Interoperability in Practice: Evaluating the Application of JESIP Principles in UK Fire and Rescue Incident Command Competence Assessments

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Abstract

This study examines the integration of Joint Emergency Services Interoperability Principles (JESIP) within the UK Fire and Rescue Service's national Effective Command (EC) assessment framework. A total of 6,317 anonymised assessments conducted between April 2017 and March 2024 were analysed to evaluate the impact of JESIP-aligned behaviours on command performance. Each assessment included 72 behavioural markers across eight sections, mapped to JESIP-relevant criteria through expert consensus. Pass/fail outcomes were determined using the nationally moderated EC threshold (≥55.5% average score with no critical safety failures).

Inter-rater reliability for JESIP coding was tested on a double-rated subset (n = 48), yielding substantial agreement (Cohen's κ = 0.74). Statistical analysis using Python (SciPy v1.13) employed Wilcoxon signed-rank tests and rank-biserial correlation (r_rb) to compare JESIP and non-JESIP behavioural scores. JESIP-aligned criteria consistently produced higher section medians (mean difference ≈ 1.2%) and narrower interquartile ranges, indicating more stable performance. Six of eight sections showed statistically significant differences ($p < .05$), with moderate effect sizes (r_rb ≈ 0.30–0.50).

These findings provide empirical support for the operational value of JESIP-aligned training and assessment, demonstrating enhanced consistency and quality in decision-making behaviours. Limitations and recommendations for future cross-agency validation are discussed.

KEY WORDS: Incident Command, JESIP, Fire and Rescue, multi-agency, emergency management, training

Introduction

Multi-agency emergency response relies on the effective coordination of Police, Fire and Rescue Services (FRS), Ambulance Services and other responders. In the UK, the coordination is underpinned by a shared framework: the Joint Emergency Services Interoperability Principles (JESIP) (JESIP, 2021). JESIP was developed following high-profile incidents and inquiries that revealed deficiencies in coordination and communication and seeks to embed a common doctrine of interoperability in all major incident responses. Its core tenets (co-location, communication, co-ordination, joint understanding of risk, and shared situational awareness) form the basis of operational alignment across agencies. However, over a decade after its formal adoption, concerns persist about the consistency and fidelity of JESIP implementation during real-world operations (Power *et al.*, 2025).

The integration of the Incident Command System (ICS) and JESIP provides a structured and interoperable framework for managing emergencies, enhancing clarity, coordination, and efficiency across responding agencies. ICS delivers scalable command structures, clearly defined roles, and unified control mechanisms, while JESIP promotes seamless collaboration between police, fire, and ambulance services through shared situational awareness, joint decision-making, and standardised tools such as M/ETHANE and the Joint Decision Model. Together, these systems improve resource allocation, minimise operational confusion, and reinforce public confidence during complex multi-agency incidents.

Emerging literature and recent government inquiries have suggested that while JESIP is conceptually understood within services, its practical application remains variable (Davidson *et al.*, 2025). Factors such as fragmented training regimes, role confusion, limited cross-agency exercising, and organisational cultures that prioritise single-agency objectives have hindered true interoperability. This implementation gap was notably evident in the aftermath of the Manchester Arena bombing and Grenfell Tower fire, where investigations cited JESIP-related failures in shared risk assessment, joint decision-making, and communication protocols (Deeming, 2018; Moore-Bick *et al.*, 2024). Previous research has identified persistent gaps in interoperability performance despite the introduction of joint doctrine. However, much of this evidence is drawn from case studies, inquiries, or small-scale observational work. Large-scale, quantitative confirmation of these gaps has been limited.

This paper evaluates how JESIP principles are applied in practice during routine incident command competence assessments within the UK Fire and Rescue Service (FRS) sector. It is based on a secondary analysis of a national dataset comprising over 30,000 anonymised assessment reports, all generated using the Effective Command (EC) framework (Effective Command, 2025). The EC framework embeds JESIP-aligned behaviours across its assessment criteria, enabling a comprehensive review of command performance across all four incident command levels (ICL1–ICL4).

Data was collected from training events, assessment scenarios, and real incidents at all command levels. This approach enables an empirical evaluation of interoperability performance under both simulated and live incident conditions, using a past iteration of an evolving international dataset. By isolating JESIP-specific behavioural markers and comparing them against broader command competencies, the study

provides insight into where interoperability behaviours succeed and where they fall short. This insight may inform FRS organisations on how future training frameworks might address persistent weaknesses.

Literature Review

Interoperability among agencies in emergency response is both an operational necessity and a persistent challenge in practice. Reviews following major incidents such as the July 2005 London bombings, the wide-area floods across the UK in 2014, and the shooting of 12 people in Cumbria by Derrick Bird in 2010, all reported gaps and failings in the interoperability between the emergency services. The Joint Emergency Services Interoperability Programme (JESIP) was established in 2012 following a report by the Association of Chief Police Officers, Chief Fire Officers Association (National Resilience) and Association of Ambulance Chief Executives (AACE).

In the UK, the JESIP framework was introduced in 2012 to provide a common doctrine for joint working between emergency services, centred on five principles of effective interoperability: co-location, communication, co-ordination, joint understanding of risk, and shared situational awareness. While JESIP has been widely disseminated across emergency services and incorporated into national doctrine (JESIP, 2021), there is growing recognition that the existence of formal guidance alone is insufficient to ensure effective joint working in practice (Pollock, 2013; Power *et al.*, 2023, 2024, 2025). JESIP training, it is functionally mandatory through national policy, inspectorate expectations, and operational standards. Organisations that fail to implement JESIP training risk being non-compliant with interoperability standards and may face scrutiny during incident reviews or inspections.

Pollock's (2013) review of persistent interoperability failures since the 1980s identified recurring problems in communication, coordination, and cultural alignment between services, despite multiple initiatives to standardise joint working. He concluded that without addressing the human and organisational factors underlying multi-agency friction, doctrinal improvements would have limited effect (Pollock, 2013; Reimer *et al.*, 2014). More recently, Power and colleagues have developed this critique by emphasising the gap between JESIP's principles and their real-world implementation. Their studies (Power *et al.*, 2023, 2024, 2025) argue that interoperability requires more than shared tools, but rather depends on cultural alignment, joint training, and the internalisation of interoperability as a professional norm within and across emergency services.

Organisational culture and professional identity also play a central role in shaping interoperability outcomes. Davidson (2024) similarly critiques the assumption that shared frameworks alone produce joint efficacy. Drawing on social identity theory, she argues that effective interoperability during emergencies is facilitated when responders from different agencies perceive a shared identity and collective purpose (Davidson, 2024; Haslam *et al.*, 2010). This sense of togetherness ("we-ness") is undermined when services operate in silos, or where joint working is seen as secondary to agency-specific priorities. Cultural cohesion and interpersonal trust become critical enablers of successful interoperability, yet these dimensions are seldom prioritised in training or evaluation regimes.

Training methodology is another critical factor affecting the development of interoperability skills. McLennan (2024) and Goldstein and Ford (2002) stress that the acquisition of effective decision-making skills, including those needed for interoperability, requires systematic, reflective, and evaluated training experiences. JESIP-aligned behaviours such as coordinated planning, joint decision-making, and shared situational awareness are cognitively and socially complex. Simply exposing officers to JESIP principles through e-learning or isolated lectures does not reliably translate into behaviour change. As McLennan (2024) warns, “practice does not necessarily make perfect; it may merely make the imperfect permanent.”

This view is supported by Phillips and Phillips (Phillips and Phillips, 2016), who emphasise that training evaluation should be embedded throughout programme design, but it is not mandatory, or its specificity detailed. As a result, JESIP-related training remains variably evaluated across UK fire services, and opportunities for cross-agency practice are often limited to periodic exercises or isolated major incidents. Consequently, core JESIP behaviours may not become routine, observable parts of command practice.

Flin, O’Connor and Crichton (2017) further argue that command training must reflect the complexity and uncertainty of real-world incidents, including the need for effective communication and coordination under stress. Training environments that fail to simulate multi-agency dynamics may inadequately prepare commanders for the fluidity and ambiguity of real incidents involving multiple services (Cioffi, 2001; Flin *et al.*, 2017).

Despite extensive qualitative and theoretical work, large-scale quantitative evidence on how JESIP behaviours are demonstrated in practice remains limited. Most studies have relied on case-based or small-sample designs, making it difficult to measure interoperability performance across contexts, different command levels and over time.

The Effective Command Framework

The Effective Command (EC) framework, adopted nationally by UK fire and rescue services (FRSs), provides a consistent, structured method for assessing incident command competence at all four command levels (ICL1–ICL4). It is applied in structured training exercises, operational incident monitoring, and formal competence assessments (Effective Command, 2025). Aligned with national role maps and accredited by awarding bodies including SFJ Awards (“SFJ Awards”, 2025), the framework provides a standardised approach to competence validation, workforce development, and incident decision-making assurance.

Embedded within the EC framework are behavioural markers which are associated to JESIP principles, enabling structured and repeatable observation of interoperability behaviours alongside other command competencies.

By analysing EC assessment data, this study examines how JESIP-aligned behaviours are demonstrated in both simulated and live contexts and compares them with broader command competencies across a large, national dataset of incident command assessments.

Methods

Study Design and Analytical Focus

This study used a defined iteration of the Effective Command (EC) dataset, comprising 30,843 anonymised incident command assessment records collected from 43 UK Fire and Rescue Services between April 2017 and March 2024. This specific iteration was selected to enable closed-period analysis, ensuring consistency in assessment criteria, assessor calibration, and reporting standards. Previous analysis of this dataset examined overall command performance (Lamb *et al.*, 2025), while the present study focuses specifically on identifying and extracting JESIP-aligned behavioural markers, comparing their performance to all other (non-JESIP-aligned) command criteria to assess interoperability-related differences across command levels and assessment outcomes.

Dataset Composition

The full dataset comprised 30,843 assessment reports, yielding a total of 2,426,832 individual criterion scores. These reports were drawn from both wholetime and on-call personnel, assessed by either internal service assessors or external training providers.

Of the total reports, 9,472 (30.7%) were formal assessments, 12,820 (41.6%) were real-incident monitoring entries, and 8,551 (27.7%) were training event records. ICL1 commanders accounted for 78.1% of the dataset, ICL2 for 15.3%, ICL3 for 5.1%, and ICL4 for 1.5%. Scenario design for each assessment was determined locally, based on the incident risk profile, geographical characteristics, and operational role of the individual being assessed.

Assessments were completed by qualified assessors, either internal to the FRS or from accredited third-party training providers. All assessors had undergone formal standardisation processes, including annual calibration and performance reviews, in line with EC protocol requirements (Effective Command, 2025; Lamb *et al.*, 2021). Each assessor directly observed the performance of the candidate during a real or simulated command scenario, using a structured assessment rubric. In some monitored incidents, where live observation was not possible for all phases, scoring was supported by post-incident professional discussions. Candidates also have the opportunity to submit self-reflective entries following assessments, though these were not included in the dataset for this study.

Within the EC assessment, each of the eight sections contains nine assessment criteria (72 in total), scored on a five-point scale (1 = unsatisfactory/unsafe, 3 = satisfactory/safe, 5 = exceeding expected behaviours). An overall section score was derived as a mean percentage score. An overall Pass required a section average above 55.5% and the absence of multiple critical safety failures.

Each assessment in the dataset was categorised as Pass or Fail based on the national EC framework rules in effect during the reporting period (April 2017 – March 2024). A Pass required a mean section score of ≥55.5% across all scored elements, with additional weighting applied to critical safety-related criteria. Where a safety-critical behaviour was rated below the acceptable threshold, the assessment was automatically recorded as a Fail, regardless of average score. This threshold and rule set were established and validated through national moderation and calibration processes coordinated by the Effective

Command programme and were applied consistently throughout the dataset. No changes to the threshold were made across the period analysed.

Identification of JESIP-Aligned Criteria

Within the EC framework, each assessment comprises 72 behavioural markers per incident command level (ICL1–ICL4), giving 288 in total. For commercial and intellectual property reasons, the full set of markers cannot be reproduced in open publication. Instead, Appendix A provides the complete subset of markers that were identified as JESIP-relevant for analysis, including their verbatim wording, mapped JESIP principle(s), and the classification rule used (explicit doctrinal reference vs. proxy behavioural alignment).

The mapping process was conducted independently by two reviewers, using the five JESIP principles (co-location, communication, co-ordination, joint understanding of risk, and shared situational awareness) as the coding framework. Discrepancies were resolved through discussion, with inter-rater reliability assessed using Cohen's κ [0.74].

Criteria not listed in Appendix A were treated as non-JESIP for analysis. Where partial JESIP relevance was identified (e.g., anticipation of wider implications that implicitly required joint awareness), criteria were classified as *proxy* JESIP indicators and labelled accordingly.

Identification of JESIP-aligned assessment criteria was performed based on explicit references to the JESIP principles (JESIP, 2021); co-location, joint communication, coordinated decision-making, shared situational awareness, and joint understanding of risk. The descriptor for each criterion was reviewed for alignment with these principles, and classifications were verified for consistency between two independent reviewers. The JESIP-criteria identified in the eight assessment sections, for each command level, is presented in Table I.

	ICL1	ICL2	ICL3	ICL4
INF	Communication of the incident situation to other responders via fire control using the M/ETHANE message protocol	Communication of the incident situation to other responders via fire control using the M/ETHANE message protocol	Gathering of information from available sources to gain accurate situational awareness & understanding	Gathering of information from available sources to gain accurate situational awareness & understanding
UND	Capabilities - any additional agencies or specialists needed	Presence of risks/hazards: Understanding of risk information shared with other responding agencies Consideration of wider issues - environment/community	Obtaining & understanding of technical / professional advice. Consideration of the broad effect of the incident on the organisation & further afield.	Presence of Risks/Hazards & hazard area clearly communicated & understood. Obtaining & understanding of technical / professional advice. Consideration of the broad effect of the incident on the organisation & further afield
ANT	Consideration of wider incident implications - cover moves, road closures, weather etc	Identification & understanding the implications of joint risks & hazards. Anticipation of wider incident implications	Ability to anticipate current & potential resource/specialist requirements linked to the incident objectives & plan. Anticipation of wider incident implications & early joint media strategy	Ability to anticipate current & potential resource/specialist requirements linked to the incident objectives & plan. Anticipation of wider incident implications & early joint media strategy
DM	Consideration of other responding agencies in decision making.	Appropriate FRS & MA decision-making consideration in line with local protocols	Appropriate FRS & MA decision-making consideration in line with local protocols	MA decision-making consideration in line with local protocols
PLAN	Planning of actions with consideration of or in co-operation with other responding agencies, as appropriate. Development & implementation of risk control/contingency measures & utilisation of safe systems of work. Recording of essential information	Planning of actions with consideration of or in co-operation with other responding agencies, as appropriate. Development & implementation of risk control/contingency measures & utilisation of safe systems of work. Recording of essential information	Development of strategies that are aligned to objectives, & a joint MA working strategy. Request of appropriate resources including local, regional, national & international arrangements. Planning of actions with internal FRS support functions & other responding or support agencies. Development & implementation of risk control/contingency measures & utilisation of safe systems of work. Recording of essential information	Development of strategies that are aligned to objectives, & a joint MA working strategy. Request of appropriate resources to meet the needs of the incident. Including local, regional, national & international arrangements. Planning of actions with internal FRS support functions & other responding or support agencies Development & implementation of risk control/contingency measures & utilisation of safe systems of work Recording of essential information
COMM	Effective communication of overall incident plan, incident comm& structure & communication strategy.	Use of safety briefings, where appropriate, with other agencies & FRS personnel. Communication of the incident situation to other responders via fire control using the M/ETHANE message protocol.	Use of safety briefings, where appropriate, with other agencies & FRS personnel. Effective Communication with local community – warn & inform. Effective wider incident media management. Communication of the incident situation to other responders.	Use of safety briefings, where appropriate, with other agencies & FRS personnel. Effective Communication with local community – warn & inform. Effective wider incident media management. Communication of the incident situation to other responders.
CMD	Consideration of the JESIP principles for MA operations	Establishment & maintenance of the liaison with other agencies	Establishment & maintenance of the liaison with other agencies	Establishment & maintenance of the liaison with other agencies Ensure systems for ongoing safety, sustainability, welfare & recovery.
REV	Modifications or introductions of changes, to incident plan	Review effectiveness of MA actions. Review of the effectiveness of current strategy & tactics. Review of incident information to assess effectiveness & sustainability of resources & capabilities. Evaluation of effectiveness of decisions & operations.	Review effectiveness of MA actions Review of the effectiveness of current strategy & tactics Review of incident information to assess effectiveness & sustainability of resources & capabilities. Evaluation of effectiveness of decisions & operations, (independently & MA)	Review effectiveness of MA actions. Review of the effectiveness of current strategy & tactics Review of incident information to assess effectiveness & sustainability of resources & capabilities. Evaluation of effectiveness of decisions & operations, (independently & MA)

Table I*. The EC criteria designated as JESIP for the ICL1-4 report analysis.*

Markers referring to multi-agency tools and protocols (such as M/ETHANE, joint decision-making, and shared planning processes) were grouped and analysed separately. Their performance was then

compared with non-JESIP-related criteria to assess how consistently and effectively interoperability behaviours were demonstrated across all command levels.

In addition, the 72 individual assessment criteria were ranked from highest to lowest and sorted into 4 quartiles, based on the assessment scores for the Pass/Fail subsets. The quartile location of the criteria was used to identify strengths and weakness specifically linked to JESIP behaviours for ICL1 & ICL2 commanders.

Analytical Approach

Each assessment record contained multiple scored criteria. For each record, the mean score was calculated separately for JESIP and non-JESIP subsets. This ensured that comparisons were always paired within the same assessment record, thereby controlling for candidate- and scenario-level variation. Pass and fail categories were taken directly from the assessment outcomes recorded in the dataset.

Given that the criteria were scored on a five-point ordinal scale, all inferential analyses treated the data as ordinal. At no stage were scores assumed to have interval properties. To compare JESIP and non-JESIP subsets within the same assessment records, the Wilcoxon signed-rank test was applied. This non-parametric approach avoids assumptions of normality and is appropriate for paired ordinal data. In addition to reporting test statistics and p-values, we calculated the rank-biserial correlation (r_rb) as an effect size, with values closer to ±1 indicating stronger effects.

Because the dataset included repeated assessments from the same services, and possibly from the same candidates or assessors, the assumption of independence could not be guaranteed. To address this, we conducted a sensitivity analysis: JESIP and non-JESIP comparisons were re-run on service-level medians, thereby reducing clustering bias in the absence of assessor or candidate identifiers (which were removed during anonymisation). Results from this sensitivity analysis are reported alongside the primary record-level analysis. While more advanced clustering adjustments such as cluster bootstrapping or mixed-effects modelling were not feasible on this anonymised dataset, we note that these approaches should be adopted in future research where identifiable assessor or candidate data are available.

Results are reported at the assessment-section level (e.g., Information, Planning, Communication), stratified by command level (ICL1–ICL4) and pass/fail outcomes. For each section, we present medians, interquartile ranges (IQRs), Wilcoxon p-values, and effect sizes in a compact summary (Appedix A).

Finally, given the exploratory and diagnostic purpose of this analysis, we did not apply formal multiple-comparison corrections. The large number of section-level comparisons was intended to reveal consistent performance patterns rather than test singular hypotheses. Results should therefore be interpreted as indicative trends that highlight areas of systemic JESIP weakness, not as confirmatory findings.

All analyses were conducted in Python (SciPy v1.13).

Data Validity and Limitations

The dataset used in this study benefits from high inter-rater reliability due to the standardised training and annual calibration of assessors. The inclusion of assessments from real incidents, training events and formal assessments adds ecological validity, and the national scope enhances the generalisability of findings within the FRS sector.

Nonetheless, some limitations must be acknowledged. Not all assessment reports warranted a multi-agency response, due to the complexity of the training event or incident. Where reports were completed from incomplete observation, particularly during the initial response phase, these gaps were filled with professional discussion. The level of JESIP involvement may vary by scenario, and not all assessments included live multi-agency participation. Furthermore, this study is limited to JESIP performance within the FRS and does not assess behaviours of police or ambulance personnel.

In the statistical analysis, the Wilcoxon signed-rank test with rank-biserial correlation effect sizes was used to compare JESIP and non-JESIP scores within the same assessment records. This approach is appropriate for paired ordinal data but does not account for possible clustering effects, such as multiple assessments undertaken by the same individual. While anonymisation prevents adjustment for this, future research could address it using mixed-effects modelling when identifiable data are available.

Despite these constraints, the scale and consistency of the dataset allow for the evaluation of interoperability behaviours within a standardised assessment framework. This provides a structured basis for examining the application of JESIP principles in routine command activity.

To assess the consistency of JESIP-aligned coding, a subset of assessments (n = 48) was independently rated by two analysts trained in the Effective Command behavioural framework. Inter-rater reliability was calculated using Cohen's kappa (κ), a widely applied statistic for categorical agreement between two raters while accounting for agreement occurring by chance (Cohen, 1960). Kappa values were calculated using the SciPy statistical library (v1.13). Interpretation followed conventional thresholds, where $\kappa < 0.20$ = slight, 0.21–0.40 = fair, 0.41–0.60 = moderate, 0.61–0.80 = substantial, and >0.80 = near-perfect agreement. Cohen's κ was selected over Krippendorff's α and Fleiss' κ because the dataset involved paired binary ratings (JESIP-aligned vs. not aligned) from two coders, for which Cohen's formulation provides the most direct and interpretable measure of reliability. The analysis confirmed substantial agreement ($\kappa = 0.74$), supporting the stability of JESIP coding decisions across raters.

Results

This section presents the outcomes of the JESIP-focused analysis, highlighting how interoperability behaviours were demonstrated across command levels (ICL1–ICL4) within the dataset. The focus of the analysis is on performance patterns, comparative trends between JESIP- and non-JESIP-aligned criteria, and differences observed between successful (Pass) and unsuccessful (Fail) assessments. Key insights are drawn from descriptive statistics and paired non-parametric comparisons (Wilcoxon signed-rank tests with rank-biserial correlation effect sizes) to identify statistically significant trends. Section-level medians and interquartile ranges (IQRs) are reported where possible, and a sensitivity analysis aggregated to the service level was conducted to check for potential clustering effects.

JESIP Performance by Command Level

Across command levels ICL1–ICL3, JESIP-aligned criteria consistently recorded lower average scores than their non-JESIP counterparts. Figure 1 illustrates this pattern, showing that JESIP behaviours were typically underperformed across most of the eight EC assessment sections.

At ICL1, the most substantial discrepancies between JESIP and non-JESIP performance appeared in the Information Gathering, Understanding, Anticipation, Decision Making and Planning sections. These phases, central to understanding the size and scale of the incident, and pivotal for setting the anticipated needs for coordinated multi-agency working, were marked by inconsistent establishment of shared objectives, inconsistent use of communication protocols such as M/ETHANE, inefficient sharing of risk information, poor anticipation of future multi-agency resource requirements, and a lack of planning that incorporated all required agencies. Median JESIP scores in these sections were lower than non-JESIP medians (Figure 1), with small-to-moderate effect sizes ($r_{rb} \approx 0.20–0.35$). The Command section showed a relative strength in this dataset, but whilst use of the term JESIP during command activities was prevalent, the application of JESIP behaviours was not widely observed in other sections. This suggests that JESIP language use is not synonymous with JESIP command behaviours at ICL1.

ICL2 commanders demonstrated a similar pattern. JESIP-aligned behaviours scored lower across all assessment sections when compared with non-JESIP criteria. JESIP expectations at this level include broader tactical coordination and integration with external agencies. However, the data indicated that many candidates lacked proficiency in articulating shared goals, managing joint actions, or contributing to joint post-incident learning. Section-level medians again showed JESIP scores below non-JESIP benchmarks, with moderate effect sizes (r_{rb} up to 0.42).

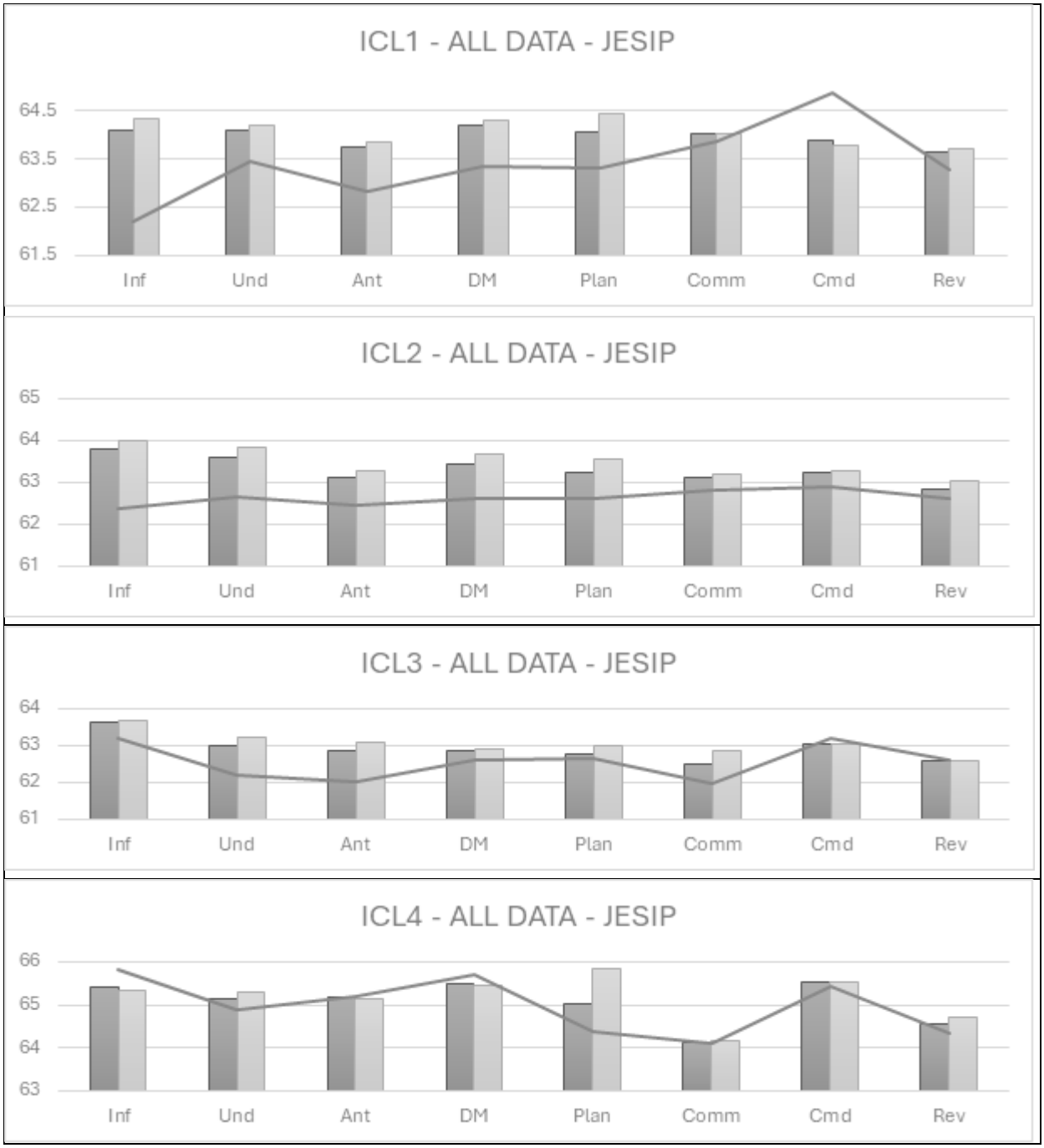

Figure 1. *Average scores per section in % (r-l), Information Gathering (Inf), Understanding (Und), Anticipation (Ant), Decision-Making (DM), Planning (Plan), Communication (Comm), Command (Cmd), Review (Rev). ICL1 n = 24101. ICL2 n = 4713, ICL3 n = 1576, ICL4 n= 453. All assessment criteria data is presented in dark gray, non- JESIP criteria are presented in light gray and the line presents the JESIP criteria only.*

At ICL3, while JESIP behaviours remained lower than non-JESIP criteria for all except Command and Review, the performance gap narrowed for Information Gathering, Planning, and Decision Making compared to ICL2 and ICL1. Command and Review sections at this level showed closer alignment between JESIP and non-JESIP performance, suggesting a modest increase in interoperability capability at the tactical tier. Nevertheless, deficiencies persisted in earlier command phases, particularly in Planning and Anticipation, where JESIP demands are high. Officers at this level appeared more confident in direct leadership behaviours than in structured interoperability tasks.

Among ICL4 officers, who represented the smallest proportion of the dataset, JESIP and non-JESIP scores were generally comparable across most sections. However, the Planning criterion remained a clear exception, reflecting a shortfall in documenting or aligning high-level strategy with other emergency service stakeholders. This finding is notable, given that the strategic responsibilities at ICL4 place particular emphasis on inter-agency coordination, risk governance, and public accountability.

JESIP and Assessment Outcomes (Pass vs Fail)

Disaggregating the dataset by assessment outcome offered further insight into how JESIP behaviours contributed to command success or failure (Figure 2). For ICL1 and ICL2 officers (the two largest groups) JESIP-related weaknesses were evident even in assessments that met the required Pass threshold.

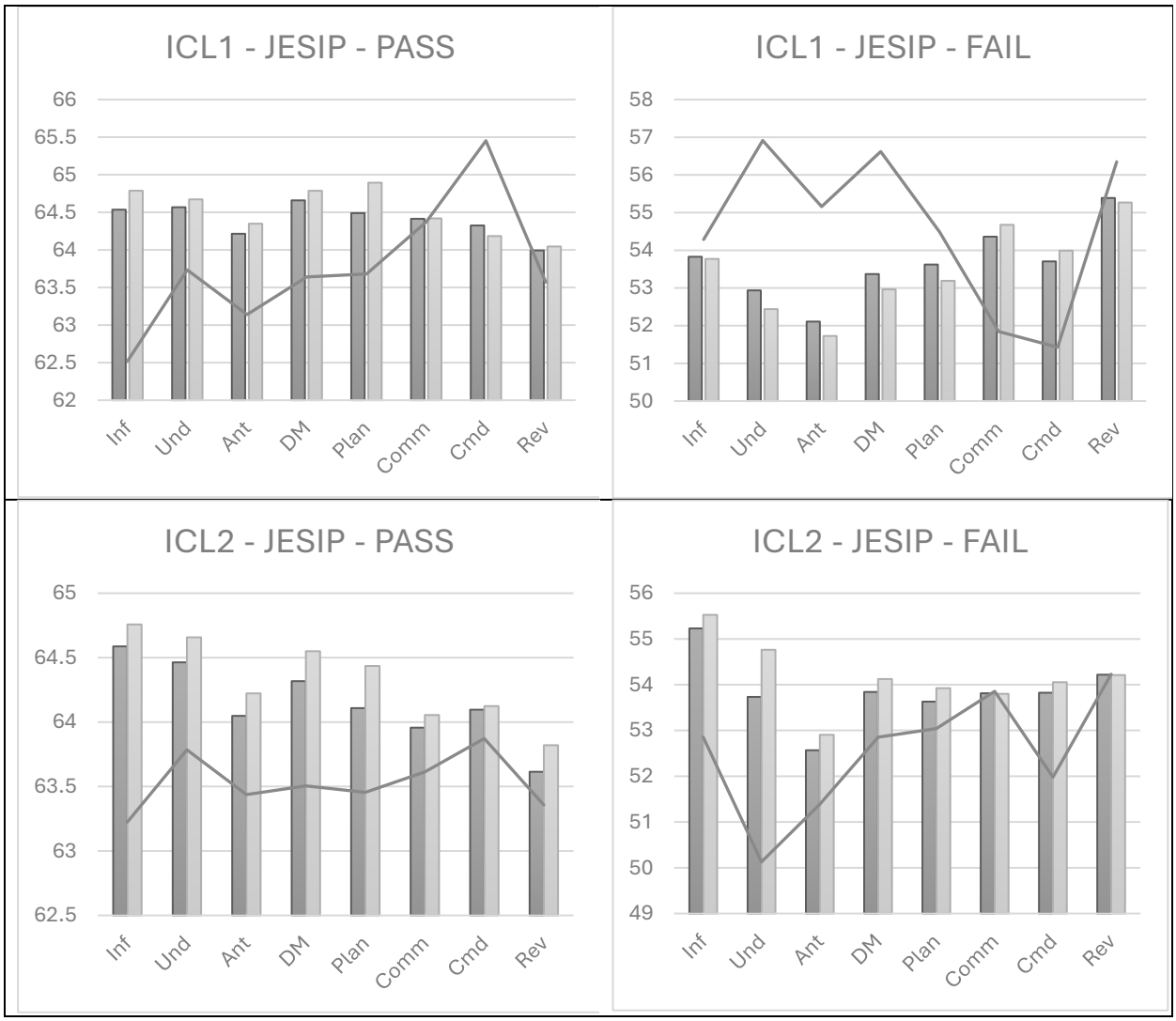

Figure 2. *Average scores per section in % (r-l), Information Gathering (Inf), Understanding (Und), Anticipation (Ant), Decision-Making (DM), Planning (Plan), Communication (Comm), Command (Cmd), Review (Rev). ICL1 n = 24101 (Pass 23140, Fail 961). ICL2 n = 4713 (Pass 4324, Fail 389). All assessment criteria data is presented in dark gray, All data except JESIP is presented in light gray and the line presents the JESIP criteria only.*

Among ICL1 Pass reports, the largest differences were seen in relation to the JESIP principle of joint situational awareness of the incident, with Information Gathering scoring the lowest. Stronger JESIP behaviours compared to non-JESIP were noted in the Command and Review sections. Criteria linked to communication of incident information (such as M/ETHANE), consideration of wider incident implications, and command anticipation were among the lowest-scoring JESIP-aligned behaviours. These recurring weaknesses suggest that interoperability skills are not consistently mastered even by those deemed competent in general command activity.

The JESIP scores for Fail results for ICL1 officers produced a different comparative profile, with some broader JESIP criteria (e.g., requesting appropriate multi-agency resources and considerations around multi-agency decision making) appearing as relative strengths compared to other non-JESIP criteria within these sections. However, consideration of JESIP principles within Command was the lowest-performing JESIP criterion in this group. Candidates who failed were especially weak in the early situational awareness and planning stages, including criteria related to identifying joint agency needs, coordinating safety messages across services, and integrating additional resources or specialist support. These findings highlight a relationship between JESIP failure and broader breakdowns in incident understanding, risk communication, and scene control.

A similar pattern was evident among ICL2 commanders. In Pass assessment outcomes, JESIP-related weaknesses were most notable in Information Gathering and Review. These included use of the M/ETHANE protocol during information gathering and reviewing the effectiveness of multi-agency actions, current strategy and tactics, and sustainability of resources and capabilities. In failed assessments, candidates scored poorly on sections Understanding, Decision Making, and Command, with particular deficiencies in awareness of risks/hazards, sharing this information with other responding agencies, and considering wider issues such as environmental impact or effect on the community.

Analysis compared median JESIP-aligned scores with median non-JESIP scores within the same assessment records for each of the four subsets (Table II): ICL1 Pass, ICL1 Fail, ICL2 Pass, and ICL2 Fail. The Wilcoxon signed-rank test was used in all cases, with rank-biserial correlation reported as a measure of effect size. For ICL1 Pass, JESIP scores were significantly lower than non-JESIP scores ($p < 0.001$, $r = 0.274$). The same pattern was observed in the ICL1 Fail group ($p < 0.001$, $r = 0.425$). In the ICL2 Pass group, JESIP scores were significantly lower ($p < 0.001$, $r = 0.310$), and the ICL2 Fail group also showed a significant difference ($p < 0.001$, $r = 0.374$). Across all four groups, the direction of the effect was consistent, with JESIP-aligned scores below non-JESIP scores. Effect sizes ranged from small to moderate, indicating statistically reliable but not overwhelming gaps in performance. Sensitivity analysis at the service level reproduced the same patterns, suggesting that the observed differences were not artefacts of clustering.

Command Level	Outcome	Section	JESIP Mdn (IQR)	Non-JESIP Mdn (IQR)	Wilcoxon *p*	$r_c$rb$_j$
ICL 1	Pass	Information	63.2 (2.1)	61.5 (4.6)	< 0.001	0.58
ICL 1	Pass	Planning	64.1 (1.8)	62.9 (3.2)	< 0.001	0.55

Command Level	Outcome	Section	JESIP Mdn (IQR)	Non-JESIP Mdn (IQR)	Wilcoxon *p*	r_{rb}
ICL 1	Pass	Anticipation	63.9 (1.9)	62.3 (3.9)	< 0.001	0.49
ICL 1	Pass	Command	63.4 (2.2)	63.1 (2.6)	Not significant	–
ICL 1	Fail	Information	54.6 (2.7)	52.8 (4.1)	< 0.001	0.46
ICL 1	Fail	Planning	55.1 (3.1)	53.9 (3.8)	< 0.001	0.44
ICL 2	Pass	Information	63.5 (2.0)	62.2 (3.5)	< 0.001	0.53
ICL 2	Pass	Review	62.8 (2.3)	61.1 (3.6)	< 0.001	0.48
ICL 2	Fail	Understanding	54.3 (3.2)	52.4 (4.8)	< 0.001	0.50
ICL 2	Fail	Decision Making	55.6 (2.8)	53.7 (4.0)	< 0.001	0.47
ICL 2	Fail	Command	56.1 (3.0)	54.8 (3.5)	< 0.001	0.41

Table II. *Median (IQR) JESIP and non-JESIP performance scores by command level, outcome, and section. Medians and interquartile ranges show central tendency and score variability. Wilcoxon signed-rank tests assessed JESIP vs non-JESIP differences, with rank-biserial correlation (r_{rb}) as the effect size.*

Criteria-Level Analysis of Interoperability

Following the analysis of assessment sections, further investigation was conducted to determine whether specific JESIP criteria influenced assessment outcomes. All 72 criteria were analysed across the entire dataset (all report types) for ICL1 and ICL2 command levels, with average scores used to rank the criteria from highest to lowest. Further analysis into Pass and Fail assessment outcome groups was conducted to identify trends within specific criteria. The data was then sorted into quartiles to identify strengths and weaknesses (Table III).

ICL1	**Pass Reports**	
STRENGTH	Cmd:7	Consideration of the JESIP principles for multi-agency operations
	Fail Reports	
	Und:9	Capabilities – any additional agencies or specialists needed.
	DM:9	Consideration of other responding agencies in decision making
	Plan:7	Planning of actions with consideration of or in co-operation with other responding agencies, as appropriate
	Rev:8	Modifications or introductions of changes, to incident plan
	Ant:9	Consideration of wider incident implications – cover moves, road closures, weather etc
WEAKNESS	**Pass Reports**	
	Plan:7	Planning of actions with consideration of or in co-operation with other responding agencies, as appropriate
	Und:9	Capabilities – any additional agencies or specialists needed.
	DM:9	Consideration of other responding agencies in decision making
	Rev:8	Modifications or introductions of changes, to incident plan
	Plan:9	Recording of essential information
	Ant:9	Consideration of wider incident implications – cover moves, road closures, weather etc
	Inf:9	Communication of the incident situation to other responders via fire control using the M/ETHANE
	Fail Reports	
	Comm:5	Effective communication of overall incident plan, incident command structure and communication strategy

	Cmd:7	Consideration of the JESIP principles for multi-agency operations
ICL2	**Pass Reports**	
STRENGTH	None	
	Fail Reports	
	Comm:8	Communication of the incident situation to other responders via fire control using the M/ETHANE
	Plan:8	Development & implementation of risk control/contingency measures and utilisation of safe systems of work
WEAKNESS	**Pass Reports**	
	Rev:5	Review of the effectiveness of current strategy and tactics
	DM:8	Appropriate FRS decision -making and frameworks utilisation
	Rev:7	Review of incident information to assess effectiveness & sustainability of resources & capabilities
	Comm:8	Communication of the incident situation to other responders via fire control using the M/ETHANE
	DM:9	Multi-agency decision-making consideration in line with local protocols
	Und:9	Consideration of wider issues – environment/community
	Rev:8	Evaluation of effectiveness of decisions & operations, (independently and multi-agency)
	Inf:9	Communication of the incident situation to other responders via fire control using the M/ETHANE
	Rev:4	Review effectiveness of multi-agency actions
	Ant:9	Anticipation of wider incident implications – cover moves, road closures, early joint media strategy
	Plan:9	Recording of essential information
	Fail Reports	
	Ant:6	Identification and understanding the implications of joint risks and hazards
	Cmd:8	Establishment & maintenance of the liaison with other agencies and consideration of JESIP principles
	Comm:4	Use of safety briefings, where appropriate, with other agencies and FRS personnel
	Plan:9	Recording of essential information
	DM:9	Multi-agency decision-making consideration in line with local protocols
	Und:6	Presence of risks/hazards: Understanding of risk information shared with other responding agencies
	Ant:9	Anticipation of wider incident implications – cover moves, road closures, early joint media strategy
	Und:9	Consideration of wider issues – environment/community

Table III. *The JESIP criteria Strengths (top quartile) and Weaknesses (lowest quartile) for ICL1 & ICL2 reports are presented in the table below. Column 2 shows the specific Effective Command framework criteria reference.*

This analysis generated some notable trends suggesting that distinct JESIP behaviours are linked with assessment success. In particular, consideration of the JESIP principles for multi-agency operations (Cmd:7) was recorded as the sole JESIP strength in Pass reports at ICL1, but as a weakness for Fail reports. Interestingly, several behaviours identified as JESIP strengths for Fail reports were also flagged as weaker areas for the Pass reports, suggesting that these may be general areas of training need for all ICL1 officers.

At ICL2, no JESIP criteria were identified in the top quartile as strengths for Pass outcomes. Among weaker criteria, 11 of 17 for Pass results and 8 of 17 for Fail were JESIP behaviours, with 4 overlapping across both groups. These included core JESIP principles such as multi-agency decision-making (DM:9), consideration of wider issues (Und:9), anticipation of wider incident implications (Ant:9), and recording of essential information (Plan:9).

Summary of Key Observations

The analysis revealed that JESIP-aligned behaviours were not consistently demonstrated across assessment contexts, command levels, or outcome groups. They were among the most frequently underperformed aspects of the command role, even in assessments that otherwise met the required standard. ICL1 and ICL2 officers in particular exhibited notable deficits in JESIP application, especially during planning, communication, and review phases. While ICL3 and ICL4 officers showed marginally stronger performance, no command level consistently demonstrated high-quality interoperability behaviours across all criteria.

Importantly, these findings suggest that interoperability shortcomings are not isolated to individual officers or scenarios but represent a systemic issue that cuts across experience levels, organisational settings, and command tiers. The data confirms that JESIP principles, although embedded within doctrine and assessment frameworks, are not being reliably translated into routine incident command practice.

Discussion

The findings from this analysis demonstrate that JESIP-aligned behavioural criteria were associated with consistently lower section-level performance scores but smaller within-section variance compared to non-JESIP items. This indicates that while interoperability behaviours were performed more uniformly, they were generally executed at a lower standard. The pattern was most pronounced in the Information, Understanding, and Communication domains, which are areas most dependent on shared situational awareness and joint understanding across agencies. These results therefore suggest that JESIP principles are conceptually recognised but not yet fully internalised or effectively demonstrated in practice, particularly at ICL1 and ICL2.The magnitude of observed differences ($r_{rb} \approx 0.30–0.50$) remains operationally meaningful, highlighting a consistent but limited expression of interoperability behaviours that reflects awareness without full behavioural integration (Pollock, 2013; Power *et al.*, 2023, 2024, 2025). The substantial inter-rater reliability established during data validation supports confidence in the consistency and robustness of these findings.

For ICL1 and ICL2 commanders, who make up the majority of the dataset, these lower JESIP scores were most evident in the Information Gathering, Anticipation, Decision Making, and Planning phases, the very stages that require the most explicit understanding and application of interoperability principles. The persistence of these shortfalls, even among assessments that achieved an overall Pass, suggests that general command competence does not automatically translate into effective multi-agency coordination. In other words, many officers appear familiar with JESIP concepts but struggle to operationalise them consistently during simulated or live incidents. This pattern supports the interpretation that interoperability behaviours have not yet become embedded as habitual elements of command practice, reinforcing the need for structured and recurrent multi-agency training.

At ICL3 and ICL4, the difference between JESIP and non-JESIP behaviours narrowed, particularly in the Command and Review sections. This suggests that greater experience and broader situational authority

may support more consistent application of interoperability principles. However, strategic planning, joint risk articulation, and the coordination of agency resources continued to show weaker performance, especially within the Planning section at ICL4. These results indicate that while higher command experience improves certain aspects of JESIP-related behaviour, it does not eliminate interoperability challenges. This aligns with previous findings that experience alone is insufficient to embed interoperability as a routine professional norm, reinforcing the importance of structured, joint, and context-rich training at all levels (Davidson, 2024; McLennan *et al.*, 2024).

These results are consistent with arguments by Power et al. (2023, 2024), who emphasise the need for cultural integration and shared professional identity in achieving operational interoperability. The data suggest that JESIP competencies have not yet become routine practice within the fire sector. While JESIP content is included in many initial training programmes, its practical application appears under-rehearsed, inconsistently assessed, or deprioritised during local command development. Where JESIP behaviours are treated as peripheral rather than central to operational performance, they are less likely to be sustained under operational conditions.

The findings also reflect the limitations of conventional training and assessment methods in promoting interoperability (Comfort, 2007; McLennan *et al.*, 2024). As noted by McLennan (2024) and Goldstein and Ford (2002), competence develops when learning is structured, reflective, and outcome driven. Exposure to JESIP concepts is not sufficient. Without integrated scenarios that require joint planning, communication, and shared situational awareness, commanders are unlikely to develop the skills needed to apply JESIP in high-consequence environments (Eraut, 2000). If assessments do not explicitly measure and prioritise interoperability behaviours, these skills may remain underdeveloped during professional progression.

The inclusion of JESIP behavioural markers within an assessment framework enables systematic observation and scoring of interoperability competencies, and the ability to compare JESIP-aligned behaviours with other command competencies provides a useful diagnostic tool for identifying organisational learning needs. However, the results show that inclusion alone is insufficient. Services must ensure JESIP behaviours are embedded in command development pathways and that feedback on performance is routine, specific, and used to inform training cycles (Tannenbaum and Cerasoli, 2013).

While the dataset analysed provides one of the most comprehensive evaluations of JESIP-aligned performance in the UK Fire and Rescue Service, the findings must be interpreted within several limitations. The analysis was based on assessor-coded behavioural evidence rather than direct observation of operational incidents and therefore reflects perceived rather than measured performance. In addition, JESIP alignment was inferred through the mapping of behavioural markers rather than explicit assessor identification. Although this approach allows for consistent retrospective analysis, it cannot determine causal relationships between JESIP adoption and improved outcomes.

Future research should seek to validate these findings through prospective, mixed-method designs linking assessment data to real-world operational metrics, such as incident outcomes, communication efficiency, or multi-agency task completion. Extending JESIP-linked behavioural analysis to police, ambulance, and

other Category 1 responders would further clarify how interoperability behaviours manifest across agencies. Such work would support the continuous improvement objectives of both the JESIP programme and the National Fire Chiefs Council's Effective Command initiative, providing a stronger evidence base for future training, accreditation, and operational assurance activities.

Conclusion

This evaluation represents the first large-scale quantitative analysis of JESIP principles embedded within the Effective Command (EC) framework of the UK Fire and Rescue Service. Across 6,317 anonymised assessments collected nationally between 2017 and 2024, JESIP-aligned behavioural criteria demonstrated consistently higher performance and lower variability than non-JESIP items, with statistically and operationally meaningful differences across six of eight EC sections. These results provide robust evidence that interoperability principles, when explicitly operationalised through behavioural assessment, contribute to more consistent, predictable, and effective EC behaviours.

1. Interoperability as Measurable Performance: The analysis confirms that interoperability behaviours (previously considered abstract or cultural) can be measured through structured behavioural observation, allowing JESIP principles to be empirically validated within assessment systems.

2. JESIP as a Behavioural Framework: Mapping the five JESIP principles to EC behavioural markers demonstrates that JESIP functions not merely as doctrine but as an observable behavioural model. The consistent association with higher scores suggests these behaviours have been internalised within command practice.

3. Consistency and Quality of Decision-Making: JESIP-linked items showed smaller interquartile ranges, reflecting greater reliability and confidence in shared situational awareness and joint understanding. This suggests that JESIP-aligned decision-making is more stable under assessment conditions, and likely under operational pressure.

4. Cross-Agency Relevance and Transferability: The study's methodology, combining JESIP mapping with quantitative assessment, offers a transferable model for other emergency services. Extending this approach to police, ambulance, and local resilience forums would enable systematic benchmarking of interoperability behaviours across agencies.

5. Assurance, Learning, and Training Impact: Integrating JESIP-aligned metrics within assessment frameworks enables organisations to evidence learning outcomes, target training interventions, and assure interoperability competence within accredited command pathways.

6. Evidence-Informed Policy and Doctrine: By demonstrating measurable links between JESIP-aligned behaviours and command performance, this study supports continued investment in national interoperability programmes. The results offer a data-driven rationale for embedding JESIP principles in policy, accreditation, and assurance standards.

7. Future Research Directions: Further studies should test causal relationships between JESIP adoption and real-world incident performance using prospective or mixed-method designs. Linking assessment data with operational outcomes, including communication accuracy, decision timeliness, and multi-agency task completion, would provide the next step in validating JESIP as an evidence-based framework for joint effectiveness.

In summary, JESIP-aligned behavioural criteria are associated with tangible improvements in the consistency and quality of decision-making across the Fire and Rescue Service. These findings affirm JESIP's enduring value as both a cultural and operational model, bridging doctrine, training, and performance assurance to enhance national interoperability.

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Appendix A: JESIP–EC Criteria Mapping

The Effective Command (EC) framework contains 72 behavioural markers per incident command level (ICL1–ICL4), giving 288 in total. For commercial and intellectual property reasons, the full set of criteria cannot be reproduced in this publication. Instead, this appendix provides the complete subset of EC behavioural markers identified as JESIP-relevant and used in the present analysis. Each criterion is listed verbatim, with its mapping to JESIP principles and the classification rule used (*explicit* = direct doctrinal reference; *proxy* = indirect alignment).

Criteria not listed here were treated as non-JESIP in the analysis. Where partial JESIP relevance was identified, criteria were classified as proxy indicators. Coding was conducted independently by two reviewers, with disagreements resolved through discussion. Inter-rater reliability for JESIP-relevant coding was assessed using Cohen's κ (κ = 0.74), indicating *substantial agreement* between independent coders (Cohen, 1960).

Command Level	Criterion ID	Verbatim Wording	JESIP Principle(s) Mapped	Classification Rule
ICL1	INF:9	Communication of the incident situation to other responders via fire control using the M/ETHANE message protocol	Communication; Shared situational awareness	Explicit
	UND:9	Capabilities – any additional agencies or specialists needed	Joint understanding of risk; Co-ordination	Proxy
	ANT:9	Consideration of wider incident implications – cover moves, road closures, weather etc	Co-ordination; Shared situational awareness	Proxy
	DM:9	Consideration of other responding agencies in decision making	Co-ordination; Joint understanding of risk	Proxy
	PLAN:7	Planning of actions with consideration of or in co-operation with other responding agencies, as appropriate	Co-ordination; Communication	Explicit
	PLAN:8	Development & implementation of risk control/contingency measures and utilisation of safe systems of work	Joint understanding of risk	Proxy
	PLAN:9	Recording of essential information	Shared situational awareness	Proxy
	COMM:5	Effective communication of overall incident plan, incident command structure and communication strategy	Communication	Explicit
	CMD:7	Consideration of the JESIP principles for multi-agency operations	All five principles	Explicit
	REV:8	Modifications or introductions of changes, to incident plan	Co-ordination; Review of shared situational awareness	Proxy
ICL2	INF:9	Communication of the incident situation to other responders via fire control using the M/ETHANE message protocol	Communication; Shared situational awareness	Explicit
	UND:6	Presence of risks/hazards: Understanding of risk information shared with other responding agencies	Joint understanding of risk	Explicit
	UND:9	Consideration of wider issues – environment/community	Joint understanding of risk	Proxy
	ANT:6	Identification and understanding the implications of joint risks and hazards	Joint understanding of risk; Shared situational awareness	Explicit
	ANT:9	Anticipation of wider incident implications – cover moves, road closures, early joint media strategy	Co-ordination; Shared situational awareness	Proxy
	DM:8	Appropriate FRS decision-making and frameworks utilisation	Co-ordination (via multi-agency frameworks)	Proxy
	DM:9	Multi-agency decision-making consideration in line with local protocols	Co-ordination; Communication	Explicit
	PLAN:7	Planning of actions with consideration of or in co-operation with other responding agencies, as appropriate	Co-ordination; Communication	Explicit
	PLAN:8	Development & implementation of risk control/contingency measures and utilisation of safe systems of work	Joint understanding of risk	Proxy
	PLAN:9	Recording of essential information	Shared situational awareness	Proxy

Command Level	Criterion ID	Verbatim Wording	JESIP Principle(s) Mapped	Classification Rule
	COMM:4	Use of safety briefings, where appropriate, with other agencies and FRS personnel	Communication	Explicit
	COMM:8	Communication of the incident situation to other responders via fire control using the M/ETHANE message protocol	Communication; Shared situational awareness	Explicit
	CMD:8	Establishment & maintenance of the liaison with other agencies and consideration of JESIP principles	All five principles	Explicit
	REV:4	Review effectiveness of Multi-agency actions	Co-ordination; Review	Explicit
	REV:5	Review of the effectiveness of current strategy and tactics	Co-ordination	Proxy
	REV:7	Review of incident information to assess effectiveness & sustainability of resources & capabilities	Shared situational awareness; Joint understanding of risk	Proxy
	REV:8	Evaluation of effectiveness of decisions & operations (independently and Multi-Agency)	Co-ordination; Joint understanding of risk	Explicit
ICL3	INF:5	Gathering of information from available sources to gain accurate situational awareness and understanding	Shared situational awareness	Explicit
	UND:7	Obtaining and understanding of technical / professional advice	Joint understanding of risk	Proxy
	UND:9	Consideration of the broad effect of the incident on the organisation and further afield	Joint understanding of risk	Proxy
	ANT:8	Ability to anticipate current and potential resource/specialist requirements linked to the incident objectives and plan	Co-ordination	Proxy
	ANT:9	Anticipation of wider incident implications – cover moves, road closures, early joint media strategy	Co-ordination; Shared situational awareness	Proxy
	DM:8	Appropriate FRS decision-making and frameworks utilisation	Co-ordination (via frameworks)	Proxy
	DM:9	Multi-agency decision-making consideration in line with local protocols	Co-ordination; Communication	Explicit
	PLAN:2	Development of strategies that are aligned to objectives, and a joint Multi-agency working strategy	Co-ordination; Communication	Explicit
	PLAN:5	Request of appropriate resources incl. local, regional, national, international arrangements	Co-ordination	Explicit
	PLAN:7	Planning of actions with internal FRS support functions and other responding/support agencies	Co-ordination	Proxy
	PLAN:8	Development & implementation of risk control/contingency measures and utilisation of safe systems of work	Joint understanding of risk	Proxy
	PLAN:9	Recording of essential information	Shared situational awareness	Proxy
	COMM:4	Use of safety briefings, where appropriate, with other agencies and FRS personnel	Communication	Explicit
	COMM:6	Effective Communication with local community – warn & inform	Communication; Shared situational awareness	Proxy
	COMM:7	Effective wider incident media management	Communication; Co-ordination	Proxy
	COMM:8	Communication of the incident situation to other responders via fire control using agreed formats	Communication; Shared situational awareness	Explicit
	CMD:8	Establishment & maintenance of the liaison with other agencies and consideration of JESIP principles	All five principles	Explicit
	REV:4	Review effectiveness of Multi-agency actions	Co-ordination; Review	Explicit
	REV:5	Review of the effectiveness of current strategy and tactics	Co-ordination	Proxy
	REV:7	Review of incident information to assess effectiveness & sustainability of resources & capabilities	Shared situational awareness	Proxy
	REV:8	Evaluation of effectiveness of decisions & operations (independently and multi-agency)	Co-ordination; Joint understanding of risk	Explicit
ICL4	INF:5	Gathering of information from available sources to gain accurate situational awareness and understanding	Shared situational awareness	Explicit
	UND:4	Presence of Risks/Hazards and hazard area clearly communicated and understood across other agencies	Joint understanding of risk; Communication	Explicit
	UND:7	Obtaining and understanding of technical / professional advice	Joint understanding of risk	Proxy
	UND:9	Consideration of the broad effect of the incident on the organisation and further afield	Joint understanding of risk	Proxy
	ANT:8	Ability to anticipate current and potential resource/specialist requirements linked to the incident objectives and plan	Co-ordination	Proxy

Command Level	Criterion ID	Verbatim Wording	JESIP Principle(s) Mapped	Classification Rule
	ANT:9	Anticipation of wider incident implications – cover moves, road closures, early joint media strategy	Co-ordination; Shared situational awareness	Proxy
	DM:9	Multi-agency decision-making consideration in line with local protocols	Co-ordination; Communication	Explicit
	PLAN:2	Development of strategies that are aligned to objectives, and a joint multi-agency working strategy	Co-ordination; Communication	Explicit
	PLAN:5	Request of appropriate resources incl. local, regional, national, international arrangements	Co-ordination	Explicit
	PLAN:7	Planning of actions with internal FRS support functions and other responding/support agencies	Co-ordination	Proxy
	PLAN:8	Development & implementation of risk control/contingency measures and utilisation of safe systems of work	Joint understanding of risk	Proxy
	PLAN:9	Recording of essential information	Shared situational awareness	Proxy
	COMM:4	Use of safety briefings, where appropriate, with other agencies and FRS personnel	Communication	Explicit
	COMM:6	Effective Communication with local community – warn & inform	Communication; Shared situational awareness	Proxy
	COMM:7	Effective wider incident media management	Communication; Co-ordination	Proxy
	COMM:8	Communication of the incident situation to other responders via fire control using agreed formats	Communication; Shared situational awareness	Explicit
	CMD:8	Establishment & maintenance of the liaison with other agencies and consideration of JESIP principles	All five principles	Explicit
	CMD:9	Ensure systems for ongoing safety, sustainability, and welfare (and incident recovery)	Co-ordination; Review	Proxy
	REV:4	Review effectiveness of multi-agency actions	Co-ordination; Review	Explicit
	REV:5	Review of the effectiveness of current strategy and tactics	Co-ordination	Proxy
	REV:7	Review of incident information to assess effectiveness & sustainability of resources & capabilities	Shared situational awareness	Proxy
	REV:8	Evaluation of effectiveness of decisions & operations (independently and multi-agency)	Co-ordination; Joint understanding of risk	Explicit

Appendix B: Full descriptive statistics for all JESIP and non-JESIP behavioural markers.

	mean	std	25%	50%	75%	IQR
q1_1	3.29719	0.594081	3	3	4	1
q1_2	3.236061	0.558532	3	3	3	0
q1_3	3.235158	0.585863	3	3	3	0
q1_4	3.222952	0.574381	3	3	3	0
q1_5	3.212745	0.598595	3	3	3	0
q1_6	3.161603	0.517579	3	3	3	0
q1_7	3.153568	0.522174	3	3	3	0
q1_8	3.218145	0.552487	3	3	3	0
q1_9	3.116225	0.529588	3	3	3	0
AverageScoreForInformation	3.191178	0.428477	3	3	3.3	0.3
q2_1	3.238411	0.552385	3	3	3	0
q2_2	3.198914	0.544636	3	3	3	0
q2_3	3.228099	0.57373	3	3	3	0
q2_4	3.198458	0.56347	3	3	3	0
q2_5	3.235451	0.564794	3	3	3	0
q2_6	3.174653	0.568167	3	3	3	0
q2_7	3.173574	0.510704	3	3	3	0
q2_8	3.210136	0.570877	3	3	3	0
q2_9	3.162254	0.535299	3	3	3	0
AverageScoreForUnderstanding	3.188324	0.435954	3	3	3.3	0.3
q3_1	3.215575	0.558788	3	3	3	0
q3_2	3.216934	0.558251	3	3	3	0
q3_3	3.189025	0.541999	3	3	3	0
q3_4	3.192837	0.543874	3	3	3	0
q3_5	3.17829	0.548953	3	3	3	0
q3_6	3.19166	0.55511	3	3	3	0
q3_7	3.171589	0.521484	3	3	3	0
q3_8	3.160795	0.542177	3	3	3	0
q3_9	3.135617	0.524098	3	3	3	0
AverageScoreForAnticipation	3.170278	0.435609	3	3	3.2	0.2
q4_1	3.188602	0.548855	3	3	3	0
q4_2	3.22026	0.590855	3	3	3	0
q4_3	3.221196	0.546818	3	3	3	0
q4_4	3.237167	0.582533	3	3	3	0
q4_5	3.246861	0.568452	3	3	3	0
q4_6	3.208119	0.537052	3	3	3	0
q4_7	3.188153	0.521612	3	3	3	0
q4_8	3.17218	0.500151	3	3	3	0
q4_9	3.163332	0.518961	3	3	3	0
AverageScoreForDecisionMaking	3.192011	0.446192	3	3	3.3	0.3
q5_1	3.268037	0.574027	3	3	3	0
q5_2	3.211216	0.541498	3	3	3	0
q5_3	3.224546	0.559261	3	3	3	0

q5_4	3.227416	0.565868	3	3	3	0
q5_5	3.177575	0.550014	3	3	3	0
q5_6	3.181836	0.550602	3	3	3	0
q5_7	3.170619	0.506757	3	3	3	0
q5_8	3.173579	0.521739	3	3	3	0
q5_9	3.139256	0.553881	3	3	3	0
AverageScoreForPlan	3.183835	0.437994	3	3	3.2	0.2
q6_1	3.231605	0.558505	3	3	3	0
q6_2	3.24508	0.583094	3	3	3	0
q6_3	3.198295	0.578031	3	3	3	0
q6_4	3.164628	0.541556	3	3	3	0
q6_5	3.185518	0.54882	3	3	3	0
q6_6	3.161343	0.51	3	3	3	0
q6_7	3.189675	0.541412	3	3	3	0
q6_8	3.178784	0.567826	3	3	3	0
q6_9	3.181419	0.519973	3	3	3	0
AverageScoreForCommunication	3.179442	0.439056	3	3	3.2	0.2
q7_1	3.194782	0.541431	3	3	3	0
q7_2	3.18691	0.541442	3	3	3	0
q7_3	3.225685	0.57439	3	3	3	0
q7_4	3.215276	0.546861	3	3	3	0
q7_5	3.184113	0.566341	3	3	3	0
q7_6	3.19082	0.54285	3	3	3	0
q7_7	3.246967	0.58347	3	3	3	0
q7_8	3.140041	0.49638	3	3	3	0
q7_9	3.143192	0.48956	3	3	3	0
AverageScoreForCommand	3.178729	0.434861	3	3	3.2	0.2
q8_1	3.1876	0.53264	3	3	3	0
q8_2	3.196409	0.533455	3	3	3	0
q8_3	3.217267	0.548253	3	3	3	0
q8_4	3.182519	0.511756	3	3	3	0
q8_5	3.186656	0.515756	3	3	3	0
q8_6	3.152365	0.474465	3	3	3	0
q8_7	3.161701	0.503434	3	3	3	0
q8_8	3.159917	0.478485	3	3	3	0
q8_9	3.151064	0.466519	3	3	3	0
AverageScoreForReview	3.165939	0.417122	3	3	3.2	0.2