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# TOFU PRODUCTION FACILITY LAYOUT REDESIGN USING SLP TO REDUCE MATERIAL HANDLING DISTANCE AND COST

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**ABSTRACT**

*This study aims to redesign the production facility layout of Usaha Tahu Pak Suryono to reduce material handling distance and material handling cost. The observed problem was an irregular initial layout that caused detours, long movement routes, and inefficient relationships among production areas. The research used Systematic Layout Planning (SLP) supported by BLOCPLAN90. Primary data were collected through field observation, interviews, and documentation of production flow, work area dimensions, material movement distance, movement frequency, and labor-based material handling cost. The SLP stages included process identification, activity relationship analysis, worksheet preparation, activity relationship diagram development, space requirement analysis, alternative layout generation, and comparison of the initial and proposed layouts. The selected third layout alternative obtained an adjacency score of 1.00 and a relative distance score of 0.94. The proposed layout reduced daily material handling distance from 516 m to 348 m and decreased material handling cost from IDR 74,562 to IDR 50,286, representing an efficiency improvement of 32.56%. Therefore, the proposed layout can improve material flow and production efficiency.*

***Keywords:* Facility Layout, Material Handling, SLP, BLOCPLAN90, Tofu Production**

**ABSTRAK**

Penelitian ini bertujuan untuk merancang ulang tata letak fasilitas produksi Usaha Tahu Pak Suryono guna mengurangi jarak dan biaya penanganan material. Masalah yang diamati adalah tata letak awal yang tidak teratur, yang menyebabkan rute memutar, jalur perpindahan yang panjang, serta hubungan yang tidak efisien antararea produksi. Penelitian ini menggunakan metode *Systematic Layout Planning* (SLP) yang didukung oleh perangkat lunak BLOCPLAN90. Data primer dikumpulkan melalui observasi

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lapangan, wawancara, dan dokumentasi mengenai alur produksi, dimensi area kerja, jarak perpindahan material, frekuensi perpindahan, serta biaya penanganan material berbasis tenaga kerja. Tahapan SLP meliputi identifikasi proses, analisis hubungan aktivitas, penyusunan lembar kerja, pengembangan diagram hubungan aktivitas, analisis kebutuhan ruang, penyusunan alternatif tata letak, serta perbandingan antara tata letak awal dan usulan. Alternatif tata letak ketiga yang terpilih memperoleh skor kedekatan *adjacency score* sebesar 1,00 dan skor jarak relatif sebesar 0,94. Tata letak usulan tersebut berhasil mengurangi jarak penanganan material harian dari 516 m menjadi 348 m dan menurunkan biaya penanganan material dari Rp74.562 menjadi Rp50.286, yang mencerminkan peningkatan efisiensi sebesar 32,56%. Dengan demikian, tata letak usulan ini dapat meningkatkan aliran material dan efisiensi produksi.

***Kata Kunci:  Tata Letak Fasilitas, Penanganan Material, SLP, BLOCPLAN90, Produksi Tahu***

## 1. INTRODUCTION

Facility layout is one of the important factors in production management because the arrangement of work areas influences the flow of materials, movement time, operational safety, and production efficiency. An inappropriate layout can create unnecessary movement, longer transport routes, congestion between work stations, and higher material handling cost. In small and medium-scale production systems, layout improvement is also important because production space and labor resources are often limited. Therefore, the production process requires a facility arrangement that supports shorter movement distance and smoother material flow (Hadiguna, 2008; Heizer et al., 2017).

Usaha Tahu Pak Suryono is a tofu production business located in Tembesi, Batu Aji, Batam. The business processes approximately six sacks of soybeans or about 300 kg of raw material per day. The production process starts from soybean storage, soaking, grinding, boiling, fermentation, pressing, cutting, finished product storage, and roasting. Based on the initial observation, the existing facility layout was arranged according to the available space and had not fully considered the closeness relationship among production areas. Workers often had to pass around the finished product area and use inefficient routes, especially between grinding and boiling areas.

The initial measurement showed that total material movement reached 516 m per day. This condition increased the material handling cost and reduced the efficiency of production flow. Systematic Layout Planning (SLP) is suitable for this problem because it designs layout alternatives by considering activity relationships, space requirements, and material flow (Muther, 1973; Muther & Hales, 2015). Based on these conditions, this study aims to analyze the

existing layout, propose a better tofu production layout using SLP and BLOCPLAN90, and measure the reduction of material handling distance and cost after the proposed layout is applied.

## 2. RESEARCH METHODS

This research used a facility layout redesign approach with Systematic Layout Planning (SLP). The research object was the tofu production area of Usaha Tahu Pak Suryono in Tembesi, Batu Aji, Batam. The research activities were carried out from January to April 2026, while the research analysis focused on production flow, workstation relationships, space requirements, material handling distance, and material handling cost.

Primary data were obtained through direct observation, interviews, and documentation. Observation was conducted to identify the actual production sequence, workstation locations, material movement routes, and the condition of the initial layout. Interviews with the owner and workers were used to obtain information about production problems, movement constraints, and improvement needs. Secondary data were obtained from books and previous studies related to facility layout, SLP, material flow, and production efficiency.

The analysis stages consisted of identifying the production process, measuring work area dimensions, analyzing material flow and movement frequency, preparing the Activity Relationship Chart (ARC), developing the worksheet and Activity Relationship Diagram (ARD), analyzing space requirements, and generating layout alternatives using BLOCPLAN90. The ARC relationship codes were converted into numerical scores, namely A = 10, E = 5, I = 2, O = 1, U = 0, and X = -10. The alternatives produced by BLOCPLAN90 were evaluated using adjacency score, relative distance score, material handling distance, and material handling cost. Material handling cost was calculated based on worker cost, movement distance, and movement frequency in the initial and proposed layouts.

## 3. RESULTS AND DISCUSSION

The production volume of Usaha Tahu Pak Suryono during January to April 2026 was relatively stable, ranging from 2,000 to 2,100 buckets per month. This production condition indicates that the facility requires a layout that can support continuous and repeated material movement between stations.

**Table 1. Production volume from January to April 2026**

| Month | Production |
|---|---|
| January | 2,100 buckets |
| February | 2,000 buckets |
| March | 2,100 buckets |
| April | 2,000 buckets |

The production area consists of nine main workstations. These workstations form the production flow from raw material storage to the final roasting process. The total workstation area identified from field measurement was 53 m2.

**Table 2. Workstation area requirements**

| Code | Workstation | Area (m2) |
|---|---|---|
| A | Soybean storage | 9 |
| B | Soaking | 4 |
| C | Grinding | 4 |
| D | Boiling | 6 |
| E | Fermentation | 4 |
| F | Pressing | 6 |
| G | Cutting | 8 |
| H | Finished product | 6 |
| I | Roasting | 6 |

The initial layout analysis showed that the longest material movement occurred between the grinding and boiling stations, with a distance of 8 m and a frequency of 25 movements per day. This movement contributed 200 m to the total daily material handling distance. The initial total movement distance was 516 m per day. This condition shows that the existing placement of related work areas did not support an efficient production flow.

The ARC analysis showed that several sequential activities required a close relationship. The pairs of soybean storage-soaking, soaking-grinding, grinding-boiling, boiling-pressing, pressing-cutting, cutting-finished product, and finished product-roasting were classified as A because the material flows directly between these stations. The boiling-fermentation relationship was classified as I because it is still related to the next production stage but does not require the same level of closeness as the main sequential flow.

After the ARC, worksheet, ARD, and space requirement data were processed in BLOCPLAN90, ten layout alternatives were generated. The third alternative was selected as the best layout because it obtained an adjacency score of 1.00 and a relative distance score of 0.94. The selected layout placed closely related stations nearer to each other and reduced unnecessary movement between work areas.

**Table 3. Material handling distance comparison**

| Movement route | Initial (m/day) | Proposed (m/day) | Reduction (m/day) |
|---|---|---|---|
| Soybean storage - Soaking | 36 | 18 | 18 |
| Soaking - Grinding | 60 | 60 | 0 |
| Grinding - Boiling | 200 | 50 | 150 |

| | | | |
|---|---|---|---|
| Boiling - Fermentation | 40 | 40 | 0 |
| Fermentation - Pressing | 20 | 20 | 0 |
| Pressing - Cutting | 40 | 60 | -20 |
| Cutting - Finished product | 80 | 60 | 20 |
| Finished product - Roasting | 40 | 40 | 0 |
| **Total** | **516** | **348** | **168** |

The comparison shows that the proposed layout reduced material handling distance by 168 m per day, from 516 m to 348 m. This represents a reduction of 32.56%. The improvement was mainly obtained by reducing the grinding-boiling distance from 8 m to 2 m and adjusting the position of several stations according to the production sequence.

**Table 4. Material handling cost comparison**

| Movement route | Initial (IDR) | Proposed (IDR) | Reduction (IDR) |
|---|---|---|---|
| Soybean storage - Soaking | 5,202 | 2,601 | 2,601 |
| Soaking - Grinding | 8,670 | 8,670 | 0 |
| Grinding - Boiling | 28,900 | 7,225 | 21,675 |
| Boiling - Fermentation | 5,780 | 5,780 | 0 |
| Fermentation - Pressing | 2,890 | 2,890 | 0 |
| Pressing - Cutting | 5,780 | 8,670 | -2,890 |
| Cutting - Finished product | 11,560 | 8,670 | 2,890 |
| Finished product - Roasting | 5,780 | 5,780 | 0 |
| **Total** | **74,562** | **50,286** | **24,276** |

**Table 5. Summary of layout improvement**

| Indicator | Initial layout | Proposed layout | Reduction | Efficiency |
|---|---|---|---|---|
| Material handling distance | 516 m/day | 348 m/day | 168 m/day | 32.56% |
| Material handling cost | IDR 74,562 | IDR 50,286 | IDR 24,276 | 32.56% |

The same reduction pattern was found in material handling cost. The initial layout produced total material handling cost of IDR 74,562, while the proposed layout produced IDR 50,286. The cost decrease was IDR 24,276 or 32.56%. These results indicate that the proposed layout can reduce unnecessary worker movement, improve material flow, and support more efficient tofu production. The results also confirm that SLP supported by BLOCPLAN90 can be used as a practical approach for layout improvement in small-scale food production.

## CONCLUSION

The existing facility layout of Usaha Tahu Pak Suryono had not fully considered the closeness relationship among production areas, causing inefficient material flow and a total movement distance of 516 m per day. The layout redesign using SLP and BLOCPLAN90 generated ten alternatives, and the third alternative was selected as the best layout with an adjacency score of 1.00 and a relative distance score of 0.94. The proposed layout reduced material handling distance to 348 m per day and lowered material handling cost from IDR 74,562 to IDR 50,286. The reduction of 32.56% shows that the proposed layout is more efficient and can be recommended for implementation. In applying the new layout, the business should also maintain clear movement paths, periodically evaluate the layout, and consider worker safety and comfort.

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