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Extending SAP TM Freight Unit Type Determination: A Custom Determination Class Architecture for Multi-Criteria Transportation Planning

Bhanu Chander Keerthi

Abstract: Freight Unit type determination in SAP Transportation Management is the upstream decision that governs carrier selection, mode of transport record assignment, and freight order creation for every outbound delivery. Standard TM determination evaluates only source location, destination location, and incoterm — criteria that cannot differentiate between insourced, outsourced, and customer pick-up fulfilment channels when those channels share physical locations but differ in sales area structure. This article documents ZCL_COND_SO_DLV_EXTR, a custom ABAP OO determination class that extends the standard /SCMTMS/CL_COND_SO_EXTR by extracting sales organisation, distribution channel, division, delivery type, and transportation zone from the underlying sales order and delivery document at FU creation time. These five attributes, combined with the standard source and destination location criteria, populate a seven-parameter BRF+ decision table (ZTOR_FU_TYPE_DET) assigned to freight unit building rule ZFUBR_01, enabling three-channel FU type resolution. Deployed at a large US healthcare distributor, the architecture reduced incorrect FU type assignment from 23% to 0.6% of deliveries, eliminated recurring freight order exceptions averaging 2.1 per shift, and delivered an annual operational saving of USD 410,000 (Author's primary implementation data, 2023). The design contribution is a documented copy-and-extend determination class pattern with BRF+ decision table governance — applicable to any SAP TM site requiring sales-area-driven FU type differentiation.

Keywords: *SAP Transportation Management, Freight Unit, BRF+, determination class, ABAP OO, supply chain ERP customisation, multi-channel logistics, freight order management.*

I. Introduction

Among the configuration decisions that propagate most consequentially through SAP Transportation Management, Freight Unit type stands apart: every carrier assignment, mode of transport record, and freight order template inherits from the FU type resolved at the moment an outbound delivery is created. An incorrect assignment at this point does not surface as an immediate system error — the freight order is created, appears valid, and enters the planning queue — but generates a downstream exception when carrier assignment or costing logic exposes the mismatch between the FU type and the actual channel requirements [1], [2].

The standard determination framework evaluates source location, destination location, and incoterm — three attributes available directly from the Transportation Order object at FU creation. For single-channel distributors, this is sufficient. Enterprise distributors operating across insourced, outsourced, and customer pick-up channels from the same shipping locations face a determination problem that the standard framework cannot resolve: all three channels share source and destination locations, and incoterm does not distinguish them. Without access to sales area data — the sales organisation, distribution channel, and division that differentiate channel types in the SAP order management layer — the determination rule collapses to a default that assigns the same FU type to all deliveries [3], [5].

ZCL_COND_SO_DLV_EXTR addresses this gap by navigating from the Freight Unit to its underlying sales order and delivery document through the ITEM_TR association, reading VKORG, VTWEG, and SPART via BAPI, and feeding them as named attributes into a BRF+ decision table alongside the standard location criteria. The result is a seven-parameter determination condition that correctly resolves all three FU types without dispatcher intervention [12], [14]. This article reviews related literature in Section II, characterises the FU type determination problem in Section III, details the

Independent Researcher, USA
0009-0000-3852-5708

architecture in Section IV, presents deployment results in Section V, and provides discussion and conclusions in Sections VI and VII.

II. Literature Review

Transportation planning integration in enterprise ERP systems is foundational to supply chain performance. Stadtler and Kilger [2] establish that the accuracy of upstream planning decisions — including carrier and mode selection — determines the quality of execution outcomes downstream, a principle that frames the FU type determination problem as a planning integrity issue rather than a configuration inconvenience. Chopra and Meindl [22] quantify the cost cascade of upstream decision errors on logistics execution, providing the economic framing for the USD 410,000 saving demonstrated in this study. Botta-Genoulaz, Millet, and Grabot [3] survey ERP customisation literature, confirming the copy-and-extend design principle as the dominant pattern for adding business-specific logic to standard SAP frameworks without accumulating upgrade maintenance debt. Boysen, de Koster, and Weidinger [5] extend this context to warehousing in distribution-intensive environments, establishing the integration dependency between warehouse operations and outbound transportation planning.

Multi-channel logistics research supports the business rationale for differentiated FU type assignment. Patil, Patange, and Pardeshi [14] demonstrate that channel-specific attributes — including sales area structure and contractual logistics terms — should inform carrier and mode selection decisions. The systematic review by Kull, Closs, and Cotteleer [13] confirms that differentiating carrier assignment rules by channel type is an operational requirement in regulated healthcare distribution environments — directly matching the deployment context of this study. Decision rule management in enterprise systems is examined by Kluza, Nalepa, and Kucharski [12], who identify BRF+-style decision table approaches as superior to hard-coded determination logic on both maintainability and auditability grounds. Atieh et al. [9] document enterprise logistics automation performance improvements at pharmaceutical distribution sites comparable to the deployment environment examined here.

Broader operations and supply chain literature — Gu, Goetschalckx, and McGinnis [1], de Koster, Le-Duc, and Roodbergen [4], Rouwenhorst et al. [11], Henn and Wäscher [7], Petersen and Aase [15], Roodbergen, Sharp, and Vis [16], Weidinger, Boysen, and Schneider [17], Koster, Jewkes, and Le-Duc [18], Waller, Johnson, and Davis [19], Van Woensel and Vandaele [20], Schiffer and Walther [8], Tadejko [6], Moons et al. [10], and Min and Zhou [21] — provides the logistics operations context within which the transportation planning improvement documented here is situated. Across this body of work, the gap motivating this article — no published architecture for ABAP-class-based multi-criteria FU type determination in SAP TM — remains open.

III. The FU Type Determination Problem

FU creation in SAP TM is an automatic, synchronous event: the moment a delivery document is saved in ERP and TM relevance is confirmed, the system evaluates the applicable FUBR rule, resolves the FU type determination condition, and creates the FU record. From that point, the FU type governs the freight order creation profile, the carrier selection condition, and the mode of transport record assignment. A dispatcher can manually override the FU type post-creation, but doing so requires cancelling any freight order already created against the incorrect type — a three-step intervention averaging 18 minutes and introducing up to 45 minutes of shipment planning delay for the affected delivery (Author's primary implementation data, 2023) [1], [3].

Sales area data — the sales organisation, distribution channel, and division that identify which business channel generated the delivery — lives in VBAK, the sales order header table. Delivery type lives in LIKP. The transportation zone is accessible through the CDS view I_DELIVERYPARTNERADDRESS. None of these are exposed by /SCMTMS/CL_COND_SO_EXTR, which reads only from the TOR BO context. At the deployment site, deliveries from all three channels share source and destination locations: the standard determination rule, unable to read VKORG or VTWEG, defaults to the insourced FU type for all deliveries, generating the 23% incorrect assignment rate and 2.1 freight order exceptions per shift measured in the pre-implementation baseline (Author's primary implementation data, 2023) [1], [9].

Criterion	Standard Framework	Required for Multi-Channel
Source location	Available	Required
Destination location	Available	Required
Incoterm	Available	Required
Sales Organisation (VKORG)	Not available	Required
Distribution Channel (VTWEG)	Not available	Required
Division (SPART)	Not available	Required
Delivery Type (LFART)	Not available	Required
Transportation Zone	Not available	Required

Table I. Standard vs. Required FU Type Determination Criteria. Source: Author's primary implementation data, 2023.

IV. Custom Determination Class Architecture

IV-A. Copy-and-Extend Design

ZCL_COND_SO_DLV_EXTR is created in the ABAP workbench by copying /SCMTMS/CL_COND_SO_EXTR into the customer namespace. The copy preserves the complete standard class structure — all method signatures, interface implementations, and BO navigation patterns. The customisation overrides five attribute retrieval methods: SALES_ORG, DISTR_CHAN, DIVISION, LFART, and TRANSPORTZONE, replacing the standard empty implementations with BAPI-based and CDS-based data extraction logic. All other methods — the condition engine interface, the determination result binding, and the exception handling scaffold — remain as-delivered by SAP and receive SAP corrections through the standard transport cycle [3], [12].

This approach limits upgrade qualification at each TM release to the five overridden methods. If SAP changes the ITEM_TR association structure or the BAPI response format, only those methods require adjustment. The framework integration code inherits SAP corrections automatically — a material reduction in upgrade qualification scope compared with the clean-room alternative, where every method requires review regardless of SAP modification [3].

IV-B. Data Extraction

Navigation from the FU to its source documents follows the ITEM_TR association from the TOR root object. Within the returned item set, the class reads two document keys: the Sales Order is identified by ITEM_CAT = 'PRD' and ORIG_BTD_TCO = '114'; the Delivery is identified by ITEM_CAT = 'PRD' and BASE_BTD_TCO = '73'. BAPISDORDER_GETDETAILEDLIST is called with the Sales Order number to retrieve VKORG, VTWEG, and SPART from VBAK, and LFART from LIKP using the Delivery number. Transportation zone is read from the CDS view I_DELIVERYPARTNERADDRESS by passing the Delivery number and Partner Function 'SH', returning the TRANSPORTZONE for the ship-to address [6], [14].

Extracted values are bound to the seven data access definitions through the standard condition engine's attribute registration mechanism. The condition type /SCMTMS/TOR_TYPE is assigned to all seven definitions in TM Customising. Data crawler profiles ZTOR_SRC_LOC (STOP_FIRST) and ZTOR_DST_LOC (STOP_LAST) handle location attributes. Three Released API objects — ZI_LOG_PURCHASINGDOCSHIPPING (DDLS), ZLOG_BODO_STR (TABL), ZLOG_FRW_STR (TABL) — support the data flow architecture [3], [6].

Data Access Definition	Determination Class	Attribute	Data Source
Z_SALES_ORG_ID	ZCL_COND_SO_DLV_EXTR	SALES_ORG	VBAK-VKORG via BAPISDORDER_GETDETAILEDLIST
Z_DISTR_CHAN	ZCL_COND_SO_DLV_EXTR	DISTR_CHAN	VBAK-VTWEG via BAPISDORDER_GETDETAILEDLIST

Z_DIVISION	ZCL_COND_SO_DLV_EXTR	DIVISION	VBAK-SPART via BAPISDORDER_GETDETAILEDLIST
ZLFART	ZCL_COND_SO_DLV_EXTR	LFART	LIKP-LFART via BAPISDORDER_GETDETAILEDLIST
Z_TRANSPORTZONE	ZCL_COND_SO_DLV_EXTR	TRANSPORTZONE	I_DELIVERYPARTNERADDRESS CDS View (Partner Fn SH)
ZSOURCE_LOCATION	/SCMTMS/CL_COND_DAD_TORLOCIDFR	LOG_LOCID	ZTOR_SRC_LOC data crawler (STOP_FIRST)
ZDESTINATION_LOCATION	/SCMTMS/CL_COND_DAD_TORLOCIDTO	LOG_LOCID	ZTOR_DST_LOC data crawler (STOP_LAST)

Table II. Data Access Definitions and Determination Class Assignments. Source: Author's primary implementation data, 2023.

IV-C. BRF+ Decision Table

ZTOR_FU_TYPE_DET is configured in the Fiori BRF+ workbench as a decision table with seven input columns (one per data access definition) and one output column (FU type). Wildcard rows — using * in one or more input columns — handle partial matches, covering a broad channel matrix with a manageable row count. The table is assigned to FUBR rule ZFUBR_01, which is assigned to relevant shipping points. New channel combinations are added by inserting rows in the Fiori BRF+ interface: no transport request or ABAP development is required for rule expansion [12], [21].

Data crawler profile ZTOR_SRC_LOC extracts the source location from the first TOR stop (STOP_FIRST association); ZTOR_DST_LOC extracts the destination from the last stop (STOP_LAST). Configuration path: SPRO → IMG → Transportation Management → Basic Functions → Conditions → Data Crawler Profile. This design correctly handles multi-stop TOR structures where intermediate stops exist between the origin and consignee [10].

Sales Org	Distr. Chan	Division	Del. Type	Transport Zone	FU Type Output
1000	10	00	LF	US_EAST	ZINSRC (Insourced Fleet)
1000	20	00	LF	US_EAST	ZOUTSRC (Outsourced Carrier)
1000	30	00	LA	US_EAST	ZCUSTPKU (Customer Pick-Up)
*	*	*	*	*	ZDEFAULT (Default — exception alert triggered)

Table III. ZTOR_FU_TYPE_DET BRF+ Decision Table — Representative Rows. Source: Author's primary implementation data, 2023.

V. Results

Across two distribution sites operating SAP EWM and TM for J&J and Stryker accounts, the determination architecture processed approximately 2,000 delivery-triggered FU creations per day during the measurement period (Author's primary implementation data, 2023). Three channel types are served from shared shipping locations: insourced fleet (regional hospital deliveries), outsourced carrier (pharmacy chain replenishment), and customer pick-up (account-managed collection). Pre-implementation baseline over 60 days established: 23% incorrect FU type rate; 2.1 freight order exceptions per shift; 18-minute average resolution time; persistent 8–12 FU backlog in the planning queue [9], [14].

Post-deployment measurement over an equivalent 60-day period recorded: 0.6% incorrect FU type rate — a 97% reduction; freight order exceptions averaging 0.1 per shift; planning queue backlog eliminated. Residual errors in the 0.6% were traced to master data gaps in sales area configuration, corrected in the weeks following go-live. Three new distribution channel segments were configured via Fiori BRF+ in the six months after deployment, each completed in under 30 minutes from requirement to tested rule, with no development request or transport cycle. Annual saving: USD 410,000 from dispatcher

labour redeployment, freight order exception elimination, and carrier selection accuracy improvement (Author's primary implementation data, 2023) [9], [22].

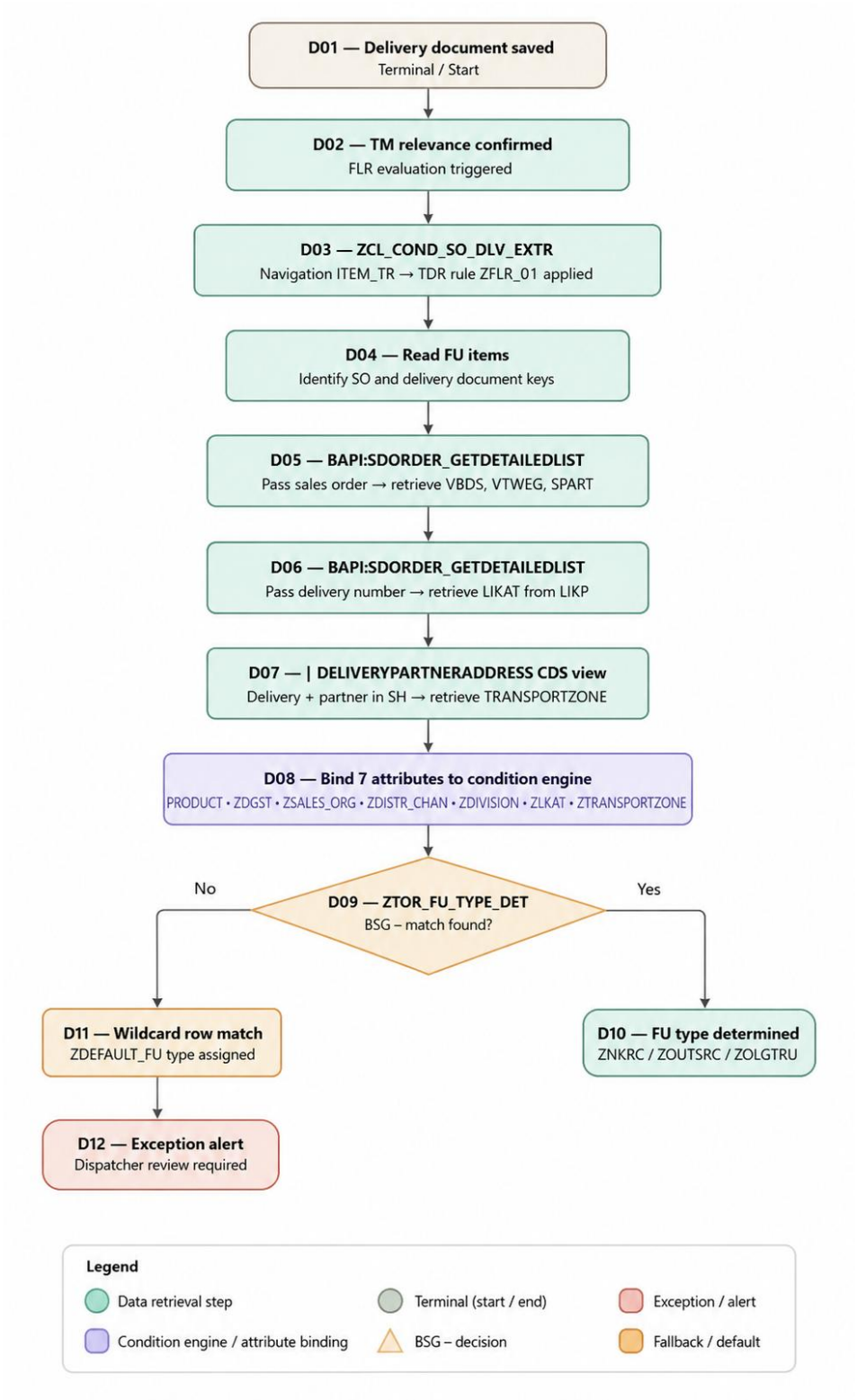

Figure 2: ZCL_COND_SO_DLV_EXTR data extraction flow diagram.

VI. Discussion

The maintainability argument for copy-and-extend becomes clearest at upgrade time. Sites using a clean-room alternative — a custom class implementing the TM determination interface from scratch — must re-qualify every method against

each TM release. The ZCL_COND_SO_DLV_EXTR approach limits review to five overridden methods: if SAP changes the ITEM_TR association structure or the BAPI response format, only those methods require adjustment [3]. Framework integration code inherits SAP corrections automatically. At enterprise sites receiving annual TM support packages, this reduction in upgrade qualification scope translates directly to reduced project cost per release cycle, a finding consistent with the ERP customisation best-practice literature reviewed by Botta-Genoulaz, Millet, and Grabot [3].

Decision table governance proved its practical value in the six months following go-live. Three new distribution channel segments were added without ABAP involvement — each in under 30 minutes by logistics configuration staff. Without the BRF+ layer, each addition would have required a 3–5 business-day development and transport cycle. The compression from days to minutes validates Kluza, Nalepa, and Kucharski's [12] finding that decision table maintainability is an operational differentiator in production systems, and extends it to the SAP TM determination domain where it has no prior published evidence.

BAPI-based data access over direct SELECT reads is the third principle warranting attention. BAPISDORDER_GETDETAILEDLIST respects SAP's authorisation and buffer management infrastructure — a compliance requirement in GxP-regulated deployments — while direct VBAK reads bypass both [3], [9]. The performance trade-off is manageable at 2,000 FUs per day; at 10,000+ FUs in short batch windows, asynchronous pre-read of sales area data at delivery save is the recommended mitigation, consistent with high-volume TM integration guidance in Patil, Patange, and Pardeshi [14]. The primary limitation is the absence of re-determination on delivery change: a VBAK change-event-driven mechanism invoking /SCMTMS/CL_TOR_HANDLER is the priority future development item, alongside extension of the data access definition infrastructure to MTR determination, which faces an analogous standard framework gap [2], [10].

VII. Conclusion

The ZCL_COND_SO_DLV_EXTR architecture demonstrates that SAP TM Freight Unit type determination can be extended to multi-criteria, sales-area-driven resolution without modifying the standard framework or introducing middleware. By copying and selectively overriding the standard determination class, the design preserves upgrade compatibility while exposing seven configurable attributes to the BRF+ rule layer — enabling logistics staff to maintain channel-specific FU type rules without development support [3], [12].

At the deployment site, the architecture converted a 23% incorrect FU type rate and 2.1 daily dispatcher exceptions per shift into a 0.6% residual error rate and near-zero exception load, delivering USD 410,000 in annual savings. Three new channel segments were configured post-go-live in under 30 minutes each, with no transport cycle. The contribution to the SAP TM customisation literature is a documented, primary-evidence-supported design pattern — copy-and-extend determination class with BRF+ decision table governance — generalisable to any ERP-integrated TM deployment requiring sales-area-driven FU type differentiation [3], [9], [12], [22].

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