

Trinity: A Situation-Aware Multi-Agent Framework for AI-Driven Data Journalism

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Abstract

Information overload, fragmented attention, and increasing demands on editorial production and audience comprehension are reshaping modern news ecosystems. While AI technologies are becoming widespread in journalism, most current approaches focus on isolated tasks rather than supporting contextual understanding across the news process. This paper presents Trinity, a situation-aware framework for AI-supported journalism structured around three components: a Data Platform, an Editorial Assistant, and Reader Tools. Trinity adopts a coordinated agentic ecosystem in which the various components are embedded within a broader layer of distributed intelligent components. Together, these components contribute to a shared situation-aware foundation for supporting both journalists and readers. The study adopts a qualitative, design-oriented approach based on interviews, personas, and scenarios to identify user needs and inform the framework design. The personas and scenarios discussed in this paper are representative examples selected from a broader set of user profiles and use situations identified during the analysis process. The proposed model is illustrated through these selected scenarios, highlighting its potential to support time-sensitive production, press review, and reader understanding.

Keywords

AI Journalism, Situation Awareness, Multi-Agent Systems, Data Journalism, Augmented Journalism, Reader Understanding

1. Introduction

The contemporary news ecosystem is marked by information overload, source fragmentation, and time pressure, all of which make it harder to identify what is actually relevant and reliable [1]. In journalism, a key challenge lies in transforming heterogeneous and rapidly evolving inputs into verified knowledge, and consequently into content that is comprehensive, accurate, and timely [2]. Journalists are increasingly required to produce news stories within short timeframes while gathering accurate and reliable information about the events they cover. In doing so, they must navigate an increasingly crowded and poorly regulated information ecosystem, which also raises significant concerns related to misinformation and fake news.

Modern AI approaches [3] can provide support in planning and writing news stories, but the journalist’s role remains irreplaceable because relevance, reliability, and public value cannot be determined automatically: they require context, ethical evaluation, and responsibility in publication. AI can therefore support journalists, but final interpretation and accountability remain human. This is the logic of augmented journalism [4].

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Our proposal starts precisely from this point and introduces Trinity, a multi-agentic platform conceived as an innovative form of editorial support. Trinity integrates a multimodal AI engine with a text-to-widget workflow, allowing heterogeneous information from multiple sources, such as editorial repositories, social media, public datasets, and historical archives, to be transformed into interactive visual analytics components tailored to user needs. Using deep learning and Natural Language Processing techniques, the platform supports contextual fact-checking and claim verification, while also generating configurable widgets, including charts, maps, and timelines, that help users rapidly grasp the broader analytical context. To the best of our knowledge, Trinity is the first human-AI teaming approach explicitly aimed at supporting readers' understanding of news, thereby enhancing Situation Awareness (SA) both for journalists involved in news production and for readers engaging with the final content.

Indeed, SA refers to the ability of a human or artificial agent to understand what is happening in a dynamic environment to support informed decision making [5]. Although SA has received limited explicit attention in journalism as a framework for supporting news production, it could provide significant benefits in this domain. In particular, Trinity aims to facilitate article and editorial planning, support journalists in collecting and interpreting sources, and assist the writing process itself, thereby also improving readers' understanding of and satisfaction with journalistic content.

Accordingly, the paper describes the Trinity multi-agent approach and illustrates it through scenario-based cases derived from the requirements elicitation process.

The remainder of the paper is organized as follows. Section 2 discusses the related work on information overload, Situation Awareness, and multi-agent approaches for situation-aware systems. Section 3 presents the Trinity framework, describing its three main components and its design of distributed intelligent agents. Section 4 explains the qualitative and design-oriented research approach based on interviews, personas, scenarios, and requirements. Section 5 illustrates the framework through three representative scenarios that involve editorial production, press review, and reader contextualization. Section 6 discusses the main cognitive, architectural, and service implications of the framework, while Section 7 concludes the paper and outlines future research directions.

2. Background and Related Work

This section discusses the main conceptual and technological foundations underlying the Trinity framework. First, it examines the challenges introduced by information overload in contemporary journalism. It then introduces Situation Awareness as the cognitive and design perspective adopted to structure contextual support, and finally discusses how recent multi-agent approaches provide an architectural rationale for distributed and situation-aware intelligent systems.

2.1. Journalism under information overload

Contemporary journalism operates in an environment characterized by a massive amount of information, rapid news cycles, and growing fragmentation across sources, platforms, and formats [1]. In such conditions, the key challenges are to identify relevant signals, verify them under time pressure, and transform heterogeneous input into coherent editorial knowledge [2, 6].

This transformation has also affected the audience side. News consumption occurs increasingly through mobile and social platforms, where users encounter complex events through fragmented, decontextualized, and often emotionally amplified content streams [1]. As a result, readers are frequently exposed to information without sufficient cues to assess source reliability, interpret significance, or understand how a story connects to a broader situation [7, 8, 9, 10].

AI-based tools can partly address these difficulties, but many current applications focus primarily on automation or content generation rather than structured support for understanding [4, 6]. For this reason, journalism needs systems that explicitly support the construction of a coherent situational picture that can be shared by both the journalist and the reader.

2.2. Situation Awareness for news ecosystems

SA offers a useful conceptual framework for addressing these challenges. In its classical formulation, SA is defined by Endsley as *the perception of relevant elements in the environment, the comprehension of their meaning, and the projection of their status in the near future* [5]. Although originally developed in high-risk operational domains, this model is highly relevant to journalism, where actors must continuously distinguish meaningful signals from background noise, interpret evolving events, and anticipate short-term developments under uncertainty [5, 11].

Endsley's three-level model is particularly useful in this regard. At the first level, perception concerns the identification of relevant elements within a complex environment. At the second level, comprehension involves integrating those elements into an interpretable picture of what is actually happening. At the third level, projection concerns the ability to anticipate how the situation may evolve in the immediate future [5]. In news work, these three levels closely correspond to editorial needs: selecting fundamental information, interpreting it within a broader context, and understanding what developments or implications may follow.

From a design perspective, this also implies that effective support cannot be achieved by simply presenting larger quantities of data. Instead, systems should be organized around users' cognitive goals and informational needs, so that information supports understanding rather than overload [12, 11]. This view is consistent with Situation-Awareness-Oriented Design, which argues that interfaces and support systems should be structured around what users need to perceive, understand, and project in order to act effectively [12, 13].

A related distinction is that between context-aware and situation-aware systems, although in the academic literature and technical applications, the terms are frequently used interchangeably, leading to a lack of conceptual clarity. Context-aware systems adapt to environmental variables or user conditions, but they do not necessarily infer their operational significance. Situation-aware systems go further by interpreting the operational significance of contextual information in relation to users' goals, constraints, cognitive workload, and decision-making needs [14]. In the journalism domain, this distinction is crucial because recognizing that a journalist is consulting multiple sources is not equivalent to understanding that they are managing a breaking-news event under severe verification pressure. For Trinity, the shift from context to situation is therefore essential to reduce cognitive burden and provide support that is genuinely relevant to decisions and interpretation.

2.3. Multi-agent perspective on situation-aware systems

The informational environment addressed by Trinity is inherently dynamic and distributed. It involves heterogeneous data sources, multiple editorial tasks, different user roles, and reader-facing outputs that must remain coherent despite rapid change, partial information, and uncertainty [15]. These characteristics make monolithic solutions less suitable than architectures in which coordination operates across multiple tightly connected components, each contributing to the progressive construction, verification, and redistribution of situationally relevant information [16].

In this sense, Trinity is a socio-technical information system in which multiple intelligent functions span the Data Platform, the Editorial Assistant, and the Reader Tools. This perspective highlights a set of cooperating functions responsible for data collection, classification, contextualization, editorial support, and reader-oriented explanation, rather than a single undifferentiated intelligence layer. This framing is especially appropriate in environments where information must be continuously gathered, interpreted, updated, and redistributed between different interaction points and user groups [17].

This architectural reading is also consistent with recent developments in the literature on agentic AI for situation-aware systems. Recent multi-agent approaches suggest that, in complex and distributed domains, situational understanding is increasingly produced through the coordination of specialized modules for perception, information structuring, retrieval, reasoning, and decision support rather than through a single general-purpose model. In smart-grid dispatching automation, for example, Liu et al. [18] describe a hierarchical architecture in which large language models, knowledge graphs,

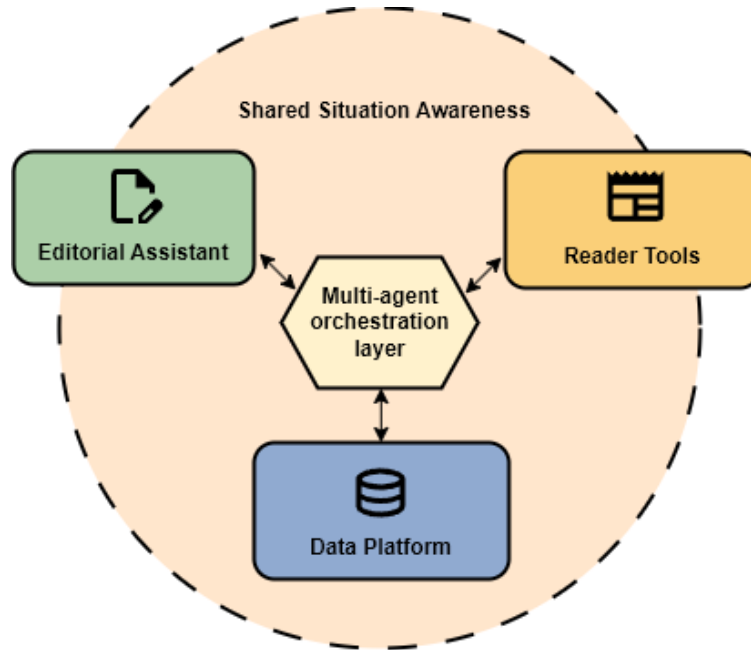


Figure 1: The Trinity framework

and AI agents interact within a closed-loop perception–cognition–decision–execution cycle. In cyber defense, Cao et al. [19] propose a multi-agent framework for zero-trust SAGIN in which summarization, advisory and decision agents cooperate to transform distributed logs and threat intelligence into an integrated defensive assessment. In multimodal wireless environments, ENWAR 2.0 by Nazar et al. [20] further extends this logic through a pipeline that combines beam prediction, environment perception, adaptive retrieval, and LLM-based reasoning in order to maintain a situation-aware representation of the surrounding physical and communication context.

Taken together, these studies suggest that the value of multi-agent architectures lies not only in modularity, but also in their capacity to preserve grounding, distribute specialized functions, and connect situational interpretation to operationally meaningful outputs. This point is directly relevant to Trinity. Although Trinity operates in a different domain, it faces a structurally similar challenge: transforming heterogeneous, rapidly changing, and partially distributed inputs into coherent support for multiple actors with different informational needs. For this reason, Trinity is best interpreted as a framework in which coordinated intelligent agents progressively turn raw signals and content flows into usable situational support for journalists, editors, and readers.

Compared with the multi-agent frameworks discussed above, Trinity places a stronger emphasis on news understanding rather than on automation alone, introducing a journalism-specific agentic architecture that transforms fragmented information flows into shared situational knowledge for journalists and readers.

3. Trinity Framework

This section presents Trinity as a situation-aware multi-agentic approach for augmented journalism. Trinity is designed as a system that connects the information infrastructure, editorial support, and reader-facing interaction under a common logic of contextual assistance. This design responds to the broader evolution of computational and AI-assisted journalism while keeping contextual understanding and human oversight central to system behavior [2, 6]. Figure 1 summarizes the overall architecture of Trinity and the relationship among its main components.

Trinity is organized around three complementary components: a Data Platform, an Editorial Assistant, and Reader Tools. This triadic structure connects infrastructural processing with differentiated forms

of support for journalistic production and public understanding, in line with work on AI-assisted journalism and human-centered AI that emphasizes interpretability, accountability, and meaningful human control [21].

The Data Platform collects and structures heterogeneous evidence; the Editorial Assistant uses this informational base to support writing, verification, and data-driven composition; and Reader Tools expose contextual intelligence through explanatory and interactive interfaces. Across these components, information is progressively transformed from raw input into goal-relevant support through shared situation-aware logic and differentiated interaction surfaces.

3.1. Data Platform

The Data Platform constitutes the infrastructural backbone of Trinity, and it deals with the storage, continuous acquisition, normalization, enrichment, and retrieval of heterogeneous data needed to build a coherent representation of ongoing situations. This is especially important in journalism, where relevant evidence is often distributed in multiple formats, sources, and temporal layers [2, 6].

In practical terms, the platform is designed to integrate different classes of sources, including open data, editorial archives, social media streams, newsroom content, agency material, and verified third-party services. This heterogeneity is valuable because complex news situations typically require the correlation of structured, semi-structured, and unstructured inputs to support interpretation, verification, and synthesis. From a SA perspective, this means organizing the available information so that users can perceive relevant signals, understand their significance, and connect them to an evolving context [13].

Once acquired, data are processed through semantic analysis and classification pipelines aimed to make them searchable, comparable, and contextually meaningful. Metadata about entities, topics, source characteristics, and spatio-temporal dimensions enable the system to support source tracing, contextual retrieval, and the identification of relevant relations across documents and events. This kind of explicit retrieval layer is also consistent with the rationale of retrieval-augmented generation, which was proposed precisely to improve factual grounding, provenance, and access to updatable external knowledge in language generation tasks.

In addition to topical and spatio-temporal metadata, the Data Platform maintains provenance and reliability descriptors for each piece of evidence, such as source type, historical accuracy, level of verification, and recency. By making provenance and reliability information available across the architecture, the platform strengthens the factual grounding of the system, reduces the risk of unsupported outputs, and helps journalists assess uncertainty more transparently.

Finally, in Trinity, the Data Platform serves as the common reference layer for the rest of the architecture. The Editorial Assistant accesses it to retrieve and contextualize evidence during writing, while Reader Tools rely on it to expose sources, background links, and explanatory material. In this way, the platform supports coherence, traceability, and contextual depth across the framework.

3.2. Editorial Assistant

The application side of Trinity is articulated into two complementary fronts, with a primary emphasis on editorial support. On the journalist side, the Editorial Assistant is conceived as a companion to the writing environment, designed to improve the efficiency and quality of data-driven news production while preserving human oversight.

Its expected functionalities include source suggestion during writing, contextual retrieval of relevant material, detection of inconsistencies between claims and available evidence, summarization, and support for narrative coherence. The assistant can also facilitate the composition of multimedia and data-rich outputs such as tables, maps, and infographics, lowering the operational cost of producing in-depth and evidence-based journalism. At the interaction level, this assistant remains human-centered, following the principle that high automation can coexist with high human control when systems are designed to support, rather than displace, expert work [22, 21].

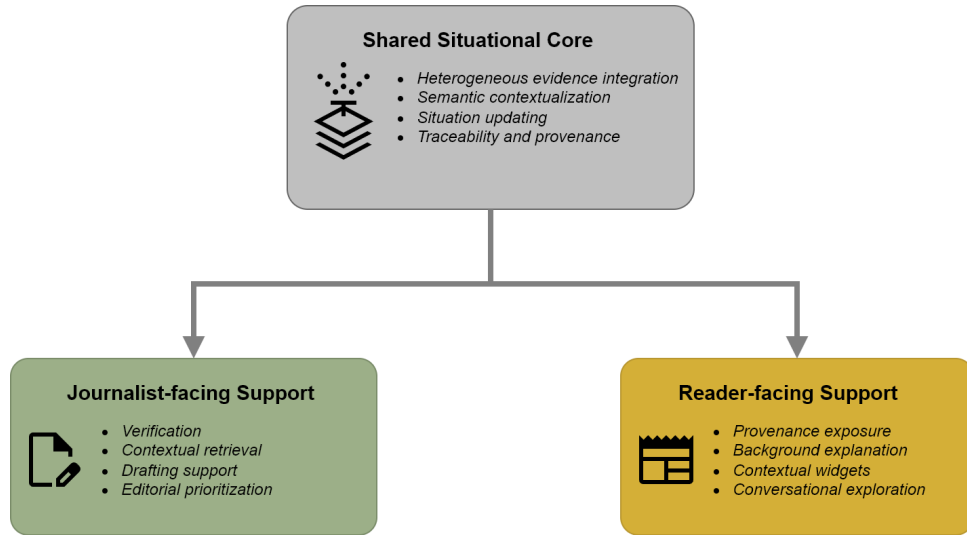


Figure 2: The triadic relation among the Data Platform, the Editorial Assistant, and Reader Tools.

3.3. Reader Tools

On the reader side, Trinity extends the same situation-aware foundation through a family of Reader Tools designed to increase transparency, clarity, and critical understanding. These tools include contextual widgets and conversational interfaces that expose sources, evidence, and explanatory links directly within the reading experience. In this way, contextual knowledge improves comprehension of what is happening, why it matters, and how the informational situation can be further explored. The reader-facing layer follows the logic of situation-aware design by helping users move from fragmented content exposure to more structured understanding [13, 21].

Taken together, the Editorial Assistant and Reader Tools show how a common reference layer can support different interaction surfaces for journalists and readers. This symmetry is central to Trinity because the support is differentiated at the interface level while converging on a shared situation awareness that grounds both journalistic work and reader understanding.

Figure 2 summarizes the relationship among the three main components of Trinity and their convergence toward a shared SA that supports both journalists and readers.

3.4. Distributed Intelligent Agents

Trinity adopts a distributed agentic ecosystem in which the Data Platform, the Editorial Assistant, and the Reader Tools are embedded within a broader layer of distributed intelligent components. The framework distributes specialized responsibilities across multiple cooperating agents that continuously exchange contextual information.

Table 1 summarizes the main agent types in Trinity. For each type, it lists typical inputs and outputs, the corresponding role in the framework, and the other agents with which it primarily interacts.

The cooperation between the agents is mediated by an orchestration layer that enables event propagation among them, acting as a communication and coordination substrate that routes events and data between distributed agents at different levels of the architecture.

At the infrastructural level, *collection agents* monitor heterogeneous informational flows such as editorial archives, news agencies, social media streams, multimedia repositories, and open-data services. These agents acquire, filter, normalize, and temporally align incoming content before transferring it to the Data Platform. *Semantic analysis agents* extract entities, topics, events, temporal references, source characteristics, and relations among actors and narratives, progressively transforming fragmented inputs into structured graph-based contextual knowledge.

A second layer is composed of *situation management agents*, responsible for maintaining and updating

Table 1
Main agent types in Trinity.

Agent type	Inputs	Outputs	Role and interactions
Collection	External content streams (archives, agencies, social, multimedia, open data).	Normalized and time-stamped items.	Collect and normalize content; forward it to the Data Platform and semantic agents.
Semantic analysis	Normalized items from collection agents.	Structured items (entities, topics, events, links).	Add semantic annotations; pass enriched items to situation management agents.
Situation management	Semantic updates and editorial feedback.	Updated shared situation model.	Maintain and update the situation model; coordinate semantic, editorial, and reader agents.
Editorial support	Journalist actions and queries; situation model views.	Context suggestions, draft structures, verification and inconsistency alerts.	Support writing and checking; send feedback to situation management agents.
Reader interaction	Reader actions and queries; situation model views.	Widgets, provenance cues, summaries, conversational replies.	Present contextual information and relay reader signals to editorial processes.

the shared representation of the evolving situation knowledge. These agents correlate new evidence with historical coverage, identify emerging topics and narrative clusters, track changes over time, and maintain provenance and traceability relations across sources.

Beyond tracking content and narrative dynamics, these agents also aggregate provenance indicators and consistency checks into trust-relevant views of the situation, for instance by highlighting clusters of mutually reinforcing sources, conflicting claims, or areas where evidence remains sparse or uncertain.

Importantly, this representation is not updated only from external data flows, but also from human interaction with the system. When journalists use the Editorial Assistant to add new sources, confirm or reject suggested evidence, correct factual details, highlight relevant relations, or introduce new contextual elements during writing, these actions become feedback signals that can update the shared situation model.

On top of this shared situational layer, *editorial support agents* interact with journalists during writing and verification activities. These agents retrieve contextual material, suggest relevant sources, summarize heterogeneous evidence, identify possible inconsistencies, correct typos, and support narrative coherence and comparative press review activities.

When operating in verification-oriented tasks, they can prioritize evidence with higher provenance scores, surface alternative sources that either corroborate or contest a given claim, and explicitly flag passages where the underlying situation model remains uncertain, prompting the journalist to perform additional checks rather than relying blindly on generated suggestions.

At the reader-facing level, *reader interaction agents* adapt the same contextual representation to public understanding needs. These agents generate contextual widgets, provenance indicators, explanatory summaries, and conversational support that help readers inspect sources, reconstruct background context, and explore ongoing events more critically and transparently.

Operationally, a typical cycle starts when collection and semantic analysis agents detect, normalize, and enrich new inputs (for example, a news agency alert or a social media signal) and update the shared situation model through the situation management agents. On this basis, editorial support agents reuse this model inside the Editorial Assistant, while reader interaction agents project it into contextual widgets, provenance indicators, and explanations in the Reader Tools, so that what is learned from data acquisition and from human editorial feedback consistently informs both newsroom and reader-facing support.

4. Research Approach

This paper adopts a qualitative and design-oriented research approach aimed at identifying user needs, operational constraints, and information requirements relevant to the Trinity framework. The study focused on how actors involved in journalistic production and news consumption experience

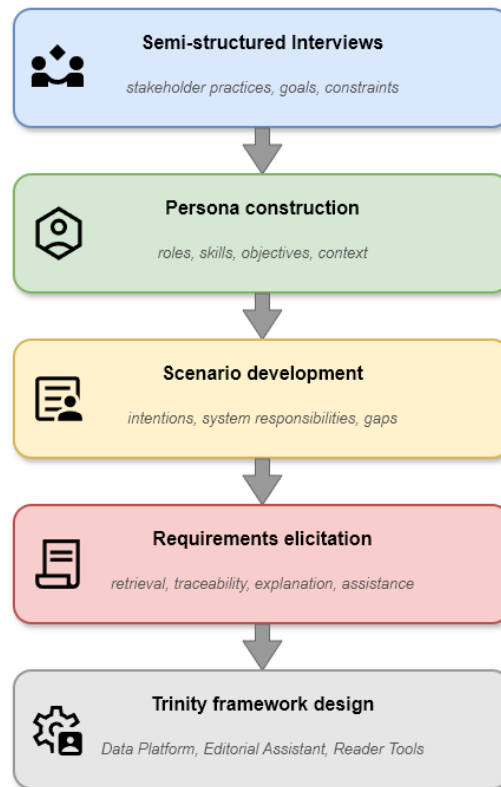


Figure 3: Qualitative and design-oriented research process adopted to derive the Trinity framework from stakeholder interviews, personas, scenarios, and requirements.

information overload, verification demands, contextual gaps, and interaction frictions. The overall process is summarized in Figure 3: semi-structured interviews were used to collect accounts of practices and difficulties, which were then abstracted into a broader set of personas and translated into scenarios and design requirements. The personas and scenarios presented in this paper should therefore be understood as selected and representative examples drawn from that broader analytical process.

4.1. Data collection

The empirical basis of the study consisted primarily of semi-structured interviews with stakeholders representing complementary positions in the Trinity ecosystem. The sample was intended to cover both the production side of journalism and the reader-facing side of information use, including profiles related to editorial writing, verification, content organization, and audience experience. Given the framework-oriented nature of the paper, the aim was not statistical representativeness but coverage of heterogeneous perspectives relevant to the conceptualized platform.

The interviews were used to surface current practices, recurrent bottlenecks, and unmet needs in dynamic information environments. On the editorial side, attention was devoted to time pressure, source checking, contextual retrieval, repetitive writing tasks, and the difficulty of integrating heterogeneous evidence streams during article production. On the reader side, the material helped clarify needs related to transparency, trust, explanation, cognitive accessibility, and differentiated levels of informational engagement.

In total, we conducted two in-depth semi-structured interviews of approximately two hours each, involving editorial stakeholders that jointly cover key archetypal roles in the newsroom. The interviewees' profiles spanned editorial direction and coordination, rolling news and service information, in-depth and investigative reporting, SEO specialists for different desks, and social media and community management.

Table 2

Representative personas used to ground the Trinity framework design.

Persona	Role / side	Core need	Expected Trinity support
Time-sensitive journalist	Journalist-side writer	Produce reliable news quickly under time pressure	Draft support, source suggestion, contextual retrieval, and verification assistance
Editorial monitor	Journalist-side editor	Compare coverage across outlets and build rapid topic awareness	Press review aggregation, source comparison, contextual clustering, and orientation support
Critical reader	Reader-side, informed but skeptical	Understand the story, inspect sources, and assess trustworthiness	Source provenance, contextual widgets, explanatory links, and transparency tools
Casual mobile reader	Reader-side, fragmented news consumer	Grasp the essential meaning of a story with low cognitive effort	Embedded summaries, lightweight contextualization, accessible explanations, and optional follow-up interaction

4.2. From interviews to personas

The first step of abstraction consisted in transforming the interview material into personas. Personas are structured user archetypes that condense recurring patterns of goals, competencies, motivations, tools, and pain points emerging from the empirical material. This use is consistent with persona-based design literature, where personas help make user groups cognitively and operationally tangible for design teams while preserving a clear link to research-based evidence [23].

Each persona was defined through a compact set of attributes including role, background, skills, technological familiarity, typical objectives, and expectations toward the system. In practical terms, the themes identified in the analysis were grouped into coherent bundles of goals, capabilities, and pain points, which were then instantiated as personas to serve as stable reference points for the subsequent scenario construction and requirement elicitation. Particular emphasis was placed on goal-related and informational dimensions, since the project is concerned with how different actors seek, interpret, and use contextual information under conditions of overload or uncertainty. To reflect the dual ambition of Trinity, the persona set includes both journalist-side and reader-side profiles, thereby linking heterogeneous user worlds to a shared architectural vision.

Table 2 summarizes four selected representative user profiles drawn from a broader set of personas identified across both the journalist-side and the reader-side of the Trinity ecosystem.

4.3. From personas to scenarios and requirements

Once the personas had been defined, they were used as anchors for the construction of scenarios. Each scenario describes a plausible situation of use by combining a specific user profile, a concrete objective, a sequence of intended actions, and the expected response of the environment. In methodological terms, this step translates relatively stable user characteristics into situated interactions, making it possible to reason about what the system should provide, when, and why.

The scenario structure adopted in the project emphasizes recurring elements such as background conditions, user intentions, environment responsibilities, current limitations of the as-is situation, and emerging requirements for the to-be system. This format helps maintain a clear link between qualitative evidence and design implications.

5. Scenario-based Results

This section presents three scenario-based results selected from the qualitative and design-oriented process described above. We use grounded scenarios to show how the Trinity framework can support representative situations of journalistic work and reader engagement. In line with scenario-based design traditions in Human-Computer Interaction (HCI), the analysis focuses on the initial informational problem, the limitations of the current situation, the intervention enabled by Trinity, and the expected form of support. Two scenarios concern editorial work, while the third addresses reader-side

Table 3

Selected representative scenarios drawn from a broader set identified during the analysis and used to illustrate Trinity support.

Scenario	Scenario focus	User need	Components
A	Earthquake article	Rapid production of a contextualized news item	Editorial Assistant, Data Platform
B	Press review	Cross-outlet comparison and trust-aware monitoring	Editorial Assistant, Data Platform
C	Reader contextualization	Access to sources, background, and contextual explanation	Reader Tools, Data Platform

understanding through contextual tools. Table 3 provides a compact overview of the three scenarios, their primary user goals, the main Trinity components involved, and the expected form of support.

The following subsections examine each case in more detail, showing how the framework is instantiated differently depending on user role, task, and informational context.

5.1. Scenario A: Earthquake news production

The first scenario concerns the production of a recurrent but time-sensitive news article on an earthquake. More specifically, this scenario can be understood as a domain-specific declination of broader local-news and proximity-news routines, namely geographically close, high-frequency, and service-oriented information updates. Such news items often follow recurrent editorial structures, because they combine rapidly updated factual data with recognizable writing patterns and contextual service information. In the current situation, the journalist must manually retrieve technical data such as magnitude, epicenter, and depth from external alerting systems, search for related articles, identify reliable expert commentary, and adapt the final text to editorial conventions under severe time pressure. This creates a fragile workflow in which repetitive tasks consume attention that would be better devoted to interpretation, verification, and contextual framing.

In the Trinity-enabled version of the scenario, the writing process begins from a dynamically generated article draft that incorporates key event data and remains editable by the journalist. During drafting, contextual support is provided through links to prior coverage, references to authoritative experts, and access to relevant background material. The aim is not to automate the article as a finished product, but to reduce low-value retrieval and formatting work while increasing the journalist's ability to understand the evolving informational situation and enrich the story with meaningful context. This configuration preserves the journalist's role in interpretation, verification, and contextual framing.

What emerges here is a shift from a repetitive and overloaded micro-workflow to a more interpretable editorial process. Efficiency matters, but the more relevant gain concerns the allocation of cognitive effort. The journalist can move more quickly from information collection to comprehension and editorial projection, in line with the higher-order processes emphasized in situation awareness research.

5.2. Scenario B: Press review and trust-aware context building

The second scenario concerns editorial press review and comparative awareness of how a topic is being covered across multiple outlets. In many current workflows, journalists and editors need to manually inspect competitors, monitor emerging themes, compare framing choices, and estimate the credibility or relevance of different signals under strong temporal constraints. The problem is the absence of a coherent representation that allows rapid orientation across sources, narratives, and trust-relevant cues.

In the Trinity-enabled configuration, press review becomes a structured awareness activity. Coverage from multiple sources can be aggregated and organized around macro-topics, salience patterns, and source-level cues that help users identify what is being emphasized, omitted, or contested. Additionally, the interface displays source reliability and highlights inconsistencies between claims and data, turning

algorithmic aggregation into a transparent tool for informed editorial judgment. This kind of support is especially important in editorial contexts where decisions are not limited to verifying isolated facts, but include judging whether a topic deserves coverage, how it should be framed, and which sources require deeper scrutiny. In this respect, the scenario also resonates with work on algorithmic transparency in the news media, which stresses the importance of making computationally mediated information practices more inspectable and accountable.

5.3. Scenario C: Reader understanding through contextual tools

The third scenario moves from editorial work to the public experience of news consumption. Here the starting point is a reader encountering a complex or potentially confusing article in a mobile and socially fragmented information environment. In many cases, the reader has access to the headline and the main story, but lacks the time, trust, or background knowledge needed to evaluate sources, reconstruct prior developments, or understand why the issue matters.

In the Trinity-enabled scenario, the first layer of support is provided by contextual widgets embedded in the reading experience. These widgets can expose source provenance, summarize key background elements, link to prior events, and clarify the role of quoted actors or cited data. Crucially, provenance and confidence cues are shown alongside the contextual information, allowing readers to inspect claims, underlying evidence, and uncertainty. Foregrounding these sources and their limitations lowers over-reliance on conversational outputs, positioning the system as a transparent guide rather than an authority. Only after this first layer does the reader engage, if needed, with a conversational interface for deeper exploration. This ordering is important because it prioritizes lightweight, on-demand contextualization before asking the user to enter a more active interaction mode. The design rationale is consistent with research on explainability and transparency showing that user-facing explanations can support trust, interpretability, and acceptance when they make underlying evidence and reasoning more accessible, especially in information environments shaped by algorithmic mediation.

In this case, the main outcome is a more structured understanding of the article and its surrounding context. The scenario therefore shows how contextual intelligence can be exposed downstream in ways that enhance transparency and enable readers to explore the content more critically.

6. Discussion

The three scenarios show that the contribution of Trinity lies in its ability to adapt the same framework to different situated needs. In the first case, support is oriented toward time-sensitive article production; in the second, toward comparative editorial awareness; and in the third, toward reader understanding through transparent contextualization. As illustrated in Figure 2, the same shared situation awareness can support different interaction needs across scenarios while preserving a common situational foundation.

Conceptually, the contribution of this work is to articulate a situation-aware and agentic reading of AI-supported journalism that connects three strands of research that are often treated separately: studies on AI and automation in newswork, cognitive models of Situation Awareness, and recent multi-agent architectures for complex, dynamic environments. Trinity positions AI not primarily as a generator of content or a recommender of items, but as an orchestrated layer that helps journalists and readers maintain and update a shared situational understanding across the news ecosystem.

It is also useful to discuss three complementary dimensions to which our approach contributes: cognitive contribution, architectural contribution, and service implications. Together, these dimensions clarify how the proposed framework can be positioned within current debates on AI-supported journalism, human-centered automation, and public understanding of information.

From a validation perspective, the present contribution should be seen as a first step toward a more extensive empirical assessment of Trinity. The next stages of the project include the progressive implementation of the framework within CMS-connected editorial workflows, the development of functional prototypes of the Editorial Assistant and Reader Tools, and formative studies with journalists

and readers to assess effects on workload, sensemaking, trust, and comprehension in both routine and time-pressured conditions.

6.1. Cognitive contribution

From a cognitive perspective, Trinity can be interpreted as an attempt to reduce the effort required to build and maintain situation awareness in a domain characterized by overload, time pressure, and heterogeneous sources. The framework is meant to support the transition from fragmented information inputs to a more coherent and decision-relevant understanding of ongoing events. This is especially relevant in journalism, where the central difficulty often lies in identifying what matters, how elements relate to one another, and what deserves editorial or interpretive attention [6].

For journalists, this support implies a shift from repetitive coordination work toward more exploratory and comparative practices. When low-value search, aggregation, and formatting activities are reduced, more cognitive space becomes available for verification, synthesis, framing, and editorial judgment. This interpretation is consistent with work on automation in newswork emphasizing that algorithmic systems are most useful when they preserve professional oversight and support hybrid forms of decision making [2, 22].

For readers, the contribution is related but distinct. Here the framework supports a move from passive exposure to more informed and critical engagement by making contextual elements easier to access and interpret. Contextual widgets and conversational support matter because they can lower the threshold for understanding sources, background, and relevance in environments where attention is fragmented and trust is often fragile.

The framework operationalizes the three classic levels of Situation Awareness by supporting perception through heterogeneous data collection and normalization, comprehension through the construction and maintenance of an explicit situation model, and projection through tools that help journalists and readers anticipate how an evolving news situation may develop and what editorial or interpretive moves it may require.

6.2. Architectural contribution

At the architectural level, the contribution of Trinity lies in connecting functions that are often treated separately in journalism-oriented AI systems. The framework links the Data Platform, the Editorial Assistant, and the Reader Tools within a common design logic. This connection is operationalized through distributed intelligent agents that cooperate around a shared situation model.

This continuity matters because intelligent systems often fail when back-end complexity and front-end usefulness remain weakly connected. In Trinity, collection agents, semantic analysis agents, situation management agents, editorial support agents, and reader interaction agents contribute to the same evolving situational foundation, which can be exposed differently depending on whether the user is writing, monitoring coverage, or trying to understand a difficult story.

A further implication concerns the role of automation. Support remains inspectable and interpretable because the shared situation model is updated not only by data flows, but also by human editorial interaction. When journalists add sources, validate evidence, or correct contextual relations, their actions refine the situation representation, helping to avoid passivity, over-reliance, and out-of-the-loop problems [22, 24].

6.3. Service implications

Beyond cognition and architecture, the framework also has implications for how informational value is produced and experienced. In the scenarios discussed, value emerges from an improved capacity to relate information, action, and understanding across different actors. Journalists benefit through better support for editorial sensemaking, while readers benefit through more transparent and explorable access to context.

This point matters because discussions of AI in journalism often focus primarily on newsroom productivity, automation of routine genres, or audience targeting. Trinity suggests a broader interpretation in which the same informational backbone can support both production-side and consumption-side needs. In this view, journalistic value is strengthened when professionals can work more reflectively and readers can engage more critically with what they encounter.

Support should therefore be understood as relational rather than merely functional. On the editorial side, it means helping professionals compare, verify, and frame information under pressure; on the reader side, it means helping users orient themselves without requiring specialist knowledge or excessive effort. Framed in this way, Trinity points toward a more balanced conception of AI-supported news systems, where value is created by redesigning how informational work is shared between computational systems and human actors.

7. Conclusions

This paper presented Trinity as a situation-aware multi-agent framework for AI-driven data journalism, designed to connect data infrastructure, editorial work, and reader understanding within a shared situation-aware informational architecture. We frame AI-supported journalism in terms of contextual assistance for building and maintaining a clearer understanding of evolving news situations for both journalists and readers.

The framework was developed through a qualitative and design-oriented process grounded in interviews, personas, and scenarios. These elements were used to identify representative needs on both the journalist and reader side and to show how the same situation-aware foundation can support different forms of interaction, from editorial assistance and press review to contextual explanation for readers.

The paper proposes an agentic reading of the Trinity framework. Distributed intelligent agents can support collection, semantic analysis, situation management, editorial assistance, and reader interaction. This perspective clarifies how the shared situation model can be continuously updated through both data flows and human editorial feedback, while keeping journalists in control of interpretation, verification, and publication decisions.

At the current stage, future work should first consolidate the SA-oriented methodological framework underlying Trinity. This includes defining more explicit design principles, cognitive roles, interaction requirements, and evaluation strategies for the different subsystems of the platform. A second direction concerns the formalization of a situation representation model for the editorial domain, able to describe entities, events, actors, sources, provenance relations, and contextual links in a structured way. A further line of work concerns the empirical evaluation of the framework in real newsroom and audience settings. This involves implementing incremental prototypes of the Trinity subsystems, integrating them into existing editorial and publishing infrastructures, and conducting mixed-method studies with journalists and readers. Quantitative and qualitative measures of perception, comprehension, projection, workload, and trust will be used to assess whether the proposed situation-aware design actually improves situation awareness and decision support for different user profiles. Finally, future work should adapt cognitive task analysis methods to journalism and news consumption settings, so that scenarios and user needs can be translated into operational requirements. In parallel, further development should clarify principles for a responsible and human-centered use of AI, with particular attention to transparency, control, and the alignment between agentic support and professional judgment.

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Declaration on Generative AI

During the preparation of this work, the authors used ChatGPT for grammar and spelling checks, paraphrasing, and rewording. After using this tool/service, the authors reviewed and edited the content as needed and assume full responsibility for the content of the publication.

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