Original Research

Redesigning the Clean Area Facility Layout through the Application of Systematic Layout Planning (SLP): A Case Study

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Abstract
Facility layout design represents a fundamental component of operations management, particularly in optimizing space utilization, enhancing material flow, and improving overall operational efficiency. This study focuses on a company engaged in the processing and distribution of broiler chickens, where the current clean area layout was identified as inefficient due to excessive material flow distances and suboptimal workspace arrangement. To address these issues, the study analyzes the existing design and proposes improvements using the established methods of Systematic Layout Planning (SLP). Data collection involved direct observation, interviews, and literature review. The SLP method emphasizes qualitative analysis through activity relationship charts and diagrams. The findings demonstrate that the layout developed through the SLP method substantially enhances material flow efficiency and promotes a more systematic organization of the workspace. The SLP-based design improves overall production flow and supports higher levels of productivity and operational sustainability by eliminating unnecessary movements and establishing a streamlined sequence of operations. Based on these findings, SLP is recommended as the preferred approach for redesigning the clean area layout to support more efficient production processes.

Keywords - Clean Area Design; Facility Layout Planning; Material Flow Efficiency; Operations Management; Systematic Layout Planning

INTRODUCTION

The food processing industry is essential for sustaining the global food supply chain. As consumer demand for processed foods rises, it becomes increasingly important to enhance operational efficiency in processing facilities to maintain high productivity and consistent product quality. Facility layout is one of the key determinants of such efficiency, directly influencing the continuity of production processes, labor effectiveness, and workplace safety and comfort [1]. An optimized layout facilitates smoother material flow, minimizes the risk of workplace accidents, and enhances overall production capacity. In food processing environments, layout planning must address hygiene standards and food safety regulations to ensure compliance with industry requirements. Several interrelated factors influence the effective design of facility layouts, including production processes, spatial requirements for storage and equipment, and the uninterrupted flow of materials and personnel throughout the workspace. A well-planned layout improves operational performance and supports a safer, more hygienic working environment.

Designing an effective facility layout is an essential part of business operations planning, as it significantly contributes to facilitating and optimizing production processes. It involves determining the optimal placement of machines, equipment, and workstations to promote smooth material flow and effective resource utilization throughout the production process [2]. In an industrial context, layout design establishes the foundation for organizing factory facilities, including the positioning of production machinery and handling systems. A well-planned layout significantly contributes to the efficiency, safety, and continuity of production operations.

Facility layout refers to the strategic arrangement of physical resources within a plant to maximize productivity, minimize handling time, and reduce operational costs [3]. It involves organizing machines, tools, materials, operators, and support elements to facilitate a seamless workflow. Furthermore, layout planning involves the allocation of tasks among resources to optimize the transformation process. A well-designed layout enables better management of material flow, labor movement, and information exchange, ultimately contributing to increased operational efficiency and effectiveness.

The selection of a facility layout is influenced by several factors, such as the type of production process, the scale of production, and specific efficiency goals. Typical facility layout types consist of fixed-position, process-based, product-based, and group (cellular) configurations. Effective facility design is critical for organizing the workspace and ensuring the optimal placement of machinery and production lines to support smooth operations [4]. The primary objective of facility layout planning is to enhance productivity and maximize the utilization of physical resources, such as machines, labor, and workspace. Additional goals include increasing output, reducing waiting times and material handling, conserving space, minimizing work-in-process inventory, shortening production cycles, lowering safety and health risks, increasing job satisfaction [5], improving supervision, and preventing production bottlenecks.

Food processing factory layouts must be designed not only for production efficiency but also to comply with stringent food safety standards. This requirement represents the primary distinction between food processing facilities and other types of manufacturing plants [6]. In the poultry processing industry, slaughterhouses are specialized facilities that convert live chickens into processed chicken products for consumers. They are usually divided into two zones: the "messy " area, where the birds are slaughtered and defeathered, and the "clean" area, where the carcasses are processed into various products based on customer requirements. In the clean area of the company under study, inefficient material flow and intersecting paths between materials and workers hinder productivity and pose safety risks. The current layout results in unnecessarily long travel distances for materials, slowing down the workflow and increasing the potential for production delays. Additionally, the intersection of material flow paths and worker movement routes disrupts the production process and increases the risk of workplace accidents. In several sections, limited space capacity further obstructs material transfer, reducing overall work efficiency.

A comprehensive redesign of the clean area layout is required to address these challenges. The redesign should aim to reduce material travel distances, optimize movement paths, and strategically place facilities according to process needs using systematic methods. This study employs Systematic Layout Planning (SLP), which organizes activities based on their interrelationships. Applying the methods is expected to result in a more efficient clean area layout that minimizes movement obstacles, improves workflow, and supports increased production capacity. The proposed layout solutions are expected to enhance operational effectiveness and offer practical recommendations for poultry processing facilities facing similar challenges.

LITERATURE REVIEW

Designing the layout of a facility is a fundamental component of planning a production system, as it directly affects the efficiency, flexibility, and overall effectiveness of manufacturing and service operations. A well-designed layout enables smooth material flow, optimizes space utilization, and enhances labor productivity while reducing non-value-adding activities, such as excessive handling and movement [7]. In essence, the layout of a facility serves as the physical framework within which production processes are executed. Thus, it plays a pivotal role in determining the success of operational strategies.

In industries with high throughput requirements, such as food processing, the layout of facilities plays a particularly critical role in ensuring operational efficiency. An efficient layout enables higher output levels, better coordination between departments, and shorter production lead times. In contrast, inefficient layouts can result in bottlenecks, production delays, increased costs, and safety hazards. Specifically, layout planning in the poultry processing sector is further complicated by stringent hygiene and food safety requirements. Poultry slaughterhouses must adhere to strict standards to prevent cross-contamination between messy and clean areas, ensure compliance with health regulations, and maintain product integrity throughout the production process. The regulatory and operational constraints make layout planning in poultry slaughterhouses a technical and compliance-driven challenge.

SLP is a structured and widely adopted method used in facility layout design to optimize the physical arrangement of operations in manufacturing and service settings. SLP is a qualitative approach that provides a logical, sequential framework for analyzing spatial relationships between functional areas to enhance the flow of materials, personnel, and information [8]. The SLP methodology consists of four key phases: (1) data gathering and analysis, (2) activity relationship chart development, (3) space requirements and available space analysis, and (4) layout generation and evaluation. One of the core features of SLP is the use of Activity Relationship Charts (ARC), which rate the importance of closeness between different operations or departments using predefined qualitative scales such as "Absolutely Necessary" (A), "Especially Important" (E), "Important" (I), "Ordinary Closeness" (O), "Unimportant" (U), and "Undesirable" (X). These ratings are then visually represented through Activity Relationship Diagrams (ARD) to create a spatial logic for proximity that guides layout alternatives. SLP emphasizes human judgment, managerial insight, and operational understanding to guide decisions, which makes it particularly useful in environments where there is limited access to empirical or quantitative data. Its advantage lies in incorporating various qualitative factors such as safety, communication requirements, contamination risks, and operational convenience into the layout design process.

A range of approaches has been utilized across various industries to design facility layouts that improve material flow and maximize space utilization [9]. One of the most commonly applied techniques is SLP. Previous studies referenced in this research illustrate the successful implementation of SLP in industries such as manufacturing and food processing. These findings underscore the effectiveness of the method in optimizing layouts and highlight its adaptability across various industrial settings.

The study conducted by [10] focused on redesigning the production layout of a palm oil processing company. The findings suggest that the SLP method yields the shortest material displacement distance, thereby enhancing overall efficiency. This study underscores the effectiveness of SLP in optimizing layout design within the processing industry. The SLP method was utilized to redesign a workshop layout [11]. The primary issue identified was inefficient material transfer between workstations, which increased production time and operational costs. Implementing the SLP method significantly reduced the distances and improved overall production efficiency. The layout of production facilities was redesigned using two methods, SLP and the Computerized Relative Allocation of Facilities Technique (CRAFT) [12]. The primary issue identified was the suboptimal placement of raw materials and production machinery, resulting in excessive distances between workstations and high material handling costs. A more efficient layout was developed that enhances production flow and reduces handling expenses. The SLP method was used to evaluate the interdepartmental relationships based on material flow and the production process, while the CRAFT method was utilized to refine the layout by minimizing material movement distances. This study effectively demonstrates how the combined use of SLP and CRAFT can contribute to the development of an optimized and efficient factory layout.

In manufacturing environments, it has been used to improve production efficiency, reduce handling costs, and increase flexibility. Research was conducted that identified inefficient material transportation between departments at a mattress manufacturing company [13]. This resulted in increased operational costs and prolonged production times. The researchers applied CORELAP, CRAFT, and Group Technology methods to develop a more efficient layout. The findings showed that CORELAP was more effective than CRAFT at reducing material handling costs and displacement distances. The study was conducted to design and optimize plant layouts in the manufacturing sector [14]. Their study addressed the limitations of conventional layout design approaches, particularly in small and medium-sized enterprises (SMEs), by using data-driven techniques and systematic analysis. It demonstrated significant enhancements in operational efficiency through key SLP stages. The findings revealed reductions in workspace area, operator travel distances, and labor inefficiencies. A study on redesigning the production facility layout of small and medium enterprises (SMEs) engaged in wood handicraft manufacturing utilized the CORELAP method to generate more efficient layout alternatives [15]. Among the three alternatives developed, the one with the lowest score value was selected as the optimal layout. Research was conducted to redesign the warehouse layout using the SLP and CORELAP methods [16]. The objective was to minimize travel distances and material handling costs. The findings revealed that both methods effectively reduced the total distance traveled, with the SLP-generated layout offering the most significant reduction. This research highlights the effectiveness of the SLP method in optimizing warehouse layouts and reinforces its relevance for clean area layout planning, where minimizing material movement is equally critical. Research was conducted to address inefficiencies in the office layout of an apartment complex [17]. The research aimed to evaluate and enhance the layout using the Activity Relationship Chart (ARC) method. Employees were surveyed to determine the intensity and importance of interdepartmental interactions, and the results were compiled into an ARC to inform the development of alternative layouts. The proposed layout successfully reduced travel time and distance, leading to improved work efficiency and a more comfortable working environment. A key contribution of this study is the application of the ARC method, typically used in manufacturing, to an office setting, demonstrating its versatility in mapping information-based and human-centric work relationships. This study offers valuable insights into the significance of functional area relationships, which are foundational to SLP approach. As such, it serves as a relevant conceptual reference for the preliminary stages of clean area facility layout planning.

Despite being a qualitative method, SLP can be integrated with quantitative tools or computer-aided systems to enhance objectivity and optimize outcomes. For instance, when used in combination with CORELAP or other heuristic algorithms, SLP can provide a solid foundation for layout alternatives that are then refined through computational methods. SLP remains a valuable and adaptable approach to facility layout planning, offering a systematic way to align spatial design with functional relationships and strategic objectives.

RESEARCH METHODOLOGY

This study used three methods to collect data: observation, interviews, and review of the literature. Direct observations were carried out in the company's clean area to record measurements of the room, equipment, and worker and product movement patterns. Interviews with the head of production, supervisors, and workers provided information on production flow and connections between facilities. Finally, the literature review examined academic sources related to layout plans, design principles, and prior research to establish a solid theoretical framework for optimizing the facility layout.

I. Data Collection and Input Analysis

This stage focuses on gathering essential information for layout planning.

Product analysis:

Identify the types and quantities of products produced or services delivered.

• Understand production volume and process sequences (routing).

Process and operation analysis:

• Create process charts or operation process charts (OPCs) to illustrate the sequence of operations.

• Define the equipment, tools, and machines used at each stage.

Flow of materials or activities:

Develop a flow diagram that shows how materials or people move between departments or workstations.

• Record the frequencies, volumes, and distances of these movements.

Space requirements:

Measure the current and projected space needs of each department or activity area, including allowances for future expansion, safety, and access.

II. Activity Relationship Analysis

This step determines how closely related or important it is to place departments or activities near one another.

Activity Relationship Chart (ARC)

Using a rating system (A, E, I, O, U, X), show closeness preferences.

A – Absolutely necessary; E – Especially important; I – Important;

O – Ordinary closeness is okay; U – Unimportant; X – Undesirable

Justify each closeness rating (e.g., based on safety, communication, shared equipment, or material flow).

Activity Relationship Diagram (ARD)

Create a bubble diagram or network showing how each department should be positioned relative to the others based on the ARC.

II. Space Requirements and Available Area

Space relationship diagram

• Translate the activity relationship diagram into a block diagram that includes the actual or estimated space required for each department.
• Consider the actual dimensions of the site or building.

Area constraints
• Taking into account structural columns, walls, entrances/exits, and utility lines.
• Identify fixed areas (e.g., restrooms, stairs, and loading docks) that cannot be moved.

III. Developing Layout Alternatives

At this stage, various feasible layouts are generated.
Develop multiple layout options based on the space relationship diagram.
• Ensure that flow logic and adjacency preferences are preserved.
• Using tools like graph paper or layout software.

Evaluate alternatives.
• Apply quantitative (e.g., total travel distance, material handling cost) and qualitative (e.g., safety, ease of communication) criteria.
• Using scoring matrices or weighted decision tables for comparison.

IV. Selecting the Best Layout

Selection of optimal layout
• Choose the layout that offers the best trade-off between cost, efficiency, safety, and flexibility.
• Validate the layout with stakeholders, including engineers, workers, and managers.

Detailed layout development
Convert the selected block layout into a detailed layout with precise placement of equipment, aisles, storage, etc.

RESULTS AND DISCUSSION

I. Production Process and Operation

The initial evaluation of the current facility layout revealed several inefficiencies in material flow and space utilization. Observations revealed that the movement paths of both materials and personnel frequently overlapped, leading to congestion and increased transfer times between workstations. The existing configuration lacked alignment with the production sequence, causing unnecessary backtracking and underutilization of floor space.

The company under study produces various types of products, including whole chicken, boneless chicken (such as boneless legs, boneless breasts, boneless skinless legs, boneless skinless breasts, fillets, ground meat), and cut-up chicken (parting or marinated cut-up). All of these products are prepared in refrigerated rooms with temperatures ranging from 10°C to 13°C. There are two workstations in the production process, namely the messy area and the clean area. The messy area is the first stage in the chicken processing, from the arrival of live birds to the production of carcasses. The clean area is where the carcasses are separated into various products according to customer demand, either for daily orders or for freezing in the blast freezer. Several stages occur in the clean area. The first stage is washing and chilling, where the carcasses are cleaned and chilled using a screw drum chiller. This process uses two drum chillers. The carcasses hanging on the shackles from the messy area are dropped into the drum chiller I for the washing process. After that, the carcasses are moved to drum chiller II for cooling, which lasts approximately 45 minutes at a temperature below 4°C and a chlorine concentration of 0.5-1 ppm. Once the process is completed, the carcasses are removed and placed in a draining container. The carcass washing and cooling process is conducted according to applicable standards. After that, the carcasses are processed based on their size. The next stage is sizing and grading, where each carcass is manually weighed to be grouped according to size and grade, based on customer orders. The crates containing the grouped carcasses are weighed again for each order at the Chicken Receipt Area (TTA). The Chicken Receipt is a crucial control point in the production process flow in the clean area. It serves as the recording and checking area for chicken products, both before and after the production process.

The clean area is divided into two sections: the raw material and the finished product. The raw material is the point at which chicken carcasses that have undergone the cooling and grading process are received for further processing. The finished product TTA is used to record the final product after all production stages are completed, before the product is distributed or stored in the warehouse. The TTA plays a crucial role in ensuring the smooth flow of production and serves as a form of internal control, ensuring that the quantity and quality of products are properly recorded.

Carcasses that have passed the TTA material will be processed according to the order. The processing activity stage, or cutting process, includes cut-up and boneless. The cut-up process involves cutting the carcass using a poultry cutter machine into 2 to 25 parts, or according to customer orders. Additionally, a filleting process is carried out, which separates the meat from the bone to produce products such as boneless legs, boneless breasts, boneless skinless legs, boneless skinless breasts, fillets, and ground meat. This process is done manually using very sharp knives. Next is the marination and packing stage. Boneless products or carcasses that are to be marinated are processed using a vacuum tumbler machine, usually with seasoning according to customer requests. Packaging is done using food-grade plastic that is safe and adjusted to the weight. The packaging serves not only to maintain cleanliness and prevent bacterial contamination but also plays a role in branding the product. During packaging, quality control (QC) inspections are conducted to ensure the products are free from physical defects and meet the quality standards expected by customers. The packaged products are then brought to the Chicken Finished Goods Receipt (TTA Hasil) table for data recording.

The following flowchart illustrates the production process in the clean area. It presents the sequence of work stages, from receiving the carcasses to producing the final products that are ready for storage in the warehouse.

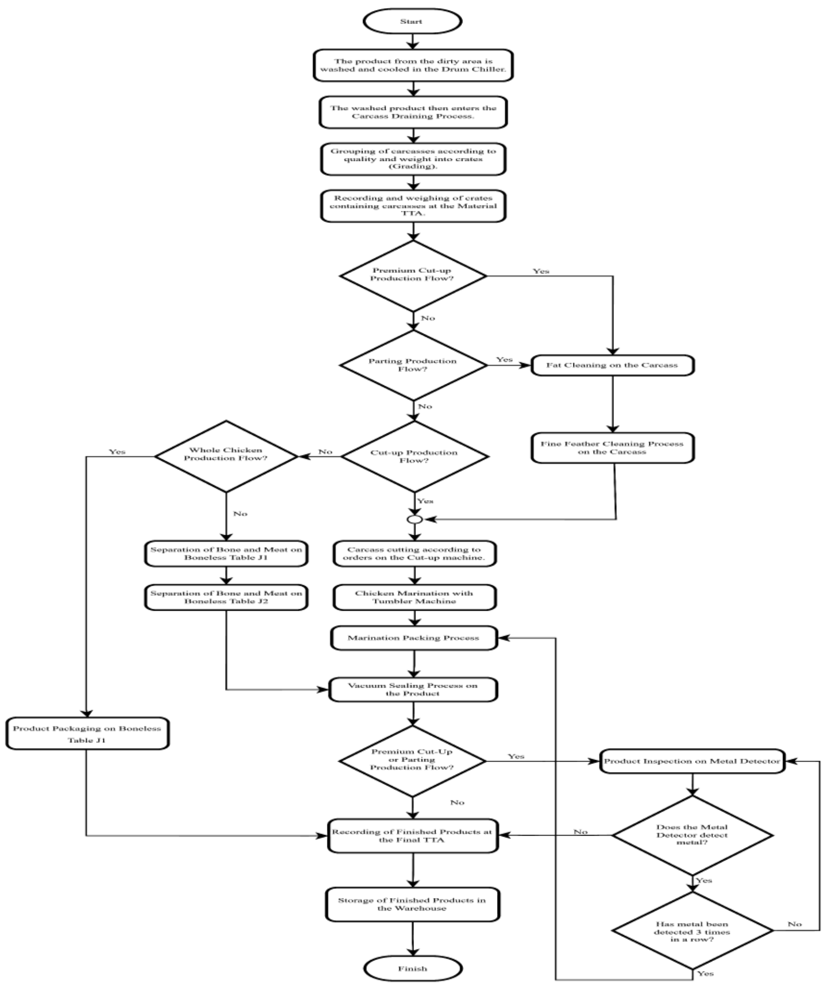

FIGURE 1
PRODUCTION PROCESS FLOWCHART FOR THE CLEAN AREA

II. Flow of Materials or Activities

The observation is carried out systematically, following the sequence of the process flow from the beginning to the end, starting from when the carcasses exit the drum chiller until they reach the TTA. Each movement between facilities is measured manually using a tape measure, taking into account the actual path traveled by workers and products. The distance data obtained is then recorded based on the process stages for each type of production, such as cut-up, premium cut-up, boneless, parting, and whole chicken. This approach aims to provide an overview of the material flow in the existing conditions. The collected distance data from field measurements is then used as the basis for the comparative distance analysis in the alternative layout.

The layout of the clean area is depicted in Figure 2. This layout plan uses a scale of 1:100. The dimensions of the room are 24,30 m in length and 13,17 m in width.

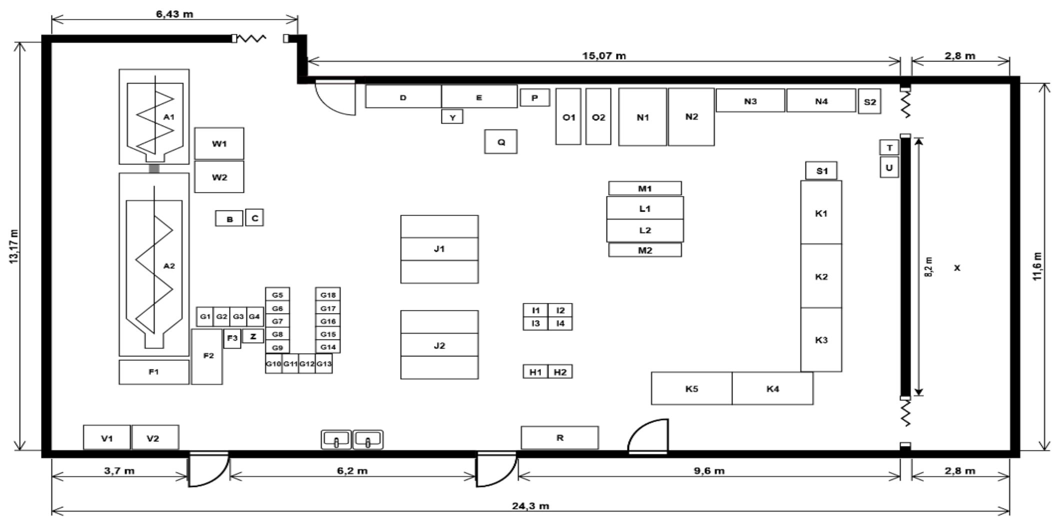

FIGURE 2
INITIAL LAYOUT DISPLACEMENT DISTANCE

III. Space Requirements and Available Area

The clean area is 320,03 m², which has 29 different types of facilities, and the total required area is 102.73 m². The following table shows the facilities and dimensions of the initial layout.

TABLE I
DIMENSION OF THE INITIAL LAYOUT FACILITIES

No	Code	Facility	Size (m)
1	A1	Drum chiller 1	3 × 1.75
2	A2	Drum chiller 2	5.8 × 1.75
3	B	Chicken Receipt (TTA) Raw Table	0.65 × 2
4	C	TTA Raw Weighing Scale	0.534 × 0.438
5	D	Chicken Receipt (TTA) Finished Goods Table	1.928 × 0.726
6	E	Writing Table	1.928 × 0.726
7	F1-F2	Carcass Draining Container	0.77 × 1.75
8	F3	Carcass Draining Crates	0.61 × 0.42
9	G1-G18	Grading Crates	0.61 × 0.42
10	H1-H2	Feather Removal Crates	0.61 × 0.42
11	I1-I4	Fat Cleaning Crates	0.61 × 0.42
12	J1-J2	Boneless Table	1.928 × 0.726
13	K1-K5	Cut-up Table	2.026 × 1.028
14	L1-L2	Marination Table	1.928 × 0.726
15	M1-M2	Marination Table Stand	1.81 × 0.428
16	N1-N2	Tumbler Machine 50	1.726 × 0.726
17	N3-N4	Tumbler Machine 100	1.82 × 1.15

18	O1-O2	Vacuum Seal machine	1.765 × 0.615
19	P	Additional Vacuum seal	0.83 × 0.54
20	Q	Metal Detector	0.80 × 0.755
21	R	Parting Table	1.926 × 0.724
22	S1-S2	Quality Control Table	0.78 × 0.56
23	T	Trash Bin	0.47 × 0.47
24	U	Allergen Storage Rack	0.655 × 0.455
25	V1-V2	Thawing Container	1.17 × 0.77
26	W1-W2	Ice Crystal Palette	1.18 × 1
27	X	Crate Washing Area	11.6 × 2.8
28	Y	TTA Finished Goods Weighing Scale	0,534 × 0.438
29	Z	Grading Scale	0.534 × 0.438

When planning the layout of clean area facilities, one important aspect to consider is the existence of constraint areas, namely, areas or facilities that cannot be moved from their original positions. The crate washing area is one such area that cannot be moved in the clean area layout design. This is because it is a special area, delimited by walls and directly connected to a permanent water and drainage system. Relocating it would require major changes to the existing utility infrastructure. Furthermore, the drum chiller must remain in place because the end of the drum chiller will receive chicken from the messy area. The following Figures 3 and 4 are the ARC and ARD of the clean area layout, respectively.

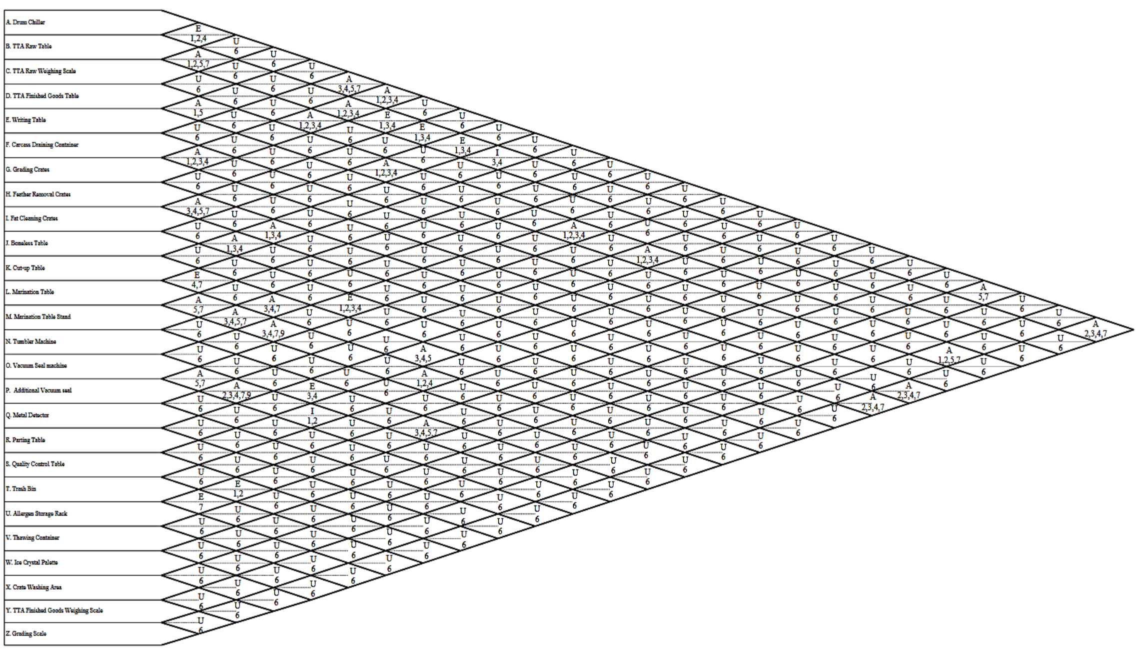

FIGURE 3
ACTIVITY RELATIONSHIP CHART (ARC)

The description below explains the symbols presented in the image above.

A = Absolutely necessary
E = Especially important
I = Important
O = Ordinary closeness is okay
U = Unimportant

The reasons for proximity are as follows:
1 = Information flow
2 = Degree of supervision
3 = Sequence of workflow
4 = Material flow
5 = Mutually supportive functions
6 = No relation
7= Interrelated facilities
8 = Noise, dirt, dust, odor
9 = Safety

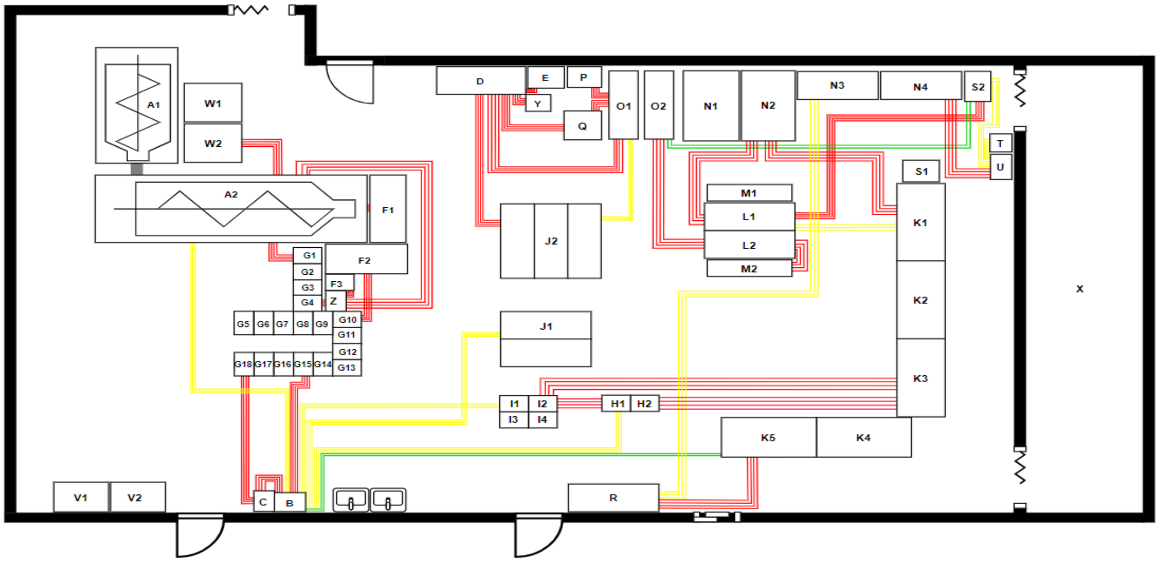

FIGURE 4
ACTIVITY RELATIONSHIP DIAGRAM (ARD)

The descriptions of the lines in the image above are as follows:

: Absolutely important (A)
: Very important (E)
: Important (I)
: Normal (O)
: Not important (U)

IV. Developing Layout

Below are the suggested alternatives for the facility layout design in the clean area, based on the principles of the production process flow. The alternative layout planning for the clean area is carried out with various adjustments to improve production flow efficiency, optimize space utilization, and ensure that aspects of Occupational Health and Safety (OHS) are maintained. The main issues currently faced are the long production flow distances and optimizing space utilization. The following are adjustments made using the SLP method to develop the alternative layout design.

a. Drum Chiller 2 (A2) has been rotated from a vertical to a horizontal position. This change aims to optimize space utilization and streamline the flow of material and workers. With more open space, the risk of obstructions in the production process can be reduced, thereby improving work efficiency and minimizing the likelihood of accidents due to space constraints.
b. Carcass Draining Container (F), Grading Crates (G), and TTA Raw Weighing Scale (Z) are relocated next to Drum Chiller 2 (A2). This change improves the organization of the area in the grading process without altering the existing workflow. Additionally, this move creates a designated space for clean crates, making the area more organized and minimizing the risk of contamination.
c. Chicken Receipt (TTA) Raw Table (B) and TTA Raw Weighing Scale (C) are moved next to the men's locker door to be closer to the grading area. This placement brings them closer to the grading area and reduces congestion in that area. With more space, workers can move more freely and reduce the risk of work accidents caused by space limitations.
d. Writing Table (E), which was previously 1.926 m × 0.724 m, has been replaced with a smaller table like the Quality Control Table (S1 & S2), measuring 0.78 m × 0.56 m. Reducing the table size improves space utilization efficiency without eliminating its function. This also reduces potential obstructions in the workers' movement paths.
e. Chicken Receipt (TTA) Finished Goods Table (D) and TTA Raw Weighing Scale (Y) are moved closer to the Writing Table (E). This arrangement allows the area for waiting crates or the queue for finished goods TTA to become more

spacious, minimizing the risk of items piling up and obstructing worker mobility, especially for movement to the warehouse.

f. Fat Cleaning Crates (I) and Feather Removal Crates (H) are relocated next to Boneless Table (J1), aligned with the end of Parting Table (R). This layout improves the organization of material flow during the production process by ensuring that the crates are within optimal reach. Furthermore, this arrangement reduces the need for workers to move too far and brings them closer to the Cut-up Table (K), which can enhance work efficiency and reduce fatigue.

g. Boneless Table (J1 & J2) is moved closer to the Marination Packing Table (L), aligned with Metal Detector (Q), and the direction of Boneless Gramasi Table (J2) is changed from horizontal to vertical. These adjustments ensure that the workflow remains smooth while creating more available space around the finished goods TTA. Expanding the waiting area for the TTA results in less obstruction in workers' movement paths during peak production periods, improving ergonomics and workplace safety.

h. Boneless Table (J1) has been reduced to two tables, down from three. By reducing the number of tables, more space is available for workers to move safely and comfortably without eliminating the functionality of the facilities. This reduces the potential for accidents due to overcrowded work areas and improves ergonomics during the work process.

i. Marination Packing Table (L) and Marination Table Stand (M) are moved closer to the Cut-up Table (K), aligned with Tumbler Machine 100 (N2). Optimizing the proximity between processes means that workers do not need to move too far, which improves time efficiency and reduces the risk of injuries due to excessive repetitive movement. Additionally, space is provided for waiting crates for marination, packing, and the vacuum seal queue.

j. Metal Detector (Q) is relocated closer to the Vacuum Seal Machine (O) and aligned with it. This arrangement helps organize the space better and provides more available area. It also reduces the potential for obstruction in the workers' movement paths.

k. Ice Crystal Pallet (W) is moved next to Drum Chiller 1 (A1), making it easier to pour ice crystals into the drum chiller. It is also recommended that more than three pallets of ice crystals be stored in the ante room or cold storage warehouse. This placement prevents the pallet area from obstructing workers' movement paths, and by suggesting storage in a separate area, the risk of accidents due to spilled ice, which could cause slippery floors, is minimized.

l. Cut-up Table (K), Tumbler Marinasi (N), Vacuum Seal (O), Vacuum Seal Machine (P), Parting Table (R), Quality Control Table (S1 & S2), Trash Bin (T), Allergen Storage Rack (U), Thawing Container (V), and Crate Washing Area (X) remain in their original positions. Machines and facilities that were not moved were kept in place to avoid disrupting processes that are already running efficiently.

m. The door to the scale storage area has been replaced with a sliding door. This change prevents the door from obstructing the clean crates as they leave the Crate Washing Area (X) and helps reduce the risk of worker collisions with Cut-up Table 5 (K5). This helps improve and streamline the mobilization of the work area.

The total transfer distance measurement for the alternative SLP layout is carried out based on production flow data that has been directly observed and measured in the clean area. This data reflects the flow of product movement between facilities for each type of production process. To facilitate the visualization and calculation of distances between facilities, the layout is illustrated using the draw.io application as a supporting tool. Before being applied to the alternative SLP layout, the application was first tested by comparing calculation results with the initial design. The calculations are conducted by comparing manual field measurements with the results obtained using draw.io. The findings show a match between the manual data and the application's visualization, thus confirming its suitability as an analytical tool. The total transfer distance for the alternative SLP layout is then calculated using the draw.io visualization, taking into account the process sequence and the actual material flow path.

1) Cut-up production

The application of the SLP method results in a reorganization of the cut-up production flow, which shortens travel distances and enhances overall efficiency. The revised process begins with the transfer of carcasses from the drum chiller to the grading area, after which the material is moved to the TTA (processing unit) at a distance of 2.98 m. From there, the transfer to the cut-up machine requires only 16.42 m, which is shorter compared to the initial layout. Following the cutting stage, the carcass pieces are transferred to the marinating area over a distance of 8.55 m. Subsequently, spices are transported from storage to the marinating machine at a distance of 5.22 m. The marinated products then proceed to the marinating packing table (1.61 m), continue to the vacuum seal machine (3.67 m), move to the finished TTA (2.67 m), and finally are transferred to the storage warehouse (8.8 m).

This revised arrangement, involving 13 change points, reduces the total material travel distance to 49.92 m, representing a decrease of 10.13 m compared to the initial layout. Efficiency is improved by optimizing the flow between grading and the TTA, as well as by strategically positioning the packing and vacuum seal areas in proximity. These modifications result in a smoother workflow, minimize material handling, and reduce unnecessary movement within the facility. The following illustrates the SLP layout of the cut-up production.

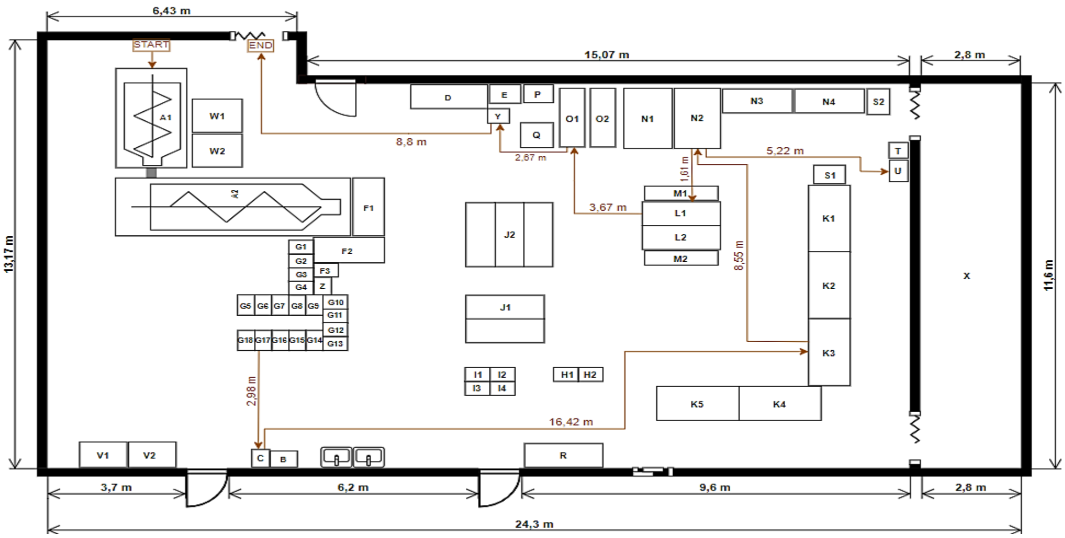

FIGURE 5
SLP LAYOUT OF THE CUT-UP PRODUCTION

2). Premium Cut-up Production

In the redesigned production process, the path from the chiller drum to grading and subsequently to the TTA material is maintained at 2.98 meters, as is the placement of the fat removal stage at 7.23 meters and the fine hair removal stage at 0.95 meters. The cut-up machine remained 5.08 meters from the cleaning stage, followed by the marinating area at 8.55 meters and the marinade collection line at 5.22 meters. The following is the SLP layout for premium cut-up production.

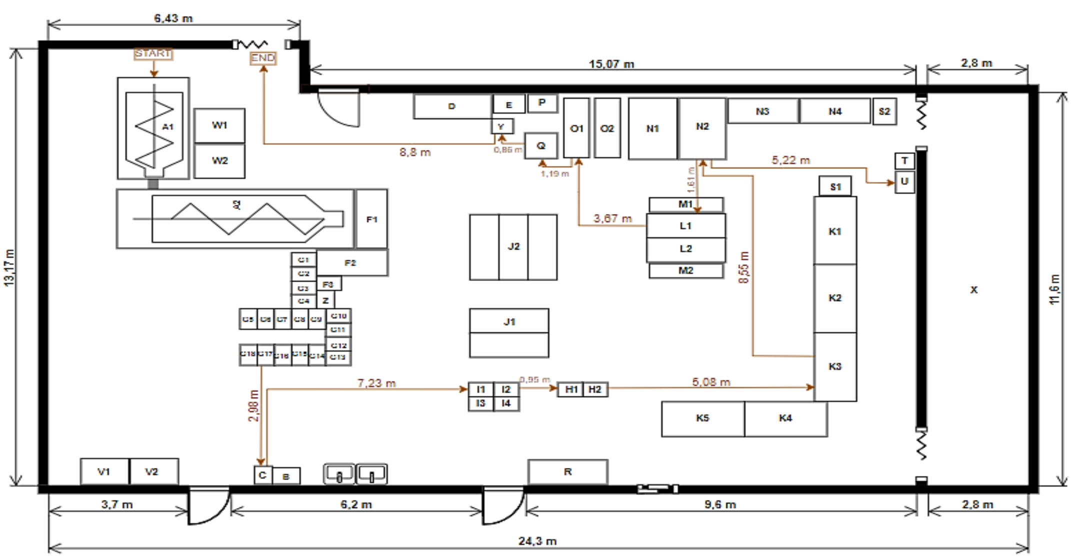

FIGURE 6
SLP LAYOUT OF THE PREMIUM CUT-UP PRODUCTION

Notable improvements are achieved in the packaging area. The marinating packing table, vacuum seal machine, and metal detector are strategically arranged close, reducing the distances between these critical stages to only 1.61 meters, 3.67 meters, and 1.19 meters, respectively. This reconfiguration not only minimizes unnecessary worker movement but also consolidates packaging operations, thereby lowering the potential for congestion and cross-traffic in the final stages of production.

Although the total distance remains at 46.14 meters, the redesigned layout enhanced workflow efficiency by centralizing worker activities and improving the linearity of the process. This outcome highlights that efficiency gains are not solely dependent on reducing overall distance, but also on optimizing spatial arrangements to support smoother transitions between workstations. Therefore, the resulting layout represents a more effective application of the SLP method for premium cut-up production.

3). Boneless production

The reorganization of the boneless production facility focuses on reducing travel distances and improving workflow centralization. The process begins at the drum chiller, after which carcasses are transferred to the grading stage and then directly to the material TTA at a distance of 2.98 meters. Following this, the carcasses are moved to the boneless table J1 (8.05 meters), where workers perform deboning by separating meat from the bones. The deboned cuts are subsequently relocated to the grammage or boneless table J2 (0.86 meters) for trimming, which involves the removal of residual bone fragments and fat to ensure product consistency.

The product then progresses to the vacuum sealing stage (2.85 meters), before being transferred to the finished TTA (2.67 meters) for consolidation. The final stage involves transportation to the warehouse (8.8 meters), completing the flow sequence. Overall, this arrangement results in a total travel distance of only 26.21 meters. Compared to the initial layout, this design achieves a reduction of more than 50% in travel distance, thereby significantly minimizing unnecessary movement while also concentrating production activities within a single, cohesive work area. This optimized configuration not only enhances operational efficiency by streamlining the process but also reduces worker fatigue associated with long-distance material handling. In addition, the centralized layout supports better supervision and coordination among workers, which further contributes to smoother production flow. The following figure illustrates the boneless production layout.

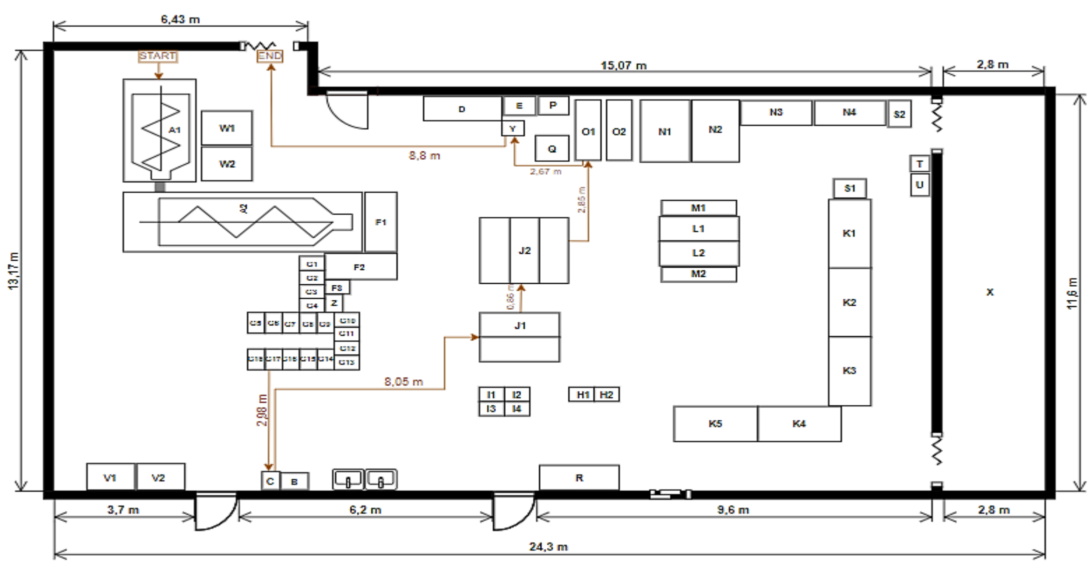

FIGURE 7
SLP LAYOUT OF THE BONELESS PRODUCTION

4). Parting Production

The parting production flow is reorganized to shorten distances and reduce unnecessary movement. The process begins at the drum chiller and then proceeds to the material TTA at a distance of 2.98 meters. From there, the carcasses are transferred to the fat cleaning area (7.23 meters), followed by the de-feathering stage (0.95 meters). Subsequently, the carcasses are transported to the cutting table (1.88 meters), where the cutting process is carried out. The meat cuts are then directed to the marinating area (13.24 meters), with the spices being retrieved from the storage rack located 5.22 meters away. After marination, the product is moved to the packing table (1.61 meters), followed by the vacuum sealing stage (3.67 meters), the metal detector (1.19 meters), and then to the finished TTA (0.86 meters). The final stage involves transportation to the warehouse (8.8 meters).

Overall, this arrangement results in a total travel distance of 47.63 meters, thereby reducing more than 10 meters compared to the original layout. This reconfiguration creates a more streamlined and centralized production flow, minimizing redundant worker movement and supporting improved operational efficiency. The following figure illustrates the parting production layout.

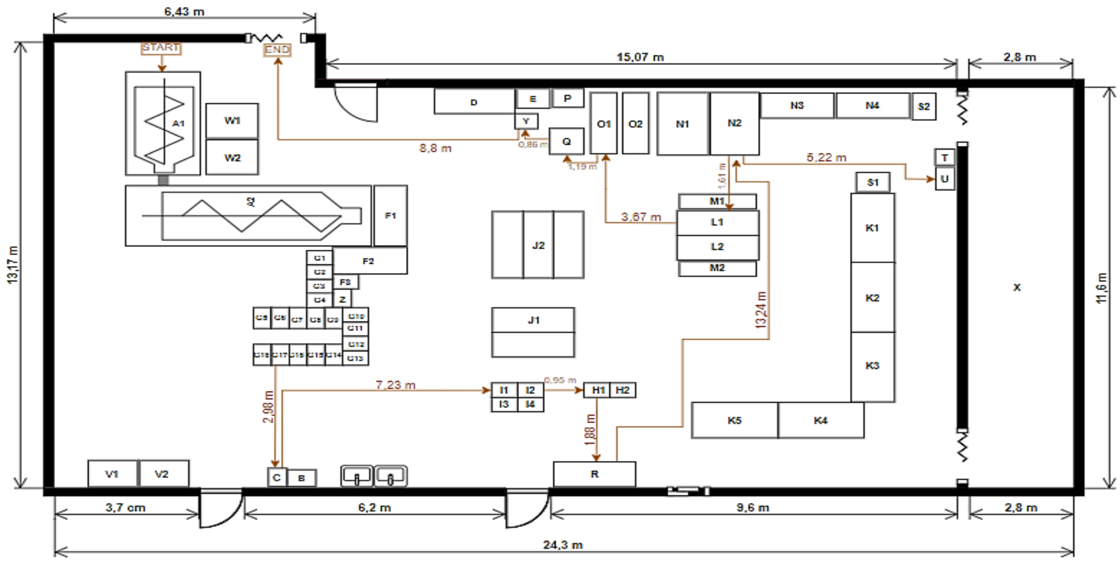

FIGURE 8
SLP LAYOUT OF THE PARTING PRODUCTION

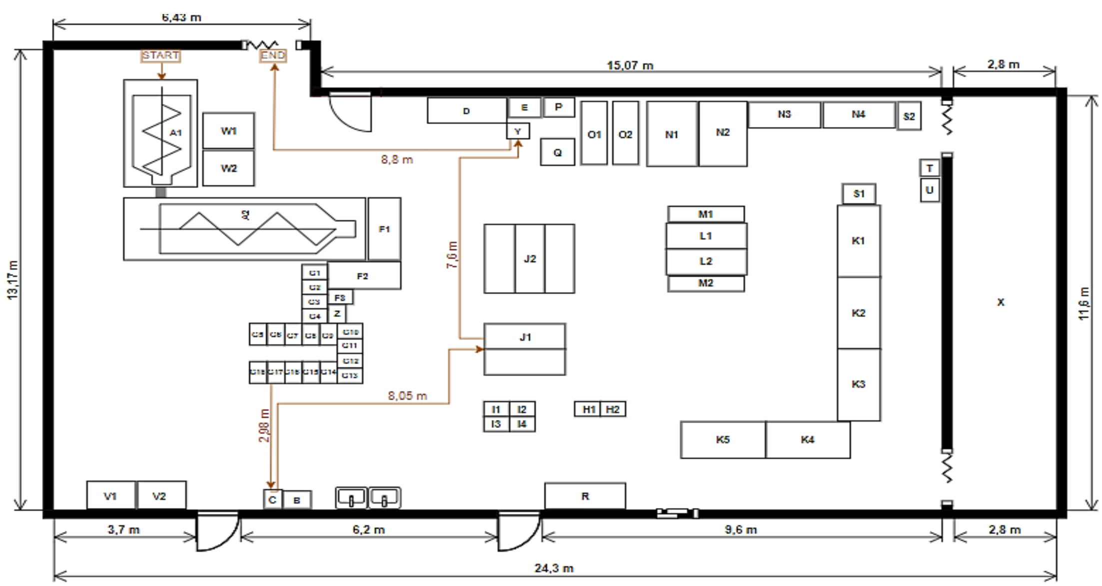

FIGURE 9
SLP LAYOUT OF THE WHOLE CHICKEN PRODUCTION

5). Whole Chicken Production Flow

The application of the SLP method to whole chicken production results in a facility layout that prioritizes proximity to core processes. After leaving the drum chiller, carcasses are directed to grading and then to the material TTA at a distance of 2.98 meters. From there, whole chickens are transferred to the J1 packing table, covering a slightly longer distance of 8.05 meters, where the packaging process is carried out. The packaged products are then transported to the finished TTA at a distance of 7.6 meters before being delivered to the storage or distribution warehouse at a distance of 8.8 meters.

This reconfigured layout results in a total travel distance of 27.43 meters. Although this is slightly longer than the original layout, the reorganization provides a more structured process flow and minimizes the potential for cross-flow between operations. Figure 9 shows the SLP layout for the whole chicken production.

V. Selecting the Optimal Layout

The layout is designed based on the proximity of activities and the actual workflow in the field. Facilities that are directly related, such as the grading area, feather and fat cleaning areas, boneless tables, parting tables, and packaging machines, are arranged close to each other and follow the production process sequence. This arrangement facilitates the movement of products and workers, reducing time and transfer distances. The layout design process is conducted manually and iteratively based on a thorough understanding of the production flow in the clean area, providing flexibility to adjust the layout to actual conditions.

Table II presents a comparative analysis between the initial facility layout and the alternative layout developed using the Systematic Layout Planning (SLP) method across five production processes: cut-up, premium cut-up, boneless, parting, and whole chicken processing. The data demonstrated that the selected layouts consistently reduced the overall travel distances for most production flows, with the exception of the whole chicken process.

TABLE II
COMPARISON OF THE INITIAL AND ALTERNATIVE LAYOUTS

No	Production process	Initial layout (m)	SLP Alternative (m)
1	Cut-up flow	60.05	49.92
2	Premium Cut-up flow	60.05	46.14
3	Boneless flow	33.08	26.21
4	Parting flow	58.20	47.63
5	Whole chicken flow	22.52	27.43
Total		**233.90**	**197.33**

$$\text{Alternative design layout efficiency} = \frac{233{,}9 - 197{,}33}{233{,}9} \times 100\%$$
$$= 15{,}63\%$$

For the cut-up production flow, the distance is reduced from 60.05 meters in the initial layout to 49.92 meters in the SLP alternative, representing a more streamlined flow with minimized cross-traffic. Similarly, the premium cut-up flow is shortened from 60.05 meters to 46.14 meters, indicating that centralizing activities around packaging and marinating significantly improved efficiency. The boneless flow shows one of the most substantial reductions, from 33.08 meters to 26.21 meters, which confirms that relocating critical stations such as the boneless tables and vacuum sealing equipment closer together successfully minimizes unnecessary movement.

The parting flow also achieved a notable improvement, with the distance reduced from 58.20 meters to 47.63 meters. This reduction is largely attributed to the better arrangement of fat cleaning, marinating, and packing processes, which allowed for smoother and more direct transitions between stages. Conversely, the whole chicken flow slightly increased in distance, from 22.52 meters to 27.43 meters. While this represented a 4.91-meter increase, the alternative design provided a more structured and organized flow, which minimizes the potential for cross-process interference and improves overall process control.

When aggregated, the total distance across all processes decreases from 233.90 meters in the initial layout to 197.33 meters in the alternative layout. This reduction of 36.57 meters corresponds to an overall efficiency improvement of 15.63%, which confirms the effectiveness of the SLP approach in reorganizing production areas, centralizing workflows, and reducing operator movement. These results highlight that the SLP-based redesign not only optimizes spatial utilization but also provides a more systematic and controlled flow of materials and products within the facility. The redesigned clean area layout of the company can be seen in Figure 10.

The SLP method is able to achieve a significant reduction in transfer distances due to its comprehensive and systematic approach to facility layout design. This enables the arrangement of a layout that considers the intensity and importance of relationships between processes, so that facilities with close relationships can be placed near each other. Additionally, SLP also considers the actual workflow in the field, including the process sequence, accessibility needs between facilities, and operator movement space, resulting in an efficient facility arrangement. Therefore, the SLP method is recommended as an effective layout design approach to support operational efficiency in the clean area of the company.

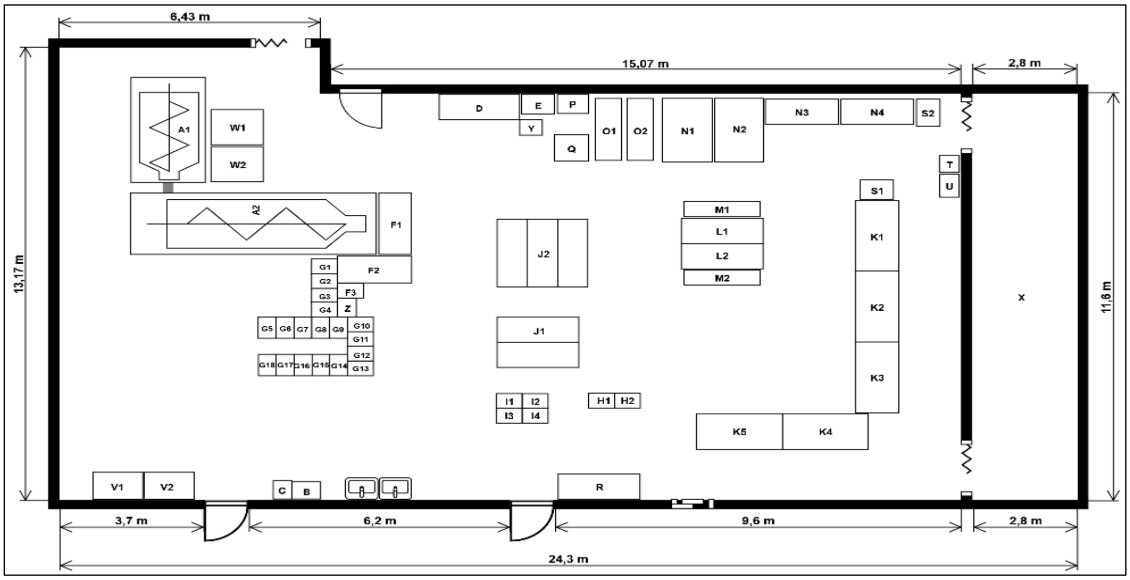

FIGURE 10
THE REDESIGNED CLEAN AREA LAYOUT

CONCLUSION AND RECOMMENDATION

This study applies the Systematic Layout Planning (SLP) method to improve facility layout and production workflows in poultry processing. The results demonstrate that SLP provides a structured and systematic approach to reconfiguring production lines in ways that enhance operational efficiency, reduce unnecessary movement, and strengthen process organization. By carefully analyzing material flow and spatial arrangements, the redesigned layouts create a more coherent production sequence, minimizing the risks of congestion and cross-flow that often arise in complex processing environments. The reorganization of production lines also emphasizes the importance of aligning layout decisions with the principles of lean manufacturing. Rather than focusing solely on distance reduction, the new layouts prioritize workflow clarity, ergonomic efficiency, and safety in the workplace. This alignment highlights that facility design is not merely a technical adjustment but a strategic decision that directly influences productivity, quality, and workforce well-being. In addition, the study underscores the adaptability of the SLP method to diverse production flows, including cut-up, boneless, parting, and whole chicken processes. Each reconfigured line demonstrates the potential of layout planning to address the specific needs of different production types while maintaining overall coherence within the facility. This adaptability reflects the broader relevance of SLP as a technique that optimizes existing facility layouts in industrial settings where efficiency, hygiene, and safety are critical.

Based on these findings, it is recommended that future research integrate SLP with digital simulation and modeling techniques to assess performance under various demand scenarios. Such integration would allow organizations to test alternative designs virtually, anticipate potential bottlenecks, and ensure long-term flexibility in responding to market changes. The combination of SLP with advanced analytical tools can therefore serve as a foundation for building more resilient, adaptive, and sustainable production systems.

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