International Journal of Computer Trends and Technology
ISSN: 2231–2803 / https://doi.org/10.14445/22312803/IJCTT-V74I8P105

Volume 74 Issue 8, 38-46, August 2026

Review Article

Manufacturing Replenishment and Production Staging in SAP Extended Warehouse Management

Varun Kumar Reddy Gaddam[1], Rajashiva Ramalingam[2]

[1]*MYGO Consulting, SAP Solution Architect, Illinois, United States.*
[2]*ACCO Brands, Manager-SAP Transportation Management, Illinois, United States.*

[1]*Corresponding Author : varun.gaddam@mygoconsulting.com*

Received: 26 June 2026 Revised: 29 July 2026 Accepted: 18 August 2026 Published: 30 August 2026

Abstract - *The handoff between the warehouse and the shop floor is one of the most important design areas in an SAP Extended Warehouse Management (EWM) implementation, but it also receives little attention. This paper considers how EWM supports manufacturing replenishment and production staging and connects these capabilities with existing research on assembly line feeding and warehouse replenishment. It looks at two EWM integration approaches: delivery-based production supply and advanced production integration using the Production Material Request (PMR). The paper compares these approaches and examines how their master data and process designs fit the needs of process and discrete manufacturing. It also looks at established concepts such as kitting, line stocking, just-in-time supermarkets, and forward-reserve replenishment. This comparison shows that EWM configuration is not simply a collection of system settings, but a practical way to address well-studied logistics and material-flow problems. The paper concludes by looking at the operational benefits of moving from paper-based processes to system-directed staging supported by radio-frequency confirmation. These changes can lead to productivity improvements of around a quarter and safety-stock reductions of roughly a fifth to a third.*

Keywords - *Warehousing, Supply Chain, Assembly Line Feeding, Kitting Versus Line Stocking, Production Material Request, Production Staging.*

1. Introduction

In a distribution warehouse, a picking task is ultimately driven by an outbound delivery that is headed to a truck. In a manufacturing plant, the situation is different. The demand comes from a work center and is driven by a production or process order, a repetitive manufacturing run, or a Kanban loop. At this point, where the warehouse and production floor meet, three things must happen correctly: components must be staged on the shop floor on time. Consumption posting is required against the manufacturing order, so inventory and costing remain correct. The finished product needs to be received back in the warehouse.

It is not a specialized issue. Feeding parts to production lines is a first-class problem in academic literature. Bozer and McGinnis [1] introduced the assembly line feeding problem, and Boysen, Emde, Hoeck, and Kauderer [2] surveyed it.

Poor line feeding creates non-value-added activity: looking for parts, excessive walking, congestion at a station, and stockouts that stop a line. An ERP-integrated warehouse solves this problem with a configurable engine called SAP EWM production integration.

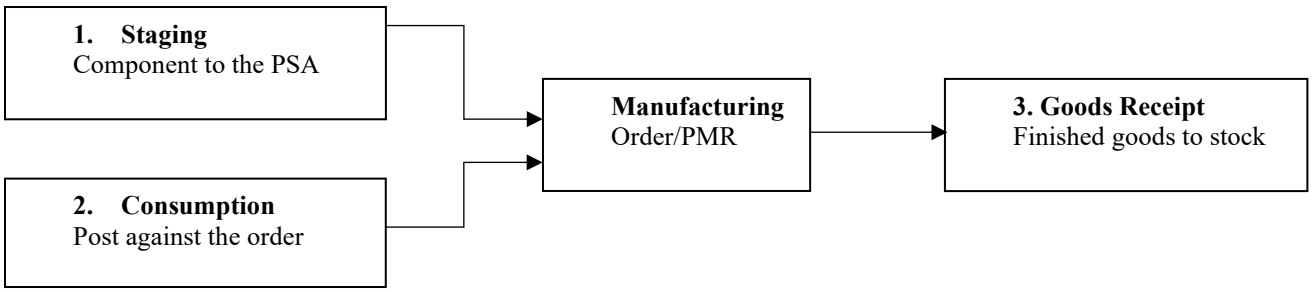

Fig. 1 The three obligations of production integration: stage components to the PSA, post-consumption against the order, and receiving the finished product into stock

2. Literature Review

The problem SAP EWM production integration addresses has a substantial research history spread across four connected streams. This section reviews each stream and positions EWM against it.

2.1. The Assembly Line Feeding Problem

The process of supplying parts to production and assembly lines is commonly described in the literature as the assembly line feeding problem. Bozer and McGinnis [1] introduced an early conceptual framework and descriptive cost model that highlighted the trade-offs involved in different feeding policies. Later, Boysen, Emde, Hoeck, and Kauderer [2] provided a comprehensive survey covering the full process, from the initial request for material through the return of empty containers. Their work also categorized the different planning problems, part-feeding policies, and associated cost drivers. A consistent finding across this research is that line feeding can account for a significant amount of non-value-added activity in a manufacturing plant, making the feeding process an important area for improvement.

2.2. Kitting Versus Line Stocking

One of the main decisions in line feeding is how to supply material to a station. One option is to provide dedicated material that is synchronized with a specific order, which is the kitting approach. The other is to keep the station continuously supplied with bulk material, or line stocking. Hua and Johnson [3] identify a range of product, storage, and production control factors that can influence this decision. Limere, Van Landeghem, Goetschalckx, Aghezzaf, and McGinnis [4] take a more analytical approach, modeling the decision as a cost-minimizing mixed-integer problem that selects between the two approaches for each part. Hanson and Brolin [5] examine the issue empirically by comparing kitting and continuous supply across different supply modes for plant materials.

2.3. Just-In-Time Supply and Supermarkets

When demand is consistent and easy to predict, getting supplies just in time from a store close to the production line can be effective. Some researchers, like Battini, Boysen, and Emde [6], talk about a "just-in-time supermarket" that acts as a middle ground between the main warehouse and the production line. This supermarket is replenished from the main warehouse.

Emde and Boysen [7] looked into how to schedule trains to move parts from this supermarket to the production lines, which make different models. Boysen and Emde [8] took this idea further by integrating these supermarkets right into the production lines. This is similar to how some systems, like EWM Kanban loops and just-in-time calls, work. In these systems, when something needs to be restocked, it triggers a transfer from the warehouse to a production warehouse that's close to the production line.

2.4. Warehouse Replenishment and Forward Reserve

The forward reserve allocation problem is the problem of keeping a picking area supplied from reserve, on the warehouse side. Van den Berg, Sharp, Gademann and Pochet [9] consider a forward area replenished from the reserve in an effort to reduce the labor in the picking period. This is the theory behind EWM fixed bin replenishment, control cycles, and minimum quantity thresholds that trigger staging to a production supply area.

2.5. Positioning SAP EWM in Literature

Two points stand out from this research. First, most of the literature focuses on optimization and remains largely system agnostic. It develops policies and algorithms, but discusses much less about how those approaches are implemented in a commercial warehouse management system. Second, relatively little peer-reviewed research focuses specifically on SAP EWM, which is notable given how widely the system is used in industry.

This paper aims to address that gap. It looks at EWM production integration as a configurable implementation of the four areas discussed above. It shows where different EWM design choices correspond to trade-offs already studied in the literature and where EWM introduces practical constraints often left out of theoretical models. In particular, batch fidelity, lean system communication, and landscape topology are important considerations.

3. Scope and Method

This paper is a conceptual synthesis, not empirical research. The paper describes the standard functionality of SAP EWM and publicly documented functionality of SAP EWM as per the platform, including the integration with production and the capabilities of warehouse processes with reference to relevant SAP Notes. It describes configuration constructs by design, not a single customer implementation. The operations research framing is based on the peer-reviewed literature reviewed in Section 2.

The analytical approach treats each EWM configuration construct as an implementation of a logistics problem already studied in the literature. The paper maps each construct to the trade-off it addresses and identifies the practical constraints that EWM introduces but that abstract models often leave out. The benefit figures presented in Section 12 come from published industry benchmarks.

Each benchmark is identified where it is used and applied only as an illustration against a hypothetical baseline. Because EWM functionality continues to evolve across S/4HANA releases, Validate release-specific behavior against the current SAP documentation for the target release.

4. Two Integration Architectures

SAP EWM gives you two fundamentally different ways to connect production with the warehouse, and choosing between them is one of the most important architectural decisions in this area. That choice determines where the process is controlled, how much information must move between ERP and EWM, and which manufacturing processes the solution can support.

4.1. Delivery-Based Production Supply

In the delivery-based model, SAP ERP remains the center of gravity. ERP creates deliveries for materials to be staged and consumed and transmits them to EWM, while EWM triggers and confirms physical movement. This model supports the widest range of processes and is the only one that can work with a supplying storage location that is not EWM-managed, or that lives in a separate EWM warehouse number, the classic shuttle scenario.

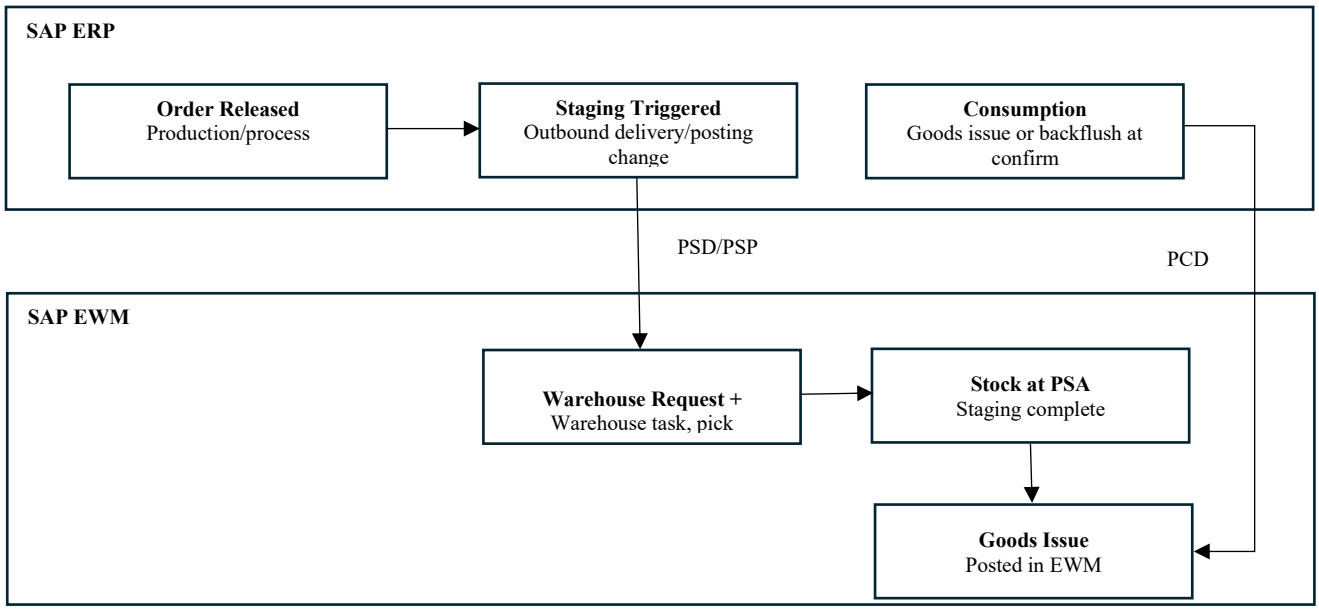

Fig. 2 Delivery-based production supply drives every step and hands physical movement to EWM. Cross-lane arrows carry the delivery documents: PSD or PSP for staging, PCD for consumption

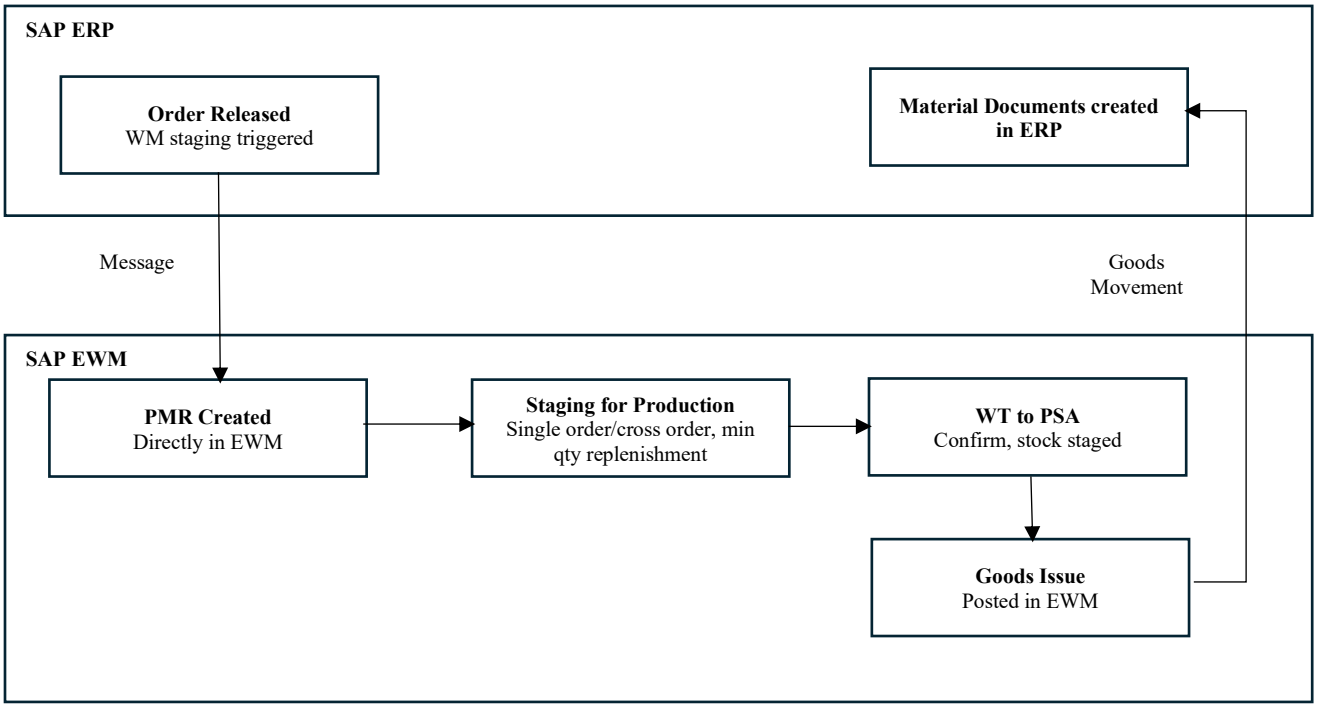

Fig. 3 Advanced production integration sends a single message to EWM, creates a PMR and controls staging and consumption; only lean goods movement messages return to ERP

4.2. Advanced production integration in EWM (PMR-based)

When a manufacturing order is released and staging is triggered, ERP sends a message to EWM, which then creates a Production Material Request (PMR) directly. ERP does not create a delivery document. Once EWM creates the PMR, it handles most of the process independently of ERP. If a component requirement is too large for a constrained PSA, EWM can split it into smaller quantities. PMR-based supply also uses lean communication, with EWM sending only goods movement messages back to ERP rather than multiple delivery documents.

4.3. Choosing between them

Table 1. Delivery-based versus advanced production integration

Dimension	Delivery-based production supply	Advanced production integration
Supported processes	Production orders, process orders, Kanban, repetitive manufacturing	Production orders, process orders
How EWM learns of demand	ERP creates outbound deliveries or posting changes and sends them	ERP sends a message, EWM creates a PMR
Staging quantity	Full reservation item quantity (pick parts) or manually requested (release order parts)	System proposes from PSA stock, open tasks, and requirements; partial and interval staging is possible.
Separate warehouse or non-EWM supply	Supported (shuttle scenario)	Not supported, PSA in the same warehouse
System communication	Multiple delivery documents	Lean goods movement messages only
Typical industry	Mechanical engineering, discrete assembly	Consumer products, process industry

The practical is industry mapping. Lean delivery-based: discrete assembly with shuttle transport and high reliance on ERP side execution.

Consumer products and manufacturing processes are used in food, beverage, chemical, and building products. SAP Note 2352810 is the same split.

5. Organizational Structures and Master Data

5.1. Storage Location Models

- Two EWM-managed storage locations in one warehouse: We use the EWM system to run the two storage locations in our warehouse. We isolate production stock in its own location so we can see it down to the bin level in EWM. Staging is handled as a posting change there, while on the ERP side, it is processed as a transfer between storage locations. This way, we can maintain efficient inventory management in both systems.
- EWM-managed one storage location: Production PSA stock is visible only in EWM, and staging requires no posting change.
- MM IM-managed storage location: Livestock is in ERP inventory management, outside EWM. From EWM, staging is an outbound delivery.
- EWM-managed with two storage locations in two warehouses. Staging is a two-step posting change: an outbound delivery from the sending warehouse, followed by an inbound delivery into the receiving one.

The first two models are available to both integration types. Only the delivery-based model can use a non-EWM-managed location or a separate EWM warehouse.

5.2. The Production Supply Area (PSA)

The PSA is the shop floor area where components are staged and withdrawn. It is always created in ERP and then needs to be made available in EWM, either by creating and mapping it manually or through automatic replication and mapping. In embedded EWM, starting with release 1909, the PSA is copied automatically. The BAdI /SCWM/EX_ERP_PSA_NAME controls the name used during replication. A PSA can be assigned to one or more storage bins, with the assignment maintained in EWM.

5.3. Control Cycles and component Types Setup

- Pick parts Setup. Staged directly against a single production order for the exact reserved quantity. Delivery-based only.
- Release order parts. Requested several orders at once in a manually requested quantity. Delivery-based only.
- Crate parts. Held in standard containers, replenished independently of any order. Quantities come from a packaging specification or an explicit quantity-based calculation in the EWM control cycle.
- EWM staging. Specific to advanced integration. EWM decides between single-order staging (like pick parts) and cross-order staging (like release order parts).

6. Delivery-Based Production Supply in Detail

6.1. Staging Documents and Delivery Type Determination

The staging document depends on the storage location model. When the MM-IM destination is used, the result is an outbound delivery. When separate warehouses are involved, the process uses a two-step transfer. When the source and destination are in the same warehouse, the process uses a posting change. On the ERP side, delivery type

determination uses the plant, storage location, and mandatory process to determine the delivery type. In EWM, the standard document types are PSD (Production Supply Inbound or Outbound), PSP (Posting Change), and PCD (Consumption for Production).

6.2. Consumption Posting and Backflushing

In the delivery-based model, ERP supports two ways to post consumption. The first is a direct goods issue against the production or process order, and the second is backflushing.

In backflushing, the system posts the goods issue automatically when the production or process order is confirmed.

6.3. Kanban Replenishment Setup

Kanban setup for replenishment of consumption on the line that triggers the next supply, avoiding the planned order. Components are stored in containers that circulate between the production supply area and the feeding storage location. When a container is empty at the line, it needs to be replenished, and EWM creates the replenishment element that brings a full container back to the PSA. Kanban refills a container only when it has been consumed. Kanban keeps a small threshold at the line, limiting line-side inventory and the time to replenish it. In EWM, the control cycle links material, PSA, and the supplying location. This means no new planning run is required. So instead, a control cycle is triggered by a physical signal, an empty container, or a scan.

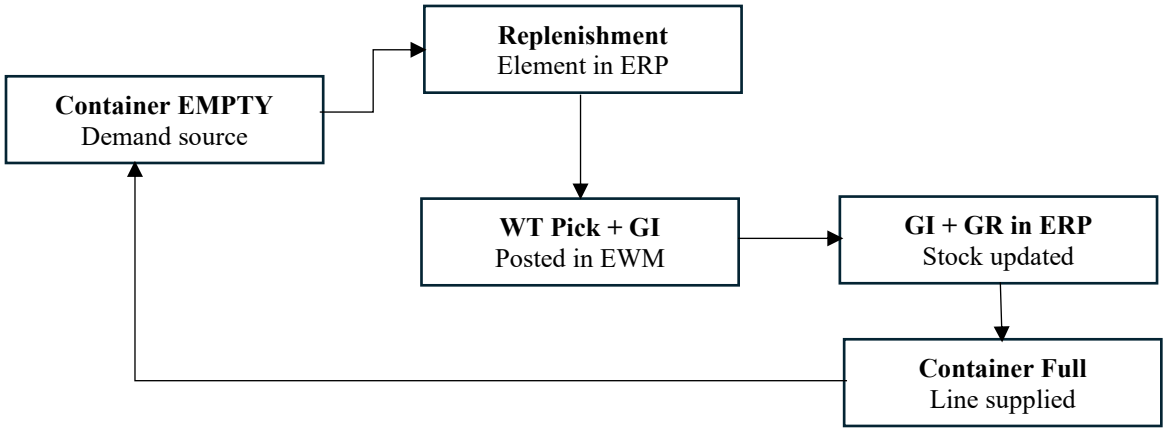

Fig. 4 Kanban replenishment loop. Empty pulls a replenishment element, EWM picks and issues the stock, ERP posts the matching movements, and the container returns to Full. Replenishment fires only on actual consumption.

6.4. JIT Calls and Stock Transfers

Just-in-time (JIT) supply delivers material to the production area when needed and is commonly used in repetitive and discrete manufacturing. A JIT call is sent from the PSA to the warehouse, which then synchronously creates an EWM stock transfer and a warehouse request with document category WMR. SAP S/4HANA 2020 introduced this interface, and JIT stock transfers are available only with embedded EWM.

7. Advanced Production Integration

7.1. The PMR and its PSA constraints

The PSA is connected to the same warehouse as the supplying location, and the shuttle scenario is not supported. Staging indicator 5 (EWM Staging) is used in all ERP control cycles, and single versus cross-order staging is determined in the EWM bin assignment. With BAdI /SCWM/EX_MFG_STAGE_INFO, it can control staging with its own logic.

7.2. Types of Staging Methods in the Warehouse

- Single order staging: One warehouse task per PMR item. After confirmation, the PSA stock references that PMR item and reserves it for that order until release.
- Cross-order staging: Consolidate the same product from more than one PMR without reference to a warehouse task; without it, it is not reserved and is for bulk product orders; orders reference the flexible mode for shared high-runner components.

7.3. Consumption and Batch Handling

Post consumption via the PMR can be done on the RF gun or at the desk. The picture changes if the PMR has batch information or selection criteria.

Once these are live, EWM will stage only one order at a time, since each order has to pull a batch that fits its requirements. That is unavoidable, and it explains a lot about the staging of plants in food, pharma, and chemicals in the first place.

8. Goods Receipt from Production

ERP or EWM can trigger the goods receipt. In EWM, the receipt can be processed using RF or Warehouse Monitor. As soon as the goods receipt is posted in EWM, the receipt status in ERP is updated accordingly to avoid duplicate postings. From a system point of view, the goods receipt is posted in EWM first.

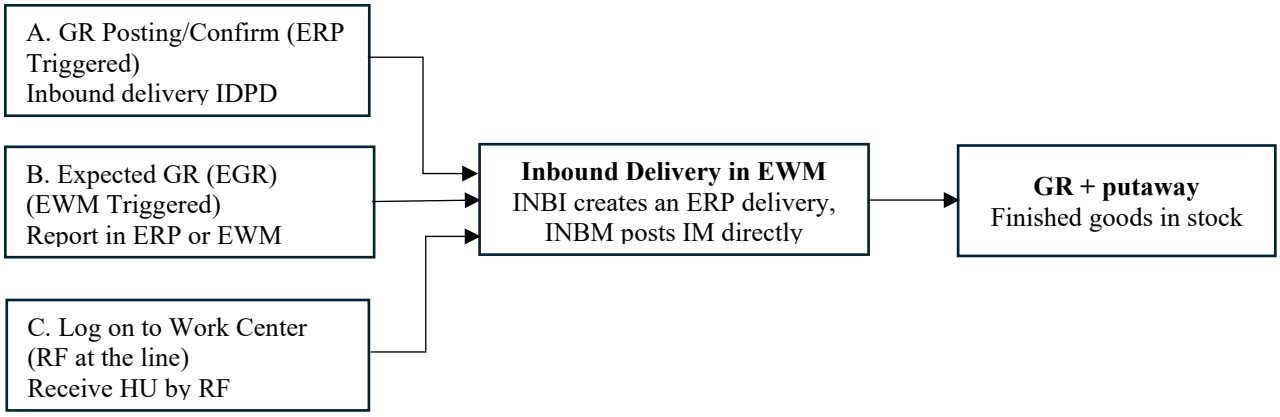

Fig. 5 Goods receipt for converging on an EWM inbound delivery and putaway. IDPD flags the production, and INBI creates a matching ERP delivery; INBM posts an inventory management document directly, and RF receipt uses the work center bin

ERP triggered: a goods receipt posting or order confirmation creates an inbound delivery replicated to EWM, using document type IDPD. EWM triggered: EWM works from an Expected Goods Receipt (EGR) document, with INBI creating a matching ERP delivery and INBM posting an inventory management document directly. RF receipt automates the end-of-line goods receipt through a work center that also drives HU label printing.

9. Clearing the Production Supply Area

Once a PMR is completed and the product is still needed for another PMR, return to regular storage. The Clear Production Supply Area transaction creates the tasks required for this return. However, the reference document must be released before the single-order staged product. Otherwise, the PSA reserved stock cannot be used for another PMR. The order is technically set to complete, but that does not automatically clear the PSA.

10. Process versus Discrete Manufacturing

Industrial activities involving process and repetitive manufacturing, which encompass items for eating and liquid drinks, consumer packaged goods, construction materials, and chemical substances, usually prefer the advanced (PMR) model. Because large goods-issue volumes exist in these industrial settings, lean communication is viewed as helpful by workers. When PSAs are limited, interval staging becomes a good option for the facility. Wide Batch management requirements often demand single-order staging with batch fidelity because this practice ensures everything is correct. Sectors such as discrete and mechanical manufacturing find that the delivery-based model supports broader functions like Kanban loops, repetitive manufacturing, shuttle transport, and JIT calls. Hanson and Brolin [5] also explored this specific classification as in-plant supply modes within their research.

11. Decision Approach

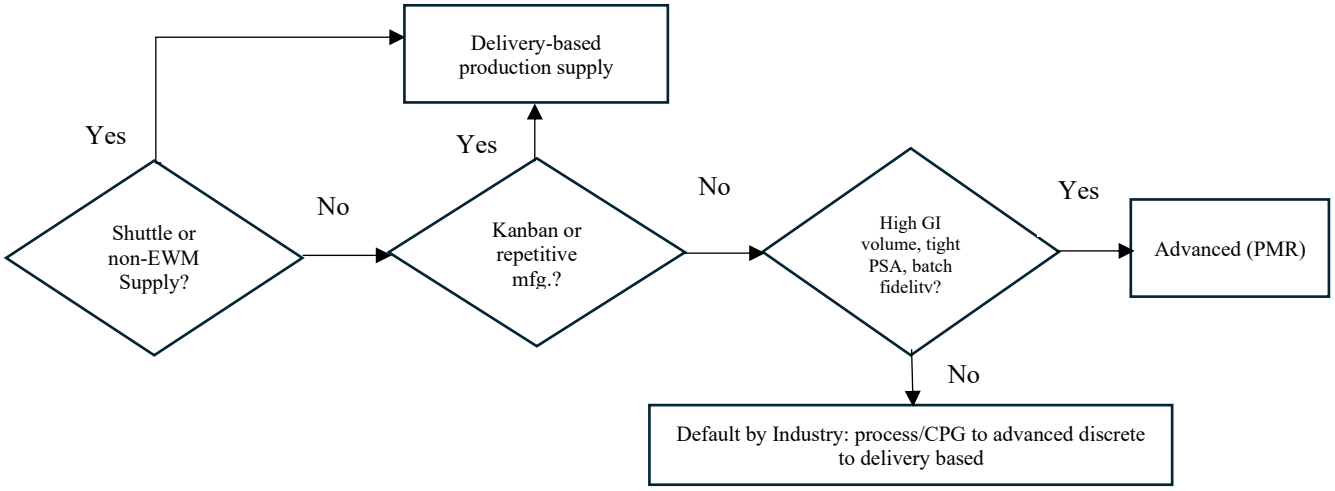

Fig. 6. Model selection flow. Kanban, repetitive manufacturing, and non-EWM supply prefer the delivery model. The advanced model is preferred in terms of volume, space, and batch. The industry standard is applied when deciding factors are present.

12. Benefits and Business Case

A well-designed production staging model in SAP EWM can translate into measurable operational and financial benefits. The matrix below provides industry benchmarks for moving from paper-based or loosely integrated production supply to system-directed, RF-driven staging supported by EWM. Actual results will vary depending on the plant, its existing level of process maturity, and the scope of the implementation. View the figures as planning ranges rather than guaranteed outcomes.

Table 2. Benefits matrix for system-directed production staging

Benefit area	Quantified gain	How EWM production staging delivers it	Financial/operational impact
Warehouse productivity	~25% gain	System-directed, RF-confirmed staging replaces paper-based work	~$0.75M per year on a $3.0M labor base
Safety stock/buffer inventory	15 to 30% reduction	Kanban and JIT replenishment created close to actual consumption	$0.30M to $0.45M freed working capital
Space utilization	10 to 20% improvement	Interval and minimum-quantity staging stop the PSA from holding material not yet needed.	More throughput per square foot
Handling operations	30% fewer	Staging, replenishment, and putaway are optimized rather than being manual	Lower labor and fewer touches
Inventory accuracy	Accuracy up to 99%	RF confirmation replaces manual paperwork, and accuracy approaches 99%	Fewer reversals, reliable costing
Labor cost	25 to 40% reduction potential	Automation of manual staging tasks	Large labor is 50 to 70% of the warehouse budget
System load (PMR lean comms)	Sharp reduction in high goods issue volume	Goods movement messages instead of many delivery documents	Peak headroom, lower total cost of ownership
Line uptime	Fewer stoppages	Timely minimum quantity staging prevents stockouts	Avoided downtime, usually the largest dollar item

Two production staging methods increase these gains. First, in the advanced (PMR) model, lean communication dramatically reduces system resource consumption in the case of high goods-issue volumes. Second, timely minimum-quantity staging reduces stockouts that idle a line. Usually, the biggest single-dollar item in the business case is avoiding line downtime because idle production capacity is far more expensive per hour than warehouse labor.

12.1. Illustrative Business Case

For a mid-sized warehouse plant with approximately $3.0M in annual warehouse and production supply labor, the benchmark ranges translate as follows.

Table 3. Illustrative business case for a mid-sized plant

Benefit lever	Estimated annual value
25% productivity gain on $3.0M annual warehouse and production supply labor	~$0.75M per year
15 to 30% cut in line-side safety stock on a $2M component buffer	$0.30M to $0.45M freed working capital
Avoided line downtime from fewer stockouts	Valued at contribution margin per production hour, often the largest single item

For illustration purposes, using published benchmark ranges creates a hypothetical baseline. The ranges are from Westernacher Consulting via 6 River Systems, the warehouse automation industry surveys (2024-2026) for the SAP EWM benefit studies. For a real business case, build it out from labor spend, buffer inventory, downtime cost, and the implementation scope of the specific plant.

13. Discussion

The above sections lead to a simple conclusion: SAP EWM production integration is a practical way to solve the line-feeding and warehouse-replenishment problems mentioned in the literature. This is not a list of random configuration options. Two alternative approaches determine where process control should reside—the delivery-based and advanced models. Delivery-based supply keeps ERP as the system of record. It covers more processes. Conversely, advanced integration provides EWM with more control and enables learner communication and more detailed staging.

The pick part, release order part, crate part, and staging type constructs are the practical mechanisms behind the kitting-versus-line-stocking decision first discussed by Bozer and McGinnis [1] and later formalized by Limere and colleagues [4].

The differences between EWM and the abstract models become particularly clear when practical constraints are considered. Research models generally optimize feeding costs based on defined assumptions, while an EWM implementation must work within constraints that those models often leave out.

Batch information is one example. When each order requires a specific compliant batch, single-order staging may be necessary, which limits the cross-order flexibility that a purely cost-based model might otherwise allow. Lean communication is another factor. While it is mainly a system-landscape consideration rather than a logistics issue, it still affects how the advanced model works in practice. Release level and deployment architecture also play a role because they determine which capabilities are available, including whether EWM is deployed as embedded or decentralized.

These are the types of practical constraints practitioners must deal with in real implementations, but academic optimization models generally do not capture them.

Two limitations should be considered when interpreting these conclusions. First, the benefit figures are benchmark ranges rather than results from a controlled implementation. They therefore indicate potential direction and magnitude rather than a guaranteed outcome. Second, much of the underlying line-feeding research focuses on automotive assembly. At the same time, many of the same mechanisms can apply to process and consumer goods manufacturing; however, this transfer has received less attention in the literature. These limitations also point to an opportunity for further research: empirical studies of SAP EWM production integration in real-world implementations could help connect the optimization literature with the systems used to manage these processes.

14. Conclusion

SAP EWM production integration offers a configurable approach to the long-standing challenges of line feeding and warehouse replenishment, rather than simply a collection of individual transactions. At a high level, there are two approaches: the broader, ERP-centric model and the leaner, EWM-centric model. The choice between them depends on factors such as the type of manufacturing, production volume, available space, and batch requirements.

For process and consumer goods plants, the advanced PMR model is generally the better fit, while discrete and automotive-style plants more often favor the delivery-based model. In either case, careful process design is essential to keeping the production line supplied and inventory accurate. Based on the benchmark ranges discussed in this paper, it can also provide an opportunity for roughly a quarter improvement in warehouse productivity and a reduction of about a fifth to a third in buffer stock.

Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Acknowledgments

The authors thank the reviewers and colleagues who guided the preparation of this manuscript. (Optional section, edit or remove as appropriate.)

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