Paper SAS603-2017

You Imported What? Supporting International Trade with Advanced Analytics

Susan Trueman, SAS Institute Inc.

ABSTRACT

Global trade and more people and freight moving across international borders present border and security agencies with a difficult challenge. While supporting freedom of movement, agencies must minimize risks, preserve national security, guarantee that correct duties are collected, deploy human resources to the right place, and ensure that additional checks do not result in increased delays for passengers or cargo. To meet these objectives, border agencies must make the most efficient use of their data, which is often found across disparate intelligence sources. Bringing this data together with powerful analytics can help them identify suspicious events, highlight areas of risk, process watch lists, and notify relevant agents so that they can investigate, take immediate action to intercept illegal or high-risk activities, and report findings. With SAS® Visual Investigator, organizations can use advanced analytical models and surveillance scenarios to identify and score events, and to deliver them to agents and intelligence analysts for investigation and action. SAS Visual Investigator provides analysts with a holistic view of people, cargo, relationships, social networks, patterns, and anomalies, which they can explore through interactive visualizations before capturing their decision and initiating an action.

INTRODUCTION

Unprecedented volumes of cargo and people are now crossing international borders. This freedom of movement is critical to supporting global trade and growing economies but places border agencies under huge pressure.

In their 2016 Annual Review, the International Air Transport Association (IATA) estimated the value of international trade shipped by air in 2015 was $5,7 trillion. And tourists traveling by air spent over $620 billion (IATA 2016, p. 14). The UN Conference on Trade and Development also estimated that, in 2015, the volume of seaborne trade exceeded 10 billion tons for the first time (UNCTAD 2016).

Each year, containers arrive in the USA through the following means (U.S. Customs and Border Protection 2017):

- 11 million maritime containers arrive at seaports
- 11 million containers arrive at land borders by truck
- 2.7 million containers arrive at land borders by rail

These numbers are staggering and set to increase. Border agencies must ensure that they maintain security, intercept passengers who might be traveling illegally, and also identify illegal or high-risk freight and contraband, even when faced with constrained budgets and increased volumes of travelers and freight arriving at ports every day.

This must be done while honoring stringent data privacy laws and minimizing disruption to legitimate cargo and passengers to ensure a country's ports remain competitive in the global market. According to the IATA, in order to improve competitiveness, the air cargo industry's aim is a 48-hour reduction in average shipping times by 2020 (IATA 2015, p. 40). This means any proactive action taken by agencies must be efficient and not introduce overheads and delays.

This paper looks at the challenges faced by border agencies and shows how the new features in SAS Visual Investigator can help by bringing together disparate data, detecting suspicious activity, presenting analysts with alerts to be triaged, and enabling investigators and intelligence analysts to conduct investigations and make appropriate, data-driven decisions.

BORDER MANAGEMENT: THE CHALLENGES

Each country is responsible for its own border control, and national border agencies face a number of challenges, including the following:

- national security and counter-terrorism
- monitoring and managing immigration
- combating human trafficking and migrant smuggling
- preventing the import and export of contraband including drugs and counterfeit goods.
- ensuring that ports of entry are connected and competitive
- efficient use of resources and public funds
- accurate collection of duties
- compliance with local and international legislation (including privacy laws)

Physical security combined with new processes and legislation are important and can help address these challenges. However, in a world of data, it is incumbent upon border agencies to also use processes and technologies that will ensure that they are pro-active and efficient in identifying and investigating suspicious events and activities.

It is not enough to simply collect data. Organizations must make good use of their data assets to ensure that high-risk passengers and cargo shipments are intercepted without a negative impact on the processing of legitimate passengers and freight at borders.

MAKING USE OF DATA

Many governments have increased their data gathering requirements. For example, airlines operating in some countries must collect and share Advance Passenger Information (API). The same is true for cargo as governments now look for airlines and other transportation industries to provide Advance Cargo Information (ACI).

In addition, border agencies have access to a variety of other data sources, including manifest details, requests for visas and other permits, watch list and sanctions information, sensor data, law enforcement records, intelligence reports, and so on. These huge volumes of data pose a challenge.

Agencies have finite human resources in the form of agents, analysts, and investigators. It is impossible for analysts to manually identify all unusual patterns of activity, bad actors, and other anomalies across this vast quantity of data. However, border agencies can use proactive analysis to identify high-risk cargo or passengers and make all data accessible to analysts and investigators so that they can take prompt action.

The United States Customs and Border Protection summed this up when they acknowledged their need to enhance their ability to collect, analyze, and appropriately share intelligence and information. This includes providing timely warnings of potential threats and proactive enforcement opportunities (U.S. Customs and Border Protection 2016, p. 12).

In addition to the sheer amount of data involved, the data is often stored in disparate silos. Historically analysts and investigators had to run separate queries in multiple isolated systems to find information that might be relevant to a particular individual, shipment, organization, or other item of interest. They would then have to manually examine each piece of seemingly unrelated data in an attempt to identify patterns and anomalies. Visualizing and sharing their findings relies on their ability to manually create a visual representation of the associations between entities or perhaps pin them to a map. Relying on analysts to do this unaided is error-prone and inefficient.

HOW CAN SAS VISUAL INVESTIGATOR HELP?

To make the most of their human assets and ensure that they make prompt decisions backed up by data, border agencies must take a pro-active approach to presenting critical information to analysts and agents. They cannot rely on individuals using time-consuming, manual processes to identify high-risk passengers and cargo shipments or other suspicious activities.

SAS Visual Investigator does the following:

1. delivers a holistic view of all available data.
2. identifies previously concealed relationships and builds social networks around people, organizations, cargo shipments, and other objects.
3. enables the design of surveillance scenarios and rules to identify areas of concern around high-risk or suspicious freight, travelers, or events and automatically alerts analysts and agents.
4. enables efficient, alert triage and disposition.
5. provides analysts with the ability to search multiple internal and external data sources from single application interface.
6. helps analysts and investigators understand and explore their data in different visualizations (for example, on a geospatial map or plotted in chronological order on a timeline).
7. enables agents and analysts to conduct and manage cases and targeted investigations supported by business process and workflow.
8. enables analysts to capture their findings and the output of investigations to support their decisions and actions.
9. supports collaboration within an agency's investigative teams.

We'll look at some of these key capabilities in more detail from the point of view of three different user roles commonly found within a border agency's investigation unit: System Administrator, Analyst, and Investigator.

ACCESSING DISPARATE DATA

Border agencies have access to a lot of data that is found not only in large volumes but often housed in different data stores that need to be accessed by many different systems. For example, separate databases might be used to store advanced passenger/cargo information and intelligence reports. The ability to bring this data together and make it accessible from a single application is built into the very foundations of SAS Visual Investigator.

SAS Visual Investigator focuses on two main categories of data:

- external entities – data that is stored in an external data store but is used by SAS Visual Investigator for surveillance, driving entity resolution and social network building, indexed for search, and made available in all end-user visualization without having to create multiple copies of the data.
- internal entities – objects created, edited, managed, and indexed within SAS Visual Investigator's primary data store. This can include investigations and cases created and edited by agents, analysts, and investigators within the SAS Visual Investigator application. This data can also be used as an input for surveillance, network building, search, and visualizations.

SAS Visual Investigator can also make use of large volumes of transactional data that is not indexed for search but is displayed in specific visualizations. Administrators can use a drag-and-drop interface to design the pages used to display data to the end-users and decide, with the click of a button, which search filters and facets to expose.

As new data sources become available, administrators can simply use the built-in administration

application to configure SAS Visual Investigator to connect to the new data stores.

SURVEILLANCE SCENARIOS

SAS Visual Investigator provides the ability to author surveillance rules and scenarios to identify anomalies or suspicious activity and generate alerts to be triaged and investigated.

Using the visual, point-and-click interface shown below, users can design multiple scenarios and test each one on a sample of their data before publishing to the live system.

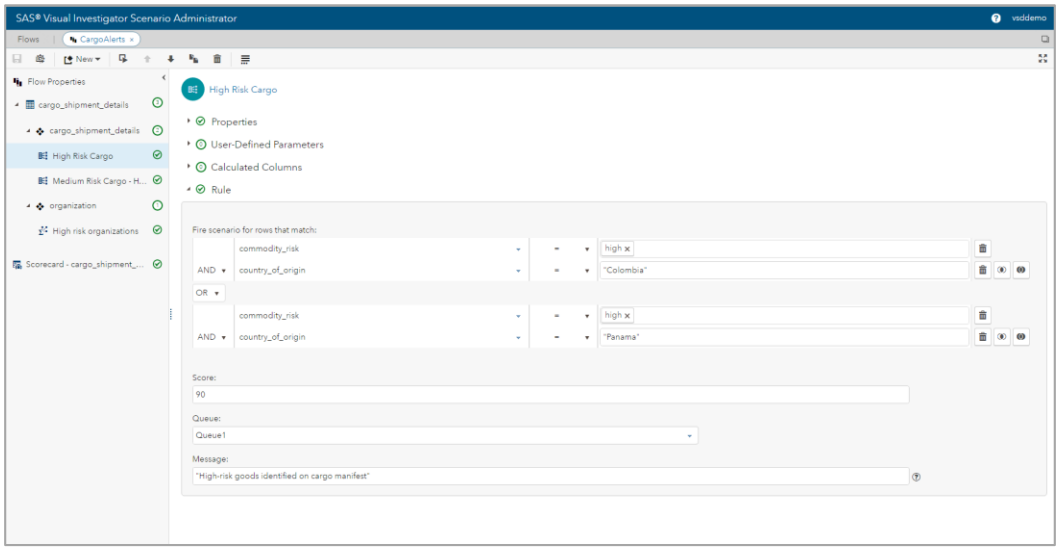

Figure 1. Authoring Surveillance Scenarios within SAS Visual Investigator

Surveillance scenarios assess risk and identify patterns of activity that might otherwise go unnoticed by human analysts. Scenarios can range from simple rules to complex analytical models. The output of the surveillance process is the generation of alerts.

Each alert represents a positive match against defined rules and includes details of exactly which rules were triggered as well as information about the alerted entity or subject of the alert, such as a specific passenger, freight shipment, organization, and so on.

A score is calculated to provide analysts with a clear picture of the risk associated with this event. The scores for each scenario are weighted and rolled up to an overall scorecard for a given alert. This provides analysts with a clear overview of the scenarios and rules that were triggered and ensures that the alert is routed to the correct queues and strategy.

Analysts and agents are assigned to specific strategies, and from here they can view, review, triage, and investigate each alert and take action.

As noted by U.S. Custom and Border Protection, systems must be able to adjust to changes in trade patterns and trends (U.S. Customs and Border Protection 2016, p. 24). SAS Visual Investigator gives agencies ownership and control of their surveillance scenarios. They can respond to changes in their environment by modifying existing scenarios or adding rules based on new information, analyst knowledge, and successful outcomes from previous investigations.

ALERT MANAGEMENT AND TRIAGE

SAS Visual Investigator's alert management process is designed to help analysts and investigators be proactive and take action on the output of an analytical process or surveillance scenario.

Alerts generated as a result of surveillance scenarios are served up to analysts and investigators via queues and strategies. Each strategy within SAS Visual Investigator represents different business problems being tackled by the border agencies. Strategies help organizations allocate specialized resources effectively. For example, separate strategies can be set up for the following:

- suspected counterfeit cargo
- consignment shipped from a high-risk shipping company or port
- cargo identified as high-risk goods from a specific freight company
- high-risk passenger who booked flight within 24 hours of travel and paid cash
- cargo from suppliers with connections to organizations or individuals on sanctions watch lists

As shown below, when analysts log on to SAS Visual Investigator, they are presented with an overview of the work allocated to them, and they can review the alerts in each strategy they have been assigned. They might be responsible for monitoring and working multiple strategies or focus on one specific area of risk.

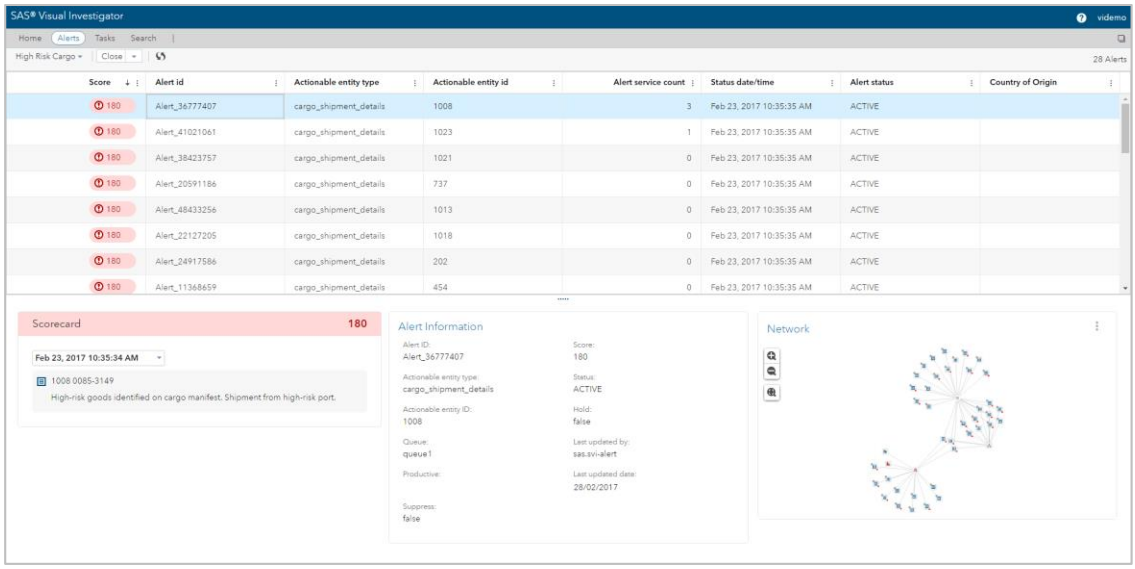

Figure 2. Alert Triage within SAS Visual Investigator

Within each strategy, an organization can define a number of different queues to represent the priority of the alerts. The score calculated by the surveillance process is clearly visible to the analysts as an indication of the severity and associated risk. This is combined with a detailed scorecard, an overview of all triggered surveillance rules, the history of the alert, and details of the associated entity to help analysts establish a clear picture of an event, threat, or emerging situation.

From the alert triage screens, analysts can review key information about each alert before using SAS Visual Investigator's rich visualizations to further understand the context of the alert and deciding which disposition action to apply. For example, they might delve into the associated social network or view a timeline of events before deciding to close the alert, suppress the alert or escalate to a case for further investigation. The available disposition actions will depend on an organization's specific process as they can be configured and extended by administrators.

In addition to alerts being generated with SAS Visual Investigator through the use of pre-defined surveillance rules, analysts might also raise manual alerts on other entities, such as people, vessels, aircraft, shipping companies, and so on that they identify as high-risk or suspicious during the course of their investigation.

SEARCH, DISCOVERY, AND EXPLORATION

While system-driven surveillance and alerting is critical to ensuring suspicious events and anomalies are identified and quickly sent to analysts for action, it is also essential that analysts and investigators have the ability to follow their own hypotheses and lines of inquiry (for example, responding to an ad hoc request or tip from a partner agency).

The search and discovery functionality within SAS Visual Investigator supports the alert triage process as well as the user-driven research and investigations.

Powerful free-text and geospatial search capabilities enable analysts to search across all internal and external data sources. Search results are returned in order of relevance, and filters and facets can be used to refine the list of results as shown below.

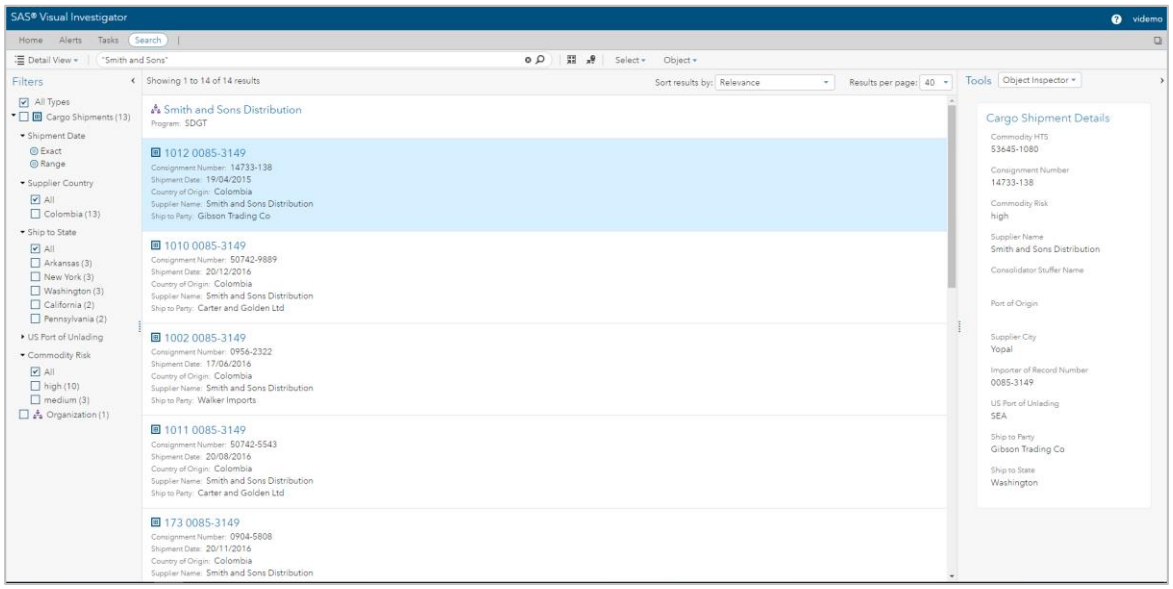

Figure 3. Visualizing Search Results within SAS Visual Investigator

Analysts can display their search results on a map view to display the geospatial data associated with their results set as shown below. From the map view, they can also initiate a search that combines free-text search criteria with one or more geospatial search areas.

At any time, the analysts can select specific entities of interest to be added to workspaces within alerts, investigations, or cases for further analysis at a later date, or to explore the data using additional investigative tools such as the network or timeline views.

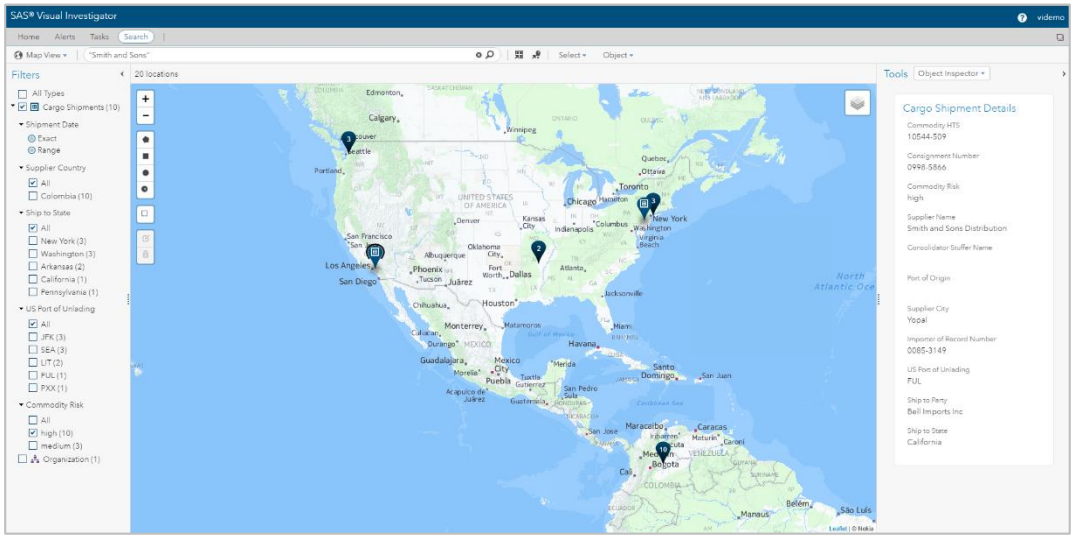

Figure 4. Exploring Geospatial Data within SAS Visual Investigator

ENTITY AND NETWORK ANALYTICS

SAS Visual Investigator uses configurable network building and entity resolution rules to automatically generate social networks based on internal and external data sources. This results in the creation of unique entities that represent real-world objects and their relationships, for example, people, addresses, organizations, telephone numbers, aircraft, and vessels. Entity resolution provides a comprehensive, 360-degree view of all information about a given freight shipment or passenger.

In addition to entity resolution, specific relationships might also be explicitly defined in the data (for example, associations based on a common ID such as a consignment number).

Regardless of how relationships are created, it is the network view, within SAS Visual Investigator that provides analysts with the ability to explore the social networks. Users can add entities to a network view and expand multiple levels of links to bring more related objects onto the canvas and identify commonality across multiple pieces of data.

Often it is the shape of the network that is important, and analysts can adjust the layout as needed. As shown below, data-driven node decorators automatically draw attention to important information within the network (for example, if an individual has previously been denied entry to the country or if a cargo shipment lists restricted or high-risk goods on its manifest). Having this information proactively presented on the network chart means that the analyst doesn't have to open each individual entity to find the most pertinent information.

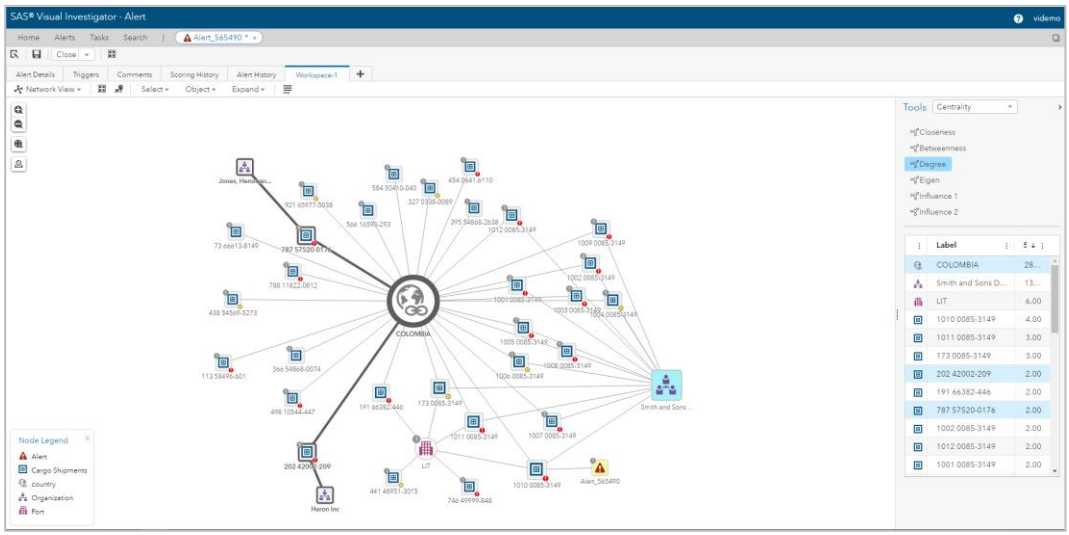

Figure 5. Exploring Social Networks within SAS Visual Investigator

Analysts can apply network analytics to their network view in the form of centrality measures to highlight entities of influence or entities most closely linked, or to highlight the shortest path between two nodes in a network.

To help explain a pattern or area of interest within the network, analysts can annotate the view by doing the following:

- changing the node color, icon, and size of nodes
- altering the style of the line used to represent the links
- adding custom nodes and links
- grouping nodes

SAS Visual investigator also provides the ability for analysts to visualize further interactions between two parties by overlaying the social network view with a transactional data flow. The transactions between two

parties might represent financial transactions or other exchanges between two parties such as emails, telephone calls, or the flow of freight between shipping company and the buyer or ship-to party.

CASE AND INVESTIGATION MANAGEMENT

After the initial alert triage is processed, it might be necessary to conduct further detailed research and investigation on the subject of the alert. Similarly, an analyst or investigator might need to start a case or carry out research based on an ad hoc request or tip from within the organization or received from a partner agency.

During the course of their research, analysts and investigators might follow a different number of leads. However, this is always underpinned by business processes and guidelines. For example, after carrying out initial research, an investigator might need to escalate a specific inquiry to a specialist group of agents who focus on the illegal import of pharmaceutical drugs or counterfeit goods. Being able to package their research, notes, and findings before sending to the appropriate users or teams helps to ensure efficiency while removing the possibility of anything being missed.

SAS Visual Investigator supports case management through the configuration of case and investigation entities that capture details of the work being done and follow a defined workflow that represents the border agencies' own business processes. Workflows might be used to send cases for review, rework, or approval, and to support collaboration between analysts and investigation teams. They can be modeled in a way to ensure border agencies capture institutional experience to guide new or inexperienced agents, analysts, and investigators through the steps required when conducting an investigation or carrying out case work.

Underpinned by workflow, case and investigation entities within SAS Visual Investigator act as work areas in which investigators can do the following:

- gather and explore data in multiple workspace and different visualizations
- add notes and comments
- attach supporting files such as documents, images, and videos
- create Insights reports, as shown below, to record their findings and build an intelligence picture to ratify decisions

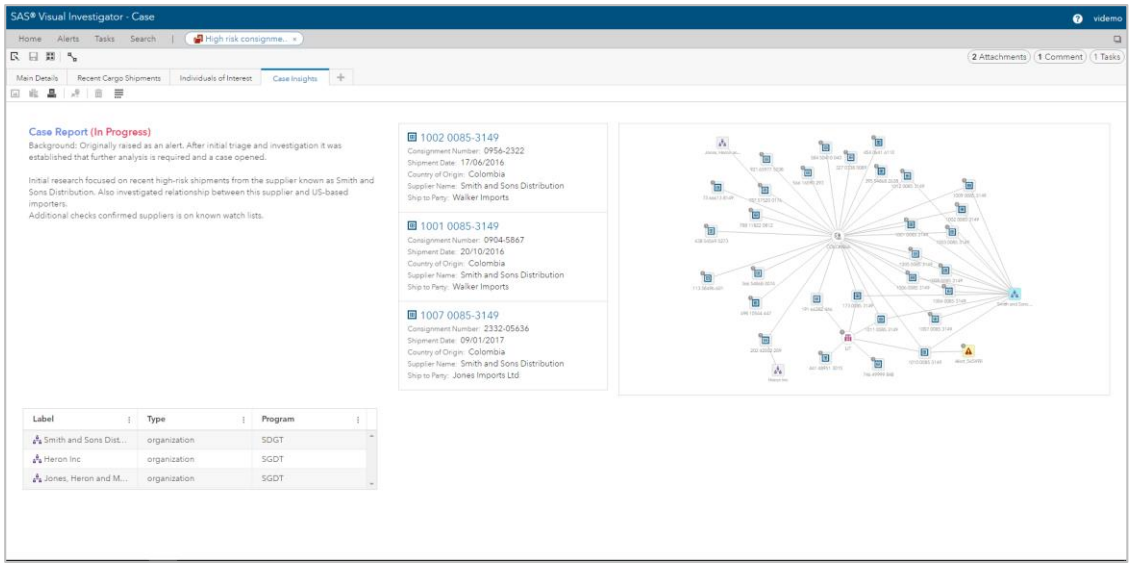

Figure 6. Managing Cases in SAS Visual Investigator

The entities and workflows that support case management can be easily updated by administrators on an ongoing basis to allow border agencies to adapt to changes in process and legislation.

CONCLUSION

Working with silos of information that are difficult for border agents and analysts to access is not suitable for the modern era of border management and international trade. It is imperative that national border agencies empower their analysts through the use of data, risk-based analysis, proactive surveillance and alerting, data exploration, and case and investigation management.

SAS Visual Investigator offers these capabilities through a single-application interface, increasing efficiency, supporting targeting investigations, and enabling agents and analysts to make prompt and informed decisions.

REFERENCES

International Air Transport Association (IATA). 2015. "Annual Review 2015." http://www.iata.org/about/Documents/iata-annual-review-2015.pdf.

International Air Transport Association (IATA). 2016. "Annual Review 2016." http://www.iata.org/publications/Documents/iata-annual-review-2016.pdf.

United Nations Conference on Trade and Development (UNCTAD). 2016. "Seaborne Trade 2015 Infographic." http://unctadstat.unctad.org/EN/Infographics.html#&gid=2016&pid=Seaborne%20trade%20in%202015.

U.S. Customs and Border Protection. 2016. "Strategic Plan: Vision and Strategy 2020." https://www.cbp.gov/sites/default/files/documents/CBP-Vision-Strategy-2020.pdf.

U.S. Customs and Border Protection. 2017. "Cargo Security and Examinations." Accessed January 19, 2017. https://www.cbp.gov/border-security/ports-entry/cargo-security.

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Susan Trueman
SAS Institute Inc.
480 Argyle Street
Glasgow, G2 8NH, United Kingdom
+44 (0)141 223 9100
susan.trueman@sas.com