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REDUCTION OF MATERIAL PICKING TIME IN PROJECT-BASED MANUFACTURING USING LEAN PRODUCTION TECHNIQUES

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Abstract

In project based machinery manufacturing, material variety and dispersed storage can extend order preparation even when individual items are available. This study assesses whether Kaizen guided project clustering and warehouse zoning can reduce material picking time in an Istanbul manufacturer. A single site, before and after case study examined warehouse location records, process observations, and time study data. Baseline timings covered 50 material requests. Components for a pilot machine were consolidated from four storage areas into two, staff were assigned zones, and visual process controls were introduced. Reported mean picking time decreased from 120 to 50 min per request (58.3%), while search time fell from 60 to 5 min and travel time from 25 to 10 min. The results indicate that storage assignment and clearer responsibility can improve internal logistics without rebuilding the warehouse. The case contributes a step level account of a lean intervention in project based production. The post intervention sample size and variation are unavailable, so the improvements are descriptive and cannot establish generalizable causal effects. The approach offers a practical pilot for manufacturers with dispersed project materials.

Keywords: Lean manufacturing; Kaizen; order picking; internal logistics; project-based production.

1. INTRODUCTION

Project based machinery production combines diverse parts with changing assembly requirements. When items required for one project are dispersed across warehouse locations, employees must repeatedly search for and travel between materials before an assembly order can be released. Lean production frames such motion and delay as process waste [1]. Research on warehouse picking identifies storage assignment, zoning, routing and batching as related design decisions [2]; comparative studies show that the benefits of a policy depend on the warehouse setting [3]. Routing studies also show that aisle configuration affects travel [4].

The studied manufacturer stored components largely by material type. Multiple project teams therefore used the same narrow aisles and storage areas. A practical response was to group parts by project, allocate work by warehouse zone and make progress visible. This study asks whether those linked changes coincide with shorter preparation time for a selected machine. Its main limitation is that the available study documents one pilot site and does not provide matched post intervention observations or variability estimates.

2. MATERIALS&METHODS

The purpose is to assess the effect of a Kaizen pilot on the time required to prepare material requests for assembly in a project-based machine manufacturer. The objectives are to map the baseline process, describe the storage and responsibility changes, compare time spent in each picking step, and identify conditions for transfer to other projects. The working hypothesis is that clustering project materials and assigning warehouse zones

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will mainly reduce search and travel, while preparation and physical picking remain relatively stable.

The contribution is a measured account of a combined storage and work allocation intervention in a high variety production setting. Its findings are intended for production engineers and warehouse managers evaluating small scale changes before committing to a complete warehouse redesign.

3. METHODOLOGY

3.1. Manufacturing and storage setting

The case is a small or medium sized machinery manufacturer in Istanbul that produces to order [5]. Its warehouse combines narrow aisle shelves for small components, heavy load pallet racks, and enclosed storage for electrical automation materials. Figures 1 and 2 reproduce the two rack types documented in the thesis. These photographs describe the storage environment; they do not record the pilot before and after states.



Figure 1. *Narrow aisle shelving documented at the facility.*

The site description reports that retrieving an item from a distant narrow aisle position and returning to the start can take about 2.5 to 5 min, depending on item size and quantity [5]. This is a location specific observation, distinct from the average request time evaluated below.



Figure 2. *Heavy load pallet rack documented at the facility.*

The heavy load rack holds two standard 0.8 × 1.2 m pallets per bay, and distant retrieval is reported to take about 6 to 12 min [5]. A powered stacking device serves this area. The coexistence of several storage modes matters because a single project request can cross areas with different handling requirements.

3.2. Baseline process and data

Warehouse addresses and material lists were examined in the company enterprise system. Before the pilot, stock was largely arranged by material type: fasteners, washers and packaging materials, for example, occupied separate locations. A Machine A request could therefore involve four stock areas. The original study reports 1,963 material entries associated with this machine, distributed as 178, 259, 868 and 658 entries across areas 1 to 4, respectively [5].

The thesis reports a time breakdown for 50 material requests prepared before the improvement. Preparation means obtaining and checking the assembly request; search means finding listed storage positions; physical picking includes counting, packaging and labelling; travel covers movement between positions; other time captures additional problems encountered

during preparation. Their reported mean durations add to 120 min per request. Before the changes, completion status was mainly available through the enterprise system, which did not provide an immediate overview of all work in progress [5].

3.3. Kaizen pilot and assessment

Machine A was selected as a pilot because its materials were numerous and dispersed. Raw materials and small components were grouped in stock area 3, while semi finished components were grouped in area 4. Workload based zones and named warehouse responsibilities were introduced. The team documented problems and follow up actions through an A3 Kaizen form; the thesis also describes one month of Yamazumi workload recording to support task allocation [5]. The stated net working day for this analysis was 420 min after breaks. The available material does not provide individual worker outcomes suitable for a before and after test.

For the outcome assessment, the reported post intervention step durations were compared with the five baseline means. Reduction percentages in this paper are recalculated from the minute values and refer to changes from the baseline. No test of statistical significance or independent economic return was estimated because the post intervention number of requests, timing variability and cost inputs are not documented in the source.

4. RESULTS AND DISCUSSION

4.1. Storage assignment

The four area distribution for Machine A was replaced with a two area allocation (Table 1 and Figure 3). All 1,963 listed material entries were then recorded in areas 3 and 4, with 1,046 and 917 entries respectively. The total number of entries remained the same: the result is a change in storage assignment, not a reduction in required components.

Table 1. *Recorded Machine A material entries by stock area.*

Stock area	Before	After
1	178	0
2	259	0
3	868	1,046
4	658	917
Total	1,963	1,963

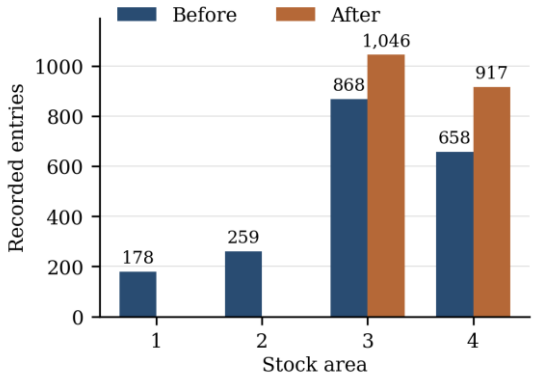


Figure 3. *Machine A entries in each stock area before and after clustering.*

This consolidation is operationally relevant in a narrow aisle setting where shared access could cause waiting. A project order now needs to be prepared from fewer areas. Neither walking distance nor aisle congestion was separately measured, so the location distribution is evidence of reorganisation rather than a direct measure of distance saved.

4.2. Material picking time

The reported mean material request time was 50 min after the pilot, compared with 120 min before it (Table 2). The absolute reduction of 70 min corresponds to 58.3% of the baseline. Search time accounted for 55 min of that difference, falling from 60 to 5 min (91.7%); travel fell from 25 to 10 min (60.0%). The remaining three activities were unchanged in the tabulated means. The measured change therefore lies entirely in finding and reaching materials, as the working hypothesis anticipated.

Table 2. *Reported mean time by material picking activity.*

Activity	Before (min)	After (min)
Preparation	5	5
Search	60	5
Physical picking	20	20
Travel	25	10
Other	10	10
Total	120	50

The percentage reduction in total time is 58.3%; 41.7% is the remaining share of baseline time.

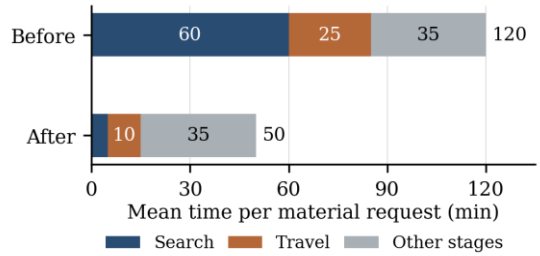


Figure 4. *Composition of reported mean request time; other stages combine preparation, picking and other delays*

Figure 4 shows how the same 35 min of preparation, picking and other activity occupies a larger share of the shorter post intervention request. Search and travel together represented 85 of 120 min (70.8%) at baseline and 15 of 50 min (30.0%) after the pilot. The shifts in percentage composition are a consequence of different total times; they are not additional time savings. In particular, 50 min is 41.7% of 120 min, while the reduction is 58.3%.

4.3. Operational interpretation

This pattern is consistent with published work that treats storage assignment, zoning and routing as linked picking decisions [2–4]. In this case, grouping by project reduced the spread of needed locations; zone responsibility and clearer follow up could also have limited repeated searches. These mechanisms are plausible explanations of the observed association, but their individual effects cannot be separated with the available data.

The thesis describes opportunities for staff to devote more time to inventory checks, warehouse organization and training once request preparation became shorter [5]. It also reports qualitative improvements in line feeding and error prevention. Those claims are useful operational observations, yet the case provides no quantitative before and after measures of stock accuracy, picking errors, delivery reliability or worker safety. None is presented here as an established secondary outcome.

4.4. Economic interpretation and study limits

The underlying thesis reports a calculated annual benefit of TRY 450,890 for two Kaizen initiatives [5]. Its cost assumptions and the share attributable to this specific picking pilot are not available in the cited results. This paper therefore does not treat that total as a verified financial return from the storage change.

The baseline covers 50 requests, but the post intervention sample size, variation, observation period and request mix are unspecified. The site is a single order-based manufacturer, and the changes were introduced together without a comparison group. These constraints prevent a statistical claim of causality or generalization to other warehouses. For a stronger replication, both phases should use comparable request classes and item counts, time each process step repeatedly, record aisle travel distance and waiting, and report the labor and relocation costs separately.

5. CONCLUSIONS

For this project-based manufacturer, consolidating Machine A materials into two stock areas and assigning zone responsibilities coincided with a reduction in reported mean request time from 120 to 50 min. Search and travel, rather than the act of physical picking, account for the entire recorded difference. The unusual feature of this case is that a project level storage

decision addresses the mismatch between type-based locations and project-based material requests.

In practice, the pilot offers a sequence for similar manufacturers: record request time by activity, identify projects whose components are spread across storage modes, group a manageable project, assign clear area ownership, and remeasure equivalent requests. Extension to other machines should be conditional on verified repeat timings, available storage capacity and handling safety. A future multi project study with documented sample sizes, route distances and itemized costs would establish whether the observed gains persist and whether they justify wider deployment.

AUTHOR CONTRIBUTIONS

***Yunus Emre Gür*:** original field investigation, collection and analysis of the case study data.

Önder Ayer: Analysis of the results, preparation of the conference paper.

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