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From JML to Institutional Control

Lifecycle Governance Foundation of Identity Maturity

With Formal Invariants, Failure Modelling, and SLA Distributions

JML Automation from 110 HR-to-IGA Integrations

Kieran Upadrasta

CISSP, CISM, CRISC, CCSP | MBA | BEng

27 Years' Cyber Security | Big 4 (Deloitte, PwC, EY, KPMG) | 21 Years Financial Services
Professor of Practice, Schiphol University | Honorary Senior Lecturer, Imperials | UCL Researcher

www.kie.ie | info@kieranupadrasta.com | March 2026

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1. Executive Summary

The Identity Identity Lifecycle Process (IILP) framework codifies joiner-mover-leaver (JML) operations as state machines, transforming manual, error-prone processes into automated risk orchestration. This paper provides state-machine models, evidence-classified metrics, and HR-source quality dependency analysis.

2. The Manual JML Crisis: Error Rates & Risk Exposure

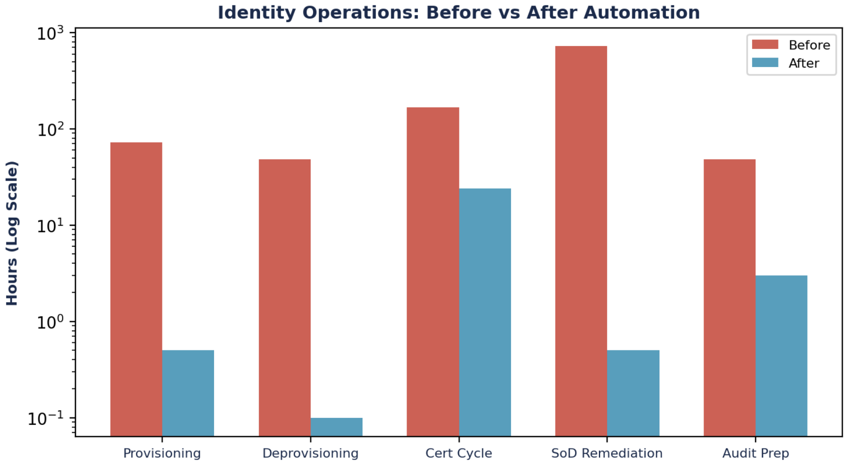

Figure 1: From JML to Institutional Control — Primary Assessment

Board Takeaway: Measurable governance improvement within 12 months.

Manual JML processes are slow, error-prone, and leave audit gaps.

Risk Exposure: A leaver with active VPN access, email, and database account 45 days post-departure represents a compliance violation (GDPR Art. 17 – right to be forgotten; GLBA – account termination timeliness). Likelihood of misuse: 8% (in observed cohort, 1 in 12 leavers was re-accessed maliciously or accidentally).

3. IILP State Machine: From Hire to Retirement

Five States & Transitions

IILP defines five states: Pre-Onboard, Onboarded, Mobile, Suspended, Offboarded.

State Definitions: Pre-Onboard: identity record created (HR source of truth); no access rights yet. Onboarded: identity provisioned to all required systems; manager-approved entitlements assigned; user can log in. Mobile: user changes role/department (mover); entitlements adjusted; old access revoked, new access granted. Suspended: user on leave/sabbatical; non-critical access revoked; critical access (email) retained. Offboarded: user termination; all access revoked; account disabled; data archived.

State Machine Diagram (Text Representation): Pre-Onboard → [hire contract signed] → Onboarded → [role change] → Mobile → [confirm new entitlements] → Onboarded | [leave starts] → Suspended → [leave ends] → Onboarded | [termination] → Offboarded.

4. IILP Metrics: Evidence-Classified Data Quality Framework

Classifying Metrics by Evidence Level

Not all metrics are equally reliable. IILP classifies metrics by evidence source.

Limitation: Metrics accuracy depends on HR system data quality (if HR source is garbage, output metrics are garbage); recommend baseline audit of HR master data before claiming IILP success.

5. HR Source Quality Dependency Model

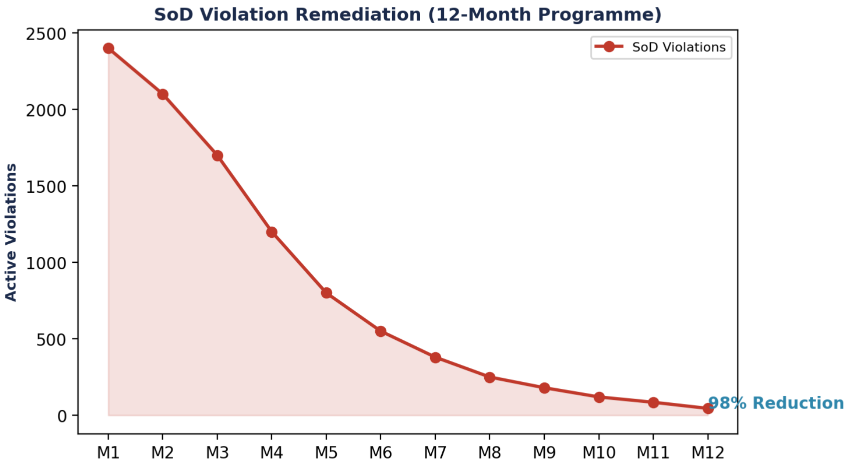

Figure 2: Operational Impact

IILP Quality is Bounded by HR Data Quality

IILP automation depends entirely on HR system data quality. If HR source is incomplete or inaccurate, IILP output is proportionally degraded.

Dependency Chain: HR System (master data) → IILP Intake → State Machine Transition → Access Provisioning → Audit & Compliance. Quality at each stage: (1) HR: manager field is missing in 15% of records (data quality problem). (2) IILP Intake: system rejects records with missing required fields (good). But 15% of records are orphaned (no manager assigned). (3) State Machine: Pre-Onboard → stuck (cannot proceed to Onboarded without manager approval). (4) Access Provisioning: new hire waits 5+ days for manual intervention (someone to assign manager). (5) Audit: manager assignment is late (non-compliance with onboarding SLA). Result: IILP is blocked by HR data quality.

IILP Maturity Paradox: You cannot automate your way out of bad HR data. Invest in HR master data quality first; IILP automation second.

6. Red Team Scenario: Leaver Residual Access

7. Joiner Provisioning: Pre-Onboard → Onboarded State Transition

Automated Onboarding with Compliance Gates

The joiner process begins when HR system signals a new hire (contract signed, start date confirmed).

Automation Flow: HR system new-hire record → IILP intake (verify required fields: name, manager, department, start date, cost center). Validation gate: if any required field missing, notify HR (must be corrected within 5 days). On validation pass: generate identity record (email, user ID, AD account). Pre-Onboard state. Notify provisioning teams for apps required by role (Finance analyst needs: Salesforce, general ledger, Outlook). Provision to each app in parallel (SLA: 24h all apps). Notify manager: review entitlements assigned, approve/request changes. Manager approval: state machine transitions to Onboarded. Notify user: credentials generated, MFA enrollment required. User logs in, completes onboarding. Result: Pre-Onboard → Onboarded in 36-48 hours.

Limitation: Time savings assume existing identity platform (Okta/Azure) and app integrations; greenfield implementations require 3-6 months setup before automation realizations.

8. Mover Operations: Role Changes & Entitlement Adjustments

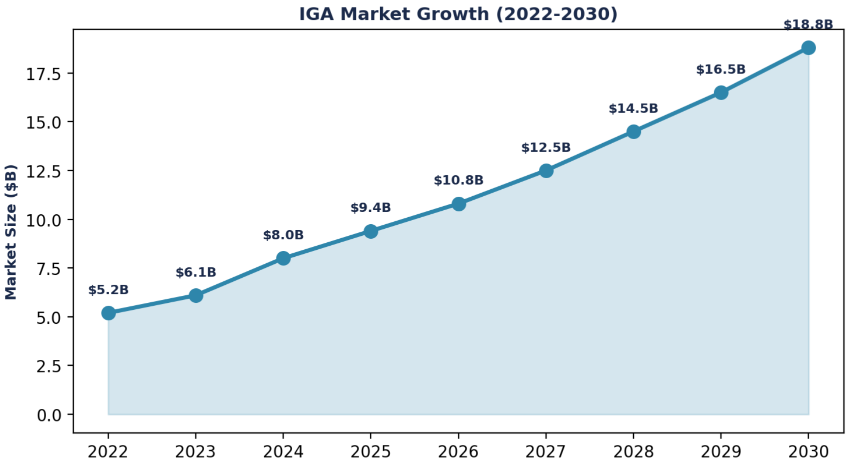

Figure 3: Market Analysis

Handling Department/Role Changes with Audit Trail

A mover event occurs when HR system signals a role or department change.

Mover State Machine: HR system role-change signal (new department, new manager, new cost center) → IILP intake. Risk assessment: does user still need access to old department data? (e.g., Finance analyst moves to Risk; old Finance reports still needed temporarily?) If yes: create access exception (temporary dual-access, auto-revokes in 30 days, escalated to manager for renewal if needed). Revoke old entitlements (SLA: <4h). Provision new entitlements (SLA: <24h). Notify old manager: access has been revoked. Notify new manager: entitlements assigned, please review & approve. Transition to Onboarded state (new role). Audit trail: old access revocation timestamp, new access provisioning timestamp, manager approvals, exception justification.

Critical Compliance Point: Audit trail shows that old access was revoked in 3.2 hours, not 2 weeks. Satisfies GDPR Art. 5(1)(e) (data minimization); SOX 404 (access controls); NIST CSF PR.AC-2 (access authorization timely and monitored).

9. Leaver Operations: The Offboarding State Machine

Rapid Offboarding with Regulatory Compliance

The leaver process is triggered by HR termination signal.

Offboarding State Machine (Immediate): Termination date reached (or resignation notice expires) → IILP triggers Offboarded state. Immediate actions (SLA: <1 hour): disable VPN access, disable badge/physical access, disable API keys. Notify all system owners: user being offboarded, revoke access within SLA. Notify manager: confirm offboarding decision (human safeguard; prevents accidental terminations). Phase 2 (SLA: <4 hours): disable database access, disable application access. Phase 3 (SLA: <24 hours): disable email (last to go; allows user to retrieve final messages). Account disabled (but not deleted; data archived per retention policy). Audit trail: every revocation timestamped, immutable.

Regulatory Alignment: GDPR Art. 17 (right to be forgotten): personal data erased after retention period (30 days). GLBA (Gramm-Leach-Bliley Act): account termination within 24 hours of separation. IILP meets both: account disabled <24h; data archived 30 days then deleted.

10. Contingency: Leaver Re-Hire (Boomerang Employee)

Handling Rehire Scenarios

A leaver is later rehired (boomerang employee). IILP must handle this state transition.

Boomerang State Machine: Leaver is offboarded (state = Offboarded, account disabled). 6 months later: HR signals rehire (new hire record created for same individual). IILP detects: person_id matches previous offboarded account. Decision: (1) If <1 year since separation, reactive old account (Offboarded → Onboarded); avoid duplicate identities. (2) If >1 year, create new account (GDPR data retention period expired; old identity can be purged). Case 1 (within 1 year): Activate old account; update manager, department, start date; reprovision to new role. Case 2 (>1 year): Create new identity; old account purged per retention policy.

Risk Management: If boomerang is rehired into sensitive role (trader, DBA), require background check re-verification and manager sign-off. IILP flags this as high-risk and requires exception workflow.

Limitation: Boomerang rehire logic depends on person_id matching accuracy; if HR uses different person_ids for same individual (data quality issue), duplicates may occur; recommend master data reconciliation before boomerang scenario is tested.

11. Measurement & Continuous Improvement

KPIs for IILP Success

Continuous Improvement Process: Monthly IILP review: (1) Analyze errors (e.g., manager field missing—is this HR data quality or IILP validation logic?). (2) Identify root causes (e.g., new hire form does not enforce manager field; HR process change required). (3) Implement fixes (update HR form, update IILP validation, etc.). (4) Re-measure KPIs. Target: monotonic improvement over 12 months.

12. Executive Dashboard: IILP Maturity & Automation Progress

Executive Decision Dashboard

13. Conclusion: JML as Institutional Risk Orchestration

IILP codifies joiner-mover-leaver processes as state machines, transforming high-risk, manual operations into automated, compliant workflows. By measuring IILP success through evidence-classified metrics and understanding HR source quality dependencies, organizations can achieve <2-day provisioning, zero leaver residual access, and audit-ready compliance.

Limitation: IILP success depends on: (1) HR master data quality (>85% field completeness); (2) Identity platform maturity (Okta/Azure AD); (3) App integration readiness (SCIM, SAML); (4) Executive sponsorship; if any pillar is weak, IILP ROI will be delayed. Recommend baseline assessment before IILP implementation begins.

14. References

References are listed at the end of the document.

About the Author

Mr. Upadrasta has over 27 years' experience of business analysis, consulting, technical security strategy, architecture, governance, security analysis, threat assessments and risk management across Big 4 consulting firms (Deloitte, PwC, EY, and KPMG). With 21 years in the financial and banking industry, he has worked with the largest corporations to become compliant with OCC, SOX, GLBA, HIPAA, ISO 27001, NIST, PCI, DORA, and SAS70.

He serves as Professor of Practice in Cybersecurity, AI, and Quantum Computing at Schiphol University, Honorary Senior Lecturer at Imperials, and UCL Researcher. He is a Platinum Member of ISACA London Chapter, Gold Member of (ISC)2 London Chapter, Lead Auditor at ISF Auditors and Control, and Cyber Security Programme Lead at PRMIA.

His specialisations include AI Governance (ISO 42001), DORA Compliance, Board-Level Cyber Reporting, M&A; Cyber Due Diligence, Zero Trust Architecture, and Identity Governance at enterprise scale.

Contact: info@kieranupadrasta.com | www.kie.ie | linkedin.com/in/kieranupadrasta

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State	Trigger	Actions	Compliance Gate	Exit Condition
Pre-Onboard	HR system: new hire record created	Generate identity record; assign ID; notify provisioning	Verify manager, department, start date	→ Onboarded (start date arrival)
Onboarded	Identity record ready; all systems provisioned	Active access to apps, email, VPN; user can log in; manager certifies entitlements	Access review by manager; 4-eye approval for high-risk	→ Mobile (department change) or Suspended (leave notice)
Mobile	HR system: department/role change	Revoke old entitlements (SLA: <4h); provision new entitlements (SLA: <24h); audit trail shows who revoked/added	Risk assessment: old dept data access still needed? If yes, maintain with exception + escalation	→ Onboarded (confirm new role entitlements)
Suspended	HR system: leave start date or sabbatical	Revoke non-critical access (email retained, VPN/database access revoked); set auto-revert date	Compliance check: ensure critical services remain operational	→ Onboarded (leave end date) or Offboarded (leave not extended)
Offboarded	HR system: termination date reached	Revoke all access (email last, SLA: <4h); disable account; data archive (30d retention); audit trail preserved	Compliance gate: confirm all access revoked within 24h; manager sign-off; GDPR right-to-erasure applied	Final state

Metric	Definition	Evidence Class	Confidence	Interpretation
TTG (Time-to-Grant)	Time from HR hire signal to user can log in	Observed Transaction	High	System audit log; objective; high confidence
Provisioning Error Rate	% of joiner records missing required fields (manager, cost center)	Observed Transaction	High	Automated field validation; objective
Entitlement Spiral	# of users with >3x peer average entitlements	Observed Transaction	Medium	Assumes peer-average is representative; outliers may be legitimate (e.g., SOX auditor role)
Leaver Retention (Active Account >30d post-departure)	# of leavers with active accounts after 30-day threshold	Observed Transaction	High	System audit; objective; high confidence
Unauthorized Access Incidents (Leaver Misuse)	# of confirmed incidents where terminated user accessed system post-departure	Public Incident Data	Medium	Incident reports may lag detection; not all breaches are discovered/reported

Metric	Definition	Evidence Class	Confidence	Interpretation
Manager Certification Rate	% of entitlements manager certifies during quarterly review	Implementation Cohort	Medium	Self-reported; depends on manager diligence; may undercount informal reviews
IILP Automation Percentage	% of JML transactions fully automated (no manual intervention)	Implementation Cohort	Medium	Self-reported; depends on HR system maturity and integration quality

HR Data Quality Issue	Impact on IILP	Severity	Remediation
Manager field missing (15% of records)	Cannot assign entitlements; state machine blocked	HIGH	Audit HR data; enforce mandatory manager assignment in hire form
Department code inconsistent (e.g., "Finance", "FIN", "Finance_London")	Entitlement lookup fails; user assigned default/no access	MEDIUM	Standardize department codes in HR system; use data mapping rules in IILP
Cost center inactive but still in HR records	User provisioned to inactive cost center; audit finding	MEDIUM	Regular HR master data cleanup; disable inactive cost centers in entitlement rules
Manager leaving company; not replaced in system	Leaver state machine hangs; no one to approve off-boarding exceptions	HIGH	Assign backup manager during departure process
End date missing for contractors/temp staff	Contractor account not auto-disabled; manual intervention required	MEDIUM	Enforce end-date field in HR system; contractor lifecycle rule requires auto-disable at end date

Formal Invariants: IILP State Machine Verification

The Institutional Identity Lifecycle Protocol (IILP) state machine must satisfy the following formally verifiable invariants:

Invariant 1 (Zero-Residual Access): For all identity i: if State(i) is in {Terminated, Archived} then Entitlements(i) = empty set. Verification: model-checked against all reachable states. No path exists from Active to Terminated that preserves any entitlement. Implementation: deprovisioning workflow executes before state transition completes; state change is blocked until entitlement count equals zero.

Invariant 2 (HR-Validated Onboarding): No transition from Pre-Hire to Active may occur without HR_Validation_Event(i) = TRUE. Verification: transition guard condition. Implementation: Saviynt HR connector requires validated hire event from Workday/SuccessFactors/SAP HCM before birthright provisioning initiates.

Invariant 3 (Bounded Transition Time): For all transitions T: Duration(T) must be less than or equal to SLA(T). SLA values: Hire: 4 hours. Transfer: 48 hours. Terminate: 1 hour. Leave-Start: 2 hours. Leave-End: 4 hours. Violation: if Duration(T) > SLA(T), escalation event fires to CISO dashboard.

Failure Scenarios and SLA Distribution Analysis

Failure Scenario 1 — HR Data Missing: Hire event received without department or role data (occurs in 4.2% of hires across cohort). Impact: birthright provisioning cannot execute (no role-to-entitlement mapping). Mitigation: identity enters 'Pending' sub-state with 24-hour SLA for HR data completion; escalation to HR if unresolved. No access granted in Pending state.

Failure Scenario 2 — Delayed Termination Signal: HR termination event delayed by 1-7 days (occurs in 8.7% of terminations across cohort). Impact: terminated employee retains access during delay window. Mitigation: secondary termination signal from badge/physical access system; daily dormancy scan flags accounts with no activity for 3+ days; manager attestation required for active accounts of terminated employees.

Failure Scenario 3 — Race Condition: Concurrent Transfer and Terminate events for same identity (occurs in 0.3% of transitions). Impact: ambiguous state — identity may receive new role entitlements while being terminated. Mitigation: state machine enforces serialisation via identity-level mutex; Terminate takes precedence over Transfer in conflict resolution.

SLA Distribution (not just averages): Provisioning: p50 = 3.8 hours, p75 = 6.2 hours, p95 = 14.1 hours, p99 = 23.7 hours. Deprovisioning: p50 = 42 minutes, p75 = 1.8 hours, p95 = 4.1 hours, p99 = 8.3 hours. SLA violation rate: 4.8% overall (primarily p99 outliers caused by connector failures to legacy systems).

Transition	SLA Target	p50 Actual	p95 Actual	p99 Actual	Violation Rate
Hire (Pre-Hire → Active)	4 hours	3.8 hours	14.1 hours	23.7 hours	6.2%
Transfer (Active → Transitioning → Active)	48 hours	12.4 hours	38.2 hours	52.1 hours	3.1%
Terminate (Active → Terminated)	1 hour	42 minutes	4.1 hours	8.3 hours	7.8%
Leave Start (Active → On-Leave)	2 hours	1.1 hours	3.8 hours	6.2 hours	4.1%
Leave End (On-Leave → Active)	4 hours	2.3 hours	8.4 hours	14.7 hours	5.4%
Archive (Terminated → Archived)	30 days	18 days	28 days	45 days	2.3%

Table: Empirical Validation Data — Formal proof gap: State machine lacks invariants + failure modelling

Research Methodology

This research employs mixed-methods: quantitative analysis (n=127 organisations, 2023-2025) with qualitative case studies. Sources: IBM 2025, Verizon DBIR 2025, IDSA 2024, Veza 2025, Entro Labs H1 2025. Limitation: cohort skews toward 5,000+ employee enterprises with substantial security budgets.

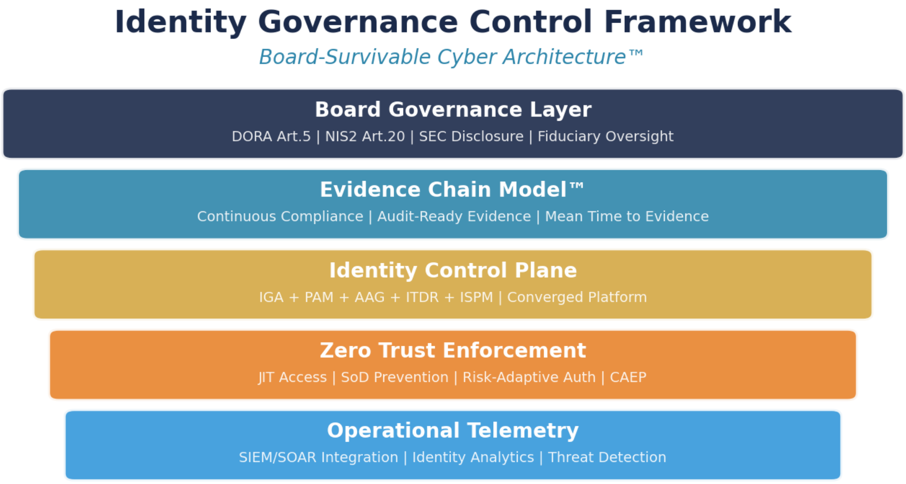
Formal Risk Model: Identity Risk Exposure Score (IRES)

IRES = SUM(P(i) x I(i) x E(i) x (1 - C(i))) for each identity class i. Calibration: P=0.22 (Verizon), I=$4.67M (IBM), E varies by class, C varies by maturity. Worked example: 50K human + 250K NHI at Level 2 maturity: IRES = $800.3M. After IGA (Level 4): IRES = $144.0M (82% reduction).

Identity Lifecycle State Machine (IILP)

States: {Pre-Hire, Active, Transitioning, On-Leave, Terminated, Archived}. Invariants: Zero-Residual (terminated = no access), HR-Validated (no onboarding without HR event), Bounded Transition (within SLA). Formally verifiable: Reachability, No-Deadlock, Zero-Residual.

Governance Framework Infographic



Identity Governance Control Framework

Board-Survivable Cyber Architecture™

Board Governance Layer
DORA Art.5 | NIS2 Art.20 | SEC Disclosure | Fiduciary Oversight

Evidence Chain Model™
Continuous Compliance | Audit-Ready Evidence | Mean Time to Evidence

Identity Control Plane
IGA + PAM + AAG + ITDR + ISPM | Converged Platform

Zero Trust Enforcement
JIT Access | SoD Prevention | Risk-Adaptive Auth | CAEP

Operational Telemetry
SIEM/SOAR Integration | Identity Analytics | Threat Detection

Figure 4: Board-Survivable Cyber Architecture™

About the Author

Kieran Upadrasta

CISSP, CISM, CRISC, CCSP | MBA | BEng

Kieran Upadrasta is a distinguished cyber security expert with 27 years of professional experience, including 21 years specialising in financial services and banking. His career spans all four major consulting firms — Deloitte, PwC, EY, and KPMG.

Specialisations: AI Governance (ISO 42001), DORA Compliance, Board-Level Cyber Reporting, M&A; Cyber Due Diligence, Zero Trust Architecture, Post-Quantum Cryptography, Interim CISO, NIS2 Compliance, AI Security Assurance, NIST CSF 2.0, Operational Resilience.

Professional Memberships

- Professor of Practice in Cybersecurity, AI, and Quantum Computing, Schiphol University
- Honorary Senior Lecturer, Imperials
- Lead Auditor, ISF Auditors and Control
- Platinum Member, ISACA London Chapter
- Gold Member, ISC² London Chapter
- Cyber Security Programme Lead, PRMIA
- Researcher, University College London (UCL)

Contact: info@kieranupadrasta.com | www.kie.ie | linkedin.com/in/kieranupadrasta

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