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SAP Dynamic Location Management System: Warehouse Visibility and Picking Optimization

A design-stage case study from a spare-parts warehouse in Pune, India

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Abstract **- A warehouse picker can only travel where the information system directs. At a spare parts warehouse serving an automotive manufacturer in Pune, India, SAP ECC 6.0 held a single prime location for every part number, whereas the bulk of the stock rested in overflow bins that existed only in a spreadsheet refreshed once a shift. Pickers consequently arrived at empty bins and were compelled to walk, wait and query other departments before the stock could be found. This paper presents a design stage study, conducted during a two month internship, that diagnoses the failure and proposes the Dynamic Location Management System, abbreviated DLMS. The system comprises a purpose built SAP table that records every prime and overflow location of a part, together with challan generation logic that prints all pick locations and quantities. The diagnosis triangulates a ten day cycle count dataset, a time and motion study, a five why chain and a fishbone diagram. The allocation logic was stress tested on five order scenarios, and a row per location table was adopted after a fixed column first draft proved incapable of holding more than four overflow locations. On the count sheets, roughly two thirds of the prime locations logged each morning were empty, and more than half of the time lost in an affected pick cycle was spent searching and querying rather than walking. The time study indicates that the average pick cycle could fall from about 23 minutes to about 10 minutes, a reduction of 56 percent, with about 6,240 man hours a year recoverable for a twenty picker team; a more conservative range of 20 to 30 percent, approved after management review, is reported alongside. All figures are design stage estimates and have not yet been validated in a live pilot. The paper contributes a reusable data model pattern, a tested allocation logic, a transparent method of reporting uncertain benefits and a phased sixteen week implementation plan.**

Index Terms **- Dynamic location management, SAP ECC, warehouse management, order picking, overflow storage, information visibility, contract logistics.**

I. INTRODUCTION

India's third party logistics sector is both vast and expanding. One market estimate places its value at roughly USD 24.87 billion in FY2025, rising to USD 78.54 billion by 2034 [1]. Within this sector, clients such as automotive manufacturers procure warehousing under multi year agreements and expect the provider to deliver continuous gains in cost and speed. Order picking is widely regarded as the most labour intensive of all warehouse activities, and travel is typically the largest component of a picker's time [2]. Any intervention that eliminates needless walking and waiting from the pick cycle therefore carries immediate commercial significance.

This paper originates in a simple observation made on the floor of a spare parts warehouse at Pune, operated by DHL Supply Chain India Pvt. Ltd. on behalf of a major automotive manufacturer. The facility manages more than 40,000 active part numbers. SAP ECC 6.0 records exactly one official "prime" location for each of them. Once a prime bin is full, surplus stock is placed in one or more "overflow" bins, occasionally six or seven for a single part. These overflow bins were invisible to SAP. They lived in an Excel sheet compiled by the Binning team and passed to Inventory roughly once per shift, so the pick document, or challan, printed only the prime location. Supervisors estimated that between 40 and 60 percent of picks in the busiest zone, and in certain examples as many as 90 percent, required an overflow query before the stock could be located.

The storage and picking literature says a great deal about where stock ought to be placed and how pickers ought to be routed [3], [4], [5]. It tends, however, to presuppose that the information system knows where the stock is. The present case contradicts that premise: the physical layout was tolerable, yet the ERP data model was structurally incapable of representing a second location for a part. Three questions therefore guide the inquiry. What is the root cause of the excess search time, and how large is its footprint? Which data model and allocation logic would eliminate it within the existing SAP landscape? And how substantial, and how certain, is the likely benefit, and how might the change be introduced without disturbing live operations?

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The paper makes four contributions. It documents measured evidence of the problem from a ten day cycle count and a time and motion study. It specifies a row per location SAP table and a challan decision logic, tested against five order scenarios. It reports expected benefits at two levels of confidence and states plainly that no live pilot has yet been run. Finally, it offers a sixteen week phased roadmap together with the preconditions for go-live. The remainder of the paper reviews related work, describes the methodology, diagnoses the problem, presents the proposed system, discusses results and limitations, and closes with conclusions and future scope.

II. RELATED WORK

Storage location assignment

Bartholdi and Hackman frame storage assignment as a trade off between space utilisation and the time required to find and reach stock; compelling every part number into a single location leaves the residual units in positions the system cannot perceive [6]. Gu, Goetschalckx and McGinnis reviewed research across receiving, storage, order picking and shipping, and treated storage assignment as one of the core decisions [3]. Rojas Reyes, Solano-Charris and Montoya-Torres surveyed the storage location assignment literature from 2005 to 2017 and classified it by solution method and objective [4]. Almost all of this work determines where stock should be placed; very little interrogates what occurs when the ERP cannot record the answer. Flores and Whybark demonstrated that single criterion ABC classification overlooks operationally important distinctions between items [7], a principle that also underlies zone based layouts such as the APR, dense, LSR and yard zones of the study site. Frazelle makes the complementary point that even an excellent storage scheme is only as good as the information system that exposes it [8].

Order picking and warehouse information systems

Rouwenhorst et al. arranged warehouse design and control into strategic, tactical and operational levels and identified the information system as the connective tissue between them [9]. De Koster, Le-Duc and Roodbergen reviewed order picking design and control and reported that travel is generally the largest share of picking time [2]. More recent syntheses address the combination of planning problems in picker to parts systems [5], the practical factors that academic models habitually omit [10], warehousing under e-commerce demand [11] and order picker routing [12]. Vanheusden et al. contend that managers rarely adopt academic findings because the underlying models disregard practical conditions [10]. The present case exemplifies such a condition, since here the pick list itself is faulty. Faber, de Koster and van de Velde explored how the use of warehouse management information systems relates to warehouse complexity [13].

Record accuracy and information visibility

A pick list can be no more reliable than the stock records behind it. DeHoratius and Raman studied inventory record inaccuracy empirically, found inaccurate records to be common at a retail chain, and examined their causes [14]. Lee, Padmanabhan and Whang showed how distorted or delayed information degrades decisions at every dependent stage of a supply chain [15]; a prime only SAP record, supplemented by an offline spreadsheet that may be a full shift old, is a small scale instance of the same distortion. Davenport cautioned that an enterprise system imposes its own logic on the organisation, and that friction arises wherever that logic diverges from the way work is genuinely performed [16]. Winkelhaus and Grosse, reviewing the literature on Logistics 4.0, place timely information from connected systems at the centre of modern logistics [17].

Root cause tools and the research gap

The diagnosis relies on two instruments from the Toyota tradition. The five why technique interrogates a symptom repeatedly until the answer is actionable, and Ishikawa's cause and effect diagram groups candidate causes so that analysis does not fixate on a single explanation [18], [19]. Both accord with the lean view that motion and waiting are forms of waste. The gap this paper addresses is accordingly narrow and practical. Layout and routing research is mature; what remains thinly documented is how a warehouse should reshape its ERP data model when stock is dispersed across several locations, and how the benefit should be estimated candidly before anything is built.

III. RESEARCH SETTING AND METHODOLOGY

Setting

The study was conducted during a sixty two day internship at DHL Supply Chain India Pvt. Ltd., from 6 June to 6 August 2026. The first month was spent at the client's national spare parts warehouse at Pune, a facility of about 3.15 lakh square feet that serves as the manufacturer's nationwide spare parts hub. Storage is partitioned into zones, namely adjustable pallet racking (APR), dense racking, light storage racking (LSR) and a yard. The APR zone combines the highest volume with the most acute empty bin problem, and was therefore selected as the pilot zone of the proposal.

Approach

The work is a single site, action oriented case study in which the author acted as a participant observer; Fig. 1 summarises its eight steps. The author first rotated through all thirteen departments. During the Binning rotation (Days 11 and 12) he noticed that location allocation depended on a manually maintained Excel sheet. Inventory, Kitting, Pick-Pack and the vehicle off road desk each independently confirmed the consequence, which established that the issue was systemic rather than one department's habit. Days 24 to 29 were devoted to building the case. Three strands of evidence were gathered: the morning cycle count sheet of the Binning department, logged for ten consecutive working days from 10 to 19 June 2026; a time and motion study of an APR pick cycle in which the prime bin proves empty; and structured root cause analysis through a five why chain and a fishbone diagram. The proposed table and logic were then tested against five order scenarios and costed in a business case reviewed by site management and the Cluster Head.

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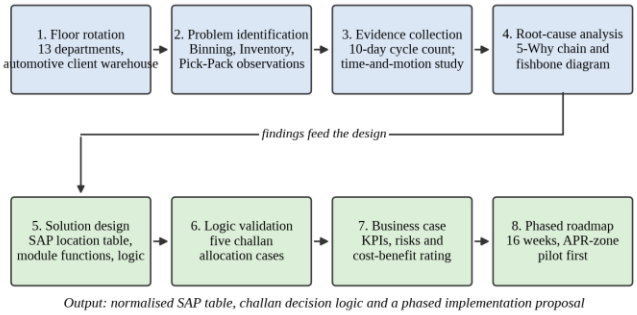


Fig. 1. Research methodology: from floor observation to a phased implementation proposal.

The scope is deliberately bounded. DLMS is a design and business proposal; building it in SAP and running a live pilot lay outside the internship. Every impact figure is consequently an estimate derived from the time study and the count data, and not the measured outcome of an operating system.

IV. PROBLEM DIAGNOSIS

How the prime and overflow structure fails

Each part number possesses one prime bin and a maximum quantity per pallet. When a delivery exceeds what the prime bin can hold, the balance flows to overflow bins. In the worked example of the proposal, 150 units of one part occupied four pallets: 15 units in the prime bin and 45 units in each of three overflow bins. Ninety percent of that part's stock therefore resided in positions the challan never printed, and a picker directed to the prime bin would find a handful of units at best.

Evidence from the morning cycle count

Every morning at about 7 a.m. the Binning team walks the aisles to find empty locations and logs three counts. Over ten consecutive working days the raw counts were retained without summarising. Table 1 reproduces them; because the three counts sum to the daily total on every day, Fig. 2 renders them as stacked bars.

Table 1 Binning morning cycle count, 10 to 19 June 2026

Date (June 2026)	Total locations on sheet	Prime locations empty	Overflow locations empty	Prime locations holding stock
10	407	240	83	84
11	368	214	65	89
12	334	197	48	89
13	406	246	53	107
14	297	159	69	69
15	405	243	54	108
16	442	218	100	124
17	448	238	85	125
18	375	172	78	125
19	389	204	60	125
10-day average	**387.1**	**213.1**	**69.5**	**104.5**

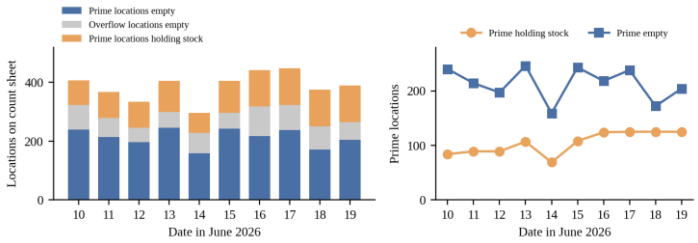


Fig. 2. Morning cycle count over ten working days. Left: the three categories composing the daily total. Right: empty prime locations against prime locations holding stock.

Two features are conspicuous. The number of empty prime locations remained high throughout, ranging from 159 to 246. Meanwhile the number of prime locations holding stock climbed from 84 on 10 June to 125 on 17, 18 and 19 June, a drift almost impossible to perceive within a single shift. The ten day averages were 213.1 empty prime locations against 104.5 prime locations holding stock, and Equation 1 expresses the share of logged prime locations that stood empty.

$$E = P_e / (P_e + P_s) = 213.1 / (213.1 + 104.5) \approx 0.67 \quad (1)$$

Here P_e denotes the average number of empty prime locations and P_s the average number holding stock. About two thirds of the prime locations on the sheet were therefore empty. This is a share of the locations logged, not of every prime location in the warehouse. It sits somewhat above the supervisors' estimate of 40 to 60 percent of picks requiring an overflow query, but the two quantities measure different things and are not directly comparable.

Evidence from the time and motion study

To locate where the time is lost, a single APR pick cycle was timed step by step, beginning from a challan that sends a picker to an empty prime bin (Fig. 3). The listed steps total 25.0 minutes if every one of them occurs. The final two, the Binning query and the back-order overhead, arise only when the stock remains unfound, which is why the reported average for the cycle is about 23 minutes. Walking to the prime, inventory and overflow locations consumes 10.5 of the 25.0 minutes (42 percent), whereas searching, querying and back-order overhead consume the remaining 14.5 minutes (58 percent). More than half of the lost time is thus spent waiting and asking, not walking, which is precisely the kind of waste that lean thinking targets. The study is a single timed observation rather than a large sample across shifts and pickers.

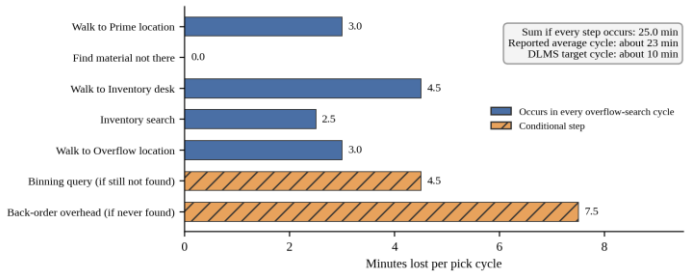


Fig. 3. Minutes lost per activity in a current-state pick cycle requiring an overflow search (APR zone).

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Root cause

A five why chain, summarised in Table 2, converges on one structural fact: SAP possesses no table, transaction or structure capable of holding several locations for a single part number.

Table 2 Five why analysis of elevated pick cycle time

Why	Question	Finding
1	Why is the pick cycle time elevated?	Pickers cannot find the material at the expected position.
2	Why is the material not at the expected position?	The prime location holds a small quantity; most stock is in overflow positions.
3	Why are overflow positions unknown to the picker?	Overflow locations are absent from the printed challan.
4	Why is overflow data absent from the challan?	SAP holds only the prime location per part; overflow is kept in offline Excel.
5 (root cause)	Why is overflow kept in Excel and not in SAP?	No SAP structure, table or transaction exists to capture several locations for one part.

A fishbone diagram with four branches (Fig. 4) corroborates the chain. Method, System and Information all lead back to the same gap, namely that no SAP object holds overflow locations. The People branch, in which pickers rely on recall and Inventory is repeatedly interrupted, describes symptoms rather than an independent cause. The evidence thus points to one system level remedy and not to a bundle of training or discipline measures. One aggravating factor deserves mention: a picker correctly directed to an overflow bin may still wait because the reach truck required to lift the pallet is occupied. DLMS reveals where stock lies, but it cannot release equipment.

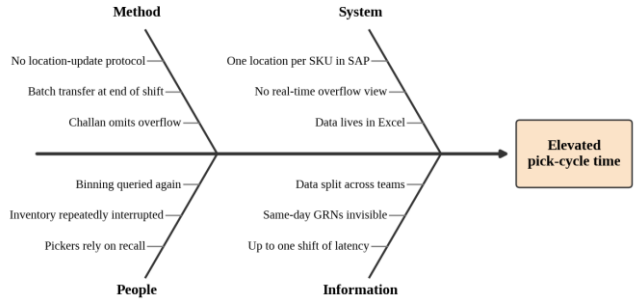


Fig. 4. Fishbone diagram of the causes of elevated pick cycle time.

V. The Proposed Dynamic Location Management System

Design principle

DLMS removes exactly one offline dependency, the spreadsheet at the Binning to Inventory handoff. Binning records each location directly in a new SAP table at the moment of put away; when a challan is generated, SAP consults that table and prints every pick location with its quantity. Racking, existing SAP transactions and departmental roles remain untouched. Fig. 5 shows the building blocks, including nine supporting module functions: location entry, a location optimiser, challan divide, auto-replenishment, challan reversal, a vehicle off road challan, rejection and quarantine handling, report generation and a manual override that names temporary placements such as the APR front.

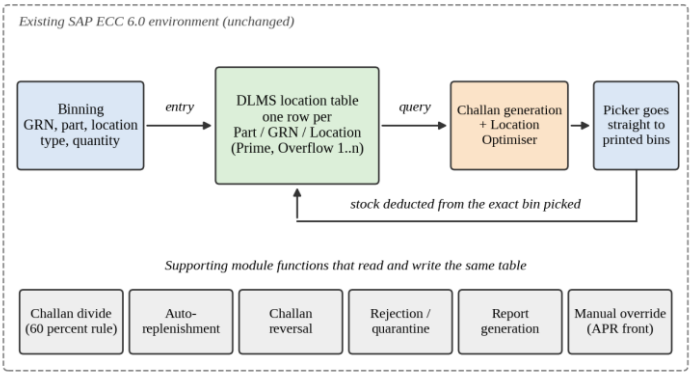


Fig. 5. Block diagram of DLMS inside the existing SAP ECC 6.0 environment.

Data model

The first draft of the table replicated the Excel layout: date, part number, GRN, total quantity, number of pallets, maximum quantity per pallet, a prime location with its quantity, and four overflow location and quantity pairs. It inherited the very weakness of the sheet it was meant to replace, since it could not accommodate a fifth overflow location. Working through the large order case below, which involves ten overflow locations, exposed that ceiling. The design was accordingly revised to a normalised table with one row for each combination of part, GRN and location, and a location type field (prime, overflow 1, overflow 2 and so on) in place of fixed columns. Table 3 shows sample rows for an illustrative part. The transaction code in the working notes is a placeholder and not a formally assigned SAP object.

Table 3 Row per location table design, sample rows for an illustrative part

Part ID	GRN ref.	Location code	Location type	Qty on hand	Max qty per pallet
BRAKE-DISC-P001	GRN-5821	APR-01-A-03	Prime	15	45
BRAKE-DISC-P001	GRN-5821	APR-07-C-02	Overflow 1	45	45
BRAKE-DISC-P001	GRN-5821	APR-09-B-01	Overflow 2	45	45
BRAKE-DISC-P001	GRN-5821	DSR-02-D-04	Overflow 3	45	45

Challan decision logic

Fig. 6 depicts the logic. On a challan request, SAP first checks whether the part is registered in the DLMS table; if it is not, the order proceeds to back-order or an alternate warehouse, exactly as today. If the part is registered and the full quantity is available, the Location Optimiser allocates stock from the nearest, highest quantity location first, spreading the order over several bins where necessary. If only part of the order is available and that part is at least 60 percent of the request, the challan is

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split: the available quantity is picked immediately and the balance is queued and generated automatically on arrival of stock. Below 60 percent, the entire order is back-ordered rather than being filled in small fractions. After the pick, SAP deducts stock from the exact bin used; if the quantity remaining at the prime bin, together with the leftover of a depleted overflow bin, fits within the maximum quantity per pallet, that leftover is moved to prime automatically.

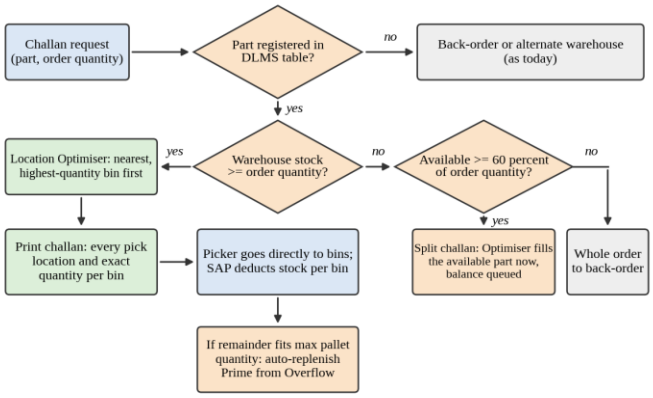


Fig. 6. DLMS decision flow for challan generation.

The logic was tested against five scenarios chosen to stress different branches: a simple prime pick, an exact overflow pick, an overflow pick that triggers consolidation, a pick drawing on two locations, and a large order spread over several overflow locations (Table 4).

Table 4 Five challan allocation cases used to test the decision logic

Case	Stock and order	Rule applied	Challan output	Result after pick
1. Simple prime pick	Stock 204 (Prime 84, OF-1 120); order 80	Order within prime quantity: pick prime only	Prime: 80	4 units left at prime; no replenishment needed
2. Simple overflow pick	Stock 204; order 120	Order equals OF-1: nearest, highest quantity	OF-1: 120	Prime below maximum per pallet; replenishment check runs
3. Overflow pick with auto-replenishment	Stock 204; order 110	Order below OF-1: pick OF-1	OF-1: 110	10 units left in OF-1 move to prime (consolidation)
4. Multi-location pick	Stock 204; order 182	Order above OF-1: empty OF-1, then prime	OF-1: 120; Prime: 62	OF-1 emptied; 22 units remain at prime; replenishment check runs
5. Large order, six or more locations	Stock 1,204 (Prime 4, OF-1 to OF-10 at 120); order 754	Skip prime (below threshold); six full overflows and part of OF-7	OF-1 to OF-6: 120 each; OF-7: 34	86 units left in OF-7 move to prime

In every case the same three rules resolve the order without special handling. Case 5 is the most demanding: 754 units against ten overflow bins of 120 units each are satisfied from six full bins and part of a seventh, and the 86 units left in the seventh bin migrate to prime. Four conditions were documented for go-live, so that the proposal does not assume away its difficult parts: existing stock must be entered first; a maximum quantity per bin or pallet must be set for every part; a complete bin and pallet count is required, with polybag packed items the hardest to count; and excessive over-picking must be stopped, otherwise the quantity logic collapses.

VI. RESULTS AND DISCUSSION

Expected impact

Two sets of figures exist for the same claims, because the proposal was moderated during review. The first is drawn directly from the time study: the target cycle of about 10 minutes removes the search and query chain, and Equation 2 gives the reduction.

$$R = (T_0 - T_1) / T_0 = (23 - 10) / 23 \approx 0.56 \quad (2)$$

T_0 is the reported current average cycle and T_1 the target cycle, both in minutes; the 10 minute target is a design target for a direct pick from the challan location and was not measured. The man hour estimate assumes that each of twenty pickers saves about one hour per shift over 312 shifts a year, as in Equation 3.

$$H = N \times h \times S = 20 \times 1 \times 312 = 6{,}240 \quad (3)$$

Here H is the annual man hours recovered, N the number of pickers, h the hours saved per picker per shift and S the number of shifts a year. Before the proposal went to the client, the site manager asked for more conservative numbers. Early working notes had claimed a pick time improvement of 50 to 90 percent, 15,600 man hours a year and an unsourced sales uplift; these were scaled back step by step and the sales claim was dropped altogether. Table 5 sets both sets of figures side by side instead of selecting the more flattering one. The 6,240 figure is the point estimate of the stated calculation, while about 4,000 is a deliberately rounded down floor; they are not contradictory, and the proposal itself marks the man hour estimate as unvalidated.

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Table 5 Expected improvement: design target and approved conservative figures

Indicator	Current baseline	Design target (time study)	Approved proposal and review decks
Average pick cycle, APR	About 23 min (overflow-search cycle)	About 10 min (56 percent shorter)	20 to 30 percent shorter (proposal); 23 to 17 min, about 26 percent (review deck)
First-time pick success, APR	About 50 percent (supervisors: 40 to 60 percent of APR picks need an overflow query)	Not derived separately	10 to 15 percent improvement (proposal); 50 to 62 percent (review deck)
Picks per man-hour, APR	About 6 to 7	Not derived separately	10 to 20 percent improvement (proposal); 6.5 to 7.8 (review deck)
Overflow visibility in SAP	0 percent	100 percent	100 percent
Man-hours recovered a year	Nil	6,240 or more (20 pickers, 1 h per shift, 312 shifts)	Up to about 4,000 (conservative floor)
Excel dependency for locations	Mandatory, daily	Eliminated	Eliminated

Benefits by department

Every benefit traces back to the same missing SAP object. Binning replaces Excel entry with SAP entry and may reduce its manual counts, currently three per shift. Inventory gains real time visibility and is freed from picker queries. Pick-Pack picks directly from the challan with no search overhead, Dispatch should see fewer back-order delays caused by location failures, and Kitting exchanges a physical search across zones for a SAP lookup. The client acquires real time access to stock and location data that it lacks today. A better Excel template for Binning, or a query dashboard for Inventory, would treat one department's symptom while the same latency resurfaced elsewhere; a single remedy at the point where the data originates resolves them all.

Relation to earlier work

The findings are consonant with the literature in three respects. Movement and waiting consume most of the cycle, in line with the finding that non-picking activity, above all travel, dominates picking time [2]. The fault lies at the operational and information level and not in layout or slotting [9], which is why the remedy is a table and a rule set rather than a re-racking exercise. And records that diverge from physical stock generate search cost [14], here because a legitimate second location could not be recorded at all. The 60 percent split rule and the consolidation rule are practical design choices of the kind that Vanheusden et al. urge models to accommodate [10]; the 60 percent threshold was set by judgement and has not been tuned, for example by simulation.

Limitations

The results must be read within clear limits. The impact assessment rests on the APR zone, where the problem is most acute, and may not transfer to the dense, LSR or yard zones. The cycle time derives from a single time study, and the count sheet logs only certain locations rather than constituting a census of all prime bins. The cost benefit assessment is qualitative, with items rated high, medium or low, and no rupee return or payback figure exists. The proposal was written by the author, who also collected the data, so observer bias cannot be excluded. Supporting documents were revised at different times and did not always agree, which is why Table 5 shows both sets of figures. Above all, no live pilot has been run, so none of the benefits is yet demonstrated.

VII. IMPLEMENTATION ROADMAP AND CHALLENGES

The proposal recommends a sixteen week phased rollout (Table 6) that begins in the APR zone, so that live picking is never interrupted. The row per location design must be confirmed, and the fixed column variant still present in one presentation slide discarded, before the build begins in Week 3.

Table 6 Sixteen week phased implementation roadmap

Phase	Name	Weeks	Main activities
1	Design and approval	1–2	Confirm the row per location table and the allocation rules; sign-off by DHL and the client.
2	Build and develop	3–6	Build the SAP table, transaction and challan logic; test against the five cases.
3	Data migration	7–8	Audit and enter legacy stock; set the maximum quantity per pallet for every part; validation checks.
4	APR zone pilot	9–10	Run SAP beside Excel as a fallback; training and written SOPs.
5	Review and fix	11–12	Measure cycle time, first-time pick success and picks per man-hour; correct defects.
6	Full rollout	13–16	Extend zone by zone; retire Excel after the parallel run.

Four challenges were identified. The first is technical: asking SAP to hold several locations for one part inside a live ERP, which it was never built to do; the build is therefore confined to a single pilot zone. The second is human. The Binning team already follows a routine of three physical counts a shift and one shared Excel sheet, and a new SAP step initially resembles extra work. The physical count is retained as a built in check on entries, and the SAP step runs alongside Excel during the pilot, supported by training and written SOPs. The third concerns data quality, since a wrong manual entry would become a wrong system record and migration of existing stock can introduce errors; validation checks and a two week parallel run therefore precede any cut-over. The fourth is change management, because Inventory, Pick-Pack and Dispatch all use location data, which the phased rollout addresses by advancing one zone at a

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time. Two further measures are recommended: naming the temporary APR front positions in SAP, for example APR-FRONT-01 onwards, so that the manual override function can track them, and blocking excessive picking in the system rather than relying on discipline alone.

VIII. CONCLUSION AND FUTURE SCOPE

This paper examined a delay in a live warehouse whose cause was missing information. SAP ECC 6.0 recorded one prime location for each part, while most of the stock sat in overflow bins visible only in a spreadsheet. A ten day cycle count showed about two thirds of the logged prime locations empty on an average morning, and a time and motion study showed that more than half of the lost time in an affected pick cycle was spent searching and querying. A five why chain and a fishbone diagram traced the delay to a single cause, the absence of an SAP structure for multi-location stock. DLMS closes that gap with a row per location table and a challan logic that resolved five varied order scenarios by the same three rules.

The principal contributions may be summarised as follows.

- Evidence: a measured, documented picture of the cost of a prime only location record, drawn from count data and a timed pick cycle.
- Design pattern: a normalised table with a location type field, which removes the fixed ceiling on overflow locations and may be reusable in other ERP environments with the same limitation.
- Allocation logic: a nearest, highest quantity rule combined with a 60 percent split rule and an automatic consolidation rule, tested on five cases.
- Transparent estimation: a design target of 56 percent shorter pick cycles and about 6,240 man hours a year, reported beside the approved conservative range of 20 to 30 percent and about 4,000 man hours.
- Implementation: a sixteen week roadmap with go-live conditions, a parallel run and a pilot zone.

For a contract logistics provider the practical message is that the first step is to verify whether the ERP can represent where stock truly resides. If it cannot, a modest change to the data model at the point of put away may yield more than a physical re-layout, and it can be introduced without halting operations.

Several avenues for future work follow. The most important is a live pilot in the APR zone that measures pick cycle time, first time pick success and picks per man hour before and after go-live, across several shifts and pickers, so that the design stage estimates can be confirmed or corrected. A formal rupee cost benefit and payback calculation should replace the qualitative rating, after which the design can be extended to the dense, LSR and yard zones. The 60 percent split threshold and the consolidation rule could be tuned by simulation. DLMS could also be combined with slotting based on multi criteria classification and with reach truck scheduling, which remains an unresolved bottleneck. Finally, the table offers a foundation for later migration to SAP S/4HANA, and the approach could be tested at other warehouses running SAP ECC.

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