



US 20190095830A1

(19) **United States**

(12) **Patent Application Publication**  
**Epstein et al.**

(10) **Pub. No.: US 2019/0095830 A1**

(43) **Pub. Date: Mar. 28, 2019**

(54) **SYSTEMS AND METHODS FOR  
INVESTIGATING AND EVALUATING  
FINANCIAL CRIME AND  
SANCTIONS-RELATED RISKS**

(71) Applicant: **INTEGER, LLC**, Santa Monica, CA  
(US)

(72) Inventors: **Matthew Epstein**, Santa Monica, CA  
(US); **Benjamin Schmidt**, Santa  
Monica, CA (US)

(21) Appl. No.: **16/104,706**

(22) Filed: **Aug. 17, 2018**

**Related U.S. Application Data**

(63) Continuation of application No. 15/713,260, filed on  
Sep. 22, 2017, now Pat. No. 10,127,511.

**Publication Classification**

(51) **Int. Cl.**  
**G06Q 10/06** (2012.01)  
**G06Q 30/02** (2012.01)  
**G06Q 30/00** (2012.01)  
**G06Q 40/08** (2012.01)  
**G06Q 50/26** (2012.01)  
**G06F 17/30** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **G06Q 10/0635** (2013.01); **G06Q 30/02**  
(2013.01); **G06Q 30/018** (2013.01); **G06F**  
**17/3053** (2013.01); **G06Q 50/265** (2013.01);  
**G06F 17/30958** (2013.01); **G06Q 40/08**  
(2013.01)

(57) **ABSTRACT**

A research, analysis, regulatory compliance and media platform that connects customers to finished research and analysis produced by subject matter experts is described. The platform facilitates research, investigations, and analysis by creating a single environment in which a group of distributed analysts conduct research and investigations, store and retrieve documents and other sources, collaborate, and publish findings. Consumers are able to query a published knowledge graph, surface high value relationships, and access insights captured by analyst through a customer web portal or external production environment. The platform allows analysts and customers to research and map the commercial, financial, and facilitation networks of sanctioned or other actors that may be associated with illicit activity. Customers can access visual graphs depicting relationships between sanctioned and non-sanctioned actors in order to evaluate their possible exposure to financial crime or sanctions-related risks.

605 RED: INDIVIDUALS AND ENTITIES THAT APPEAR ON THE US  
SANCTIONS LIST, TO INCLUDE THE SDN, SSI, AND ISA LISTS

DARK GREY: INDIVIDUALS AND ENTITIES THAT APPEARED  
ON THE US SANCTIONS LIST AND WERE SUBSEQUENTLY  
REMOVED FROM THE US SANCTIONS LIST

BLUE: PERSONS THAT DO NOT APPEAR ON THE US  
SANCTIONS LIST

PURPLE: ENTITIES, INCLUDING COMPANIES,  
ORGANIZATIONS, CHARITIES, AND GOVERNMENT BODIES  
THAT DO NOT APPEAR ON THE US SANCTIONS LIST

GREEN: CONTACT INFORMATION, INCLUDING ADDRESSES  
AND PHONE NUMBERS

LIGHT GREY: EVENTS AND ACTIVITIES, INCLUDING  
MEETINGS, CONFERENCES, ATTACKS, AND FINANCIAL  
TRANSACTIONS

ORANGE: LITIGATION, REGULATION, AND ENFORCEMENT  
ACTIONS, INCLUDING CRIMINAL CASES, ARRESTS, AND  
INVESTIGATIONS

PINK: ACCOUNTS AND PUBLICATIONS, INCLUDING BANK  
ACCOUNTS, SOCIAL MEDIA ACCOUNTS, WEB DOMAINS,  
BLOGS, AND SOCIAL MEDIA POSTS

610  SANCTIONED PERSON

 SANCTIONED ENTITY

 DELISTED ENTITY

 PERSON

 ENTITY

 CONTACT INFORMATION

 EVENTS & ACTIVITIES

 LITIGATION, REGULATION, &  
ENFORCEMENT ACTIONS

 ACCOUNTS & PUBLICATIONS

600

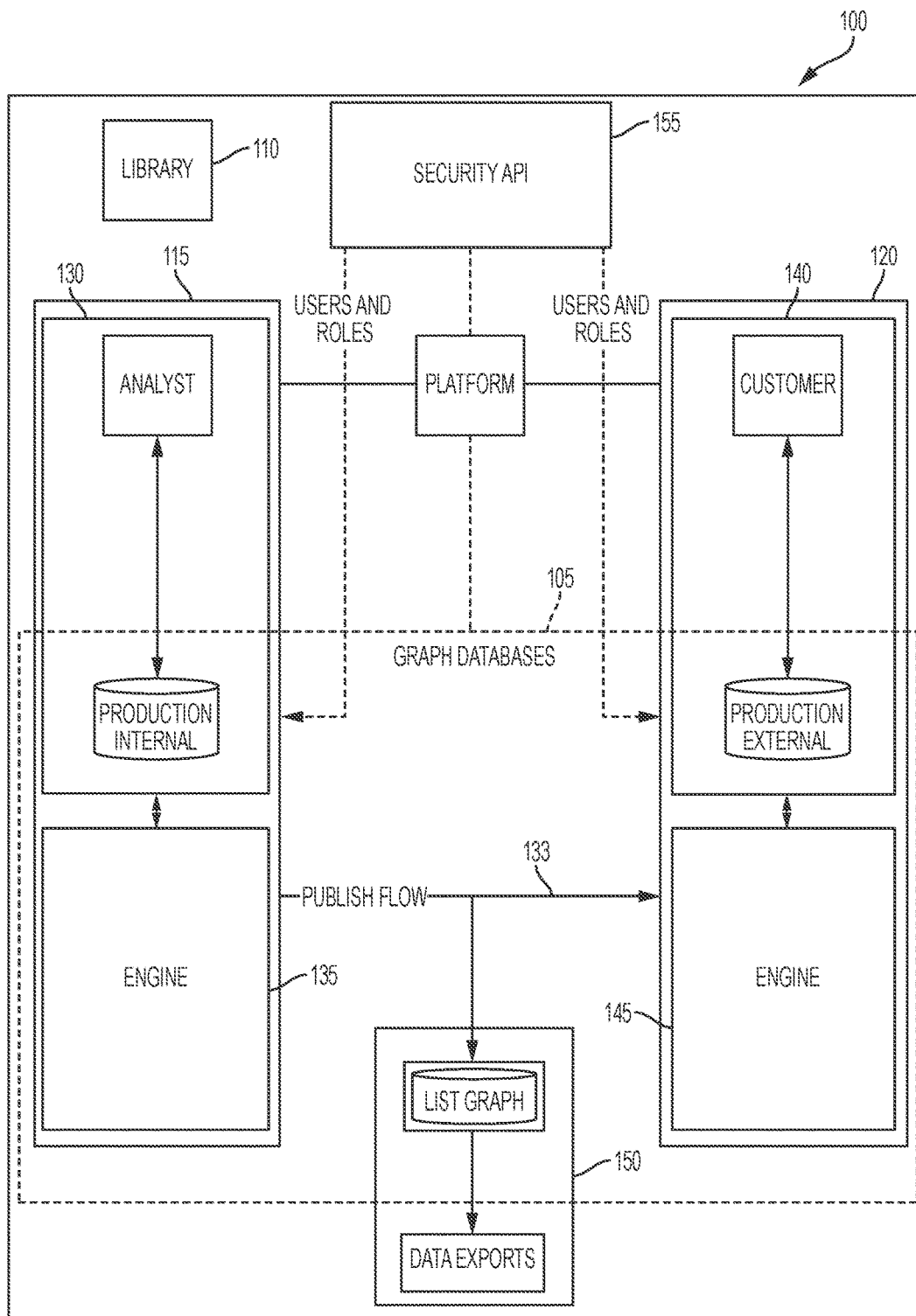


FIG. 1

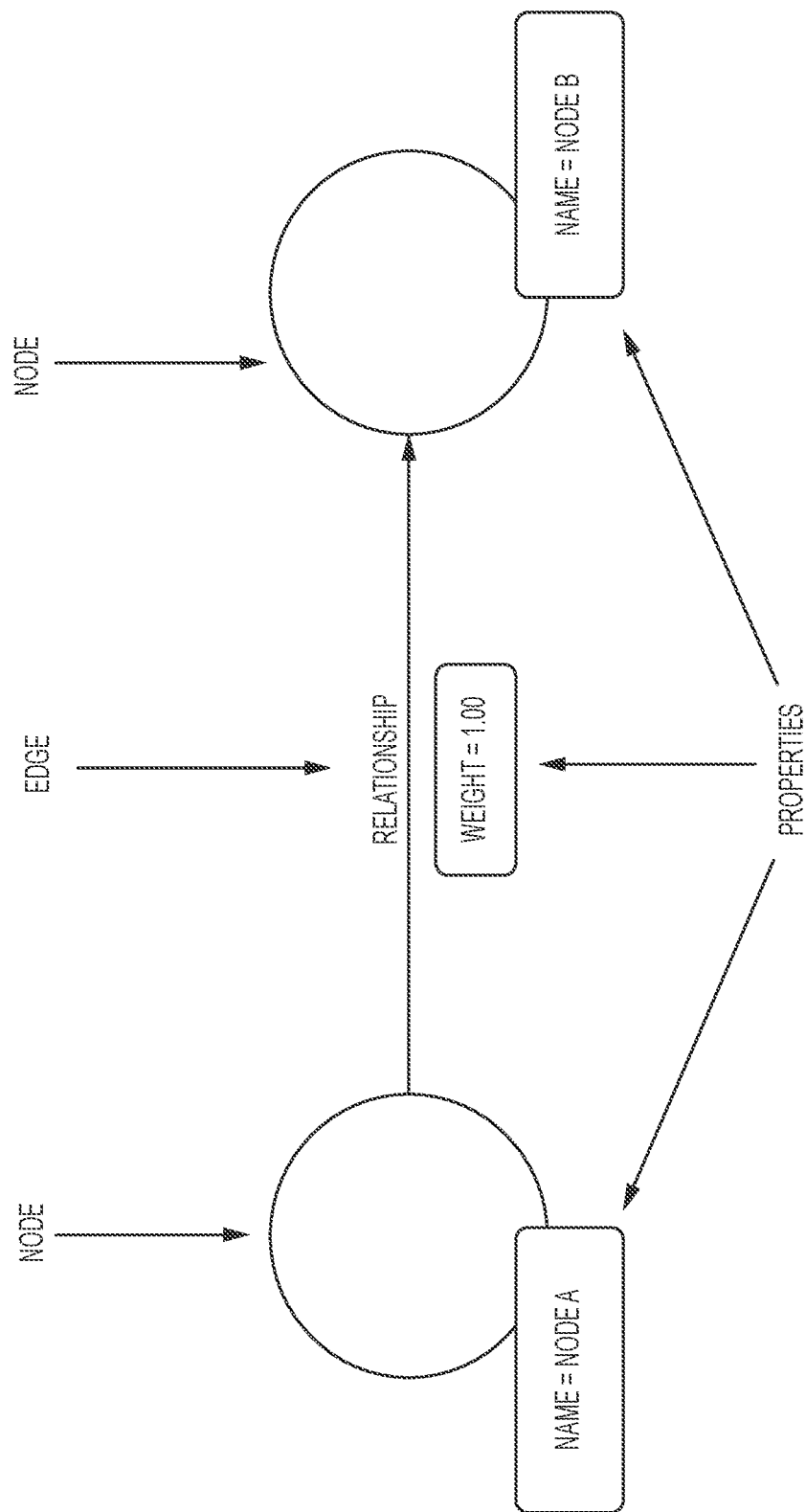


FIG. 2

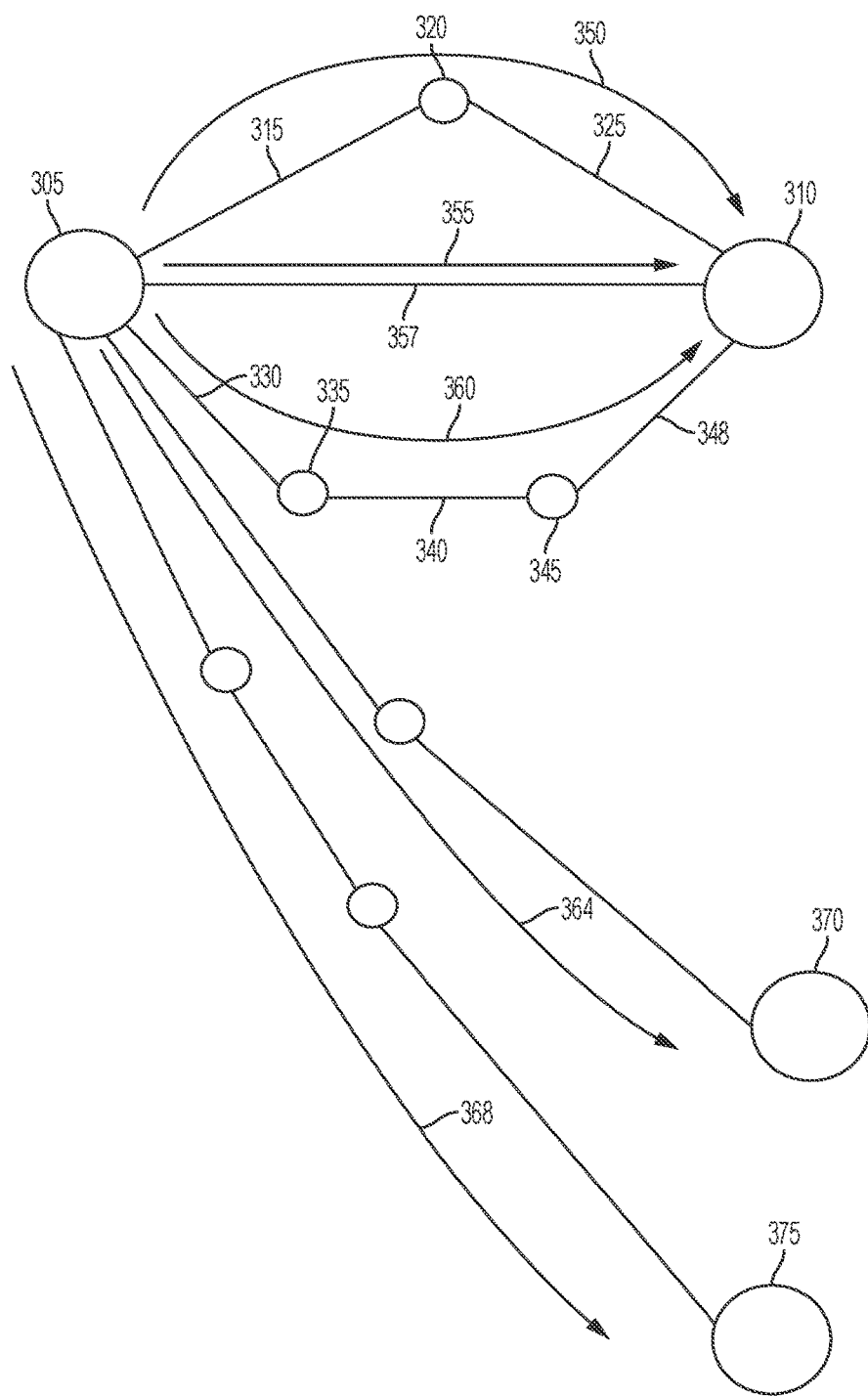


FIG. 3

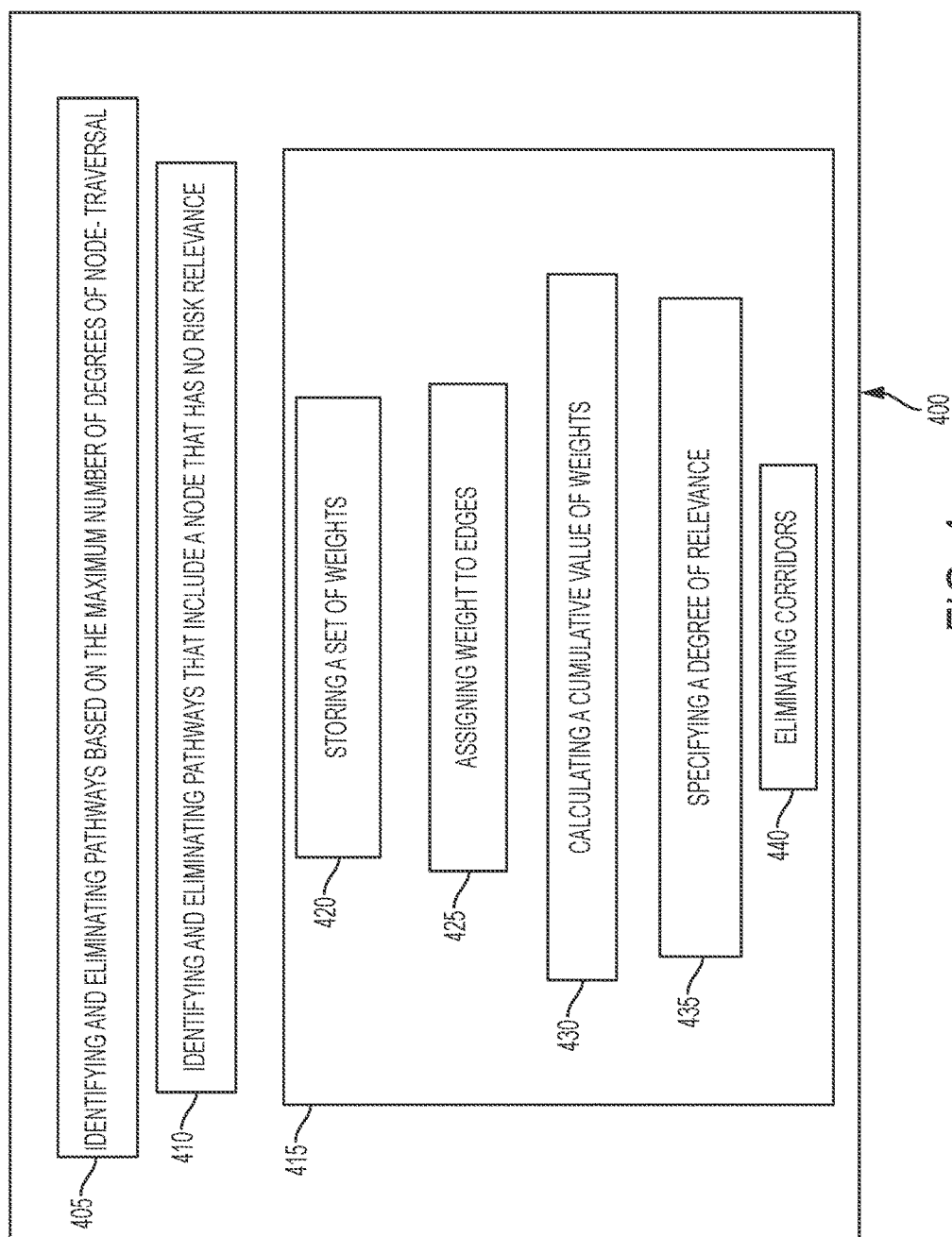


FIG. 4

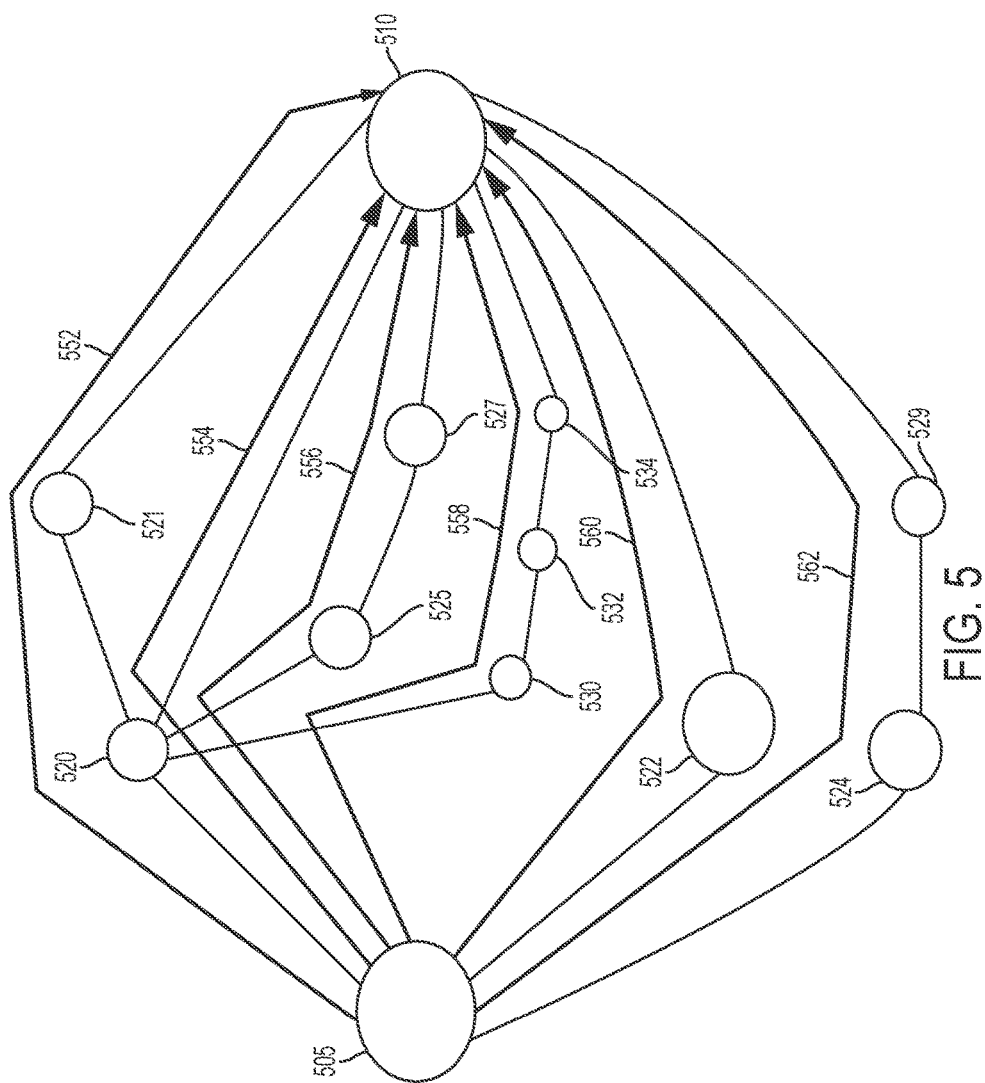




FIG. 6

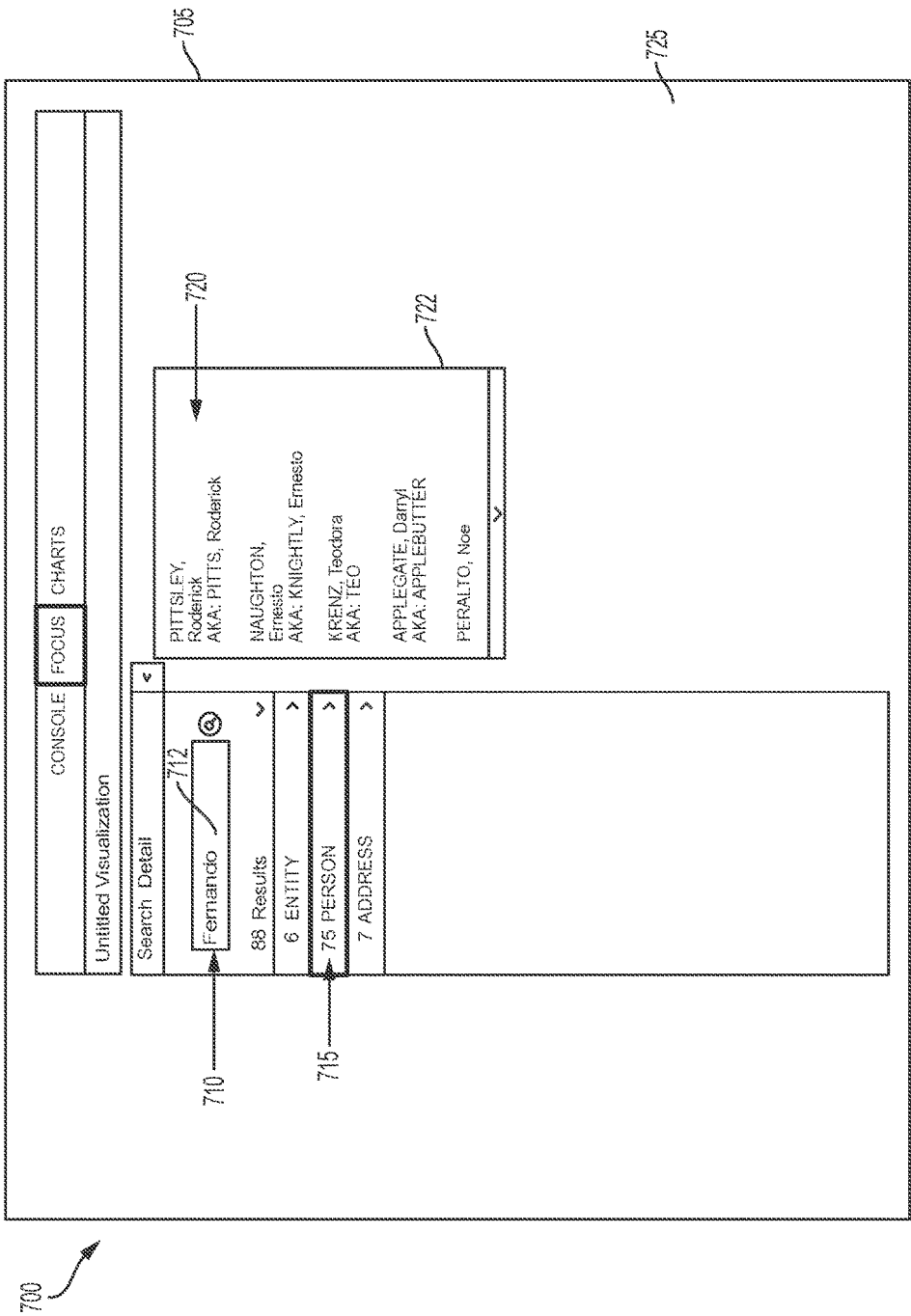


FIG. 7



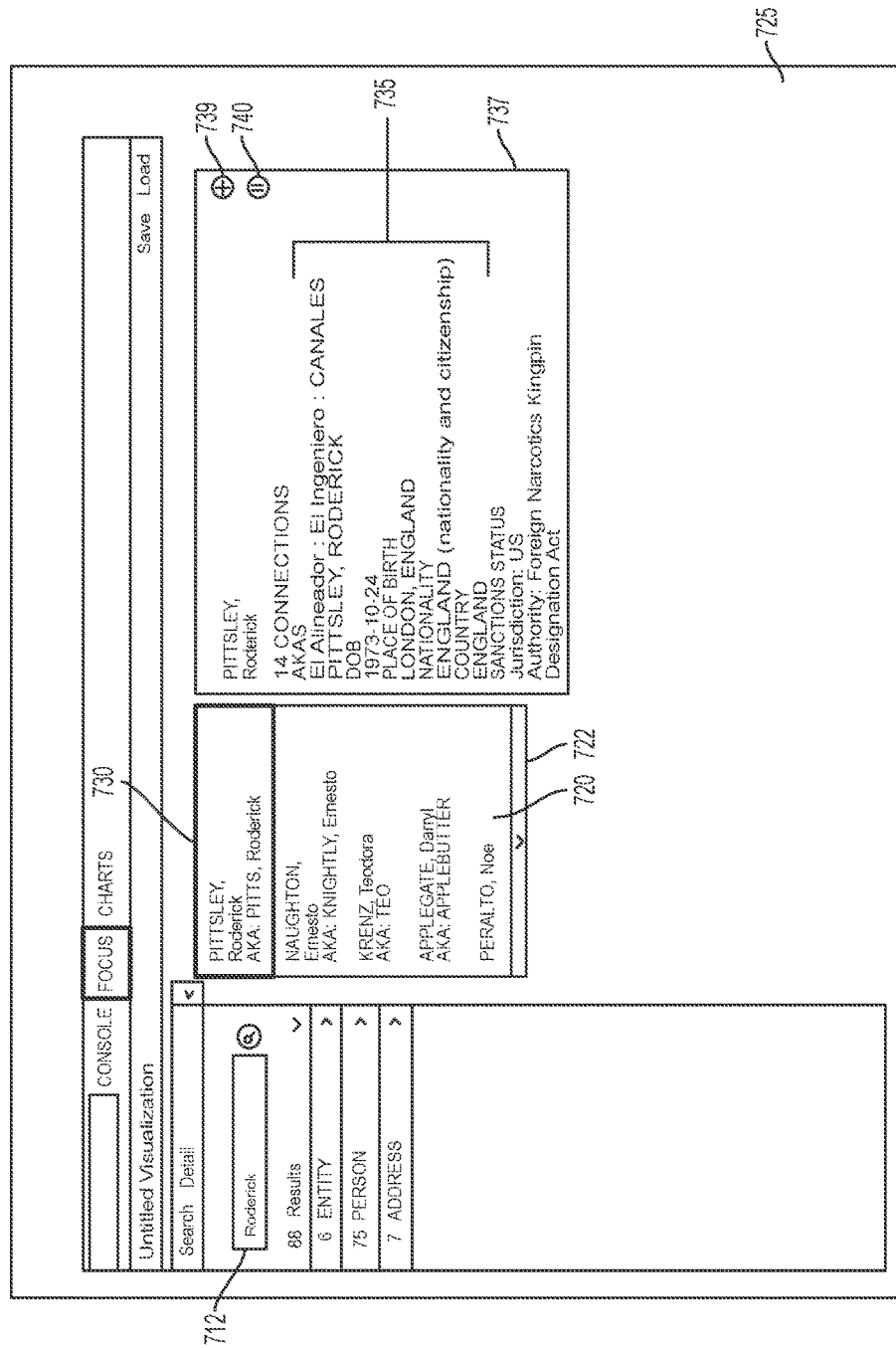


FIG. 8

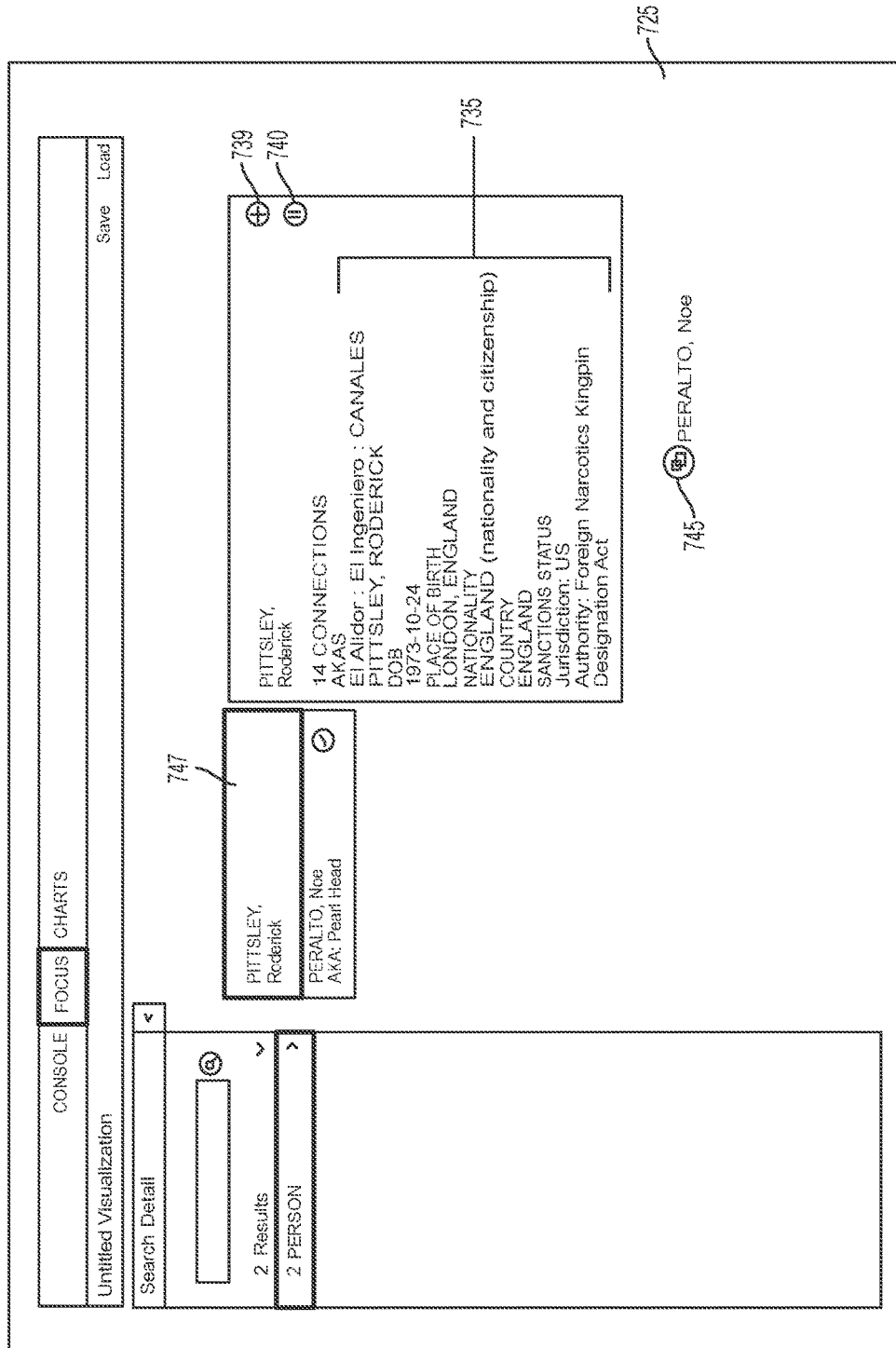


FIG. 9

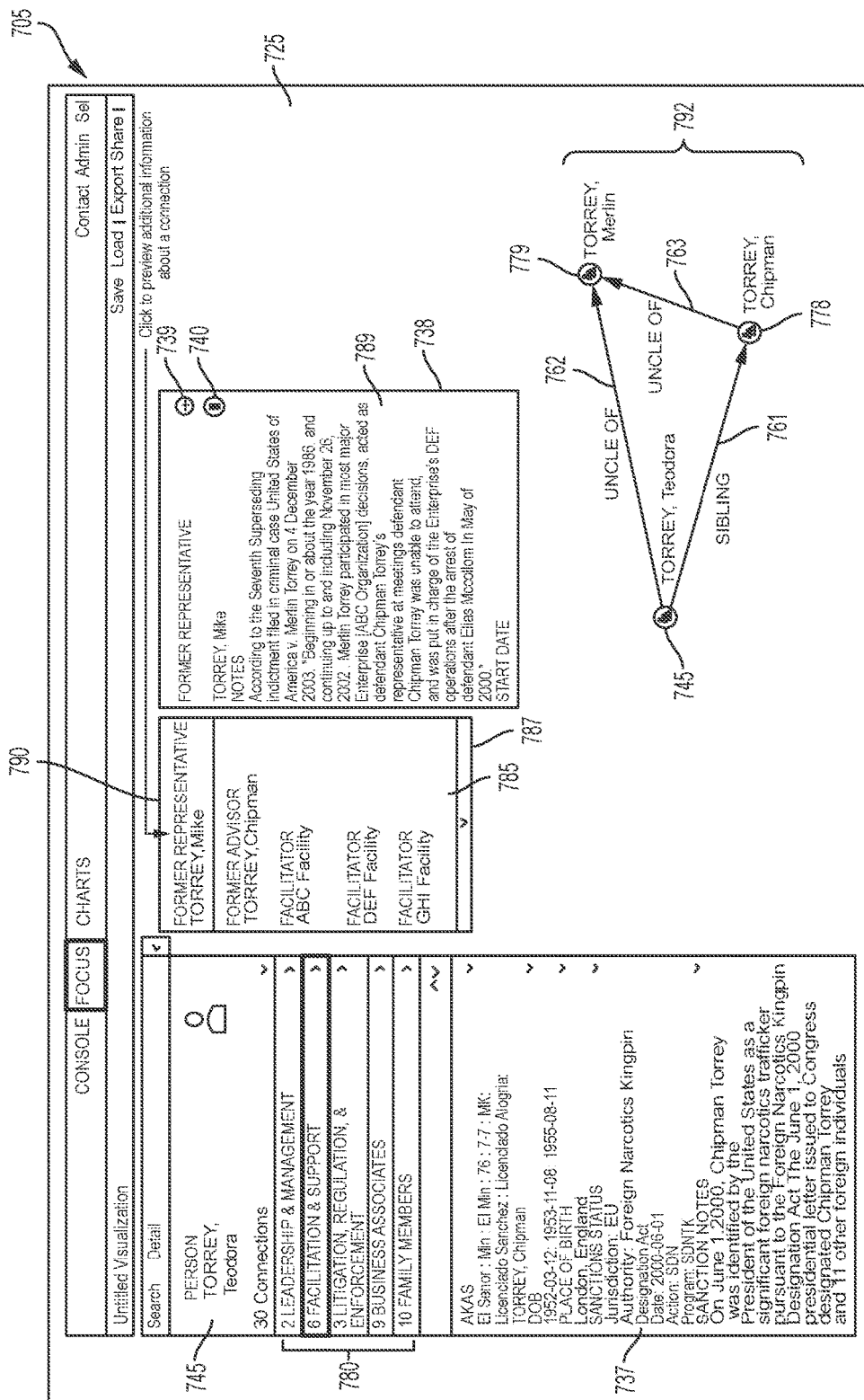


FIG. 10

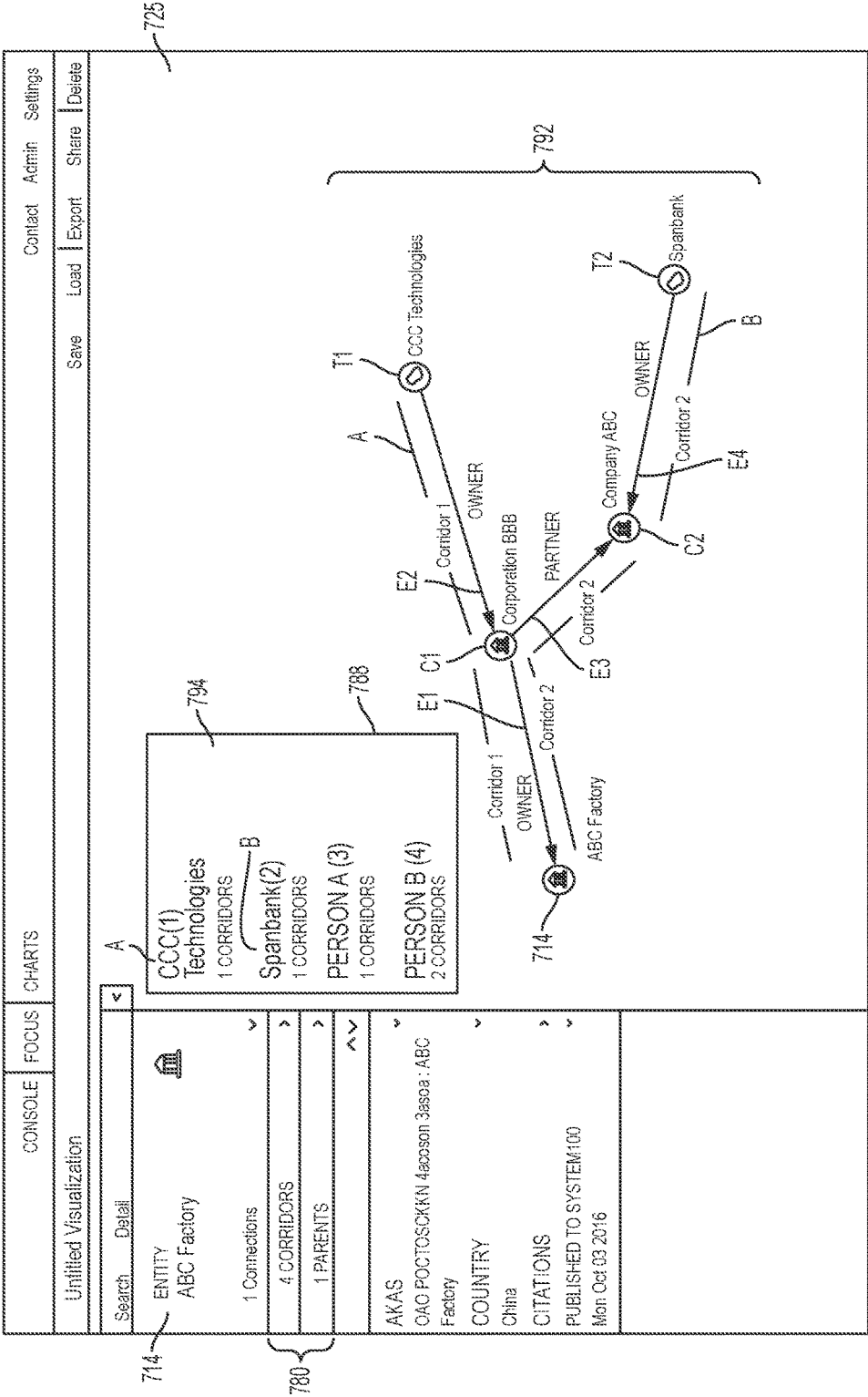


FIG. 11

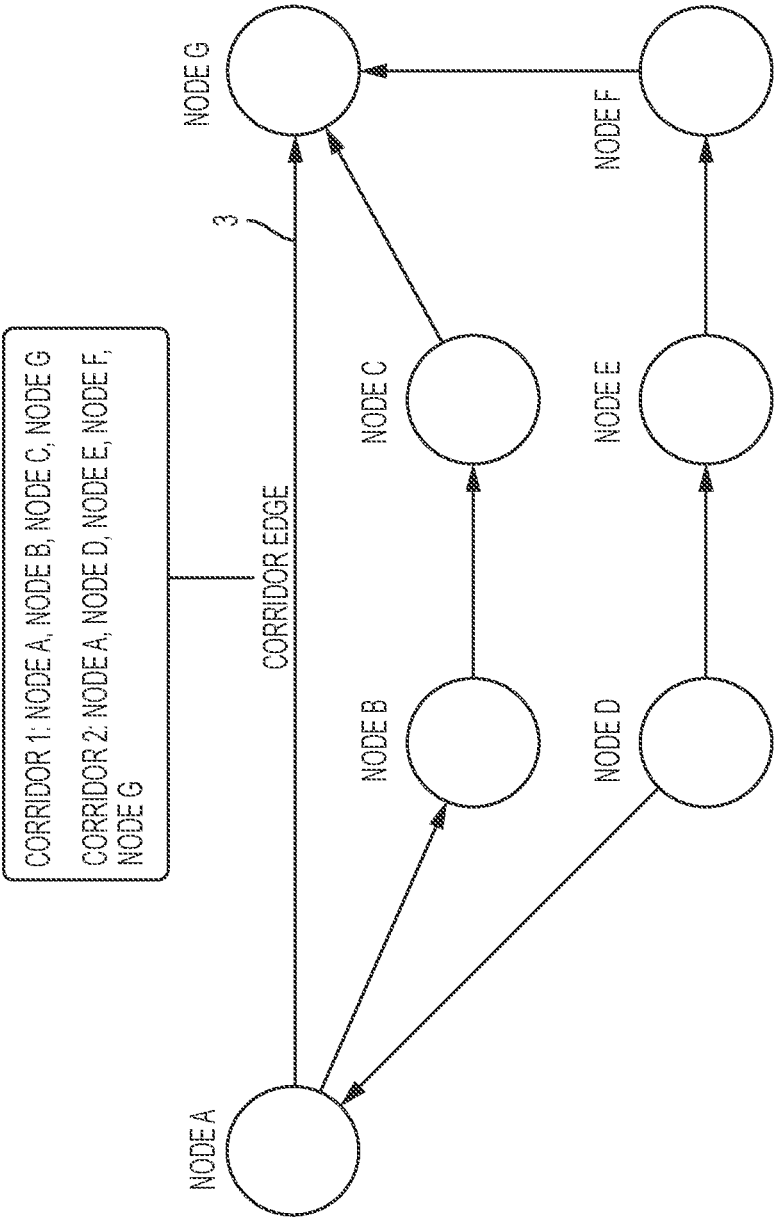


FIG. 12

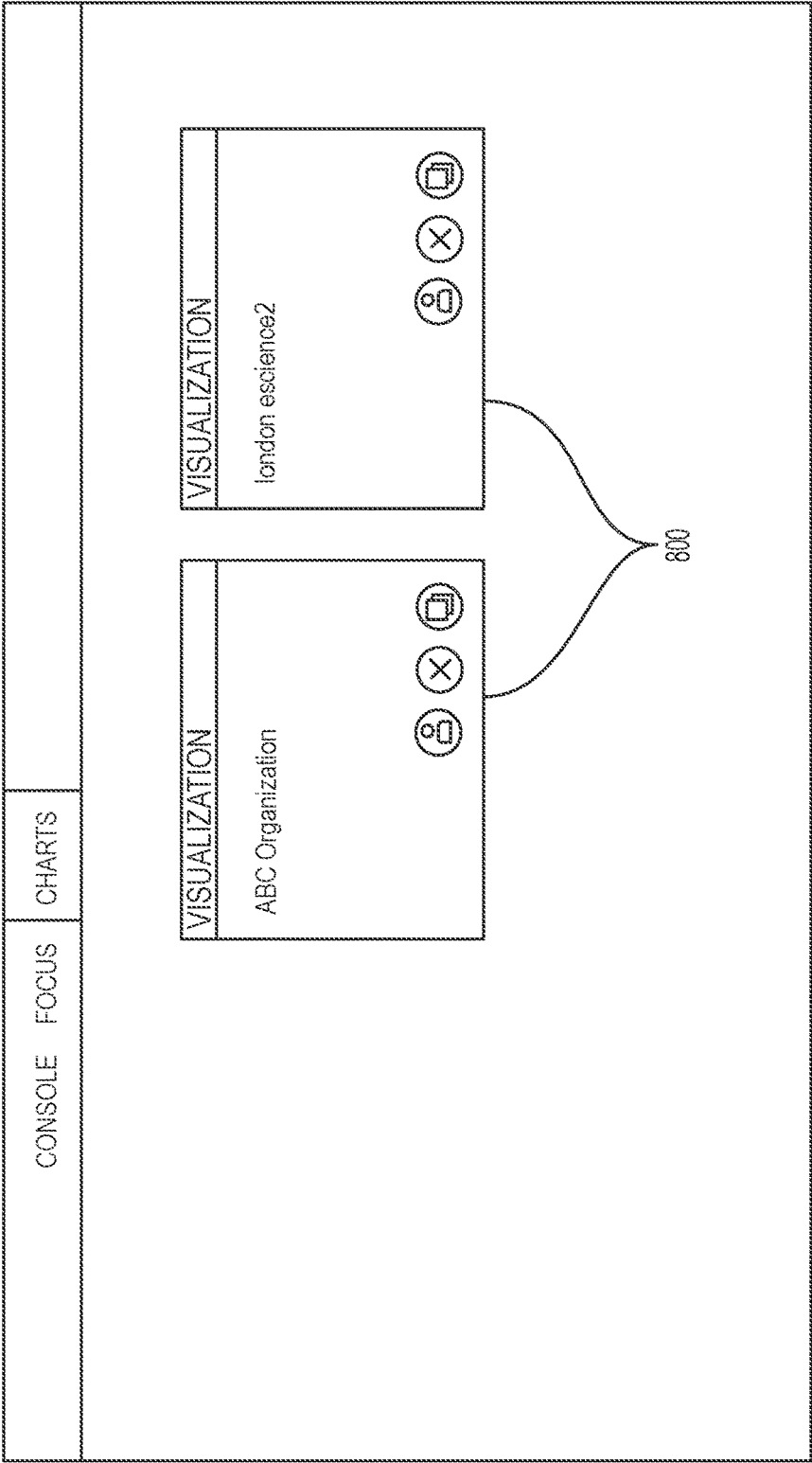


FIG. 13

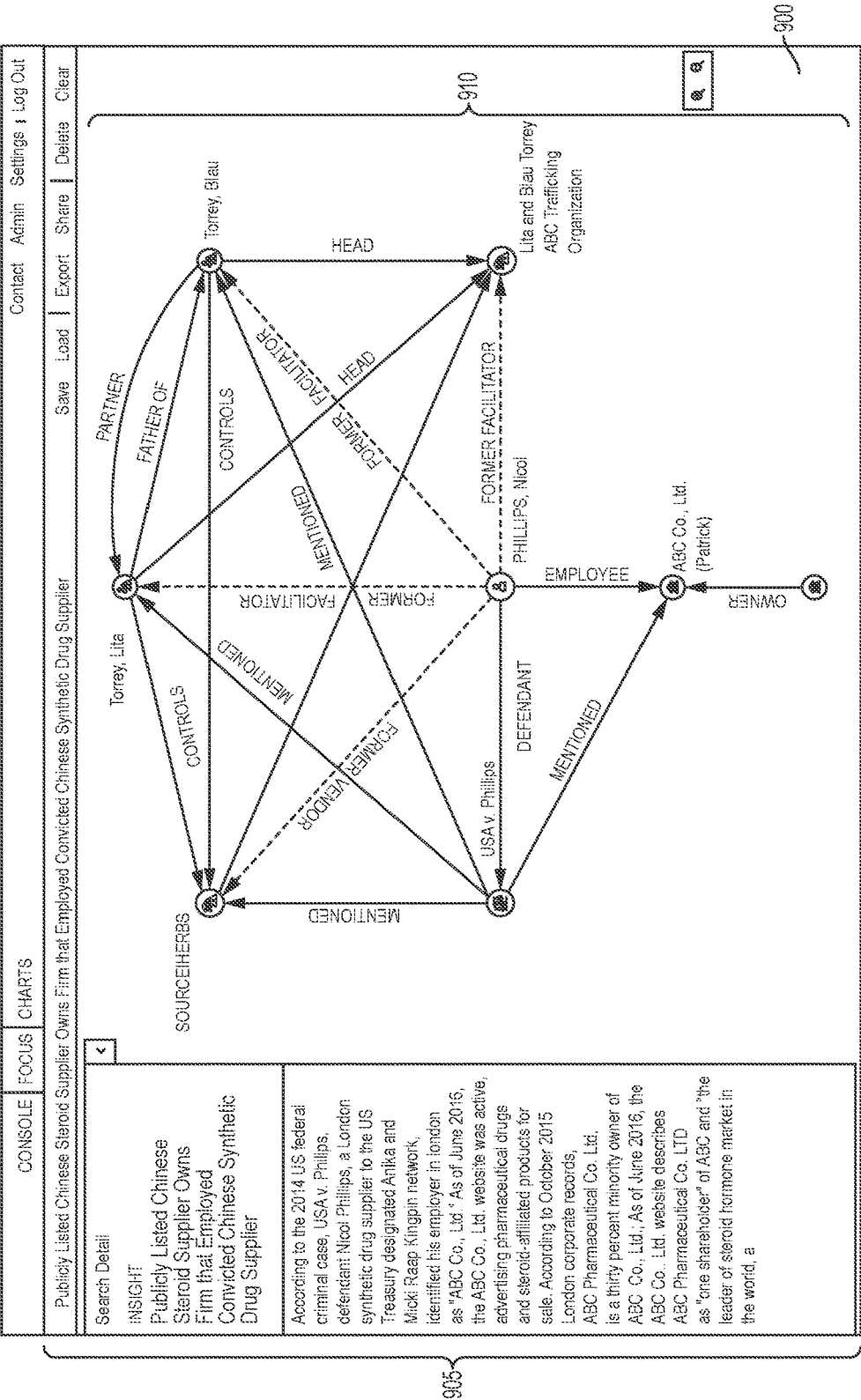


FIG. 14A

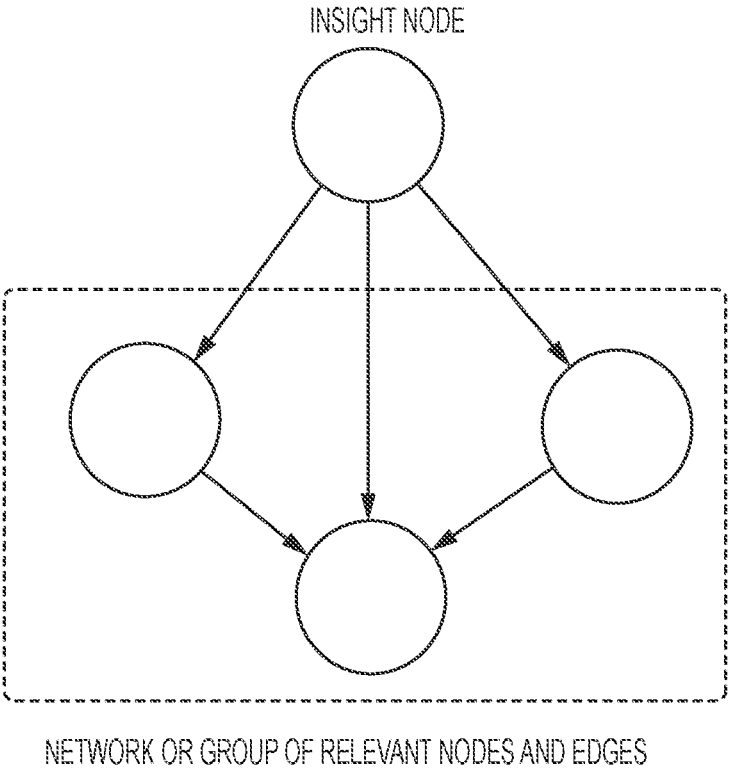


FIG. 14B



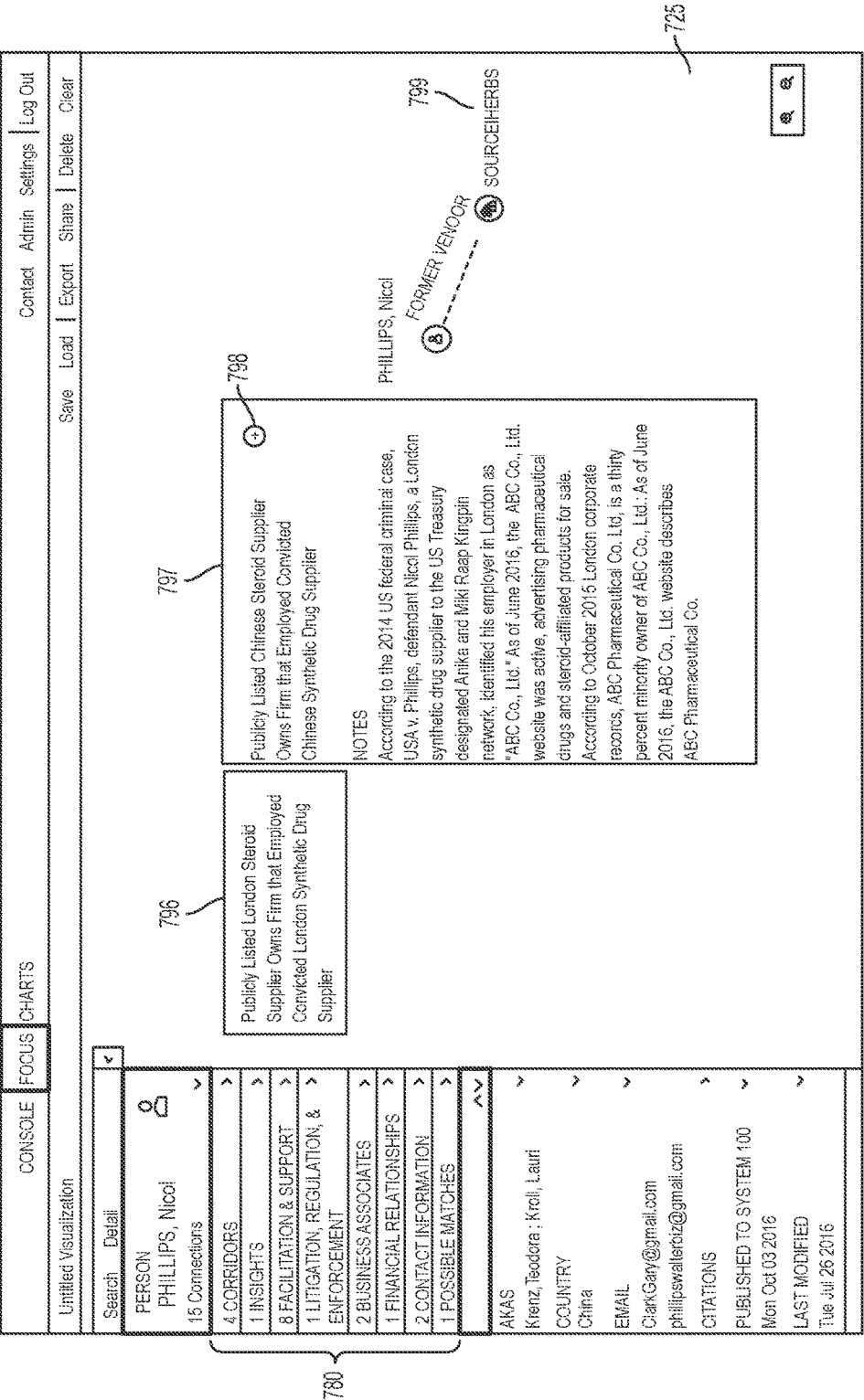
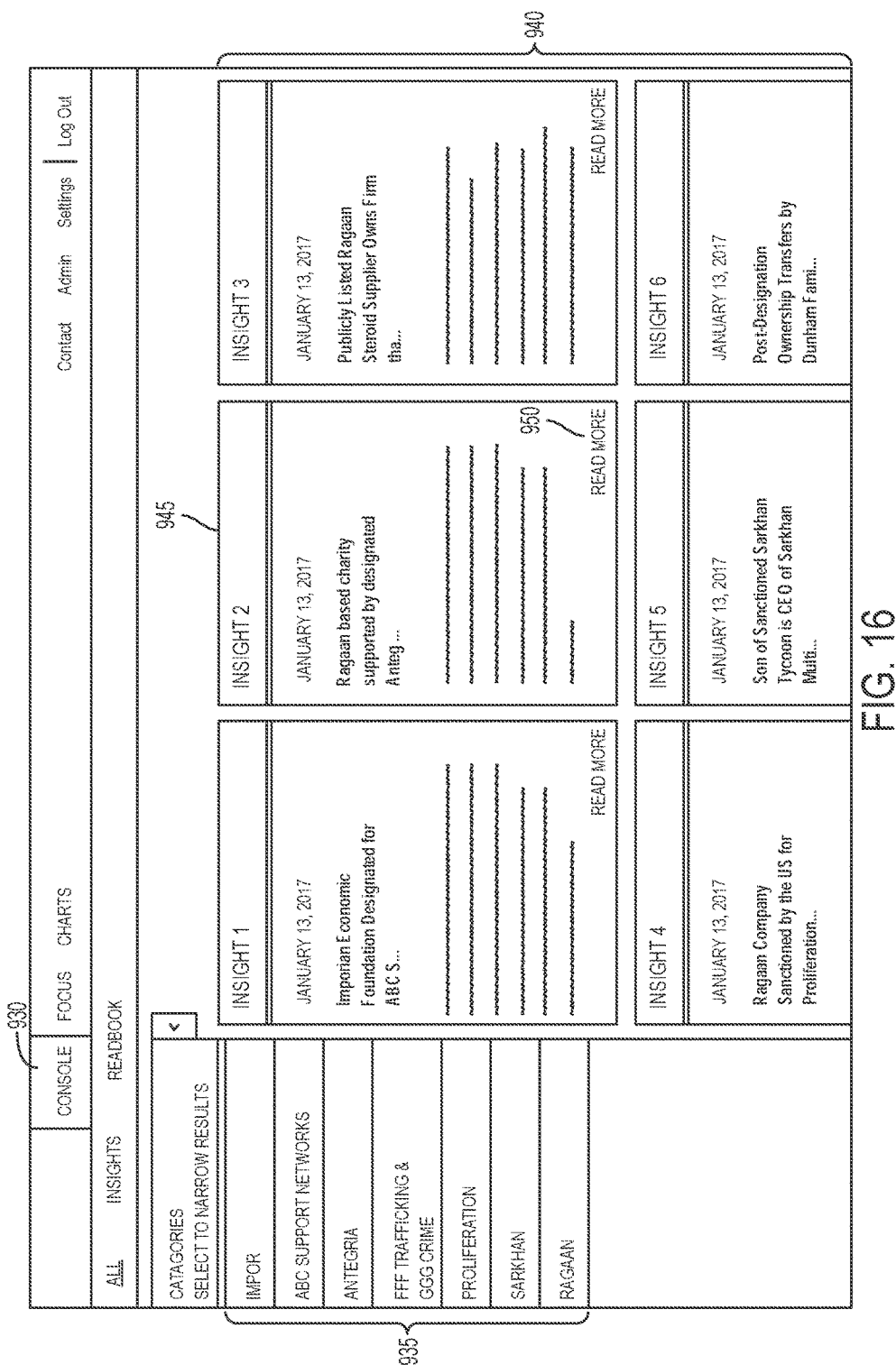


FIG. 15



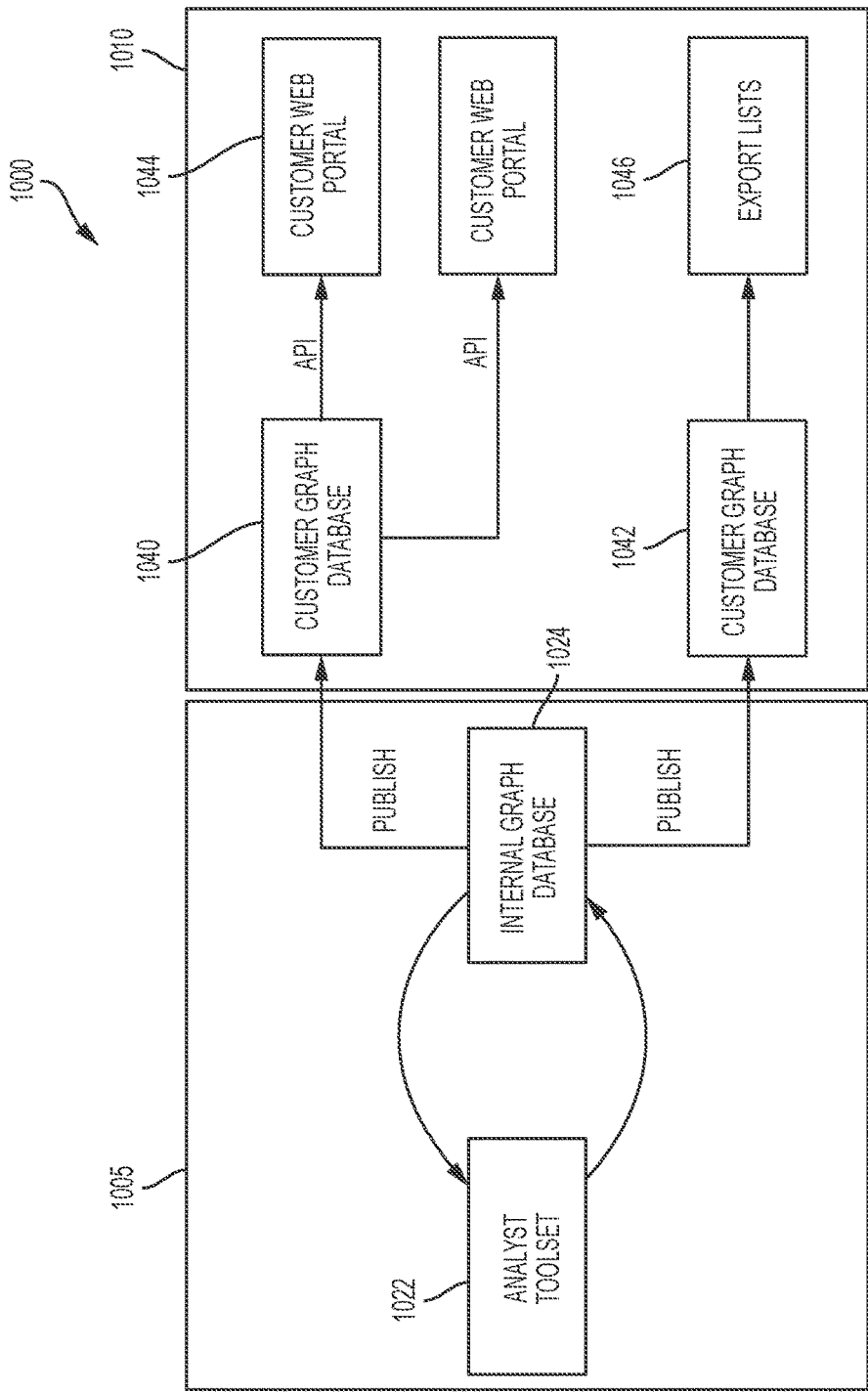
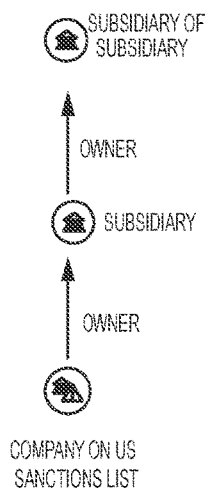


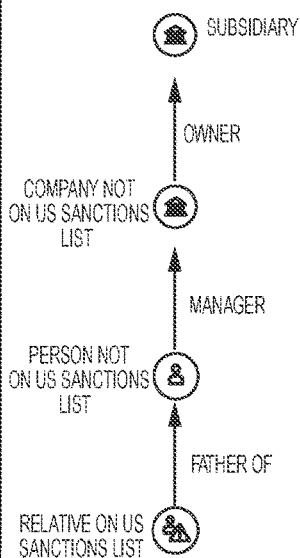
FIG. 17

# CORRIDOR EXAMPLES:

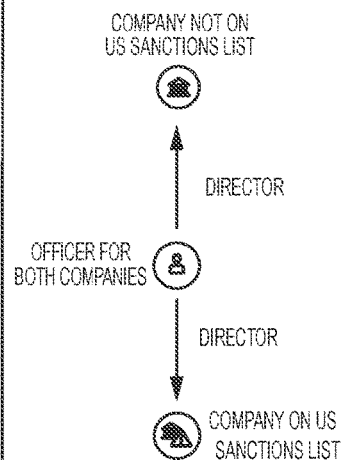
## OWNERSHIP STRUCTURES & SUBSIDIARIES



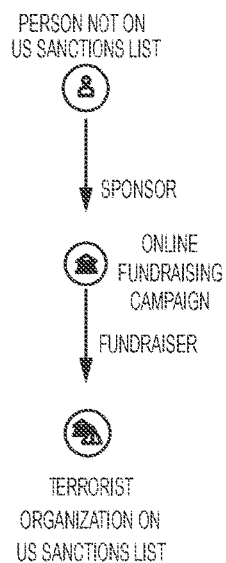
## FAMILY MEMBERS & AFFILIATED COMPANIES



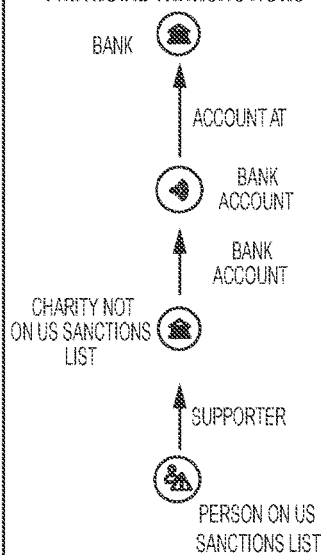
## ENTITIES WITH A SHARED DIRECTOR



## FINANCIERS & FUNDRAISING CAMPAIGNS



## BANK ACCOUNTS & FINANCIAL TRANSACTIONS



## ENTITIES WITH A SHARED ADDRESS

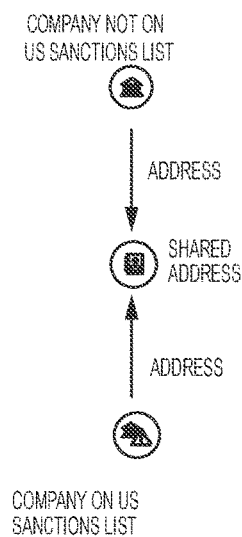
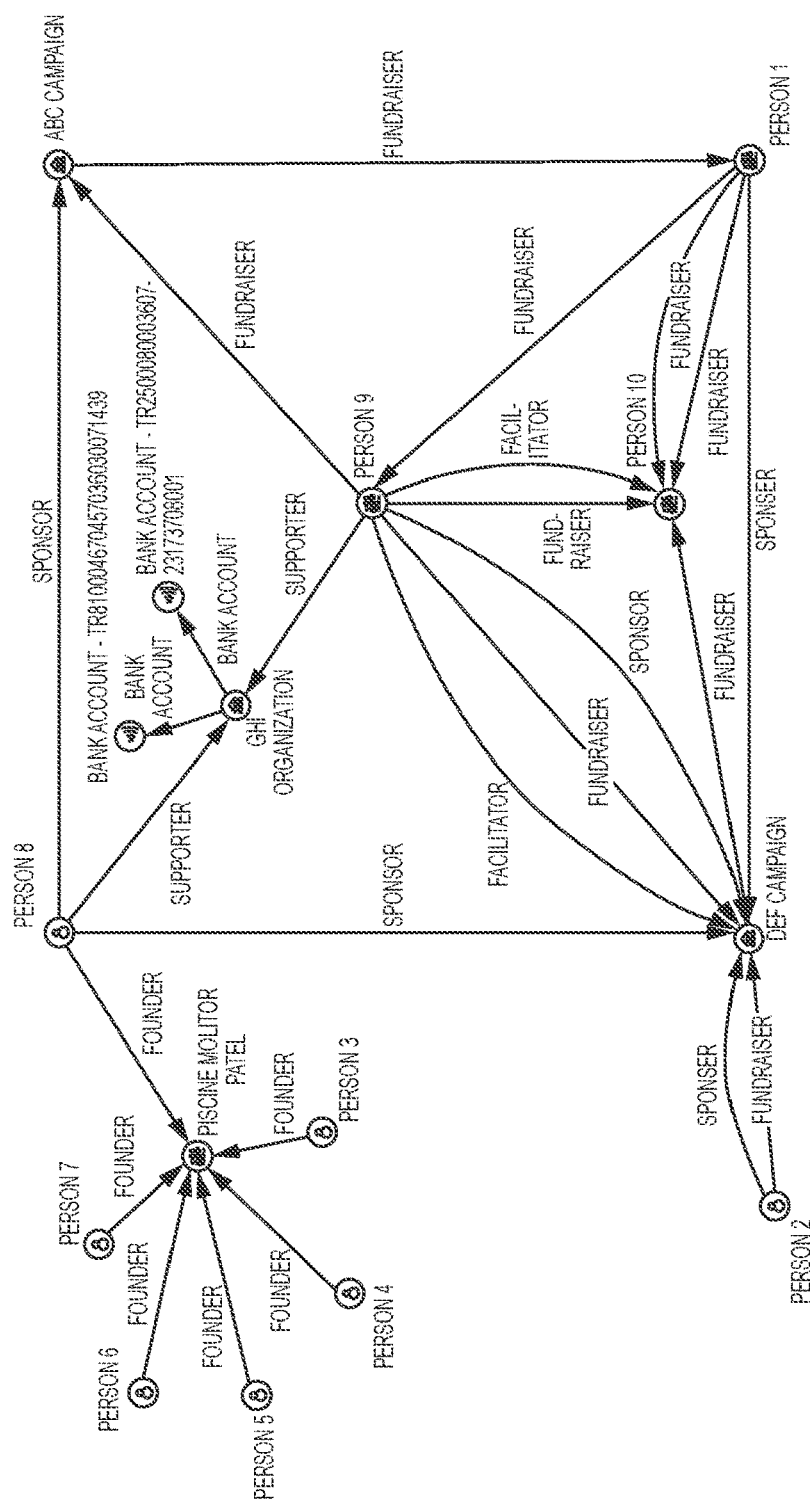


FIG. 18



# SYSTEMS AND METHODS FOR INVESTIGATING AND EVALUATING FINANCIAL CRIME AND SANCTIONS-RELATED RISKS

## CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. application Ser. No. 15/713,260, filed Sep. 22, 2017, the entirety of which is herein incorporated by reference.

## COPYRIGHT NOTICE

[0002] The present application includes material that is subject to copyright protection. The copyright owner does not object to the facsimile reproduction of the application by any person as the application appears in the records of the U.S. Patent and Trademark Office, but otherwise reserves all rights in the copyright.

## FIELD OF INVENTION

[0003] The present invention is generally directed to systems and methods for investigating and evaluating financial crime and sanctions-related risks. More particularly, the present invention is related to systems and methods involving an internal production environment configured to interact with analysts and an external production environment configured to interact with customers. The combination of the two environments and other mechanisms help maintain and evaluate financial crime and sanctions-related risks.

## BACKGROUND OF THE INVENTION

[0004] Today's banking and financial systems are subject to complex regulations that can subject those institutions to significant fines, other regulatory penalties, and reputational risk. Various procedures and systems have been developed to assist these institutions in monitoring, investigating, and avoiding risks addressed by such regulations. Financial crime and sanctions-related risks can arise from directly or indirectly conducting or supporting financial transactions with entities under sanctions or otherwise engaged in illicit activity. These regulations can be complex and can involve identified entities and other entities that fall under sanctions by association. There are a number of existing systems but they have been found thus far to be inadequate in providing the institution with a cogent and quick representation of the risk as new situations arise. There is a tremendous amount of information, and understanding and assessing the information down to relevant parts has been difficult to achieve. The efficiency in providing such services and the way the information is interactively made available have also been inadequate.

## SUMMARY OF THE INVENTION

[0005] In accordance with principles of the invention, a computer implemented system for providing a visual interactive software tool that permits users to investigate and evaluate financial crime and sanctions-related risks is contemplated. In one embodiment, the system may comprise a graph database configured to store edges, nodes, and properties, a first subsystem configured to store and publish a style guide over a network, a document library, an internal production environment configured to interact with analysts,

and an external production environment configured to interact with customers. The graph database is located in non-volatile memory or stores nodes, edges, and properties in nonvolatile memory. The first subsystem is implemented on a computer configured with volatile and non-volatile memory and configured to communicate over a network. The style guide includes a plurality of data models that are identified in the style guide to model different categories of situations and contains requirements for a structure and format of data used to enter nodes, edges, and properties for a particular data model. The document library is also implemented on a computer configured with volatile and non-volatile memory and to communicate over a network. The document library can communicate with different sources to receive information to be reviewed by analysts and save received information that is used by analysts to enter nodes, edges, and properties. Each of the internal production environment and the external production environment is implemented on one or more servers configured with volatile and non-volatile memory and configured to communicate over a network. The internal production environment can communicate with analysts' computers over a network. The external production environment can communicate with customers' computers over a network.

[0006] The internal production environment implements an electronic online workspace for analysts. The internal production environment configures the electronic online workspace to provide analysts with a software interface to enter a first category of information to identify and input individual nodes and to enter a second category of information specifying edges (i.e., different types of relationships) between the nodes in the first category. The inputted nodes include source nodes and corridor endpoint nodes. The internal production environment, in response, stores the entered nodes, edges, and properties in the graph database.

[0007] The internal production environment also comprises a software engine that finds corridors. The software engine, in response to the entered nodes, edges, and properties, automatically traverses pathways which are available starting from each source node through connected edges and nodes. The software engine identifies any new pathways and traverses the pathways until it reaches a corridor endpoint node before a maximum number of degrees of node-traversal as specified by the software engine has been reached, or it reaches a node or edge in the traversal process that has no risk relevance or low risk relevance for the purpose of corridor generation.

[0008] The software engine then eliminates some of the identified pathways. The elimination process includes eliminating pathways that include the nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation and the pathways that include a total number of nodes at or above the maximum number of degrees of node-traversal. The software engine stores a set of weights in correspondence with the different types of edges and assigns weights based on the type of edge or connected node to the edges in each pathway. In response to eliminating pathways and assigning weights, the software engine identifies the remaining pathways to be the resulting corridors for the source node and further based on a cumulative value of weights on edges in each resulting corridor specifies a variable degree of relevance to the resulting corridors.

**[0009]** The system also comprises a second subsystem configured to perform a publish process. The publish process approves and transmits the resulting one or more corridors and the nodes, edges, and properties to an external production environment. The second subsystem is implemented on a computer configured with volatile and nonvolatile memory to communicate over a network.

**[0010]** The external production environment is configured to receive and store the one or more resulting corridors and the nodes, edges, and properties in an external graph database which aggregates corridors and nodes, edges, and properties and maintains edge connections between nodes in different corridors.

**[0011]** The external production environment comprises an electronic online customer platform. The platform includes a visual interactive interface having interactive tools. The tools include a search engine that provides keyword searching capability that surfaces possible matching nodes in the external graph database, that provides the user with the ability to add an identified node to the visual workspace, that generates a visual graphic as representation of the identified node in the workspace, that communicates that the identified node has a number of connections (connected nodes) that include a number of corridors, and that permits the user to select one of the connections or corridors to add to the visual workspace. In response to adding the connection or corridor to the visual workspace, the engine displays additional nodes and edges that are part of the connection or corridor using separate visual graphical elements for nodes and edges that visually illustrate the connection or corridor.

**[0012]** The external production environment can communicate a relative relevance of a plurality of corridors based on the weights. The external production environment is further configured to display underlying properties for the nodes and edges by retrieving the underlying properties from the external graph database.

**[0013]** The electronic online customer platform is further configured to permit the customer to add a node to the workspace that already contains the identified node. In response to the addition, the workspace automatically displays a graphic representation of a connection between the added node and the identified node, if a relationship between the two nodes exists.

**[0014]** The electronic online customer platform is further configured to permit the customer to add a corridor to the workspace that already contains the identified node. In response to the addition, the workspace automatically displays graphic representations of nodes and edges of the added corridor.

**[0015]** The electronic online customer platform is further configured to provide the customer with option to interactively select a node displayed on the workspace. In response to the selection, the workspace communicates corridors associated with the selected node that can be added to the workspace.

**[0016]** The electronic online customer platform is further configured to provide the customer with option to interactively select a node displayed on the workspace. In response to the selection, the workspace communicates other nodes associated with the selected node that can be added to the workspace.

**[0017]** In accordance with principles of the invention, a computer implemented method for investigating and evaluating financial crime and sanctions-related risks is contemplated.

In one embodiment, the method comprises storing edges, nodes, and properties in a graph database, storing and publishing a style guide over a network, receiving information in a document library to be reviewed by analysts and saving received information in the document library that is used by analysts to enter nodes, edges, and properties, implementing an internal production environment configured to interact with analysts, and implementing an external production environment configured to interact with customers. The graph database is located in nonvolatile memory. The style guide is stored in and published via a first subsystem implemented on a computer configured with volatile and non-volatile memory and to communicate over a network. The style guide includes a plurality of data models that are identified in the style guide to model different categories of situations and contains requirements for a structure and format of data used to enter nodes, edges, and properties for a particular data model. The document library is also implemented on a computer configured with volatile and non-volatile memory and to communicate over a network. The document library can communicate with different sources to receive information to be reviewed by analysts and save received information that is used by analysts to enter nodes, edges, and properties. Each of the internal production environment and the external production environment is implemented on one or more servers configured with volatile and non-volatile memory and to communicate over a network. The internal production environment can communicate with analysts' computers over a network. The external production environment can communicate with customers' computers over a network.

**[0018]** The internal production environment implements an electronic online workspace for analysts. The workspace is configured to provide analysts with a software interface to enter a first category of information to identify and input individual nodes or groups of nodes and to enter a second category of information specifying edges (i.e., different types of relationships) between the nodes in the first category. The inputted nodes include source nodes and corridor endpoint nodes. In response to entering the first and second category of information, the method stores the entered nodes, edges, and properties in the graph database.

**[0019]** The internal production environment implements a software engine that finds corridors. In response to the stored nodes, edges, and properties, the method, via the software engine, automatically traverses pathways which are available starting from each source node through connected edges and nodes. The method identifies, via the software engine, any new pathway and traverses the pathways until it reaches a corridor endpoint node before a maximum number of degrees of node-traversal as specified by the software engine has been reached, or it reaches a node or edge in the traversal process that has no risk relevance or low risk relevance for the purpose of corridor generation.

**[0020]** The method then eliminates, via the software engine, some of the identified pathways. The elimination process includes eliminating pathways that include the nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation and the pathways that include a total number of nodes at or above the maximum number of degrees of node-traversal. The method stores, via the software engine, a set of weights in correspondence with the different types of edges and assigns weights based on the type of edge or connected node to the

edges in each pathway. In response to eliminating pathways and assigning weights, the method, via the software engine, identifies the remaining pathways to be the resulting corridors for the source node and further based on a cumulative value of weights on edges in each resulting corridor specifies a variable degree of relevance to the resulting corridors.

**[0021]** The method also includes a publication process that approves and transmits the resulting one or more corridors and the nodes, edges, and properties to an external production environment. The publication process is performed by a second subsystem that is implemented on a computer configured with volatile and non-volatile memory and to communicate over a network.

**[0022]** The method also includes receiving and storing, via the external production environment, the one or more resulting corridors and the nodes, edges, and properties in an external graph database which aggregates corridors and nodes, edges, and properties and maintains edge connections between nodes in different corridors.

**[0023]** The method includes implementing an electronic online customer platform in the external production environment. The platform provides a visual interactive interface that comprises a visual workspace and interactive tools. The tools include a search engine that is configured to provide keyword searching capability that surfaces possible matching nodes in the external graph database, that provides the user with the ability to add an identified node to the visual workspace, that generates a visual graphic as representation of the identified node in the workspace, that communicates that the identified node has a number of connections that include a number of corridors, and that permits the user to select one of the connections or corridors to add to the visual workspace. In response to adding the connection or corridor to the visual space, the method, via the engine, displays additional nodes and edges that are part of the connection or corridor using separate visual graphical elements for nodes and edges that visually illustrate the connection or corridor.

**[0024]** The method further comprises communicating, via the external production environment, a relative relevance of a plurality of corridors based on the weights.

**[0025]** The method further comprises displaying, via the external production environment, underlying properties for the nodes and edges by retrieving the underlying properties from the external graph database.

**[0026]** The method further comprises permitting, via the electronic online customer platform, the customer to add a node to the workspace that already contains the identified node. In response to the addition, the method automatically displays, via the electronic online customer platform, a graphic representation of a connection between the added node and the identified node, if a relationship between the two nodes exists.

**[0027]** The method further comprises permitting, via the electronic online customer platform, the customer to add a corridor to the workspace that already contains the identified node. In response to the addition, the method automatically displays, via the electronic online customer platform, graphic representations of nodes and edges of the added corridor.

**[0028]** The method further comprises providing, via the electronic online customer platform, the customer with option to interactively select a node displayed on the workspace. In response to the selection, the method communi-

cates, via the electronic online customer platform, corridors associated with the selected node that can be added to the workspace.

**[0029]** The method further comprises providing, via the electronic online customer platform, the customer with option to interactively select a node displayed on the workspace. In response to the selection, the method communicates, via the electronic online customer platform, other nodes associated with the selected node that can be added to the workspace.

**[0030]** In accordance with principles of the invention, a computer readable data medium storing computer-executable instructions that, when executed by a processor, cause the processor to perform a method for investigating and evaluating financial crime and sanctions-related risks is contemplated. The method comprises establishing a graph database configured to store edges, nodes, and properties in nonvolatile memory, storing and publishing a style guide, receiving information in a document library to be reviewed by analysts and saving received information in the document library that is used by analysts to enter nodes, edges, and properties, communicating with an internal production environment configured to interact with analysts, and communicating with an external production environment configured to interact with customers. The graph database is located in nonvolatile memory. The style guide is stored in and published via a first subsystem implemented on a computer configured with volatile and non-volatile memory and to communicate over a network. The style guide includes a plurality of data models that are identified in the style guide to model different categories of situations and contains requirements for a structure and format of data used to enter nodes, edges, and properties for a particular data model. The document library is also implemented on a computer configured with volatile and nonvolatile memory and to communicate over a network. The document library can communicate with different sources to receive information to be reviewed by analysts and save received information that is used by analysts to enter nodes, edges, and properties. Each of the internal production environment and the external production environment is implemented on one or more servers configured with volatile and non-volatile memory and to communicate over a network. The internal production environment can communicate with analysts' computers over a network. The external production environment can communicate with customers' computers over a network.

**[0031]** The internal production environment implements an electronic online workspace for analysts. The workspace is configured to provide analysts with a software interface to enter a first category of information to identify and input individual nodes or groups of nodes and to enter a second category of information specifying edges (i.e., different types of relationships) between the nodes. The inputted nodes include source nodes and corridor endpoint nodes. In response entering the first and second category of information, the method stores the entered nodes, edges, and properties in the graph database.

**[0032]** The internal production environment implements a software engine that finds corridors. In response to the stored nodes, edges, and properties, the method, via the software engine, automatically traverses pathways which are available starting from each source node through connected edges and nodes. The method identifies, via the software



engine, any new pathway and traverses the pathways until it reaches a corridor endpoint node before a maximum number of degrees of node-traversal as specified by the software engine has been reached, or it reaches a node or edge in the traversal process that has no risk relevance or low risk relevance for the purpose of corridor generation.

**[0033]** The method then eliminates, via the software engine, some of the identified pathways. The elimination process includes eliminating pathways that include the nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation and the pathways that include a total number of nodes at or above the maximum number of degrees of node-traversal. The method stores, via the software engine, a set of weights in correspondence with the different types of edges and assigns weights based on the type of edge or connected node to the edges in each pathway. In response to eliminating pathways and assigning weights, the method identifies, via the software engine, the remaining pathways to be the resulting corridors for the source node and further based on a cumulative value of weights on edges in each resulting corridor specifies a variable degree of relevance to the resulting corridors.

**[0034]** The method also includes a publication process that approves and transmits the resulting one or more corridors and the nodes, edges, and properties to an external production environment. The publication process is performed by a second subsystem that is implemented on a computer configured with volatile and non-volatile memory and to communicate over a network.

**[0035]** The method also includes receiving and storing, via the external production environment, the one or more resulting corridors and the nodes, edges, and properties in an external graph database which aggregates corridors and nodes, edges, and properties and maintains edge connections between nodes in different corridors.

**[0036]** The method includes implementing an electronic online customer platform in the external production environment. The platform provides a visual interactive interface that comprises a visual workspace and interactive tools. The tools include a search engine that is configured to provide keyword searching capability that surfaces possible matching nodes in the external graph database, that provides the user with the ability to add an identified node to the visual workspace, that generates a visual graphic as representation of the identified node in the workspace, that communicates that the identified node has a certain number of connections that include a number of corridors, and that permits the user to select one of the connections or corridors to add to the visual workspace. In response to adding the connection or corridor to the visual workspace, the method, via the engine, displays additional nodes and edges that are part of the connection or corridor using separate visual graphical elements for nodes and edges that visually illustrate the connection or corridor.

**[0037]** The method further comprises communicating, via the external production environment, a relative relevance of a plurality of corridors based on the weights.

**[0038]** The method further comprises displaying, via the external production environment, underlying properties for the nodes and edges by retrieving the underlying properties from the external graph database.

**[0039]** The method further comprises permitting, via the electronic online customer platform, the customer to add a

node to the workspace that already contains the identified node. In response to the addition, the method automatically displays, via the electronic online customer platform, a graphic representation of a connection between the added node and the identified node, if a relationship between two nodes exists.

**[0040]** The method further comprises permitting, via the electronic online customer platform, the customer to add a corridor to the workspace that already contains the identified node. In response to the addition, the method automatically displays, via the electronic online customer platform, graphic representations of nodes and edges of the added corridor.

**[0041]** The method further comprises permitting, via the electronic online customer platform, the customer with option to interactively select a node displayed on the workspace. In response to the selection, the method communicates, via the electronic online customer platform, corridors associated with the selected node that can be added to the workspace.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0042]** The nature and various advantages of the present invention will become more apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

**[0043]** FIG. 1 depicts an illustrative computer-implemented system for providing a visual interactive software tool that permits user to investigate and evaluate financial crime and sanctions-related risks in accordance with some embodiments of the present invention;

**[0044]** FIG. 2 depicts illustrative nodes, properties, and an edge and their respective roles in accordance with some embodiments of the present invention;

**[0045]** FIG. 3 depicts illustrative corridors in accordance with some embodiments of the present invention;

**[0046]** FIG. 4 depicts an illustrative process for finding corridors in accordance with some embodiments of the present invention;

**[0047]** FIG. 5 depicts illustrative steps that determine whether pathways have satisfied certain automated rules to be qualified as corridors in accordance with some embodiments of the present invention;

**[0048]** FIG. 6 depicts illustrative visual graphical elements with color indicating a particular type of node and symbol indicating a particular type of subject in accordance with some embodiments of the present invention;

**[0049]** FIGS. 7-11, 13, 14A, 15, and 16 depict illustrative screenshots of a graphical user interface, an interactive window(s), and related displayed features generated by the system through which the user interacts on their computer or PC to use the advantages provided by the system in accordance with some embodiments of the present invention;

**[0050]** FIG. 12 depicts additional illustrative corridors and an illustrative corridor edge in accordance with some embodiments of the present invention;

**[0051]** FIG. 14B depicts an illustrative structure for constructing the visual graphic of an illustrative insight in accordance with some embodiments of the present invention;

**[0052]** FIG. 17 depicts another illustrative computer-implemented system for providing a visual interactive software tool that permits user to investigate and evaluate

financial crime and sanctions-related risks in accordance with some embodiments of the present invention;

**[0053]** FIG. 18 depicts additional illustrative corridors that have certain types of relationships in accordance with some embodiments of the present invention; and

**[0054]** FIG. 19 depicts an illustrative visual graphic of one or more identified nodes in accordance with some embodiments of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0055]** In accordance with principles of the present invention, a system is provided that can efficiently identify for users direct and indirect relationships between an actor that does not appear on a sanctions list and other actors that do appear on a sanctions list using, among other things, a graph database and a style guide. The style guide allows many analysts to incrementally add to the data in the graph database in a consistent, structured, and connected way. As new nodes are added to the system, a computer implemented process is implemented that traverses pathways from the new node to a node that is identified on a sanctions list and which relies on rules that identify only a subset of pathways for use by the customers. The system eliminates pathways that have a degree of separation at or above a predetermined threshold and implements other rules such as rules eliminating pathways that include nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation. The resulting pathways that are found are considered “corridors” and are saved by the system in the graph database. Thus, for example, in some embodiments, the system incrementally adds corridors and stores them instead of traversing the entire graph. This technique also supports an interactive graphical interface of the system which provides an interactive tool for users to quickly and cogently understand risk using a visualization of one or more corridors. The interface provides a visual workspace that allows the user to search by keywords and the interface, in response, lists search results for possible matching nodes in the database. The interface further permits the user to select a node from the list of search results (e.g., a person) and in response, the interface or system generates a related list that includes a list of corridors (pathways in the graph database from that starting node to a node that appears on a sanctions list, also referred to as a corridor endpoint node) and other connected nodes under subject groupings. The user can interact with the interface to select a corridor and add it to the workspace. The user can select other corridors from the list and add to the workspace and display it. This provides a powerful and elegant solution to the needs of the institution with respect to financial crime and sanctions compliance. The interface permits the user to select individual nodes that are in the workspace and in response, lists of related information including corridors that are associated with that node, and other connected nodes, and the user can similarly add those to the workspace. This technique quickly adapts the source data and in operation, quickly surfaces the relevant information in a visual way for understanding by those in charge of evaluating financial crime and sanctions compliance issues at institutions. The known prior art is not able to accomplish such powerful results.

**[0056]** Embodiments of the present invention are directed to a software platform that allows analysts and customers to research and map the commercial, financial, and facilitation

networks of sanctioned or other actors that may be associated with illicit activity. Through embodiments to the present invention, financial institutions, multinational corporations, legal professionals, and other stakeholders can access visual graphs depicting relationships between sanctioned and non-sanctioned actors in order to evaluate their possible exposure to financial crime or sanctions-related risks. Embodiments illustrated herein are directed to financial crime and sanctions-related solutions and have particular suitability to solving and assisting users with financial crime and sanctions compliance related issues. It should be understood that described features or systems can have broader or different applications. Sanctions refers to laws or regulations issued by a government that places commercial restrictions on certain identified entities or entities that are described in more general terms or indirectly (e.g., all subsidiaries of an entity that is specifically identified) and also place restrictions on commercial activities involving the restricted entities. Individuals, companies, or organizations that violate the restrictions are subject to civil or criminal penalties, which can be significant source of risk, typically arising from being a primary or secondary actor in a financial transaction. In the United States, government organizations involved in issuing and enforcing such regulations include the Department of the Treasury, the Department of State, and the Department of Justice, but others exist in the U.S. and in other countries.

**[0057]** FIG. 1 depicts an illustrative computer-implemented system **100** for providing a visual interactive software tool that permits users to evaluate financial crime and sanctions-related risks. The system **100** comprises a graph database **105** configured to store nodes, edges, and properties a document library **110** configured to communicate with different sources over a network to receive financial crime and sanctions-related risk information and save received information used by analysts to create nodes, edges, and properties, an internal production environment **115** configured to interact with analysts, and an external production environment **120** configured to interact with customers. The graph databases **105** include an internal graph database and an external graph database. The internal graph database is configured to store nodes, edges, and properties inputted into the internal production environment **115** by analysts, store nodes, edges, and properties for access and use by analysts in the internal production environment **115**, and store other information entered and produced from the internal production environment **115**. The information produced from the internal production environment **115** may be information created using the nodes, edges, and properties (e.g., connections and corridors). The external graph database is configured to store nodes and edges for customers' use in the external production environment **120** and store visual graphs produced and saved by customers in the external production environment **120**. The graph database **105** may be a component separate from the internal production environment **115** and the external production environment **120** or be integrated with the internal production environment **115** and the external production environment **120** (e.g., with the internal graph database built into the internal production environment **115** and with the external graph database built into the external production environment **120**). The system **100** is configured to logically divide (e.g., by a mechanism such as user authentication executed by subsystem **155**) between the internal graph database and the external graph

database, wherein customers are not permitted to access or interact with nodes or edges in the internal graph database.

**[0058]** A node represents a subject. The system **100** is configured to allow for the subject to be an individual, entity, postal address, e-mail address, event, number, telephone number, campaign, or other subject. The subject may be one that appears on a sanctions list or one that has a criminal record (sanctioned subject), one that is materially associated with a sanctioned subject but does not appear on a sanctions list (associated subject), or one that is neutrally associated with a sanctioned subject or an associated subject and does not appear on a sanctions list (neutral subject). A node is described by properties that include one or more words, numbers, symbols, or a combination thereof by which the underlying subject is known or referred to. When the subject (or property) is a number, the number may be a phone number, fax number, driver license number, social security number, passport number, bank account number (including credit card and debit card account numbers), identification number used by the system **100**, or other number.

**[0059]** An edge represents a relationship between two nodes. The relationship may be a business relationship (e.g., creditor, supplier, joint-venture, etc.), an ownership relationship (e.g., majority shareholder, minority shareholder, subsidiary, etc.), a position relationship (e.g., director, manager, owner, etc.), a banking relationship (e.g., account holder, mortgagor, etc.), a familial relationship (e.g., father, daughter, cousin, etc.), and other relationships. An edge is described by properties that include one or more words, numbers, symbols, or a combination thereof by which the underlying subject is known or referred to. FIG. 2 depicts an illustrative node, property, and edge and their respective roles. FIG. 2 depicts a graphical structure of the node, property, and edge that is presented to user when he or she assembles them through the workspace in the internal or external production environment. The graph database **105** stores nodes, edges, and information from the environments **115**, **120** in nonvolatile memory. Nodes and edges are part of a graph database and can also have a graphical representation as part of a user interface.

**[0060]** The internal production environment **115** includes an electronic online workspace for analysts **130** and a software engine **135**. The workspace **130** provides a software interface that allows an analyst to enter a first category of information to input individual nodes or group of nodes. The nodes may be inputted into or created in the internal production environment **115** from information stored in the document library **110**. Analysts can access the internal production environment **115** over network connections as over an Internet connection. The document library **110** communicates with different data sources over a network to receive financial crime and sanctions-related information. Data sources may include government sanctions lists, court records, records of incorporation, corporate filings, shipping records, news, websites, public social media postings, multimedia, and other sources. An analyst may review the stored information, determine subjects from the stored information, and enters each determined subject and relevant information into the internal production environment **115** to create or input a node and related properties. The information relied on by the analyst to create nodes can be saved in the document library so it is available for review by the analyst and other analysts and users. In this way, analysts and users can check accuracy of the entered nodes and properties, and

review the actual received information directly (instead of just the nodes, edges, and properties) if necessary. For example, the received information may include an article from a newspaper (or other source), a link to the article, or information about the article, and the analysts and users can review that article. An analyst may also obtain financial crime and sanctions-related information from places other than the document library and use the internal production environment **115** to merely input or create nodes. Once an inputted node is identified by the system or an analyst as appearing on a sanctions list, the system designates it as a corridor endpoint node. The designation imparts to the inputted node different characteristics and effects that enables the software engine **135** to find paths and corridors (further discussed below) accordingly and that allows the electronic online platform of the external production environment **120** to generate a visual graphic as a distinctive representation. A node can also be created to represent an article or other data that serves as a source for additions made by an analyst. This type of node is configured not to have a graphical node inserted into a workspace.

**[0061]** The software interface also allows the analyst to enter a second category of information specifying an edge and related properties between inputted nodes. The software interface provides a list of available edges, and the analyst can select and specify an edge from the list. The analyst may also create additional edges from the software interface if they are not in the list. In some embodiments, inputting a certain node and/or specifying the type and direction of the relationship between two nodes may cause the system **100** to automatically select a certain relationship between that certain inputted node and another inputted node. The relationship selected by the system **100** may be a mandatory relationship. In some embodiments, specifying a certain relationship may cause the system **100** to automatically change or specify the type of inputted node (e.g., source or corridor endpoint node). The type of node selected by the system **100** may be a mandatory type of node.

**[0062]** The first category of information and the second category of information are stored in the graph database **105** and can be accessed by the workspace **130**.

**[0063]** The internal production environment **115** or the system **100** includes a first subsystem that is configured to store and provide a style guide. The style guide includes a plurality of data models defined by analysts or administrators to model different situations and contains requirements for a structure and format of data used to enter nodes, edges, and properties for a particular data model. For example, the situations may include arrest, investigation, and litigation situations, and the data model can specify how the information of each situation should be entered into the internal production environment **115**. For instance, in an arrest situation, the data model may specify the types of nodes that should be used, the edges that should be used for each type of node, the properties that should be used for each type of node and edge, and the format that the node, edge, and property should be entered to clearly convey the information represented by the nodes, edges, and properties. For example, the data model may require the analyst to enter the nodes, edges, and properties in an "Arrest of [Person A] in [Country], who is [relationship] of [Person B]" format with the nodes, edges, and properties inserted in the corresponding bracket. The text in the format (e.g., "Arrest of," who is," and "of") may be entered by the analyst or automatically

generated by the environment **115** when the analyst selects the data model of the arrest situation to be used for the information he is about enter. The data model may have similar specifications for investigation, litigation, and other situations. In this way, analysts can follow the same rules and requirements for each situation and build the information for each situation in the same manner.

**[0064]** A data model can govern what and how each piece of information is entered into the internal production environment **115** in each situation, relate the entered information to a node in the graph database **105** based on information in the entered information, and determine how the entered information should be linked to or integrated with the node if the entered information is related. In some embodiments, a data model may be available as a template for entering the first and/or second category of information. In some embodiments, an analyst can enter the first and/or second category of information and the system **100** can automatically select the appropriate data model to add or integrate the information in the data model into the graph database **105**. The data model may include the corresponding fields and the required data structure and format so that the system **100** or the graph database **105** can be built and maintained uniformly across all analysts. The data models can also be created for other situations.

**[0065]** The development and publication of the style guide can be an important component of the system **100**. A rigorous set of requirements and definitions can be specified in the style guide for a wide range of situations, subjects, or relationships. This approach embeds structured consistency in the analyst-created nodes, edges, properties, graphs, or related information (the creation of which may involve many different analysts and can involve many different sources of information or types of sources) that permits the database to grow efficiently. The system **100** can, in using the created information, automatically identify edges or relationships between subjects. This can for example result in avoiding having multiple representations of the same subject in the database which can create disconnects or result in duplicate or redundant paths. Other advantages are also gained from such a system. Note that this is one option and in some embodiments other variations can be implemented.

**[0066]** The system is configured to allow collaboration. The system can be configured to have many analysts interact and save their work on the system. The system can be configured to allow analysts to see the work of other analysts on the system and to build on that work (efficiently building a larger and more complex set of information). The system can be configured to allow analysts to view the work saved by other analysts or can have restrictions in place that limit the access of analysts to nodes, edges, or properties that have been approved and added to the external production environment. For example, the internal production environment **115** allows analysts to collaborate and build a database storing information that visually identifies direct and indirect relationships between an actor that does not appear on a sanctions list and other actors that do appear on a sanctions list. Analysts (e.g., other analysts) can then add additional actors or nodes to the database to continue the direct and indirect relationships and/or new actors or nodes to the database to create new direct and indirect relationships that are not already in the database. The internal production environment **115** also includes an approval process for new

information that is being added by an analyst. The approval process can be configured as an automated process involving a workflow in which the contributing analyst specifies to the system that a new set of subjects or relationships are being added to the system and in response, an automated approval process is implemented that can involve approval by peers through the system or by supervisory reviewers.

**[0067]** The software engine **135** includes a set of computer implemented rules (generally referred to as rules) that are configured to traverse paths and find (“surface”) a subset of the paths that meet certain rules (and therefore, eliminate other paths). The subset that meets the rules is referred to herein as corridors. The software engine **135** is configured to find or identify corridors based on the stored first and second category of information. A corridor is a pathway connecting any node that is not a corridor endpoint node to a node that is designated as a corridor endpoint node via one or more edges and/or one or more connecting nodes. A connecting node can be any node except a node designated as a corridor endpoint node and/or other nodes deemed to have no (or low) illicit finance or sanctions-related risk relevance for the purpose of corridor generation. As a matter of clarification, at the time an analyst creates a new node for a subject, the system **100** may not be configured to require that the analyst specifies whether it is a corridor endpoint node or some other kind of node (e.g., a node that has no risk relevance or low risk relevance for the purpose of corridor generation, or any further specificity with respect to the type of node can for example be determined by the software engine **135** based on the edges or paths connected to that node). At a base level, a corridor is determined (found) by identifying a node (that is not a corridor endpoint node) from the first category of information and connecting the identified node to a designated corridor endpoint node in the first category of information via a direct edge connection or via other nodes in the first category of information and the edges in the second category of information. Rules are incorporated into the software engine **135** that traverses or finds paths from identified nodes to designated corridor endpoint nodes and finds corridors as a subset of all paths where a path from an identified node can be traversed by the software engine **135** to reach a designated corridor endpoint node. In operation, the software engine **135** automatically traverses from the identified node through connected nodes and edges until it reaches a designated corridor endpoint node. A corridor endpoint node is a type of node that is specified or designated within the system as having different properties than other nodes. A corridor endpoint node cannot be the starting point of a corridor and is only available to end a pathway or corridor. The corridor endpoint node is defined by the system **100** (e.g., by rules, configurations, or data structures) to function that way with respect to identified nodes. A corridor is found when the identified node is connected to a corridor endpoint node and also certain rules are satisfied. A corridor can be graphically illustrated by the system **100** (e.g., as part of the graphical user interface) using a graphical structure comprising the connected nodes, edges and corridor endpoint node that form the corridor. Subject to meeting certain additional rules (discussed herein) a corridor can be identified by the software engine **135** whenever an identified node can reach a corridor endpoint node. Multiple corridors can be generated for an identified node. The multiple corridors may be pathways between an identified

node and a corridor endpoint node, between an identified node and multiple corridor endpoint nodes, or a combination thereof.

**[0068]** FIG. 3 depicts illustrative corridors **350**, **355**, **360**, **364**, **368**. As mentioned above, a corridor is a pathway between a source node and a corridor endpoint node that meets certain rule requirements. For discussion purposes, in connection with FIG. 3, corridors are discussed in more general terms and additional specificity is discussed further below. The corridors **350**, **355**, **360** represent pathways between a source node **305** and a corridor endpoint node **310**. The corridor **350** includes an edge **315** joining the source node **305** and a connecting node **320**, a connecting node **320**, and an edge **325** joining the connecting node **320** and the corridor endpoint node **310**. The corridor **355** is an edge **357** between the source node **305** and corridor endpoint node **310**. The corridor **360** includes an edge **330** joining the source node **305** and a connecting node **335**, a connecting node **335**, an edge **340** joining the source node **335** and a connecting node **345**, a connecting node **345**, and an edge **348** joining the connecting node **345** and the corridor endpoint node **310**. The corridor **364** represents a pathway between the same source node **305** and a different corridor endpoint node **370**. The corridor **368** represents a pathway between the same source node **305** and another different corridor endpoint node **375**. The software engine **135** may not generate corridors for some of the source nodes since not all the source nodes can be connected to a corridor endpoint node.

**[0069]** The software engine **135** is programmed with a maximum number of degrees of node-traversal. The maximum number of degrees of node-traversal refers to the number of nodes in a pathway the software engine **135** is permitted (by rule) to traverse to reach a corridor endpoint node from a particular source node. The software engine **135** will end the node traversal, exits the traversed pathway, and eliminates that traversed pathway from qualifying as a corridor when the software engine **135** determines that the current traversed node is equal to the maximum number of degrees of node-traversal. The software engine **135** is configured to eliminate a pathway when the number of nodes in the path (after the source node) reaches a maximum. The maximum can be specified internal to the system and not otherwise visible to users or analysts when interacting with the system. The maximum can for example be selected to be one of 4, 5, 6, 7, or 8 nodes, which can have advantages in processing, relevancy, and presentation. Other maximums are contemplated. With this rule, the software engine **135** prevents pathways that exceed the maximum number of degrees of node-traversal from qualifying to be corridors. If the software engine **135** has reached the maximum number and no corridor endpoint node is found, then the software engine **135** moves onto traversing another pathway (e.g., which can start from the same source node again if that source node has other pathways or from the next source node) to find a corridor endpoint node. Since the graph database **105** may store a large number of nodes and edges, their combinations may produce an enormous number of pathways. The maximum number can control the number of iteration performed by the software engine **135** to save processing time and power consumption. For brevity, the term maximum number of degrees of node-traversal is sometimes referred to or abbreviated as the maximum number, the maximum number of node traversal, the maxi-

imum number of node traversal or degrees of traversal, or the maximum number of traversal nodes.

**[0070]** FIG. 4 depicts an illustrative process **400** for finding corridors. In addition to the programmed maximum number, the software engine **135** is configured to apply a process that identifies and eliminates pathways that include a node in the path (between a source node and a corridor endpoint node) that has been designated as having no risk relevance or low risk relevance for the purpose of corridor generation when traversing through that node to a corridor endpoint node. The determination by the system of which nodes (or edges) are ones that have no risk relevance or low risk relevance for the purpose of corridor generation can be performed in one or more ways (or combinations thereof) that are described herein as illustrative examples. A node (or edge) can be designated as having no risk relevance or low risk relevance by an analyst via the electronic online analyst workspace. The software engine **135** can also determine whether a node is one that has no risk relevance or low risk relevance, without an analyst identifying it as such. The software engine **135** can make the determination by analyzing the edge connecting the two nodes, the properties of the edge and two nodes, the number of edges the node has, or a combination thereof, and determining that the inclusion of the node, or the path associated with the node, would indicate a neutral or primarily neutral relationship between the two nodes. If desired, a software module that incorporates artificial intelligence or a set of rules can be implemented in some embodiments that determines whether a node or edge has no or low risk relevance for the purpose of corridor generation. Low risk relevance is mentioned to explain that a low level of relevance would still not be sufficient to reach a threshold value for the purpose of corridor generation. The software engine **135** is configured to recognize nodes that have no risk relevance or low risk relevance (e.g., government node).

**[0071]** This configuration improves the technical and informational aspects of the resulting corridors. For example, a node for a government entity is removed by this rule because its inclusion provides very limited or no relevance for the purpose of evaluating financial crime and sanctions-related risks for two distinct nodes that connect through the government node. In operation, in one embodiment, the system implemented a process in which as part of the automated node traversal process, it determines whether each node is identified as a type of node that the system has stored with a designation that this type of node has no risk relevance or low risk relevance for the purpose of corridor generation. If the system identifies a match, the system would eliminate that pathway and would discontinue traversing that pathway. The node and related connection would be available and displayed (if desired) in a workspace to provide additional information to a user.

**[0072]** FIG. 5 depicts illustrative steps **405** and **410** of FIG. 4. In this example, a low maximum number (e.g., 3) is used for explanatory purposes. FIG. 5 shows a graphical illustration of the process in order to further elaborate about its operation. If desired, the graphical illustration could be incorporated into an interactive graphical interface. In FIG. 5, node **505** may have been recently added to the internal production environment and approved to be added to the external production environment. At this point, for example, the system processes the addition as part of the already existing nodes and edges in the already existing external

production environment. The system will automatically start at node **505** and traverse connections (e.g., one by one, at the same time, or some variation thereof) and applies automated rules to select corridors. In this case, node **505** has connections to node **510** (a node on a sanctions list and thus a corridor endpoint node) through nodes **520**, **521**, **525**, **527**, **530**, **532**, **534**, **522**, **524**, and **529**. The software engine **135** would traverse connected edges and nodes until reaches node **510** or the node traversal is terminated before it reaches node **510** when the software engine **135** determines that the current path it is traversing has reached a maximum number of nodes before reaching a corridor endpoint node or a node or edge (reached in the traversal process) that is in the category of nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation. In the illustration, for convenience, lines **552**, **554**, **556**, **558**, **560**, and **562** are provided as a way to mark and discuss an associated set of nodes and edges that (based on information stored in the environment) establish a path from node **505** to node **510**. Those lines are markers for discussion purposes. For example, in this case, using step **405** of FIG. 4, the software engine **135** identifies pathways, referenced using associated markers, **552**, **554**, **556**, **558**, **560**, **562** that connect node **505** to corridor endpoint node **510** and eliminates pathway **558** because pathway **558** involves more than 3 connecting nodes (e.g., **520**, **530**, **532**, and **534**). In operation, the process would stop the traversal process when it reaches the maximum number of traversal nodes (3 in this example) and the system would not identify or “know” that there is a pathway **558** to node **510** because it would have stopped the traversal process when it reached the maximum (i.e., node **532**). By performing step **410** of FIG. 4, the software engine **135** identifies that node **522** has no risk relevance or low risk relevance for the purpose of corridor generation, when it reaches that node in the node traversal process, and eliminates pathway **560** associated with node **522**. Similarly, in operation, the process would stop the traversal process when it reaches the node **522** (determines node has no risk relevance or low risk relevance for the purpose of corridor generation) and at that point the system would not identify or “know” that there is a pathway **560** to node **510** because it would have stopped the traversal process when it reached node **522**. As a result, the software engine **135** keeps only pathways **552**, **554**, **556** and **562** after performing steps **405** and **410** and the kept pathways are determined to be corridors associated with node **505** in relation to node **510** (since there can be other relations). Corridors are automatically added to the external production environment when or in response to being found by the software engine **135**. Other implementations are also contemplated.

**[0073]** The predetermined node type for non-traversal, the type of node that the process should identify and use to eliminate path being traversed (no risk relevance or low risk relevance), and the predetermined number of connecting nodes (maximum number of node traversal or degrees of traversal) may be inputted by the analyst into the software interface but is preferably pre-programmed in the software engine **135** (in the implementation of the overall system).

**[0074]** The process **400** (FIG. 4) further comprises determining a degree of relevance for the corridors **415**. The step **415** comprises storing a set of weights in correspondence with the different types of edges **420**, assigning weights based on the type of edges in each corridor **425**, calculating

a cumulative value of weights for each found corridor based on the assigned weights **430**, and specifying a degree of relevance to other corridors for each corridor **435** based on the cumulative value. The types of edges may be based on whether the relationship is a shareholder one, an employment one, a banking one, a familial one, or other one and/or the rank in the relationship (majority shareholder vs. minority shareholder, director vs. associate, son vs. cousin, etc.). Each relationship type and rank has an assigned weight, and certain relationships types and ranks have a weight higher than other relationship types and ranks. Higher weight may refer to a higher assigned number or a higher multiplier in the calculation step **430** or the formula used in the calculation step **430**. The calculation step **430** may be based on adding all the assigned weights of the connecting edges in a corridor. The total sum or cumulative value may be used as the only parameter in the specifying step **435** to determine the degree of relevance. The cumulative value may also be used with other parameters or in another procedure to determine the relevance in step **435**. A higher cumulative value may represent that the corridor has a higher relevance compared to other corridors. In some embodiments, a lower cumulative value may represent that the corridor has a higher relevance compared to other corridors. The degree of relevance may be output as a number on a scale configured to convey such degree. For example, the corridor with the strongest degree of relevance may be marked with “1”, the corridor with the second strongest degree of relevance may be marked with “2,” and so forth. Other numbers, letter, characters, or orders (e.g., from large number to small number) may also be used. The number may be different from the cumulative value. The system can be configured to only assign weights that are equal or greater than 1 (with 1 indicating most relevant and ascending numbers, totals, indicating lower relevance, in relation to a weight of 1).

**[0075]** If desired as an option, the step **415** may further comprise a step **440** that eliminates corridors based on relevance determined from calculating weights. The step **440** may eliminate corridors based on assigned weights in step **425** and before the calculation step **430**. In this case, steps **430** and **435** calculate a cumulative value and specify a degree of relevance for the remaining corridors. The step **440** may eliminate corridors based on the calculated cumulative value in step **430**. The step **440** may eliminate corridors that do not have a cumulative value that is above, below, or matches a predetermined cumulative value. In this case, step **435** specifies a degree of relevance for the remaining corridors. The predetermined cumulative value may be provided by analyst from software interface or be pre-programmed in the software engine **135** and be subsequently modified to a different number by analyst from the software interface.

**[0076]** The step **415** may be performed after the step **405** is executed, after the step **410** executed, or after both steps **405** and **410** are executed. In any of these scenarios, the step **415** may operate to determine a degree of relevance for corridors kept by step **405** and/or **410** without the step **440**. The step **415** may also operate to further eliminate one or more corridors kept by step **405** and/or **410** and determine a degree of relevance for the remaining corridors. In other words, the step **440** may be optional in some embodiments.

**[0077]** In some embodiments, the step **415** may be configured to perform before steps **405** and/or **410**. In that situation, steps **405** and/or **410** may further eliminate corri-

dors kept by the step 415 (whether step 415 performs the eliminating step 440 or not). In some embodiments, the step 415 may be configured as an alternative step to steps 405 and 410. The process 400 may operate based on the step 415 to eliminate corridors without steps 405 and 410.

[0078] All the data available to (e.g., all the predetermined numbers, assigned weights, etc.) and produced by the software engine 135 (e.g., the generated corridors, the cumulative values, kept/resulting corridors, etc.) may be stored in the internal graph database.

[0079] The system 100 includes a second subsystem that is configured to approve and provide the kept or resulting corridors and the associated nodes, edges, and properties from the internal production environment 115 (or the internal graph database) to the external production environment 120 (or the external graph database) via link 133 (FIG. 1). In one embodiment, the second subsystem may provide a multi-stage approval process. In the first stage, the second subsystem may transmit the work added by an analyst (e.g., a set of new nodes and edges that are related to a sanctioned subject based on a court record) to the computers of peer analysts for peer analysts' review (which is understood to include web browser implementations, which should be generally understood with respect to other aspects as well). The second subsystem may require a certain number of analysts to approve the work (added research) in order to advance to the next stage. Upon approval by the required number of analysts, the second subsystem may transmit the analyst-approved work to the computer of a senior analyst for the senior analyst's review. Upon approval by the senior analyst, the work (a particular set of nodes, edges, or properties) are provided (inserted and saved) to the external production environment 120. The approval process may have additional or fewer stages. During any of the stages, any rejected work will not be transferred to the external production environment 120. The kept or resulting corridors are used interchangeably throughout this application to refer to corridors that remain after an eliminating step is performed, which may be step 405, 410, and/or 415. The second subsystem is configured to automatically feed approved work to the external production environment 120. The second subsystem also provides approved work to the third subsystem.

[0080] The external production environment 120 (FIG. 1) is configured to receive and store the resulting corridors and the associated nodes, edges, and properties in the external graph database. The external graph database can aggregate resulting corridors and associated source nodes (e.g., adding current resulting corridors and associated nodes, edges and properties to resulting corridors and associated nodes, edges, and properties previously stored in the external graph database) and maintain edge connections between nodes in different corridors.

[0081] The external production environment 120 includes an electronic online customer platform 140 (and is accessible via a web portal 1044 as shown in FIG. 17) and a software engine 145. The customer platform 140 provides a visual interactive interface that allows a customer to enter a keyword search, search for nodes with properties that match the keyword search in the external graph database, add a node that matches the keyword search to an electronic workspace, view information accompanying a node in a side panel, and add additional nodes and/or a corridor to the workspace. The customer platform 140 perform its functions

through the software engine 145. As the customer enters a keyword search through the interface, the software engine 145 searches indexed properties on nodes in the external graph database and identifies nodes that match or are similar to the search query. When the customer selects and adds an identified node to the workspace, the software engine 145 adds the identified node to the workspace by generating and displaying a visual graphical element as representation of the identified node in the workspace. The software engine 145 also retrieves the accompanying information (which includes properties) of the identified node from the external graph database and displays that information through the visual interactive interface. The displayed or accompanying information may include the relevant information entered by analyst during the input step, other nodes directly connected to the identified node, and a number of corridors. Upon the customer selecting and adding one of the corridors, the software engine 145 generates and displays a visual graphic as representation of the corridor in the workspace. The visual graphic for the corridor is generated and displayed by the nodes and edges that form the corridor. Customers can access the external production environment 120 over network connections such as over an Internet connection.

[0082] The software engine 145 is configured to generate and display a plurality of visual graphical elements. The software engine 145 may generate a circle as the visual graphical element for a node (see FIGS. 2, 3, and 5). The circle may have a different size or color to indicate whether the node is identified as a particular type of node, including, for example, a corridor endpoint node. The circle may be further produced with a symbol indicating a particular type of subject. FIG. 6 depicts illustrative visual graphical elements 600 of a node with color 605 indicating a particular type of node and symbol 610 indicating a particular type of subject. The software engine 145 may generate a line as the visual graphical element for an edge (see FIGS. 2, 3, and 5). The line may have a different thickness, length, or color to indicate the type of relationship. The line may also have an arrow at either end to indicate the direction of the relationship. The visual graphic of corridor can be generated based on the above circle and line. A separate traversal line (e.g., arrow lines in FIGS. 3 and 5) can also be provided to illustrate the path of the corridor. Visual graphic refers to a visual representation created by one or more visual graphical elements. The software engine 145 may also generate other shapes to represent node, edge, and corridor.

[0083] FIGS. 7-11, 13, 14A, 15, and 16 depict illustrative screenshots of a graphical user interface 700 (FIG. 7) for customers and its operation through a software engine. Referring to FIG. 7, the graphical user interface 700 comprises a visual interactive interface 705. The visual interactive interface 705 includes a first command 710 configured to enter keyword searches on the external production environment. Customer conducts keyword searches for a node 712 by typing letters, numbers, symbols, marks, or a combination thereof in the first command 710 and the interface 705 displays the search results 715 in categories. The categories include an entity category, a person category, an address category, or other categories. Each category includes nodes of the corresponding category that match the keyword search. The search results include nodes that are similar or match the keyword search node 712. The interface 705 displays the number of results (or nodes) in each category and the total number of results (or nodes) of all the category

ries. The results delivered in response to the keyword search 712 can include any type of node, including any corridor endpoint node. Customer may select a category to view all the results 720 in that category from the interface 705. In FIG. 7, the customer selects the person category and the interface 705 displays the nodes 720 in that category in a window 722. The interface 705 includes buttons, tabs, windows, screens, and other mechanisms to receive customer selection and to display search results. The interface 705 also includes an electronic workspace 725 to which nodes can be added and displayed via visual graphical elements. The interface 705 is software that is implemented and running on a computer using computer instructions that are stored in memory that, when executed by a processor, displays or provides the graphical and user-interactive features described herein (wherein the user can interact with the interface using an input device of the computer such as a keyboard). This includes the situation where the interface 705 is provided through a web browser such as when a customer or analyst logs into the platform from their Internet browser running on their computer over an Internet connection to the platform. The interface 705 is configured to implement the various related features described herein.

[0084] From the search results 720, the customer may select a displayed node 730 to view additional information 735 about the selected node 730 as shown in FIG. 8. Additional information 735 helps the customer decide if the selected node 730 matches the keyword search 712 or the node the customer intends to investigate for sanctions-related risks. The nodes in each category have their corresponding additional information. For example, additional information 735 of the person category may include a total number of connections (explained below), the real name, alias, date and place of birth, nationality, resident country, sanctions status of the person, and other information. Sanctions status information may include the jurisdiction (e.g., country or state) that sanctioned the person or entity represented by the node, the date the person committed the illegal act, and other information. Additional information 735 is displayed in another window 737 configured with one or more commands 739, 740 to add the selected node 730 to the electronic workspace 725. The command 739 may allow the customer to add and place a node on the workspace 725 immediately upon clicking the command 739. The location of the node is determined by the software engine 145. The location can be subsequently changed by the customer if needed. The command 740 may allow the customer to drag a node onto the workspace 725. Upon clicking and holding the mouse on the command 740, the selected node may be affixed to the mouse cursor and be moved along with the mouse cursor. The location of the node is determined by the customer and the customer can move the node to a location he or she desires. The node can be placed at the desired location upon releasing the mouse at the desired location. The node that appears on the workspace 725 is the visual graphical element of the node generated by the software engine 145. The visual graphical element of the node is referred to as node in the description of FIGS. 7-16 for the ease of reading the instant application. Adding a node to the electronic workspace 725 (visual workspace) may also be referred to as adding a node to the workspace.

[0085] FIG. 9 depicts an illustrative visual interactive interface displaying a node 745 (a node that has been displayed on the workspace 725 by the user interacting with

the interface). The customer may select another node 747 to add to the workspace 725. The node 747 may be one of the connections (explained below) of the node 745 or another node searched by the customer. The customer may view the additional information 735 and decide whether to add the node 747 to the workspace 725 via the command 739 or 740.

[0086] FIG. 10 depicts adding additional nodes 778, 779 to a node 745. Upon adding a node 745, the customer may view connection information 780 of the node 745 by selecting the node 745 on the workspace 725. In this example, the subject of the node 745 is a person. The connection information 780 includes nodes connected to the node 745, and the visual interactive interface 705 also displays the connected nodes in categories 780. A connected node is a node that has an edge connection to the displayed node. The categories are based on the relationship of the connected nodes to the node 745 (displayed node that is clicked on/selected by the user resulting on the system retrieving relationship information, instantly). The categories for relevant nodes connected to a displayed node (e.g., node 745) may include a leadership & management category, a facilitation & support category, a litigation, regulation enforcement category, a business associates category, and a family members category. The interface 705 displays the number of relevant nodes in each category and the total number of relevant nodes of all the categories. The total number of relevant nodes of all the categories is also the total number of connections the node 745 has. The interface 705 also displays the additional information 737 about the added node 745 in conjunction with the connection information 780. The customer may select a category to view all the relevant nodes 785 in that category from the interface 705. In FIG. 10, the customer selects the facilitation & support category and the interface 705 displays the relevant nodes 785 in that category in a window 787. To clarify, in the context of the interface 705, the system permits the user to search and add nodes to the workspace 725 that fall in the category of nodes that have no risk relevance for the purpose of corridor generation. These can also be found as part of connected nodes to a displayed node (e.g., when a user clicks on the displayed node and the system provides relationship information). This can add another dimension of visual information that can aid the user. With respect to associated corridors, corridors that are retrieved and listed for node 745 when the customer selects node 745, contain only the nodes or edges in resulting pathways that were identified by the node traversal process to produce corridors, which was performed before this information is made available on the external production environment.

[0087] From the connected nodes 785, the customer may select a node 790 to view additional information 789 contained in window 738 about the node 790. The additional information 789 includes the name of the connected node 790 and a description of the relationship between the connected node 790 and the node 745. Additional information 789 helps the customer decide if the connected node 790 should be added to the workspace 725 to view their relationship in a graphical form. Window 738 is configured with one or more commands 739, 740 to add the connected node 790 to the workspace 725. The commands 739, 740 operate in the same manners discussed above. Relevant nodes 778, 779 are illustrative nodes added via the steps explained above. When the nodes 778, 779 are added to the workspace 725, their corresponding edge connections 761-763 to the



nodes **745**, **778**, and **779** are also added to the workspace **725**. The edge or edge connection that appears on the workspace **725** is the visual graphical element of the edge or edge connection generated by the software engine **145**. The visual graphical element of an edge or edge connection is referred to as an edge connection in the description of FIGS. **7-16** for the ease of reading the instant application. The nodes **745**, **778**, **779** and the edge connections **761-763** create a visual graphic **792**. The visual graphic **792** can be created with any number of nodes and edge connections. The structure or shape of the visual graphic **792** can be changed by moving a node to a different location on the workspace **725** to arrange the nodes and their relationships in different manners and to facilitate the understanding of their relationships. When a node is being moved to another area, the corresponding edge connection remains connected to the displayed node during the moving process. When the node is moved to another area, and the edge connection is also moved to another area.

[**0088**] When a node **714** has corridors, the connection information **780** also includes corridor information and corridors are stored in a corridor category for selection and display as shown in FIG. **11**. When the customer selects the corridor category, the interface displays corridors **794** in a window **788**. The corridors **794** are the resulting corridors from the second subsystem. The corridors **794** may be ranked by the determined degree of relevance and be displayed based on the rank. The corridors **794** may be displayed with the one having the highest degree of relevance first and with the remaining ones arranged in a descending order. The corridors **794** may also be displayed in other orders. The interface may also display the corridors **794** with a measurement (e.g., (1), (2), (3), (4)) indicating the number of connecting nodes between the displayed node and the corridor endpoint node.

[**0089**] From the displayed corridors **794**, the customer may select and add a corridor to the workspace **725**. The selected corridor is visually illustrated in the workspace **725**. The corridor is generated and presented with nodes and edge connections and their corresponding graphical elements. For example, when corridor A is added, corridor A is produced with edge connection E1, connecting node C1, edge connection E2, and corridor endpoint node T1. For another example, when corridor B is added, corridor B is produced with edge connection E1 (if not already produced or if corridor A is not added yet), connecting node C1 (if not already produced or if corridor A is not added yet), edge connection E3, connecting node C2, edge connection E4, and corridor endpoint node T2. Although the node **714** is not mentioned in the above corridors, it is also part of the corridor. The line associated with the corridor is used to illustrate the path of the corridor and it may or may not be displayed on the interface. The interface allows the customer to add one or more corridors for the node **714**. The subject of the node **714** is an entity, and the customer can evaluate financial crime and sanctions-related risks associated with the entity from the visual graphics **792**.

[**0090**] FIG. **12** depicts additional corridors **1** and **2** and corridor edge **3** to illustrate the concept of corridors. Corridors **1** and **2** are pathways between node A and corridor endpoint node G. Corridor edge **3** is an edge that stores corridors **1** and **2** using nodes and properties. For simplicity, only the nodes involved are mentioned (not the edge connections). Corridor **1** includes node A, connecting node B,

connecting node C, and corridor endpoint node G. Corridor **2** includes node A, connecting node D, connecting node E, connecting node F, and corridor endpoint node G.

[**0091**] Additional information depicted in **735** (FIG. **9**), **789** (FIG. **10**) and connection information depicted in **780** (FIG. **10**) are derived from the accompanying information or the relevant information an analyst entered during the input step discussed above.

[**0092**] The visual interactive interface also allows the customer to save created visual graphics **800** in the external graph database, load previous created and saved visual graphics **800** from the external graph database, and share created visual graphics **800** with other individuals as shown in FIG. **13**. Each saved visual graphic **800** may be referred to as a chart. The visual interactive interface also allows the customer to export created visual graphics and the accompanying information to a particular file format (e.g., PDF, Word, Powerpoint, etc.) for saving or communicating with another computer system. The visual interactive interface also allows the customer to view charts or insights specifically created by an analyst. An insight is a specific research conducted by analyst for a particular subject or certain relationships that are illustrative, instructive, interesting, or unique. FIG. **14a** depicts an illustrative insight **900**. The insight **900** includes a short summary **905** and a visual graphic **910** representing the summary **905**. The insight may be provided to a customer only if an insight is relevant to or contains information that has appeared in the customer's search or work history or the customer's previous inquiries. The insight may also always be provided to customers whenever it is created by analyst.

[**0093**] An insight is created through an insight node with insight edges and relevant nodes and properties. An insight node is created by an analyst in the internal production environment and may be published to the external production environment. An insight is intended to provide a brief summary so the visual graphic should have only a certain amount of complexity. An insight node and relevant nodes selected by analyst may have a limited number of edges or may be a node having a plurality of edges but only a few of them are used by analyst. The insight node, relevant nodes, and edges are created to form a narrative or description that corresponds to the brief summary. FIG. **14b** depicts an illustrative structure for constructing the visual graphic of an insight.

[**0094**] The interface may provide insights to customer through two locations. The customer may access insights from the connection information **780** as shown in FIG. **15**. The connection information **780** includes an insight category, and insights associated with a node will be displayed in a window **796**. Upon selecting from the displayed insights in **796**, the customer may view a short summary of the selected insight in another window **797** configured with a command **798** to add its visual graphic **799** to the workspace **725**.

[**0095**] The customer may also access insights from a location **930** that stores and displays insights as shown in FIG. **16** among other things, without the customer first querying a node or obtaining the connection information. The stored insights may be divided into different categories and the customer may select a category **935** to view insights **940** in that category. Each insight **945** may be depicted as a small window **945** displaying a portion of the brief sum-

mary. The window **945** is configured with a command **950** that can access the entire brief summary and the associated visual graphic.

**[0096]** The system **100** also includes a third subsystem **150** (FIG. 1) configured with a list graph that enables bulk exporting of tailored subsets of data and a fourth subsystem **155** (FIG. 1) configured to provide user authorization and secure communications. The list graph in the third subsystem **150** receives data from the publish flow **133** (FIG. 1) from the internal production environment **115** (FIG. 1). The list graph in the third subsystem **150** is configured to allow internal users to apply advanced query searches to identify all nodes in the list graph that meet customer specified requirements. For example, a customer may want a list of all nodes that are identified as officers or directors of corridor endpoint nodes. To identify nodes matching customer specified requirements, the corridor endpoint node may serve as the starting node from which the relationships are traversed (rather than querying a node that is related to a corridor endpoint node and that does not appear on a sanctions list). The certain subset of information and work produced by executing customer specified queries on the third subsystem **150** can be exported in bulk to a particular type of file and/or distributed by other means. The exportation allows individuals to access the information without using the external production environment **120**.

**[0097]** The fourth subsystem **155** is configured to provide user authorization and secure communication. The fourth subsystem **155** can determine whether a user is authorized to access the system **100** and the level of access of the user. User can be analyst, customer, administrator, or other individuals. Analyst refers to individuals who use the internal production environment (including the internal graph database) or who build a database of financial crime and sanctions-related information. Customer refers to individuals who access the external production environment (including the external graph database) via a web portal or who evaluate financial crime-related and sanctions-related risks based on the information built by analyst. Analyst and customer may not have access to the other's environment and graph database. Administrator refers to individuals who monitor and maintain the system **100** to ensure that the system **100** is operating in the correct manner. Administrator may also be individuals who can grant access to analyst and customer. The technology of the fourth subsystem **155** may be based on security API and may include protocols such as RDS MySQL, LDAP, OAuth2, and other protocols.

**[0098]** FIG. 17 depicts another illustrative computer-implemented system **1000** for providing a visual interactive software tool that permits user to investigate and evaluate financial crime and sanctions-related risks. The system **1000** comprises an internal production environment **1005** and an external production environment **1010**. The internal production environment **1005** includes an analyst toolset **1022** and an internal graph database **1024**. The analyst toolset **1022** includes the electronic online workspace for analysts **130** in FIG. 1. The internal production environment **1005** also includes the software engine **135** in FIG. 1, and the software engine **135** may be part of the analyst toolset **1022**. The analyst toolset **1022** communicates with the internal graph database **1024** to save and access the information and work analyst produced from the workspace **130**. The internal

graph database **1024** is configured to feed or publish the information and work the analyst produced to the external production environment **1010** or external graph databases **1040**, **1042** (customer graph database). The publication process is performed by the second subsystem, and the second subsystem may be part of the internal graph database **1024** or the internal production environment **1005**. The external graph databases may include one **1040** dedicated to customer web portal **1044** and one **1042** dedicated to bulk exporting of tailored subsets of data. Customer may log into the external production environment **1010**, or the platform for customers **140** shown in FIG. 1, via the portal **1044**. The communication between customer and the platform **140** and between the customer web portal **1044** and the internal graph database **1024** may be based on an application programming interface (API) to determine whether a customer is an authorized user and to ensure that the communications are secure. The customer platform **140** communicates with the external graph database **1040** to access the information and work analyst produced and to save the work customer produced from the platform **140**. The external graph database **1042** is configured to allow bulk exporting of tailored subsets of data or files containing the information and work analyst produced. The lists may be exported periodically from the database **1042** and for distribution. Exported lists allow individuals to view information and work analyst produced without the individuals keyword searching through the external production environment **1010**.

**[0099]** In some embodiments, databases **1040** and **1042** may be one single database configured to be accessible by customer web portal **1044** and to export lists **1046**. The external production environment **1010** also includes the software engine **145** in FIG. 1 to perform the operations of the platform **140**.

**[0100]** FIG. 18 depicts additional illustrative corridors that have certain types of relationships. The types of relationships may include ownership structures & subsidiaries, family member & affiliated companies, entities with a shared director, financiers & fundraising campaigns, bank accounts & financial transactions, entities with a shared address, and other types of relationships.

**[0101]** FIG. 19 depicts an illustrative visual graphic of one or more nodes. The complexity of the visual graphic may depend on the number of nodes and edges involved. From FIG. 19, the customer can visually determine the relationships between different nodes, view their properties and evaluate financial crime and sanctions-related risk. The visual graphic can include additional nodes and edges if there are additional relevant nodes or if the customer adds more nodes.

**[0102]** Each of the system **100**, the internal and external production environments, the graph databases, and the subsystems in FIG. 1 can be implemented on one or more computer systems and be configured to communicate via a network connection. They all may also be implemented on one single computer system. In either situation, the computer system(s) can communicate with analysts' computers and customers' client devices. The computer system(s) may also be referred to as servers. The computer system(s), the analyst's computer, and the customer's client device may adopt the following computer system.

**[0103]** In one embodiment, the computer system includes a bus or other communication mechanism for communicating information, and a hardware processor coupled with bus

for processing information. Hardware processor may be, for example, a general purpose microprocessor.

**[0104]** The computer system also includes a main memory, such as a random access memory (RAM) or other dynamic storage device, coupled to bus for storing information and instructions to be executed by processor. Main memory also may be used for storing temporary variables or other intermediate information during execution of instructions to be executed by processor. Such instructions, when stored in non-transitory storage media accessible to processor, render computer system into a special-purpose machine that is customized to perform the operations specified in the instructions.

**[0105]** Computer system further includes a read only memory (ROM) or other static storage device coupled to bus for storing static information and instructions for processor. A storage device, such as a magnetic disk or optical disk, is provided and coupled to bus for storing information and instructions.

**[0106]** Computer system may be coupled via bus to a display, such as a cathode ray tube (CRT), for displaying information to a computer user. An input device, including alphanumeric and other keys, is coupled to bus for communicating information and command selections to processor. Another type of user input device is cursor control, such as a mouse, a trackball, or cursor direction keys for communicating direction information and command selections to processor and for controlling cursor movement on display. This input device typically has two degrees of freedom in two axes, a first axis (e.g., x) and a second axis (e.g., y), that allows the device to specify positions in a plane.

**[0107]** Computer system may implement the techniques described herein using customized hard-wired logic, one or more ASICs or FPGAs, firmware and/or program logic which in combination with the computer system causes or programs computer system to be a special-purpose machine. According to one embodiment, the techniques herein are performed by computer system in response to processor executing one or more sequences of one or more instructions contained in main memory. Such instructions may be read into main memory from another storage medium, such as storage device. Execution of the sequences of instructions contained in main memory causes processor to perform the process steps described herein. In alternative embodiments, hard-wired circuitry may be used in place of or in combination with software instructions.

**[0108]** The term storage media as used herein refers to any non-transitory media that store data and/or instructions that cause a machine to operation in a specific fashion. Such storage media may comprise non-volatile media and/or volatile media. Non-volatile media includes, for example, optical or magnetic disks, such as storage device. Volatile media includes dynamic memory, such as main memory. Common forms of storage media include, for example, a floppy disk, a flexible disk, hard disk, solid state drive, magnetic tape, or any other magnetic data storage medium, a CD-ROM, any other optical data storage medium, any physical medium with patterns of holes, a RAM, a PROM, and EPROM, a FLASH-EPROM, NVRAM, any other memory chip or cartridge.

**[0109]** Storage media is distinct from but may be used in conjunction with transmission media. Transmission media participates in transferring information between storage media. For example, transmission media includes coaxial

cables, copper wire and fiber optics, including the wires that comprise bus. Transmission media can also take the form of acoustic or light waves, such as those generated during radio-wave and infra-red data communications.

**[0110]** Various forms of media may be involved in carrying one or more sequences of one or more instructions to processor for execution. For example, the instructions may initially be carried on a magnetic disk or solid state drive of a remote computer. The remote computer can load the instructions into its dynamic memory and send the instructions over a telephone line using a modem. A modem local to computer system can receive the data on the telephone line and use an infra-red transmitter to convert the data to an infra-red signal. An infra-red detector can receive the data carried in the infra-red signal and appropriate circuitry can place the data on bus. Bus carries the data to main memory, from which processor retrieves and executes the instructions. The instructions received by main memory may optionally be stored on storage device either before or after execution by processor.

**[0111]** The computer system also includes a communication interface coupled to bus. Communication interface provides a two-way data communication coupling to a network link that is connected to a local network. For example, communication interface may be an integrated services digital network (ISDN) card, cable modem, satellite modem, or a modem to provide a data communication connection to a corresponding type of telephone line. As another example, communication interface may be a local area network (LAN) card to provide a data communication connection to a compatible LAN. Wireless links may also be implemented. In any such implementation, communication interface sends and receives electrical, electromagnetic or optical signals that carry digital data streams representing various types of information.

**[0112]** Network link typically provides data communication through one or more networks to other data devices. For instance, network link may provide a connection through local network to a host computer or to data equipment operated by an Internet Service Provider (ISP). ISP in turn provides data communication services through the world wide packet data communication network now commonly referred to as the "Internet." Local network and Internet both use electrical, electromagnetic or optical signals that carry digital data streams. The signals through the various networks and the signals on network link and through communication interface, which carry the digital data to and from computer system, are example forms of transmission media.

**[0113]** Computer system can send messages and receive data, including program code, through the network(s), network link and communication interface. In the Internet example, a server might transmit a requested code for an application program through Internet, ISP, local network and communication interface.

**[0114]** The received code may be executed by processor as it is received, and/or stored in storage device, or other non-volatile storage for later execution.

**[0115]** Embodiments described herein are primarily described in the context of providing a tool for evaluating prospective financial crime and sanctions-related risks for businesses considering commercial dealings, but it should be understood that applications in other areas including application of particular features in other areas are contemplated.

[0116] It is understood from the above description that the functionality and features of the systems, devices, or methods of embodiments of the present invention include generating and sending signals to accomplish the actions.

[0117] It should be understood that variations, clarifications, or modifications are contemplated. Applications of the technology to other fields are also contemplated.

[0118] Exemplary systems, devices, and methods are described for illustrative purposes. Further, since numerous modifications and changes will readily be apparent to those having ordinary skill in the art, it is not desired to limit the invention to the exact constructions as demonstrated in this disclosure. Accordingly, all suitable modifications and equivalents may be resorted to falling within the scope of the invention.

[0119] Thus, for example, any sequence(s) and/or temporal order of steps of various processes or methods (or sequence of device connections or operation) that are described herein are illustrative and should not be interpreted as being restrictive. Accordingly, it should be understood that although steps of various processes or methods or connections or sequence of operations may be shown and described as being in a sequence or temporal order, but they are not necessarily limited to being carried out in any particular sequence or order. For example, the steps in such processes or methods generally may be carried out in various different sequences and orders, while still falling within the scope of the present invention. Moreover, in some discussions, it would be evident to those of ordinary skill in the art that a subsequent action, process, or feature is in response to an earlier action, process, or feature.

[0120] It is also implicit and understood that the applications or systems illustratively described herein provide computer-implemented functionality that automatically performs a process or process steps unless the description explicitly describes user intervention or manual operation.

[0121] It should be understood that claims that include fewer limitations, broader claims, such as claims without requiring a certain feature or process step in the appended claim or in the specification, clarifications to the claim elements, different combinations, and alternative implementations based on the specification, or different uses, are also contemplated by the embodiments of the present invention.

[0122] It should be understood that combinations of described features or steps are contemplated even if they are not described directly together or not in the same context.

[0123] The terms or words that are used herein are directed to those of ordinary skill in the art in this field of technology and the meaning of those terms or words will be understood from terminology used in that field or can be reasonably interpreted based on the plain English meaning of the words in conjunction with knowledge in this field of technology. This includes an understanding of implicit features that for example may involve multiple possibilities, but to a person of ordinary skill in the art a reasonable or primary understanding or meaning is understood.

[0124] Software can be implemented as distinct modules or software applications or can be integrated together into an overall application such as one that includes the user interface and that handles other feature for providing the functionality to the user on their device.

[0125] It is intended that the specification and examples be considered as exemplary only, with a true scope being indicated by the claims and their equivalents.

1. A computer implemented system for providing a visual interactive software tool that permits users to investigate and evaluate financial crime and sanctions-related risks, comprising:

- a database configured to store graph data structures including edges, nodes, and properties in nonvolatile memory;

- a style guide comprising a plurality of data models that model different categories of situations and contains requirements for a structure and format of data used to enter nodes, edges, and properties for a particular data model;

- a system configured to receive data input and use the inputted data to enter nodes, edges, and properties pursuant to the style guide into the database;

- a software engine that finds corridors, the software engine is configured to automatically traverse pathways which are available starting from a node through connected edges and nodes, to identify any new pathways and traverses the pathways until it reaches a corridor end-point node, to identify and eliminate pathways by analyzing edges connecting two nodes, properties of the edges connecting two nodes, and the number of edges a node has and determining whether a threshold value has been met between two nodes based on the style guide, and to identify the remaining pathways to be the corridors for the starting node; and

- an electronic online customer platform that includes a visual interactive interface having a visual workspace and interactive tools, the tools include a search engine that provides keyword searching capability that surfaces possible matching nodes in the database, wherein the visual interactive interface provides the user with the ability to add an identified node to the visual workspace, automatically generates a unique and interactive visual graphic as a representation of the identified node in the visual workspace, communicates that the identified node has a certain number of connections that include a number of corridors, displays the corridors in order of priority based on a cumulative value of weights on edges in each resulting corridor, and permits the user to select one of the connections or corridors to add to the visual workspace and in response displays additional nodes and edges that are part of the connection or corridor using separate visual graphical elements for nodes and edges that visually illustrate the connection or corridor and automatically displays a graphic representation of a corresponding connection between nodes, if a relationship between two nodes exists.

2. The computer implemented system of claim 1, wherein the received data input includes information regarding entities and individuals on a sanctions list and related entities and individuals.

3. The computer implemented system of claim 1, wherein the pathways identified and eliminated by the software engine are pathways that include nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation or pathways that include a total number of nodes at or above the maximum number degrees of node-traversal.

4. The computer implemented system of claim 1, wherein the software engine is further configured to store a set of

weights in correspondence with the different types of edges and assign weights based on a type of edge to the edges in each pathway.

5. The computer implemented system of claim 4, wherein the software engine is further configured to determine whether a threshold value has been met between two nodes using the assigned weight.

6. The computer implemented system of claim 4, wherein the software engine is further configured to determine a cumulative value of weights on edges in each corridor using the assigned weights and rank the corridors in order of priority based on the determined cumulative values.

7. The computer implemented system of claim 1, further comprising a subsystem configured to perform a publication process, wherein the publication process transmits the identified corridors to a production environment that is accessible by the electronic online customer platform.

8. The computer implemented system of claim 1, wherein the system is configured to receive data that is inputted by analysts.

9. A computer implemented method for investigating and evaluating financial crime and sanctions-related risks, comprising:

storing graph data structures including edges, nodes, and properties in a database in nonvolatile memory;

storing a style guide that comprises a plurality of data models that model different categories of situations and contains requirements for a structure and format of data used to enter nodes, edges, and properties for a particular data model;

receiving data input via a system and using the inputted data by the system to enter nodes, edges, and properties pursuant to the style guide into the database;

implementing a software engine that finds corridors, the software engine is configured to automatically traverse pathways which are available starting from a node through connected edges and nodes, to identify any new pathways and traverses the pathways until it reaches a corridor endpoint node, to identify and eliminate pathways by analyzing edges connecting two nodes, properties of the edges connecting two nodes, and the number of edges a node has and determining whether a threshold value has been met between two nodes based on the style guide, and to identify the remaining pathways to be the corridors for the starting node; and

implementing an electronic online customer platform that includes a visual interactive interface having a visual workspace and interactive tools, the tools include a search engine that provides keyword searching capability that surfaces possible matching nodes in the database, wherein the visual interactive interface provides the user with the ability to add an identified node to the visual workspace, automatically generates a unique and interactive visual graphic as a representation of the identified node in the visual workspace, communicates that the identified node has a certain number of connections that include a number of corridors, displays the corridors in order of priority based on a cumulative value of weights on edges in each resulting corridor, and permits the user to select one of the connections or corridors to add to the visual workspace and in response displays additional nodes and edges that are part of the connection or corridor using

separate visual graphical elements for nodes and edges that visually illustrate the connection or corridor and automatically displays a graphic representation of a corresponding connection between nodes, if a relationship between two nodes exists.

10. The computer implemented method of claim 9, wherein the step of receiving data input by the system includes receiving information regarding entities and individuals on a sanctions list and related entities and individuals.

11. The computer implemented method of claim 9, wherein the identification and elimination of pathways by the software engine includes identifying and eliminating pathways that include nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation or pathways that include a total number of nodes at or above the maximum number degrees of node-traversal.

12. The computer implemented method of claim 9, further comprising storing, by the software engine, a set of weights in correspondence with the different types of edges and assigning, by the software engine, weights based on a type of edge to the edges in each pathway.

13. The computer implemented method of claim 12, further comprising determining, by the software engine, whether a threshold value has been met between two nodes using the assigned weight.

14. The computer implemented system of claim 12, further comprising determining, by the software engine, a cumulative value of weights on edges in each corridor using the assigned weights and ranking, by the software engine, the corridors in order of priority based on the determined cumulative values.

15. The computer implemented method of claim 9, further comprising performing, by a subsystem, a publication process, wherein the publication process includes transmitting the identified corridors to a production environment that is accessible by the electronic online customer platform.

16. The computer implemented method of claim 9, wherein the step of receiving data via the system includes receiving data that is inputted by analysts.

17. A computer readable data medium storing computer-executable instructions that, when executed by a processor, cause the processor to:

establish a database storing graph data structures including edges, nodes, and properties in nonvolatile memory;

communicate with a computer configured with volatile and non-volatile memory that stores a style guide, the style guide comprises a plurality of data models that model different categories of situations and contains requirements for a structure and format of data used to enter nodes, edges, and properties for a particular data model;

implement a system that is configured to receive data input and use the inputted data to enter nodes, edges, and properties pursuant to the style guide into the database;

implement a software engine that finds corridors, the software engine is configured to automatically traverse pathways which are available starting from a node through connected edges and nodes, to identify any new pathways and traverses the pathways until it reaches a corridor endpoint node, to identify and eliminate pathways by analyzing edges connecting two

nodes, properties of the edges connecting two nodes, and the number of edges a node has and determining whether a threshold value has been met between two nodes based on the style guide, and to identify the remaining pathways to be the corridors for the starting node; and

implement an electronic online customer platform that includes a visual interactive interface having a visual workspace and interactive tools, the tools include a search engine that provides keyword searching capability that surfaces possible matching nodes in the database, wherein the visual interactive interface provides the user with the ability to add an identified node to the visual workspace, automatically generates a unique and interactive a visual graphic as a representation of the identified node in the visual workspace, communicates that the identified node has a certain number of connections that include a number of corridors, displays the corridors in order of priority based on a cumulative value of weights on edges in each resulting corridor, and permits the user to select one of the connections or corridors to add to the visual workspace and in response displays additional nodes and edges that are part of the connection or corridor using separate visual graphical elements for nodes and edges that visually illustrate the connection or corridor and automatically displays a graphic representation of a corresponding connection between nodes, if a relationship between two nodes exists.

**18.** The computer readable data medium of claim **17**, wherein the received data input by the system includes receiving information regarding entities and individuals on a sanctions list and related entities and individuals.

**19.** The computer readable data medium of claim **17**, wherein identifying and eliminating pathways by the software engine includes identifying and eliminating pathways that include nodes or edges that have no risk relevance or low risk relevance for the purpose of corridor generation or pathways that include a total number of nodes at or above the maximum number degrees of node-traversal.

**20.** The computer readable data medium of claim **17**, wherein the software engine is further configured to store a set of weights in correspondence with the different types of edges and assign weights based on a type of edge to the edges in each pathway.

**21.** The computer readable data medium of claim **20**, wherein the software engine is further configured to determine whether a threshold value has been met between two nodes using the assigned weight.

**22.** The computer readable data medium of claim **20**, wherein the software engine is further configured to determine a cumulative value of weights on edges in each corridor using the assigned weights and rank the corridors in order of priority based on the determined cumulative values.

**23.** The computer readable data medium of claim **17**, further comprising computer-executable instructions that, when executed by a processor, cause the processor to implement a publication process on a computer using memory to configure the computer to perform the process, wherein the process includes transmitting the identified corridors to a production environment that is accessible by the electronic online customer platform.

**24.** The computer readable data medium of claim **17**, wherein the system configured to receive data includes receiving data that is inputted by analysts.

\* \* \* \* \*