as total material handling distance, production time, space utilization, safety considerations, and estimated implementation costs. This comparative approach will allow the selection of the most effective and feasible layout, ensuring that the improvement process is comprehensive and optimally aligned with both operational efficiency and the community enterprise's long-term sustainability goals.

6. Acknowledgement

The researchers wish to express their sincere gratitude to the Housewives Farmers' Group of Ban Phai Chumphon, a community enterprise in Mueang District, Phitsanulok Province, Thailand, for their invaluable cooperation and support throughout this study. Their generosity in sharing experiences, operational insights, and local wisdom greatly enriched the research and contributed significantly to the understanding of community enterprise development and sustainable agricultural practices.

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