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Research Article

Data-Driven SAP Framework for Synchronizing Production Requirements and Procurement Activities in Resilient Supply Chains

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Abstract

Supply chain resilience increasingly depends on the ability of organizations to synchronize production requirements with procurement activities under changing operational conditions. Conventional planning approaches often treat production scheduling, material requirements, procurement decisions, and supply continuity as partially independent activities, creating temporal mismatches between demand, inventory, supplier capacity, and manufacturing requirements. This paper proposes a Data-Driven SAP Framework for Synchronizing Production Requirements and Procurement Activities in Resilient Supply Chains, designed around integrated requirement sensing, production–procurement synchronization, exception identification, adaptive decision-making, and resilience-oriented feedback mechanisms. The conceptual foundation is informed by the synchronization, coverage, scheduling, optimization, and adaptive-control principles identified in the supplied literature. Studies on sensor coverage demonstrate how distributed resources can be coordinated to achieve complete and efficient coverage, while scheduling and nonlinear control research illustrates the importance of adaptive allocation under dynamic conditions (Du et al., 2022; Sun et al., 2018; Wu et al., 2017). The proposed framework transfers these principles to SAP-enabled production and procurement coordination. Kalal (2026) particularly establishes the relevance of integrated SAP production planning–procurement synchronization to supply chain resilience. The paper develops a conceptual architecture connecting production requirements, material availability, procurement execution, supplier responsiveness, inventory status, and exception management. Analytical findings indicate that synchronization should be treated not merely as transaction integration but as a continuous decision-control process. The framework contributes a structured basis for reducing planning gaps, improving procurement responsiveness, and strengthening resilience through data-driven coordination.

Keywords: SAP; Supply Chain Resilience; Production Planning; Procurement Synchronization; Data-Driven Framework; Material Requirements; Supply Chain Integration; Adaptive Planning; Procurement Management.

INTRODUCTION

1.1 Background

Supply chain resilience is increasingly associated with an organization's ability to maintain coordination between operational requirements and resource availability when conditions change. Production planning establishes what materials, components,

capacities, and resources are required, whereas procurement transforms these requirements into supplier-facing activities. When these processes operate without effective synchronization, production requirements may be generated before procurement has sufficient visibility of their urgency, while procurement activities may continue according to outdated requirements.

An integrated SAP environment provides a suitable conceptual foundation for addressing this coordination problem because production and procurement decisions can be connected through shared operational data. However, integration at the information level does not automatically guarantee synchronization at the decision level. The central challenge is therefore to transform continuously changing production requirements into procurement actions while simultaneously considering inventory, supplier responsiveness, timing, and resilience.

Kalal (2026) directly emphasizes the importance of integrated SAP production planning and procurement synchronization in strengthening supply chain resilience. The significance of this perspective is that resilience is not treated exclusively as a supplier-management problem; instead, it is connected to the internal coordination mechanism through which production requirements become procurement decisions.

The supplied literature, although primarily concerned with wireless sensor networks, coverage, scheduling, and optimization, provides useful methodological concepts for constructing such a framework. Full-view coverage research addresses the coordination of multiple resources to satisfy a common system requirement (Du et al., 2022; Du et al., 2024). Similarly, node scheduling research demonstrates that resource activation and allocation can be organized around coverage requirements rather than independent decisions (Wu et al., 2017). These principles can conceptually inform the synchronization of production requirements and procurement activities.

1.2 Problem Statement

A major weakness in conventional production–procurement coordination is the possibility of requirement–execution latency. A production plan may identify a material requirement, but the corresponding procurement action may occur too late because of approval delays, fragmented information, supplier constraints, or changes in production priorities.

This problem becomes more significant under disruption. A fixed procurement schedule may be optimal under stable conditions but ineffective when demand changes, suppliers become unavailable, inventory falls unexpectedly, or production priorities are revised. Research on imperfect and dynamic coverage demonstrates that practical systems may need to operate under conditions where theoretically optimal solutions cannot always be maintained (Luo et al., 2014). This principle is directly relevant to resilient supply chains, where perfect synchronization is rarely achievable continuously.

1.3 Research Relevance and Objectives

The primary objective of this paper is to develop a conceptual data-driven SAP framework capable of synchronizing production requirements with procurement activities.

The specific objectives are to establish an integrated production–procurement architecture, identify the data and decision flows required for synchronization, develop an adaptive synchronization mechanism, and evaluate the conceptual implications of the framework for supply chain resilience.

1.4 Scope and Significance

The paper focuses on conceptual SAP-enabled synchronization rather than a particular SAP implementation, industry, or software configuration. It addresses the relationship between production requirements, material availability, procurement activities, supplier responsiveness, and resilience.

Its significance lies in positioning production–procurement synchronization as a continuous coordination problem. The framework also draws an interdisciplinary methodological connection between optimization and coverage research and enterprise supply chain planning.

LITERATURE REVIEW

The supplied literature primarily examines wireless sensor networks, coverage optimization, scheduling, and resource coordination. Although these studies do not directly investigate SAP or procurement, their underlying analytical principles provide a useful theoretical foundation for developing a synchronization-oriented supply chain framework.

Du et al. (2022) investigate full-view camera sensor coverage through group set coverage. The fundamental concept is that multiple resources should collectively satisfy a system-level coverage requirement. Applied conceptually to supply chains, this suggests that production requirements should not be evaluated solely as isolated material requests. Instead, groups of interconnected requirements can be considered collectively according to their contribution to a production objective.

Du et al. (2024) extend the full-view coverage perspective toward moving-object monitoring. The dynamic nature of the problem is particularly relevant to resilient supply chains. Production requirements are similarly dynamic: quantities, timing, priorities, and dependencies can change as manufacturing conditions evolve. Therefore, a synchronization mechanism must continuously reassess whether procurement activities still provide adequate support for current production requirements.

Su and Du (2023) examine full-view coverage using group set cover. Their work reinforces the importance of grouping resources and requirements rather than evaluating every component independently. Within a production–procurement environment, procurement priorities can similarly be grouped around production orders, material families, critical components, or manufacturing stages.

Liu and Du (2021) address K-Sweep coverage using mobile sensor nodes. The study contributes a perspective in which coverage is achieved through movement and adaptive allocation rather than static positioning. This principle supports the argument that procurement resources should be dynamically reallocated as production requirements move across priority states.

Wu et al. (2017) examine node scheduling strategies for full-view area coverage. Scheduling is particularly relevant because procurement actions involve temporal decisions. A purchase order, supplier confirmation, delivery schedule, and production requirement must align in time. A procurement activity that satisfies quantity but fails to satisfy timing cannot be considered fully synchronized.

Sun et al. (2018) examine nonlinear coverage control in mobile sensor networks. The adaptive-control perspective suggests that a system can continuously modify its behavior according to changing system conditions. In supply chain planning, this can correspond to dynamically modifying procurement priorities based on inventory deviations, requirement changes, or supplier responsiveness.

Wu et al. (2020) examine optimal coverage in wireless sensor networks. The optimization

perspective establishes that system-level performance depends on coordinated allocation of resources. Similarly, procurement optimization should not be measured exclusively through purchase price; it must consider timing, availability, inventory exposure, production continuity, and resilience.

Zhu and Zhou (2023) investigate multiobjective optimized deployment of edge-enabled wireless visual sensor networks for target coverage. Their multiobjective orientation is relevant to procurement decisions because supply chain planning frequently involves competing objectives. Cost minimization, delivery reliability, inventory reduction, production continuity, and supplier responsiveness cannot always be optimized simultaneously.

Luo et al. (2014) challenge the assumption that perfect coverage is always the appropriate objective. This insight is important for resilience. A supply chain framework should distinguish between theoretical optimality and operational sufficiency. During disruptions, maintaining critical production requirements may be more important than achieving perfect synchronization across all materials.

The principal research gap is therefore the absence, within the supplied literature, of a direct framework connecting these coordination principles to SAP-based production and procurement synchronization. Kalal (2026) provides the most direct conceptual basis by positioning integrated SAP production planning and procurement synchronization as a resilience mechanism. The present framework extends this perspective by explicitly incorporating data-driven requirement sensing, synchronization logic, adaptive prioritization, and feedback.

METHODOLOGY

3.1 Research Design

This study adopts a conceptual framework-development methodology. Rather than conducting a statistical survey or software implementation experiment, the research synthesizes the supplied literature into a structured architecture for SAP-enabled production–procurement synchronization.

The methodological logic consists of four stages: requirement identification, synchronization modeling, adaptive procurement allocation, and resilience feedback.

The framework assumes that production requirements are continuously generated from operational planning information. These requirements are compared with material availability and procurement status. Any mismatch is classified as a synchronization gap. The system then prioritizes procurement actions according to production criticality and supply conditions.

3.2 Proposed Framework Architecture

The proposed architecture contains five interconnected layers.

Layer 1: Data Acquisition.

This layer collects production requirements, material requirements, inventory positions, open procurement activities, supplier commitments, delivery information, and production priorities.

Layer 2: Requirement–Availability Analysis.

The system compares required quantities and dates with available inventory and

expected receipts. A simplified synchronization gap can be represented as:

$$SGi=Ri-(Ii+Ei)$$

where SGi represents the synchronization gap for material i, Ri represents the production requirement, Ii represents available inventory, and Ei represents expected incoming quantity.

A positive value indicates a potential shortage requiring procurement intervention.

Layer 3: Synchronization Engine.

The engine connects production requirements to procurement activities. Rather than treating every material independently, related materials can be grouped according to production orders or manufacturing stages. This reflects the group-based coordination principle found in full-view coverage research (Du et al., 2022; Su & Du, 2023).

Layer 4: Adaptive Decision Layer.

Procurement priorities are dynamically adjusted according to shortage magnitude, production criticality, delivery urgency, supplier responsiveness, and disruption exposure. This corresponds conceptually to adaptive scheduling and nonlinear control principles (Sun et al., 2018; Wu et al., 2017).

Layer 5: Resilience Feedback.

Actual procurement outcomes are compared against planned outcomes. Delivery delays, quantity deviations, or supplier disruptions feed back into subsequent planning cycles.

3.3 Production–Procurement Synchronization Model

A central feature of the proposed model is the conversion of production requirements into synchronized procurement actions.

For a production order Pj, the system determines the required material set:

$$Mj=\{m1,m2,\ldots,mn\}$$

Each material is evaluated against quantity and timing requirements. A material can then be assigned a synchronization priority:

$$SPi=w1Ci+w2Ui+w3Gi+w4Di$$

where Ci represents production criticality, Ui urgency, Gi synchronization gap, and Di disruption exposure. The w values represent organizationally determined weights.

This formulation does not claim that a single universal weighting system exists. Instead, it establishes a decision structure through which organizations can formalize procurement prioritization.

3.4 Dynamic Requirement Monitoring

Static planning assumes that previously generated requirements remain valid. Resilient planning requires continuous reassessment. Du et al. (2024) and Liu and Du (2021) demonstrate, in different coverage contexts, why changing operational conditions require adaptive allocation.

In the proposed framework, a production requirement is therefore periodically re-

evaluated. If a production order is accelerated, its associated procurement activities receive increased priority. If the order is delayed, procurement urgency may be reduced, thereby avoiding unnecessary inventory accumulation.

3.5 Exception Management

The framework classifies synchronization conditions into four categories: synchronized, at-risk, shortage, and disrupted.

A synchronized condition exists when inventory and expected procurement adequately support production. An at-risk condition exists when planned supply is technically sufficient but timing or supplier reliability creates uncertainty. A shortage condition occurs when expected supply does not satisfy the requirement. A disrupted condition occurs when supplier or logistics information indicates that expected procurement cannot reasonably support production.

This classification provides a practical bridge between SAP transaction data and managerial decision-making.

3.6 Resilience-Oriented Optimization

The proposed framework does not define resilience as the elimination of every deviation. Luo et al. (2014) demonstrate the analytical importance of accepting imperfection when perfect system conditions are impractical. Accordingly, the framework prioritizes critical production continuity rather than attempting to achieve identical synchronization quality across all materials.

This also aligns with multiobjective optimization principles represented in the supplied literature (Zhu & Zhou, 2023). Procurement decisions must balance cost, timing, inventory, availability, and resilience rather than optimize one variable in isolation.

3.7 Hypothetical Application

Consider a manufacturing plant producing two product families. Product A requires three critical components, while Product B requires five. If a supplier unexpectedly delays one component for Product A, the synchronization engine identifies the affected production order and increases the component's procurement priority.

Instead of generating a generic procurement response, the system evaluates alternative inventory, open purchase orders, supplier commitments, and production sequencing. If another component is already available in sufficient quantity, its procurement activity does not receive the same priority.

The outcome is a coordinated response in which procurement decisions are driven by production consequences rather than isolated purchasing parameters.

RESULTS

The conceptual analysis produces five principal findings.

First, production–procurement synchronization should be treated as a continuous process rather than a one-time planning activity. The literature on dynamic coverage and scheduling demonstrates that system requirements can change as operating conditions evolve (Liu & Du, 2021; Du et al., 2024). In an SAP environment, this implies that procurement activities should continuously reflect updated production requirements.

Second, group-level coordination is more appropriate for complex production systems

than isolated material evaluation. Group set coverage research demonstrates the value of coordinating multiple resources around a collective objective (Du et al., 2022; Su & Du, 2023). Analogously, SAP procurement decisions can be evaluated according to their impact on complete production orders or manufacturing stages.

Third, scheduling is a critical component of synchronization. A material technically available after the production requirement is not operationally equivalent to material available before production begins. Node scheduling research emphasizes temporal resource coordination (Wu et al., 2017), supporting the framework's focus on requirement dates and procurement timing.

Fourth, adaptive decision-making improves resilience under uncertainty. The nonlinear control perspective in Sun et al. (2018) supports the conceptual proposition that resource allocation should respond to changing conditions. Within supply chains, this means that procurement priorities should change when shortages, production changes, or supplier disruptions occur.

Fifth, resilience requires prioritization rather than universal optimization. Luo et al. (2014) demonstrate why practical systems may need to operate without perfect coverage, while Zhu and Zhou (2023) emphasize multiobjective optimization. The proposed framework therefore prioritizes production-critical materials and disruption-sensitive requirements instead of treating all procurement activities equally.

The framework consequently identifies synchronization as a three-dimensional relationship involving quantity, time, and operational consequence. Quantity synchronization ensures that enough material is available; temporal synchronization ensures that material arrives when required; and consequence synchronization ensures that procurement priorities reflect the production impact of deviations.

These findings are consistent with the integrated SAP perspective proposed by Kalal (2026), in which production planning and procurement synchronization constitute an important mechanism for strengthening supply chain resilience. The present framework extends that perspective by specifying the data flow, synchronization logic, exception classification, and feedback mechanisms required for operationalization.

DISCUSSION

The proposed framework has important theoretical implications because it reframes production–procurement integration from a transactional concept into a dynamic coordination mechanism. Traditional integration may imply that production and procurement systems exchange information. However, information exchange alone does not establish synchronized decision-making. The framework argues that synchronization requires continuous comparison between requirements, availability, expected supply, timing, and production consequences.

The first important implication concerns data-driven decision quality. When production requirements and procurement status are analyzed through a shared decision structure, discrepancies can become visible before they develop into production interruptions. This principle is consistent with the resource coordination logic evident in coverage and scheduling studies (Du et al., 2022; Wu et al., 2017).

The second implication concerns adaptability. Supply chain resilience cannot depend exclusively on an optimized baseline plan because disruptions can invalidate the assumptions underlying that plan. The dynamic coverage perspectives of Liu and Du (2021) and Du et al. (2024) support a model in which allocation changes as requirements change. Within SAP, this translates into continuous reassessment of material

requirements and procurement priorities.

The third implication is the importance of multiobjective decision-making. Procurement departments frequently emphasize purchase price and supplier terms, while production departments emphasize continuity and timing. Zhu and Zhou (2023) illustrate the broader importance of multiobjective optimization. The proposed framework therefore treats cost as one objective among several rather than as the sole procurement performance measure.

There is also an important trade-off between inventory resilience and inventory efficiency. Increasing safety inventory can protect against disruption but may increase carrying costs and obsolescence exposure. Conversely, aggressive inventory reduction may improve efficiency while increasing vulnerability to supplier delays. The framework does not eliminate this trade-off; instead, it makes the trade-off visible within synchronization decisions.

Another limitation concerns data quality. A data-driven framework is only as reliable as the information underlying it. Incorrect inventory records, outdated supplier confirmations, inaccurate lead times, or delayed production updates can generate inappropriate procurement priorities. Consequently, SAP integration must be accompanied by strong data governance.

A further limitation is that the supplied literature does not provide empirical SAP implementation evidence. Most references concern sensor coverage, scheduling, and optimization rather than enterprise resource planning. Therefore, the transfer of these principles should be interpreted as a conceptual methodological synthesis rather than empirical proof of SAP performance. Kalal (2026) provides the direct conceptual connection between SAP production planning and procurement synchronization, while the remaining references provide transferable analytical principles.

Finally, the framework should not be interpreted as requiring complete automation. Managerial intervention remains important when procurement decisions involve strategic suppliers, contractual restrictions, unusual disruptions, or competing business priorities. The strongest implementation model is therefore likely to combine automated detection and prioritization with human decision authority.

CONCLUSION

This paper developed a Data-Driven SAP Framework for Synchronizing Production Requirements and Procurement Activities in Resilient Supply Chains. The framework conceptualizes synchronization as a continuous process connecting production requirements, material availability, procurement execution, supplier conditions, exception management, and resilience feedback.

The literature synthesis demonstrates that principles of coverage, scheduling, adaptive control, and multiobjective optimization can provide useful methodological foundations for production–procurement coordination (Du et al., 2022; Sun et al., 2018; Zhu & Zhou, 2023). Kalal (2026) provides the direct foundation for positioning integrated SAP production planning and procurement synchronization as a resilience mechanism.

The primary contribution is the proposed architecture in which procurement priorities are determined not simply by purchasing requirements but by their relationship to production criticality, timing, supply gaps, and disruption exposure. This approach can potentially reduce requirement–execution latency and improve the visibility of production-related procurement risks.

Future research should empirically validate the framework using SAP-enabled

manufacturing environments, develop quantitative synchronization-performance indicators, and compare alternative prioritization algorithms under simulated disruption scenarios. Such research would strengthen the transition from conceptual synchronization architecture toward measurable and implementable supply chain resilience solutions

REFERENCES

1. Du H, Zhang Z, Duan Z, Tian C, and Du D-Z Formulate full view camera sensor coverage by using group set coverage. International Wireless Internet Conference 2022 Switzerland Cham: Springer Nature

2. Du H, Su J, Zhang Z, Duan Z, Tian C, Du D-Z (2024) Full View Maximum Coverage of Camera Sensors: Moving Object Monitoring[J]. ACM Transactions on Sensor Networks, 1-23

3. Kalal, M. (2026). SUPPLY CHAIN RESILIENCE THROUGH INTEGRATED SAP PRODUCTION PLANNING–PROCUREMENT SYNCHRONIZATION. Power System Protection and Control, 54(1), 620-637.

4. Liu C, Du H (2021) t, K-Sweep coverage with mobile sensor nodes in wireless sensor networks[J]. IEEE Int Things J 8(18):13888–13899

5. Luo H, Du H, Kim D, Ye Q, Zhu R, Jia J (2014) Imperfection better than perfection: Beyond optimal lifetime barrier coverage in wireless sensor networks. 2014 10th International Conference on Mobile Ad-hoc and Sensor Networks. IEEE, 24-29

6. Su J and Du H Algorithms for Full-View Coverage of Targets with Group Set Cover. International Computing and Combinatorics Conference 2023 Switzerland Cham: Springer Nature

7. Sun Z, Zhao G, and Xing X ENCP: A new energy-efficient nonlinear coverage control protocol in mobile sensor networks[J] EURASIP J on Wirel Commun Netw 2018 2018 1-15

8. Wu P-F, Xiao F, Sha C, Huang H-P, Wang R-C, and Xiong N-X Node scheduling strategies for achieving full-view area coverage in camera sensor networks[J] Sensors 2017 17 6 1303

9. Wu W, Zhang Z, Lee W, et al. (2020) Optimal coverage in wireless sensor networks[J]. 2020. Springer.

10. Zhu X and Zhou M Multiobjective optimized deployment of edge-enabled wireless visual sensor networks for target coverage[J] IEEE Int Things J 2023 10 17 15425

11. Kalal, M. (2026). SUPPLY CHAIN RESILIENCE THROUGH INTEGRATED SAP PRODUCTION PLANNING–PROCUREMENT SYNCHRONIZATION. Power System Protection and Control, 54(1), 620-637.620-637.