

The End of the Conference Table

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1 Abstract

Recent conflicts have demonstrated that the traditional model of assembling leaders and decision-makers physically in one place is increasingly unacceptable. The war in Ukraine highlights the need for distributed, resilient approaches to command and control that can adapt to rapidly changing circumstances [1].

This paper argues that we are approaching the “end of the conference table”. Continuing ‘as before’ is no longer an option; instead, new technologies must be leveraged not to replicate familiar environments, but to create fundamentally new ways of operating across domains.

Immersive technologies, and in particular virtual reality (VR), open possibilities that go far beyond conventional teleconferencing or digital replicas of meeting rooms. Rather than reproducing walls and tables, VR-native environments enable the fusion of live operational data, geospatial intelligence, sensor feeds, and human collaboration into a shared space where complexity is made comprehensible [2]. This spatialization of data allows distributed teams to visualize, interpret, and act upon dynamic information collectively, creating an operational picture that supports faster, more accurate, and more confident decision-making.

For multi-domain operations, the implications are profound. Distributed headquarters and virtual joint operations centers can be established rapidly, with participants collaborating across geographic distances as though co-located. Real-time force tracking of layered geospatial overlays, and integrated sensor inputs can be manipulated directly within immersive environments, supporting planning, rehearsal, and execution in contested or denied areas where physical gathering is not possible. Such environments are inherently dual-use: the same capabilities that support multi-domain command and control can also be applied to disaster response, civil protection, and cross-agency coordination in crises.

From a human performance perspective, immersive collaboration reduces the cognitive burden of interpreting fragmented data streams. Abstract information becomes tangible, enabling teams to reach shared understanding more quickly. Younger generations adapt readily to these environments, while intuitive design can reduce adoption barriers for more senior personnel. The result is a human-technology interface that strengthens, rather than complicates, the decision-making process under pressure.

Architecturally, VR-native solutions can interconnect with existing systems such as TAK servers or GIS platforms, while remaining extensible to future capabilities including artificial intelligence, predictive

analytics, and natural language interfaces. This flexibility creates the foundation for distributed, resilient, and adaptive command structures suited to multi-domain operations of the future.

Immersive environments therefore represent more than a substitute for physical meetings: they are an operational enabler. By reimagining how humans and technology interact to make sense of complexity, defense organizations can achieve new levels of situational awareness, interoperability, and adaptability. These possibilities redefine not just where commanders gather, but how they think, decide, and act in the multi-domain battlespace.

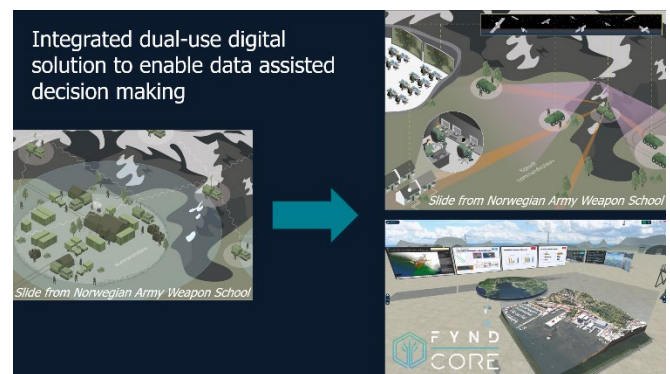


Fig. 1. Moving from a centralized HQ to a virtual, distributed, version.

2 Introduction

Recent conflicts and contested communications environments have exposed the fragility of command models that depend on physically co-located decision makers. When teams cannot reliably assemble around a conference table, organizations must adopt distributed, resilient approaches that maintain tempo and decision quality under pressure. Immersive technologies, especially virtual reality (VR), offer a path beyond teleconferencing and flat dashboards by enabling shared, spatialized operational pictures where data, geography, and human collaboration converge.

These technologies are rapidly changing and adapting and as Lt. Gen. M. Beagle et al. states: “The aaS (“as a Service”) approach enables rapid adoption of emerging technology and mobility, and it opens the door to competition among providers, which ensures our soldiers have the very best capability available. Consider, for example, the unique and creative ways Ukraine is using Starlink’s capabilities without owning the satellites and the associated skill sets and support infrastructure” [3].

This paper synthesizes insights from Fynd Reality and the Norwegian Defense Research Establishment’s (FFI) experiment on distributed command support tools and develops an architectural and human factors case for VR

native operations centers that can be assembled rapidly, can integrate with existing systems, and can be scaled across domains.



Fig. 2. Screenshot from platform software Fynd CORE during an exercise.

3 Background

Traditional command centers depend on proximity to build shared understanding: maps on walls, planners around tables, and face to face interaction over a conference table to resolve ambiguity. In high threat, degraded, or denied environments, however, physical co-location becomes untenable. Immersive technologies, and in particular virtual reality (VR), open possibilities that go far beyond conventional Communications and Information Systems (CIS). As Jim Storr states in his analysis of the command of western armed forces: “(...) digital technology *should* enable people to work better. It already allows people to do things that were impossible 20 or 30 years ago (for example, you can now operate a drone from a smartphone. You can receive and record its imagery in real time).” [3].

The Norwegian Army (Brigade Nord) and partners have therefore joined Fynd Reality and FFI in exploring digital substitutes for rehearsal of concept drills (ROC drills) and short “huddles” using existing tools (voice, chat, K2IS apps like NORCCIS) versus VR based collaboration. The project “Digital Tools for the Army’s Command Posts” ran in 2024–2025 with Fynd Reality (VR technology and platform provider) and the Army Weapons School as user representatives [2].

4 Experiment overview

Fynd Reality and FFI conducted a controlled experiment at Bardufoss with six to seven participants drawn from Brigade Nord staff and battalions, distributed across three to four rooms in an office-like indoor setting.

Two processes were executed in distributed fashion: a ROC drill and a huddle. Each process was run twice—first with “today’s tools” (Day 1: voice via TVS, chat via JChat, and NORCCIS K2IS application), then with a VR application (Day 2: experimental variant of Fynd CORE). In VR, participants entered a shared virtual room via headsets and controllers; the environment featured a 3D floor map, relevant overlays, and documents pinned to virtual walls. Avatars allowed users to see each other, speak, point, and move pieces on the map [2].

To manage security and resources, two related but not identical scenarios were used. Day 1 employed a known plan segment; Day 2 used a slightly adapted scenario with an

emergent situation for the huddle. The evaluation relied on structured group discussions after each run (four total), focusing on usability, understanding, and perceived operational applicability. FFI cautions that the short duration (~3 hours of active play) and limited participant count constrain the strength of conclusions, but several notable indications emerged [2].

5 Findings

5.1 Baseline (“Today’s Tools”)

Participants generally agreed that voice, chat, and NORCCIS can support distributed ROC drills and huddles “well enough,” with stronger fit for prepared processes (ROC) than for spontaneous coordination (huddle). Advantages include clear shared map visibility and ease of distributing ROC outputs (text and images) to non-participants. Reported drawbacks include reduced human contact when communicating “from behind a screen” and dependence on prior familiarity with the plan to achieve good understanding [2]. Participants emphasised the need for disciplined facilitation, consistent map layers, robust pointing/annotation, movable pieces, and careful preparation of ROC scripts.

5.2 VR-Based Collaboration

All participants considered the VR application sufficiently functional to run both processes and potentially usable in operations [2]. Some found it particularly well suited to spontaneous information sharing (huddle). VR often yielded better understanding of plans than baseline tools and felt closer to a physical meeting; several judged it superior to a physical paper map because many can participate concurrently and 3D affordances improve spatial reasoning. Avatars, embodied pointing, and piece manipulation contributed to richer human interaction. Noted caveats included motion sickness for a few users and the small slice of a larger process covered in the experiment [2].

5.3 FFI’s Assessment

The experiment concludes that both approaches can support distributed processes, though each face technical and human factor challenges. “Low hanging fruit” exist to improve current tools via better functionality, setup, and method discipline [2]. Importantly, the experiment indicates that VR (3D headsets + virtual rooms) may enable better comprehension of maps and plans than voice/chat/K2IS alone, likely due to immersive 3D navigation of terrain and force dispositions, embodied co presence with visible gestures and object manipulation, and an increased sense of human interaction compared to screen mediated communication. The experiment results stresses uncertainty and calls for broader, more realistic trials across levels and units, and for rigorous consideration of operational requirements (security, communications, local processing/storage, sustainment) [2].

6 Interpreting the results

Spatialisation of data, turning abstract streams into navigable terrain, reduces cognitive overhead in fusing geospatial intelligence, sensor feeds, and human inputs. In VR, commanders can walk the map, trace routes, test timing, and visualise layered effects (fires, EW, ISR) as lived geometry rather than flat symbols. Embodied cues (where a colleague stands, points, or moves units) enrich shared understanding beyond what teleconferencing or 2D dashboards can convey [2]. These affordances plausibly explain the observed improvement in plan comprehension and the “closer to physical meeting” sentiment in the experiment [2].

7 Architecture for VR-native Distributed Command

A pragmatic architecture should augment existing systems rather than replace them overnight. Based on the experiment’s integration conditions and operational realities, the following is proposed:

1. Main VR Collaborative Layer (VR C2): A secure, session-based environment with 3D terrain, multiuser avatars, shared objects, and ICE (Ingest Compute Exploit) pipelines for live data. They must support robust pointing, annotation, object manipulation, and versioned scenario states (plan, COAs, rehearsals).
2. Interoperability with K2IS/GIS (e.g., NORCCIS or similar): Two-way sync for overlays, symbols, and products; authoritative data stays in K2IS while VR provides the collaborative “lens.” Fynd Reality, FFI and participants explicitly highlighted integration with NORCCIS as a requirement going forward.
3. TAK/Edge Integration: Where available, federate with TAK servers to ingest field reports and sensor cues; abstract feeds into 3D layers for force tracking and ISR (alignment with FFI’s note to test across processes and levels before procurement decisions).
4. Security and Network Resilience: Zero trust posture, multi-level security enclaves, and offline/fallback modes with local processing and storage to meet operational requirements FFI flags (security, comms, local compute, sustainment).
5. Operational Sustainment: Roles for VR C2 administrators, data stewards, and scenario librarians; device lifecycle plans; training pipelines to ensure users have necessary competence, which is another explicit participant prerequisite.

8 Human Factors and Adoption

The participants of the experiment pointed to richer human interaction via avatars and gestures, and to the importance of facilitation, consistent layers, and prepared content regardless of medium. To translate that into doctrine:

- Facilitated Turn Taking: Explicit moderation for large huddles to avoid cognitive overload.

- Common Operational Picture Discipline: Shared layer standards, symbol conventions, and authorised pointing/annotation channels to prevent divergence.
- Motion Comfort: Session lengths, locomotion modes (teleport vs. smooth), and acclimatisation to reduce sickness reports.
- Record Keeping: Maintain a “referent” role for ROC drills to log plan adjustments; VR should export state changes to textual/visual artifacts.
- Training Pathways: Tiered familiarisation for senior personnel to reduce adoption barriers, leveraging the observed intuitiveness for younger users while ensuring cross generational usability (consistent with participants’ competence prerequisite).

9 Limitations and research needed

The experiment results explicitly cautions that conclusions are tentative: short duration, few participants, roles not always matching normal duties, and vendor coaching present during sessions. Future work should expand trials to cover full plan–order cycles, include more players, and test different echelons and units. Procurement decisions must follow rigorous evaluation of security, communications, local processing/storage, and sustainment constraints in crisis/war conditions.

10 Operational Use Cases

Virtual Joint Operations Centres (VJOCs): Rapidly established cross service cells where ISR overlays, EW effects, and fires planning are co manipulated in 3D, enabling faster COA comparison and rehearsal when physical gathering is unsafe (aligned with FFI’s indication that VR improved map/plan comprehension, especially for spontaneous coordination).

Distributed Brigade HQs: Brigade and battalion staff remain dispersed yet conduct ROC drills within an immersive COP, preserving tempo during mobility or under threat.

Civil Military Crisis Cells: Dual use application for disaster response and civil protection, where agencies integrate geospatial layers (infrastructure, hazards, resources) and coordinate in VR when physical EOCs are compromised (The experiment results call for broader testing across processes/levels before adoption).

Recommendations

The following constitutes the main recommendations for further testing and piloting of VR for distributed command, based on the experiment results.

- Iterative VR-C2 Pilots: Conduct longer, scenario-complete experiments (planning → ROC → order → execution) with larger teams and realistic constraints (bandwidth, emissions control, security).
- NORCCIS Integration Prototype: Build a bidirectional adapter for overlays, symbol sets, and ROC artifacts; validate export/import of state changes and audit trails

(referent logs).

- Human-Factors Protocols: Standardize facilitation, pointing/annotation, and motion comfort settings; introduce pre-session briefings and post-session artifact generation.
- Operational Readiness Assessment: Security architecture, comms resilience, local compute/storage, device management, and operator training plans—preconditions FFI lists for any real operational use.
- Cross-Echelon Trials: Test at multiple levels (company, battalion, brigade, joint) and across different services to pinpoint where VR yields the greatest marginal benefit

Conclusion

The end of the conference table is not simply about replacing physical rooms with their digital twins. It is about transforming how teams see, reason, and decide together, with one or more people sitting at the end of their own conference tables. The experiment suggests that VR-native environments can improve understanding of complex geospatial plans and enable richer human interaction than screen-bound tools, particularly for spontaneous coordination. While today's tools can still deliver "good enough" distributed processes, and should be improved with low-effort fixes, VR opens a path to operationally meaningful collaboration: distributed HQs, VJOCs, and crisis cells that fuse data and human intention in space, not just on screens.

Achieving this vision demands disciplined integration with existing systems (e.g., NORCCIS), careful attention to security and sustainment, and robust human-factors practices. With those in place, immersive environments cease to be a substitute and become an enabler—reshaping not where commanders meet, but how they think, decide, and act across the multi-domain battlespace.

It also demands that the people who sit at the end of the conference table are ready to exploit the possibilities presented by new technologies such as VR.

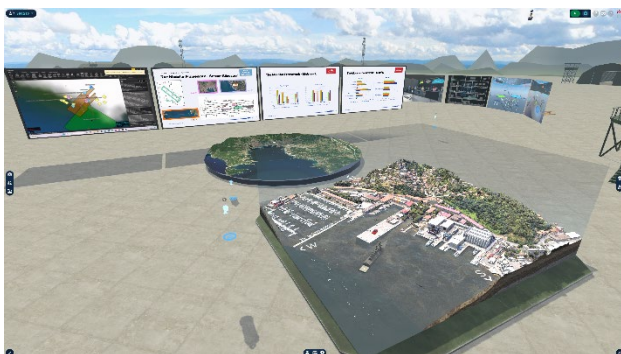


Fig. 3. Screenshot from platform software Fynd CORE during exercise

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Kristine is the CTO of Fynd Reality. She develops the company's technology strategy focusing on the use of Extended Reality technologies in training and education. She has experience with XR training solutions for military and civilian users and sees the challenges that large organizations face with implementing these technologies.