SLP (Systematic Layout Planning) for Enhanced Plant Layout Efficiency

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Abstract: ***In manufacturing setups characterized by low volume, high optionality, substantial work content, and reliance on trivial knowledge, small and medium-scale industries often lack a systematic approach when it comes to redesigning their existing manufacturing lines or launching new manufacturing process lines. Traditional approaches to plant layout design, while having served their purpose in the past, come with inherent limitations and challenges that may hinder the adaptability and competitiveness of manufacturing facilities in the United States. This white paper delves into the pivotal role of plant layout design in industrial settings for a manufacturing line that consists of 16 sub-assembly lines, explores the drawbacks associated with conventional methods, and advocates for the adoption of a scientific, data-driven approach, precisely, Systematic Layout Planning (SLP), to overcome these challenges and propel manufacturing into a more efficient and adaptable future.***

Keywords: Lean manufacturing; line balancing; manufacturing engineering; layout planning; value added; Layout Design; Layout Optimization; Total Closeness Rating, Productivity

1. Introduction

The layout of a manufacturing facility is considered as the puzzle pieces that fit together perfectly to create a complete picture, especially if 16 lines have to work in sync to build a product. In manufacturing, each element is strategically placed, much like arranging puzzle pieces, to ensure a seamless and effective production process. Efficient plant layout design is critical to achieving optimal workflow, minimizing wastage of resources with reference to the seven lean wastes, ensuring worker safety, and enhancing overall productivity.

2. Limitations of traditional approach

While traditional approaches to plant layout design have been the cornerstone of manufacturing practices for decades, especially homegrown small-medium-sized manufacturing organizations, they are not without their shortcomings. Outdated facilities, resistance to change, and a lack of data-driven decision-making are common challenges companies face when relying on conventional methods.

Moreover, global competition prioritizes American manufacturers' ability to improve efficiency continually. Facilities with outdated layouts may struggle to compete with counterparts embracing more advanced and adaptive approaches to plant layout design.

3. Purpose of the white paper

This white paper's primary purpose is to serve as a comprehensive guide for manufacturers seeking to enhance their plant layout efficiency. By highlighting the importance of plant layout design, acknowledging the limitations of traditional approaches, and introducing the benefits of adopting a scientific, data-driven approach like Systematic Layout Planning (SLP), this paper aims to provide actionable insights and practical recommendations for crafting future-ready manufacturing facilities.

4. Potential impact of adopting SLP

The adoption of SLP promises to revolutionize plant layout design in industrial settings. By emphasizing a systematic and data-driven approach, SLP addresses the limitations associated with traditional methods. Objective decision-making, efficient resource utilization, cost reduction, and enhanced flexibility are among the key benefits that can be realized through the implementation of SLP.

5. Approach-Overview of the key elements in the SLP

The Systematic Layout Planning (SLP) approach involves a series of steps, each addressing specific aspects of the layout design.

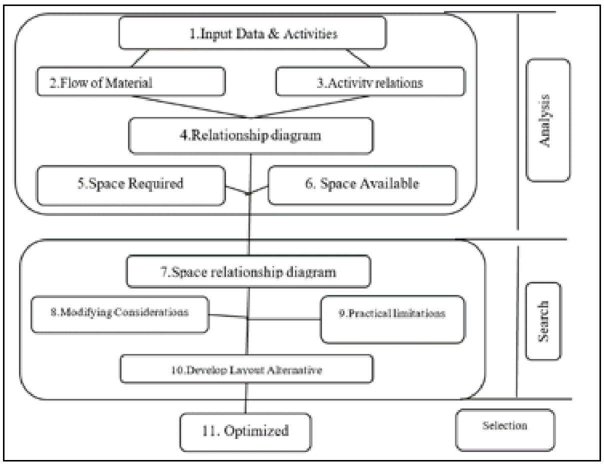

Figure 1: SLP approach

1) Input data: Product and process information
Understanding the nature of the products to be manufactured, the production processes involved, and the volume.
2) Activities: Identification of activities
Specifying the equipment, machinery, and personnel needed for each activity.
3) Flow of materials: Material flow analysis
Determining the modes of material transportation, such as conveyors, forklifts, or manual handling.
4) Activity relations: Sequence and dependency
Communication and Information Flow: Considering how information flows between activities.
5) Relationship Diagram
Developing a visual representation of the relationships between various activities and departments.
6) Space available
Evaluating the existing space to determine the limitations and opportunities for layout design.
7) Space required.
Estimating the space needed for each activity based on equipment, personnel, and material handling considerations.
8) Space relationship diagram
Creating a visual representation of the spatial relationships between different activities and departments.
9) Modifying considerations.
Considering the ability of the layout to adapt to changes in production processes or business needs.
10) Practical limitations
Acknowledging constraints such as structural limitations, safety regulations, and budgetary constraints.
11) Develop layout alternatives.
Assessing each alternative against the established criteria.
12) Optimized layout
Choosing the layout that best meets the objectives, considering efficiency, productivity, and other relevant factors.

6. Key Concepts Deep Dive

A step-by-step approach was used to implement SLP into an existing layout and measure the benefits of adopting the approach. The steps below outline and describe the activities to be performed in each step.

6.1 Decipher the Codes

One important aspect of SLP is the use of reason codes and scoring criteria to prioritize factors influencing the layout. Richard Muther's codes and criteria are as follows.

Table 1: SLP codes

Code	Reason
1	Process flow
2	Common trolley usage
3	Ease of supervision
4	Equipment usage
5	Communication & paperwork
6	Material control

Code	Score	Criteria
A	6	Absolutely necessary
E	5	Especially important
I	4	Important
O	3	Ordinary closeness
U	2	Unnecessary
X	1	Not Desirable

Reason codes

Process flow (Code 1)
This reason code considers the logical flow of the production process, material flow. It aims to create a layout that minimizes disruptions and bottlenecks.

Common trolley usage (Code 2)
This reason code emphasizes the shared use of trolleys or material handling equipment. It promotes efficiency by reducing the need for multiple handling and transportation.

Ease of supervision (Code 3)
This section focuses on the ability of supervisors to oversee and manage work areas easily. A layout that facilitates effective supervision can lead to better control and coordination.

Equipment usage (Code 4)
It considers the efficient utilization of equipment within the layout. This includes placing workstations to optimize their use and minimize downtime.

Communication & paperwork (Code 5)
Addresses the need for effective communication and paperwork flow between departments. A well-designed layout can enhance information exchange with limited paperwork.

Material control (Code 6)
It focuses on properly controlling, storing, handling, and managing raw materials and finished goods throughout the production process.

Scoring criteria

A (Score 6 - Absolutely necessary)
Assigned to factors that are critical and non-negotiable for the layout.

E (Score 5 - Especially important)
Given the factors that contribute significantly to the overall efficiency of the layout.

I (Score 4 - Important)
Indicates factors that are important but may have some flexibility in their arrangement.

O (Score 3 - Ordinary closeness)
Represents factors that require a standard level of attention.

U (Score 2 - Unnecessary)
Assigned to factors that do not play a critical role in the layout and can be considered lower priority.

X (Score 1 - Not desirable)
Designates factors that are undesirable and should be avoided in the layout.

In Systematic Layout Planning (SLP), a Relationship (REL) Chart is a graphical representation that illustrates the proximity preferences between different activities or departments within a facility. The chart helps identify the most suitable placements for these activities based on their

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relationships and interdependencies.

6.2 REL chart in the SLP approach

Purpose of REL chart

Visual representation:
Provides a visual representation of the desired relationships between activities or departments.

Proximity preferences
Illustrates the preferred distance between activities to optimize workflow and communication.

Logical sequence
It helps establish a logical sequence for the placement of activities, enhancing the efficiency of material flow and information exchange.

Steps in creating an REL Chart: Identify activities
List and identify the various activities or departments involved in the production process.

Define relationships
Determine the relationships and dependencies between each pair of activities. Consider factors such as material flow, communication needs, and shared resources.

Assign relationship codes
Use codes to represent the nature of relationships between activities. Common codes include:
“A” for Absolutely Necessary
“E” for Especially Important
“I” for Important
“O” for Ordinary Closeness
“U” for Unnecessary
“X” for Not Desirable

Create the chart
Develop a matrix or chart representing each activity along the X and Y axes. The intersection of each pair of activities contains the assigned relationship code.

Analyze the chart
Review the REL chart to identify patterns and preferences in the placement of activities. Higher-ranked relationships indicate a stronger preference for proximity.

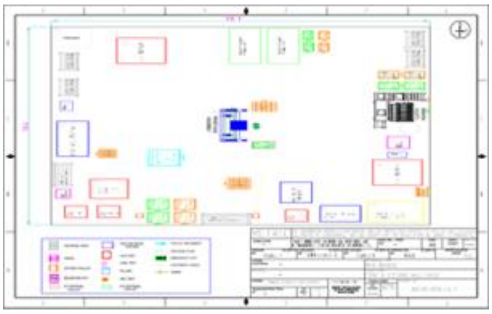
Example REL chart
Consider a simplified REL chart for a manufacturing facility with three activities: A, B, and C.

	A	B	C
A	-	E	I
B	E	-	A
C	I	A	-

In this example
Activity A prefers to be especially close to B, and it is important to be close to C.

Activity B prefers to be especially close to A and important to be close to C.
Activity C prefers to be important to A and especially close to B.

6.3 Identify the Key performance indicators (KPIs)



Space utilization efficiency
- Space Utilization Efficiency refers to how effectively the available space within the plant is utilized for productive activities, minimizing wasted space.
- It involves optimizing the layout to ensure that every square foot of the plant is utilized efficiently, minimizing unused or underutilized areas.

Material flow
- Material Flow denotes the movement of materials throughout the plant, from receiving to storage, processing, and shipping.
- It involves designing a layout that minimizes bottlenecks and congestion points, ensuring smooth and efficient movement of materials.

Operators travel distance
- Operator Travel Distance refers to the total distance operators need to travel within the plant to perform their tasks.
- It involves minimizing unnecessary movement for operators and optimizing their workstations’ proximity to each other and to the materials they need.

Cycle time reduction
- Cycle Time Reduction focuses on decreasing the time it takes to complete a production cycle or process.
- Shorter cycle times increase production output, reduce lead times, and improve responsiveness to customer demands, enhancing competitiveness.

Number of operators
- The Number of Operators refers to the quantity of personnel required to operate the plant efficiently.
- It involves optimizing staffing levels to meet production demands while minimizing labor costs and maintaining operational effectiveness.

7. Case Study and Implementation

This project aims to conduct systematic layout planning (SLP) to optimize the assembly station layout for a series of sub-assembly parts, following the steps defined in section 4. The assembly station involves the assembly of various components, including gearboxes, front axles, clutch housings, shaft sub-assemblies, and more.

Table 2: Sub-assembly description

Sub-assembly Description	
Gear box Assembly	Indexing fixture- housing
Leak Test-GB	Stud fitment
Filling	FREEZER
Run Test-GB	Clutch Housing/Cover Sub-Assembly
Front Axle main Assembly	Balancing Machine
Run Test-FD	Clutch Cover Sub-Assembly
Filling	Shaft Sub-Assembly
Leak Test-FD	Differential Housing Sub-Assembly

7.1 Review the traditional layout.

The steps started with reviewing the existing layout and identifying the key performance indicators to measure the layout efficiency.

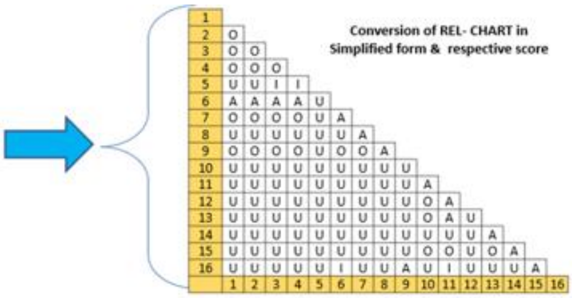


Figure 2: Traditional layout

7.2 Traditional Layout's Key Performance Indicators (KPIs)

- Space Utilization Efficiency:
  Measures how effectively space is used in the assembly station (229.5 Sq. M).
- Material Flow:
  Tracks the total distance materials travel within the station (101.4 Meters).
- Operator Travel Distance:
  This reflects the total distance operators move within the station (67.6 meters).
- Cycle Time Reduction:
  Indicates the total assembly cycle time (284.82 Mins).
- Number Of Operators:
  Specifies the workforce needed to operate the station (5).

Table 3: Traditional layout KPI's

KPIs	Current layout
Space Utilization Efficiency	229.5 Sq. Meters
Material Flow	101.4 Meters
Operator Travel Distance	67.6 Meters
Cycle Time Reduction	284.82 Mins
Number Of Operators	5 operators

7.3 Relationship Chart & Functional Relationship – AS IS Layout

The REL Chart systematically identifies and quantifies the functional relationships between different departments or workstations within the facility. It categorizes these relationships based on factors such as material flow, information flow, and operational dependencies. By graphically representing these relationships, the REL Chart clearly explains how each department contributes to the production process.

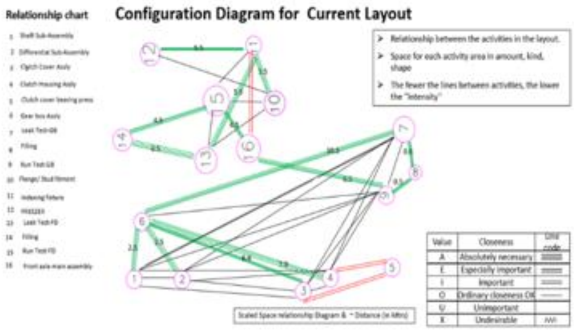


Figure 3: Relationship chart, Traditional Layout

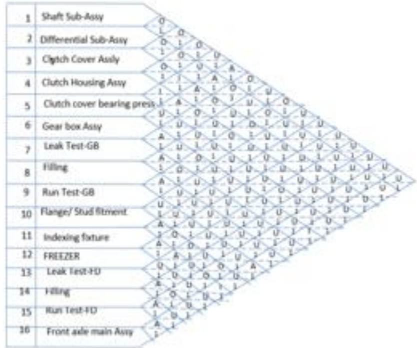


Figure 4: Functional relationship

Figure 5: Simplified relationship chart

7.4 REL(Relationship) Chart scoring

Quantification of relationships
The REL Chart assigns numerical values or scores to the relationships between departments, indicating their strength or intensity. This quantification allows designers to prioritize certain relationships over others and optimize the layout to enhance the most critical functional connections. For example, departments with high material flow between them may receive higher REL scores, signifying their importance in the layout design.

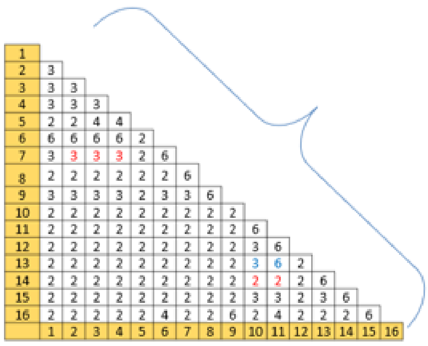


Figure 6: Simplified relationship chart quantification

Visualization of interaction patterns
The REL Chart visualizes the interaction patterns between departments or workstations through graphical representation. It helps identify patterns of material flow, communication, and collaboration, highlighting areas where

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departments interact closely and depend on each other for successful operations. This visualization aids in designing layouts that facilitate seamless interaction and cooperation between different facility parts.

7.5 Total Closeness Rating (TCR)

TCR: The sum of numerical values assigned to the close relationship between departments and all other departments. In systematic layout planning (SLP), the Total Closeness Rating (TCR) is a crucial metric used to determine the optimal layout of departments or stations within a facility.

Table 4: Total closeness rating

Sub-assembly	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TCR
1		3	3	3	2	6	3	2	3	2	2	2	2	2	2	2	39
2	3		3	3	2	6	3	2	3	2	2	2	2	2	2	2	39
3	3	3		3	4	6	3	2	3	2	2	2	2	2	2	2	41
4	3	3	3		4	6	3	2	3	2	2	2	2	2	2	2	41
5	2	2	4	4		2	2	2	2	2	2	2	2	2	2	2	34
6	6	6	6	6	2		6	2	3	2	2	2	2	2	2	4	53
7	3	3	3	3	2	6		6	3	2	2	2	2	2	2	2	43
8	2	2	2	2	2	2	6		6	2	2	2	2	2	2	2	38
9	3	3	3	3	2	3	3	6		2	2	2	2	2	2	6	44
10	2	2	2	2	2	2	2	2	2		6	3	3	2	3	2	37
11	2	2	2	2	2	2	2	2	2	6		6	6	2	3	4	45
12	2	2	2	2	2	2	2	2	2	3	6		2	2	2	2	35
13	2	2	2	2	2	2	2	2	2	3	6	2		6	3	2	40
14	2	2	2	2	2	2	2	2	2	2	2	2	6		6	2	38
15	2	2	2	2	2	2	2	2	2	3	3	2	3	6		6	41
16	2	2	2	2	2	4	2	2	6	2	4	2	2	2	6		42

Table 5: Reorganized subassembly list

Sub Assembly No	Sub Assembly Description
1	Lay Shaft/Intermediate Shaft Sub-Assembly
2	Differential Housing Sub Assembly
3	Clutch Cover Assembly
4	Clutch Housing Assembly
5	Clutch Cover Bearing Press
6	Gear box Assembly
7	Leak Test-GB
8	Filling
9	Run Test-GB
10	Flange assembly/Stud fitment
11	Indexing fixture- housing
12	FREEZER
13	Leak Test-FD
14	Filling
15	Run Test-FD
16	Front Axle main Assembly

TCR (Total Closeness Rating) quantifies one department's overall closeness or proximity to all other departments based on their functional relationships, material flow, and operational dependencies.

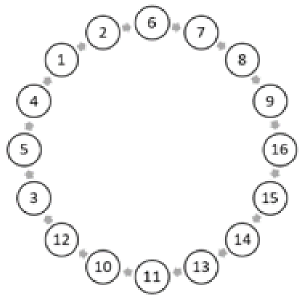

Figure 7: Total Closeness Rating

Table 6: Reorganized assembly list

No. of blocks	Sub-assembly description	Sequence of Sub-assembly
11	Gear box Assembly	6
2	Leak Test-GB	7
1	Filling	8
4	Run Test-GB	9
15	Front Axle main Assembly	16
2	Run Test-FD	15
1	Filling	14
1	Leak Test-FD	13
7	Indexing fixture- housing	11
2	Stud fitment	10
2	FREEZER	12
4	Clutch Housing/Cover Sub-Assembly	3
4	Balancing Machine	5
3	Clutch Cover Sub-Assembly	4
2	Shaft Sub-Assembly	1
1	Differential Housing Sub Assembly	2

When employing SLP for plant layout design, the department, function, or station with the largest TCR is typically selected as the first department to establish a layout foundation. In above case it is Sub Assembly. - 6 i.e. Gear Box Assembly.

Table 7: TCR for reorganized assembly list

Sub-assembly Description		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Gearbox Assembly	6	A	A	A	A	U		A	O	O	U	U	U	U	U	U	I
Leak Test-GB	7	O	O	O	O	U			A	O	U	U	U	U	U	U	U
Filling	8	U	U	U	U	U				A	U	U	U	U	U	U	U
Run Test-GB	9	O	O	O	O	U					U	U	U	U	U	U	A
Front Axle Main Assembly	16	U	U	U	U	U					U	I	U	U	U	A	
Run Test-FD	15	U	U	U	U	U					O	O	U	O	A		
Filling	14	U	U	U	U	U					U	U	U	A			
Leak Test-FD	13	U	U	U	U	U					O	A	U				
Indexing fixture-housing	11	U	U	U	U	U					A		A				
Stud fitment	10	U	U	U	U	U							O				
FREEZER	12	U	U	U	U	U											
Clutch Housing/Cover Sub-Assembly	3	O	O		O	I											
Balancing Machine	5	U	U		I												
Clutch Cover Sub-Assembly	4	O	O														

7.6 SLP-based layout with stations numbered.

The future state layout was created using TCR(Total Closeness rating). The layout locations were numbered based on TCR to visualize the impact. The layout below showcases the developed layout.

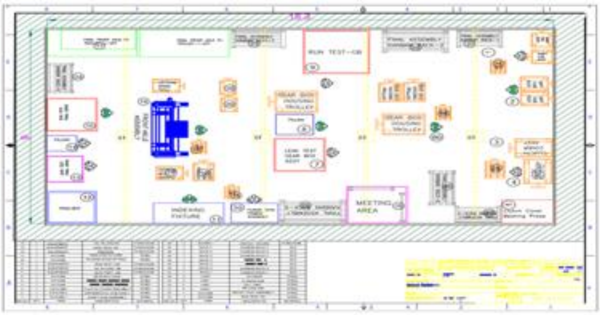

Figure 8: SLP layout

8. SLP-based layout with defined process flow.

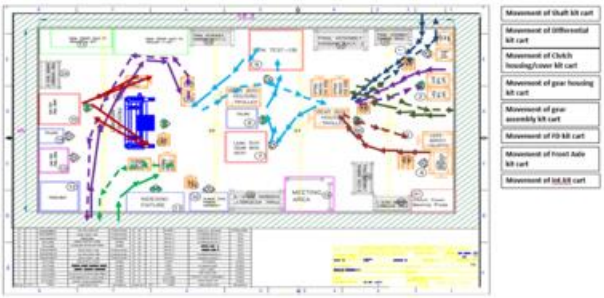

Figure 9: Process flow

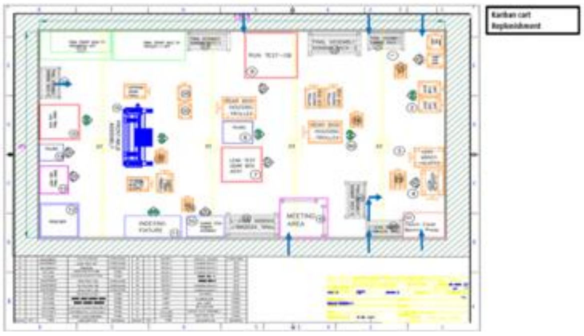

Figure 10: Final layout

Visualization of spatial relationships

The space relationship diagram visually represents the spatial relationships between different departments, workstations, or functional areas within the facility. It illustrates the physical proximity and adjacency requirements necessary for efficient material flow and operational processes.

Identification of functional dependencies

By depicting the layout of departments and their interconnections, the space relationship diagram helps identify functional dependencies between various areas within the facility. It highlights the flow of materials, information, and personnel between different departments, enabling designers to understand how each department contributes to the overall production process.

Optimization of material flow

The space relationship diagram facilitates material flow optimization by identifying the most efficient paths for moving materials through the facility. It allows designers to minimize transportation distances, reduce congestion points, and streamline the flow of materials from one department to another, ultimately improving productivity and reducing lead times.

Evaluation of layout alternatives

Space relationship diagrams enable designers to evaluate different layout alternatives by visually comparing the spatial configurations of departments. Designers can experiment with various department arrangements and assess their impact on material flow, operational efficiency, and overall layout performance. This iterative process helps identify the most suitable layout design that meets the facility's objectives and constraints.

Communication and Collaboration

Space relationship diagrams serve as a communication tool for stakeholders involved in the layout design process. They provide a common visual language for discussing layout concepts, sharing ideas, and soliciting feedback from key stakeholders such as production managers, engineers, and operators. This promotes collaboration and alignment of objectives throughout the design process.

Basis for decision-making

The space relationship diagram serves as a basis for making informed decisions regarding the layout design. It provides designers with a clear understanding of the spatial requirements, functional relationships, and operational considerations that influence the layout design. This helps ensure that the final layout configuration effectively supports the facility's production processes and business goals.

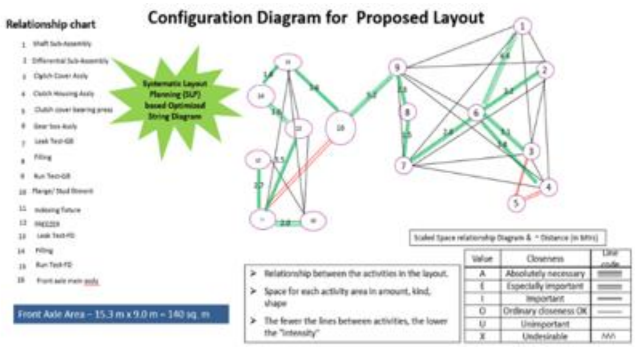

Figure 11: Final SLP relationship diagram

9. Cycle time analysis for SLP-based layout

Reducing the operator count from 5 to 4 through the implementation of systematic layout planning (SLP) signifies a significant improvement in operational efficiency and resource utilization within the facility. Here's how this reduction in operator count could be explained

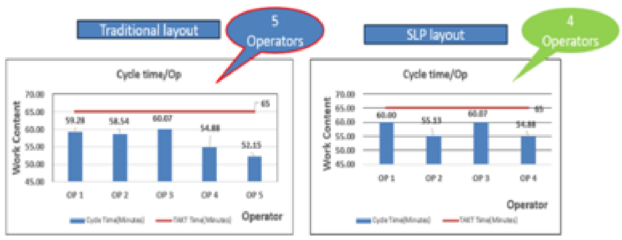

Table 8: Operator count

Optimized workflow

By strategically arranging workstations and improving material flow, SLP enables operators to perform their tasks more efficiently, reducing the need for additional manpower. Minimized non-value-added activities

By eliminating non-value-added activities and reducing idle time, operators can accomplish tasks more quickly and effectively, thus requiring fewer operators to maintain the same level of productivity.

Enhanced ergonomics and workstation design
By optimizing the layout to reduce excessive reaching, bending, or stretching, operators can perform their tasks more efficiently and with less physical strain, enabling each operator to handle a larger workload effectively.

Streamlined processes
By optimizing the layout to minimize bottlenecks and congestion points, operators can work more smoothly and collaboratively, leading to improved productivity and a reduced need for additional manpower.

Improved training and skill utilization
With a more streamlined and efficient layout, operators may require less training time to familiarize themselves with the production processes and equipment.

Cost savings and resource optimization
Reducing the operator count from 5 to 4 can result in cost savings associated with labor expenses, training, and benefits.

Overall, the reduction in operator counts from 5 to 4 demonstrates the tangible benefits of implementing systematic layout planning (SLP): improved workflow efficiency, minimized non-value-added activities, enhanced ergonomics, streamlined processes, and cost savings.

Table 9: KPI comparison

KPIs	Current layout	SLP layout	Delta
Space Utilization Efficiency	229.5 Sq. Meters	140 Sq. Meters	40%
Material Flow	101.4 Meters	78.6 Meters	34%
Operator Travel Distance	67.6 Meters	39.3 Meters	42%
Cycle Time Reduction	284.82 Mins	230.08 Mins	19%
Number Of Operators	5 operators	4 operators	20% less

9.1 Results and Conclusion

Systematic layout planning (SLP) significantly impacted the listed key performance indicators (KPIs) by optimizing the layout design, enhancing operational efficiency, and ultimately achieving substantial improvements across various metrics:

Space utilization efficiency
SLP reduced the space utilization from 229.5 Sq. M to 140 Sq. M, representing a 40% reduction.

- By strategically arranging workstations and departments, SLP minimized wasted space and maximized the facility's efficient use of available space.
- This optimization allowed for a more compact layout while still accommodating all necessary operations, leading to significant space savings without compromising functionality.

Material flow
Material flow decreased from 101.4 Meters to 78.6 Meters, marking a 34% reduction.

- Through careful analysis of material handling processes and streamlining of workflow patterns, SLP minimized material handling distances and optimized the flow of materials between departments.
- This improvement in material flow reduced transit times, minimized congestion points, and enhanced overall operational efficiency within the facility.

Operators travel distance
Operator travel distance decreased from 67.6 Meters to 39.3 Meters, resulting in a 42% reduction.

- SLP optimized the layout to minimize unnecessary movement and transportation for operators by strategically positioning workstations and departments.
- By reducing operator travel distances, SLP minimized idle time, improved productivity, and reduced physical strain on operators, leading to a more efficient use of labor resources.

Cycle time reduction
Cycle time reduced from 284.82 Mins to 230.08 Mins, achieving a 19% decrease.

- Through optimizing workflow and reducing material handling distances, SLP streamlined production processes and minimized unnecessary delays.
- This reduction in cycle time led to improved throughput, faster response to customer demands, and increased overall production efficiency within the facility.

Number of operators

- The number of operators decreased from 5 to 4, representing a 20% reduction.
- By optimizing workflow efficiency, reducing non-value-added activities, and enhancing resource utilization, SLP enabled the facility to achieve the same level of productivity with fewer operators.
- This reduction in the number of operators resulted in cost savings associated with labor expenses, training, and benefits, contributing to improved profitability for the organization.

In summary, systematic layout planning (SLP) was crucial in achieving significant improvements across the listed KPIs by optimizing space utilization, streamlining material flow, minimizing operator travel distance, reducing cycle time, and optimizing resource utilization within the facility.

These improvements reflect the effectiveness of SLP in enhancing operational efficiency and driving positive impacts on key performance metrics.

9.2 Future steps

To sustain the above gains from systematic layout planning (SLP) and further enhance operational efficiency:

- Monitoring and training: Implement regular monitoring of performance metrics and provide ongoing employee training for layout optimization.
- Process refinement: Continuously refine workflow processes, leveraging technology and lean principles to

streamline operations and reduce cycle times.

- Supply chain collaboration: Collaborate closely with suppliers and partners to optimize material flow and enhance supply chain efficiency.
- Technology integration: Explore advanced technologies like robotics and IoT to automate tasks and improve decision-making, thereby maximizing resource utilization.
- Continuous improvement culture: Foster a culture of continuous improvement, encouraging feedback and innovation at all organizational levels.

References

[1] Taho Yang and Chao Ton-Su (Nov 2020), "Systematic layout planning: A study on semiconductor wafer fabrication facilities," International Journal of Operations & Production Management. Vol. 20 No. 11, pp. 1359-1371.

[2] Wang Yao and Guohua Gao and Yang Li (September 2022), "Research on digital design and simulation of factory based on SLP", International Conference on Mechanical Design and Simulation (MDS 2022), Volume 122614x2022.

[3] ManojDeep Singh Jasrotia, (2024), "Unlocking Efficiency: A Comprehensive Approach to Lean In-Plant Logistics," International Journal of Science and Research (IJSR), Volume 13, Issue 3, pp. 1579-1587.

[4] Lisiane Bitencourt and Karoline dos Santos Baldez(2024), "Proposta de layout para uma fábrica de alfajores utilizando o método SLP", Revista Produção Online,Volume 24(1):5131.

[5] Yuxian Song and Xiyu Zhang and Zhuwei Xu (2023), "Layout Optimization of M Hospital based on SLP," Academic Journal of Management and Social Sciences, 3(2):100-106.