COMMENTARY

Visualizing Armed Groups: The Democratic Republic of the Congo's M23 in Focus

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New information technologies can help unpack the relationships and tendencies that persist in complex networks. We present an interactive, web-based visualization that captures interlocking networks related to the Mouvement du 23 Mars (M23) rebel group in the Democratic Republic of the Congo (DRC) to demonstrate the utility of visually summarizing relationships in a multi-dimensional dataset. We draw exclusively from the findings the UN Group of Governmental Experts report S/2012/843 documenting the procurement of weapons and ammunition by the M23 network. The visualization was built using a hierarchical edge bundling algorithm (Holten 2006) implemented in Data-Driven Documents (d3) (Bostock 2011), an open-source JavaScript-based library for interactive web visualizations. We contend that such visualizations can provide improved understanding of complex social networks both within and beyond the confines of war.

Introduction

Few wars have been more destructive and protracted than the many interlocking armed conflicts affecting the Democratic Republic of the Congo (DRC). The country has been torn apart by episodic spasms of violence throughout the twentieth and twenty-first centuries. Analysts typically differentiate between the first (1996–1997) and second (1998–2002) Congo wars, though the country continues to be chronically unstable more than a decade after formal declarations of peace. A key spoiler over the past few years has been the group known as the Mouvement du 23 Mars (M23). The group suffered a temporary military defeat in November 2013 following a concerted military campaign by the Congolese armed forces, backed by the United Nations Stabilization Mission, or MONUSCO (UN 2013a). Yet the group has proven to be surprisingly resilient. On 30 January 2014, the United Nations Security Council unanimously adopted resolution 2136 which renewed an arms embargo and sanctions against the DRC. The Council requested specific measures targeting the M23, including their continued recruitment and military activities.

Notwithstanding its devastating consequences, the DRC conflict is not accorded the same attention as many other hot wars

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underway around the world. This is partly because it is exceedingly difficult to keep track of the many layers of the country's armed conflicts, not least the characteristics, dynamics and networks of armed groups such as the M23. A United Nations (UN) Group of Governmental Experts report S/2012/843 (2012) attempted to document the myriad ways in which entities such as M23 procured weapons and ammunition. And whilst heavily criticized by some governments in the region (especially Rwanda), they painstakingly assembled information and testimonies from hundreds of witnesses and secondary sources (Mancini 2013). Many of the findings and nuances of the report were lost on outsiders, owing to its complexity, density and length.

New information technologies can help unpack some of the relationships and tendencies that persist in complex networks. Indeed, one of the more interesting developments in the aid world is the rise of digital humanitarians, crisis mapping tools and large-scale event datasets that allow for useful ways of visualizing incident data. Following a cursory review of the DRC conflict, we present a web-based visualization of the M23 network, drawing exclusively from the findings in S/2012/843. The visualization was built by modifying existing, publicly-available code (Bostock 2011b; Bostock 2011c; Hartwick 2012) based on the hierarchical edge bundling algorithm (Holten 2006) implemented in Data-Driven Documents (d3) (Bostock 2011), an open-source JavaScript-based library for interactive web visualizations.

The visualization algorithm identifies the optimal paths between connected nodes in hierarchical data and bundles them together along their joint paths. This is similar to the way in which electrical wires are bound together along the length of a wall until fanning out again to reach their individual destinations. In this way, connections between individuals at the lowest level are bundled together according to the parent nodes. It thus allows higher-level connections not directly visible in the data to be implicitly inferred, and reduces visual clutter in the graph. As a reader-driven tool, users can explore the data by interacting with selected elements, allowing for self-paced discovery. Importantly, the visualization can be used to render complex data more legible to policy makers, practitioners, researchers and lay-people.

We begin this commentary with a short overview of the DRC conflict, focusing in particular on the historical factors that gave rise to the M23. While familiar with the region, the authors are relying principally on data generated by the UN Group of Governmental Experts. The article then turns to the M23 specifically, followed by a discussion of the visualization tool and its functionalities. Names of individuals and armed groups in the text that also appear in the visualization are highlighted in bold text when first mentioned. This is intended to provide some additional context for readers to better navigate the tool. In the latter sections, the visualization is described in more detail – this includes background information on the underlying data, display features and ways of interacting with the application. We contend that such visualizations can provide insight into complex forms of data, both within and beyond the confines of war.

First Congo War (1996–1997)

As with so many wars, the trigger of DRC's armed conflicts can be traced outside the country. Specifically, the Rwandan genocide in 1994 precipitated an influx of over a million refugees and Hutu *génocidaires* across the border (Nzongola 2002: 224). The **RPF** (Rwandan Patriotic Front) launched an offensive to counter the threats posed by the Hutu extremists, destroying refugee camps and rebel bases littering the border areas with DRC on 6 October 1996.[1]

Violence intensified with the capture of the city of Uvira (South Kivu, 18–20 October), likely by the Rwandan and Burundian armies (Turner 2007: 92), and the creation of

Laurent Kabila's **AFDL** (Alliance des forces démocratiques pour la libération), a coalition of four Congolese groups (18 October). The AFDL rebel movement, supported by Rwanda and Angola (Turner 2007: 5), swept through South and North Kivu, ultimately deposing President Mobutu Sese Seko in Kinshasa on 17 May 1997 with Laurent Kabila declaring himself president of DRC.

During the AFDL advance in the Kivu provinces, the distribution of natural resources, previously controlled through local business channels, was appropriated by foreign power structures. This paved the way for systemic and spectacular exploitation (UN 2001, para. 23). Rwanda, Uganda and Burundi used their support of Kabila and the AFDL as a way to establish territorial control (Nzongola 2002: 227).

Second Congo War (1998–2002)
While the precise numbers are contested, the second Congo war killed an estimated 3.3 million people (1998–2002) (IRC 2003). It broke out as relations between Laurent Kabila and his Rwandan and Congolese Tutsi supporters deteriorated, triggering an invasion by Rwanda and Uganda (2 August 1998) and a failed march on Kinshasa (6 August–1 September). Meanwhile, the anti-Kabila **RCD** (Rassemblement congolais pour la démocratie) was formed by Congolese rebels in the city of Goma (North Kivu), but its lack of popular support prompted Uganda to sponsor the **MLC** (Mouvement pour la libération du congo) rebel group in November that same year (Nzongola 2002: 231).

The war rapidly degenerated into partition, predation and plunder. Burundian, Rwandan, Ugandan and/or RCD soldiers extorted (September 1998–August 1999) (UN 2001, para. 32) and later extracted (UN 2001, para. 46) goods from occupied zones. Rwanda and Uganda were also accused of setting up front companies to facilitate illegal extraction activities (UN 2001, para. 79ff). The UN and wider international community expanded their support during this period,

ostensibly to promote more stability and reconstruction in the region.

An Unstable Decade (2003–2013)
After the formal end of war, the Kivus remained 'a slaughterhouse' (Prunier 2009: 281) due in large part to guerilla movements and various **Mai Mai** factions and their shifting alliances. The instability was also exacerbated by protracted conflict in the northeastern Ituri region, itself exacerbated by Uganda's desire to retain a foothold in the area (Prunier 2009: 281–282). By December 2004, the UN force expanded from 10,800 to 16,000. Even after general elections in July 2006, the DRC was rife with armed groups: Mai Mai, Ugandan-backed Ituri warlords, foreign guerrilla groups such as the **ADF** (Allied Democratic Forces; Uganda), **FNL** (Forces nationales de libération; Burundi), and the **FDLR** (Forces démocratiques de libération du Rwanda), and troops loyal to Laurent **Nkunda** (Prunier 2009: 321–323).

For his part, Nkunda was a former commanding officer of RCD in the city of Goma. At the end of 2006, he created the CNDP (Congrès national pour la défense du peuple), recruiting locally as well as in Rwanda and Burundi (Prunier 2009: 321–323). Intense fighting escalated in North Kivu between Nkunda and the DRC armed forces, subsiding after Nkunda's capture in 2009. CNDP commander Bosco **Ntaganda** assumed control from Nkunda and was subsequently promoted to a senior position in the DRC army during its integration of CNDP forces.

The Rise and Fall of the M23
On 23 March 2009, the CNDP and the DRC government signed a peace agreement that granted the CNDP the status of a political party in exchange for the release of imprisoned members (AFP 2009). The peace process was, like many before it, short-lived. On 4 April 2012, the M23 rebel group – named after the date of the 2009 peace deal – was created after 300 mainly ex-CNDP soldiers mutinied against the DRC government,

arguing that the government had failed to live up to the terms of the peace agreement and protesting the poor treatment in the DRC army (UN S/2012/843: 143 Annex 46). The M23 were to emerge as one of the most formidable armed groups in DRC.

The rapprochement between Kigali and Kinshasa encouraged the Rwandans to arrest Nkunda. This was purportedly in exchange for privileged command positions within the DRC army for the former CNDP rebels. But this also laid the groundwork for a return to war from a position of significant strength, since these ex-CNDP had access to weapons, minerals, and ties to other Congolese armed groups who had opposed their previous rebellion.[2] From the beginning, there was evidence that M23 was backed by extensive foreign support (UN 2012: 3; ICG 2012). The M23 rapidly expanded its control over Rutshuru territory that borders Uganda in North Kivu, and allegedly received direct military support and equipment from Rwanda, in violation of the arms embargo, as well as from Uganda (UN 2012: 3).

The precise composition of M23 was not entirely clear to outsiders. Many key figures in M23 are foreigners or maintain close ties with foreign powers. The M23 also established pacts with other armed groups in the Kivus, Ituri and Kasai-Occidental and carried out brutal attacks, executed prisoners of war, and recruited child soldiers (UN 2012: 3). The M23 movement reached its apex with the fall of the city of Goma on 20 November 2012.

After a rapid rise, the M23 experienced a similarly speedy demise, defeated on 5 November 2013 by the Congolese armed forces and a 3,000-strong UN brigade consisting of South African, Tanzanian and Malawian soldiers (Plett 2012). Moreover, M23 had been considerably weakened by internal leadership struggles between Ntaganda and **Makenga** (M23 military commander (UN 2012: 3)). On 15 March 2013, troops loyal to Makenga defeated Ntaganda's loyalists while Rwanda dismantled Ntaganda's network of s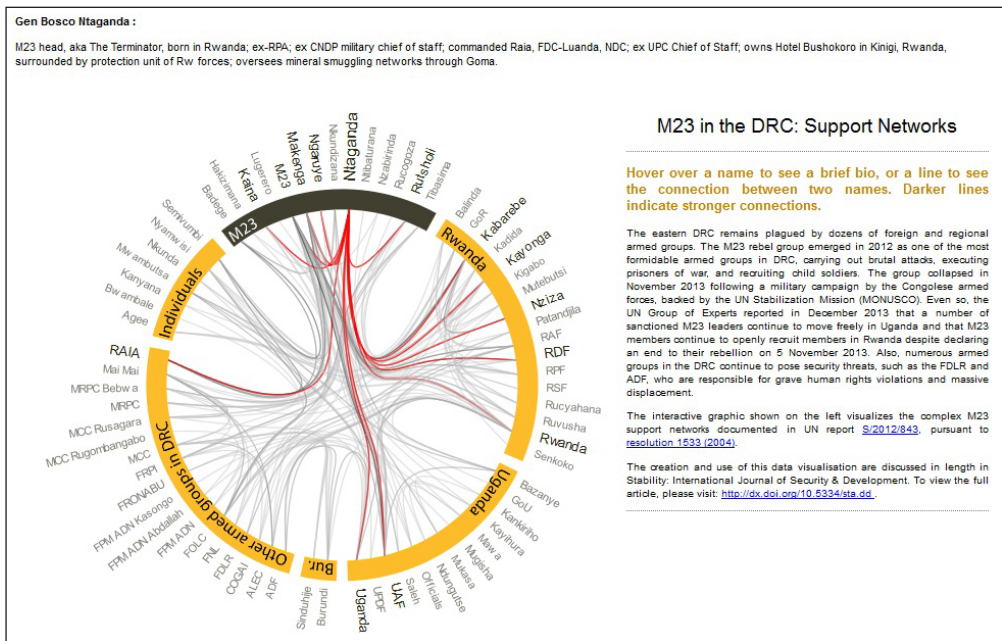upport and recruitment in Rwanda (UN 2012: 4). Ntaganda turned himself into the International Criminal Court in Rwanda and hundreds of his troops also crossed the border, where they were supposedly disarmed (UN 2103, para. 28). Meanwhile, Makenga struggled to rebuild the weakened M23.

The specific role of outside powers in shaping the fall of the M23 continues to be debated. Up until the final operations against the rebels in October 2013, M23 received **RDF** (Rwanda Defence Force) troop reinforcements, as the M23 reportedly became almost completely dependent on RDF troop support since the in-fighting in the top ranks (UN 2013a). There is widespread belief that increased international pressure on the Rwandan government contributed to reduced M23 support from within Rwanda (UN 2013a: 3). Even so, the UN Group of Experts reported (UN 2013a: 1) in December 2013 that a number of sanctioned M23 leaders continue to move freely in Uganda and the group continues to openly recruit members in Rwanda despite declaring an end to their rebellion on 5 November 2013. Also, numerous armed groups in the DRC continue to pose security threats, such as the FDLR and ADF, who are responsible for grave human rights violations and massive displacement (UN 2013b: 1).

How the Visualization Works
Input data
The underlying information used for the visualization was extracted exclusively from the UN Group of Experts report S/2012/843. The UN report documents the Panel's investigation into the procurement of military equipment by armed groups in the DRC, their financial networks, and their involvement in the exploitation and trade of natural resources. Although criticized by some close to the Rwandan government[3] the Panel adhered to a strict methodology approved by the Security Council that relied heavily on first-hand witnesses to events, primarily ex-combatants; however, the reliability of the information presented in the UN report is

Gen Bosco Ntaganda :
M23 head, aka The Terminator, born in Rwanda; ex-RPA; ex CNDP military chief of staff; commanded Raia, FDC-Luanda, NDC; ex UPC Chief of Staff; owns Hotel Bushokoro in Kinigi, Rwanda, surrounded by protection unit of Rw forces; oversees mineral smuggling networks through Goma.

*Node names connected to Ntaganda (the selected node) are also enlarged, and the connecting lines are displayed in red. A brief biography of Ntaganda is displayed at the top of the screen.

Figure 1: Example screenshot of visualization: the case of Ntaganda*.
Source: http://www.stabilityjournal.org/hosted/m23-rebel-support-in-drc/.

dependent on the methods of those who collected the original data.

Specifically, the authors interviewed over a hundred former M23 members individually, including 57 who claimed to be Rwandan, and added personal testimonies. The collected data were subsequently triangulated with a larger network of over a hundred other sources, including eyewitnesses and others considered to be credible (local leaders, businessmen, border agents, peasants, ex-militia and active sources within the M23). In addition to interviews, tangible evidence was also sought, such as text messages, photos, receipts, communication records, and satellite images.

To build the input dataset for the visualization, individuals and/or groups associated with M23 or engaged in activity related to M23 operations as documented in the UN report were recorded in a spreadsheet. This spreadsheet includes rank (where applicable), affiliation ('M23,' 'Rwanda,' 'Uganda,' 'Burundi (Bur.),' 'Other armed groups in DRC,' or 'Individuals,') and a brief biography, along with a description of the interaction involving M23 and a list of individuals/groups who were involved. Each individual/group is a *node* in the dataset; the affiliations are *parent nodes* and are one level higher in the hierarchy. The spreadsheet was then converted into JSON (JavaScript Object Notation) files, a format that allows server to browser data transfer.

The display
Figure 1 shows a screenshot of the visualization with a selected node (Ntaganda) highlighted. The nodes are grouped according to their affiliation and plotted on a circle in separate arcs, one for each of the six affiliations (black arc for M23 and gold arcs for

the others). Pairs of nodes that are associated together are connected by a line weighted by the number of times the node pair has interacted (i.e. darker lines mean more interactions). Connections between nodes are undirected and therefore do not indicate the direction of relationship or relative influence of one individual upon the other. Note that lines connect *pairs* of nodes only; if more than two nodes are associated with the same interaction/event, separate lines will be drawn between each pair of nodes.

The trajectory of the lines is calculated by the hierarchical edge bundling algorithm (as explained in the introduction) so as to minimize clutter by sharing routes to similar destinations. Because the visualization is a *summary over time*, it does not reflect the dynamic nature of the connections between individuals and groups owing to, for example, fluctuating alliances. Interactions that have occurred once in time are frozen in the visualization, regardless of subsequent changes in the alliance.

User interactivity
The data visualization is intended to be intuitive and user-friendly. It is also preliminary, with updates likely as data quality improves. Users can:

1. Hover over any node on the circle: doing so (i) displays the node's name and a brief biography at the top of the screen, (ii) indicates all the nodes connected to it by coloring the corresponding connecting lines in red, and (iii) enlarges the font size of the connected nodes;
2. Hover over any line connecting two nodes in the graph: doing so turns the line red and triggers the display of a brief synopsis at the top of the screen describing how the nodes are associated, i.e. the interaction(s) that connects the two nodes.

In these two ways, the user is free to explore the data in the visualization. For example, to

find out more about the connection between **Nkundizana** and **Bazanye** in the visualization, the user hovers over the line connecting this node pair to reveal two interactions documented in the UN report:

1. Mwambutsa, Bazanye, Nkundizana and Ugandan armed forces officers helped organize recruitment for and financial contributions to M23.
2. Mwambutsa regularly travelled to Kisoro (Uganda) to organize recruitment for and financial contributions to M23 with Kisoro District Chairperson Bazanye, Nkundizana, and local UAF officers.

Also, for historical context, the user can use the visualization to discover the M23-related activities of the individuals or groups printed in bold text (when first mentioned) in the historical overview of the DRC conflict given above, since these names are nodes (i.e. ADF, FDLR, FNL, Kabarebe, Kayonga, M23, Mai Mai, Makenga, Nkunda, Ntaganda, RDF, RPF).

Applications and insights
The M23 data visualization is straight-forward and intuitive. It is obviously not exhaustive, drawing as it does on a report by the UN Group of Experts. But, it is illustrative of the extraordinary heterogeneity of such groups and their backers. As an analytical tool, the visualization provides a compelling snapshot of the complexity of the M23 and its relationship to key conflict actors.

First, such information can assist conflict mediators, early warning specialists, and high-level decision-makers to acquire a rapid sense of the bigger picture. Second, the interactivity of the data visualization allows for data exploration that may reveal other (and potentially hidden or under-examined) dimensions in the conflict, and can be used to stimulate debate and reflection among the media, practitioners, civil society and scholars. Finally, the visual representation of hundreds of stories in a single connected graph can ensure that the DRC conflict

is made somewhat more comprehensible to outsiders.

More generally, the d3-based hierarchical edge bundling algorithm can be applied to datasets with multiple levels of hierarchy (our dataset has only two), which can potentially reveal links between nodes at higher levels that might otherwise be missed. Applications of the visualization tool are not limited to conflict networks only – which are wide-ranging themselves – but could include social networks, gangs, or corruption networks, for example. Furthermore, the diversity of interactive visualization tools to choose from in the award-winning (ONA 2013) d3 gallery is continually expanding.

Conclusions

The fog of war routinely undermines a clear and balanced assessment of the facts. In the case of the DRC, repeated and protracted conflict and instability have made it especially difficult for outsiders and locals to fully understand the characteristics and motivations of armed groups. While there is extensive evidence of mass atrocities committed by the M23, and a repository of studies implicating foreign players, the details are often lost on the public. The development of new visual tools can help keep a general record of key actors, their relationships, and the ways in which they evolve over time.

Interactive web-based data visualizations can usefully capture complex social networks by summarizing relationships (both extent of influence and direction) between various groups in a multi-dimensional dataset. And while the visualization presented here is based on a single source – itself a composite of thousands of hours of investigative research – future iterations can draw on a wider array of information. Undoubtedly, the future of monitoring conflict and holding armed groups to account will benefit from harnessing these innovations.

Notes

[1] Lemera Hospital in Uvira Territory was also attacked – possibly by the Burundian army to target Burundian Hutu extremists (Turner 2007: 92) – resulting in the violent deaths of dozens of patients and destroying much of the hospital's equipment. Lemera Hospital has yet to recover from the pillage.

[2] Interview with former member of the UN Group of Government Experts, January 2014.

[3] See e.g. UN 2012, Annex 3 para. 89–94.

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