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GINA Military
Methodological Notes
HCSS Datalab

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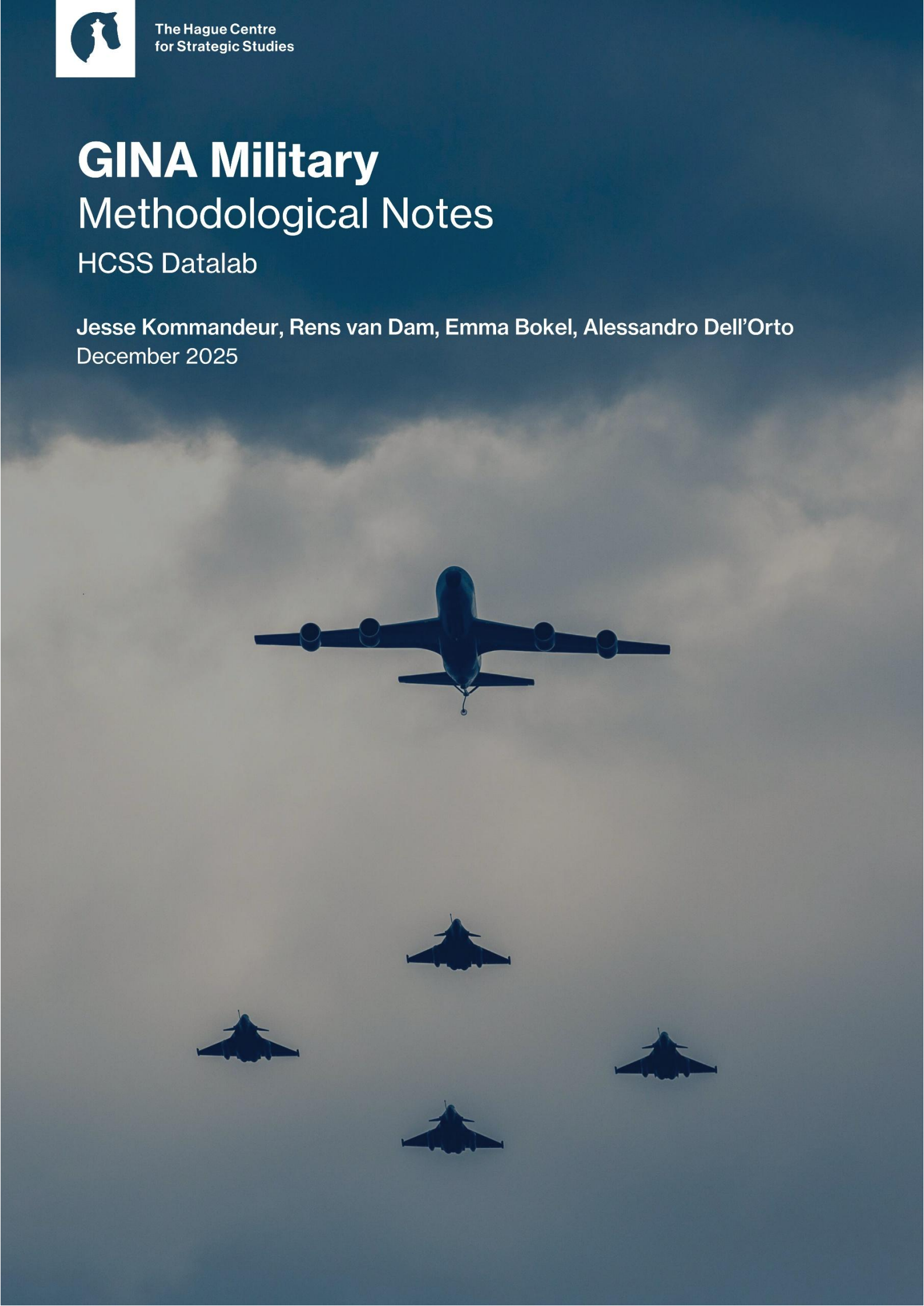

GINA Military
Methodological Notes

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GINA Military in short

The Geopolitical Interactive Network Analysis (GINA) Military dashboard, developed by the HCSS Datalab in cooperation with Strategic Analysts, applies network science to explore global patterns of conflict and military cooperation. Drawing on open-source and systematically maintained datasets, it visualises how states and non-state actors are connected through organised violence and arms transfers, providing a structured, data-driven view of the military dimension of international relations.

Based on data from the Uppsala Conflict Data Program (UCDP) and the Stockholm International Peace Research Institute (SIPRI), the tool integrates decades of verified records on armed conflict and major conventional weapons transfers. It enables users to examine how conflicts evolve over time, how actors interact through violence, and how military capabilities flow across borders. By linking these datasets through a network-based framework, GINA Military reveals the relational structures underlying global security dynamics.

The dashboard is organised into two analytical modules. The Conflict module visualises interactions between actors in organised violence, showing where, when, and between whom conflicts occur. The Cooperation module maps arms trade relationships, highlighting patterns of defence interdependence and capability exchange. Together, these modules offer a multi-layered overview of military competition and cooperation from the local to the global level.

While GINA Military provides a consistent and transparent methodological foundation, its insights depend on the availability and quality of open-source data. Conflict reporting gaps, definitional inconsistencies, and the non-monetary nature of SIPRI's Trend Indicator Value (TIV) may limit comparability across countries and time periods. As such, the dashboard serves as a conservative but robust analytical baseline for exploring how power, conflict, and defence cooperation intersect within the global security network.

1. Introduction

As international tensions fluctuate and alliances shift, the need for advanced analytical tools to decode these interactions has never been more pressing. The Hague Centre for Strategic Studies (HCSS) has developed the **GINA Series**, an initiative by the HCSS Datalab in collaboration with Strategic Analysts, to apply network science frameworks to multiple dimensions of international relations. Drawing on publicly available datasets, GINA examines patterns, interdependencies, and power dynamics between states across four domains: Diplomatic, Military, Economic, and Information.

Figure 1 - GINA Suite overview

Each interactive dashboard allows users to explore data through dynamic maps, networks, and graphs across varying time frames and geographic scales, from individual countries to the global level. While the series provides a consistent methodological foundation and employs techniques such as natural language processing and similarity modelling, its insights depend on the quality and completeness of open-source data, positioning it as a conservative yet robust starting point for understanding international dynamics.

Many applications of network analysis in the military domain have focused on the social and organisational dimensions of defence systems, examining how communication, coordination, and decision-making unfold within complex environments. Studies have used relational and communication mapping to understand interaction patterns in command-and-control structures and to improve organisational effectiveness.[1] Other research has applied structural network analysis to assess the connectivity and resilience of information and sensor systems within command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) architectures.[2]

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[1] Norbou Buchler et al., 'Mission Command in the Age of Network-Enabled Operations: Social Network Analysis of Information Sharing and Situation Awareness', *Frontiers in Psychology* 7 (June 2016), https://doi.org/10.3389/fpsyg.2016.00937; Laura R. Marusich and Norbou Buchler, 'Time Series Modeling of Army Mission Command Communication Networks: An Event-Driven Analysis', *Computational and Mathematical Organization Theory* 22, no. 4 (2016): 467–86, https://doi.org/10.1007/s10588-016-9211-7.

[2] Muhammad Junaid Farooq and Quanyan Zhu, 'Secure and Reconfigurable Network Design for Critical Information Dissemination in the Internet of Battlefield Things (IoBT)', arXiv.Org, 2 March 2017, https://doi.org/10.23919/WIOPT.2017.7959892.

More recent work has extended these approaches to international cooperation and emerging defence technologies, using social network analysis to map collaborative ties among states in areas such as military artificial intelligence and capability development.[3] These studies demonstrate the flexibility of network analysis for exploring relationships within military systems, yet most remain focused on individual organisations, exercises, or specific operational contexts rather than on the broader global structures that shape defence interdependence.

By applying network-based methods to data on armed conflict and arms transfers, it becomes possible to visualise and analyse how states and actors are linked through material exchanges and strategic dependencies, revealing another important dimension of how power and influence operate in global security networks. **GINA Military** builds on this potential by offering an interactive analytical environment that applies network analysis to two major open-source datasets on organised violence and arms trade.[4] The tool enables users to systematically explore these complex relationships through a range of configurable lenses and focus layers, supporting more nuanced insights into the relational dimensions of conflict and defence interdependence.

The methodological note accompanying the dashboard aims to guide the reader from the conceptual foundations of the GINA Military framework to its practical application within the dashboard. Each chapter builds on the previous one, moving from theory to data to network construction and finally to analytical interpretation. The structure mirrors the logic of the GINA series and aims to make both the reasoning behind the model and its operational choices transparent.

Section 2 sets out the conceptual foundations of GINA Military. It introduces the core ideas of organised violence and military cooperation, clarifies how these concepts are understood in this study, and highlights their shared structural, situational and relational drivers. It also explains how conflict and cooperation interact within wider security systems, establishing the conceptual bridge between UCDP, SIPRI and a network-science approach.

Section 3 presents the typology and data sources underpinning the dashboard. It describes the categories used to classify organised violence and military cooperation and outlines how these categories relate to the UCDP and SIPRI datasets. The section also details the harmonisation of country entities across sources and concludes with a data summary table, offering a concise overview of definitions, coverage and operationalisation.

Section 4 explains how the two network layers are constructed from these datasets. It outlines how actors become nodes, how interactions become edges, how weights are assigned and how temporal filters are applied. A dedicated subsection describes the visual logic shared across both layers – layout, colouring and scaling – to ensure users understand how to interpret the structures displayed in the dashboard. The section ends with a summary table of all modelling decisions.

Section 5 introduces the analytical outputs available through the dashboard. It presents examples of insights that can be drawn from the global and state-level networks and discusses the complementary visualisations that support broader interpretation, including maps, quantitative summaries and temporal patterns. This section illustrates how users can move from raw relationships to meaningful analysis by exploring variation across actors, regions and time.

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[3] Mahmoud Javadi and Michal Onderco, 'State Positioning in European Military AI Networks: A Social Network Analysis of European Partnerships in Military AI', *Journal of Contemporary European Studies*, 3 June 2025, 1–20, https://doi.org/10.1080/14782804.2025.2514846.

[4] 'SIPRI Arms Transfers Database | SIPRI', accessed 11 November 2025, https://www.sipri.org/databases/armstransfers; Magnus Öberg, 'Mapping Global Violence: The Uppsala Conflict Data Program', *One Earth* 8, no. 9 (2025), https://doi.org/10.1016/j.oneear.2025.101394.

Section 6 reflects on the main methodological limitations of GINA Military and outlines avenues for refinement. It discusses constraints related to data coverage, reporting biases, the treatment of non-state actors, and the interpretation of network measures, as well as the implications of focusing on major conventional weapons and recorded events. The section also identifies potential extensions, including the integration of additional datasets or alternative weighting schemes, and clarifies how these limitations should be kept in mind when interpreting the dashboard's outputs.

Taken together, the methodological note is structured to offer both a clear overview and a technical roadmap. Readers can follow it sequentially for a complete understanding of the GINA Military logic, or consult each section as a standalone reference depending on whether their focus is on conceptual clarity, data transparency, methodological choices or analytical interpretation. [5]

[5] Portions of this methodological note were created with support from generative AI tools. In line with the HCSS Maxims for Responsible Use of Generative AI, the use of these tools served only to augment the analytical process, not to substitute expert judgement. All AI generated suggestions were verified for accuracy, authenticity, and integrity. Sweijs, T., Kommandeur, J., and de Ruijter, A. (2024). Augmentation, Not Substitution. HCSS Manual for the Responsible Use of Generative AI.

2. Conceptual Foundation

This section establishes the conceptual basis for the GINA Military framework by clarifying how armed conflict and military cooperation are understood and operationalised in this project. Because both phenomena involve structured interactions among organised actors, they form complementary layers of the broader security environment that GINA seeks to analyse. Clear definitions are essential for ensuring that these interactions can be measured consistently, compared across cases, and represented accurately within a network-science approach. Section 2.1 outlines the key elements, forms, and drivers of armed conflict, while Section 2.2 develops an equivalent foundation for military cooperation. Together, these concepts provide the groundwork for the typology in Section 3 and for understanding how patterns of confrontation and collaboration shape the structure and evolution of military networks.

2.1. Armed Conflict

2.1.1. Definition

Armed conflict refers to the organised and sustained use of armed force between collective actors that pursue incompatible objectives and are unable or unwilling to resolve their disputes peacefully. Because the use of force is coercive and often lethal, armed conflict involves levels of violent harm that set it apart from non-violent political disputes. These confrontations are political in nature, since violence reflects struggles over power, authority, territory, or governance.[6] Armed conflict also unfolds within wider social and international contexts and is shaped by the capacities, intentions, and interactions of the actors involved.

Armed conflict appears in different settings. It can involve state armed forces confronting each other over contested borders, government forces fighting organised insurgent groups over political control, or non-state armed groups competing violently for territory or resources.[7] Despite these differences, armed conflicts share several core features: actors are organised, violence is deliberate, and the underlying incompatibility is important enough to sustain coercion. Recurring clashes along a disputed frontier or prolonged fighting between a government and a rebel group over control of a region illustrate how force is used to pursue political aims.

Another key feature of armed conflict is that it develops over time. Conflicts rarely emerge suddenly. They tend to grow out of long-term conditions, escalate due to specific triggers, and change as actors adjust their strategies in response to shifting opportunities and constraints.[8] A disputed election that leads to intensified confrontation, or a military buildup along a border that turns into open clashes, shows how political tensions can evolve into organised violence.

This definition provides the basis for the analysis that follows. By focusing on incompatibility, organised actors, and the deliberate use of force, it offers a clear way to distinguish armed conflict from criminal violence, spontaneous unrest, or diplomatic disputes and links directly to the forms of conflict discussed in the next paragraphs.

2.1.2. Forms of Armed Conflict

Armed conflict takes different forms depending on who is involved, where the fighting occurs, and whether outside states participate.[9] For analytical clarity, four main forms are distinguished: interstate

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[6] Carl von Clausewitz, 'On War | Princeton University Press', 21 June 1989, https://press.princeton.edu/books/paperback/9780691018546/on-war.
[7] Stathis N. Kalyvas, *The Logic of Violence in Civil War*, Cambridge Studies in Comparative Politics (Cambridge University Press, 2006), https://doi.org/10.1017/CBO9780511818462.
[8] Johan Galtung, 'Violence, Peace, and Peace Research', *Journal of Peace Research* 6, no. 3 (1969): 167–91, https://doi.org/10.1177/002234336900600301.
[9] Ian Davies and Claudia Pfeifer Cruz, 'Global Developments in Armed Conflicts, Peace Processes and Peace Operations | SIPRI', in *SIPRI Yearbook 2022: Armaments, Disarmament and International Security* (Oxford University Press, 2022), https://www.sipri.org/yearbook/2022/02.

conflict, intrastate conflict, internationalised intrastate conflict, and non-state armed conflict. These forms vary in actor composition and geographic scope, but all involve the organised use of force that can produce casualties, even if the level of violence differs across settings.

Interstate conflict involves armed confrontation between two or more sovereign states. These conflicts usually revolve around contested territory, questions of sovereignty, or regime survival. A typical example is when neighbouring governments mobilise their armed forces along a disputed border and engage in repeated clashes.[10]

Intrastate conflict occurs within a single state and generally involves the government and one or more organised non-state actors seeking political, territorial, or regime change. For example, an insurgent movement challenging central authority over a specific region can provoke sustained armed confrontations with government forces.[11]

Internationalised intrastate conflict describes an internal conflict in which external states intervene directly or indirectly, for instance by deploying troops, supplying weapons, or providing logistical support. Such involvement can expand the scale of violence and transform a domestic dispute into a broader, more complex confrontation.[12]

Non-state armed conflict involves sustained violence among organised non-state armed groups without a state actor directly participating on one side. These conflicts often emerge in environments where state authority is weak or fragmented, and where competing armed factions seek to control territory, resources, or influence.[13]

In practice, armed conflicts may evolve from one form to another. An initially domestic confrontation may become internationalised through external support, while interstate rivalries can be expressed indirectly through assistance to aligned non-state groups. These distinctions help organise patterns of violence into a coherent typology and support consistent comparison across contexts, which will be operationalised in Section 3.

2.1.3. **Causes and Drivers**

Armed conflict is shaped by the interaction of structural, situational, and relational drivers. These factors do not determine violence on their own, but together they influence where conflict emerges and how it evolves.

Structural drivers are long-term conditions that increase a society's vulnerability to organised violence. Studies of civil war onset consistently highlight low income, weak or exclusionary state institutions, and persistent inequality as key risk factors.[14] For example, states with limited capacity to provide security or accommodate political opposition are more prone to armed challenges.

Situational drivers are short-term shocks that can trigger or intensify conflict in fragile settings. Economic crises, coups, contested elections, and sudden changes in leadership can quickly alter perceptions of risk and opportunity, making armed confrontation more likely.[15] A disputed election that undermines the legitimacy of state authority is a typical illustration.

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[10] Bastian Herre et al., 'War and Peace', *Our World in Data*, 20 March 2024, https://ourworldindata.org/war-and-peace.
[11] 'Understanding Intrastate Conflict', CFR Education from the Council on Foreign Relations, 16 May 2023, https://education.cfr.org/learn/reading/understanding-intrastate-conflict.
[12] Sylvain Vité, 'Typology of Armed Conflicts in International Humanitarian Law: Legal Concepts and Actual Situations', *International Review of the Red Cross* 91, no. 873 (2009): 69–94, https://doi.org/10.1017/S181638310999021X.
[13] Benedetta Berti, 'What's in a Name? Re-Conceptualizing Non-State Armed Groups in the Middle East', *Palgrave Communications* 2, no. 1 (2016): 16089, https://doi.org/10.1057/palcomms.2016.89.
[14] Håvard Hegre and Nicholas Sambanis, 'Sensitivity Analysis of Empirical Results on Civil War Onset', *The Journal of Conflict Resolution* 50, no. 4 (2006): 508–35.
[15] Edward Miguel et al., 'Economic Shocks and Civil Conflict: An Instrumental Variables Approach', *Journal of Political Economy* 112, no. 4 (2004): 725–53, https://doi.org/10.1086/421174.

Relational drivers concern how conflicts are embedded in regional and international networks. Research shows that civil wars often cluster in space and time and that conflict in one country increases the likelihood of violence in neighbouring states, especially when external actors provide support to local parties.[16] Cross-border alliances, proxy relationships, and arms flows can transform a domestic dispute into an internationalised conflict or link several conflicts into a broader regional system.

2.1.4. **Dynamics and Trajectories**

Armed conflict unfolds as a process that changes in intensity, scope, and actor behaviour over time rather than as a single episode of violence. Conflicts often escalate when parties mobilise additional forces, expand operations into new areas, or gain external support. These shifts can produce increases in battle-related casualties or transform limited clashes into broader confrontations.[17] In many cases, escalation is followed by periods of de-escalation as actors face resource constraints, mounting costs, or pressure from domestic or external stakeholders. Local ceasefires, temporary restraint, and partial agreements may reduce violence without fully resolving the underlying dispute.[18]

Conflict endings vary widely. Some conflicts conclude with negotiated settlements that address core incompatibilities, while others end through military victory or external enforcement.[19] Many conflicts do not end decisively but instead settle into prolonged stalemates in which large-scale fighting subsides while tensions remain. These unresolved arrangements can produce recurring cycles of violence or the re-emergence of hostilities when incentives shift. Understanding these dynamics is essential for interpreting fluctuations in event frequency, actor involvement, and casualty levels across time.

2.1.5. **Analytical Purpose**

Taken together, these conceptual foundations clarify what armed conflict is, how its main forms differ, and which factors shape its emergence and evolution. They provide the analytical basis for understanding armed conflict as a system of interactions among organised actors rather than as isolated incidents of violence. The following sections will translate these concepts into an operational typology and a network-science framework that identifies actors, relationships, and events as interconnected nodes and links. This enables GINA Military to represent patterns of violence, alliances, and hostilities as dynamic networks, allowing for systematic comparison across conflicts and over time.

2.2. Military Cooperation

2.2.1. **Definition**

Military cooperation refers to formal and purposeful interactions through which states or defence institutions coordinate, exchange, or develop military capabilities.[20] Such cooperation involves identifiable actors, documented commitments, and activities that serve a clear military function, including the transfer of equipment, joint training, defence-industrial collaboration, or operational support.[21] These engagements reflect shared strategic interests and help states manage threats, strengthen collective security, or improve their military effectiveness within the wider international

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[16] Halvard Buhaug and Kristian Skrede Gleditsch, 'Contagion or Confusion? Why Conflicts Cluster in Space', *International Studies Quarterly* 52, no. 2 (2008): 215–33.
[17] Juan A. Lacomba et al., 'On the Escalation and De-Escalation of Conflict', *Games and Economic Behavior* 86 (July 2014): 40–57, https://doi.org/10.1016/j.geb.2014.03.006.
[18] Magnus Lundgren et al., 'Local Ceasefires and De-Escalation: Evidence From the Syrian Civil War', *Journal of Conflict Resolution* 67, nos 7–8 (2023): 1350–75, https://doi.org/10.1177/00220027221148655.
[19] Virginia Page Fortna, *Peace Time: Cease-Fire Agreements and the Durability of Peace* (Princeton University Press, 2004), https://www.jstor.org/stable/j.ctv39x5v5.
[20] Camille Morel and Friederike Richter, *Defence Cooperation in the 21st Century*, Research Report (Institut de recherche stratégique de l'École militaire, 2021), 65, https://sciencespo.hal.science/hal-03703110.
[21] Spencer L Willardson and Richard Al Johnson, 'Arms Transfers and International Relations Theory: Situating Military Aircraft Sales in the Broader IR Context', *Conflict Management and Peace Science* 39, no. 2 (2022): 191–213, https://doi.org/10.1177/0738894221992034.

system.[22] Military cooperation differs from informal political alignment or temporary coordination, as it requires observable and traceable interactions. Examples include long-term arms supply agreements, co-production of defence technologies, military training missions, and structured advisory assistance.[23] Focusing on these measurable forms of cooperation allows for consistent comparison across countries and time and supports a network-based understanding of how defence relationships form, deepen, or shift within regional and global security environments.[24]

2.2.2. **Forms of Military Cooperation**

Military cooperation can take different forms depending on the purpose of the interaction, the actors involved, and the level of commitment between them. For analytical clarity, the following forms are distinguished: operational cooperation, capability cooperation, institutional cooperation, and ad hoc cooperation. These forms vary in scope and depth, but all involve deliberate, documentable activities that strengthen military capacity or coordination between states.

Operational cooperation refers to activities in which armed forces coordinate or conduct actions together. This includes joint exercises, combined training programmes, coordinated patrols, or intelligence-sharing arrangements.[25] Such cooperation enhances interoperability and helps states prepare for shared security challenges. For example, regular joint naval exercises or cross-border patrols demonstrate how states coordinate military behaviour in practice.

Capability cooperation involves the exchange, development, or transfer of military resources and technologies. This includes arms transfers, co-production agreements, defence-industrial partnerships, and training missions aimed at building another state's military capacity.[26] These interactions strengthen long-term capabilities and often create enduring ties, such as the joint development of weapons systems or sustained advisory deployments.

Institutional cooperation encompasses formalised agreements or frameworks that structure ongoing military relations. Examples include defence pacts, alliance commitments, basing agreements, and multilateral security arrangements.[27] These institutionalised forms of cooperation establish rules, expectations, and mechanisms for sustained coordination over time.

Ad hoc cooperation is short-term or situational coordination in response to specific events. This may include crisis-driven deployments, temporary coalition arrangements, humanitarian assistance operations, or rapid support missions.[28] Although temporary, these interactions still reflect purposeful military collaboration and can evolve into more structured forms.

These forms help organise patterns of military interaction into a coherent typology, allowing for consistent comparison across cases and over time. They also support the representation of cooperative ties within the GINA Military network model, where different types of cooperation shape how actors are connected and positioned in regional and global security environments.

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[22] M. Kanetake et al., 'State Responsibility for Arms Transfers: The Law of State Responsibility and the Arms Trade Treaty', *Ars Aequi* 2020, no. 2 (2020): 151–60.
[23] Patrick Robert Bentley, *Alliances, Arms Transfers and Military Aid: Major Power Security Cooperation with Applications and Extensions to the United States*, 16 April 2013, https://etd.library.vanderbilt.edu/etd-03262013-141440.
[24] Igor Davidzon, *Theoretical Approaches to Patterns of Military Cooperation and Alliances* (2021), 13–36, https://doi.org/10.1007/978-3-030-82886-8_2.
[25] Camille Morel and Friederike Richter, *DEFENCE COOPERATION IN THE 21ST CENTURY*, no. 86 (IRSEM (Institut de Recherche Stratégique de l'École Militaire), 2021), https://www.irsem.fr/storage/file_manager_files/2025/03/etude-irsem-86-defence-cooperation.pdf.
[26] M. Mehrl et al., 'Sharing Rivals, Sending Weapons: Rivalry and Cooperation in the International Arms Trade, 1920–1939', *Review of International Organizations*, Springer Nature, 17 October 2023, https://eprints.whiterose.ac.uk/id/eprint/201272/.
[27] Brandon J. Kinne, 'Defense Cooperation Agreements and the Emergence of a Global Security Network', *International Organization* 72, no. 4 (2018): 799–837, https://doi.org/10.1017/S0020818318000218.
[28] Dick Zandee et al., *Front Matter*, Defence Cooperation Models (Clingendael Institute, 2016), [i]-[ii], https://www.jstor.org/stable/resrep05420.1.

2.2.3. **Causes and Drivers**

Military cooperation, like armed conflict, is influenced by a combination of structural, situational, and relational factors. While these categories mirror those used in the previous section, the mechanisms they capture differ: instead of generating incentives for confrontation, they shape the conditions under which states choose to coordinate, support, or align their military activities.

Structural drivers reflect long-term conditions that make cooperation attractive or necessary. States facing similar security challenges or operating within the same strategic environment often seek to pool resources, increase interoperability, or share the burden of defence.[29] Defence-industrial linkages, geographic proximity, and longstanding political alignment also create incentives for sustained cooperation.[30] These factors provide a stable foundation that supports recurring or institutionalised military engagement.

Situational drivers arise from short-term changes in the security environment. Sudden crises, emerging threats, technological shocks, or shifts in regional power dynamics can prompt states to deepen cooperation quickly. Leadership change, specific incidents such as attacks or border tensions, and strategic competition can similarly open windows of opportunity for new agreements or joint activities.[31] These situational pressures often accelerate or expand existing cooperative ties.

Relational drivers concern how cooperation is embedded within wider networks of alliances, partnerships, and defence-industrial relationships. States may cooperate because allies or major partners do so, because they depend on external support for training or equipment, or because they are integrated into broader institutional frameworks.[32] Patron–client relations, historical ties, and defence-technology dependencies can make cooperation more likely and more durable. These relational factors help explain why cooperation often clusters within regions or strategic blocs.

Together, these drivers highlight that military cooperation is shaped by enduring structural conditions, reactive responses to short-term developments, and the networked nature of international security relations. Understanding these factors supports the analysis of how cooperative ties form, deepen, or shift over time.

2.2.4. **Dynamics and Trajectories**

Military cooperation is not static but evolves through stages of deepening, broadening and, sometimes, contraction or termination. Research shows that partnerships often begin with limited exchanges – such as training or equipment donations – and expand into more integrated collaborations over time. As cooperation matures, states may shift from bilateral arrangements to multilateral frameworks, cover additional domains (for example cyber or space), and create overlapping institutional ties.

Yet cooperation can also stall or decline. Changes in strategic priorities, reduced capability investment, political realignments or crises can lead partners to scale back commitments, suspend joint programmes or exit formal agreements altogether.[33] Recognising how cooperation ties evolve matters for GINA Military's network approach, because ties vary not only in presence or absence but also in strength, scope and duration. By viewing military cooperation as a dynamic process of relationship evolution, the framework clarifies how actors move from one form of cooperation to another and how networks of military collaboration expand or retract over time.

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[29] Zandee et al., *Front Matter*.
[30] Morel and Richter, *Defence Cooperation in the 21st Century* (IRSEM (Institut de Recherche Stratégique de l'École Militaire), 2021).
[31] Michael J. Mazarr et al., *Security Cooperation in a Strategic Competition* (2022), https://www.rand.org/pubs/research_reports/RRA650-1.html.
[32] Kinne, 'Defense Cooperation Agreements and the Emergence of a Global Security Network'.
[33] Tobias Mueller, 'Drivers and Impact of European Defence Market Integration: A Literature Meta-Synthesis with Economic Focus', *Defence and Peace Economics* 36, no. 5 (2025): 577–612, https://doi.org/10.1080/10242694.2024.2396416.

2.2.5. **Analytical Purpose**

The concepts outlined above provide the basis for understanding military cooperation as a set of observable and evolving relationships between states. By distinguishing forms of cooperation and the factors that drive them, this framework clarifies how states build military ties, how these ties change over time, and how they relate to broader patterns of security behaviour. For GINA Military, these distinctions translate directly into the representation of cooperation within a network-science approach, where each cooperative activity forms an edge connecting actors.

Military cooperation does not exist in isolation from armed conflict. States often maintain cooperative and competitive relations at the same time, and shifts in one domain can affect the other. Recognising this interplay supports a fuller understanding of how states position themselves within regional and global security environments and how cooperative ties can mitigate, reinforce, or coexist with conflict dynamics.

By providing clear definitions and categories, this conceptual foundation ensures that the operational typology introduced in the next section can be applied systematically. It links strategic behaviour to measurable interactions, allowing GINA Military to trace how cooperative networks form, evolve, and intersect with other dimensions of military activity over time.

3. Typology and Data Sources

This section outlines the empirical foundations on which GINA Military is built. Because the dashboard combines two distinct forms of interaction, organised violence and military cooperation, it draws on data sources that differ in coverage, structure and actor composition. Section 3.1 introduces the UCDP framework for organised violence, explaining how events, actors and conflict types are defined and recorded. Section 3.2 describes the SIPRI Arms Transfers Database, which provides systematic information on the global exchange of major conventional weapons. Section 3.3 then details how country entities are standardised across datasets to ensure consistent naming and identification. Together, these components establish a coherent typology and a harmonised empirical basis for the construction of the conflict and cooperation network layers.

3.1. UCDP Organised Violence Data

Although in recent decades the most conflict-related deaths have occurred within major wars, the bulk of global conflict is made up of smaller, non-state confrontations.[34] Network science frameworks can be used to extract insights from such a complex set of interactions.[35] The Uppsala Conflict Data Program (UCDP) constructs a comprehensive and continuously updated record of organised violence worldwide, systematically capturing when, where, and between whom violent events occur. By compiling decades of georeferenced conflict data, UCDP enables the analysis of global and local trends in violence, the identification of emerging hotspots, and the examination of how small-scale conflicts collectively shape broader conflict patterns.[36]

Organised Violence is UCDP's umbrella concept and the highest level of its methodological framework. It encompasses state-based conflict, non-state conflict, and one-sided violence, and identifies the smallest unit of analysis under the concept of an event.

Events are instances of organised violence where armed force is used by an organised actor against another organised actor, or against civilians, resulting in at least one direct death at a specific time and place. This definition intentionally excludes unorganised or spontaneous violence (e.g., riots), non-fatal incidents (e.g., threats, kidnappings, or protests), and indirect deaths (e.g., from famine or displacement). Events are the primary unit of analysis across all three types of organised violence.

State-based armed conflict is defined as a contested incompatibility concerning government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths in one calendar year.

Non-state conflict is defined as the use of armed force between two organised armed groups, neither of which is the government of a state, resulting in at least 25 battle-related deaths in a calendar year.

One-sided violence is defined as the deliberate use of armed force by the government of a state or by a formally organised group against civilians, resulting in at least 25 deaths in a year.

The 25-death threshold in a calendar year serves as a defining inclusion rule. Episodes of violence that fall below this threshold are not recognised as organised violence within the UCDP framework and are consequently excluded.

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[34] Shawn Davies et al., 'Organized Violence 1989–2023, and the Prevalence of Organized Crime Groups', *Journal of Peace Research* 61, no. 4 (2024): 673–93, https://doi.org/10.1177/00223433241262912.

[35] C. Lungu, 'Social Network Analysis and Armed Conflicts', 2014, https://www.semanticscholar.org/paper/Social-Network-Analysis-and-Armed-Conflicts-Lungu/9611bd3bdb599fdbfab3a7ac6289024d127edab2.

[36] Öberg, 'Mapping Global Violence'.

3.2. SIPRI Arms Transfer Database

Military cooperation takes multiple forms, reflecting both strategic and industrial objectives. The most common include arms trade and transfer agreements, which cover direct government-to-government sales and military aid[37]. Other forms such as offset and compensation arrangements, where suppliers provide technology transfers or industrial participation in exchange for purchases, and co-production or joint development programs deeper transnational collaboration in arms design and production[38]. Additional mechanisms include licensing and technology transfer agreements that enhance domestic defence industries, industrial integration and joint ventures among defence firms across borders, and regional or multilateral initiatives that promote transparency and harmonised procurement policies.

Most of these forms of cooperation suffer from a lack of usable data. Arms trade is suitable for in-depth network analysis as it encompasses standardised, reported flows that clearly reflect cooperative defence relationships. The Stockholm International Peace Research Institute (SIPRI) Arms Transfers Database offers the most comprehensive and consistent available data on the international transfer of major conventional weapons.

Because the database records transfers almost exclusively between states, and because transfers to non-state armed groups are rare, inconsistently reported, and often excluded from formal arms-transfer datasets due to traceability and verification problems, the cooperation network in GINA Military captures only state actors.[39] This differs from the conflict data used in Section 3.1, which includes both state and non-state armed groups.

International arms transfers are identified by SIPRI as deliveries or licensed productions of military equipment from one state, rebel group, or international organisation to another, covering both sales and gifts and, where applicable, manufacturing licences granted to produce weapons abroad. Each transfer must involve items with a demonstrable military purpose and identifiable supplier and recipient, ensuring that captured, stolen, or unintentional flows are excluded.

Weapons coverage encompasses major conventional weapons such as aircraft, armoured vehicles, artillery, sensors, guided missiles, warships, and related components such as engines, turrets, and reconnaissance satellites. SIPRI collects information from a wide range of open source (e.g. official national reports, defence publications, industry statements, international registries) cross-checking multiple references to validate recorded transfer.

Trend Indicator Value (TIV) is a metric that assigns a standardised notional value to each item based on its military capability, derived from known unit production costs, technical characteristics (such as range, payload, and performance), and the era of production. Weapons that have previously been used by another armed force (i.e. surplus weapons) are given a value equal to 40 per cent of that of a new weapon. Used weapons that have been significantly refurbished or modified by the supplier before delivery are given a value of 66 per cent of the value when new.

TIV is not a monetary value but a standardised measure of the volume of military capability transferred, allowing comparison of arms flows across countries and time. It reflects the relative scale of military cooperation rather than financial transactions, focusing on capability transfers instead of market prices.

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[37] Paul Holtom et al., *Measuring International Arms Transfers* (Stockholm International Peace Research Institute, 2012), https://doi.org/10.55163/FYMR2694.

[38] Björn Hagelin and Pieter D Wezeman, *8. International Arms Transfers*, n.d.

[39] Paul Holtom, *Prohibiting Arms Transfers to Non-State Actors and the Arms Trade Treaty*, 1 January 2012, https://unidir.org/publication/prohibiting-arms-transfers-to-non-state-actors-and-the-arms-trade-treaty/.

Table 1: Overview of Data Sources

Dataset	What It Measures	Source	Coverage	Level of Analysis	Use in GINA Military
UN General Debate Corpus (UNGDC)	Speeches delivered by Member States during the UN General Assembly General Debate	Uppsala Conflict Data Program (UCDP), Georeferenced Event Dataset (GED).	1989–2024 (annual updates).	Event level (individual violent incidents) and actor level (Side A and Side B).	Events are filtered by user-selected years. Each event maps to an undirected edge between two actors. Edge weights represent the number of events recorded between actors. Actor set includes states, non-state armed groups, and civilians.
SIPRI Arms Transfers Data	Records international transfers of major conventional weapons.	Stockholm International Peace Research Institute (SIPRI), Arms Transfers Database.	1950–2024 (annual updates).	Transfer-level records (supplier → recipient).	Only delivered transfers with valid TIV values are used. Transfers map to directed edges. Edge weights represent total TIV delivered between states in the selected years. Actor set includes only states.

3.3. Countries Standardisation

To ensure consistency across datasets and prevent mismatches in naming or country definitions, the GINA series uses an internal reference table as the master standard for all country and state entities. In GINA Military, both datasets were parsed and all country entries were automatically matched to this reference; ambiguous or unmatched cases were resolved through manual verification. The table links a unique numeric identifier to a harmonised country name that is used across all pages, charts, and network components. This harmonisation step ensures that actors are represented consistently across time and across data sources and establishes a coherent actor base before network construction begins.

4. Network Construction

This section describes how the GINA Military framework translates the conflict and cooperation typologies into two relational network layers. Each layer is constructed directly from event- or transfer-level data and follows clear rules for defining nodes, edges, weighting, and temporal selection. Section 4.1 outlines how UCDP event data are transformed into a conflict network capturing patterns of violent interaction between actors. Section 4.2 explains the construction of the cooperation network based on SIPRI arms transfer records, representing how states exchange military capabilities. Together, these procedures ensure that both layers provide transparent, reproducible, and conceptually aligned representations of organised violence and military cooperation.

4.1. Conflict Network

The conflict layer of the GINA Military network translates event-level data from the UCDP Georeferenced Event Dataset (GED) into a relational structure that captures how frequently armed actors interact through organised violence. This operationalisation follows directly from the typology outlined in Section 3.1 and reflects UCDP's event-based definition of organised violence.

Node set. Nodes represent all actors recorded in UCDP GED as Side A or Side B within the selected time period. This includes state armed forces, non-state armed groups, and civilians in cases of one-sided violence. UCDP's non-state actor naming and grouping conventions are followed without modification. As a result, the conflict network can represent both simple dyads and complex conflict systems involving multiple, overlapping actors.

Event-to-edge translation. Each row in the GED dataset corresponds to a single conflict event at a specific time and location. For every event with valid Side A and Side B identifiers, an interaction is created between the two actors. Events lacking a complete dyad (for example, missing actor information) are excluded. This produces an undirected graph in which edges represent the presence of violent interaction between actors.

Edge aggregation and weighting. Multiple events between the same pair of actors are aggregated into a single edge. Each event contributes a weight of 1. The final edge weight therefore reflects the number of recorded conflict events linking the two actors during the user-selected time window. Other attributes available in the UCDP data, such as battle-related deaths or intensity levels, are not used for weighting in the current version of the model. The resulting network captures the frequency of violent interactions rather than their lethality.

Temporal selection. The network does not impose a fixed temporal window. Instead, temporal filtering is applied prior to graph construction: users select a single year or a multi-year period, and only events within that period are used to generate the graph. This allows the conflict network to reflect year-specific snapshots, cumulative patterns, or rolling windows depending on analytical needs.

The resulting conflict network represents organised violence as an event-frequency structure in which higher edge weights indicate more frequent armed interaction between actors. This approach highlights patterns of repeated confrontation, the structure of multi-actor conflict systems, and the shifting configuration of violent relationships over time. Because it directly reflects UCDP's event-level data, the network provides a granular view of conflict dynamics that complements aggregate statistics and conventional conflict classifications.

4.2. Cooperation Network

The cooperation layer of the GINA Military network translates arms transfer records from the SIPRI Arms Transfers Database into a relational structure that captures how states exchange military capabilities. This operationalisation follows directly from the forms of military cooperation outlined in

Section 3.2 and reflects SIPRI's definition of major conventional weapons transfers as documented, verifiable transactions between identifiable suppliers and recipients.

Node set

Nodes represent states included in the SIPRI dataset as either suppliers or recipients of major conventional weapons. Because SIPRI records transfers almost exclusively between recognised state actors, and because transfers to non-state groups are rare, inconsistently reported, and often excluded for reliability reasons, the cooperation network consists only of state actors. This produces a state-only relational layer that complements, rather than mirrors, the broader actor set used in the conflict network.

Transfer-to-edge translation

Each row in the SIPRI arms transfer data corresponds to a delivered transfer from one state to another. For every record with valid supplier and recipient identifiers, a directed interaction is created between the two states. Transfers with missing actor identifiers or zero-value deliveries are excluded. This produces a directed graph in which edges represent the flow of military capabilities from suppliers to recipients.

Edge aggregation and weighting

Multiple transfers between the same pair of states are aggregated into a single directed edge. Each transfer contributes a weight equal to its SIPRI Trend Indicator Value (TIV), which quantifies the military capability embodied in the delivered system. The final edge weight therefore reflects the total volume of delivered weapons transferred between two states during the user-selected time period. Other attributes available in the SIPRI data, such as unit counts or procurement terms, are not used for weighting in the current version of the model. The resulting network captures the scale of capability transfer rather than the number of transactions or financial value.

Temporal selection

As with the conflict layer, temporal filtering occurs before graph construction. Users select a single year or a year range, and only transfers whose order year falls within this interval are included. All transfers within the selected period are aggregated when constructing the graph. This enables the cooperation network to represent annual snapshots or cumulative multi-year patterns depending on analytical requirements.

The resulting cooperation network represents the global structure of military capability exchange, where directed edges indicate the direction of arms flows and edge weights reflect their scale. This approach highlights patterns of supplier–recipient relations, the concentration or diversification of procurement, and the position of states within broader structures of military cooperation. Because it directly reflects SIPRI's transfer-level data, the network provides a consistent and transparent representation of defence cooperation that complements the interaction patterns observed in the conflict layer.

4.3. Visual Representation

Both network layers use a common visual logic to ensure that structural differences between conflict and cooperation networks reflect the underlying data rather than presentation choices. The layout, colouring, and highlighting mechanisms are identical across the two layers, providing a consistent basis for comparison.

Layout algorithm

Nodes are positioned using a ForceAtlas2-based force-directed layout. This algorithm places actors closer together when they share strong or frequent connections and farther apart when their ties are weaker or absent.[40] This creates a map of the network where clusters emerge naturally from the data:

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[40] Mathieu Jacomy et al., 'ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software', *PLOS ONE* 9, no. 6 (2014): e98679, https://doi.org/10.1371/journal.pone.0098679.

actors involved in many interactions tend to appear near the centre, while those with fewer links move toward the edges. Because the conflict and cooperation layers use the same layout rules, any differences in how the networks look stem from the underlying relationships rather than from the visual method itself.

Colour Assignment. In both layers, node colours represent communities detected through a greedy modularity algorithm. The method groups actors that are more closely connected to one another than to the rest of the network.[41] Using the same approach for conflict and cooperation ensures that colour patterns reflect the structure of each network rather than predefined categories. Clusters therefore emerge from the interaction data itself, making visual differences comparable across layers.

Node and edge size. Visual prominence in both networks is driven by the underlying edge weights. Edge thickness reflects the weight assigned during network construction, meaning that frequently interacting conflict dyads or high-value arms transfer pairs appear with thicker links. Node size is derived from the same logic and is calculated by summing the weights of all edges connected to a given actor. In the conflict network this highlights actors involved in many recorded violent events, while in the cooperation network it highlights states participating in substantial volumes of arms transfers.

Together, these shared visual rules ensure that both layers can be interpreted using the same intuitive cues. Differences in structure, clustering, or actor prominence therefore reflect genuine variation in patterns of violence and cooperation rather than artefacts of design. This coherence allows users to compare the two networks directly and to identify how conflict and cooperation patterns align, diverge, or overlap within the broader military landscape.

Table 2: Summary of Network Construction Choices in GINA Military

Feature	Conflict Layer	Cooperation Layer
Underlying Data	UCDP Georeferenced Event Dataset (GED)	SIPRI Arms Transfers Database
Nodes	All actors listed as Side A or Side B, including states, non-state armed groups and civilians	States only (suppliers or recipients)
Edges	Violent interactions between actors; each event creates a tie	Delivered arms transfers; each record creates a supplier → recipient tie
Directionality	Undirected	Directed
Edge Definition	Presence of at least one violent event between actors in the selected period	Delivered transfer with valid supplier and recipient
Edge Weighting	Number of UCDP events between actors	Total SIPRI TIV value of all delivered transfers
Node Size Logic	Sum of edge weights connected to the actor (total event involvement)	Sum of edge weights connected to the actor (total transfer involvement)
Layout Method	ForceAtlas2-based force-directed layout (shared across layers)	ForceAtlas2-based force-directed layout (shared across layers)
Community Detection	Greedy modularity algorithm	Greedy modularity algorithm
Temporal Aggregation	User selects a single year or year range; events filtered before graph construction	User selects a single year or year range; transfers filtered before graph construction
Resulting Interpretation	Highlights frequency patterns of violent interaction and structure of conflict systems	Highlights scale and direction of arms transfers and structure of defence cooperation

[41] Heru Cahya Rustamaji et al., 'Community Detection with Greedy Modularity Disassembly Strategy', *Scientific Reports* 14, no. 1 (2024): 4694, https://doi.org/10.1038/s41598-024-55190-7.

5. Analysis and Visualisation

This section explains how the outputs of GINA Military can be interpreted and how the different visualisations support analytical use. The dashboard translates the methodological choices described in earlier sections into interactive network views, maps and quantitative indicators. Section 5.1 illustrates the types of insights that users can draw from the network visualisations, both at the global level and for selected states. Section 5.2 introduces the complementary tools available on each page, including geographic representations, summary metrics and temporal trends, and describes how these elements contribute to a fuller understanding of conflict and cooperation patterns. Together, these components guide the reader in using GINA Military as an exploratory and comparative analytic environment.

5.1. Network Analysis

This section presents examples of how the GINA Military dashboard can be used to derive analytical insights from the conflict and cooperation networks. Although the two layers capture different types of interactions, their shared visual and structural logic allows them to be interpreted side by side. At the global level, the networks reveal broad patterns of clustering, centrality and structural division. At the state level, they highlight how individual countries relate to others through both violent and cooperative ties. Taken together, these examples illustrate how the network approach can uncover meaningful patterns in the international security environment and support more informed analysis of conflict dynamics and defence relationships.

5.1.1. Global conflict dynamics

The global conflict network for 2000–2024 reveals a highly clustered structure in which organised violence is concentrated within a few dense conflict systems. Three major clusters dominate the network. The largest cluster (orange) is centred on civilians, who emerge as the most connected node in the entire network. This reflects the widespread use of one-sided violence across numerous low-intensity conflicts. The Government of Russia appears as the second most prominent actor within this cluster, indicating its involvement across multiple theatres where civilian targeting and dispersed violent events are common. A second cluster (light blue) corresponds to the Syrian conflict system. Here, the Islamic State, the Government of Syria, and Syrian insurgent groups form a tightly connected triad that anchors the cluster. Their centrality reflects the scale, duration, and complexity of the Syrian war, which produced a dense pattern of violent interactions among numerous actors.

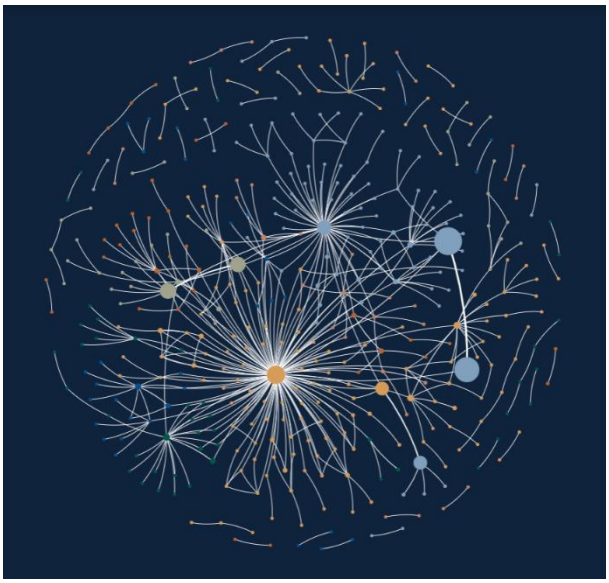

Figure 2 - Global network of conflict events (2000-2024)

The third major cluster (olive green) centres on the conflict in Afghanistan, with the Government of Afghanistan and the Taliban forming the two dominant nodes. Their strong mutual connectivity and separation from other clusters illustrate the relatively self-contained nature of the Afghan conflict, even as it remained one of the world's most intense theatres of violence.

It is important to notice that the colouring algorithm does not take meaning of the network elements to create clusters, but only their characteristics within the network itself. Nonetheless, it identified three clusters with a clear meaning: the Syrian conflict, the Afghan conflict, and civilian involvement. A further exploration of this system can highlight similarity between non immediately relatable actors that derive from their position in the network.

5.1.2. **Global cooperation dynamics**

Compared to the conflict network, the global cooperation network is more interconnected. Three main clusters appear here as well:

First, an orange cluster encompasses the main suppliers of the network (Russia, China and USA), with peripheral recipients. The second, light-blue cluster is composed of states that are highly active both as recipient and suppliers within themselves: there we find many European countries, but also Middle eastern like Oman and Saudi Arabia, or Asian ones, like Singapore. The last cluster (dark green) is sort of a bridge between the other two: countries that interact with the big players and the more interconnected batch. Among them we find Morocco, India, Israel and South Korea.

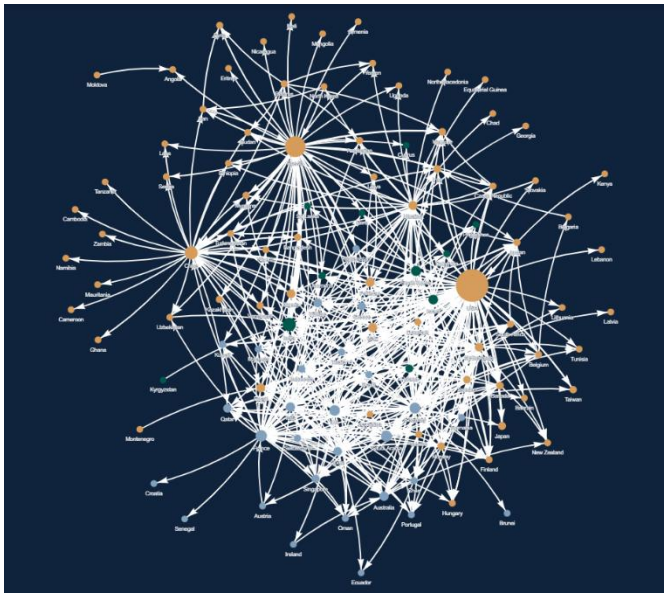

Figure 3 - Global network of arms trade (2000-2024)

Taken together, these clusters illustrate how military cooperation is structured around both dominant suppliers and densely interconnected regional groupings. The network highlights not only the central role of great powers in global arms flows but also the emergence of intermediary actors that connect different parts of the system. This structure provides a useful baseline for examining how the geography of defence ties evolves over time and how shifts in supply relationships reshape broader patterns of military cooperation.

5.1.3. **State Comparisons**

The state-level networks allow users to zoom in on individual countries or examine how a selected group of states relates to one another within and across the two layers. Comparing conflict and cooperation structures side by side can be particularly informative, as it reveals how patterns of arms transfers intersect with, underpin or diverge from observed conflict dynamics. For example, looking at China, the United States, Russia and Iran for the period 2022–2024 shows how the cooperation network provides essential context for interpreting the much smaller conflict structures. China does not appear as an actor in recorded violent events during this period, and the United States has no direct conflict ties with Russia or Iran. Yet the cooperation network highlights the scale and reach of their respective arms transfers, illustrating how the United States supplies a wide set of partners, how China supports several of the same recipients, and how China is (directly and indirectly) connected to Russia and Iran through different chains of military transfers. This type of comparison demonstrates how state-level views can reveal the broader military relationships behind major conflict systems and offer a more complete picture of countries' roles in the global security environment.

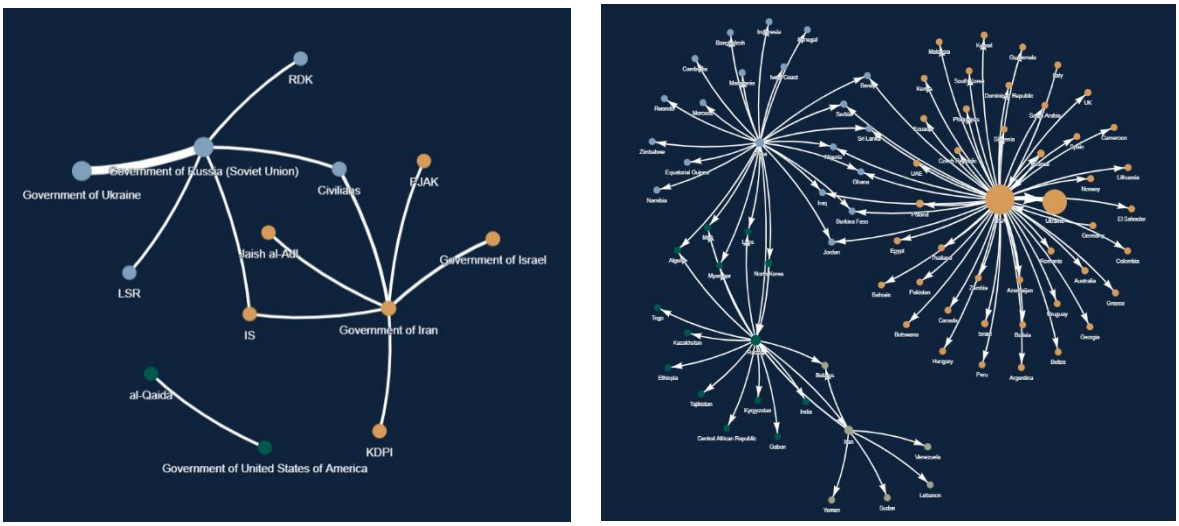

Figure 4 - Conflict and Cooperation Networks of China, Iran, Russia and USA (2022-2024)

5.2. Additional Visualisations

Beyond the network layers, GINA Military provides several complementary visualisations that allow users to explore spatial patterns, quantitative summaries and temporal trends. These tools offer alternative entry points into the data and help contextualise the relational structures shown in the network views.

5.2.1. **Map-based patterns**

Both the conflict and cooperation layers include a global map visualisation that summarises country-level activity for the selected period. In the conflict layer, the choropleth displays either the number of recorded organised violence events or total fatalities, highlighting where violence is concentrated and how intensity varies across regions. In the cooperation layer, the map can show total arms transfers, imports (as recipient) or exports (as supplier), making it possible to identify major hubs in the global arms trade and regional patterns of dependence or capability acquisition.

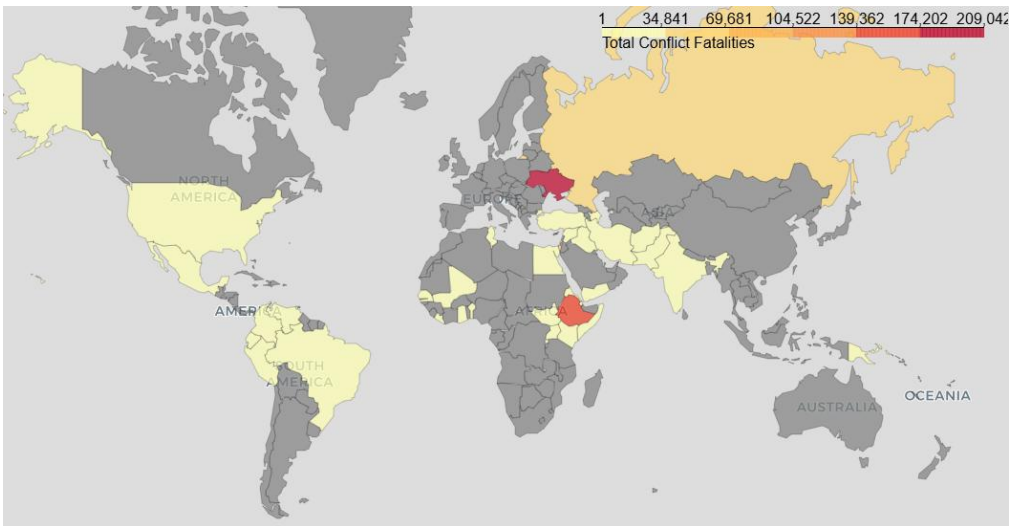

Figure 5 - Map of conflict events (2022-2024)

The map also functions as an entry point into the state-level view: selecting a country on the map directly loads its corresponding network and metrics. This provides an intuitive bridge between spatial patterns and relational structures.

5.2.2. **Quantitative Overview**

Both layers present a set of summary statistics that provide a quick overview of the magnitude and direction of activity in the selected period. In the conflict layer, these include total events, total fatalities and the number of active conflict dyads, each shown with a year-on-year change to indicate escalation or de-escalation. In the cooperation layer, statistics summarise the number of transfers, total SIPRI TIV value and counts of imports and exports, again with a delta relative to the previous year.

These indicators offer a compact snapshot of the broader trends that underpin the network structures and help users situate individual actors or regions within global patterns.

5.2.3. **Temporal Dynamics**

A dedicated time-series view in both layers illustrates how conflict activity or military cooperation evolves over time. For conflict, users can track changes in event counts or fatalities across the selected period, identifying cycles of escalation, stabilisation or sharp shifts linked to major political developments. For cooperation, time series show the number of transfers or the total volume of delivered capabilities, helping reveal long-term procurement relationships, surges in arms flows or the emergence of new supplier–recipient patterns.

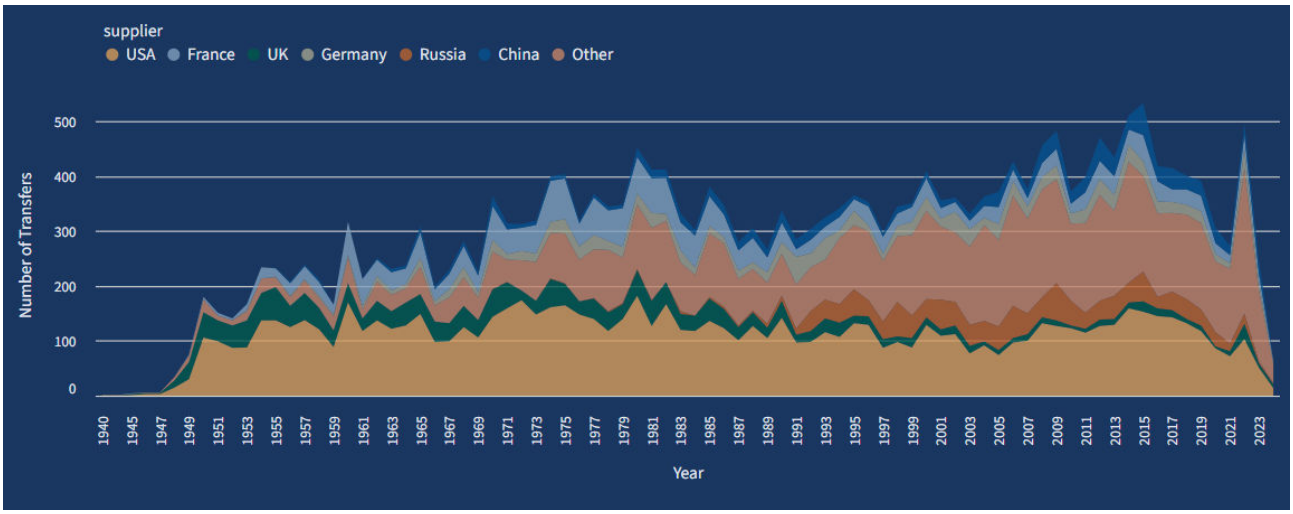

Figure 6 - Global-level time series tool for Cooperation page

Users may choose different chart types (area, line or bar), allowing them to switch between cumulative and discrete visual styles depending on the analytical question.

6. Limitations

This chapter outlines key constraints in the data and methodological choices underlying GINA Military. Section 6.1 details limitations in the UCDP and SIPRI datasets, including possible underreporting of violent events, variation in how conflicts are defined, the exclusion of indirect conflict deaths, and the conceptual nature of SIPRI's TIV measure, which reflects military capability rather than financial value. It also notes timing discrepancies between arms orders and deliveries. Section 6.2 explains how aggregation and normalisation introduce simplifications, and that this version performs no network-analytic computations, offering primarily exploratory visualisations. Together, these limitations clarify the caution required when interpreting patterns and indicators presented in the dashboard.

6.1. Data Limitations

A few observations must be made regarding the Uppsala Conflict Data Program (UCDP) data. The accuracy of UCDP data heavily relies on the availability and reliability of source information. Given that conflict zones are often remote and information-scarce environments, some incidents of violence might not be reported or documented accurately, potentially leading to underreporting of events in certain regions or time periods. The interpretation of what constitutes a "conflict" can vary across different contexts, potentially leading to inconsistencies in how different events are categorised and recorded, which can affect comparative analyses across regions or time periods.

It is important to note that the fatality estimates used in this dashboard represent battle-related deaths, which encompass fatalities directly linked to combat, including conventional battlefield engagements, guerrilla tactics, and bombardments. However, these figures do not capture the full human cost of conflict, as they exclude indirect deaths due to disease, starvation, displacement, or one-sided violence deliberately directed against civilians. The UCDP provides three estimates for battle-related deaths (low, high, and best estimate), and this dashboard uses the "best estimate" for all visualisations and statistics. Users should be aware that actual casualty figures may fall anywhere within the range between low and high estimates, and the true toll of conflicts often extends far beyond the battle-related deaths recorded in this dataset.

SIPRI's TIV measures the volume of arms transfers based on production costs rather than actual financial transaction values. Users should note that TIV values cannot be directly compared with financial data or used for economic analysis, as they reflect the transfer of military capability rather than monetary worth. The TIV methodology involves subjective decisions about how different weapon types are weighted and valued, which can lead to inconsistencies in comparisons between countries or equipment categories. Additionally, older weapons models may receive lower TIV scores despite potentially remaining strategically significant or militarily effective, meaning the metric may not fully capture the true military or geopolitical importance of certain transfers.

The database records transfers based on the year when orders were placed, but actual deliveries often span multiple subsequent years, which means the timing reflected in the data represents procurement decisions rather than the physical movement of equipment. These limitations should be considered when interpreting patterns and trends in the cooperation visualisations, particularly when making cross-country comparisons or assessing the strategic significance of specific arms transfers.

6.2. Methodological Limitations

While the methodological framework aims to provide a multi-layered and dyadic understanding of military dynamics, it relies on aggregated and normalised data from multiple sources. This process, although useful for comparability, can introduce simplifications or generalisations that may obscure underlying contextual nuances.

It is also important to note that no specific network analysis calculations, such as centrality, similarity, or connectivity measures, are performed within this version. The dashboard is primarily designed for

visualisation and exploratory purposes, offering users an interactive means to observe patterns and relationships rather than to conduct advanced network analytics or statistical modelling.

Furthermore, as the data used (UCDP and SIPRI) are not updated in real time and may contain definitional or categorical inconsistencies, the timeliness and precision of the derived indicators can be limited. Consequently, while GINA Military provides valuable insights into global conflict and cooperation patterns, users should interpret the results with caution, recognising that ongoing methodological improvements and the inclusion of deeper analytical techniques are planned for future versions.

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