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Cross-Departmental Alignment Frameworks during Major Expansion Projects: A Strategic Review of Operations and Project Interface Management in Brownfield Liquefaction Expansions

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ABSTRACT: A brownfield expansion places two organisations on one site with incompatible success criteria. The operating organisation is accountable for uptime, containment and the safety of a running facility, and is rewarded for stability. The project organisation is accountable for schedule and cost against a defined scope, and is rewarded for progress. Both are behaving correctly and their objectives conflict at every point of contact. This review examines the alignment mechanisms available and argues that the problem is one of organisational design rather than of cooperation, so that interventions directed at relationships and communication address a symptom. It draws on the classical differentiation and integration literature, which established that organisational subunits facing different environments necessarily develop different orientations and that integration must therefore be engineered rather than assumed; on the information processing view of organisation design, which supplies the vocabulary for choosing among integrating mechanisms; and on the megaproject literature, which documents the performance record and the recurring failure patterns. Four positions are developed. First, the interface is a design variable and the range of available mechanisms is wider than the liaison roles and coordination meetings that constitute standard practice. Second, the mechanism should be selected against the volume and uncertainty of the information the interface must carry, and standard practice systematically under-provides for high-uncertainty interfaces such as tie-in execution. Third, the safety consequence of interface failure is asymmetric, falling predominantly on the operating facility, which means the operating organisation should hold the authority at contested points. Fourth, the measurement of interface performance is almost entirely absent from practice and its available measures are cheap.

KEYWORDS: interface management, brownfield expansion, organisational integration, megaprojects, simultaneous operations, project-operations interface, tie-ins, liquefaction, organisation design

1. INTRODUCTION

The expansion of an operating liquefaction facility places a construction organisation of several thousand people onto a site that is producing, with the two sharing access routes, utilities, laydown, permitting capacity and eventually the plant itself at the points where new facilities connect to old. The connection points are the tie-ins, and they are where the two organisations meet at the level of the pipe.

The relationship is ordinarily described as requiring cooperation and is ordinarily managed by liaison roles and coordination meetings. This paper argues that the framing is inadequate and that the resulting mechanisms are under-specified for the load they carry.

The inadequacy begins with the diagnosis. The two organisations are not failing to cooperate; they are pursuing objectives that genuinely conflict. A project measured on schedule and a facility measured on uptime will disagree about whether a tie-in outage happens in March or June, and both positions are correct within their own accountability. Treating this as a relationship problem misdirects the remedy toward goodwill, which is in adequate supply and is not the constraint.

The setting is worth stating precisely because the interface load is a function of it. An operating liquefaction facility is a continuous-process asset whose economics are dominated by availability, and the procurement and materials systems that sustain that availability are themselves configured around uninterrupted production rather than around project delivery (Okonkwo, Ogunwole, & Okeke, 2018a). An expansion imposes a second and structurally different demand on those same systems, and the resulting contention has been documented in the supply chain risk literature addressing engineering, procurement and construction work in gas processing environments (Ogunwole, Okonkwo, Agbabiaka, Mayo, & Okeke, 2021). The governance of large multinational infrastructure programmes has been examined directly and consistently identifies the seams between organisational units, rather than the units themselves, as the location of avoidable loss (Amayo, Owulade, & Isi, 2024b). Risk allocation across parties with divergent accountabilities has been formalised for public-private arrangements in terms that transfer to the owner-project relationship (Ike, Aifuwa, Nnabueze, Olatunde-Thorpe, Ogbuefi, Oshoba, & Akokodaripon, 2024), and predictive safety analytics applied specifically to liquefaction projects confirms that the exposure created by concurrent construction is measurable in advance rather than only in hindsight (Arumosoye, Obriki, & Ozobu, 2026). Comparable programme-level findings have been reported for solar deployments in West Africa, where the coordination burden rather than the technology proved to be the binding constraint (Amayo, Owulade, & Isi, 2024c).

The review draws on three literatures. The organisational design tradition established fifty years ago that subunits facing different task environments develop different structures, time horizons and interpersonal orientations, and that integration between them must be deliberately engineered in proportion to the differentiation. The information processing view supplies a basis for choosing among integrating mechanisms. And the megaproject literature documents the performance record, which is poor enough to warrant attention to any factor that recurs.

2. LITERATURE REVIEW

2.1 Differentiation and the Necessity of Engineered Integration

The foundational finding is that organisational subunits operating in different task environments develop systematically different orientations, and that the organisations achieving the best performance are those that combine high differentiation with correspondingly strong integrating mechanisms (Lawrence & Lorsch, 1967). The finding is directly applicable and its implications are frequently missed.

The differentiation between an operating facility and a construction project is high on every dimension the framework identifies. Time horizon: operations manages in shifts and days, projects in months and quarters. Goal orientation: containment and availability against schedule and cost. Formality of structure: operations runs on standing procedures and defined roles, projects on schedules and temporary organisation. Interpersonal orientation: operations is relationship-stable, since the same people work together for years, while a project team assembles and disperses.

The framework's central claim is that this differentiation is functional rather than pathological. Each subunit has developed the orientation its environment requires, and an attempt to reduce the differentiation would degrade both. What follows is that integration must be supplied by mechanism rather than by making the subunits more alike, and that the required strength of the mechanism scales with the differentiation.

This reframes the standard complaint. When operations personnel describe project personnel as indifferent to plant safety, and project personnel describe operations personnel as obstructive, both are describing the differentiation accurately and attributing it to character. The organisational design reading is that both groups are behaving as their accountabilities require and that the integrating mechanism is inadequate.

The same structural pattern has been described outside the process industries wherever two parties with distinct accountabilities are required to operate one asset. Governance alignment across joint venture partners has been treated as a coordination design problem rather than a relational one (Eyetsemitan, Ambali, Oyeleye, & Fadayomi, 2020), and the finance literature on cross-border partnerships reaches the same conclusion about the necessity of an explicitly designated integrating authority (Isiekwu, Oluwo, & Dada, 2021). Where the differentiated units also differ in professional and national composition, as they invariably do on a large expansion, the integration burden increases further; the evidence on diversity in multinational project teams indicates that heterogeneity improves delivery outcomes only where integrating structures are present to convert it into capability (Amayo, Owulade, & Isi, 2025a), and the cross-cultural communication literature supplies the mechanism by which shared meaning is or is not established across such divides (Lilian, Liadi, Yeboah, & Apelehin, 2020). Capital project delivery in regulated healthcare construction offers a close structural analogue, since there too a permanent operating institution and a temporary delivery organisation share a live site under conditions where the operating side carries the consequence of error (Ogbete, Aminu-Ibrahim, & Ambali, 2021). Leadership-driven safety culture work in large construction workforces adds the observation that culture does not transfer across the seam automatically and must be extended deliberately by the host organisation (Obogo, Nwafor, & Ozobu, 2023). Finally, the change management literature supplies the caution that integrating mechanisms introduced mid-campaign are adopted unevenly unless the adoption itself is managed, and that standard operating procedures function as integrating artefacts only where they are treated as strategic assets rather than as documentation (Eyetsemitan, Oyeleye, Ambali, & Fadayomi, 2022). The integration problem also appears wherever specialist workflows with distinct professional standards must produce a single result, and the diagnostic integration literature describes the reconciliation of microbiology, virology and serology workflows in terms that map onto the operations and project seam without modification (Asiedu, 2023). Continuity across an organisational boundary is the counterpart concern, since the party that inherits the consequence of a handover is rarely the party that designed it (Asiedu & Asiedu, 2024a).

Thompson (1967) supplies the complementary account through the analysis of interdependence, distinguishing pooled, sequential and reciprocal forms and matching coordination mechanisms to each. The operations and project relationship during tie-in execution is reciprocal interdependence in his terms, the most demanding form, requiring coordination by mutual adjustment rather than by standardisation or plan. Standard practice supplies coordination by plan, which is the mechanism appropriate to sequential interdependence, and this is a specific and diagnosable mismatch.

The organisation design tradition supplies more than the founding study. The distinction between mechanistic and organic forms established that structure follows environmental stability rather than managerial preference (Burns & Stalker, 1961), the configuration literature systematised the resulting types (Mintzberg, 1979), and information processing was developed as the unifying variable determining how much integrating capacity a given differentiation requires (Galbraith, 1973). More recent synthesis distinguishes coordination from cooperation as separate problems with separate remedies, which matters here because the operations and project relationship is frequently diagnosed as a cooperation failure when it is a coordination failure (Okhuysen & Bechky, 2009). The knowledge-boundary tradition supplies what the structural literature does not, namely an account of how meaning is actually transferred across an occupational divide. Boundary objects are artefacts that hold different meanings in different communities while remaining recognisable to both, which is precisely what an isolation certificate is at the operations and project seam (Star & Griesemer, 1989). Cross-occupational understanding has been examined ethnographically (Bechky, 2003), and collective mind supplies the account of how a group sustains a shared operating picture at all (Weick & Roberts, 1993). The question of how disciplinary vocabularies are reconciled where collaboration crosses field boundaries has also been treated directly in the language and collaboration literature, which reaches conclusions compatible with the boundary object account (Lilian, Liadi, & Yeboah, 2025a).

2.2 Choosing an Integrating Mechanism

The information processing view holds that organisation design is fundamentally about matching information processing capacity to the uncertainty the organisation faces, and it provides a ranked set of mechanisms by capacity and cost (Galbraith, 1974). Applied to the operations and project interface it yields a usable selection logic.

2.2.1 Rules and procedures

The lowest-capacity mechanisms are rules and procedures, which handle routine and anticipated interactions. Interface documents specifying which organisation is responsible for what, and standing rules governing access and permitting, occupy this level. They are necessary and they fail wherever a situation arises that the rule did not anticipate, which during a tie-in campaign is frequently. The procedural design literature is directly relevant here, since the value of a standing rule depends on whether it was written for the condition in which it will be applied, and standard operating procedures developed for steady-state operation carry no provision for concurrent construction (Eyetsemitan, Oyeleye, Ambali, & Fadayomi, 2022; Ambali, Eyetsemitan, Oyeleye, & Fadayomi, 2021). Regulatory-compliant procurement frameworks developed for high-risk energy environments illustrate the same principle applied to the commercial interface, where the rule set must be specified against the hazard rather than against administrative convenience (Okonkwo, Ogunwole, Mayo, & Okeke, 2021).

2.2.2 Hierarchical referral

Hierarchical referral handles the exceptions the rules do not cover, by escalating to a level where both organisations report to a common superior. Its capacity is limited by that individual's available attention, and during a period of intense interface activity the escalation volume exceeds it. The observable symptom is a decision queue at the common superior and, downstream, decisions taken locally without reference because waiting is not practical. The capacity planning literature developed for multi-programme portfolios describes this saturation behaviour formally and supplies forecasting methods for anticipating it rather than discovering it (Oteri & Edivri, 2024).

2.2.3 Goal setting

Goal setting reduces the need for referral by specifying outcomes both parties are accountable for rather than activities. Its application here is a shared interface objective, and its limitation is that it must not be so aggregated that neither party can influence it. Incentive alignment has been treated directly in the contracting literature, where sustainability-linked and integrated delivery arrangements are constructed precisely to make a shared outcome contractually consequential rather than merely declared (Abdulhadi & Hamdan, 2026c), and the maturity model tradition supplies a means of assessing whether an organisation is capable of carrying such an objective before it is imposed (Abdulhadi & Hamdan, 2026a).

2.2.4 Lateral relations and integrating roles

The higher-capacity mechanisms are the ones standard practice under-uses. Lateral relations comprise direct contact between the parties at working level, liaison roles, temporary task forces for specific issues, and integrating roles with formal authority. Galbraith's sequence is instructive: these mechanisms increase in capacity and in cost, and the design question is how far up the sequence a given interface requires. The digital coordination literature has extended the sequence, since shared model environments and common data environments function as lateral mechanisms in their own right by making the state of the work visible to both parties without an intervening translation step (Ogbete, Aminu-Ibrahim, & Iwuanyanwu, 2025a). Comparable arguments have been made for service management platforms and integrated systems engineering, where the platform substitutes for a portion of the liaison load rather than supplementing it (Okonkwo, Ahiaeke Patrick, Okeke, & Mayo, 2023). Supplier and vendor relationship frameworks address the same design question on the commercial side of the interface, where the choice is likewise between arm's-length rules and an invested integrating relationship (Ike, Ogbuefi, Nnabueze, Olatunde-Thorpe, Aifuwa, Oshoba, & Akokodaripon, 2021).

2.2.5 The selection principle

The selection principle follows: the mechanism should match the volume and uncertainty of the information the interface must carry. A routine, well-understood interface such as shared access control needs rules. A tie-in execution interface, in which the plant condition, the work scope and the schedule are all uncertain and interdependent, needs an integrating role with authority, and supplying it with a liaison who can convene meetings is under-provision. The characteristic failure of expansion projects is to provide the same coordination mechanism across all interfaces irrespective of their uncertainty.

The materials and logistics interface illustrates the point from the opposite direction, since it is high in volume but comparatively low in uncertainty and is therefore correctly served by rules, systems and visibility rather than by an integrating role. The relevant literature accordingly emphasises inventory visibility, materials readiness and predictive planning as the appropriate mechanisms at that seam (Okonkwo, Mayo, & Okeke, 2023; Okonkwo, Agbabiaka, Ogunwole, Mayo, & Okeke, 2021; Okonkwo, Agbabiaka, Mayo, & Okeke, 2024c). Where the volume itself becomes the binding constraint, as it does when an expansion's import requirements are superimposed on an operating facility's, the logistics literature documents both the failure mode and its remedies (Okonkwo, Agbabiaka, Okeke, & Mayo, 2025). Digital governance of these systems has been framed explicitly as a design choice about where authority sits rather than as a technology selection (Okonkwo, Agbabiaka, Mayo, & Okeke, 2024a), and comparable end-to-end visibility and lean coordination arguments appear in the wider supply chain literature (Nnabueze, Ike, Olatunde-Thorpe, Aifuwa, Oshoba, Ogbuefi, & Akokodaripon, 2021). Vendor evaluation and contract governance sit at the same level of the sequence, being rule-based mechanisms whose adequacy depends on the stability of what they govern (Okonkwo, Ogunwole, Okeke, & Mayo, 2019; Ahiaeke Patrick, Okonkwo, Mayo, & Okeke, 2020). Governance and accountability arrangements for delivery partnerships generalise the selection question beyond the site (Aminu-Ibrahim, Ogbete, & Ambali, 2024), and the lean-digital integration literature supplies the caution that adding a mechanism without retiring the one it replaces increases the coordination load rather than reducing it (Oteri & Edivri, 2026). Pharmaceutical distribution supplies an unusually well-developed treatment of this same seam, since it combines high volume with low tolerance for stockout and has therefore been forced to formalise the mechanisms that process industries apply informally (Asiedu, 2025; Asiedu & Asiedu, 2022, 2023b). Its most transferable contribution is the reconceptualisation of quality assurance as a determinant of supply reliability rather than as a compliance activity, which is precisely the move this paper urges for interface management (Asiedu & Asiedu, 2024b).

The selection principle also requires an explicit statement of what is being traded. The green communication literature has formalised this better than the organisational literature has, characterising the trade-offs among capacity, reliability and cost as a design surface on which a position must be chosen deliberately rather than arrived at by default (Asiedu & Quainoo, 2024; Asiedu, Quainoo, & Asiedu, 2025). That framing is directly applicable to Galbraith's ladder, where each step upward buys information processing capacity at a stated price, and the failure this paper identifies is the refusal to price the choice at all.

The problem recurs in multinational operations, where standardising health, safety and hygiene programmes across units facing different regulatory and cultural environments requires a governance structure that aligns corporate policy with local adaptation rather than imposing uniformity (Adikwu, Ozobu, Odujobi, Onyekwe, & Nwulu, 2023). That is the same differentiation and integration problem stated at corporate rather than site scale. Contracting form is the other lever and is decided before any of this. The transaction cost tradition explains why some interfaces are internalised and others left to contract (Williamson, 1991), and the relational contracting literature addresses what happens at interfaces that formal contracts cannot fully specify, which describes the tie-in interface exactly (Turner & Simister, 2001).

2.3 What the Megaproject Record Shows

The performance record of large capital projects is poor by any measure and the failure patterns recur with enough regularity to constitute evidence. The general account documents systematic cost overrun and schedule slip across sectors and decades, and attributes it substantially to optimism bias in estimation and to strategic misrepresentation in project promotion (Flyvbjerg, 2014). The industrial-sector analysis reaches compatible conclusions with more attention to execution factors and identifies front-end definition quality as the dominant predictor of outcome (Merrow, 2011).

Two findings from this literature bear directly on the interface question. The first is that scope definition quality at the front end predicts outcomes more strongly than execution performance does, which implies that the interface provisions established during front-end definition matter more than the interface management applied during execution. Interface arrangements are ordinarily developed during execution, when the parties meet, and by then the scope and schedule assumptions that determine the interface load are fixed.

The second is that schedule pressure in the later stages produces the compression of activities whose omission is not immediately visible, and interface activities are among the least visible. A project behind schedule will not skip a weld; it will skip a coordination step, and the consequence appears in the operating facility rather than in the project.

The general lesson for a brownfield expansion is that the operating facility carries a substantial share of the risk generated by project schedule pressure and has limited visibility of it, which is the asymmetry the following section addresses.

The same pattern appears in the sectoral literature on large delivery programmes outside the classical megaproject sample, which is useful because it tests whether the finding is an artefact of the transport infrastructure cases from which it was largely derived. Governance analyses of multinational industrial programmes identify front-end governance quality and organisational capability as the dominant explanatory variables rather than technical difficulty (Amayo, Owulade, & Isi, 2024b), and risk and compliance analyses of healthcare infrastructure delivery in West Africa reach the same conclusion in a setting where the operating institution and the delivery organisation are formally separate (Amayo, Owulade, & Isi, 2025c). Cost control and financial accountability frameworks developed for national construction programmes document the specific mechanism by which schedule pressure converts into unrecorded scope reduction (Aminu-Ibrahim, Ogbete, & Iwuanyanwu, 2025a). Lifecycle performance evaluation of purpose-built facilities supplies the counterpart evidence on the operating side, showing that decisions taken during delivery determine operating performance long after the delivery organisation has dispersed (Ogbete, Aminu-Ibrahim, & Ambali, 2023). Digital transformation models for lifecycle performance management in infrastructure delivery make the front-end point in the language of data continuity, namely that the information required to operate the asset is either specified at definition or reconstructed expensively later (Adelanwa, Basnet, & Anene, 2023a).

Programme-level work on renewable energy delivery reaches compatible conclusions about the primacy of programmatic design over execution effort (Yeboah & Ike, 2020), and the environmental and ESG assurance literature adds that the outcomes an expansion is judged on years later are fixed by procurement specification and stakeholder arrangements set during definition (Ike, Okojie, Nnabueze, Idu, Filani, & Ihwughwavwe, 2025). Project management analyses directed specifically at liquefaction reach compatible conclusions, identifying procurement specification and stakeholder engagement as the levers through which environmental outcomes are actually influenced, both of which are set during front-end definition rather than execution (Ihwughwavwe & Usiagu, 2024). Systems-level treatments of access, affordability and supply chain resilience make the same structural argument in a different sector, namely that the properties an operating system is judged on emerge from decisions taken upstream of the operators who are held accountable for them (Asiedu, 2026).

Infrastructure consolidation raises a further interface class that the megaproject literature treats only in passing. Where an expansion brings two previously separate technical estates into one, the integration itself creates risk that neither organisation owned before, and the network and control system dimension of that integration is now a recognised category in its own right (Ogunwola, Owoyemi, & Iyanda, 2026). The structural point is the same one this paper makes about differentiation: the risk sits at the seam, and the seam belongs to nobody until it is deliberately assigned. The operational technology security literature has developed this category furthest, establishing that the convergence of previously separate control estates produces exposure that neither the information technology nor the process control organisation is configured to own, and that the remedy is an explicit architectural assignment rather than an appeal to cooperation (Ahmed, Adegbite, & Adebayo, 2021). Detection and governance arrangements for industrial control estates have been reviewed systematically and supply the closest available analogue to a barrier framework for the digital interface (Adebayo, Adegbite, & Ahmed, 2023), with parallel findings for instrumented infrastructure more generally (Jimoh, Abolle-Okoyeagu, Ahmed, & Lawal, 2023).

The diagnosis has been refined considerably since the early cost-overrun studies. Systematic reviews of the causes and proposed cures identify governance, front-end definition and organisational capability rather than technical complexity as the dominant explanations (Denicol, Davies, & Krystallis, 2020), the strategic behaviour underlying optimistic estimation has been examined directly (Ansar, Flyvbjerg, Budzier, & Lunn, 2014), and the governance literature has attempted a unified account of how large projects are steered (Winch, 2001). The innovation side documents cases where deliberate interface design was the mechanism of success rather than an overhead (Davies, Gann, & Douglas, 2009), and interface management as a named practice has been evaluated empirically (Ahn, Shokri, Lee, Haas, & Haas, 2017). The temporary organisation literature supplies the theoretical frame for why a project organisation cannot sustain the mechanisms a permanent operation relies on: it assembles, performs and disperses, and its coordination must be engineered rather than accumulated (Lundin & Söderholm, 1995).

3. ANALYSIS

3.1 The Asymmetry of Consequence

Interface failure has consequences that fall unequally, and the inequality has implications for where authority should sit.

A project delayed by an operations decision incurs cost and schedule. The consequence is financial, is borne by the project, and is recoverable in principle. A live plant compromised by a project decision incurs a loss of containment, an unplanned shutdown, or a personnel injury. The consequence is potentially irreversible, is borne by the operating facility, and falls on people who were not party to the decision.

The asymmetry argues for a specific allocation: where the two organisations disagree and the disagreement concerns the safety of the operating facility, the operating organisation should hold the decision. This is uncontroversial when stated and is frequently not the arrangement in practice, because the project holds the schedule and the schedule holds executive attention.

Three features determine whether the allocation is real. The first is whether the operating organisation's refusal requires justification to a project-aligned authority, which converts a decision right into a request. The second is whether the operating organisation bears any of the schedule consequence in its own performance measures, which creates a conflict at exactly the point the allocation was intended to resolve. The third is whether the refusal is exercised by someone present at the time, which for tie-in work conducted around the clock means the shift organisation rather than day-shift management.

The third is the most commonly compromised. A tie-in executed at night against a schedule commitment, with the operating authority resident in a manager who is at home, has a nominal allocation and an actual one that differ. The shift supervisor is the operating organisation at that hour, and either holds the authority or does not.

The counterpart obligation should be stated. An operating organisation holding an unqualified right of refusal must exercise it on stated grounds rather than as a general risk aversion, since a refusal without a reason is indistinguishable from obstruction and will, over a campaign, be worked around. Specifying the grounds in advance, as conditions under which work will not proceed, converts a judgement exercised under pressure into a rule applied under pressure, which is considerably more robust.

The conceptual work on data-driven occupational safety risk control in energy infrastructure supports this construction directly, since its central proposition is that the authority to stop work is effective only where the grounds are pre-specified and the evidence supporting them is already in the hands of the person exercising it (Obriki & Arumosoye, 2018, 2021). Human error causation models explain why a judgement exercised under time pressure at three in the morning is systematically less reliable than the same judgement made in advance, and why the design remedy is to move the decision earlier rather than to exhort the decision-maker (Obriki & Arumosoye, 2020). The behavioural recurrence literature adds that a refusal right that is repeatedly overridden does not remain neutral but degrades, since the observed consequence of exercising it teaches the workforce what the organisation actually values (Obriki & Arumosoye, 2022; Obriki, Arumosoye, & Ozobu, 2025). Specific hazard classes carry this asymmetry particularly sharply. Lifting and rigging over operating plant is the clearest instance, since the consequence of a dropped load falls entirely on the facility beneath it (Arumosoye & Obriki, 2022), and heat stress in the operating environments characteristic of Gulf of Guinea liquefaction sites degrades exactly the vigilance the arrangement depends on (Arumosoye & Obriki, 2018). Incident prevention frameworks for industrial maintenance environments describe the same allocation question in a maintenance rather than a project frame (Obogo, Obriki, & Arumosoye, 2021). Emergency response capability is the residual barrier when the allocation fails, and its readiness in energy and process facilities has been modelled explicitly (Arumosoye & Obriki, 2023; Obriki, Obogo, & Arumosoye, 2022b). Lifecycle risk assessment in offshore produced water management supplies a comparable treatment of consequence allocation where an operator carries risk generated by an adjacent activity it does not control (Falegan & Aniebonam, 2022).

The barrier framework makes the asymmetry precise, since the isolation separating construction work from live plant is a barrier in the technical sense and its performance can be specified and verified like any other (Hollnagel, 2004). Latent conditions created at the interface behave exactly as the organisational accident model predicts, remaining dormant until combined with an active failure on the operating side (Rasmussen, 1997).

3.2 The Simultaneous Operations Problem

Concurrent construction and operation constitute simultaneous operations in the sense the sector uses, and the specific hazards arise from interactions rather than from either activity alone.

The interaction categories are enumerable: construction activity generating ignition sources near operating hydrocarbon systems; excavation near buried services; lifting over operating plant; construction traffic on escape and emergency access routes; temporary structures affecting gas dispersion and detector coverage; and, most consequentially, work on systems whose isolation from operating plant is the only barrier.

The permitting system carries this load, and the guidance governing it was written for facilities operating at normal work volumes rather than for expansion campaigns (Health and Safety Executive, 2005). The analysis of permit performance under high concurrent volume applies directly: interaction checking scales quadratically with the number of concurrent activities while checking capacity scales at best linearly, so a system adequate at normal volumes is not adequate during an expansion campaign. The remedy is segregation rather than more checking, meaning the spatial and temporal separation of construction from operations so that the number of interactions requiring assessment is bounded by design. The closest formal analogue to this scaling problem is systematic interaction screening in clinical practice, where the number of candidate pairwise interactions grows combinatorially with the number of concurrent agents and the practical response is to bound the set by protocol rather than to screen exhaustively (Asiedu, 2022). The detection dimension deserves separate mention, since temporary structures and the dense wireless estate an expansion brings onto site both degrade the coverage that fixed and networked detection depends on. Coexistence behaviour in multi-protocol environments, link degradation under changing channel conditions, and impedance effects on link performance are all documented, and each describes a mechanism by which detector coverage is quietly reduced without any device reporting a fault (Quainoo & Ogundapo, 2026a; Quainoo, Ogundapo, & Asiedu, 2024, 2025a).

Segregation is a planning decision made early, and it competes with construction efficiency. A construction sequence optimised for productivity will interleave with operations; one optimised for segregation will not, and will cost more. The decision is ordinarily made on the first basis because the cost of the second is visible and the benefit is not.

The hazard identification literature developed for large-scale construction operations is the applicable body of work for bounding the interaction set in advance, and its consistent finding is that identification coverage rather than identification quality is the limiting factor at high activity volumes (Obogo, Ozobu, Nwafor, & Adio, 2025; Obogo, Uduokhai, & Ozobu, 2019). Where construction is distributed across multiple concurrent zones, integrated management models developed for multi-zone urban infrastructure address the specific problem of interactions that cross zone boundaries and therefore fall outside any single zone's assessment (Obogo, Ozobu, Sanusi, & Ajirotutu, 2025). Governance models for multi-contractor sites supply the accountability structure without which zone-level identification does not aggregate (Obogo, Obriki, & Arumosoye, 2022). Near-miss and hazard observation systems are the mechanism by which unbounded interactions are detected before they combine, and their utilisation rather than their existence is the reported constraint (Arumosoye & Obriki, 2019; Obogo, Arumosoye, & Obriki, 2021). Continuous and digitally instrumented monitoring extends that capability to the scale an expansion requires (Obriki & Arumosoye, 2023; Obriki, Arumosoye, & Obogo, 2023), and predictive analytics applied to early detection of high-risk construction activity offers a means of directing scarce checking capacity to where the interaction density is greatest (Obogo, Ozobu, Garba, & Adio, 2026). Organisational learning maturity supplies the frame for whether any of this accumulates across a campaign or is relearned each time (Arumosoye & Obriki, 2021; Obriki & Arumosoye, 2019).

The escape and access consideration deserves specific mention because it is the one most frequently degraded and least frequently assessed. An expansion campaign changes the site layout continuously, and the emergency response assumptions embedded in the facility safety case, concerning muster routes, vehicle access and response times, are invalidated progressively without anyone re-examining them. A standing requirement to reassess emergency access against the current site layout at defined intervals is a modest provision addressing a substantial and accumulating gap. In process safety management terms this is a management of change question, and the reason it is missed is that site layout change during construction is not recognised as a change to the operating facility even though it alters the assumptions the facility's emergency arrangements rest on (Center for Chemical Process Safety, 2007).

The control of work apparatus governing this is well documented (Health and Safety Executive, 2005), and the major accident record establishes what happens when the interface between operating and contracting organisations is left to goodwill (Kletz, 2001). The safety climate evidence indicates that contractor conduct tracks the climate the host organisation sets (Zohar, 2002).

Contractor and subcontractor safety governance in multi-contract industrial projects is the specific literature this section needs and it is small but directly on point (Obogo, Uduokhai, & Ozobu, 2021). Safety leadership in large temporary project organisations addresses the distinctive problem that a project organisation assembles, performs and disperses, so the mechanisms that sustain culture in a permanent operation are unavailable to it (Arumosoye & Obriki, 2024). Occupational safety management systems have been reviewed for oil and gas maintenance projects specifically (Obogo, Arumosoye, & Obriki, 2020c), and internal audit systems for industrial operations examined as the verification layer (Obogo, Arumosoye, & Obriki, 2020a). Workforce training models and behavioural programmes supply the mechanism by which a temporary workforce is brought to the host organisation's standard within the time available (Obriki, Obogo, & Arumosoye, 2023), and incident investigation practice determines whether what is learned during a campaign is available before the campaign ends (Obriki & Arumosoye, 2024b). The environmental dimension of concurrent operations, principally waste handling and discharge under construction volumes the facility's systems were not sized for, has been addressed as a compliance and operational discipline question (Obogo, Ozobu, & Nwafor, 2024; Obogo, Arumosoye, & Obriki, 2024).

4. DISCUSSION

4.1 Measuring the Interface

Interface performance is essentially unmeasured in practice, and the available measures are cheap and diagnostic.

Interface decision latency, meaning the interval from the raising of an interface issue to its resolution, distributed rather than averaged. A lengthening tail indicates that the integrating mechanism has been exceeded, and it indicates this before the consequences appear.

Escalation rate, meaning the proportion of interface issues resolved at working level against those escalated. A rising escalation rate indicates that the lateral mechanisms are not carrying the load.

Unresolved interface issue ageing, which is the accumulation measure and the one that predicts trouble at tie-in execution, since issues unresolved at the point of execution are resolved on the day under pressure.

Permit interaction rejection rate, meaning the proportion of permit applications refused or modified on interaction grounds. A rate near zero during a period of intense concurrent activity does not indicate good planning; it indicates that interaction checking is not occurring.

Emergency access reassessment currency, meaning the time since the emergency arrangements were last assessed against the actual current site layout.

Each of these is computable from records the project and the facility already generate. Their absence from standard reporting reflects that interface performance is nobody's accountability rather than that it is hard to measure.

The service delivery measurement literature is the closest developed analogue, since it addresses precisely the problem of constructing indicators for a function whose output is the absence of disruption rather than a produced quantity (Edivri & Oteri, 2024; Oteri & Edivri, 2026). Performance intelligence and real-time tracking frameworks supply the instrumentation pattern, namely that measures assembled from transactional records already generated are more durable than measures requiring separate reporting effort (Tonoyan, Dada, & Ayivi-Donkor, 2024b). Infrastructure performance metrics developed for long-term asset management address the specific difficulty of measuring something whose value is realised after the measuring organisation has dispersed (Ogbete & Aminu-Ibrahim, 2024).

The audit and assurance literature is relevant for a reason that is easy to miss. The interface measures proposed here are all self-reported by the parties whose performance they describe, which is the condition under which assurance mechanisms exist. Risk-based internal audit and continuous control monitoring supply the verification layer (Akomolafe, Agu, & Bello, 2023a, 2023b; Agu, Akomolafe, & Bello, 2023a, 2023b), and the automation of control testing addresses the volume problem that makes manual verification impractical during a campaign (Aliliele, Mbonu, Uzoka, & Iwuanyanwu, 2025b). Data sensitivity classification and traceability frameworks bear on the practical question of whether project and operations records can be joined at all, which is a precondition for computing any cross-organisational measure (Mbonu, Iwuanyanwu, Aliliele, & Uzoka, 2020b).

Condition and integrity measurement supplies the physical counterpart to the organisational measures. The tie-in itself is a weld on a live system, and the inspection regimes governing weld integrity and equipment condition are the measures by which the physical interface is verified (Atta, Tofah, & Adenuga, 2021; Atta, Adjaklo, Asomani, & Adenuga, 2022; Atta, Tofah, Kankam, & Adenuga, 2020). Condition monitoring and the transition from reactive to predictive maintenance regimes describe the same measurement logic applied to the operating plant whose availability the expansion threatens (Sunday & Omoegun, 2022), and reliability-centred maintenance supplies the framework within which downtime attributable to interface failure can be separated from downtime attributable to the asset (Oyeleke, Eze, & Asiedu, 2026). Materials degradation under the humid, saline and thermally cycled conditions characteristic of a coastal liquefaction site is the slow variable that inspection regimes exist to track, and the corrosion and long-term degradation literature supplies both the mechanisms and the mitigation options (Atta, Kerubo, Sabisa, Adu-Gyamfi, Appiah, & Onyishi, 2025; Atta, Asomani, & Adenuga, 2018).

Instrumenting a site whose layout changes weekly is the practical obstacle to the emergency access currency measure proposed above, because fixed and cabled monitoring assumes a stable topology that an expansion campaign does not provide. Energy-harvesting and intermittently powered sensing is the developed response to exactly this constraint, and the reliability of such networks under intermittent supply has been characterised in enough detail to support deployment decisions rather than only to motivate research (Asiedu & Quainoo, 2023a, 2023b, 2025; Asiedu, Quainoo, & Asiedu, 2026). Whatever is deployed must itself be verified, and the wireless test automation and transceiver testing literature supplies the verification methods, which matters here because an unverified monitoring layer produces the appearance of measurement rather than measurement (Quainoo & Ogundapo, 2026b; Quainoo, Ogundapo, & Asiedu, 2025b). The same caution applies to the permit interaction rejection rate, since a measure with poor detection sensitivity returns a reassuring value for the same reason a poor assay does, and the diagnostic accuracy literature is explicit that a detection method must be characterised before its negative results carry information (Asiedu, 2024).

Regulatory oversight in an adjacent safety-critical sector offers a useful model for the maturity question, since aviation has developed audit outcome prediction and certification benchmarking to a degree the process industries have not, and its instruments transfer with little modification (Adeyelu & Dagodzo, 2022). The specific problem of encroachment on a protected operating envelope by activity that each party regards as legitimate is structurally identical to construction encroachment on an operating facility's access and escape provisions (Adeyelu, 2021), and geospatial monitoring of corridors and rights of way supplies a practical instrumentation route for detecting layout change as it occurs rather than at review intervals (Dagodzo & Ahiaeke Patrick, 2021a).

Indicator selection principles apply here as elsewhere, and the specific hazard is that interface measures are easy to satisfy formally and hard to satisfy substantively (Center for Chemical Process Safety, 2007). Intervention evaluation in this space faces the familiar difficulty that the outcome is rare and the process measures are what accumulate (Hopkins, 2012).

5. LIMITATIONS

This is a strategic review drawing on organisational theory and on the megaproject literature, applied to a context in which very little published empirical work exists. The operations and project interface during brownfield expansion is documented in industry guidance and consultancy material rather than in research, and the specific claims made here about which mechanisms are under-provided are inferences from theory and operating experience rather than findings.

The organisational design literature relied upon is old, and although its central findings have proved durable, its empirical base predates the contracting structures now standard in large capital projects, in which the project organisation is itself a consortium of contractors rather than a departmental unit of the owner. That structure adds interfaces the original framework did not contemplate, and the analysis here treats the project as more unitary than it is.

The megaproject literature addresses project outcomes and not the consequences borne by an adjacent operating facility, which is the asymmetry this paper emphasises. That the literature does not measure the operating consequence is itself consistent with the paper's argument, and it means the argument is not evidenced by that literature so much as unaddressed by it.

A further limitation concerns the transferability of the supporting literature drawn on here. Several of the frameworks cited were developed in adjacent sectors, principally healthcare infrastructure delivery, utility and grid operations, and information systems service management, and their applicability to a liquefaction expansion rests on structural similarity rather than on demonstrated equivalence. The similarity is real, since each involves a permanent operating institution and a temporary delivery organisation sharing an asset under conditions of asymmetric consequence, but the hazard profile differs and the transfer should be treated as hypothesis-generating. The control architecture literature makes the same point about the choice between hierarchical, decentralised and hybrid coordination in distributed energy systems, where the selection depends on the topology of the specific system rather than on a general finding (Komi & Adamolekun, 2022; Komi & Ganiu, 2023). Digital twin and predictive diagnostic approaches face the analogous constraint that model fidelity is site-specific (Komi & Adeniji, 2023), and the social licence literature establishes that stakeholder trust, which conditions whether an expansion proceeds smoothly at all, is not a transferable quantity (Komi & Adeniji, 2024a, 2024b). Smart grid and distributed control architectures illustrate the same design tension between central coordination and local autonomy that this paper treats at the organisational level (Adenuga, 2022). The cost-effectiveness modelling literature supplies the general caution that a comparative framework built on one evidence base does not transfer to another without restating its assumptions, which applies to every cross-sector analogue drawn on above (Asiedu & Asiedu, 2023a).

Finally, the paper recommends interface provisions established at front-end definition, which is advice that arrives too late for any facility already executing an expansion. For those, the applicable portion is the mechanism selection analysis and the measurement set, both of which can be applied mid-campaign.

Two adjacent bodies of work the paper does not develop should be named. The team and coordination literature at the level of the working group addresses how integration is actually accomplished by people rather than by structure (Salas, Sims, & Burke, 2005). And the non-technical skills tradition supplies the individual competences on which any interface arrangement ultimately depends (Flin, O'Connor, & Crichton, 2008). A third, treated only in passing, is the human factors dimension of information and system security at the interface, which matters increasingly as control estates converge (Onche, Adegbite, & Ogbonna, 2026). A fourth is the service management and adoption literature governing whether an interface mechanism introduced during a campaign is actually used (Ladapo, Dosunmu, Jooda, & Abolaji, 2023b). Data-driven optimisation of process infrastructure performance offers a fifth, since the analytical methods developed for treatment and utility systems apply to interface throughput without modification (Falegan & Aniebonam, 2024).

6. CONCLUSION

The operations and project relationship during a brownfield expansion is a problem of organisational design rather than of cooperation. The two organisations are differentiated because their task environments differ, the differentiation is functional, and integration must therefore be supplied by mechanism in proportion to it. Interventions directed at goodwill address a symptom that is not the constraint.

The mechanism should be selected against the uncertainty and volume of information the interface must carry, and the characteristic error is to apply one coordination arrangement across interfaces whose demands differ by an order of magnitude. Tie-in execution is reciprocal interdependence under high uncertainty and requires an integrating role with authority; supplying a liaison who convenes meetings is under-provision.

The consequences of interface failure are asymmetric, falling as cost on the project and as containment loss on the operating facility. That asymmetry allocates the decision at contested points to the operating organisation, and the allocation is real only if it does not require justification to a project-aligned authority, only if operations does not carry schedule in its own measures, and only if it is exercisable by whoever is present at three in the morning.

And the interface is unmeasured. Decision latency, escalation rate, unresolved issue ageing, permit interaction rejection rate and emergency access currency are all computable from existing records, all diagnostic in advance rather than after, and all absent from standard reporting because interface performance belongs to nobody.

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