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Mega Sporting Event Scenario Analysis and Drone Camera Surveillance Impacts on Command-and-Control Centre Situational Awareness for Dynamic Decision-Making

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Abstract: Mega sports events may encounter safety and security challenges related to risk management issues such as overcrowding, disorderly behavior, assaults, and security breaches. An incident during the Champions League Final in France in 2022 serves as an example of such challenges. Therefore, this study focuses specifically on the Champions League Final in France, 2022, and presents a situational scenario analysis for safety and security professionals. The objective is to enhance situational awareness and improve risk management strategies for similar events. The study commences by investigating the awareness among security and safety professionals regarding the potential consequences of mega sporting events, utilizing a post-hoc damage evaluation of France '22. It then compares the effectiveness of fixed and drone cameras in surveillance imaging, aiming to identify ways to enhance situational analysis for improved risk management. The findings indicate that safety and security professionals acknowledged the negative outcomes of adverse events and demonstrated higher situational awareness when using drone surveillance as opposed to relying solely on fixed cameras. They also expressed positive attitudes towards the adoption of surveillance for mega sporting events. Moreover, the study introduces a model for drone surveillance scenario analysis, designed for dynamic decision-making. This model has been developed and aligned to effectively integrate drone surveillance and enhance situational awareness, not only for mega sports events but also for similar applications in various contexts. This research contributes to the understanding of risk management and situational awareness in the realm of mega sports events. It underscores the significance of drone surveillance and proposes strategies to enhance security professionals' ability to respond effectively to potential threats, ensuring the safety of participants and spectators.

Keywords: scenario analysis; mega sporting events; situational awareness; dynamic decision making; drone surveillance

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1. Introduction

1.1. Scenario Analysis (ScenAn) History and Role

ScenAn is a strategic planning technique used by organizations to anticipate and prepare for future challenges. It involves creating and analyzing multiple plausible future scenarios to understand potential outcomes and their implications. ScenAn helps organizations enhance their readiness, resilience, and responsiveness by providing insights into different possible futures. By exploring a range of scenarios, organizations can identify potential risks, opportunities, and uncertainties. This enables them to develop robust strategies, adapt their operations, and allocate resources effectively to address both expected and unexpected challenges. Scenario analysis also plays a vital role in risk management by identifying vulnerabilities and enabling organizations to develop contingency plans tailored to different scenarios. It enhances organizational preparedness, ensuring proactive measures are in place to mitigate risks and seize opportunities [1].

Designing scenarios within the context of strategic military planning was already common practice by the 1950s [2], and by the end of the 1960s private corporations like General Electric and Royal Dutch Shell were employing scenario analysis (ScenAn) to explore situational awareness (SitAw) for the first time, generating the first energy scenarios. Scenarios are used in several contexts; some of their significant applications include strategic corporate planning, municipal and land-use planning, political consultancy, and global scenarios addressing the future of energy or the environment. Numerous scenario strategies have been created for diverse sectors of application. Strategists claim that scenarios help them make strategic decisions, particularly with regard to contextual uncertainty. Long-term forecasts are often useless in the face of dynamic or unexpected changes in the external environment, and ambiguous trends are often hard to detect. Increasingly, managers have replaced forecasting techniques with scenario methods (and similar methods) to mitigate this problem. ScenAn is fundamentally defined and distinguished from other forms of strategic analysis by predicting what might happen in the future, assuming that a phenomenon or trend will continue; it has become a common strategic tool to ensure organizational resilience and responsiveness in extraordinary or new contexts, seeking to minimize damage, recover operations, and reorient processes (where necessary) [1].

The use of scenarios to deal with uncertainty is effective. Rather than obtaining forecasts, ScenAn proposes alternative images of the external environment's future development. By highlighting essential tensions, scenarios affect the strategic decisions managers have to make. Since its introduction, the scenario approach has undergone significant changes, although the forecasting substitution argument still [1]. Multiple-ScenAn is becoming increasingly attractive to managers due to newly developed functions [2]. It is now claimed that ScenAn supports the entire strategic management process, including elements such as the generation of options, the building of consensus, and even the implementation of strategies.

The term "scenario" describes a possible future situation, including the path that led to it. Many people describe a scenario as a depiction of a possible future condition (conceptual future), and the routes of development that may lead to that future circumstance [3]. Unlike an abstract future, which shows a possible future condition of events, a scenario describes the changes, dynamics, and moving factors that result in a given abstract future. The purpose of scenarios is not to define the future entirely, but rather to identify the key factors that will influence future developments and highlight critical elements of possible futures. The goal of scenarios is to generate orientation for future results by observing certain crucial critical aspects.

Scenarios may also be used to develop communication and enlighten subjects and priorities, broadening awareness of topic areas, thereby shedding light on problem situations, and enhancing discourse on these issues, ideally with the inclusion of diverse internal and external stakeholders' perspectives [2]. Hence, three points should be considered while undertaking the ScenAn process or evaluating the outcomes of such analysis:

- A scenario is not a whole picture of the future; instead, its real job is to bring attention to one or more specific, clearly defined portions of reality.
- Scenarios are hypothetical sequences of events designed to draw attention to causal processes and decision points [3].
- Various selected aspects and events are consciously incorporated into certain interrelated clusters during the analytical process [3].

1.2. ScenAn in Risk Management

Many scenario analysts emphasise that scenarios are hypothetical constructs that do not claim to represent reality *per se*. To begin with, scenarios help generate knowledge about the present and the future, as well as to identify their limitations. Second, scenario production is frequently based on exchanging ideas between persons with various viewpoints, so that ScenAn can serve a communication purpose. Scenarios may also be used to attract attention to specific concerns through public communication. Third, scenarios can help

decision-makers develop goals. Finally, scenarios may be used to assess the prospective efficacy of organisational tactics. Scenarios can be evaluated based on their plausibility, internal coherence, comprehensibility and traceability, distinctness, and transparency. The appropriate scenario technique is defined by the goals of the research endeavour and the context in which the study is done [3].

Scenarios are used to attain diverse goals and meet the need for various services. These functions may be classified into four categories: explorative and scientific processes, communication functions, target concretisation and production duties, and decision-making and strategy formulation functions [3]. They also focus on potential development paths, differentiating characteristics, crucial factor interactions, and the range of possible outcomes. A transformation effect may be achieved with the help of scenarios, whereby an initially unknown future environment characterised by a spectrum of possible developments (i.e., a range of potential futures) can be transformed into a future climate in which products are assembled into scenarios, allowing for the identification of clearly different alternative or alternate futures [3]. Furthermore, scenarios can broaden the breadth of our reflections and increase their correctness in terms of options outside the boundaries of standard paradigms.

Scenarios are also employed in decision-making and strategic planning procedures, since they give points of guidance for those who carry out the planning [3]. Alternatives and actionable indicators might be established based on circumstances. They also assess decision-making processes, proposed actions, and strategies. This work is frequently done with a variety of scenarios, which are then contrasted to highlight probable future developments, and allow the ramifications of various actions and decision-making processes to play out against a virtual backdrop. Scenarios may therefore be used to assess policy dependability, robustness, and efficacy. Aside from the several objectives of scenarios, it is wise to understand the limitations of what can be performed with them [3].

When applied effectively, ScenAn can help organisations maintain their readiness, resilience, and responsiveness to meet unexpected (and expected) future challenges. For example, the scenario of a company facing bankruptcy should be used to devise a plan for such a contingency, which would be appropriate risk management for this potential future. Consequently, if this risk arises in reality, the company is prepared to tackle the problem and find a solution in a calm manner [4]. This would be possible due to the ScenAn that the company had undertaken, prepared itself for potential bankruptcy before the problem or scenario was an actuality. This is why such analyses are crucial for risk management. They prepare a person or corporation for future possibilities and provide them with time to develop a strategy to tackle the problem if the scenario turns out to be true.

1.3. ScenAn for Mega Sporting Events (MSEs)

The unprecedented global lockdowns following the spread of COVID-19 revealed the potential for public health diktats to close whole economies, signalling a major threat for mega sports and clubs. They cannot function based on the presumption under the same conditions as they did previously, and national and international competitions may be cancelled or postponed at a moment's notice by erratic and unpredictable political decisions. Sponsorship contracts may be re-evaluated, and cash flow may be affected by particular and macroeconomic fallout from the unprecedented economic shocks reverberating around the global economy [5].

There is the potential for successive waves of infectious diseases, and under conditions of relative normalcy, when large crowds are permitted back into stadiums for mega sports, sports and event managers need to prioritize the safety and security (S&S) of the players as well as customers. Therefore, sports organisations must prepare for many scenarios and eventualities now more than ever before. The short- and long-term planning of sports organisations is essential even without pandemics or lockdowns [6]. For example, a sports manager will make assumptions about the transfer market and the current team before making any moves. Upon the opening of the transfer window, he must revise his assumptions in response to dynamic changes caused by other players on the market [7]. As

a result, every transfer decision directly affects the team's performance, and therefore the club's internal context.

For planning purposes, the coaching team also assumes plausible outcomes. It may be possible to plan training cycles on a seasonal basis, on a six-week basis, or even on a weekly basis. The coaching staff will conduct the training session based on their projections for the forthcoming term. Coaches can rely on their alternative planning based on predicted situations to react as rapidly as feasible if internal or external circumstances change. Short-term scenario planning may be seen in the "match plan" for upcoming games, which is essentially a set of "if-then" scenarios that predefined reactions on the field. In this context, the coaching staff must foresee certain scenarios, such as key players being injured unexpectedly, red cards being issued, overtime in close games, and so on, and then take appropriate action based on these forecasts. Anticipating significant scenarios is vital since unanticipated changes in game parameters can impact dynamics in seconds [6].

In the beginning, organisations should set a time frame for their scenario planning, such as considering whether they wish to plan scenarios for the next match, three months, six months, or a year ahead of time. After selecting an appropriate time frame, they can identify important trends and driving forces that will have an impact on their organization (i.e., team) within that time period. Workshops, brainstorming, and polling can be used in this process, along with historical background data [8]. Mega sporting events (MSEs) are attended by many thousands of spectators, and hundreds of thousands can potentially be associated with such events in surrounding hinterlands (e.g., people watching football games in city pubs in addition to those attending the match within a stadium in the same city) [9].

For mega sports, ScenAn may encompass a wide variety of risk management issues, such as overcrowding factors, drunk and disorderly behaviour, assaults, missing or kidnapped children, sexual harassment, or exhibitionists running onto the field to disrupt play [10]. Risk management plans typically include surveillance, with traditional fixed cameras (FCs) installed in key locations, and drone cameras (DCs) on standby, or deployed as necessary. Institutional security and law enforcement agencies must also be on standby during MSEs, and heightened readiness and responsiveness is also expected of emergency services, such as standby paramedic units and ambulances to deal with emergencies, including medical injuries among players and spectators. It is also necessary to protect the privacy of players and high-profile spectators during MSEs, who may be vulnerable to harassment, violent attacks, or even assassination or kidnapping attempts. Risk management for MSEs entails making every effort possible, including many tiers of back-up and emergency planning, in order to provide the optimum S&S for those attending and playing in events, and the surrounding general public.

1.4. ScenAn Methodology

Different organisations use ScenAn methodologies in different ways, or actively seek to imitate the successful practices of others. This can be seen in the active imitation of Shell's ScenAn system in various organisations and institutions over the decades [1]. This methodology, which has also been adopted by European Commission, applied the Pierre Wack Intuitive Logics method for ScenAn [8]. This a "wind tunnel" approach was developed by the eponymous Pierre Wack, a Shell Group planner during the 1960s and 1970s, to test business plans or projects, prompt public debate, and increase coherence [1]. It aims to help managers anticipate and prepare for various futures by working on their mindsets [11].

The organisation develops estimates about how different scenarios would affect various business elements, such as borrowing rates and raw material costs. In general, a variety of possibilities are analysed, ranging from best-case to worst-case scenarios (e.g., ranging from significant revenue being generated from the sale of a new product released into the market to a fire accident leading to operations being shut down for months, allowing insurgent competitors to commandeer market share) [3]. Such scenarios have to include

almost every possible contingency, in order to ensure that the organisation is fully prepared when such scenarios materialise. Hypothetical scenarios are explored with regard to input variables to calculate the business effect of each potential outcome. ScenAn may take into account a wide range of variables such as rent, labour, taxes, utilities, and other costs that may be included in an analysis of the prospective financial effect of developing a new facility.

Although there are many distinct types of scenario analysis tools, the scenario process is fundamentally similar across these approaches. The first step of the scenario process involves identifying the scenario field, which refers to the range of potential future situations or conditions that an organization considers during the scenario development process. It represents the space of possibilities within which the scenarios are created. This step also includes defining the specific issues to be addressed and determining the scope of the study [3].

In the second step, the essential elements are determined. These elements encompass critical uncertainties or key factors that have a significant impact on how the future unfolds. By exploring different combinations or variations of these essential elements, a set of distinct scenarios can be developed. These scenarios capture different plausible futures within the defined scenario field, enabling organizations to gain a better understanding of the range of possibilities and make informed decisions accordingly. During this step, researchers identify the essential elements that will have significant impacts on the future and examine their effects [3].

The third step then investigates the spectrum of outcomes that these major elements may cause. This is followed by a fourth phase in which the list of primary factors is condensed, or essential factor values are bundled together to form a reasonably small number of meaningfully identifiable scenarios. The last stage of the scenario process is known as scenario transfer, and it entails using the completed scenarios for objectives such as strategy evaluation [3].

1.5. Adopted Model of SitAw and Dynamic Decision-Making (DDM)

As the S&S of MSEs requires a comprehensive approach to establish appropriate levels of SitAw, sensitive and responsive to changing environments, model of SitAw shown in Figure 1 was adapted, which was originally developed in the 1990s by Endsley [12], and which has subsequently been improved. It covers three successive and interrelated core elements: perception, comprehension, and projection. The first stage is the most crucial one in the model, whereby human beings should established a very good understanding of the environment through applying the available sensing method, in order to translate that in an informative understanding for the situation at that given time in order to establish options for correct actions [13,14].

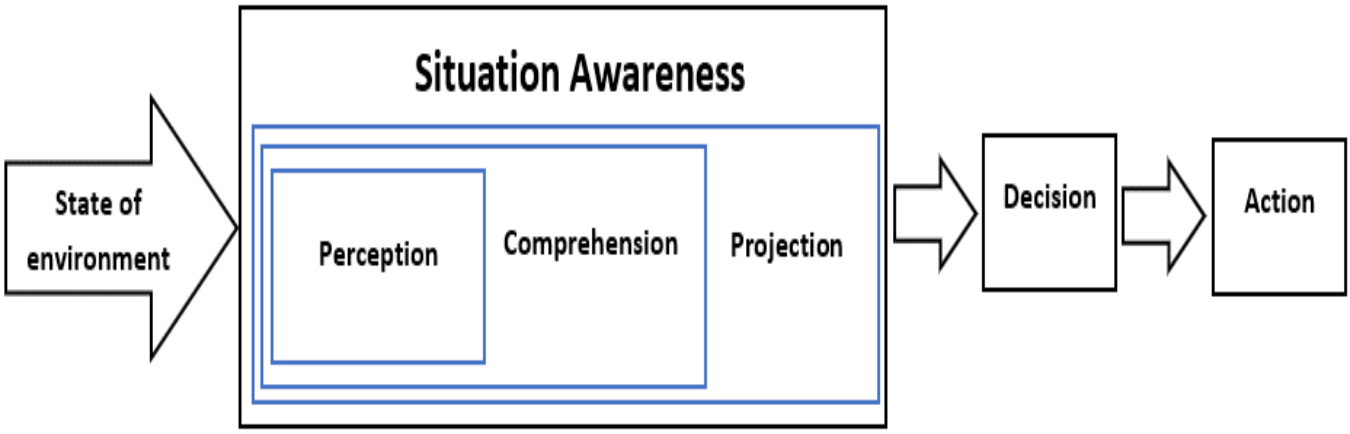

Figure 1. Model of SitAw in dynamic system. Source: based on Ensley [11].

The term "reception state" is not commonly used in the context of decision-making. However, in the context of communication or information processing, it could refer to the state of receiving or perceiving information. The reception state is crucial in decision-making as it affects the availability and quality of information on which decisions are based. It involves being aware of and understanding the presented information, including its relevance, accuracy, and reliability. The reception state influences decision-making by shaping the inputs and knowledge that decision-makers rely on when evaluating options and making choices [14].

Effective decision-making requires a clear and accurate reception state, where decision-makers actively seek, process, and comprehend relevant information. Maintaining a robust reception state is essential to make informed judgments and decisions, leading to more effective outcomes [11].

It is important to note that any impairment or lack of information during the reception state can result in a lack of understanding of the current situation and potentially lead to incorrect or less effective decisions, especially in dynamic environments. Regular sensing and monitoring are necessary to sustain a comprehensive awareness mechanism that facilitates appropriate decision-making. This concept is evident in scenarios such as military airplane operations, where pilots must establish a high level of SitAw in rapidly changing and unpredictable environments. To address such contexts, an aligned model to fit this scenario was recently presented by Munir, Aved, and Blasch [15].

The model integrates artificial intelligence and dynamic data-driven application systems to facilitate adaptive measurement and resource allocation based on the changing situations perceived and projected by the SitAw core. The model revolves around the SitAw core, with sensing and decision-making elements designed around it. Various sensors are deployed to perceive the environment and collect data on its state. The gathered data from these sensors is fused to remove redundancies, such as similar views captured by different cameras or multiple quantities sensed by sensors in close proximity. This fusion process also addresses limitations of data obtained from a single source, such as occlusions, changes in lighting conditions, or environmental unpredictability [15].

Applying the same concept may be appropriate for MSEs, which can be very dynamic and volatile, requiring swift and decisive courses of action. Therefore, it is important to devise an aligned model for SitAw to accommodate MSE requirements, to facilitate decision making to ensure S&S of major events, to avoid any negative consequences. This study specifically aims to utilize ScenAn to extract insights from the recent occurrence of the Champions League Final in France, 2022. The objective is to increase the awareness of safety and security professionals in Qatar regarding the repercussions of major sporting incidents and to establish a SitAw model for DDM in the context of MSEs.

2. Research Design

A mixed-methods research design was selected to achieve the objectives of this study [16–30]. The first phase comprises quantitative content analysis to extract information related to France '22, In order to analyze the identified scenario and establish a scenario analysis based on the previous incident in France '22 for the purpose of mitigating risks associated with similar incidents in the future. While and the second phase was a quantitative questionnaire administered to S&S professionals (S&SPs) in Qatar, to explore their opinions about the possible consequences of such events, assess their level of SitAw in relation to given examples, and investigate their attitudes towards the role of drone surveillance in improving SitAw for DDM. The outcomes from the first phase led to establishing the second phase method, to enable data collection from concerned with command and control centre (C&C) operations. As France '22 was very recent during the time of this study's fieldwork (June–July, 2022), most of the information related to this incident was related to the availability of emerging news articles, videos, and investigative reports. Hence, the most suitable method to extract information related to the event causation, consequences, and investigation outcomes was content analysis [17].

Content analysis enables a full understanding of incidents and helped to identify pertinent videos of sufficient quality to be used to establish the ScenAn for this [18]. A preliminary pilot study was conducted with three participants, to make sure the study instruments were easily understood, before commencing formal data collection. Data analysis from the content analysis phase was undertaken though the thematic approach [19], to identify possible consequences when incidents occur. Data collected by questionnaire was analysed using SPSS [20] and the SitAw mathematical formula, as described below [15].

Figure 2 illustrates the research design. It begins by identifying the case of the France '22 Champions League finals incident for content analysis, which involves investigating the impact of the incident and selecting informative videos and documentation to construct a comprehensive understanding of the event. The second phase focuses on establishing the scenario analysis through a questionnaire. This questionnaire includes assumptions about the potential consequences of the incident, both through legal simulation and real-life imagery. It also involves gathering the opinions of safety and security professionals in Qatar. The final phase involves conducting the study itself. This phase includes a pilot study to refine the research approach, followed by data collection and analysis using the finalized methodology.

$$\text{SitAw} = \frac{\text{Number of identified evidence}}{\text{Total number of evidence}} \quad (1)$$

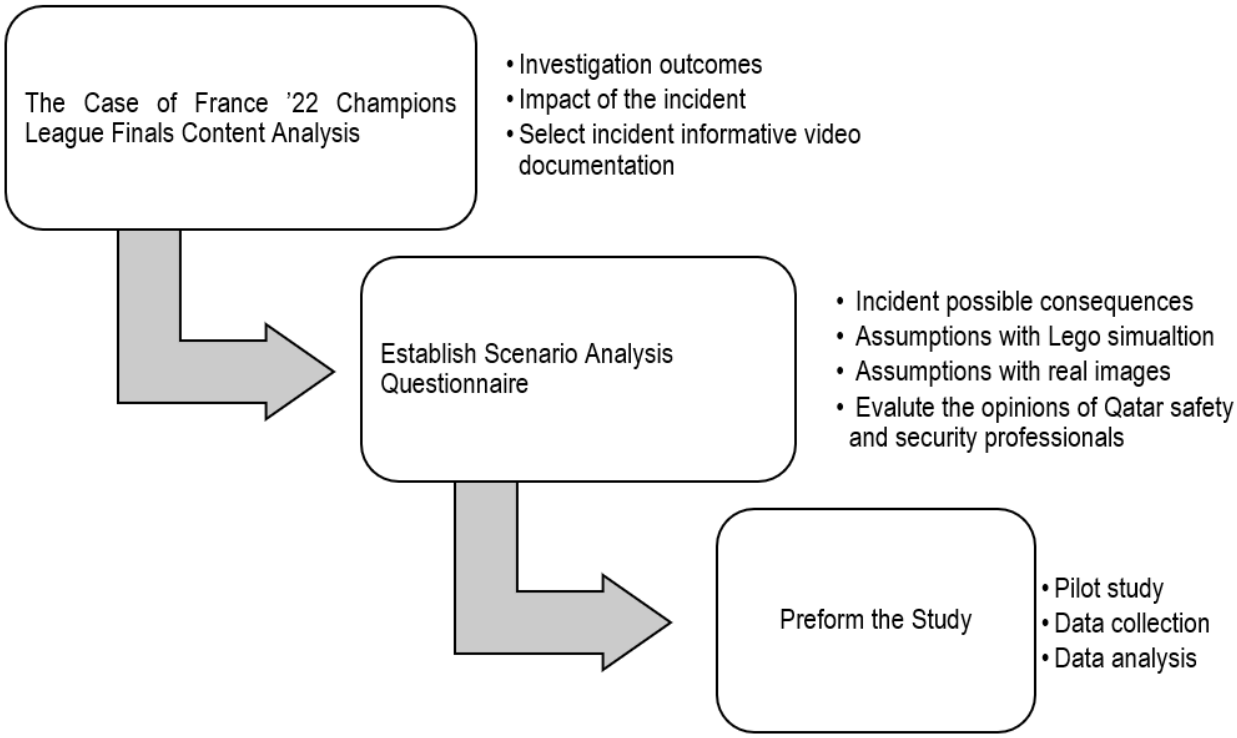

Figure 2. Research design.

This formula provides a quantitative measure of situational awareness based on the ratio of identified evidence to the total evidence, providing insights into the extent to which the available information has been effectively perceived and processed. In this context, "evidence" refers to relevant information or cues that contribute to understanding the current situation. The formula suggests that SitAw is determined by the ratio of identified evidence to the total available evidence. A higher value for SitAw indicates a greater level of situational awareness, implying that a larger proportion of the available evidence has been successfully identified and taken into account. On the other hand, a lower value

suggests a lower level of situational awareness, indicating that a significant portion of the evidence has not been recognized or considered.

3. Content Analysis of 2022 Champions League Finals (France '22)

3.1. Context

The case of France '22, revealed a good example why ScenAn is so vital for sporting events, and ensuring the safety of all those involved in such events, avoiding negative incidents, or minimising their impacts when they do occur. The Champions League Final helf at the Stade de France on 28 May 2022, between Liverpool and Real Madrid, resulted in major complications. Hazardous crushes and risks to human health arose as a result of access restrictions, and many supporters were indiscriminately tear-gassed or pepper-sprayed by police. The debacle was catastrophic for France's reputation, damaging it severely to a point that many questioned whether France was capable to deliver safe sporting events in the future, including the upcoming 2023 Rugby World Cup and 2024 Olympics. The core problems encountered in France '22 related to people flows and crowd issues, which ultimately deteriorated into mayhem [21].

Tens of thousands of Liverpool fans had traveled to the city, leading to growing restlessness due to massive congestion in the stadium's surroundings [22]. As a result of these congestion issues, the game started 35 min late. In an attempt to control the flow of people, the French police opted to use police buses [23]. However, this approach had adverse effects in terms of public perception and legal implications. The use of police buses to restrict individuals' movement was viewed as heavy-handed, impeding the freedom of innocent spectators and potentially escalating tensions within the crowd. Images and videos capturing these actions circulated widely, further tarnishing the image of the police and fueling public discontent [24]. The police's actions faced criticism for potentially infringing upon individuals' rights, including the right to freedom of movement and peaceful assembly. Such actions could result in legal challenges and negative repercussions for the involved police force [22].

At this juncture, the French authorities were embarrassed by the failure of people flows in and around the stadium, and some Liverpool supporters were also robbed or beaten by local criminals [25]. The authorities increasingly blamed the fans as the incidents escalated, accusing them of entering with counterfeit tickets, which they claimed was the cause of overcrowding [21]. This built on previously police reports that a handful of fans had procured false tickets and disrupted entrance to the stadium, causing a delay [22]. The organisers, after initially attributing the delays to security difficulties, blamed fans for arriving late. The Liverpool end of the stadium was jammed with supporters who bought bogus tickets that did not work at the turnstiles, resulting in crowds building behind them.

French police launched unprovoked tear gas and pepper spray attacks on spectators as a large crowd gathered outside the stadium in the hours leading up to kick-off at 21:00 CET, with scores of arrests and hundreds of injuries. Many Liverpool fans who had purchased tickets could not enter the stadium until halftime (despite the delay), and fans were also attacked as they exited the Stade de France following the game. UEFA and several French politicians backed the repressive measures adopted by the security services, and Liverpool fans were smeared with accusations of unruly behaviour, and unlawfully entering the stadium with counterfeit tickets. There were 68 arrests associated with the Champions League Final, according to Paris police, and firemen treated 238 minor injuries, according to local media [22].

In the aftermath, UEFA acknowledged that the police used tear gas to disperse supporters, and announced it would quickly evaluate these problems in collaboration with the French police and authorities, as well as the French Football Federation. In the meantime, Liverpool requested a formal investigation into the origins of these unacceptable concerns. The French authorities were under increasing pressure for seven days to investigate what the press had dubbed a failure [25]. Gérald Darmanin, France's Interior Minister, reiterated his claim that Liverpool fans had attempted to use 40,000 fake tickets, provoking outrage

both at home and abroad. Many fans with legal tickets found that the scanners wouldn't accept them as real, so even the figures were undoubtedly exaggerated. Early reports indicated that fewer than 3000 counterfeit tickets had been detected at the turnstiles [26]. An investigation has been ordered by UEFA to figure out what went wrong and what happened so it could never happen again in the future [21].

Laurent Lafon, a co-chair of the inquiry, told reporters at a press conference that these dysfunctions occurred at every level, not just during the implementation (during the game), but also during the preparations [22]. Due to a transport strike, the stadium was not anticipating how and when supporters would arrive, and inadequate instructions were provided. Police checkpoints became pressure points, constraining the flow of people and exacerbating congestion.

The infamous event emphasised the importance of ScenAn and planning for any future events to avoid unnecessary damage to human health, property, or reputation and image of an organisation and country holding an MSE.

3.2. Investigation Outcomes

The French Senate's Commission of Culture and Education [27] issued a report on France '22 in which they dubbed the debacle as "an inevitable fiasco". Laurent Lafon, Co-President of the Commission, highlighted a sequence of shortcomings before the match, stating that authorities operated on their plans without much collaboration—and that there had been "failures" both "in the execution" and "planning" of the event. The French Senate questioned several key figures in the aftermath of the events, and the initial official narrative that essentially sought to blame Liverpool fans [27]. These included the Interior Minister, Gérald Darmanin, and the Sports Minister, Amélie Oueda-Castéra, alongside officials from the French Football Federation, the Parisian public transportation agencies, and Liverpool West Derby MP Ian Byrne, who was in attendance for the final. The report unequivocally denounced the initial attempts to blame fans, and acknowledged the systemic failure that had led to the events (i.e., poor S&S planning and responsiveness):

"It is unfair to have sought to blame Liverpool fans for the disturbances, as the Interior Minister did, to divert attention from the inability of the state to manage the crowds present adequately and to curb the action of several hundred violent and coordinated offenders" [27].

Laurent Lafon, President of the Panel for Culture, and Francois Francois-Nol Buffet, President of the Commission for Legislation, apologised to the English supporters, and suggested that further hearings would be held soon. Lafon went into detail about the wild night, lamenting the "unusual severity" of the organisational flaws and the repercussions that "might have been tragic." They noted that neither the French nor the English authorities could uncover the truth of the ticket fraud issues; the prevalence of petty crimes and antisocial behaviour increasing in the neighbourhood that day from 2 p.m. [25].

According to Buffet, "the organisation of this event was the source of the major occurrences," namely the way the movement of spectators into and out of the stadium was handled. He also chastised police head Didier Lallement for focusing on spectator management rather than the minor criminality that began outside the stadium about midday. The destruction of security footage from the Stade de France was also cited as a "serious error," according to Lafont, who concluded that there was a sense that no one was taking responsibility for what happened, although everyone involved in the operation failed. All of the actors were linked to the State [28].

The public were subjected to dangerous crowd control measures, tear gas, and baton charges from police, and legal action against the authorities. The Senators stated that they would like to speak with UEFA about the usage of paper tickets, having issued a request but not yet gotten a response from the governing body of European football, but it was clear that there was sufficient grounds for the French government to apologise comprehensively to Liverpool and Real Madrid fans [25].

The outcome of the investigation showed that not only were the police not able to deal with large crowds, but they overreacted instead of trying to calm the situation, which led to a disproportionate and brutal response. It also led to the entire world criticising and questioning the ability of France to organise and host major international events, with grave implications for the 2023 Rugby World Cup and 2024 Olympics.

3.3. Recommendations for MSEs

The official report investigating the incident included 15 recommendations to avoid such problems in the future, including mandating event organisers to keep video surveillance photos for one month after the event, and making forgery-proof tickets mandatory [27]. Some particular egregious breaches that occurred during France '22 were adumbrated, as described below.

Many supporters arrived at the stadium with plenty of time to spare to pick up their credentials and get inside. People noticed the Police Nationale guiding people in any direction as they neared the stadium's perimeter, and there did not appear to be any strategy. Four stewards were verifying tickets at the bottom of the ramp that hundreds of fans were using to enter the stadium's main concourse. Soon after, cries could be heard. To move them out of the crowd, little toddlers were hastily lifted onto shoulders to ensure their safety. This unpreparedness put a lot of children at risk of harm or being trampled or kidnapped due to how crowded the approach ramp was. The four stewards in charge of checking tickets eventually became disrespectful and antagonistic towards fans, as one recalled:

"They'd been forced to scan hundreds of tickets between the four of them, and it was evident that they'd had enough. They just yelled 'ticket,' and if you didn't have one for them to scan—or, like me, got an email from UEFA stating to get your accreditation—they were simply uninterested, even physically shoving individuals back into the mob." [25].

After the police arrived they erected barricades that hemmed in the crowds, followed by tear gassing, for no crime other than queuing to enter the stadium [25].

The Police Nationale did not discriminate when it came to their targets, and men, women, and children were indiscriminately gassed [24]. The police brutality against the fans caused outrage, prompting the Liverpool coach to demand a thorough investigation into the incident. France's reputation as a signatory of the Saint-Denis Convention in 2016 was obliterated [29]. The Convention represented the long development of MSE principles begun with the Heysel Stadium Spectator Violence Convention of 1985, in the aftermath of the Heysel Stadium disaster, although as the title implies, that was excessively focused on security rather than the entire administration of a large athletic event.

By 2011–2012, the Monitoring Committee had accepted 28 specific ideas to improve safety, security, and service at major athletic events. The Secretary of the Saint-Denis Convention, Paulo Gomes, discussed some of its key elements, which emphasised the need to coordinate processes and address all required standards in terms of safety, security, and service within athletic venues, with the three key concerns being pyrotechnics, any violent or other prohibited behaviour, and racist or other discriminatory behaviour. A separate article dealt with these issues outside of athletic arenas, and the need to cover the entire journey of the fans from their house to the city and stadium and back again was emphasised, including fan zones, as well as everything going on in the city centre and around the stadium [29].

It also has an article on emergency and contingency planning to deal with any incident that may occur inside or outside the stadium. For the first time, this Convention emphasised the need for dialogue and trust between public authorities, namely the police, supporters' organisations, and local communities and companies. An article on police operations and strategy adumbrated best practices for policing football events, such as the importance of intelligence gathering, dynamic risk assessment, risk-based police officer deployment, and, perhaps most significantly, proportionate police intervention to minimise escalation of danger or disruption. It is necessary to intervene proportionately, which evidently did

not occur in France '22. As a final step, evidence should be collected and shared with the appropriate authorities for prosecutions [29].

MSE S&S is all about worldwide collaboration in international matches, and it is critical that sports authorities and police exchange experiences and information. There is a European network of National Football Information Points (NFIPs), one in each member state, that allows the exchange of police information. Spanish and British counterparts in the NFIPs must have provided essential police information to the French police in Saint-Denis so they could plan and prepare for the policing of this event. During the weeks before the final, the Spirit of Shankly fans' organisation collaborated extensively with Liverpool, Football Supporters Europe, and Merseyside police on fan safety, which is particularly poignant given the tragic history of Liverpool Football Club in this regard, but UEFA and the French authorities ignored their collaboration efforts [29].

This incident had a major global impact, and the Council of Europe officially contacted the French authorities to consider the lessons learned at its next meeting. More impacts could be seen through the trauma this inflicted on people [29]. The police's action could not only have harmed people but the event and property, with potential for massive insurance claims and financial losses. Macroeconomic impacts could be experienced by France, which could see its tourism industry reducing due to potential tourists looking at videos about the chaos or reading or watching media covering the event detailing how brutal the police were to fans. The police officers themselves could lose their jobs due to their malpractice and attempted cover-up. The most important impact could be the damage to international relations, especially in terms of the humiliation and disgrace suffered by France (and, by extension, Europe in general) due to such disgusting treatment of innocent football fans at a MSE of global importance and interest.

4. ScenAn Questionnaire

The questionnaire was developed based on related literature to target S&SP in Qatar, and included four parts, as described below.

4.1. Part 1: Opinions of Safety and Security Professionals (S&SPs) on France '22

This part assessed the opinions of S&SPs on the possible consequences of MSE incidents such as the case of France '22, covering aspects listed in Table 2. This preliminary questionnaire section primed the participants with increased awareness and familiarity with which to engage with the themes of the other parts of the instrument.

4.2. Part 2: Overcrowded Football Stadium Simulation Analysis

In this part, participants were presented with the scenario of people starting to overcrowd a football stadium in front of one security guard, considering two hypotheses:

H1. *FC surveillance information provides adequate SitAw for DDM by the C&C.*

H2. *DC surveillance information provides adequate SitAw for DDM by the C&C.*

The scenarios related to H1 and H2 were simulated using Lego figures, as illustrated in Figures 3 and 4 (respectively).

4.3. Part 3: Overcrowded Football Stadium Video Analysis

For this part of the study, a scenario was presented of people starting to overcrowd the football stadium, using video film captured from France '22, considering H1 and H2, as displayed in Figures 5 and 6 (respectively). Figure 6 was extracted from a video that was filmed from the top of the bridge, similar to a video captured by a drone.

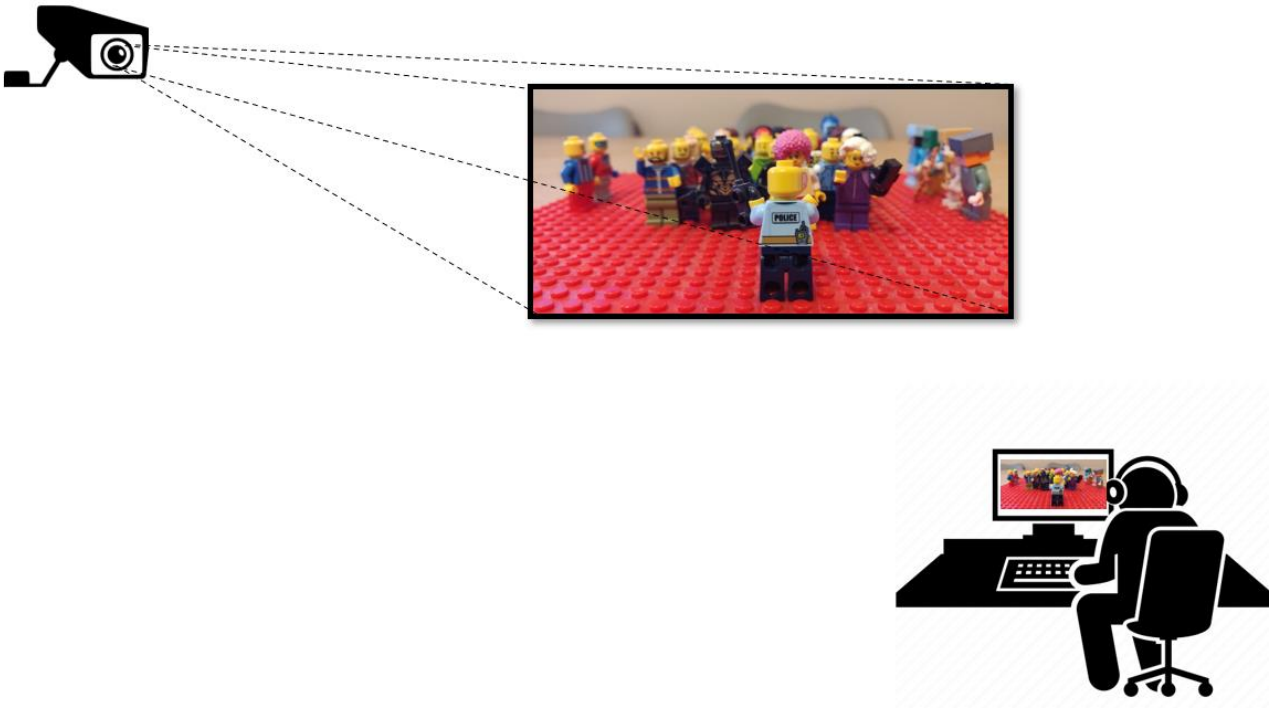

Figure 3. Simulated FC surveillance feed using Lego.

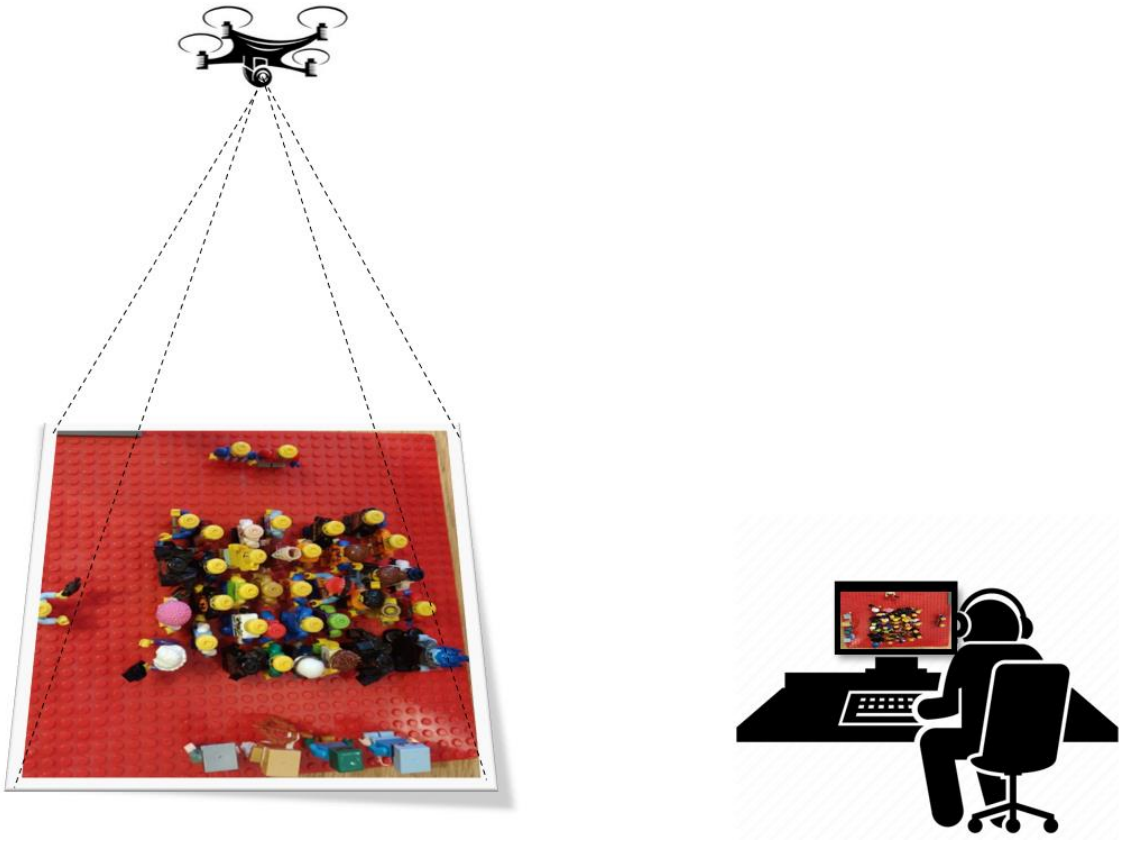

Figure 4. DC surveillance feed.

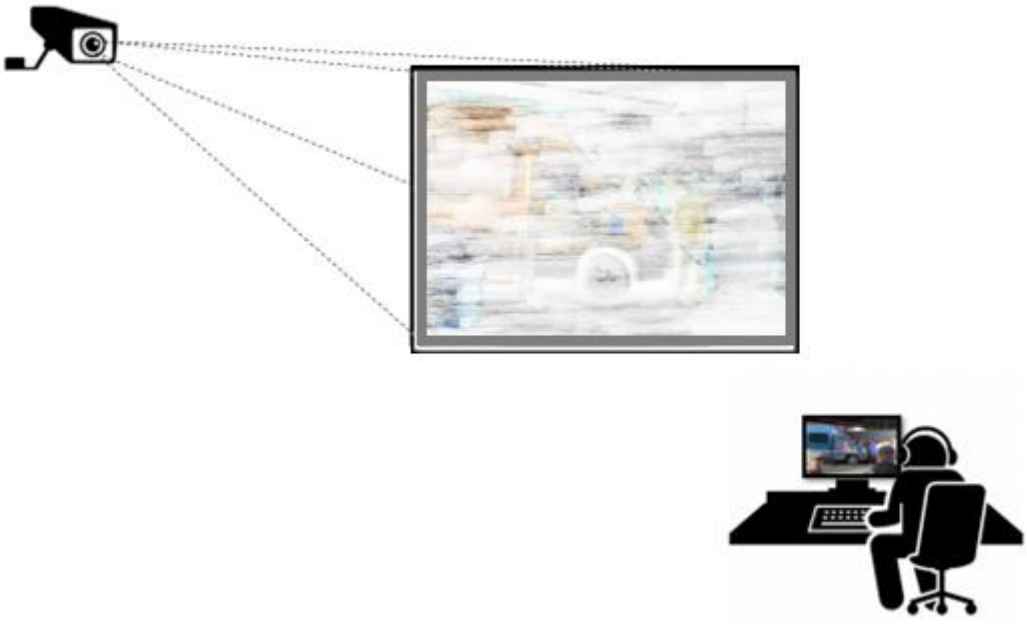

Figure 5. FC surveillance feed from France ′22.

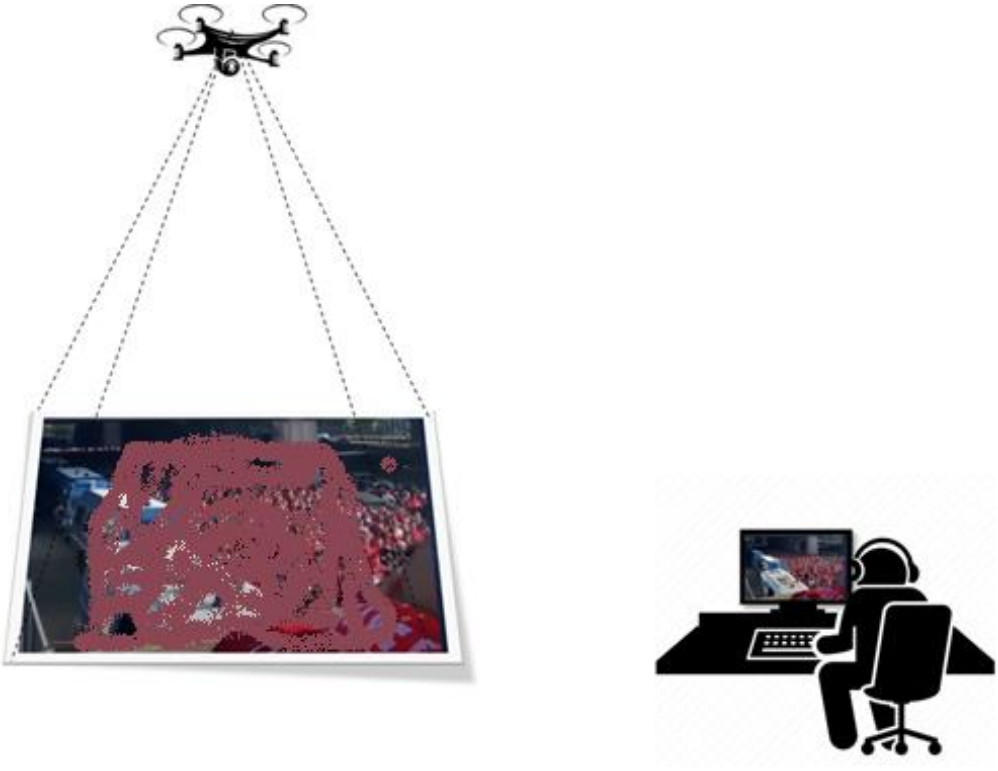

Figure 6. DC surveillance feed from France ′22.

4.4. Part 4: Opinions of S&SPs on ScenAn for DDM

This part evaluated the opinions of Qatari S&SPs on the impact of DC surveillance enhancing C&C SitAw for DDM.

5. Analysis and Findings

5.1. Statistical Testing

The mean, standard deviation (SD), frequency, percentage, and degrees values were calculated from scores based on the following:

$$Length\ of\ period = \frac{Upper\ bound - lower\ bound}{Number\ of\ levels} = \frac{5-1}{3} = 1.33$$

The number of levels was categorised as follows: low (1–2.33), medium (2.34–3.67), high (3.68–5).

Cronbach's alpha coefficient was used to test the stability of the study instrument, alongside independent and paired sample T-tests. Questionnaire reliability is indicated by a Cronbach's alpha of at least (0.6), which indicates that questionnaire items measure the variables they are supposed to effectively, thereby demonstrating the consistency and dependability of the instrument [20]. The questionnaire achieved a Cronbach's alpha coefficient of (0.77), indicating that it is valid for study purposes [16].

5.2. Demographic Characteristics

Table 1 shows that the majority of the participants were from the safety sector (62.5%, n = 25), while over a third were from the security sector (37.5%, n = 15).

Table 1. Demographic information.

Variable		N	%
Work sector	Safety	25	62.5
	Security	15	37.5
Total		40	100

5.3. Consequences of MSE

Table 2 shows the mean scores for participants' opinions on the possible consequences of MSE incidents based on France '22. All items were measured using a five-point Likert scale, and all statements got high scores, ranging between (4.9–4.98). The overall average was high (4.94).

Table 2. S&SPs' rating of possible consequences of MSE.

	Mean	SD	%	Degree
Possible negative reputation of the country	4.98	0.158	99.5	High
Possibility of putting people at risk	4.98	0.158	99.5	High
Possible damage to the event itself	4.95	0.221	99	High
Possible financial loss	4.95	0.221	99	High
Possible damage due to media coverage	4.95	0.221	99	High
Possible damage to property and infrastructure	4.93	0.267	98.5	High
Possible traumas to people involved	4.93	0.267	98.5	High
Possibility of facing challenges to host future events	4.93	0.267	98.5	High
Possible damage to international relation	4.90	0.304	98	High
Possibility damage for future career of S&SP	4.90	0.304	98	High
Average	4.94		98.75	High

Table 3 shows that the T-value is not statistically significant at ($\alpha \leq 0.05$), so we conclude that there is no difference in S&SPs' opinions on the possible consequences of MSE ScenAn according to work sector, based on the case of France '22.

Table 3. Independent sample T-test to test the effect of work sector.

	N	Mean	SD	T-Value	*p*-Value
Safety	25	4.93	0.090	0.51300	0.611
Security	15	4.95	0.083		

5.4. Results from Lego Simulation of Fixed Camera (FC) and Drone Camera (DC) Surveillance Images

To determine the achieved SitAw for each image, the Formula (1) employed in military and air force analysis [15] was utilized. This formula calculates precision, which is a measure of the proportion of correct detections or predictions made by the SitAw system in relation to the total number of activities detected. Precision is typically expressed as a ratio or percentage, reflecting the accuracy of the system's outputs compared to the total activities detected.

Figure 7 compares the calculated SitAw from the two scenarios of FC and DC images, using Lego figures to simulate a number of people facing security guards. The difference between the two calculated SitAw values is very significant; the FC provides an average SitAw of 49%, while the DC achieves an average of 98%. Table 4 shows that the T value is statistically significant at ($\alpha \leq 0.05$), thus it can be concluded that there is a difference between the quality of SitAw between the FC image in Figure 4 and the DC image in Figure 5, with better awareness being recorded for the latter; This means that DC surveillance can improve situational awareness and dynamic decision making.

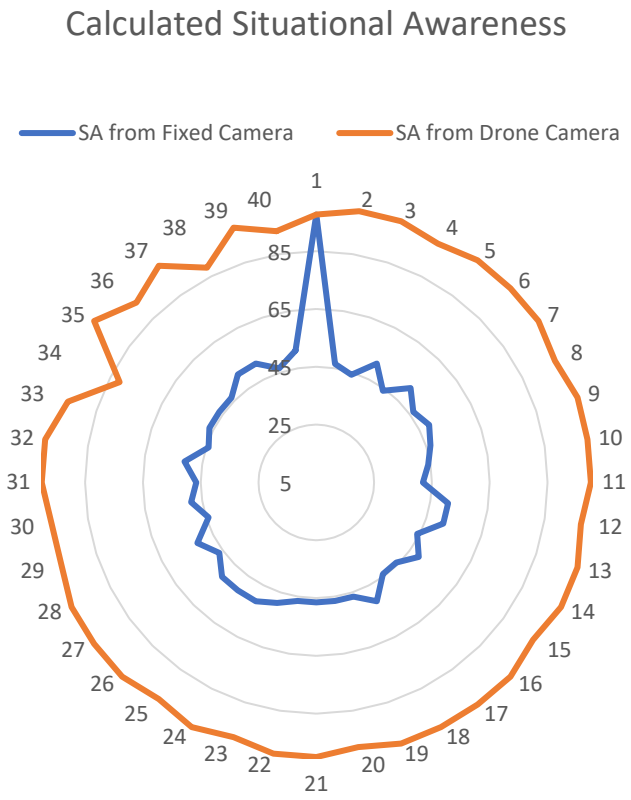

Figure 7. Lego simulation calculation of SitAw.

Table 4. Paired sample T-test to test the different between SitAw for E1F camera image and SitAw for DC image.

Scenario	Mean	N	SD	T-Value	*p*-Value
SitAw for image 4 FC	0.477	40	0.0284	65.37300	0.000
SitAw for image 5 DC	0.981	40	0.0364		

5.5. Evaluation of FC and DC Surveillance Impact on C&C Situational Awareness (SitAw) for DDM

Figure 8 shows, the analysis of the SitAw results from the real FC and the DC images obtained from 'France 22 (Figures 6 and 7) revealed that FC images did not provide high level of SitAw, which was identified as a major contributing factor to the negative incident, while drone surveillance (represented by the second image, Figure 6) provides a high level of SitAw. Table 5 shows that the SitAw from the DC surveillance feed was superior to that from the FC feed.

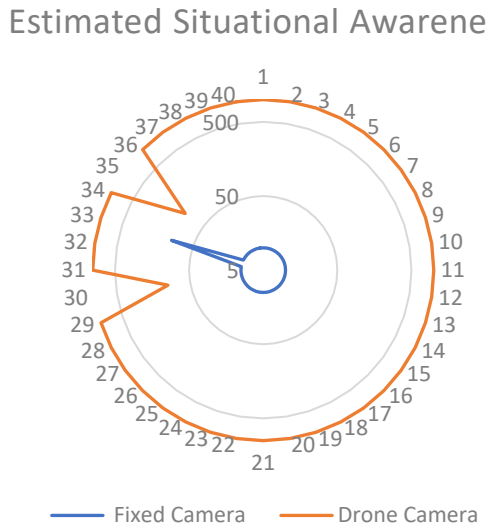

Figure 8. Estimated SitAw using real images from France '22.

Table 5. Evaluation of FC and DC.

			N	%
From the FC surveillance feed (picture 6), I can see the crowd in:	100 rds	Low-level SitAw	1	2.5
	10 ns	Very low-level SitAw	39	97.5
From the DC surveillance feed (picture 7), I can see the crowd in:	1000 nds	High-level SitAw	38	95.0
	100 rds	Low-level SitAw	2	5.0
Total			40	100.0

5.6. Opinions on the Use of DC Surveillance

Figure 9 shows that S&SPs held very positive opinions about using DC surveillance in enhancing SitAw For DDM. The findings demonstrate that they perceive that the DC can play as a major contributing factor in in enabling the C&C officer to establish better SitAw, which leads to improved DDM. Table 6 shows that the T-value is not statistically significant at ($\alpha \leq 0.05$), so we conclude that there is no difference due to the work sector on opinions on DC surveillance enhancing C&C SitAw for DDM; that means both S&SPs agree on the positive contribution of DC surveillance in improving situational awareness and dynamic decision making.

Figure 9. DC surveillance in enhancing SitAw for DDM.

Table 6. Independent sample T-test to test the effect of work sector.

Can DC Surveillance Enhance C&C SitAw for DDM?					
Sector	**N**	**Mean**	**SD**	**T-Value**	***p*-Value**
Safety	25	4.96	0.200	0.366	0.717
Security	15	4.93	0.258		

5.7. Drone Surveillance ScenAn Model for DDM

Based on the findings of this study, it is evident that the use of drones significantly contributes to enhancing SitAw, as demonstrated through both Lego simulations of crowd scenarios and real images from the France '22 case study. Therefore, integrating drone surveillance as a source of environmental sensing aligns the SitAw model and serves as a key component of the first level of the Endsley model, which involves the reception of elements in the environment. This enhancement in environmental sensing leads to better inputs for the other two levels: comprehension of the current situation and the projection of future status. This integration enables more effective DDM. Figure 10 illustrates that FCs can provide approximately 50% effective coverage in the best SitAw scenario, while DCs can enable nearly 100% SitAw coverage.

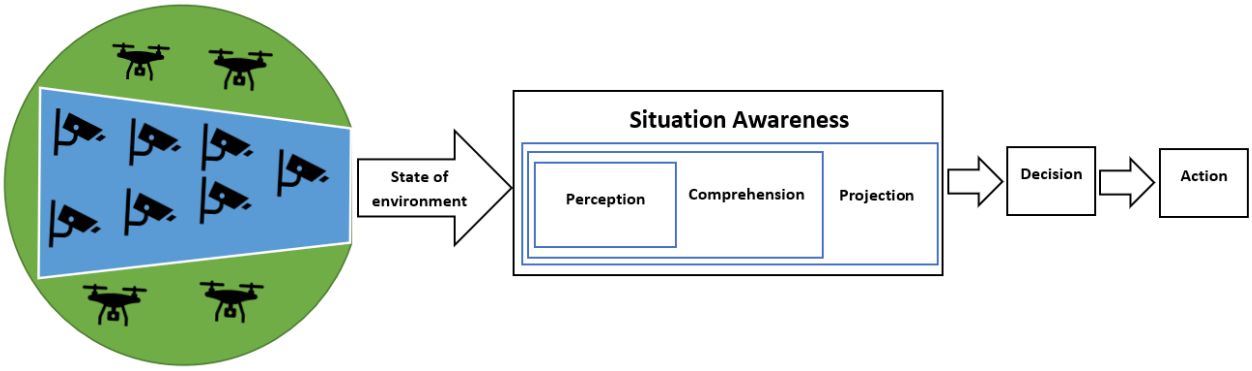

Figure 10. Drone surveillance SitAw model for dynamic decision-making.

It is worth noting that while MSEs comprise the case of concern to this study, other events or situations involving large groups of people that require S&S measures can benefit from this model (e.g., music festivals, pilgrimages, or political rallies), to achieve a more robust strategy for effective risk management.

6. Conclusions and Recommendations

The incident during the France '22 Champions' League serves as a significant warning for countries interested in hosting major sporting events, emphasizing the potential for errors and the importance of implementing advanced risk management strategies. This study was conducted to raise awareness among Qatar's S&SPs about the potential consequences of such incidents. Additionally, the study aimed to explore the application of ScenAn in evaluating the level of SitAw using Lego simulations and real images from the France '22 incident.

The attitudes of S&SPs were examined regarding the use of drone surveillance to enhance SitAw among Command-and-Control officers. The results of the study indicated that S&SPs recognized the negative implications of adverse events and exhibited a higher level of SitAw when drone surveillance was employed, compared to using only FCs. They also displayed positive attitudes towards implementing surveillance for safety and security purposes during mega sporting events.

A drone surveillance SitAw model for DDM was presented, demonstrating its effective integration to enhance SitAw in MSEs and similar applications. It is important to note that the conclusions drawn in this study are based solely on the findings obtained within the scope of this research. Therefore, further studies, particularly involving the full deployment of drone camera surveillance systems in real-life scenarios, are necessary to determine their complete contribution to Command-and-Control SitAw for DDM.

Moreover, it is essential to address other technical and operational challenges prior to the actual implementation of such systems, including aspects such as the security of communication channels and the availability of a regulatory framework for drone applications.

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