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Tackling the complexity of border corruption

How technological tools such as the project FALCON dashboard can support investigations

Jacopo Costa and Marco San Biagio | April 2026

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About this report

This report conceptualises border corruption as a complex system of actors, events and illicit exchanges that is difficult to detect and investigate. Drawing on research from the Horizon Europe FALCON (Fight Against Large-scale Corruption and Organised Crime Networks) project, it explores how innovative technological tools – illustrated by the "FALCON dashboard" – can help investigators manage, visualise, interpret and report large volumes of heterogeneous data in support of more effective investigations.

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Executive Summary

Corruption at land and sea borders facilitates smuggling, sanctions evasion, tax offences and the entry of counterfeit, substandard or unsafe goods into countries including EU member states. It is a complex and multifaceted phenomenon that poses significant challenges to law enforcement. Based on a literature review and empirical research including interviews and case studies, this report conceptualises border corruption as a dynamic system of actors, events and illicit exchanges. It also assesses how new technologies and innovations can strengthen investigations.

Border areas are spaces that bring together a variety of public and private actors, regulatory functions and illicit activities. Corruption is structurally embedded, making it difficult to detect and investigate. Investigations in this context require the integration and interpretation of large volumes of heterogeneous data spanning administrative records, financial transactions, corporate structures, border crossing data and information from social media.

This level of complexity can result in information overload, fragmented analysis and limited capacity to extract actionable insights for planning law enforcement operations. Additionally, issues with reporting and information sharing can hinder collaboration between field operatives and their line managers and superiors, who have critical responsibilities in terms of case management and financial planning.

Building on research conducted within the Horizon Europe FALCON (Fight Against Large-scale Corruption and Organised Crime Networks) project, the report presents one of the project's technological outputs as an example of how technology can be leveraged: the FALCON dashboard. Currently in the piloting phase, this innovative tool has been designed to support investigations into border corruption and related offences by enabling the systematic collection, integration, visualisation and analysis of investigative information and evidence.

This report demonstrates how the FALCON dashboard can assist investigators in managing hybrid data sources (manual and automated), constructing and navigating evidence graphs, and identifying key actors and relational patterns. The tool also lets investigators track the evolution of their investigations over time. Particular attention is paid to the dashboard's capacity to reduce visual saturation, enable multi-level analysis and facilitate targeted queries, thereby enhancing sense-making and investigative prioritisation.

Although the FALCON dashboard itself is not yet publicly available, its presentation in this report provides inspiration for similar technological innovation. The report argues that tools such as the FALCON dashboard can bolster investigative capabilities by enhancing analytical clarity, operational efficiency and communication between investigators, supervisors, prosecutors and other relevant stakeholders. However, it also prompts the need for further

reflection on broader challenges relating to data quality, interoperability, institutional coordination and data protection.

Overall, the study provides a conceptual and practical framework for understanding how technological platforms can support evidence-based, adaptive responses to border corruption.

1 Introduction

As various studies have shown, the mechanisms of corruption and related offences at land and sea borders have become increasingly complex and multi-layered in recent years, making them difficult to investigate (Costa & Kassa, 2025). Investigators[1] are faced with the daunting task of collecting and analysing large volumes of data in a way that makes it understandable and enables them to draw useful conclusions. These practitioners could benefit from innovations and new technological solutions applied to the anti-corruption domain. In this report, we will describe one such solution developed within the Horizon Europe project FALCON (Fight Against Large-scale Corruption and Organised Crime Networks).

FALCON is a three-year project that began in September 2023 and is scheduled to conclude at the end of August 2026. It supports innovation in the fight against corruption and organised crime by designing, testing and piloting tools and software based on artificial intelligence and machine learning, including large language models. The project draws on the collaboration of social scientists, technology developers and law enforcement agencies. It targets four critical types of corruption: public procurement fraud, sanctions circumvention, conflicts of interest involving politically exposed persons (PEPs) and corruption at borders.

As the project nears its conclusion, it has already produced significant technological outcomes in the form of experimental beta versions and software models, including tools for trend and predictive analytics, advanced corruption risk assessment, open-source intelligence (OSINT), and vehicle recognition. While the ultimate objective is to introduce these tools to the market and commercialise them, they are still subject to improvements resulting from testing and piloting efforts within the FALCON framework.

[1] In this report, we use the term “investigators” broadly to encompass all criminal justice professionals involved in border corruption investigations.

1.1 Introducing the FALCON dashboard

This report aims to show the usefulness of one of these tools in strengthening the detection and investigation of border corruption: the FALCON dashboard.

This is a platform where investigative information and findings can be gathered and consolidated into clear graphical visualisations. This can assist investigators responsible for detecting border corruption and other offences that are facilitated by corruption. We will explain how the dashboard works and the ways in which it supports the work of law enforcement in tackling border corruption.

This tool has been developed by integrating know-how, input, goals and practical needs of all FALCON project participants. Its value lies in the fact that it has been designed with the specific needs and operational requirements of investigators in mind. The involvement of social scientists and subject-matter experts in the design stage aligned it with the most recent evidence on the characteristics of the four types of corruption covered by the FALCON project.

In light of the growing efforts within the anti-corruption community to leverage technological innovation, this report contributes towards establishing robust conceptual frameworks and evidence-based confirmation processes.

1.2 Methodological note

The report is based on three pillars. The first pillar includes the analysis of available literature on corruption risks in border areas, as well as the analysis of the FALCON project deliverables D2.2, D4.2 and D5.[2] The aim is to explore the complex nature of the investigative activities regarding border corruption, and to provide an overview of the data, sources, risk indicators, and technological solutions designed under the FALCON project.

In particular, deliverable D2.2 provides a comprehensive overview of risk indicators and their definitions, along with the procedures for operationalising them in different domains, including border corruption. Deliverable D4.2 details the technical procedures and operative steps involved in extracting the indicators used for the early detection of corruption risks from underlying data/datasets, anomaly detection tools and trend analysis protocols. Deliverable D5.1 provides an overview of the tools developed under the FALCON project, detailing their scope, structure and potential to support law enforcement and anti-corruption authorities.

[2] The three FALCON deliverables can be downloaded from the project's official website: https://www.falcon-horizon.eu/deliverables/.

The second pillar includes activities that delve deeper into what emerged from the initial literature review. This stage included:

a. a set of semi-structured interviews with 20 selected respondents from the following categories: Ten law enforcement agencies and practitioners, three scholars and seven NGOs;
b. the analysis of two in-depth case studies of corruption risks at the port of Rotterdam (Kassa & Costa, 2025) and Kapitan Andreevo border checkpoint (unpublished);
c. the analysis of handbooks and guidelines that describe step-by-step strategies for investigating corruption cases (International Anti-Corruption Resource Center, 2025; UNODC, 2024) and for policing border spaces (European Commission, 2022; UN-DPO, 2023; UN-ESCAP, 2012).

Finally, the third pillar is based on a review of the practical experience gained from piloting the FALCON dashboard throughout the project. This includes the main points from the presentation made to the European Commission at the Interim Review Meeting held online on 29 March 2025. Additionally, we have considered the comments of FALCON consortium partners after the pre-pilot on 4–5 December 2024 in Karlsruhe, the first pilot held online on 29 January 2025 and the second pilot on 19–21 November 2025 in Lyon.

2 Conceptualising the complexity of border corruption risks

David Jancsics (2019, 2020) defined border corruption as the illegal exchange of resources between border officials (i.e. bribe takers) and clients (i.e. bribe givers). However, beneath this simple definition lies a universe of complexity, as evidenced by the literature (Chêne, 2013, 2018; McLinden, 2005; McLinden & Durrani, 2013).

2.1 Variety of spaces, goals and offences

One factor contributing to this complexity is the **variety of spaces that characterise borders** (Chêne, 2013, 2018; Hors, 2001; Kim & Tajima, 2022). Border corruption can occur along difficult-to-protect boundary lines that physically separates two countries. It can also occur at border checkpoints that facilitate the movement of people, vehicles and goods between countries (Costa & Kassa, 2025).

A second factor of complexity relates to the **variety of goals and functions that incentivise border corruption** by public and private actors. For instance, corruption can facilitate situations in which individuals or businesspeople lack the necessary documentation, such as visas, trading licences or insurances, or wish to transport more goods than permitted, carry

prohibited goods, or present forged permits or documentation (Costa & Kassa, 2025; UNODC, 2013, 2020).

Related to that comes a third factor of complexity, that is the **variety of offences related to border corruption**. Corruption at the border can facilitate smuggling activities (Kim & Tajima, 2022). Traders may bribe to speed up border procedures or avoid declaring goods, thereby evading the payment of taxes and fees (Igbanugo, 2011; Klopp et al., 2022; Đorđević, 2014). They can also use corruption to circumvent restrictions on certain goods and transport counterfeit or substandard products (Azcarraga et al., 2022; De Wulf & Sokol, 2005). Consequently, corruption can result in tax offences and the entry of unsafe or substandard goods into a country. It may also facilitate sanctions evasion. Organised crime groups seeking to illegally smuggle goods or people into another country may use corruption to build criminal networks within the border environment and secure services from public officials (Chêne, 2018; Europol, 2023; Jancsics, 2019, 2020; Kassa & Costa, 2025; Roks et al., 2021). These can include refraining from conducting controls and surveillance, protecting smugglers from police investigations, helping to store or move illegal goods out of the border zone, escorting private or commercial vehicles, and sharing confidential information (CSD, 2012; Đorđević, 2014; Jancsics, 2019, 2020, 2021).

2.2 Public and private actors

A fourth factor contributing to the complexity of border corruption stems from the **multitude of public and private actors involved** in these interactions. Many public authorities operate in border areas, including customs agents, immigration officials, border police, border patrol units and health authorities (Hoffman et al., 2013; Jancsics, 2019). Customs agents are particularly vulnerable to corruption risks, as they are responsible for checking goods transported by commercial and private vehicles, reporting any irregularities in declarations and permits, and collecting taxes (McLinden & Durrani, 2013). Border guards are also exposed due to their role in controlling checkpoints and monitoring the flow of vehicles and people entering and leaving the country (Jancsics, 2021).

Private individuals involved in border corruption can be divided into three groups (Jancsics, 2019). The first group comprises individuals who cross borders in private cars, on motorcycles, in commercial passenger vehicles, on foot or on passenger ships and other vessels. The second group includes formal organisations, such as trading and transport companies, clearing agents, freight forwarders and intermediaries. The third category are informal organisations, including criminal groups involved in smuggling or trafficking activities.

2.3 Collusive and coercive corruption and infiltration

The **nature of the corrupt interaction** is also relevant to consider. In this regard, both public and private actors can engage in *collusive* or *coercive* forms of corruption (Chêne, 2013; Jancsics, 2019; Kassa & Costa, 2025; Sergi, 2020).

Collusion is defined as a partnership between public and private actors to achieve illegal goals. This collaboration is often fuelled by the demand for illicit goods that shapes transnational supply chains. Criminal organisations use it to link the supply of goods with their final markets, overcoming obstacles and bottlenecks in the process (Costa, 2022; Deville, 2013). For individuals and businesses, collusive corruption can expedite border or customs procedures and circumvent stringent controls on documents or goods. Criminal groups benefit even more, as collusive arrangements reduce risks by ensuring the passage of illicit goods and securing additional services from public officials.

Coercion is determined by the power imbalances between public and private actors. For example, public officials may exploit this imbalance to extract rent from clients by creating red tape and unnecessary bureaucratic hurdles that force people crossing borders to pay bribes (Center for the Study of Democracy, 2012; Klopp et al., 2022; Yang, 2008). Private individuals and formal organisations are often the victims of coercive corruption, being forced to resort to bribing to access services they need and may in fact be entitled to. In contrast, when it comes to organised crime, the power imbalance favours criminal organisations. These groups often use intimidation tactics to recruit border and customs officials into their networks in order to achieve their criminal goals.

A third typology of corrupt interactions is *infiltration* (Kassa & Costa, 2025; Sergi, 2020). This corruption mechanism occurs when members of criminal networks infiltrate public offices through formal employment and HR processes. This enables them to perform administrative and surveillance duties, access confidential information, establish connections and facilitate the employment of other members of their network, particularly if they ascend to senior positions.

2.4 Sophisticated strategies

Finally, the complexity of corruption in border areas is evident in the **strategies employed by citizens, businesses and criminals to circumvent obstacles and controls** (Kassa & Costa, 2025). These strategies involve concealing the transportation of consumer, counterfeit or illicit goods and orchestrating financial fraud to reduce the taxable value of traded goods.

Research activities at the Kapitan Andreevo border checkpoint between Bulgaria and Turkey have highlighted numerous examples of these strategies. For instance, in one case of a large scheme aimed at tax evasion, a tax declaration was made for the export of goods from Turkey to Romania via Bulgaria. However, upon entering Bulgaria, the goods were unloaded from the vehicles. The trucks, which appeared to be re-exporting the goods to Romania, in fact left the country empty. In this case, the operation was presented formally as an export and transit transaction; this means that the Bulgarian operators did not pay the VAT and could also claim VAT refunds on those goods that supposedly left the country. Evidence suggests that this scheme was made possible thanks to bribes paid to customs agents and border guards operating at the Kapitan Andreevo border checkpoint.

In another case, a transportation company sent three identical trucks carrying consumer goods and counterfeit items across the border. However, only one of the trucks contained the illicit cargo. The scheme is as follows: if one of the trucks containing illicit goods were selected for more thorough customs checks, its licence plate would be swapped with that of an unselected "clean" truck. This was only possible thanks to the bribes paid to customs agents and border guards (PMG Analytics, 2024).

3 Investigating border corruption: a multifaceted exercise

The complexity of border corruption and related offences needs to be addressed through multifaceted investigative activities. Indeed, this is reflected in the growing complexity of corruption investigations generally (International Anti-Corruption Resource Center, 2025; UNODC, 2024). Interviews with experts and practitioners provided insights into how border corruption investigations are conducted. This helped us identify the issues investigators face and how the FALCON dashboard can support them.

3.1 Indicators of risk

When investigating potential border corruption, investigators aim to collect evidence relating to events, individuals of interest, vehicles, connections and transactions that demonstrate the link between illicit exchanges and offences such as smuggling or tax evasion. For instance, suspicions of smuggling activities may arise from:

- the repeated entry and exit of vehicles or individuals across the border within a short timeframe;
- the brief stays of vehicles and individuals in the country;
- frequent collective border crossings of specific groups of vehicles or individuals;
- clearance procedures for vehicles and individuals that are shorter than would usually be expected.

These indications of risk do not automatically correspond to risks of corruption but they can be correlated to other variables to offer a more complete picture of where suspicious activity might be happening. In fact, linking these signals to corruption would require demonstrating, for example, that specific customs agents or border guards (individuals or teams) were frequently, if not always, on duty when vehicles or individuals involved in suspicious activities crossed the border. This could signal collusion enabling certain vehicles or individuals to cross the border checkpoint without undergoing proper controls.

In other words, it is necessary to detect an anomalous rate of association between those suspected of being involved in crimes such as smuggling or tax evasion and particular groups of public officials at the border checkpoint (Chalendard et al., 2023).

Finally, investigators must also demonstrate an illicit flow of resources from private actors to public officials. To confirm the presence of corruption, investigations must reveal the mechanisms through which bribes are exchanged between bribe-givers and bribe-takers. Achieving all these objectives requires various investigative steps and a large amount of information and evidence.

3.2 Investigative strategies: an intricate web of information

There are many sources for this kind of information and data. These include administrative and border crossing datasets, asset and interest declarations, video and car recognition records, open-source information, wiretaps, bank and financial statements, company registers, cadastres and vehicle registries (UNODC, 2024). Collection and evaluation of such data should be, of course, subject to the applicable data protection regulations.[3]

Evidence collection can be manual or automated. Technological innovation has enabled the design of automated tools for open-source intelligence gathering, border crossing analysis, vehicle visual recognition and financial transaction analysis. Data and information generated by these systems can be stored in web-based datasets and retrieved as required to visualise investigative results on a dashboard.

3.2.1 Detecting border corruption

Investigations into border corruption can begin in various ways. Valuable information can come from tips and leaks by witnesses or whistle-blowers, businesspeople or ordinary citizens (UNODC, 2024). An investigation at Kapitan Andreevo border checkpoint that led to the arrest of Bulgarian customs officials in 2024 began with foreign truck drivers complaining to their embassies about being subjected to exploitative practices whenever crossing the border between Bulgaria and Turkey.

Information for initiating investigations can also be obtained by analysing documents or datasets such as financial and bank statements that reveal suspicious transactions. This may be prompted, for example, by journalistic revelations about a change in the lifestyle of a public official (UNODC, 2024). Nowadays, artificial intelligence tools can speed up the process of extracting evidence from documents. Corruption risk assessment tools can flag suspicious

[3] The important topic of data protection requires further consideration, but this goes beyond the scope of this report.

behaviours on which investigators should focus their attention (International Anti-Corruption Resource Center, 2025; The World Bank, 2023; UNODC, 2024).

3.2.2 Initial investigations and data gathering

Once an investigation has begun, investigators will scrutinise the detected suspicious behaviour at border checkpoints to identify vehicles, public and private entities and individuals suspected to engage in criminal activities. The key lies in collecting and making sense of an intricate web of information that is often difficult to visualise and interpret.

When targeting vehicles and their border crossing activities, investigators collect information on the vehicle's model, year of manufacture, colour, licence plate number and vehicle identification number. Other key information includes details of border crossing behaviours, such as the date and time of entry and exit at a specific checkpoint, how long the clearance procedure takes, how long the vehicle stays in the country, and any potential associations with other vehicles. Data can be collected using vehicle visual recognition tools or by exploring border crossing datasets.

Investigators also need to search for information on individuals (e.g. the driver of a vehicle) and entities (e.g. the company that owns the vehicle). Individual profiling will involve collecting personal and family data, names of associates, contact information and criminal records (UNODC, 2024). Some of this information can be obtained through systems used to verify identity documents at borders, while other information requires external sources. With regard to companies, investigators will search for data on the registration address and location (paying particular attention to registration in offshore jurisdictions or areas with a high incidence of criminal activity), as well as the legal and beneficial owners and any previous involvement in suspicious activities. This data can be extracted from company registries and used to create specific risk indicators.

Information on vehicles and individuals is then cross-checked against the details of public officials working at the checkpoint. This establishes whether specific officials frequently work during border crossings involving vehicles and individuals exhibiting anomalous behaviour, revealing potentially collusive associations (Chalendard et al., 2023). Investigators must collect information on officials' identities, team compositions and shift schedules. Data on inspection activities is crucial for determining what was done, when and by whom, and can be obtained from administrative and HR datasets as well as inspection reports.

Investigators also verify other types of association between public and private actors (International Anti-Corruption Resource Center, 2025; UNODC, 2024). They can examine the social and kinship networks of public officials. This could help to identify whether any family members, friends or business associates have criminal records for specific offences (Bergin, 2023; Izcara Palacios, 2019; Jancsics, 2020). Determining whether public and private actors live in the same city, town or district can also help to identify potential overlap (Chalendard et

al., 2023). Investigators may also find that private and public actors attend the same social events, spend holidays together or participate in the same leisure activities (Bergin, 2023; Chêne, 2013, 2018). This information can be obtained from various sources, ranging from asset and interest declarations to social media and other publicly available information obtained via open-source intelligence tools.

3.2.3 “Following the money”

At this stage, investigators have a better understanding of the suspicious behaviours and opaque relationships between public and private actors that may have contributed to the suspected crime. They can now focus on the flow of money between public and private actors, as well as the schemes used by public officials to convert bribes into legitimate funds. This will help identify illicit payments and bribes to public officials working at border checkpoints, as well as the dynamics associated with their illicit enrichment, such as lifestyle changes (Dornbierer, 2021; International Anti-Corruption Resource Center, 2025; UNODC, 2024).

“Following the money” requires cross-checking of a vast amount of information and data. Data sources may include HR datasets, bank statements, financial transaction reports, cadastres, real estate registries, vehicle and vessel registries and company registries.

Examining public officials' assets more closely to see if they have made investments, acquired shares or taken on debts is also worthwhile. Comparing this information with what is reported in their asset declarations can help identify discrepancies and anomalies. This data can then be supplemented with information from other sources. For instance, investigators could use an open-source intelligence tool to search public officials' social media profiles for evidence of a change in lifestyle, such as posts about enjoying exotic holidays, luxury cars or other expensive goods.

3.3 Difficulties in handling the complexity of the investigative activities

Although this overview of investigative strategies and the data required is far from exhaustive, it illustrates the intricacy and nuances that characterise investigations into border corruption today. The investigators must navigate multiple dimensions in order to uncover evidence solid enough to withstand legal scrutiny. The difficulties in visualising all this data in a coherent way and interpreting their meaning while extracting interesting patterns of suspicious activities are also evident. This overview helps us identify the problems and weaknesses affecting the activities of investigators.

One obvious challenge is the need to compile coherent, robust data and information from the multitude of sources describing different instances, timeframes and components, such as events, actions, flows, financial transactions, individuals, legal entities and vehicles.

Additionally, the proliferation of tools for the automated collection of information raises the issue of how data collected manually through traditional methods can be integrated smoothly.

Bringing all this information together poses a significant challenge. Regardless of how it was generated and collected, the sheer amount of information risks becoming overwhelming.

The huge amount of data can make visualising the investigative results difficult. It can lead to visual overload or the presence of background noise caused by redundant information or investigative avenues that have led nowhere, yet are still present in the visualisation. This makes it hard to keep track of what's important. Investigators may find it challenging to interpret the results of investigations and extract meaningful patterns. It can hinder their capacity to identify the most significant components of interest, such as a person, vehicle or event, from the vast amount of information.

As one of our interview participants explained, this inextricable tangle of information and connections can also make it difficult for investigators to present their findings to supervisors or to prosecutors in a straightforward manner. So, excessive redundancy and confusion in the visualisation of collected data can hinder effective communication between field officers, their superiors and prosecutors.

These problems can be exacerbated by the discrepancy between the dynamic nature of investigations and the often-static nature of the visualisation of investigative findings. This can prevent investigators from promptly identifying potential new lines of investigation.

Addressing these problems could help prioritise investigative activities and maximise the use of resources. Innovative tools such as the FALCON dashboard can contribute significantly to this effort.

4 The added value of the FALCON dashboard

Sections 2 and 3 of this report analysed the complexity of border corruption and the activities for investigating it. This section explains how the FALCON dashboard can help address some of the issues that make these investigations difficult.

As mentioned, investigators increasingly rely on large amounts of evidence to unravel criminal networks and map events, individuals, vehicles and legal entities. However, the amount of data risks overwhelming investigators, who may need technological support to connect all the dots in complex, often transnational settings. At the same time, visualising, interpreting and making sense of the intricate webs of evidence can be difficult due to their multidimensionality.

The FALCON dashboard aims to simplify investigators' work by providing a flexible tool for analysing the evidence they have collected. The following subsections will cover the added value of the tool in four areas: 1) managing data and evidence; 2) visualising investigative

information; 3) supporting investigative activities; and 4) reporting investigative results. Before doing so, we provide a few details on the fictitious scenario created to support the analysis.

4.1 Presenting the fictitious scenario

To demonstrate how the FALCON dashboard can support border corruption investigations and provide a sneak peek of its visualisation capabilities, this report used a fictitious investigative scenario. The scenario is grounded in empirical insights derived from case studies, interviews and existing literature, and reflects the cumulative nature of real-world investigations. At the same time, the events, individuals and organisations in the scenario are fictional and were generated randomly using AI (ChatGPT). There is no intended connection or reference to any real persons, organisations or events.

The investigation in the scenario expands concentrically from a limited set of initial “nodes” (i.e. individual investigative components such as an event, individual, vehicle or action) to increasingly complex relational “clusters” of nodes, encompassing administrative, corporate and financial dimensions. This design allows us to simulate investigative complexity and to evaluate the capacity of the FALCON dashboard to integrate heterogeneous data sources and render evidence networks intelligible through visualisation and analysis.

The scenario concerns a land border crossing between two neighbouring countries. It centres on a suspected scheme of smuggling, tax evasion and corruption in the trade of mineral resources. The scheme involves a logistics operator formally importing low-taxed goods for a domestic manufacturing sector, while concealing the cross-border movement of higher-value products subject to higher duties. The operation is facilitated by intermediaries responsible for customs clearance and is embedded in a broader environment of regulatory capture, involving corrupt exchanges with border officials and politically connected actors.

Initial investigative attention is triggered by media reports indicating lifestyle anomalies among customs personnel, which activate law enforcement scrutiny. From these initial nodes, the investigation progressively reconstructs transnational commercial ties, intermediary roles and financial linkages, revealing a multi-actor network characteristic of organised economic crime at borders.

4.2 Managing data and evidence

The FALCON dashboard is designed to make it easier to properly manage the data, information and evidence collected during an investigation. As mentioned above, investigators collect this information in two ways: manually through traditional investigative work; and by relying on technologies that facilitate the automated collection of data from digital sources (UNODC, 2024).

There is a strong trend towards the adoption of innovative technologies, such as artificial intelligence and machine learning, for the collection and analysis of investigative evidence. The development of open-source intelligence (OSINT), corruption risk assessment and predictive analytics tools show this trend. These tools can automatically provide various pieces of information that are invaluable for investigations (UNODC, 2024).

The FALCON dashboard allows users to integrate both: they can manually add evidence they collected and they can automatically retrieve data from various web-based repositories and tools. This flexibility is essential for covering the increasingly hybrid nature of investigative activities at the intersection of manual and automated processes.

Figure 1 shows the various digital investigative tools integrated in the FALCON dashboard, including OSINT and corruption risk assessments (ACRA), among others. Users can automatically import data from these tools and incorporate it into the graph.

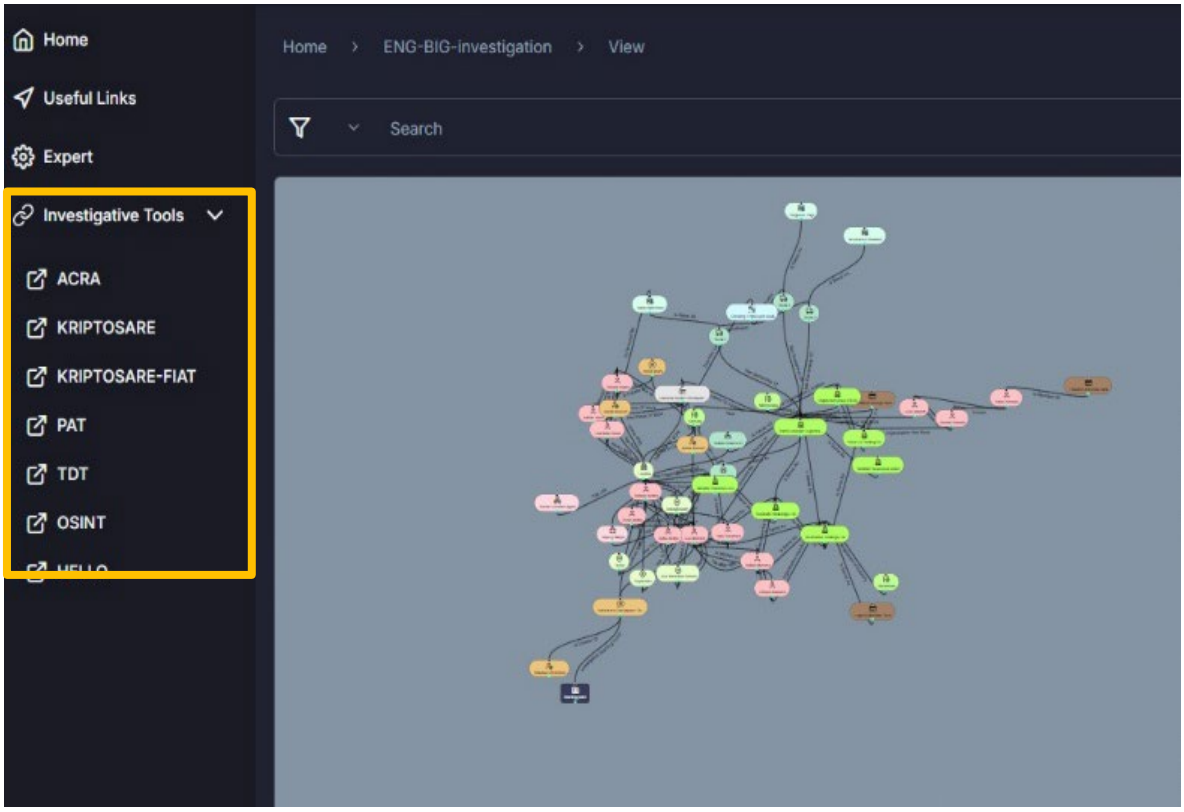

Figure 1: External investigative tools and sources from which the FALCON dashboard can automatically retrieve information.

4.3 Visualising the investigative information

A strength of the FALCON dashboard is its ability to visualise data, information and evidence in a clear and useful way. The dashboard shows the graph as it evolves between the start and the end of the investigation. As investigators enter and import data, the graph grows

progressively, mapping legal entities, individuals, vehicles, events, places and the relationships connecting them.

Node types are visually differentiated through dedicated icons, making it easier to navigate the graph at a glance. Figure 2 shows the icons available in the FALCON dashboard.

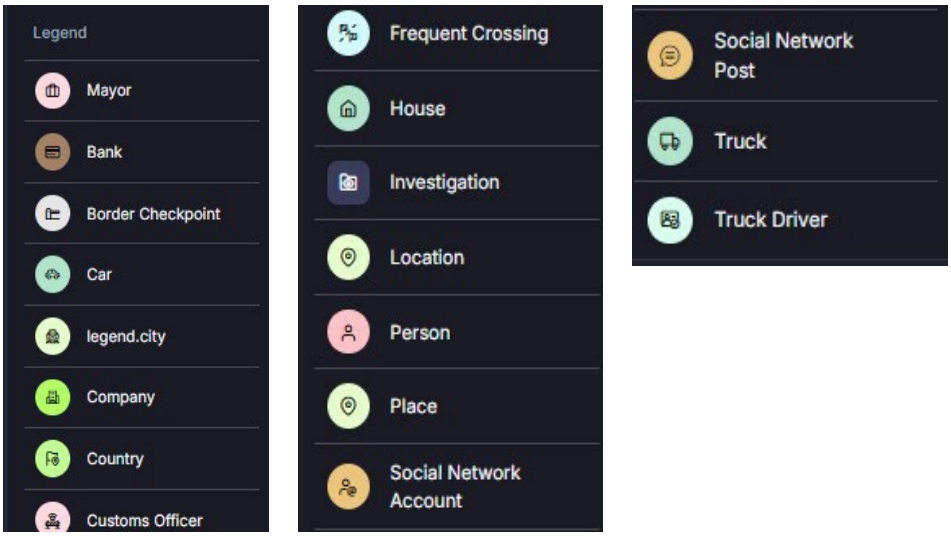

Figure 2: Legend of icons for different node types. “Social Network Account/Post” may refer to both social media accounts and posts as well as to media outlets and media reports.

The key elements of the visualisation process are:

- Flexible navigation and exploration of graph components.
- Clear visual distinction between individual nodes, even in large and complex graphs.
- An editable layout, allowing nodes and connections to be repositioned as needed.

Pilot participants confirmed that the combination of these features significantly reduces the time and effort required for information analysis and sense-making, particularly in complex corruption cases involving large graphs.

Figure 3 shows the evidence graph emerging at the end of the investigation into our fictitious scenario. Some of the icons listed in the legend above can be seen, as well as the links that connect them. Each of these links has an attached label describing the type of connection between the two nodes, such as kinship ties, shared location, ownership or membership. The black box node at the bottom left of the graph, clearly distinct from all the other nodes, is the starting point of the entire investigation. In the fictitious scenario, the first entry is the newspaper article about the lifestyle changes of senior officials and politicians around a border checkpoint. All other nodes and subgraphs branch out from this initial node.

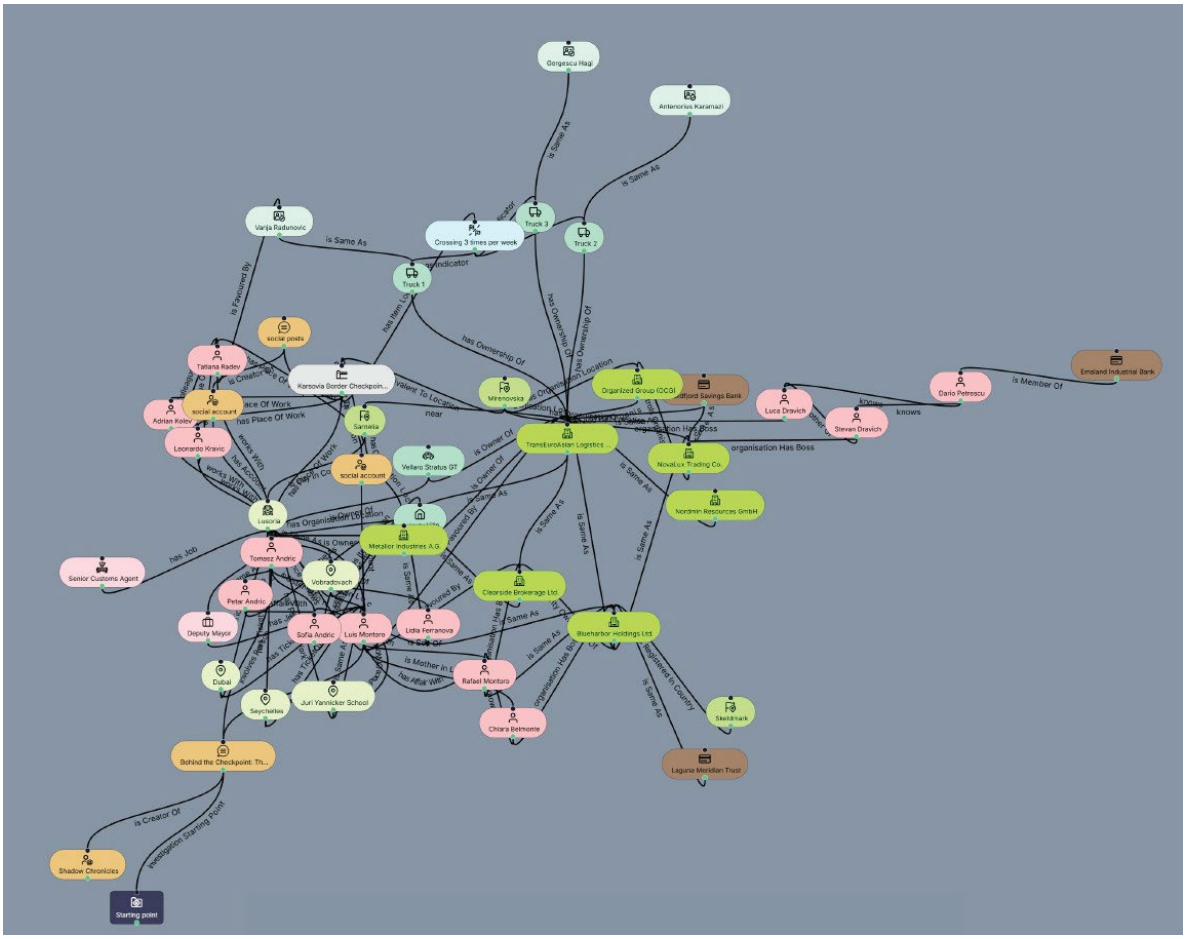

Figure 3: Bird's-eye visualisation of an entire evidence graph in the FALCON dashboard, based on the fictitious scenario.

The FALCON dashboard is designed to reduce the information overload that can result from visualising the entire web of connections between individuals, entities, vehicles and events. To this end, the tool offers options for exploring specific nodes and their key information or delve deeper into specific graph sections and node clusters. In this sense, the tool enables users to switch between different levels and view the data from a bird's-eye or a more granular perspective. This is a valuable feature that helps investigators improve their ability to interpret complex evidence and identify suspicious patterns. It also increases the clarity and accuracy of data visualisation.

Clicking on a node opens a window that summarises the background information entered by users during the investigation process, when evidence was added into the dashboard. This helps investigators understand immediately what kind of node they are looking at, without the need for complicated searches.

Users of the dashboard can customise the level of detail that is disclosed about the nodes in the graph based on their investigative goals and needs, as they can select the attributes assigned to each node. This depends, of course, in part on how much information investigators

were able to collect on the selected node in the first place, as well as on the quality and depth of this information.

Finally, the tool offers filtering options that allow users to select relevant nodes at a specific stage of the investigation. Investigators can choose to filter nodes based on a connection threshold (e.g. visualising only nodes with more than *n* links), their typology (e.g. visualising only nodes belonging to specific categories, such as banks, cities or individuals), or the entry date (e.g. visualising only nodes added at a specific time and date). This helps investigators to quickly identify the nodes and graph components they want to target. This reduces background noise that can cause confusion, making their work faster and more effective.

Figure 4 illustrates the filter function. In this figure, the filter for displaying nodes with a specific number of connections has been set to four. This means that the graph only shows nodes with four or more connections. From an investigative standpoint, using this filter option helps investigators concentrate on nodes with multiple connections. The focus can be adjusted as new information, evidence or circumstances emerge.

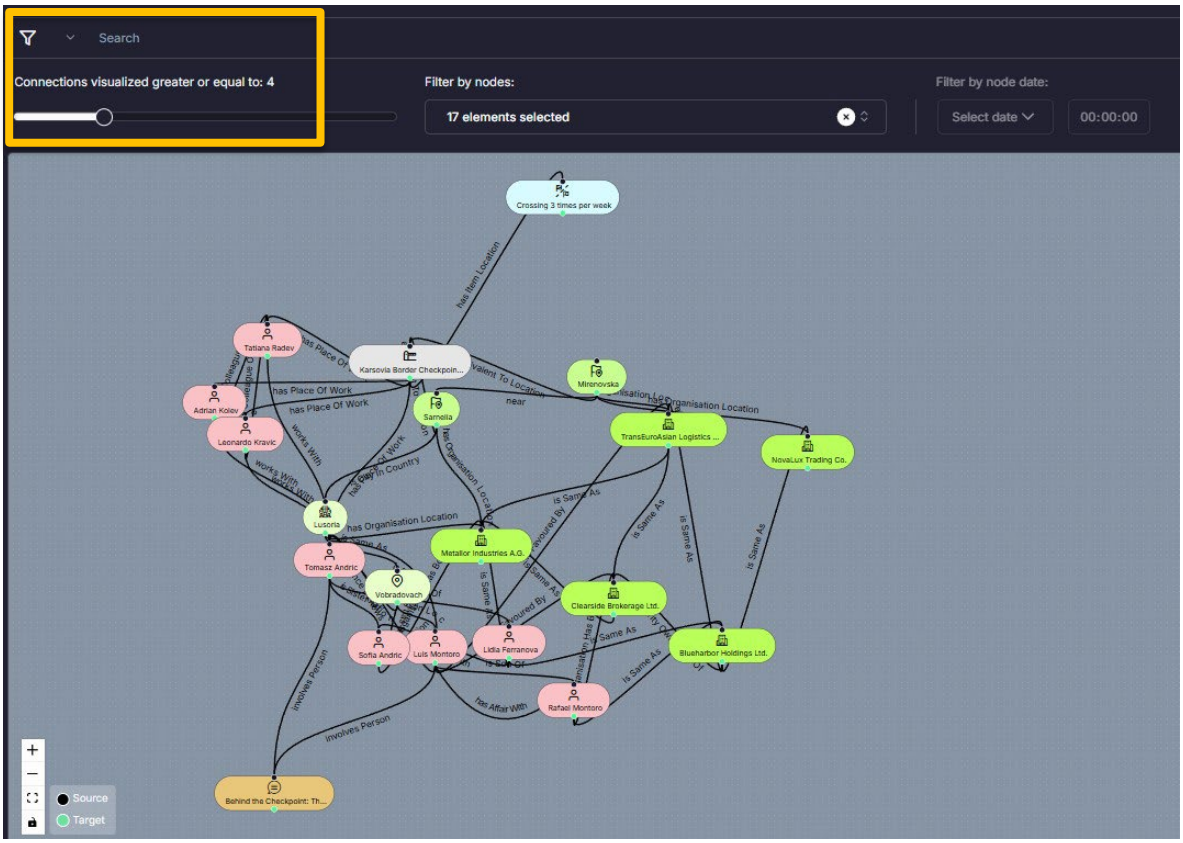

Figure 4: Displaying only selected nodes using the filter function.

4.4 Supporting investigative activities

Another strength of the FALCON dashboard is its inclusion of several functions that facilitate investigative work.

For instance, investigators can update the graph at any time by adding new information collected during the investigation, such as additional node attributes or connections.

Investigators can also choose to display the graph at various stages of an investigation. The initial trigger sets the starting point of the investigation, creating a core node or cluster at T_0. As the investigation progresses and more information and data are entered (at T_1, T_2, etc.), additional nodes and subgraphs branch out from this core. Users can display the graph as it was on a specific date or after a specific period (e.g. three months into the investigation) at any time. By tracking how an investigation evolves from a few initial nodes into a broader network of nodes and clusters across investigative activities, investigators can monitor progress and evaluate which investigative avenues to prioritise.

Figure 5 shows the evolution of our fictitious evidence graph at three stages of the investigation. As can be seen, the graph gradually expands in size and density as new nodes are added and more relational clusters are mapped out.

Figure 5: Evolution of an evidence graph.

Another feature of the FALCON dashboard that facilitates investigative work is that it integrates concepts from social network analysis to identify key nodes. This enables nodes to be visualised according to their degree or betweenness centrality (Borgatti et al., 2013; Hanneman & Riddle, 2005). That is, those nodes that have the greatest number of direct links or those nodes that are most often acting as a bridge along the shortest path between other nodes can be made bigger and more visible in the graph. This function can help improve the prioritisation of activities or the identification of key players in a criminal case (Borgatti, 2006).

Finally, the FALCON dashboard also contains a query system that allows users to search for nodes with specific characteristics or that are involved in particular behaviours. For instance, users may need to identify a vehicle with a specific licence plate or vehicle identification number, or alternatively, a vehicle that crossed a border checkpoint on a specific date and at a specific time. It is also possible to query the identification of vehicles that appear to be involved in suspicious activities, such as crossing a border checkpoint too frequently in a month or staying in a country for an unusually short time.

Thanks to this query system, searching for nodes of interest is much easier and quicker than if users had to search for them manually in a long dataset. Investigators can either build their own query or select one from a pre-set list created through collaboration between tool developers, end users and researchers.

4.5 Reporting investigative outputs

A further added value of the FALCON dashboard is its role in supporting the communication, reporting and management of investigative activities. Beyond the use of analytical functions, investigators are routinely required to produce reports, summary statistics and visual outputs for a range of audiences, including other law enforcement units, prosecutors, supervisors and, in some cases, external stakeholders such as journalists. These practices are integral to investigation management, as they enable coordination, accountability and strategic decision-making in situations of time pressure and informational asymmetry.

In this respect, the FALCON dashboard is designed to translate complex investigative material into accessible and structured representations that can be easily understood by actors who may be unfamiliar with the operational details of a case or lack the time to engage with raw data. The FALCON dashboard is equipped with a system that can generate relevant statistics about the structure of the evidence graph. For example, it can show how many nodes of a certain type are part of the network, and which types of ties connect them most frequently. This makes it much easier for users to extract this kind of information during investigative activities on a specific criminal case and present it to their superiors or other relevant stakeholders.

By facilitating the synthesis and visualisation of the investigative progress, relational patterns and emerging priorities, the dashboard contributes to improving both internal and inter-institutional communication. This, in turn, supports shared situational awareness, clarifies the current status and direction of an investigation and helps align resources and priorities across the organisations involved.

5 Conclusion and outlook

In recent years, border corruption has become increasingly complex, presenting significant challenges for investigators and policymakers alike (Costa & Kassa, 2025; Kassa & Costa, 2025). Traditional methods often prove inadequate for dealing with large volumes of heterogeneous data, intricate networks of individuals and swiftly evolving illicit activities. This highlights the urgent need for dedicated tools to support the collection, integration, analysis and visualisation of evidence, and to enhance coordination between investigators, prosecutors and other stakeholders.

The FALCON dashboard shows how technology can improve four important parts of investigative work: managing and visualising data, providing operational support, and reporting. By facilitating the identification of patterns, key actors and relational networks, the tool enhances investigative capacity and ensures decision-makers are kept informed about the progress, priorities and resource requirements of ongoing cases. Integrating automated analytical tools, OSINT, predictive analytics and risk assessment algorithms with manual investigative procedures provides a more systematic and actionable understanding of illicit activity, moving beyond siloed approaches.

From a policy perspective, the experience with the FALCON dashboard highlights many opportunities. However, there are also challenges to consider. Effective integration of investigative tools requires the resolution of issues relating to data quality, interoperability, standardisation and accessibility (Riccardi et al., 2025). Policymakers and institutional leaders should prioritise investment in these areas, promote inter-agency collaboration and develop frameworks that facilitate the sharing of real-time information.

At the same time, they must also understand how to balance the need for data accessibility and sharing with the need for confidentiality, privacy protection and the safeguarding of sensitive information. This becomes increasingly pertinent in times of conflict and geopolitical turbulence. Achieving the right balance between these two sets of needs will greatly impact the availability of data sources for the ongoing development of new tools.

Moreover, technological innovation should not be viewed as a one-time solution. Border corruption continues to evolve, and the introduction of advanced tools to counter it may influence illicit strategies (Chalendard et al., 2023; Kassa & Costa, 2025). Therefore, continuous adaptation, monitoring and investment in technological and human capacities are essential to maintaining an effective anti-corruption posture.

Technological platforms such as the FALCON dashboard can facilitate evidence-based, coordinated and adaptive responses to border-related crime. Such innovative tools enhance investigative efficiency, transparency and strategic decision-making. They can support policymakers and law enforcement agencies in addressing the evolving landscape of corruption and ensuring that resources are deployed where they are most effective.

It is expected that such tools will at some point become a standard part of law enforcement and prosecutorial procedures in key anti-corruption areas, including border management. The availability of the appropriate technological devices and infrastructures, the provision of trainings to public officials on how to use them and the enhancement of digital literacy generally are a few fundamental prerequisites for the effective integration of the tools into the daily workflow of criminal justice professionals.

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