Supplementary Material

Table S1. Stability diagnostics for the BERTopic solution (k = 35).

Robustness check	Comparisons (n)	K topics (median [min–max])	Noise share (mean ± SD)	Matched Jaccard@15 (mean ± SD)	Matched cosine (mean ± SD)	Stable topics (count / %)	Prevalence stability ϱ (mean ± SD)
UMAP seed variation (baseline vs other seeds)	9	35 [35–35]	0.0876 ± 0.0041	0.8732 ± 0.0215	0.7814 ± 0.0289	33/35; 94.2857	0.9658 ± 0.0124
Preprocessing variant: Turkish lemmatization vs baseline	1	35 [35–35]	0.0901 ± 0.0000	0.8425 ± 0.0000	0.7527 ± 0.0000	31/35; 88.5714	0.9512 ± 0.0000

Notes. The model was re-estimated across 10 UMAP random seeds (embedding and clustering fixed) and under a Turkish lemmatization preprocessing variant (e.g., Zemberek). Topics were aligned to the baseline solution by maximizing cosine similarity of c-TF-IDF topic vectors; Jaccard overlap was computed on the top-15 c-TF-IDF terms. A topic is considered stable if Jaccard ≥ 0.80 and cosine ≥ 0.70.

Table S2a. Language-stratified topic summaries and Turkish–English topic alignment

Summary item	Value
Turkish-only model topics (K_TR)	35
English-only model topics (K_EN)	35
Matched topic pairs (1–1)	35
Mean matched cosine similarity (±SD)	0.7808 ± 0.0575
Mean matched Jaccard@15 (±SD)	0.6055 ± 0.0722
Share of strong matches (%)	80.0000

Note. "strong" = cosine ≥ 0.70 **ve** Jaccard@15 ≥ 0.55.

Table S2b. Topic-level alignment.

Macro-theme	TR Topic	TR label	TR keywords (EN; top-15, first 8 shown)	TR prev. within TR (%)	EN Topic	EN Label	EN keywords (top-15, first 8 shown)	EN prev. within EN (%)	Cosine	Jaccard@15	Alignment
Fulfillment Disruptions	T1	Delivery delays	delay, late, promised, courier, slot, tracking, transit, dispatch…	1.0635	T1	Delivery delays	delay, late, promised, courier, slot, tracking, dispatch, transit…	5.0449	0.8017	0.5990	Strong
Fulfillment Disruptions	T2	Missed delivery windows	delivery, window, slot, missed, reschedule, doorbell, attempt, not_home…	3.2288	T2	Missed delivery windows	delivery, window, missed, slot, reschedule, attempt, not_home, courier…	0.4395	0.8680	0.6581	Strong
Fulfillment Disruptions	T3	Stalled tracking updates	tracking, stuck, update, scan, status, information, system, refresh…	6.0907	T3	Tracking stuck / scan latency	tracking, stuck, scan, latency, update, status, information, refresh…	2.5922	0.8612	0.6930	Strong
Fulfillment Disruptions	T4	Lost parcels	lost, missing, not_delivered, depot, investigation, claim, courier, tracking…	2.3072	T4	Lost parcels	lost, missing, not_delivered, depot, investigation, claim, courier, tracking…	0.4338	0.7745	0.6055	Strong
Fulfillment Disruptions	T5	Wrong or partial delivery	wrong, item, partial, missing_items, quantity, package, received, ordered…	1.2375	T5	Wrong/partial delivery	wrong, item, partial, missing_items, quantity, received, ordered, mismatch…	0.1850	0.7851	0.5631	Strong
Fulfillment Disruptions	T6	Damage on arrival	damaged, broken, crushed, box, packaging, dented, torn, leak…	4.7719	T6	Damaged on arrival	damaged, broken, crushed, packaging, box, dented, torn, leak…	1.3823	0.7707	0.6254	Strong
Fulfillment Disruptions	T7	Courier conduct issues	courier, rude, behavior, not_calling, note, returned, branch, pickup_point…	0.3589	T7	Courier conduct issues	courier, rude, behavior, not_calling, note, returned, branch, pickup_point…	0.1164	0.7740	0.5530	Strong
Fulfillment Disruptions	T8	International shipping/cu	customs, import, duty, tax, clearance,	1.5422	T8	International	customs, import, duty, tax, clearance, fee, international, held…	1.1536	0.7638	0.5825	Strong

		stoms problems	fee, international, held…			shipping/customs					
Remediation Frictions	T9	Refund pending	refund, pending, days, waiting, bank, reversal, processed, timeline…	4.7897	T9	Refund pending	refund, pending, days, waiting, bank, reversal, processed, timeline…	1.0129	0.7876	0.5634	Strong
Remediation Frictions	T10	Partial refund disputes	partial, refund, amount, mismatch, dispute, missing_difference, fee, calculation…	1.4656	T10	Partial refund disputes	partial, refund, amount, mismatch, dispute, missing_difference, fee, calculation…	3.5670	0.8344	0.5953	Strong
Remediation Frictions	T11	Chargeback guidance and reversals	chargeback, bank, dispute, reversed, proof, process, transaction, unauthorized…	2.4588	T11	Chargeback reversals	chargeback, bank, dispute, reversed, proof, process, transaction, unauthorized…	1.0189	0.7415	0.6708	Strong
Remediation Frictions	T12	Return pickup and label issues	return, pickup, label, barcode, courier, shipment, printer, dropoff…	1.4032	T12	Return pickup & label issues	return, pickup, label, barcode, courier, shipment, printer, dropoff…	2.1534	0.7690	0.5699	Strong
Remediation Frictions	T13	Return denied	return, denied, rejected, inspection, condition, policy, reason, not_accepted…	2.8421	T13	Return denied	return, denied, rejected, inspection, condition, policy, reason, not_accepted…	2.7051	0.8082	0.5982	Strong
Remediation Frictions	T14	Restocking and hidden fees	restocking, hidden_fee, shipping_fee, service_fee, deduction, policy, unfair, surprise…	2.3033	T14	Restocking/hidden fees	restocking, hidden_fee, shipping_fee, service_fee, deduction, policy, unfair, surprise…	3.7993	0.7880	0.6004	Strong
Remediation Frictions	T15	Wallet or store credit blocks	wallet, store_credit, blocked, withdraw, cash, refund, voucher, balance…	1.0160	T15	Wallet/store credit blocks	wallet, store_credit, blocked, withdraw, cash, refund, voucher, balance…	4.7348	0.8468	0.6078	Strong

Remediation Frictions	T16	Promotional refund and points disputes	promotion, points, coupon, cashback, campaign, missing, credited, terms…	2.0103	T16	Promo points disputes	promotion, points, coupon, cashback, campaign, missing, credited, terms…	2.4872	0.7770	0.5890	Strong
Product Integrity Risks	T17	Counterfeit/ inauthentic goods	fake, counterfeit, authenticity, replica, brand, serial, proof, seller…	5.0863	T17	Counterfeit goods	fake, counterfeit, authenticity, replica, brand, serial, proof, seller…	0.7260	0.7971	0.6308	Strong
Product Integrity Risks	T18	Used item sold as new	used, opened, refurbished, scratches, seal, missing_accessories, worn, unacceptable…	2.1774	18	Used sold as new	used, opened, refurbished, scratches, seal, missing_accessories, worn, unacceptable…	1.0083	0.8208	0.5821	Strong
Product Integrity Risks	T19	Listing-photo mismatch	photo, description, misleading, different, mismatch, image, listing, advertised…	1.4770	T19	Listing-photo mismatch	photo, description, misleading, different, mismatch, image, listing, advertised…	1.8320	0.8168	0.5944	Strong
Product Integrity Risks	T20	Specification mismatch	specification, mismatch, model, feature, capacity, size, color, variant…	2.6891	T20	Specification mismatch	specification, mismatch, model, feature, capacity, size, variant, wrong_info…	1.2644	0.7330	0.6234	Strong
Product Integrity Risks	T21	Wrong variant/size/ color	wrong, variant, size, color, ordered, received, exchange, return…	0.5057	T21	Wrong variant/size/color	wrong, variant, size, color, ordered, received, exchange, return…	1.3926	0.7773	0.5797	Strong
Product Integrity Risks	T22	Seller misrepresentation and bait listings	bait, listing, misrepresentation, seller, promise, not_as_described, deceptive, report…	3.2894	T22	Bait listings/misrepresentation	bait, listing, misrepresentation, seller, promise, not_as_described, deceptive, report…	2.3597	0.7612	0.5856	Strong
Product Integrity Risks	T23	Warranty eligibility disputes at purchase stage	warranty, eligibility, invoice, guarantee, coverage, serial, registration, seller…	2.3093	T23	Warranty eligibility disputes	warranty, eligibility, invoice, guarantee, coverage, serial, registration, seller…	3.1830	0.6900	0.5000	Weak

Escalation Failures	T24	Chatbot loop and scripted replies	chatbot, script, automated, loop, template, same_reply, resolved, closed…	0.5908	T24	Chatbot loop/scripted replies	chatbot, script, automated, loop, template, same_reply, resolved, closed…	1.5790	0.7737	0.6866	Strong
Escalation Failures	T25	Human agent unreachable	agent, unreachable, call, wait, line, support, no_answer, escalation…	4.2403	T25	Human agent unreachable	agent, unreachable, call, wait, line, support, no_answer, escalation…	1.1592	0.7707	0.6039	Strong
Escalation Failures	T26	Escalation failure and handoff barriers	escalation, handoff, human_review, blocked, case, ownership, evidence, routing…	5.4013	T26	Escalation handoff barriers	escalation, handoff, human_review, blocked, case, ownership, evidence, routing…	1.5061	0.7845	0.6091	Strong
Escalation Failures	T27	Ticket auto-closure without review	ticket, closed, auto_closure, no_review, resolved, status, system, reopen…	0.9109	T27	Ticket auto-closure	ticket, closed, auto_closure, no_review, resolved, status, system, reopen…	2.5942	0.7890	0.6204	Strong
Escalation Failures	T28	Slow response and backlog	slow, response, backlog, queue, days, waiting, followup, update…	2.2085	T28	Slow response/backlog	slow, response, backlog, queue, days, waiting, followup, update…	2.6930	0.8116	0.6073	Strong
Escalation Failures	T29	Inconsistent resolutions across contacts	inconsistent, different, agent, conflicting, info, procedure, unfair, repeat…	1.4541	T29	Inconsistent resolutions	inconsistent, different, agent, conflicting, info, procedure, unfair, repeat…	2.1931	0.7981	0.5561	Strong
Governance Threats	T30	Unauthorized transactions	unauthorized, transaction, card, payment, fraud, security, charge, dispute…	1.1270	T30	Unauthorized transactions	unauthorized, transaction, card, payment, fraud, security, charge, dispute…	2.3280	0.8131	0.5859	Strong
Governance Threats	T31	Account takeover and lockouts	account, takeover, hacked, locked, suspended, access, reset, identity…	2.6266	T31	Account takeover/lockouts	account, takeover, hacked, locked, suspended, access, reset, identity…	0.3596	0.7998	0.5636	Strong

Governance Threats	T32	OTP and verification failures	otp, verification, sms, code, not_received, error, twofactor, authentication…	0.3142	T32	OTP/verification failures	otp, verification, sms, code, not_received, error, twofactor, authentication…	0.7861	0.7378	0.6602	Strong
Governance Threats	T33	Phishing and social engineering incidents	phishing, scam, link, social_engineering, fake_support, message, fraud, report…	0.6852	T33	Phishing/social engineering	phishing, scam, link, social_engineering, fake_support, message, fraud, report…	5.1734	0.8027	0.5941	Strong
Governance Threats	T34	Privacy consent and data sharing concerns	privacy, consent, data_sharing, marketing, kvkk, gdpr, unsubscribe, leak…	0.2507	T34	Privacy consent/data sharing	privacy, consent, data_sharing, marketing, kvkk, gdpr, unsubscribe, leak…	1.7288	0.6600	0.4800	Weak
Governance Threats	T35	Dark patterns and subscription traps	dark_pattern, subscription, trap, recurring, billing, cancel, difficult, auto_renew…	0.5931	T35	Dark patterns/subscription traps	dark_pattern, subscription, trap, recurring, billing, cancel, difficult, auto_renew…	1.3702	0.6300	0.4100	Weak

Note. T1–T8 Fulfillment, T9–T16 Remediation, T17–T23 Product Integrity, T24–T29 Escalation, T30–T35 Governance. It was re-estimated using BERTopic on Turkish-only and English-only subsets. It aligned topics across languages using topic representation similarity, capturing both top-term overlap (Jaccard computed on the top-15 descriptors) and representation similarity (cosine). Keywords are shown in English for readability. Prevalence values are computed within each language subset (columns sum to 100% within language, excluding the noise/low-confidence set per the main pipeline).

Table S2c. Macro-theme distribution by language and unadjusted statistical test

Macro-theme	Turkish share within assigned topics (%)	English share within assigned topics (%)	Difference (EN – TR, pp)	Direction of difference
Fulfillment Disruptions	26.81	16.67	-10.14	Higher in Turkish
Remediation Frictions	23.81	31.55	7.74	Higher in English
Product Integrity Risks	22.82	17.29	-5.53	Higher in Turkish
Escalation Failures	19.27	17.23	-2.04	Slightly higher in Turkish
Governance Threats	7.29	17.26	9.97	Higher in English

Note. Omnibus test of language × macro-theme distribution: Pearson $\chi^2(4) = 3124.84$, $p < 0.001$, Cramér's V = 0.189

Table S2d. Adjusted language effect from multinomial logistic regression

Outcome category	English vs Turkish (RRR)	95% CI	p	Interpretation
Remediation Frictions	1.52	[1.45, 1.59]	<0.001	English complaints are more likely than Turkish complaints to fall into this category relative to Fulfillment Disruptions
Product Integrity Risks	0.82	[0.78, 0.86]	<0.001	English complaints are less likely than Turkish complaints to fall into this category relative to Fulfillment Disruptions
Escalation Failures	0.93	[0.89, 0.98]	0.006	English complaints are slightly less likely than Turkish complaints to fall into this category relative to Fulfillment Disruptions
Governance Threats	1.86	[1.77, 1.96]	<0.001	English complaints are much more likely than Turkish complaints to fall into this category relative to Fulfillment Disruptions

Note. Controls: platform, month fixed effects, source composition, Joint Wald test for language: $\chi^2(4) = 148.72$, $p < 0.001$, N: 87,479, Pseudo R^2: 0.028

Table S3a. Full topic inventory (label, top terms, prevalence, and representative texts).

Topic ID	Macro-theme	Final label	Top c-TF-IDF terms (top-15)	Prevalence (%)	Representative texts
T1	Fulfillment Disruptions	Delivery delays	delay, late, promised, courier, slot, tracking, dispatch, transit, delivery_date, schedule, wait, days, status, arrival, reschedule	7.8000	See S3B: T1 (10 items)
T2	Fulfillment Disruptions	Missed slots	slot, window, missed, attempt, not_home, doorbell, reschedule, appointment, delivery_time, failed_attempt, call, notification, cancel, reattempt, courier	1.9000*	See S3B: T2 (10 items)
T3	Fulfillment Disruptions	Tracking failures	tracking, status, update, scan, stuck, system, no_update, refresh, information, barcode, transit, delayed_scan, app, error, discrepancy	2.1000*	See S3B: T3 (10 items)
T4	Fulfillment Disruptions	Lost parcels	lost, missing, not_delivered, depot, investigation, claim, parcel, warehouse, locate, scan, unresolved, report, compensation, refund, replacement	4.3000	See S3B: T4 (10 items)
T5	Fulfillment Disruptions	Wrong/partial delivery	wrong, item, partial, missing_items, quantity, incorrect, received, ordered, mismatch, package, invoice, exchange, return, variant, seller	1.6000*	See S3B: T5 (10 items)
T6	Fulfillment Disruptions	Damaged package on arrival	damaged, broken, crushed, packaging, box, torn, dented, leak, fragile, return, replacement, photo, condition, refund, courier	1.5000*	See S3B: T6 (10 items)
T7	Fulfillment Disruptions	Courier conduct complaints	courier, rude, behavior, attitude, not_calling, note, refused, dropoff, complaint, unprofessional, argument, phone, door, disrespect, harassment	1.2000*	See S3B: T7 (10 items)
T8	Fulfillment Disruptions	International shipping/customs issues	customs, import, duty, tax, clearance, fee, international, held, border, declaration, delay, warehouse, documentation, return_to_sender, tracking	0.9000*	See S3B: T8 (10 items)
T9	Remediation Frictions	Refund pending	refund, pending, days, waiting, bank, reversal, processed, timeline, transaction, status, confirmation, delay, support, transfer, approved	7.1000	See S3B: T9 (10 items)
T10	Remediation Frictions	Partial refund disputes	partial, refund, amount, difference, missing, calculation, shipping_fee, deduction, unfair, dispute, charged, compensation, invoice, item_value, policy	1.8000*	See S3B: T10 (10 items)
T11	Remediation Frictions	Chargeback guidance and reversals	chargeback, bank, dispute, reversed, proof, process, transaction, card, documents, claim, deadline, merchant, appeal, rejection, evidence	3.4000	See S3B: T11 (10 items)

T12	Remediation Frictions	Return pickup and label issues	return, label, pickup, courier, barcode, shipment, dropoff, scan, printer, appointment, tracking, failed, code, instructions, return_window	5.6000	See S3B: T12 (10 items)
T13	Remediation Frictions	Return denied	denied, policy, rejected, reason, inspection, condition, return, not_accepted, opened, time_limit, dispute, unfair, appeal, seller, platform	3.6000	See S3B: T13 (10 items)
T14	Remediation Frictions	Restocking and hidden fees	restocking, fee, hidden, deduction, shipping_fee, service_fee, charge, refund, policy, unfair, surprise, cost, invoice, return, penalty	1.3000*	See S3B: T14 (10 items)
T15	Remediation Frictions	Wallet or store credit blocks	wallet, store_credit, credit, blocked, withdraw, balance, voucher, cashout, transfer, limit, expired, forced_credit, refund, account, restriction	1.2000*	See S3B: T15 (10 items)
T16	Remediation Frictions	Promotional refund and points disputes	promotion, points, coupon, cashback, campaign, missing, credited, terms, eligibility, refund, voucher, bonus, expired, dispute, calculation	1.1000*	See S3B: T16 (10 items)
T17	Product Integrity Risks	Counterfeit/inauthentic goods	fake, counterfeit, authenticity, replica, brand, serial, original, invoice, warranty, proof, seller, report, refund, platform, verification	6.4000	See S3B: T17 (10 items)
T18	Product Integrity Risks	Used item sold as new	used, opened, refurbished, scratches, seal, missing_accessories, worn, not_new, box, condition, replacement, refund, complaint, seller, return	2.5000*	See S3B: T18 (10 items)
T19	Product Integrity Risks	Listing-photo mismatch	photo, description, misleading, different, mismatch, image, advertised, not_as_described, listing, color, model, feature, seller, return, proof	5.1000	See S3B: T19 (10 items)
T20	Product Integrity Risks	Specification mismatch	specification, mismatch, model, feature, capacity, size, color, variant, wrong_info, advertised, performance, compatibility, version, return, refund	2.3000*	See S3B: T20 (10 items)
T21	Product Integrity Risks	Wrong variant/size/color	wrong, variant, size, color, ordered, received, exchange, return, mismatch, option, selection, seller, stock, replacement, refund	2.1000*	See S3B: T21 (10 items)
T22	Product Integrity Risks	Seller misrepresentation and bait listings	bait, listing, misrepresentation, seller, deceptive, promise, not_as_described, report, enforcement, takedown, complaint, scam, fake_stock, cancel, refund	2.4000*	See S3B: T22 (10 items)

T23	Product Integrity Risks	Warranty eligibility disputes at purchase stage	warranty, eligibility, invoice, guarantee, coverage, serial, registration, authorized, service, seller, brand, proof, refusal, return, purchase	1.8000*	See S3B: T23 (10 items)
T24	Escalation Failures	Chatbot loop and scripted replies	chatbot, script, same, automated, loop, template, generic, ticket, closed, resolved, reopen, escalation, agent, unhelpful, no_human	4.7000	See S3B: T24 (10 items)
T25	Escalation Failures	Human agent unreachable	agent, unreachable, call, wait, line, support, queue, no_answer, hotline, chat, response, connect, escalation, representative, callback	4.1000	See S3B: T25 (10 items)
T26	Escalation Failures	Escalation failure and handoff barriers	escalation, handoff, blocked, routing, ownership, supervisor, specialist, evidence, review, case, transfer, denied, no_followup, dead_end, complaint	1.3000*	See S3B: T26 (10 items)
T27	Escalation Failures	Ticket auto-closure without review	ticket, closed, resolved, no_review, status, system, auto_close, reopen, bot, ignored, evidence, case, support, response, time_limit	3.2000	See S3B: T27 (10 items)
T28	Escalation Failures	Slow response and backlog	slow, response, backlog, queue, days, waiting, followup, update, delay, support, ticket, pending, unresolved, SLA, priority	1.1000*	See S3B: T28 (10 items)
T29	Escalation Failures	Inconsistent resolutions across contacts	inconsistent, different, agent, conflicting, info, procedure, unfair, repeat, contact, history, case, escalation, policy, contradiction, frustration	1.1000*	See S3B: T29 (10 items)
T30	Governance Threats	Unauthorized transactions	unauthorized, card, payment, fraud, security, charge, transaction, dispute, refund, verification, account, suspicious, merchant, investigation, protection	3.9000	See S3B: T30 (10 items)
T31	Governance Threats	Account takeover and lockouts	account, takeover, hacked, locked, suspended, access, reset, identity, login, password, recovery, verification, support, email, security	2.3000*	See S3B: T31 (10 items)
T32	Governance Threats	OTP and verification failures	otp, verification, sms, code, not_received, error, twofactor, authentication, phone, timeout, app, login, security, resend, blocked	2.2000*	See S3B: T32 (10 items)
T33	Governance Threats	Phishing and social engineering incidents	phishing, scam, link, fake_support, message, social_engineering, fraud, report, impersonation, call, email, account, steal, money, warning	2.0000*	See S3B: T33 (10 items)
T34	Governance Threats	Privacy consent and data sharing concerns	privacy, consent, data_sharing, marketing, kvkk, gdpr, unsubscribe, leak, permission, third_party, notification, profiling, email, call, complaint	2.6000*	See S3B: T34 (10 items)
T35	Governance Threats	Dark patterns and subscription traps	dark_pattern, subscription, trap, recurring, billing, cancel, auto_renew, difficult, misleading, hidden_option, refund, trial, charges, terms, UI	2.5000*	See S3B: T35 (10 items)

Table S3b. Representative complaints.

Topic ID	Final label	Representative complaints (10 items)
T1	Delivery delays	1) "Estimated delivery date passed; tracking still shows 'in transit' for days."2) "Courier keeps postponing; no clear update or new delivery slot is offered."3) "Package was promised yesterday but hasn't arrived; status hasn't changed."4) "Delivery window missed twice; support says 'wait 48 hours' repeatedly."5) "Tracking shows dispatched, then nothing—no scan updates since last week."6) "Item is late and I need it urgently; no option to reroute or expedite."7) "The system says delivered today, but it's not here; timeline is inconsistent."8) "Order delayed without explanation; I only see generic 'processing' messages."9) "Courier attempted delivery outside the selected slot; marked as 'customer unavailable'."10) "Delivery date moved three times; I want either a firm date or cancellation."
T2	Lost parcels	1) "Package is missing; last scan was at the depot and then it disappeared."2) "Tracking hasn't updated for a week; courier says they can't locate the parcel."3) "Marked as delivered but nothing arrived; neighbors also didn't receive it."4) "Investigation opened but no outcome; I need compensation or replacement."5) "Parcel lost during transfer; support asks for the same documents repeatedly."6) "Warehouse scan shows received, yet courier claims it was never handed over."7) "I keep getting 'we are looking into it' but no timeline is shared."8) "Item is expensive; seller refuses refund without a 'loss report' from courier."9) "Wrong delivery proof photo; it's not my address—parcel seems misdelivered."10) "Missing parcel and no clear process; I want the case escalated."
T3	Tracking failures	1) "Box arrived crushed; product is broken and unusable."2) "Seal was torn and items were leaking; packaging was not protective."3) "Delivered with dents and scratches; clearly mishandled in transit."4) "Fragile item shipped without padding; arrived shattered."5) "Courier left the parcel in rain; packaging soaked and item damaged."6) "I submitted photos but refund was denied; I need a proper review."7) "Replacement requested; support keeps redirecting between seller and courier."8) "Package opened on arrival; missing parts and damage visible."9) "Return process is confusing; label provided but pickup never happens."10) "Damage claim closed automatically; please reopen and inspect evidence."
T9	Refund pending	1) "Refund approved but not received; bank shows no reversal after many days."2) "Support says 'processed' yet I have no confirmation number or timeline."3) "Partial refund issued; the remaining amount is still pending."4) "Refund promised within 3–5 days; it's been two weeks."5) "Transaction status keeps changing; I need a consistent refund date."6) "Refund sent to wallet without consent; I need it back to my card."7) "Case closed while refund still missing; please provide proof of transfer."8) "Seller claims refund done; platform shows pending—who is responsible?"9) "Refund was 'failed'; no instruction on how to correct bank details."10) "I want escalation because the same scripted answer repeats."
T12	Return pickup & label issues	1) "Return label barcode doesn't scan; courier refuses pickup."2) "Pickup scheduled but no one came; system marked 'attempted' incorrectly."3)

		"Drop-off code invalid; store cannot accept the return."4) "Label generated for a different carrier; instructions don't match."5) "Barcode missing on PDF; I can't print properly."6) "Courier says address mismatch; app shows correct address."7) "Tracking for return never activates; I'm stuck with the item."8) "Multiple pickups cancelled automatically; need a manual booking."9) "Return window is closing due to pickup failures; please extend."10) "Support keeps asking for screenshots; I already provided them."
T17	Counterfeit / inauthentic goods	1) "Received a counterfeit item; serial number doesn't match the brand database."2) "Packaging and logo quality indicate a replica; seller claims it's original."3) "Invoice looks fake; warranty registration was rejected."4) "Product differs from official photos; authenticity concerns are ignored."5) "Requested verification; support says 'contact the seller' with no protection."6) "Brand confirmed it's not authentic; I need a full refund."7) "Seller offered partial refund to keep the item; unacceptable."8) "Reported counterfeit listing; it's still active—why wasn't it removed?"9) "Authentication documents requested but never provided by seller."10) "I want escalation because this is a safety/consumer protection issue."
T24	Chatbot loop & scripted replies	1) "Chatbot repeats the same steps; I can't reach a human agent."2) "Ticket closed automatically after a bot message; issue not resolved."3) "Every reply is a template; no one reads the details."4) "I select 'still need help' but it restarts the bot flow."5) "Escalation request ignored; only generic responses appear."6) "Case status shows resolved, but nothing changed in my order/refund."7) "Bot asks for the same info I already provided; loop continues."8) "No option to upload evidence; bot ends the conversation."9) "Support claims policy, but won't explain; needs human review."10) "Please reopen the ticket and assign a specialist."
T30	Unauthorized transactions	1) "Unauthorized charge appeared; I didn't approve this transaction."2) "Account shows suspicious payments; I need immediate security action."3) "Card was charged twice; one is fraudulent—please investigate."4) "I received a verification SMS after the charge; too late to stop it."5) "Chargeback initiated; platform asks for documents without guidance."6) "Merchant name unknown; I want refund and account protection."7) "My account was compromised; password reset didn't prevent new charges."8) "Dispute rejected unfairly; evidence wasn't reviewed."9) "I need a written investigation outcome and timeline."10) "Escalate to fraud team; this is urgent."

Table S3c. Targeted manual review of texts assigned to the HDBSCAN noise class

Review category	n	% of reviewed noise sample	Interpretation
Weak fit to existing topics	94	47.0	Complaints plausibly related to an existing topic but too ambiguous or low-confidence for stable assignment
Mixed / nonspecific / insufficient detail	73	36.5	Multiple issues combined, highly generic narratives, or texts lacking enough detail for interpretable clustering

Review category	n	% of reviewed noise sample	Interpretation
Residual spam / boilerplate / off-topic	19	9.5	Low-information, formulaic, or non-substantive texts not suitable for topic interpretation
Potential omitted emerging-risk candidates (isolated / nonrecurring)	14	7.0	Individually notable cases reviewed for recurrence, but not forming a coherent omitted topic
Total reviewed	200	100.0	

Note. As an additional coverage check, a random sample of 200 texts from the HDBSCAN noise class was manually reviewed after the main BERTopic solution had been finalized. The aim was to assess whether the noise cluster contained a coherent omitted emerging-risk category not represented in the retained 35-topic solution. Most reviewed texts were weak fits to existing topics, mixed-issue or low-specificity complaints, or residual non-substantive entries. Although a small number of texts were flagged as possible emerging-risk candidates, these cases were isolated and did not recur in a sufficiently coherent pattern to justify an additional topic. This pattern is consistent with the broader robustness evidence reported in Table S1 and the topic-coverage documentation reported in Tables S2a–S3b.

Table S3d. Condensed codebook for topic-to-macro-theme assignment

Panel A. Macro-theme assignment rules

Macro-theme	Core decision rule for assignment	Included topic IDs
Fulfillment Disruptions	Assign here when the focal complaint concerns delivery execution, shipment control, courier handling, or parcel movement, including delay, loss, damage, misdelivery, or logistics breakdown before remedy processing becomes the main issue.	T1-T8
Remediation Frictions	Assign here when the focal complaint concerns refunds, returns, reversals, credits, denials, or fee-related recovery processes after the transaction problem has already been recognized and a remedy pathway exists.	T9-T16
Product Integrity Risks	Assign here when the focal complaint concerns authenticity, listing accuracy, specification mismatch, seller misrepresentation, or information asymmetry at or before purchase/receipt.	T17-T23
Escalation Failures	Assign here when the focal complaint concerns blocked access to review, ineffective customer support, failed handoff, unresolved ticket loops, inconsistent case handling, or inability to obtain substantive reconsideration.	T24-T29
Governance Threats	Assign here when the focal complaint concerns platform-level safeguards, security, fraud prevention, privacy, consent, account integrity, or manipulative interface design, rather than resolution of a single transaction alone.	T30-T35

Note. The five macro-themes and their constituent topic ranges follow the main manuscript's topic architecture: Fulfillment Disruptions (T1-T8), Remediation Frictions (T9-T16), Product Integrity Risks (T17-T23), Escalation Failures (T24-T29), and Governance Threats (T30-T35).

Panel B. Boundary conditions for adjacent or potentially confusing categories

Boundary pair	Use this rule
Fulfillment Disruptions vs. Remediation Frictions	Code as Fulfillment Disruptions when the complaint is mainly about whether the item arrives correctly and on time. Code as Remediation Frictions when the complaint is mainly about what happens after the failure is acknowledged, especially refund, return, reversal, or fee processing.
Remediation Frictions vs. Escalation Failures	Code as Remediation Frictions when a remedy channel exists but is slow, burdensome, denied, or opaque. Code as Escalation Failures when the problem is that the user cannot reach meaningful review, cannot move beyond first-line support, or is trapped in repetitive case handling.
Escalation Failures vs. Governance Threats	Code as Escalation Failures when the grievance concerns procedural access to resolution for a particular case. Code as Governance Threats when the grievance concerns the platform's broader safeguard system, including security, fraud exposure, privacy, consent, or deceptive interface practices.
Product Integrity Risks vs. Governance Threats	Code as Product Integrity Risks when the complaint is about the item or listing itself (e.g., counterfeit, mismatch, misleading product information). Code as Governance Threats when the complaint centers on platform-level trust safeguards rather than product representation alone.
Product Integrity Risks vs. Remediation Frictions	Code as Product Integrity Risks when the initiating grievance is what was sold or represented. Code as Remediation Frictions when the focal complaint has shifted to refund/return processing after that defect or mismatch is already established.

Note. In condensed form, remediation concerns the execution of recovery, escalation concerns procedural access to review, and governance concerns the integrity of the broader platform environment. This distinction is consistent with the manuscript's conceptual framing of post-failure response, procedural justice, and institutional trust.

Panel C. Topic-level mapping with short assignment rationale

Topic ID	Final label	Macro-theme	Short rationale for assignment
T1	Delivery delays	Fulfillment Disruptions	Delivery execution failure
T2	Missed slots	Fulfillment Disruptions	Delivery timing failure
T3	Tracking failures	Fulfillment Disruptions	Shipment visibility/control failure
T4	Lost parcels	Fulfillment Disruptions	Parcel loss in logistics chain
T5	Wrong/partial delivery	Fulfillment Disruptions	Misdelivery / incomplete fulfillment
T6	Damaged package on arrival	Fulfillment Disruptions	Physical delivery condition failure
T7	Courier conduct complaints	Fulfillment Disruptions	Courier-side execution problem
T8	International shipping/customs issues	Fulfillment Disruptions	Cross-border delivery/logistics disruption
T9	Refund pending	Remediation Frictions	Delayed monetary recovery
T10	Partial refund disputes	Remediation Frictions	Incomplete monetary remediation
T11	Chargeback guidance and reversals	Remediation Frictions	Recovery via reversal/dispute workflow

Topic ID	Final label	Macro-theme	Short rationale for assignment
T12	Return pickup and label issues	Remediation Frictions	Return-process friction
T13	Return denied	Remediation Frictions	Refused recovery pathway
T14	Restocking and hidden fees	Remediation Frictions	Fee burden in recovery process
T15	Wallet or store credit blocks	Remediation Frictions	Restricted non-cash remediation
T16	Promotional refund and points disputes	Remediation Frictions	Recovery dispute involving credits/points
T17	Counterfeit/inauthentic goods	Product Integrity Risks	Authenticity uncertainty
T18	Used item sold as new	Product Integrity Risks	Product-condition misrepresentation
T19	Listing-photo mismatch	Product Integrity Risks	Listing representation mismatch
T20	Specification mismatch	Product Integrity Risks	Product-information mismatch
T21	Wrong variant/size/color	Product Integrity Risks	Variant mismatch
T22	Seller misrepresentation and bait listings	Product Integrity Risks	Seller/listing deception
T23	Warranty eligibility disputes at purchase stage	Product Integrity Risks	Purchase-stage assurance mismatch
T24	Chatbot loop and scripted replies	Escalation Failures	Automated support blocks substantive review
T25	Human agent unreachable	Escalation Failures	No meaningful access to human review
T26	Escalation failure and handoff barriers	Escalation Failures	Blocked transfer/escalation path
T27	Ticket auto-closure without review	Escalation Failures	Procedural closure without substantive hearing
T28	Slow response and backlog	Escalation Failures	Support queue blocks timely review
T29	Inconsistent resolutions across contacts	Escalation Failures	Procedural inconsistency across case handling
T30	Unauthorized transactions	Governance Threats	Platform/payment security safeguard risk
T31	Account takeover and lockouts	Governance Threats	Account integrity and recovery risk
T32	OTP and verification failures	Governance Threats	Verification/control system failure
T33	Phishing and social engineering incidents	Governance Threats	Fraud exposure tied to safeguard weakness
T34	Privacy consent and data sharing concerns	Governance Threats	Data governance / consent risk
T35	Dark patterns and subscription traps	Governance Threats	Manipulative interface and rule-design risk

Panel D. Sampling logic for the 10 representative complaints

Item	Procedure
Sampling pool	Only texts with high-confidence topic assignment were eligible for exemplar selection.
Number per topic	10 representative complaints were retained for each topic.
Selection basis	Exemplars were selected from texts most clearly associated with the topic, using the topic-assignment output and coder review for interpretive fit.
Purpose	The exemplars were used to support human validation, topic labeling, and interpretive transparency.
Reporting	Full representative complaints are reported in Table S3b.

Note. The manuscript already states that two independent coders labeled topics using top c-TF-IDF terms and 10 representative complaints per topic sampled from high-confidence assignments, following a shared codebook with boundary conditions; inter-coder agreement for topic labeling was Cohen's $\kappa = 0.81$.

Additional note on macro-theme validation. After topic labeling, the macro-theme grouping was reviewed through coder-guided adjudication using the assignment rules and boundary conditions reported in this table. Because this step was finalized by consensus rather than conducted as a separate independent coding round, a distinct macro-theme-level agreement statistic was not computed.

Table S4. Bilingual automation-marker dictionary used for triangulation.

Category	Turkish markers (examples)	English markers (examples)
Chatbot / bot mediation	chatbot; bot; robot; "robota bağlıyor"; "chatbot döngüsü"	chatbot; chat bot; bot
Scripted / templated replies	otomatik yanıt; hazır cevap; standart yanıt; şablon cevap; "kopyala-yapıştır"	automated reply; auto reply; templated reply; template reply; scripted response; canned response
Blocked access to human agent	canlı destek yok; müşteri temsilcisine bağlanmıyor/bağlanamıyorum; "insana bağlan"	can't reach agent; cannot reach agent; no human agent; reach a human
Ticket auto-closure / routing barriers	talep kapatıldı; otomatik kapandı; kayıt kapatıldı; IVR; sesli yanıt	ticket auto-closed; auto-closed; IVR
Escalation / handoff blockage	aktarılmıyor; yönlendirmiyor; "üst birime iletmiyor"; "yetkiliye bağlamıyor"	blocked handoff; no escalation; handoff to human

Note. Texts are flagged if they contain ≥1 marker after case-insensitive matching on normalized text. The dictionary can be expanded with spelling variants as needed.

Table S5. Monthly prevalence of automation markers around 2023-02.

Month	Full corpus N	Full corpus flagged n	Full corpus share (%)	Escalation Failures N	Escalation Failures flagged n	Escalation Failures share (%)

2022-08	1850	74	4.0	210	16	7.4
2022-09	1920	90	4.7	220	18	8.3
2022-10	2050	105	5.1	230	21	9.0
2022-11	2100	111	5.3	240	23	9.4
2022-12	2250	128	5.7	250	25	10.0
2023-01	2180	140	6.4	245	33	13.5
2023-02	2200	172	7.8	255	31	12.0
2023-03	2300	120	5.2	260	35	13.5
2023-04	2150	174	8.1	250	37	14.8
2023-05	2280	192	8.4	265	41	15.4
2023-06	2400	216	9.0	270	43	15.9
2023-07	2350	214	9.1	260	45	17.2

Note. Shares are computed as flagged n / N × 100. The window shown matches the six months before and after 2023-02 used in the main analysis.

Table S6. Pre–post tests for automation-marker prevalence (six-month windows).

Sample	Pre mean monthly share (%)	Post mean monthly share (%)	Δ (pp)	Mann–Whitney p	Cliff's δ
Full corpus	5.2	7.9	+2.7	0.015	0.83
Escalation Failures only	9.6	14.8	+5.2	0.010	0.92

Note. Two-sided Mann–Whitney tests are applied to monthly shares (n = 6 months per period). Positive Cliff's δ indicates higher post-period prevalence.

Table S7. Source-type decomposition of major temporal shifts

Macro-theme	Main breakpoint used	Pooled direction	Complaint portal pre (%)	Complaint portal post (%)	Δ portal (pp)	Portal p	Portal Cliff's δ	App-store pre (%)	App-store post (%)	Δ app-store (pp)	App-store p	App-store Cliff's δ	Directional consistency
Fulfillment Disruptions	2020-04	Up	15.90	19.80	+3.90	0.004	0.83	13.20	15.80	+2.60	0.031	0.61	Same
Product Integrity Risks	2020-04	Down	25.10	22.50	-2.60	0.002	-0.79	22.80	21.60	-1.20	0.048	-0.54	Same
Governance Threats	2022-06	Up	22.40	23.40	+1.00	0.041	0.56	23.50	25.70	+2.20	0.006	0.74	Same
Escalation Failures	2023-02	Up	9.70	11.50	+1.80	0.018	0.67	11.30	14.80	+3.50	0.002	0.86	Same

Table S8. Temporal sensitivity checks for macro-theme turning points

Macro-theme	Main breakpoint	Main reporting window	Main direction	4-month window direction	4-month p	4-month Cliff's δ	8-month window direction	8-month p	8-month Cliff's δ	Dependence-aware monthly comparison	Overall conclusion
Fulfillment Disruptions	2020-04	6-month pre/post	Up	Up	0.021	0.67	Up	0.004	0.72	Consistent	Robust
Remediation Frictions	2021-12	6-month pre/post	Down	Down	0.083	-0.41	Down	0.027	-0.55	Partially consistent	Broadly robust
Product Integrity Risks	2020-04	6-month pre/post	Down	Down	0.002	-0.81	Down	<0.001	-0.85	Consistent	Robust
Escalation Failures	2023-02	6-month pre/post	Up	Up	0.003	0.86	Up	<0.001	0.90	Consistent	Robust
Governance Threats	2022-06	6-month pre/post	Up	Up	0.028	0.61	Up	0.006	0.70	Consistent	Robust

Note. Main turning points are based on six-month pre/post windows around the PELT break month. Alternative four-month and eight-month windows and a dependence-aware monthly comparison yielded the same main directional conclusions. The strongest shifts were robust across specifications, whereas the decline in Remediation Frictions was somewhat more sensitive and is interpreted more cautiously.

Table S9. Full multinomial regression reporting for platform comparisons

Outcome category (ref. = Fulfillment Disruptions)	Contrast	RRR	95% CI	p	Effect-size interpretation
Remediation Frictions	Marketplace B vs Marketplace A	1.43	[1.34, 1.53]	<.001	Moderate relative concentration on Marketplace B
Remediation Frictions	Marketplace C vs Marketplace A	1.21	[1.13, 1.30]	<.001	Slight-to-moderate relative concentration on Marketplace C
Remediation Frictions	Marketplace C vs Marketplace B	0.85	[0.79, 0.92]	<.001	Lower relative concentration on Marketplace C than Marketplace B
Product Integrity Risks	Marketplace B vs Marketplace A	1.07	[1.00, 1.15]	.063	Very small difference; not substantively emphasized
Product Integrity Risks	Marketplace C vs Marketplace A	1.47	[1.37, 1.58]	<.001	Substantially larger relative concentration on Marketplace C
Product Integrity Risks	Marketplace C vs Marketplace B	1.38	[1.29, 1.48]	<.001	Larger relative concentration on Marketplace C than Marketplace B
Escalation Failures	Marketplace B vs Marketplace A	0.90	[0.85, 0.96]	.002	Lower relative concentration on Marketplace B than Marketplace A
Escalation Failures	Marketplace C vs Marketplace A	0.74	[0.69, 0.80]	<.001	Much lower relative concentration on Marketplace C than Marketplace A
Escalation Failures	Marketplace C vs Marketplace B	0.82	[0.76, 0.89]	<.001	Lower relative concentration on Marketplace C than Marketplace B
Governance Threats	Marketplace B vs Marketplace A	1.10	[1.03, 1.18]	.006	Modest relative concentration on Marketplace B
Governance Threats	Marketplace C vs Marketplace A	1.41	[1.31, 1.52]	<.001	Clear relative concentration on Marketplace C
Governance Threats	Marketplace C vs Marketplace B	1.28	[1.20, 1.37]	<.001	Larger relative concentration on Marketplace C than Marketplace B

Note. Outcome variable: modal macro-theme assignment. Reference outcome: Fulfillment Disruptions, selected because it is the most prevalent macro-theme and provides a substantively meaningful baseline for comparing the relative concentration of the other complaint domains. Reference platform: Marketplace A. Marketplace A = Trendyol, Marketplace B = Hepsiburada, Marketplace C = Amazon Turkey. The focal predictor is marketplace. Controls include month fixed effects and language controls. Estimates are reported as relative risk ratios (RRRs) with robust standard errors and 95% confidence intervals.

Joint Wald test of platform effects: $\chi^2(8) = 214.60$, $p < .001$, N: 87,479, Pseudo R^2: 0.031