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"Where has all the money gone?" is probably the most important question in asset recovery. This is swiftly followed by "How can we get it back, and who can help us?" In the old days, legal teams helping their client recover assets would obtain 50 boxes of documents from banks and turn it over to a forensic accountant. The information contained within these banking documents would then be manually entered into spreadsheets by inexperienced staff. Linking the disparate information in order to trace funds through correspondent bank accounts and offshore trusts was a very time-consuming and difficult exercise.

Furthermore, given the manual nature of the work and high volume of information, the identification of patterns and finding leads were often the result of pure luck and the good memories of the team members. Today data analytics and data visualisation techniques can transform how efficiently and effectively the tracing team can overcome the other side's diversionary tactics and track down the stolen assets.

In this chapter we explain how modern data-driven techniques are enhancing the established art of *"following the money"*: how the already well-honed techniques of evidence collection and a multi-disciplined, multi-jurisdictional team can reap the benefits of new tools and technologies.

The information challenge

Asset tracing is a painstaking task. Through a breach of trust or other dishonest act, assets are taken from an organisation, most often in the

form of a series of high-value bank transfers, and then rapidly dissipated through the international banking system into offshore trusts and valuable property. The challenge for the legal and forensic accounting team is to identify the location of these assets which may be controlled from fiscal paradises, in accounts in the name of trusts, in shares in offshore companies, in physical property and even yachts in far-flung jurisdictions. The ownership of such trusts, companies and property is often made deliberately opaque to hinder identification and recovery.

Three factors add further difficulty to the challenge. The first is the problem of the moving target. Assets can continue to be moved from jurisdiction to jurisdiction while the team obtains compelling evidence to gain court orders to freeze them or subpoenas for more information.

Second, the evidence itself must be obtained from jurisdictions where achieving the necessary disclosure of information is hard-fought. In some jurisdictions the challenge is exacerbated by under-resourced authorities and even local corruption, particularly where the State has been involved in the asset misappropriation.

These two factors result in a process in which new material is constantly added, requiring the corpus of data to be updated iteratively while duplicate or contradictory information is detected. A well-designed evidence collection and data analytics process is ideally suited to these tasks especially where time is of the essence to have a chance of prosecution or recovery of assets.

The third factor is the relentless innovation that characterises the financial services industry. Near-instantaneous funds transfer and the emergence of crypto-currencies are two examples of developments that make the task of asset tracing more challenging.

Establishing a central repository of information

The foundation of successful asset tracing is the effective management of evidence through a comprehensive information management strategy. Information is likely to be received sporadically and in many forms. It will have to be converted and interpreted swiftly and accurately.

Moreover, the variety of information sources and data types is also increasing. Historically-used sources, such as emails, bank statements, transactional data, accounting records and contractual information, needs to be combined with newer intelligence sources such as social media networks and activity, mobile phone records and IP address data from remote log-in events. Knitting together these pieces of information helps to paint the picture – identifying individuals instructing the transfers, the described purpose of the transactions and other contextual details. However, to extract additional intelligence and further extend the range of the asset tracing, such details need to be matched to individual transactions and then be closely examined.

To start building this picture, information must be gathered and stored in a central repository and digitised, if necessary. This repository must be capable of accommodating and integrating data from disparate sources that could be delivered in a multitude of formats including both structured data (e.g., banking transactions spreadsheets and accounting systems) and unstructured data (e.g., emails, PDF bank statements, account opening documents, corporate records and transfer instructions).

Another essential consideration is data privacy and protection regulations. Given the multi-jurisdictional nature of asset tracing, it is critical to develop effective data governance protocols in the intake and storage of received data in order to comply with international data protection regulations (e.g., the EU's GDPR) and country-specific statutes (e.g., China's State Secrets Law). Failure to do so can result in harsh penalties or a damaged reputation. Therefore, in certain situations, it is not possible to establish a single central repository, so careful thought must be given to mitigate operational and regulatory risks.

Taking all this into account, having a well-designed, comprehensive and up-to-date information repository is a key prerequisite for the deployment of advanced data analytics.

Preparing the data for analysis

In order to track the passage of cash as it moves through the global banking system, the key data processing activities are data conversion and data standardisation. There are a wide range of tools and techniques available to perform these activities.

Ideally, relevant information such as bank transactions will be obtained in electronic form. For this the process of transfer into the database

is relatively simple. However, information may also be provided in the form of hard copies or scanned images, in which case they must be converted using tools such as Optical Character Recognition (OCR) software. These technologies have continuously evolved so that documents such as bank statements can swiftly and accurately be scanned, converted and validated into structured formats with limited manual intervention beyond set up and quality checks. Once this is complete, the data is loaded into the database and the data can be assessed for standardisation needs.

Data standardisation is a critical activity as the same type of information (e.g., bank transactions) could be received from different sources and contain different formats, codes, languages, quality and levels of detail. As such, the data will need to be standardised into a single format, which enables the investigator to holistically review the disparate pieces of information. An experienced data analyst can efficiently review the data to determine the extent of standardisation that is required. Judgment will be required and the analyst should prioritise data fields from the disparate data sources where standardisation enables the data linkages to be made.

Other documents such as emails and attachments, which may be in hard copy or electronic forms, should normally be converted and uploaded into an eDiscovery review platform. While metadata is likely to be readily available for electronic documents, hard copy documents will require more manual work to determine information relating to their provenance and authorship.

Irrespective of the source of the documents, developments in the automation of document identification and the extraction of intelligence mean that the deployment of new technologies at this stage can save a great deal of time. With this aspect of the matter more efficiently addressed, the investigator is free to use their skills and experience to execute the overall asset tracing and investigation strategy.

Combining structured and unstructured data and the use of artificial intelligence (AI)

Over recent years, one of the most significant developments in investigations, including asset tracing, has been the ability to effectively and almost seamlessly combine structured and unstructured data within an investigation. The objective of this integration is to enable the investigator readily to access details of a transaction alongside documentary evidence that has been collected and identified as relating to the inception, purpose or rationale of that transaction.

Careful design of the review platform can enhance the ease with which forensic accountants and lawyers work through the information. However, beyond simply improving the quality of the forensic accountant's interaction with the data, AI can be used to automatically suggest matches between communications and documents with specific payments and receipts. In this context, AI is intelligently comparing key pieces of information such as companies, individuals, dates and amounts with all other pre-existing data in the possession of the investigator.

To illustrate this concept, consider the example of dealings in a property in Ukraine for which some documents have been disclosed and processed into the data repository. Analytical processes may, through identification of dates, prices and addresses within the document, infer that the property may have been purchased using funds that were transferred out of Dollar or Euro denominated bank accounts in Cyprus and the British Virgin Islands. This could be achieved by a data analyst configuring the algorithms and parameters to look for matches based on date ranges, exchange rates and company information.

Even where the complexity or obscurity of the transaction defeats the matching algorithms, powerful search capabilities and intuitive user-interfaces can ease the matching efforts. In some cases, the system can be programmed to provide a range of 'best guess' alternatives for human validation.

Automating the tasks

All of the hard work and time invested in designing and building the digital repository pays off when it comes to tracking the movements of funds between the bank accounts and into the destination assets. Modern techniques can simply automate what were previously repetitive tasks. This means that through collaboration between the forensic accountants and data analysts, the tracing can be accomplished faster and with more objectivity.

For example, the date and amount of a payment may not exactly correspond with the date and

Irrespective of the source of the documents, developments in the automation of document identification and the extraction of intelligence mean that the deployment of new technologies at this stage can save a great deal of time

amount for that same transaction that appears in the receiving bank account. Differences in the value date, changes in currency and the imposition of bank charges can inhibit exact matching, especially in situations where there are many payments of similar value taking place within short timeframes.

Using data analytics techniques, transaction value and date matching tolerances can be programmed so that matches can be suggested where the recorded dates vary by a few days, values differ by typical bank charge amounts or by taking into account variations in exchange rates. Matched results can be assigned confidence scores to help investigators in their review. Paired entries which have been detected using matching algorithms can be presented, along with supporting linked documents, to the investigator for final validation.

Further, the information may point to a single payment being split at some intermediate stage before being credited to multiple accounts. Under these circumstances, database queries can be created to iteratively seek out and test the many permutations and combinations such that the most likely transaction flow is identified.

Using data analytics to further enhance the skills of the investigator

One of the key challenges that arises is when funds move into accounts which already contain other, potentially unconnected funds or which are overdrawn. The challenge is how to treat subsequent payments out of the account containing the mixed funds or, indeed in the latter case, the earlier payments which caused the overdraft in the first place.

The interpretation may be subject to strict rules which the defendant may use to their benefit. For example, in the UK, the extent to which the funds paid out from the receiving account can be treated as trust assets may be determined by applying the appropriate legal rules of tracing. Such rules are required where, for example, an intermediate account already contained non-trust funds or was overdrawn prior to receiving the claimant's funds. While the detail of such rules is outside the scope of this chapter, data analytics provides an opportunity to adhere to such rules more efficiently.

Encoding the legal tracing rules into automated routines and algorithms has significant benefits to the effectiveness of the investigation. First, once translated into database scripts, the rules are consistently applied across all transactions and replace considerable manual effort and subjectivity on the part of multiple investigators. Second, as further information is added to the data repository, the routines may be re-run and the revised money flows revealed almost instantly.

Similarly, the effect of assumptions as to the source of certain funds or the destination of particular payments may be tested. In this way, investigation efforts may be directed at the areas which are likely to yield most benefit in terms of the identification of the greatest value of assets for recovery. For example, where an account receives a large credit from an as yet unknown source, the impact of assuming that the source was in fact trust assets can be tested. If such an assumption yields an increase in value of recoverable trust funds, a decision may be made to deploy more investigative efforts to determine its true source. Conversely, if the effect is small, the investigator may decide that their time is be better spent examining other branches of the transaction flows.

A further related benefit of using data analytics to track the flow of funds is the identification of repeating patterns of transactions. When fraudsters alight upon a mechanism that works, they

will often repeat it. This repetition may be in the form of combinations of money flows between particular jurisdictions, the acquisition of certain types of asset and the use of more complex arrangements such as back-to-back loans. Data analysts can write programs to identify such patterns and repetitions and save the investigator a great deal of time and effort.

So, data analytics and the automation of the data matching mean that time is saved and payments can be linked with greater objectivity, but more importantly the investigator can concentrate on understanding where the money has gone and critiquing the links between entities and transactions that are suggested by the machine analysis.

Uncovering the networks using data visualisation

One of the areas where there has been a proliferation of technological advances has been data visualisation, and it is here that the effects of applying technology will, by definition, be most visible. As much of asset tracing is based on interpreting transactions as flows of funds and identifying hidden links between individuals and entities, such data visualisation can be incredibly valuable to the investigator.

We illustrate how the underlying story of the asset flows may be told with four types of visualisation techniques.

Link charts

On the most basic level, building up link charts such as i2 showing the source and destination of each funds transfer has historically provided an effective way of tracking progress. These will be familiar to many as they have been used for years in both analogue and digital forms. A link chart uses a variety of icons to depict bank accounts, trusts, property and valuable items such as aircraft and cars. Each item depicted by the icon is associated with a virtual index card which contains all the information known about that entity, or indeed the transfers of money into it.

The investigator is able to use such charts to identify the current-state extent of the intelligence extracted from the information and determine the end-points on which to focus investigation efforts. Further, link charts may be used to understand and depict the other linkages between entities – such linkages may include common ownership and connected individuals such as legal or financial advisors or addresses.

Geographical map

Another simple, but effective approach to illustrating the flows of funds is to overlay them on a geographical map – drawing on the metadata surrounding the individuals, companies and bank accounts. In this way key jurisdictions where the activity takes place are readily identifiable.

Amongst the variety of other less conventional visualisation methods that are available today, we will highlight two techniques which lend themselves well to asset tracing: *Sankey* and *Chord Diagrams*.

Sankey diagrams *(see Figure 1)*

Designed by Captain Matthew Sankey in the nineteenth century to illustrate the energy efficiency of

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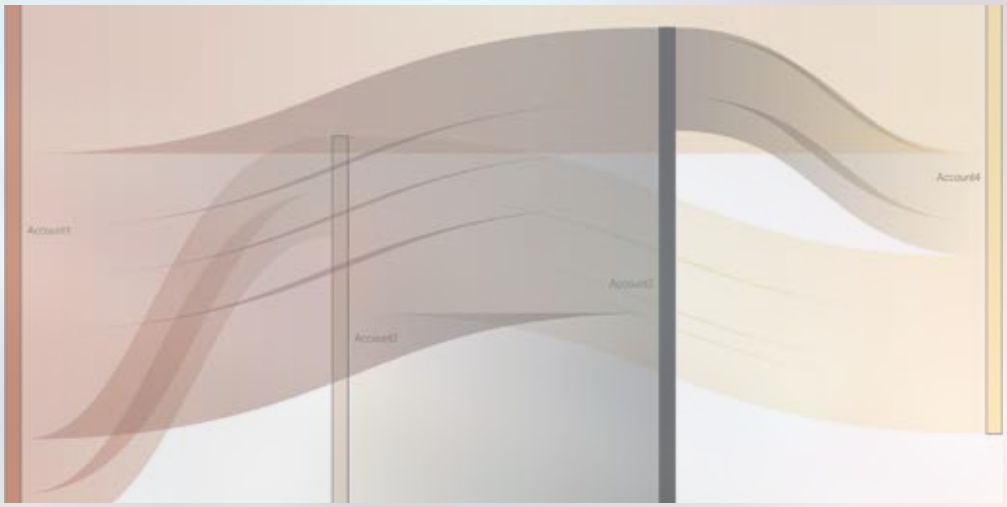

Figure 1 - example of a Sankey diagram

a steam engine, Sankey diagrams are a type of flow diagram in which the strength of linkage between two entities is depicted by the thickness of the interconnecting line. In their twenty-first century form, these charts are interactive such that the connections can be explored and the source and destination of assets can be tracked and demonstrated through multiple intermediate stages.

Chord diagrams *(see Figure 2)*

This type of visualisation, also known as a Hierarchical Edge Bundling chart, is another way of depicting the extent of flows and linkages between entities. Chord diagrams are named after the line which connects two points on a circle.

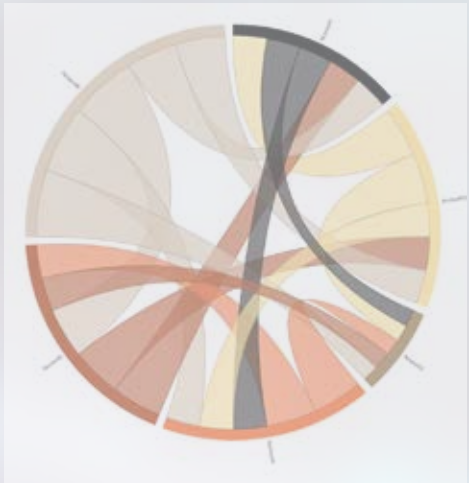

Figure 2 - example of a Chord diagram

Edge bundling is a technique for combining similar end points, such as bank accounts or corporations, to simplify and make such visualisations more useful. Again, the charts are interactive and enable the investigator to explore the linkages and gain an alternative perspective that may elude them when examining tables of data or link charts.

If these types of visualisation do not suit the specific situation or the investigator's preferences, there are many more that can be easily connected to the underlying investigation data repository irrespective of the underlying database. Whether they are a stand-alone tool or from an open-source, there are libraries of pre-built visualisations that are designed to be displayed and to enable interaction with data in any web browser.

Whatever the intended output, the key to enabling the use of all of these visualisations is the design of the digital repository. It is essential that the information store is configured in such a way that it is capable of supporting the intended outputs.

Dashboards

All of the hard work and ingenuity that we have described in this chapter would be wasted without an effective interface between the data and the human mind. In this context, dashboards are user interfaces which enable the investigator to easily peruse the data, drill into specific transactions to examine the underlying evidence and tweak assumptions at the click of button. Typically

delivered through a web-browser so that teams can be distributed between firms and jurisdictions, such dashboards may be customised to match the needs of the case and even those of each type of user.

As we have explained, one of the main benefits of data analytics and data visualisation is that the investigator can apply a range of assumptions and examine their effects. The dashboards are designed to be interactive, enabling a non-data scientist to effectively work with the information. Filters are used to change the views, date ranges or specific entities may be selected and the visualisations programmed to change in response. The user may drill down on specific transactions to view the associated documents and even add details and record inferences.

To achieve this interactivity, the dashboard brings together many of the features described previously: for example, data visualisations illustrating the flows of assets, simple lists of transactions and panels displaying related documents such as bank statements or emails.

Presenting the findings

Historically, the output from an asset tracing exercise was presented to courts in long written reports carefully narrating each transaction and the associated evidence. Such reports were accompanied by static charts which reflected the effect of the reported transactions.

The clarity and usability of the outputs from asset tracing investigations has been transformed by the use of interactive visualisations and dashboards of the type described above. The effectiveness of the presentation of the facts of the case is enhanced and the networks of asset flows and entities may be explored and reworked by the parties or the judge as the matter proceeds and more evidence is uncovered. It may be that the best way of presenting the findings of an asset tracing case, today or in the future, is by way of live modelling of the data in a courtroom, using data visualisation tools – with all the flexing of the model fully explained by the operator, and with the model and assumptions disclosed to the other side, so that it can carry out its own testing and validation.

Conclusion

As we have explained, the core challenges of asset tracing remain managing and interpreting large volumes of disparate data, to achieve the overall goal of finding and recovering the assets. What has changed is that both the volume of data and the variety of data sources have increased alongside relentless innovation in financial services and payment processing. Helpfully, technologies have been developed that enable the forensic accountant to better meet these challenges. With careful planning and an integrated multi-disciplinary team, effective and efficient asset tracing can be achieved. The key aspects of such an approach include:

- The integration of structured and unstructured data to enable seamless switching between transactions and the underlying documents and the provision of this information through interactive dashboards and eDiscovery platforms.
- Exploiting data visualisation techniques to portray transaction flows and asset movements in a way that enables better assessment of the evidence and communication of the findings.
- The use of advanced data analytics to automate repetitive matching tasks and uncover hidden connections between transactions, events and entities.

But it is important to recognise that such an approach does not replace the requirement for the investigative skills of the forensic accountant. Rather, the use of technology should be seen as an enabler – providing the investigator with the time, space and facilities to deploy their own, unique skills to answer the question of "Where has all the money gone?" and help to recover assets for their client.

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Mason helps his clients assess allegations of misconduct and respond to regulatory investigations by applying data analytics to narrow the investigative focus, map relationships between disparate systems and identify data patterns and irregularities to derive conclusions based on electronic evidence. He also provides risk assessment, litigation and disputes consulting services and has extensive experience with compliance monitorships post government settlement.

On the proactive side, Mason helps enterprises design and implement analytics-led compliance monitoring and anti-fraud/bribery/corruption solutions to enable enterprises to continuously detect, understand and manage their risks while complying with new regulations and enforcement activity.

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