

Combating Money Laundering with Digital Technologies

Javor, Nina

Master's thesis / Diplomski rad

2020

Degree Grantor / Ustanova koja je dodijelila akademski / stručni stupanj: **University of Zagreb, Faculty of Economics and Business / Sveučilište u Zagrebu, Ekonomski fakultet**

Permanent link / Trajna poveznica: <https://um.nsk.hr/um:nbn:hr:148:752771>

Rights / Prava: [Attribution-NonCommercial-ShareAlike 3.0 Unported/Imenovanje-Nekomercijalno-Dijeli pod istim uvjetima 3.0](#)

Download date / Datum preuzimanja: **2025-01-31**



Repository / Repozitorij:

[REPEFZG - Digital Repository - Faculty of Economics & Business Zagreb](#)



University of Zagreb
Faculty of Economics and Business
Managerial Informatics

**COMBATING MONEY LAUNDERING WITH DIGITAL
TECHNOLOGIES**

Master thesis

Nina Javor, 0067615118

Mentor: Mario Spremić

Zagreb, September 2020

Abstract

The main goal of this master thesis is to examine the practice of money laundering as well as to demonstrate how select emerging digital technologies can significantly assist in combating it. Throughout the paper, money laundering is explained in much detail, including its three-step process and several different methods it can utilize. In addition, its use cases are also presented as well as several biggest money laundering scandals uncovered so far. Next, numerous digital technologies and their utilizations for anti-money laundering purposes are examined, while simultaneously covering the basics of anti-money laundering programs. Moreover, success stories of the top anti-money laundering solutions providers are presented as well as examples of some recent happenings. Finally, there is a discussion on the impact of the COVID-19 pandemic on money laundering, its predicate offences, and anti-money laundering efforts. Therefore, this paper provides an overview of money laundering and how to effectively battle it using new technologies.

Key words: money laundering, anti-money laundering solutions, digital technologies

Table of Contents

1. INTRODUCTION	1
1.1 INTRODUCTION AND MASTER THESIS GOALS	1
1.2 DATA SOURCES AND COLLECTION METHODS	1
1.3 MASTER THESIS CONTENT AND STRUCTURE	2
2. MONEY LAUNDERING	3
2.1 LITERATURE REVIEW ON MONEY LAUNDERING	3
2.2 INTRODUCTION TO MONEY LAUNDERING	5
2.3 MONEY LAUNDERING CYCLE	7
2.4 MONEY LAUNDERING METHODS	13
2.5 USE CASES	20
2.6 PROFESSIONAL MONEY LAUNDERING	26
2.7 BIGGEST MONEY LAUNDERING SCANDALS	27
3. DIGITAL TECHNOLOGIES FOR ANTI-MONEY LAUNDERING	30
3.1 LITERATURE REVIEW ON THE USE OF DIGITAL TECHNOLOGIES FOR ANTI-MONEY LAUNDERING	30
3.2 INTRODUCTION TO DIGITAL TECHNOLOGIES	31
3.3 USING DIGITAL TECHNOLOGIES FOR ANTI-MONEY LAUNDERING	38
3.4 ANTI-MONEY LAUNDERING SOLUTIONS	50
4. CRITICAL REFLECTION ON THE CURRENT SITUATION AND FUTURE OUTLOOK	55
4.1 EXAMPLES AND CASE STUDIES	55
4.2 DISCUSSION ON COVID-19'S IMPACT ON MONEY LAUNDERING	59
4.3 DISCUSSION ON THE FUTURE OF ANTI-MONEY LAUNDERING SOLUTIONS	65
5. CONCLUSION	67
REFERENCES	70
TABLE OF FIGURES	83

1. Introduction

1.1 Introduction and master thesis goals

United Nations Office on Drugs and Crime reports that it is estimated that somewhere between \$800 billion and \$2 trillion, which translates into 2 – 5% of global GDP, is being laundered across the globe annually.¹ Given these facts, it is obvious that the problem of money laundering is real as it represents a very serious challenge when trying to combat it. Simply put, money laundering is the illegal process of making the “dirty” proceeds or money gotten from illegal activities appear as it has been legally obtained.² When looking at the recent technological innovations, they have both had a positive as well as a negative impact on the practice of money laundering globally. To be more precise, as financial information, technology, and communication advance, money is being able to be moved around the world quicker and easier than ever before, which just adds on to the importance of having good anti-money laundering solutions in place. On the other hand, as digital technologies mature, more and more companies are able to create new innovative software solutions with the aim of combating money laundering. Therefore, the goal of this master thesis is to thoroughly explain and examine money laundering as well as demonstrate how some of the latest digital technologies can be used in order to help with combating money laundering.

1.2 Data sources and collection methods

This paper will be defining different terms and concepts by reviewing various literature, explaining these concepts through various real-life examples, analyzing numerous reports and researches, examining case studies, exploring different anti-money laundering solutions, and discussing the current money laundering situation and future predictions. In order to be able to write this master thesis and support all the claims that will be made, a vast variety of sources will be used. Some of them include online books, reports written by world known companies and organizations, and some articles published on selected accredited news pages. The full reference list can be found at the end

¹United Nations Office on Drugs and Crime, (n.d.). *Money-Laundering and Globalization*. [Online] Available at: <https://www.unodc.org/unodc/en/money-laundering/globalization.html> [Accessed 12 June 2020].

²International Compliance Organization, (n.d.). *What is Money Laundering?*. [Online] Available at: <https://www.int-comp.org/careers/your-career-in-aml/what-is-money-laundering/> [Accessed 12 June 2020].

of this paper and among many other, it includes reports from Association of Certified Anti-Money Laundering Specialists (ACAMS), BAE Systems, Deloitte, Europol, EY, Financial Action Task Force (FATF), International Compliance Organization, McKinsey & Company, NICE Actimize, Oracle, SAS, United Nations Office on Drugs and Crime, and the World Bank.

1.3 Master thesis content and structure

This master thesis will consist of three distinct parts, each with its own purpose. After introducing the topic and stating some general facts about the thesis, different aspects of money laundering will be explained and thoroughly analyzed. These will include some general information about money laundering, how it works or its cycle, some of the most common methods used by criminals to launder money, its use cases which are typically other crimes where criminals need to launder their proceeds, the practice of professional money laundering, and some of the biggest money laundering scandals known so far. When explaining these concepts, different examples will be used in order to better explain them and demonstrate how these concepts would work in real life.

The second part of the paper will be focused on some digital technologies that currently exist and their use for anti-money laundering purposes. Some of these technologies include big data, network analytics, deep learning and machine learning which are subsets of artificial intelligence, advanced analytics, robotic process automation, and blockchain. After explaining all these technologies, their respective applications for anti-money laundering will be systematically discussed and analyzed. Next, some of the actual solutions for money laundering that currently exist on the market will be reviewed, including the ones from NICE Actimize, SAS, and BAE Systems and will all be accompanied by real life stories from their clients in order to show how they perform in practice.

The last big chapter of the paper will be focused on analyzing the current world situation with regards to money laundering as well as some of the predictions for the future. An important part of this chapter will be the one with the focus on the coronavirus crisis and its impact on money laundering and anti-money laundering efforts, as well as the way it has and it will keep on influencing other financial crimes, and other offences as they are all connected to money laundering because criminals need to “legalize” their money somehow. Since this is the last big chapter of the paper, it will be followed by a conclusion and some general closing thoughts.

2. Money laundering

2.1 Literature review on money laundering

As a prerequisite for writing this master thesis, it was crucial to conduct a thorough literature review and get familiarized with reports that have already been published, in addition to learning about all the different aspects of money laundering. Some of the superior e-books about money laundering that are freely accessible online include the Association of Certified Anti-Money Laundering Specialists' Study Guide for the CAMS Examination, Sullivan's *Anti-Money Laundering in a Nutshell*, Cox' *Handbook of Anti-Money Laundering*, Reuter and Truman's *Chasing Dirty Money*, and Schott's *Reference Guide to Anti-Money Laundering and Combating the Financing of Terrorism*.

Even though all of these resources are a great way to start learning about money laundering and its numerous distinguishing and interesting features, each one of these e-books approaches the topic in a slightly different way, focusing on different parts of laundering or looking at it from a different standpoint. For example, ACAMS' Study Guide for the CAMS Examination does an excellent job explaining all the concepts that the professionals must know, ranging from all general information about money laundering to compliance and conducting investigations. This piece also gives particular attention to all the possible methods of laundering by thoroughly explaining them and all the concepts connected to them as well as their risks.³ Similarly, Sullivan's *Anti-Money Laundering in a Nutshell* also systematically examines a lot of the methods as well as the general laundering cycle, in addition to also discussing international anti-money laundering standards and programs.⁴ To the contrary, Cox' *Handbook of Anti-Money Laundering* takes on a more practical standpoint by providing recent regulations as well as guidance for implementation. Therefore, this publication is a superb choice for someone who needs less theoretical facts about money laundering and more real-life implementations through various means.⁵ Next, in their book called *Chasing*

³ Association of Certified Anti-Money Laundering Specialists (ACAMS), (2012). *Study Guide for CAMS the Certification Examination*. [Online] Available at: http://higherlogicdownload.s3.amazonaws.com/ACAMS/e91557e6-bbb6-4fc9-9b7c-eeef66256706a/UploadedImages/pdf/%20downloads/StudyGuides/2012_English_Study_Guide.pdf [Accessed 13 June 2020].

⁴ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress. Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

⁵ Cox, D., (2014). *Handbook of Anti-Money Laundering*. [Online]. ProQuest. Available at: https://ebookcentral.proquest.com/lib/efzg/detail.action?docID=1809740&query=Anti-money+lauding#goto_toc [Accessed 12 June 2020].

Dirty Money, Reuter and Truman also take a different approach to the practice of money laundering, again considering it from another aspect. They focus their work on studying the scale and characteristics of money laundering and the existing anti-money laundering system, in addition to developing a framework for assessing its quality.⁶ On the other hand, Schott's Reference Guide to Anti-Money Laundering and Combating the Financing of Terrorism first introduces its readers with the main ideas of money laundering before moving on to the more complex, real-life concepts. The guide is written in a way that it is meant to represent a comprehensive source of real-world information, particularly useful to countries combating money laundering and terrorist financing.⁷

However, if someone is more interested in the use cases of money laundering, that is the offences that eventually lead to people needing to launder their proceeds, there are numerous reports on such topics by the United Nations Office on Drugs and Crime, in addition to a report of Global Financial Integrity. Moreover, Europol has also published several reports on different topics with astonishing statistics and real-life cases. Likewise, the Financial Action Task Force has also issued many reports about money laundering, risks connected to laundering money, and some different methods, just to name a few. Personally, I find the report of Global Financial Integrity very interesting and useful as it approaches the majority of laundering use cases with actual numbers and gives insight into how big those problems actually are, while simultaneously giving the same amount of attention to all the use cases presented. In my opinion, if someone would like to educate themselves on all the crimes connected to money laundering, this is the optimal report.⁸ Furthermore, I would also recommend Europol's Why is cash still king report as it offers great insights into using cash for money laundering while also answering some very interesting questions about it such as why do criminals use cash and what is known about criminal cash.⁹ All in all, I think the sufficient amount of resources on money laundering is available online, either in a form of reports, e-books, websites, or articles, giving anyone wanting to learn about money laundering great tools to do so.

⁶ Reuter, P. & Truman, E. M., (2004). *Chasing Dirty Money*. [Online]. PIIE. Available at: <https://www.piie.com/bookstore/chasing-dirty-money-fight-against-money-laundering>. [Accessed 14 June 2020].

⁷ Schott, P. A., (2006). *Reference Guide to Anti-Money Laundering and Combating the Financing of Terrorism*. [Online]. World Bank. Available at: http://siteresources.worldbank.org/EXTAML/Resources/396511-1146581427871/Reference_Guide_AMLCFT_2ndSupplement.pdf [Accessed 13 June 2020].

⁸ May, C., (2017). *Transnational Crime and the Developing World*. [Online]. Global Financial Integrity. Available at: https://secureservercdn.net/45.40.149.159/34n.8bd.myftpupload.com/wp-content/uploads/2017/03/Transnational_Crime-final.pdf [Accessed 19 June 2020].

⁹ Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

2.2 Introduction to money laundering

The term money laundering dates back to the beginning of the 20th century, more precisely the 1920s, which are considered to be a gangster era of the American history. As gambling, prostitution, and sales of alcohol were booming during that time, people were generating a lot of cash that needed to be laundered in order for the government to not know the true origins of their funds. Because of this, a method for disguising the sources of gangsters' funds had to be invented as they could not just put the funds directly to the bank. The reason why this money could not just be deposited into a bank is that it would raise numerous questions as the bank, and ultimately the government, would wish to know the source of the funds, and the gangster would not be able to provide a legitimate explanation. In addition, the funds could not just be spent on numerous luxury items as that would again raise suspicion. Furthermore, these funds were oftentimes in small dollar bills and low-value coins which only added to the gangsters' problems as storing large amounts of it was challenging.¹⁰

Therefore, in order to try to solve their problems of storing money and ultimately enjoying it without raising any concerns, the criminals opted to start their own legitimate businesses such as laundromats, with the purpose of assisting them in making their illegally-obtained money appear legitimate. Since large amounts of coins were used at laundromats on a daily basis, this business model represented a great way for money launderers to hide the true origins of their funds. The gangsters would use this money to “wash clothes”, keeping in mind that the true amount of coins used to actually wash clothes was far less than the amount they made it appear has been used, hence the term *money laundering*.¹¹ “By mixing legitimate and illegitimate funds, the entire amount could potentially appear to be legitimate, and would therefore have been laundered, achieving the objectives of the money launderer. The funds will appear to have come from the legitimate business whereas some of the funds actually have arisen from criminal activity of some type.”¹² To illustrate this concept with a simple example, consider a business that usually takes in approximately

¹⁰ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress.

Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

¹¹ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress.

Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

¹² Cox, D., (2014). *Handbook of Anti-Money Laundering*. [Online]. ProQuest. Available at:

https://ebookcentral.proquest.com/lib/efzg/detail.action?docID=1809740&query=Anti-money+lauding#goto_toc [Accessed 12 June 2020].

\$20 000 in cash on a monthly basis. The big question is if anyone notice if the business' monthly profits increase to \$25 000. Since the vast majority of the profits is actually legitimate, is it very difficult for a financial institution to recognize that the last \$5 000 does not actually come from the main revenue stream and are indeed proceeds from an illegal act that are just being laundered through the business.¹³

Nowadays, money laundering is simply defined as “the practice of integrating the proceeds of criminal enterprises into the legitimate mainstream of the financial community”¹⁴ or put in a more complex way, “the conversion or transfer of property, knowing it is derived from a criminal offense, for the purpose of concealing or disguising its illicit origin or of assisting any person who is involved in the commission of the crime to evade the legal consequences of his actions”.¹⁵ Both of these definitions essentially translate into people trying to make their money gotten from various crimes look like it has been legally obtained so that they can enjoy it in any way they want, which represents their main motivation for laundering. On the other hand, they also “need” to launder their money because of several reasons, including that the financial system might be the safest place for them to keep their money, the ability to move the proceeds around the globe quickly, and not being suspicious to the authorities once the spending starts. Therefore, the process of money laundering represents a key stage for drug traffickers, terrorists, organized criminals, inside dealers, and many more who need to avoid any kind of unwanted attention from the authorities once they become wealthy due to their unlawful activities. Precisely because money laundering is used to “legalize” the profits from different kinds of crimes, is money laundering considered to be illegal. The reasoning behind this is that it is considered wrong to provide financial services as well as assist criminals to benefit from their crimes as that would serve as an endorsement for their actions.¹⁶

¹³ Cox, D., (2014). *Handbook of Anti-Money Laundering*. [Online]. ProQuest. Available at: https://ebookcentral.proquest.com/lib/efzg/detail.action?docID=1809740&query=Anti-money+lauding#goto_toc [Accessed 12 June 2020].

¹⁴ ¹⁵ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress. Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

¹⁶ International Compliance Organization, (n.d.). *What is Money Laundering?*. [Online] Available at: <https://www.int-comp.org/careers/your-career-in-aml/what-is-money-laundering/> [Accessed 12 June 2020].

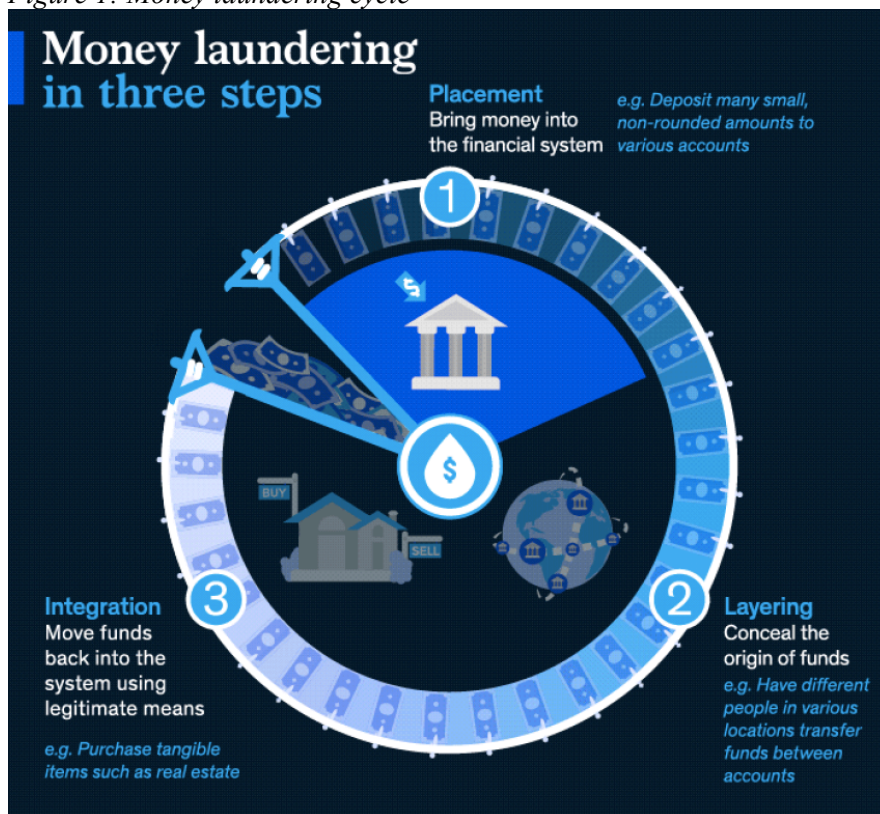
2.3 Money laundering cycle

Even though money laundering is used to disguise the origins of funds that are a result of numerous different types of crimes, the process or the laundering cycle always consists of three distinct phases or steps. As seen in Figure 1 below, those are:

1. placement
2. layering
3. integration.

In the simplest terms, placement involves introducing the “dirty” money into the financial system, layering includes performing many complex transactions so that the funds are being moved around in a way that they are not leaving any trail behind, and integration implicates that “clean” funds are reintegrated into the legitimate economic and financial system.¹⁷

Figure 1: Money laundering cycle



Source: Richardson, B., Williams, D. & Mikkels, D.,(2019). *Network analytics and the fight against money laundering*. [Online]. McKinsey & Company. Available at: <https://www.mckinsey.com/business-functions/risk/our-insights/transforming-approaches-to-aml-and-financial-crime> [Accessed 13 June 2020].

¹⁷ Global Organization of Parliamentarians Against Corruption (GOPAC), (2012). *Anti-Money Laundering Action Guide for Parliamentarians*. [Online]. GOPAC Network Available at: http://www.gopacnetwork.org/Docs/GOPAC_AML_ActionGuide_EN.pdf [Accessed 13 June 2020].

Placement

Placement denotes the first step in the laundering process, which happens directly after the funds have been illegally obtained due to a crime being committed. In this stage, criminals physically take their funds and aim to introduce them into the financial system in order for the laundering process to be able to take place. This step is most commonly done through a financial institution, but other ways also exist and will be discussed shortly. Introduction to the financial system can be done in multiple ways including depositing cash, exchanging currencies, converting the funds into financial instruments, purchase of a security or any form of an insurance contract. In order not to bring any attention to themselves, money launderers break their cash bills into smaller ones and deposit them over time and at different locations of either a single financial institution or multiple different ones. Similarly, when converting their proceeds into different currencies, they also tend to change the denominations of their bills for the same reason.¹⁸

It is important to note that placement is not just the movement of cash into the financial system, but any action that allows the money launderer to proceed to the next phase of layering by moving the illegal funds away from their original source and into some other form. To elaborate, the placement step can be done through purchase of paintings, antiques, stamps, coins, investment products, new or used cars, boats, casino chips, lottery tickets, premium bonds, company shares, commodities, precious metals, and many other. The logic that underpins this is that the launderer can buy an item, sell it later, and have a legitimate explanation of the funds' origins. Moreover, launderers are also known to target people or businesses that are known to be struggling financially in some way. For example, if a bank branch is identified as being pressured to increase its deposits, the launderers will consider it their target. Likewise, if launderers know of a bank that is considered to be struggling with its liquidity, they will also target it for placement. Essentially, the placement phase is only as limited as the launderer's creativity as there are countless ways to perform it.¹⁹

¹⁸ Schott, P. A., (2006). *Reference Guide to Anti-Money Laundering and Combating the Financing of Terrorism*. [Online]. World Bank. Available at: http://siteresources.worldbank.org/EXTAML/Resources/396511-1146581427871/Reference_Guide_AMLCFT_2ndSupplement.pdf [Accessed 13 June 2020].

¹⁹ Cox, D., (2014). *Handbook of Anti-Money Laundering*. [Online]. ProQuest. Available at: https://ebookcentral.proquest.com/lib/efzg/detail.action?docID=1809740&query=Anti-money+lauding#goto_toc [Accessed 12 June 2020].

Layering

Once the funds have passed through the placement phase of the process, the layering phase is ready to start. The main goal of this stage is to separate the illegal proceeds from their original source in a way that it is not easily traceable as well as so that the location of the funds at a given time is not clear. As not everyone launders money the same way, this step can be as simple as investing into something legitimate, but can also be a series of complex transactions that create layers across the globe. Some examples of simpler processes include purchases of antiques, paintings, and stamps that can be privately acquired with no formal records of the purchase or sale. This is a great option for a money launderer because they can acquire the goods privately and can then explain their possession of the goods as if they have inherited them, found them, or got them from someone.²⁰ Another option is to purchase bigger items such as cars, boats, and planes and register them by another person's name for example a friend, relative, student, or a senior. The incentive for these people is money that is paid to them by the launderer for the deal.²¹

In some other laundering cases, launderers will opt for much more complex schemes that involve moving money around between numerous accounts, jurisdictions, and companies to try to make sure that the trail of their funds is as complicated and confusing as possible. Conducting these transactions eventually makes the trail very ambiguous and breaks any connections between these funds and the original criminal ones. When the laundering is being done by a professional launderer it is possible that the funds “spin” for up to ten times before proceeding to the final stage of the cycle.²² Some of these layering transactions include “wire transfers from one account, institution or jurisdiction to another one, converting deposited cash into monetary instruments, bonds, stocks or life insurance, investing in real estate and legitimate businesses, and using shell companies or other such structures with the same purpose of obstructing the ownership of the assets”.²³

²⁰ ²² Cox, D., (2014). *Handbook of Anti-Money Laundering*. [Online]. ProQuest. Available at: https://ebookcentral.proquest.com/lib/efzg/detail.action?docID=1809740&query=Anti-money+laundrying#goto_toc [Accessed 12 June 2020].

²¹ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress. Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

²³ Association of Certified Anti-Money Laundering Specialists (ACAMS), (2012). *Study Guide for CAMS the Certification Examination*. [Online] Available at: http://higherlogicdownload.s3.amazonaws.com/ACAMS/e91557e6-bbb6-4fc9-9b7c-ee66256706a/UploadedImages/pdf%20downloads/StudyGuides/2012_English_Study_Guide.pdf [Accessed 13 June 2020].

Integration

After the first two stages of the cycle have been successfully performed, it is time for the last one, namely the integration phase. In this stage, the criminal proceeds and re-integrated into the legitimate financial system and can now be returned to and used by the money launderer, as they will look like they come from a legitimate source. Therefore, in this stage the money launderer strives to successfully integrate the illegally-gotten funds with the legitimate ones in order for the distinction between the two to become almost invisible and so they can be used for any purpose the launderer wants. By doing this, the criminal also hopes to perform this in a way that does not draw any unwanted attention or suspicion to themselves for it could ruin the whole process, as it is oftentimes the case that the criminal's greed eventually gets them caught.²⁴

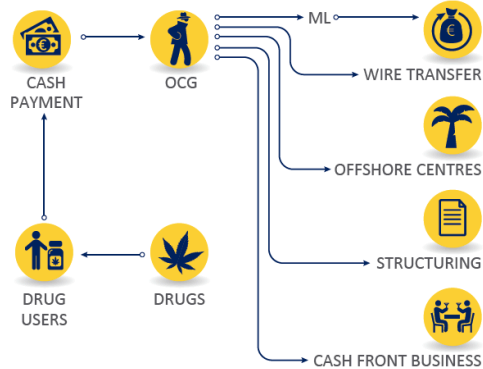
Like in any other stage of the laundering cycle, integration can also take numerous different forms, which makes it that much more challenging to spot. One of the simplest methods of integration is transferring funds to a legitimate bank account from a shell bank that is in the ownership of the launderer. Another way is to send inflated invoices in which the goods and services are overvalued thus making it possible to transfer funds internationally, with these invoices acting like confirmations of origins of the money. Due to secrecy being guaranteed in some countries, launderers are also able to “open anonymous companies, grant themselves loans from the laundered money when a future legal transaction occurs, increase profits, and even claim tax relief on the loan repayments”. Next, the integration can also happen through the use of trading accounts in a way that the launderer transfers the illegal funds into an open brokerage account so that the funds can be traded by a financial institution. Once the funds have been traded and therefore laundered, the launderer takes them back. Another technique is selling the acquired assets and preferably collecting the payment digitally to a legitimate account. Of course, these are just a few of the possibilities for launderers as they can also choose to invest in real estate and luxury assets or can decide on a completely different integration method. The main objective for the launderer at this stage is to try to increase their actual wealth with their crime proceeds in any way possible.²⁵

²⁴ ²⁵ Cox, D., (2014). *Handbook of Anti-Money Laundering*. [Online]. ProQuest. Available at: https://ebookcentral.proquest.com/lib/efzg/detail.action?docID=1809740&query=Anti-money+lauding#goto_toc [Accessed 12 June 2020].

Laundry cycle example

The following figure represents some of the options criminals, or in this case drug traffickers, have when starting their laundering process, and also pictures the overall process that leads to them having to launder their proceeds. To clarify, OCG in the figure stands for organized crime group.

Figure 2: Money laundering options example



Source: Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020]

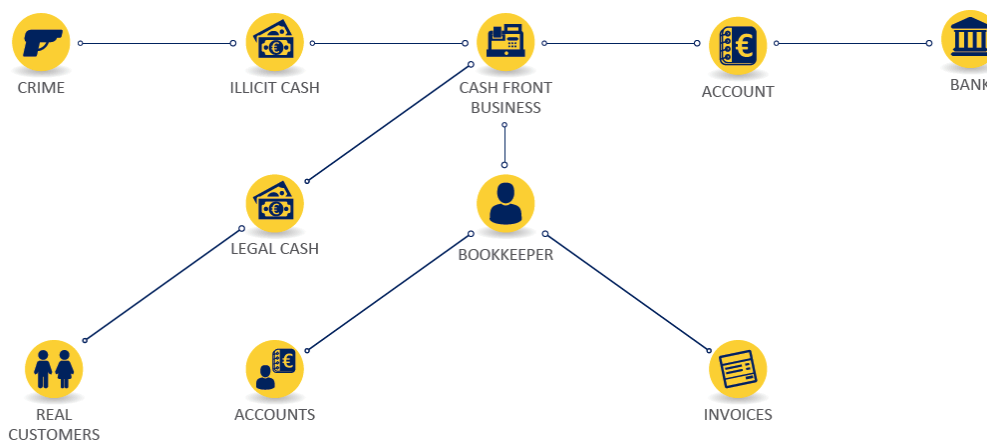
To better illustrate how the three-step laundering process works in practice, consider a simple case example that can originally be found in Sullivan's *Anti-Money Laundering in a Nutshell*. Even though this is a very basic example, it manages to capture all the different steps of the money laundering process. Let there be a drug dealer that usually sells about \$20 000 worth of drugs a week, but is in fact unemployed. This drug dealer realizes that he cannot just go into a bank and deposit all of his money because he would seem very suspicious as he does not have a legitimate source of income that would explain where he gets that much money on a fairly regular basis. This is where the drug dealer turns to money laundering and its three-step process. With that being said, he first needs to convert his illegally-gotten money into a subtle form (placement), then he needs to make sure that the money cannot be easily connected to its true origins (layering), and finally he needs to make it look like he obtained the money from a legal source (integration) so that he can do whatever he wants with it.

For the laundering, this drug dealer decides to pay another person to act as his nominee, meaning that the person would only be in charge of an account or a business on paper, while the dealer would be the true owner. By using this nominee's account, the dealer slowly puts money into the

account by depositing smaller amounts of cash so that he does not raise any red flags at his bank. When there is enough money in the account to buy a legitimate business, for example a pizza place, he purchases it, which means that the placement of his dirty money is done. Due to the fact that he does not use his own name when purchasing the business, but the one of a nominee, layering is also done as the funds cannot be traced back to the dealer or his criminal activity. Finally, as the dealer can now have proof of his employment, he becomes eligible for credit at a bank which then enables him to buy himself a real estate property, for example. This means that he has now completed his money laundering cycle as he can provide legitimate explanation of his funds which he has successfully re-integrated into the legitimate system.

The reason why this money launderer appears to launder money successfully this way is that he mixes his dirty money with the legitimate money from the pizza place. To clarify, assume he makes cash deposits of \$3 000 on a daily basis, making it look like his business is a huge success as the revenues are outstanding. However, the law enforcement surveillance recognizes that the pizza place does not appear to do that much business and with further investigation, they conclude that the purchases of supplies do not reflect the \$3 000 daily demand. Upon the closure of their investigation, the law enforcement establishes that the pizza place was a forefront of a money laundering operation, which leads to the drug dealer being arrested and his assets seized.²⁶ A visual representation of this laundering model can be seen in the figure below.

Figure 3: Cash-based business laundering example



Source: Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

²⁶ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress. Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

2.4 Money laundering methods

Unlike most of the other crimes that are being committed around the world, money laundering has the distinguishing feature of having numerous different methods, forms, participants, and settings.²⁷ Due to the scope of this paper as well as the diversity and number of different methods that are currently known to the officials, only a selected few methods that are considered to be some of the more common ones will be discussed. However, the following figure does include all the methods recognized by the Association of Certified Anti-Money Laundering Specialists (ACAMS).²⁸

Figure 4: Money laundering methods

Banks and other depository institutions	Non-financial institutions	Non-financial businesses and professionals
<ul style="list-style-type: none"> • electronic transfer of funds • correspondent banking • payable-through accounts • concentration accounts • private banking • structuring • bank complicity • credit unions/building societies 	<ul style="list-style-type: none"> • credit card industry • money remitters and money exchange houses • insurance companies • securities 	<ul style="list-style-type: none"> • casinos and other gambling venues • dealers in high-value items • travel agencies • vehicle sellers • gatekeepers: notaries, accountants, auditors, lawyers • investment and commodity advisors • trust and company service providers • real estate industry • manipulation of prices (import/export) • black market peso exchange

Source: made by the author of this master thesis

As can be seen in Figure 4, all the money laundering methods are divided into three separate categories depending on the institutions or businesses involved in the scheme. It is also worth noting that due to numerous governments implementing some anti-money laundering obligations for the banking sector in the recent years, “there has been a shift away from the traditional banking sector and towards the non-bank financial sector as well as to non-financial businesses and professions”.²⁹

²⁷ Reuter, P. & Truman, E. M., (2004). *Chasing Dirty Money*. [Online]. PIIE. Available at: <https://www.piie.com/bookstore/chasing-dirty-money-fight-against-money-laundering> [Accessed 14 June 2020].

²⁸ ²⁹ Association of Certified Anti-Money Laundering Specialists (ACAMS), (2012). *Study Guide for CAMS the Certification Examination*. [Online] Available at: http://higherlogicdownload.s3.amazonaws.com/ACAMS/e91557e6-bbb6-4fc9-9b7c-eeef66256706a/UploadedImages/pdf%20downloads/StudyGuides/2012_English_Study_Guide.pdf [Accessed 13 June 2020].

Cash smuggling

Cash smuggling is thought to be one of the oldest placement techniques, and is considered to be increasingly used by the launderers, possibly due to banks having better anti-money laundering measures put in place.³⁰ To illustrate the magnitude of the matter, in 2013, there was more than 520 people arrested in the United States alone as they were trying to smuggle money across the border that accumulated to more than \$59 million.³¹ Furthermore, in 2005 Financial Action Task Force, referring to the EUR 500 banknote, stated “countries should give consideration to the elimination of large denomination banknotes ... used by cash smugglers to substantially reduce the physical size of cash shipments ... and by doing so, significantly complicate detection exercises”.³²

The definition of cash smuggling states that it is physically carrying money to different locations by hiding in on a person, in luggage, cars, boats, cargo, or any other mean. As this is a method most used for the placement stage of the three-stage process, its main goal is to physically move the cash offshore and into a country that has strict bank secrecy laws in order for the layering to be able to begin. In the more recent years, launderers have become more innovative and have started to place the bulk cash into automobile transmissions, television sets, battery chargers, electrical appliances, diaper boxes, and grocery goods. Furthermore, they have also been opting for more creative ways such as putting their money onto private planes, airline couriers, commercial vessels, and even the U.S. Postal Service, UPS, or FedEx. Some launderers even go so far that they acquire shipping businesses so that they have the option of storing the money into the goods. Another method used by the criminals is to firstly “convert the cash into negotiable instruments such as traveler’s checks and money orders before shipping it to overseas banks”.³³ However, one of the most extreme methods that has been detected so far is definitely that of cash swallowing in which cash couriers physically swallow pellets of high denomination notes and then transport them.³⁴

³⁰ Reuter, P. & Truman, E. M., (2004). *Chasing Dirty Money*. [Online]. PIIE. Available at: <https://www.piie.com/bookstore/chasing-dirty-money-fight-against-money-laundering> [Accessed 14 June 2020].

³¹ U.S. Immigration and Customs Enforcement, (2018). *Combating Bulk Cash Smuggling*. [Online] Available at: <https://www.ice.gov/bulk-cash-smuggling-center/faq> [Accessed 14 June 2020].

³² Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

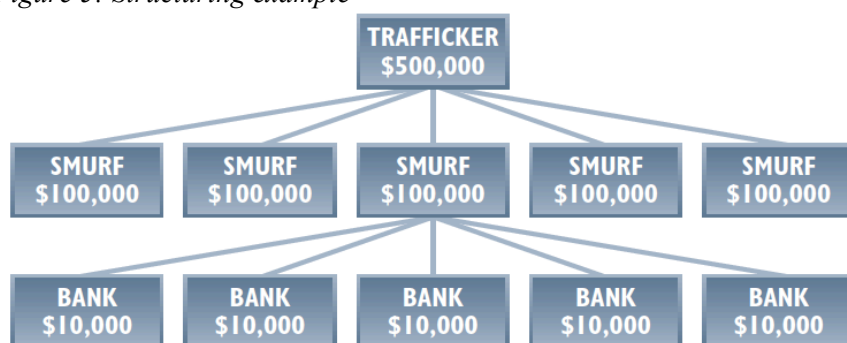
³³ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress. Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

³⁴ Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

Structuring

Structuring or smurfing is “the act of parcelling what would otherwise be a large financial transaction into a series of smaller transactions to avoid scrutiny by regulators or law enforcement. Typically, each of the smaller transactions is executed in an amount below some statutory limit that normally does not require a financial institution to file a suspicious transaction/activity report with a government agency. Criminal enterprises often employ several agents (smurfs) to make the transactions.”³⁵ This technique is possibly the most commonly known money laundering method and is usually used in jurisdictions with compulsory currency reporting requirements. A graphical representation of this method is presented in the figure below.

Figure 5: Structuring example



Source: Global Organization of Parliamentarians Against Corruption (GOPAC), (2012). *Anti-Money Laundering Action Guide for Parliamentarians*. [Online]. GOPAC Network. Available at: http://www.gopacnetwork.org/Docs/GOPAC_AML_ActionGuide_EN.pdf [Accessed 13 June 2020].

Over the years, a new form of smurfing called cuckoo smurfing has surfaced. It is considered a “form money laundering related to alternative remittance systems in which illegally-gotten funds are moved through the account of innocent people who are in fact expecting some funds or payments from someone overseas”. Since in cuckoo smurfing people are unknowingly being used for depositing money into their accounts, whereas in traditional structuring smurfs are used, this represents the key difference between the two methods. Additionally, cuckoo smurfing also requires an insider within a financial institution to help facilitate the transactions.³⁶

³⁵ Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

³⁶ Association of Certified Anti-Money Laundering Specialists (ACAMS), (2012). *Study Guide for CAMS the Certification Examination*. [Online] Available at: http://higherlogicdownload.s3.amazonaws.com/ACAMS/e91557e6-bbb6-4fc9-9b7c-ee66256706a/UploadedImages/pdf%20downloads/StudyGuides/2012_English_Study_Guide.pdf [Accessed 13 June 2020].

Casinos and other gambling venues

Historically, the gambling industry has been known to be used for money laundering as it provides the launderers with the opportunity to have a legitimate explanation of how they acquired their funds. Most of the gambling businesses are predominantly cash-based, which is the reason why they tend to get used for the laundering process. Some of the most popular gambling places for launderers involve casinos, bookmaking, particularly horse races, and lotteries. Like for any other method, laundering schemes in the gambling industry can also vary from very simple to quite complex. An example of a fairly straight-forward one is purchasing a winning ticket for more than the value of the prize money. This way the criminal proceeds will get replaced by the legitimate ones once the lottery or bet is won, and the excess cash will represent the money laundering commission.³⁷

Similarly, the laundering process at casinos can also be a simple transaction but can involve into a multinational operation. Casinos are typically used for the placement of funds, but can also be a way of layering in which the trace of funds is to be concealed.³⁸ The way casinos are used in the laundering process is that criminals first come in with loads of money and purchase chips. After some time passes, and criminals either gamble or do not, they are ready to trade the chips for a check from the casino, preferably to a third party to further distance themselves from the funds. A more complicated version of this process occurs when the casino is a part of a group of casinos that operate in multiple countries. When this is the case, launderers are able to request they get credit at another casino in a completely different location, making it that much harder to catch them in the act.³⁹ Interestingly, since casinos are recognized to be a fairly good place for money laundering, it has been reported that criminals actually see them as good and safe places for them to socialize due to all of their safety and security measures that are put in place.⁴⁰

³⁷ Europol, (2015). *Why is cash still king?*. [Online] Available at:

<https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

³⁸ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress.

Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

³⁹ Reuter, P. & Truman, E. M., (2004). *Chasing Dirty Money*. [Online]. PIIE. Available at:

<https://www.piie.com/bookstore/chasing-dirty-money-fight-against-money-laundering> [Accessed 14 June 2020].

⁴⁰ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress.

Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

Shell corporations

“Shell companies are corporate entities that are used for legitimate purposes such as to hold stock or intangible assets of another business entity. However, they can also be misused by illicit actors and have no legitimate commercial purpose.”⁴¹ Due to their nature, shell companies can be used in a variety of different criminal acts such as a tool for conducting the placement and layering phases of money laundering. Because of their frequent usage in money laundering schemes, they also tend to be defined as companies that exist only on paper as they do not perform any business or only an extremely small amount.⁴² When involved in a money laundering structure, launderers strive to make the shell company look like it is a legitimate business offering some products or services and having customers who purchase the same. Because transactions with cash increase the anonymity of anyone involved, launderers choose cash-based business such as beauty salons and plumbing services for their shell companies. After they have set up their shell company, they begin to bring in their dirty money disguising it as the business’ revenue, while simultaneously creating fake invoices and receipts to create an illusion that their company is actually doing some legitimate business. Once the dirty cash has been deposited into accounts of the shell company, launderers have the ability to either take the money or to make further transactions to additional shell companies, thus creating a more complex layering scheme.⁴³

To exemplify the importance of shell companies in money laundering, a U.K. study has proven that “shell companies have been involved in almost all complex UK money laundering schemes”.⁴⁴ Some of the reasons why shell companies are so popular for money laundering include the fact that they can be single or multipurpose entities set up onshore and offshore, and that their ownership structures can take forms including registered and bearer forms, issued to a natural or legal person.

⁴¹ Financial Action Task Force (FATF), (2010). *Money Laundering Using Trust and Company Service Providers*. [Online] Available at: <https://www.fatf-gafi.org/media/fatf/documents/reports/Money%20Laundering%20Using%20Trust%20and%20Company%20Service%20Providers.pdf> [Accessed 16 June 2020]

⁴² Reuter, P. & Truman, E. M., (2004). *Chasing Dirty Money*. [Online]. PIIE. Available at: <https://www.piie.com/bookstore/chasing-dirty-money-fight-against-money-laundering> [Accessed 14 June 2020].

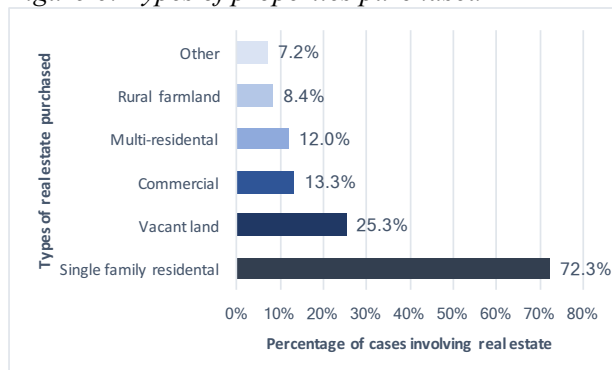
⁴³ Legal Information Institute, Cornell Law School, (n.d.). *Money Laundering*. [Online] Available at: https://www.law.cornell.edu/wex/money_laundering#:~:text=To%20launder%20money%2C%20the%20shell,to%20often%20pay%20with%20cash.&text=The%20launderer%20then%20deposits%20the,to%20account%20for%20the%20cash. [Accessed 16 June 2020]

⁴⁴ Organisation for Economic Co-operation and Development (OECD), (2001). *Behind the Corporate Veil*. [Online]. OECD Publications. Available at: <http://www.oecd.org/daf/ca/43703185.pdf> [Accessed 16 June 2020].

Real estate

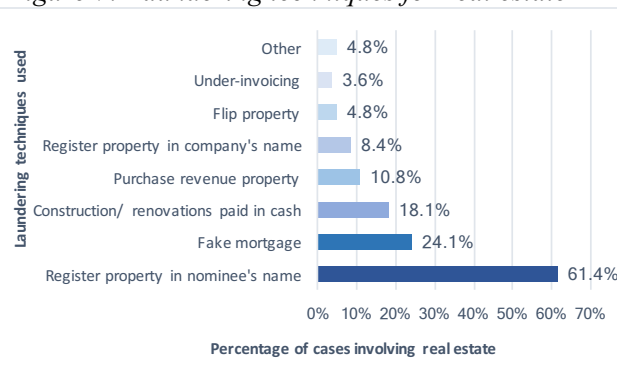
Real estate represents another sector that is of particular interest to money launderers across the world that is oftentimes used. A Canadian study has found that approximately 56% of their money laundering cases that were investigated by their Royal Canadian Mounted Police (RCMP) involved real estate in some way. Their report further goes on and states that real estate is one of the “most significant sectors in laundering when measured by frequency of use, as well as the volume of criminal proceeds that enter the legitimate economy”.⁴⁵ The following graphs are based on the same study and give a deeper look into the types of properties that are purchased with dirty money, and the techniques for laundering in the real estate industry most commonly used by the launderers.

Figure 6: Types of properties purchased



Source: made by the author of this master thesis

Figure 7: Laundering techniques for real estate



Source: made by the author of this master thesis

Once a launderer successfully acquires a real estate, they can then choose which method to use in order to generate clean profits. Some of the options include selling the property or renting it, which will both make the launderer better off and therefore increase their wealth. Another option is to use it to mix legitimate funds with dirty ones and that way launder money through the property, for example by having legitimate construction or renovation costs. There are many reasons why real estate is so attractive to money laundering, including the fact that it can be effectively used in any of the three phases of the money laundering cycle. By its nature, real estate is a large market with a vast variety of high-value assets that is easy to enter. Since the assets are high-valued, it is not uncommon to place large sums of money on them in both the original purchase and financing of real estate. Additionally, there exist many ways to hide to official ownership of a property which

⁴⁵ Schneider, S., (2004). *Money Laundering in Canada: An Analysis of RCMP Cases*. [Online]. Nathanson Centre. Available at: <http://old.csd.bg/fileSrc.php?id=560> [Accessed 16 June 2020].

is also a positive aspect for launderers. Another attractive feature for launderers is that investing in real estate is fairly secure as properties tend to hold their value or even increase it in when demands are raising. For example, due to increasing demands in a Canadian province British Columbia partly caused by money laundering, housing prices are estimated to have increased by 5%, which is causing numerous problems for many households that are trying to truly acquire homes.⁴⁶

Cryptocurrency

In recent years, launderers have also started using cryptocurrencies as another mean of cleaning their proceeds, laundering a total of \$2.8 billion in 2019 alone.⁴⁷ Cryptocurrency is defined as “any form of currency that only exists digitally, that usually has no central issuing or regulating authority but instead uses a decentralized system to record transactions and manage the issuance of new units, and that relies on cryptography to prevent counterfeiting and fraudulent transactions”.⁴⁸

The first step in laundering via cryptocurrencies is opening up online accounts with digital currency exchanges through which money can be placed into the cryptocurrency system. The next step comprises of money being moved around the cryptocurrency system using different cryptographic techniques in order to conceal the trail leading back to the funds’ original source. This is usually achieved by mixing the initial cryptocurrency amount with other cryptocurrencies, followed by transferring smaller amounts to a chosen address. Once the whole amount is transferred, and the origins of the money are untraceable, the funds are integrated into the legitimate financial system. However, the total of the funds transferred does not completely correspond the original amount as coin mixing companies tend to take a profit for themselves ranging from 1% to 3% of the initial amount. Since cryptocurrencies are still fairly new, they present a significant challenge for financial institutions and anti-money laundering programs as formal regulations are still pending.⁴⁹

⁴⁶ Maloney, M., Somerville, T. & Unger, B., (2019). *Combating Money Laundering in BC Real Estate*. [Online]. Expert Panel on Money Laundering in BC Real Estate. Available at: <https://www2.gov.bc.ca/assets/gov/housing-and-tenancy/real-estate-in-bc/combating-money-laundering-report.pdf> [Accessed 16 June 2020].

⁴⁷ Roberts, J. J., (2020). *How shadowy brokers allegedly launder billions for crypto criminals*. [Online]. Fortune. Available at: <https://fortune.com/2020/01/15/crypto-criminals-brokers-launder-billions/> [Accessed 16 June 2020].

⁴⁸ Merriam-Webster, (n.d.). *Cryptocurrency*. [Online] Available at: <https://www.merriam-webster.com/dictionary/cryptocurrency> [Accessed 16 June 2020].

⁴⁹ Rebora, A., (2019). *The Use of Cryptocurrency for Money Laundering*. [Online]. Medium. Available at: <https://medium.com/@andrearebora/the-use-of-cryptocurrency-for-money-laundering-e94131748cc7> [Accessed 16 June 2020].

2.5 Use cases

The prerequisite for money laundering to occur is for some kind of a criminal act to have been committed, generating profits that then need to be laundered. It is believed that crimes in general are committed for at least one of the following four reasons; greed/profit/personal gain, passion, terrorism, or unbalanced mind. The first reason is believed to be accountable for approximately 95% of all the crimes, usually including some organized crime groups, with its participants ranging from a drug dealer, thief, corporate embezzler, to a credit card skimmer. The second reason, passion, does not account for nearly as many crimes but only a small portion of them. Offences with this motivation behind them are almost unpredictable as nobody can know if and when something will trigger a person to committing one. The next possible motivation is terrorism, a motivation that can also include money but only in instances where it supports some other larger cause. The last thought motivation behind various types of crimes is unbalanced mind making them also extremely difficult to predict.⁵⁰

Once this motivation evolves into a crime actually being committed, chances are that if it is a part of a larger scheme, some money laundering will need to happen at one point. Because money laundering occurs consequently to almost all profit generating crimes which tend to happen in almost all parts of the world, money laundering can too appear anywhere on the globe. However, launderers tend to choose locations with lower risk of detection due to a country's or sector's poor anti-money laundering practices. On the other hand, since criminals wish to get their illegal funds back after the laundering process is over, they also need to make sure that they are laundering their proceeds through stable financial systems.⁵¹ Several crime types that are motivated by money and have ties with money laundering, as it is often the requirement for criminals if they wish to enjoy their proceeds, are drug trafficking, human trafficking, and a vast variety of white collar crimes that can involve complex financial crimes, in addition to financing terrorism.⁵² To demonstrate the

⁵⁰ Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress.

Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].

⁵¹ Financial Action Task Force (FATF), (2019). *Money Laundering*. [Online]

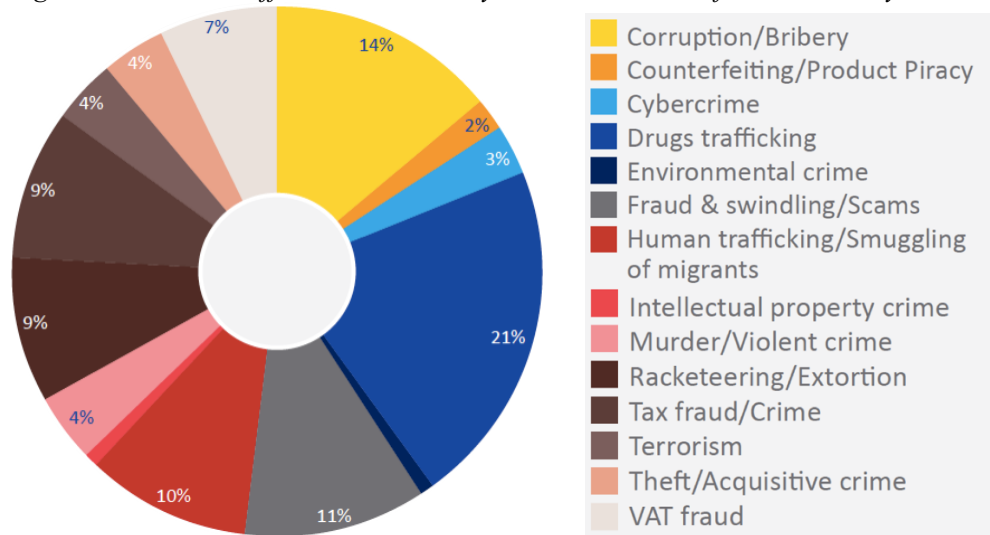
Available at: <https://www.fatf-gafi.org/faq/moneylaundering/> [Accessed 17 June 2020].

⁵² Federal Bureau of Investigation (FBI), (2016). *White-Collar Crime*. [Online] Available at:

<https://www.fbi.gov/investigate/white-collar-crime#:~:text=Reportedly%20coined%20in%201939%2C%20the,of%20physical%20force%20or%20violence.> [Accessed 17 June 2020].

variety of criminal offences that eventually tend to lead to money laundering, Figure 8 incorporates all the offences linked to the use of cash in money laundering.

Figure 8: Predicate offences most closely linked to the use of cash in money laundering



Source: Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

Drugs trafficking

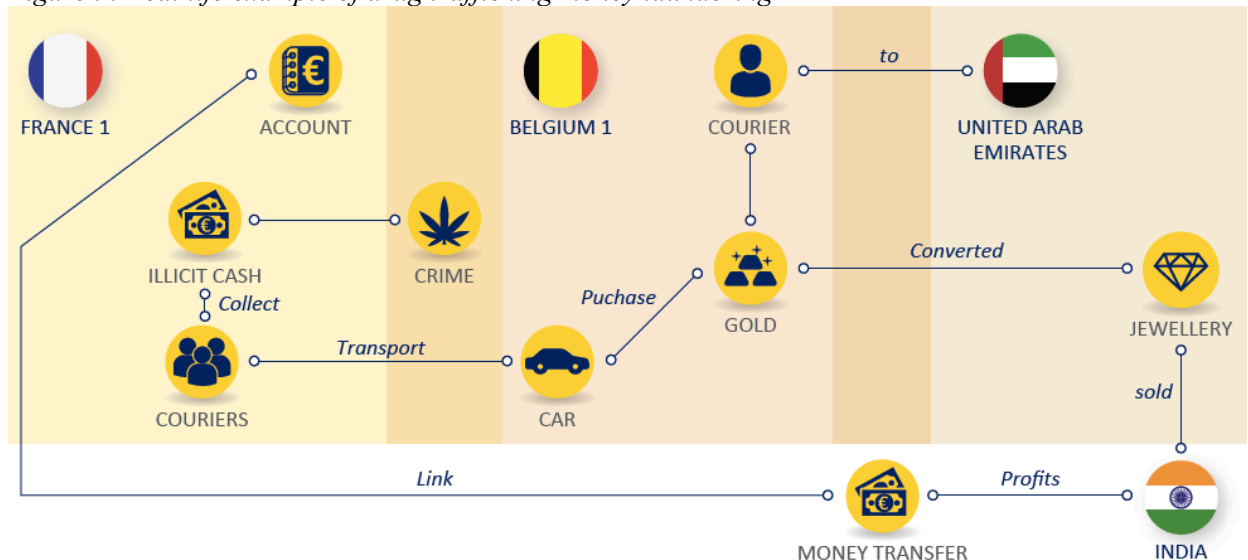
As seen in Figure 8, illicit drugs trafficking is the number one predicate offence linked to the use of cash in money laundering. “Drug trafficking is a global illicit trade involving the cultivation, manufacture, distribution and sale of substances which are subject to drug prohibition laws.”⁵³ The link between trafficking of illegal drugs and money laundering is fairly simple; drug traffickers need to launder their dirty drug proceeds in order to be able to use them. To show just how big the industry of illegal drugs is, in 2017 it was estimated that the global trade of illicit drugs was worth \$426 billion to \$652 billion a year, which equated approximately a third of all transnational crimes studied.⁵⁴ Furthermore, a 2019 study assessed that between 2006 and 2016, “the total amount spent by Americans on cannabis, cocaine, heroin and methamphetamine fluctuated between between \$120 billion and \$145 billion each year”. To put these numbers in perspective, the same researchers

⁵³ United Nations Office on Drugs and Crime, (n.d.) *Drug trafficking*. [Online] Available at: <https://www.unodc.org/unodc/en/drug-trafficking/index.html#:~:text=Drug%20trafficking%20is%20a%20global,comprehensive%20understanding%20of%20their%20dynamics>. [Accessed 18 June 2020].

⁵⁴ May, C., (2017). *Transnational Crime and the Developing World*. [Online]. Global Financial Integrity. Available at: <https://secureservercdn.net/45.40.149.159/34n.8bd.myftpupload.com/wp-content/uploads/2017/03/Transnational-Crime-final.pdf> [Accessed 19 June 2020].

stated that yearly American spending on alcohol tends to be around \$158 billion.⁵⁵ Similarly, a 2017 Europol study suggested that drug markets continue to be the largest criminal markets in the European Union with the estimated market worth of at least EUR 24 billion a year. Another interesting statistic from the same report states that around “35% of the all Organized Crime Groups (OCGs) active in the EU on an international level are involved in the production, trafficking or distribution of illegal drugs”. The report also says that “the global anti-money laundering framework implemented by law enforcement and other authorities in the EU has shown to have a poor success rate in identifying and seizing illegal funds generated by criminal organizations. Barely 1% of criminal proceeds are confiscated by relevant authorities at EU level”.⁵⁶ It is also worth noting that the total retail value of transnational crime industry is estimated to be worth between \$1.6 trillion and \$2.2 trillion.⁵⁷ The following figure represents a real life drug trafficking case with the international money laundering scheme behind it.

Figure 9: Real life example of drug trafficking money laundering



Source: Europol, (2015). *Why is cash still king?*. [Online] Available at: <https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf> [Accessed 14 June 2020].

⁵⁵ RAND Corporation, (2019). *Spending on illicit drugs in US nears \$150 billion annually*. [Online]. Science Daily. Available at: <https://www.sciencedaily.com/releases/2019/08/190820081846.htm> [Accessed 18 June 2020].

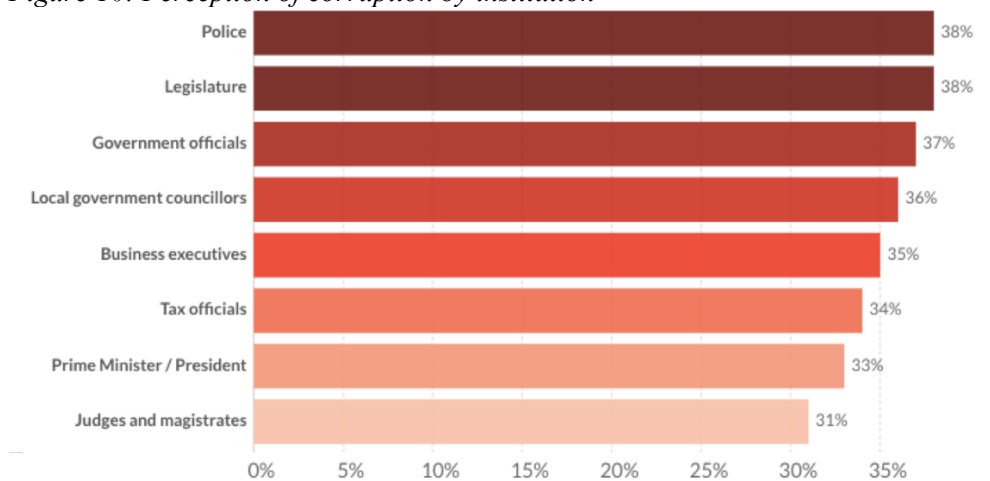
⁵⁶ Europol, (2017). *How Illegal Drugs Sustain Organized Crime in the EU*. [Online] Available at: https://www.europol.europa.eu/sites/default/files/documents/business_fundamentals_how_illegal_drugs_sustain_organised_crime_in_europe.pdf [Accessed 18 June 2020].

⁵⁷ Presse, A. F., (2012). *The International Organized Crime Industry Is Worth \$870 Billion*. [Online]. Business Insider. Available at: <https://www.businessinsider.com/the-international-organized-crime-industry-is-worth-870-billion-2012-10> [Accessed 18 June 2020].

Corruption/ bribery

“Corruption is a crime committed by officials (public or private) abusing of their role to procure gain for themselves or somebody else. Several forms of corruption exist: bribery, embezzlement, abuse of power, just to name a few.”⁵⁸ Like Figure 8 on page 21 states, it is the second biggest offences tied to laundering in terms of using cash, showing just how closely the two offences are linked. In 2018, United Nations stated that in total \$3.6 trillion is lost annually due to corruption; \$1trillion is paid in bribes, and \$2.6 trillion is stolen.⁵⁹ When some kind of corruption takes place, significant funds can be generated and therefore received by a party which then have to be laundered. On the other hand, corruption can also help facilitate money laundering, implying that there is a two-sided relationship between corruption and money laundering. The way corruption can aid in performing laundering is that the process can be influenced by corrupt officials.⁶⁰

Figure 10: Perception of corruption by institution



Source: Roser, M. & Ortiz-Ospina, E., (2019). *Corruption*. [Online]. Our World in Data. Available at: <https://ourworldindata.org/corruption> [Accessed 18 June 2020].

When looking globally, the perception is that the most corrupt institutions are the police, and legislature, closely followed by governments, as can be seen in Figure 10.⁶¹ When looking more

⁵⁸ United Nations Office on Drugs and Crime, (n.d.) *Corruption*. [Online] Available at: <https://www.unodc.org/unodc/data-and-analysis/corruption.html> [Accessed 18 June 2020].

⁵⁹ United Nations, (2018). *The costs of corruption: values, economic development under assault, trillions lost, says Guterres*. [Online] Available at: <https://news.un.org/en/story/2018/12/1027971> [Accessed 18 June 2020].

⁶⁰ Kyriakos-Saad, N., Esposito, G. & Schwarz, N., (2012). *The Incestuous Relationship Between Corruption and Money Laundering*. [Online]. Cairn.info. Available at: https://www.cairn.info/revue-internationale-de-droit-penal-2012-1-page-161.htm#:~:text=Corruption%20and%20money%20laundering%20are,without%20the%20stigma%20of%20illegality_ [Accessed 18 June 2020].

⁶¹ Roser, M. & Ortiz-Ospina, E., (2019). *Corruption*. [Online]. Our World in Data. Available at: <https://ourworldindata.org/corruption> [Accessed 18 June 2020].

locally, more precisely at the prevalence (number of businesses who have bribed a public official at least once, as a percentage of business that had contact with the same official, all in a 12-month period) “of bribery across business sectors in Croatia, building and construction (13.7%) takes the first place, followed by accommodation and food service activities (12.9%), and by manufacturing, electricity, gas, and water supply section (11.3%)”. Another worrying fact that was brought up in the report explained that “businesses representatives in Croatia rank corruption as the third most important obstacle to doing business”.⁶²

Human trafficking

Another form of crime that could not survive without money laundering is trafficking of human beings, often referred to as human trafficking. As defined by FATH, it is “the recruitment, transportation, transfer, harbouring or receipt of persons, by means of the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation. Exploitation shall include, at a minimum, the exploitation of the prostitution of others or other forms of sexual exploitation, forced labour or services, slavery or practices similar to slavery, servitude or the removal of organs”.⁶³ Similar to the case of drugs trafficking, human trafficking also generates enormous illegal profits that need to be laundered, hence the connection between money laundering and the practice of human trafficking. Since this is another illegal way of making money, it is difficult to assess its true size, but the estimated annual profit value was \$32 billion in 2017, with \$15.5 billion being made in industrialized countries⁶⁴, while the revenue value was \$150.2 billion.⁶⁵

⁶² Bisogno, E. et al., (2013). *Business, corruption and crime in Croatia: The impact of bribery and other crime on private enterprise*. [Online]. United Nations Office on Drugs and Crime. Available at: https://www.unodc.org/documents/data-and-analysis/statistics/corruption/Croatia_Business_corruption_report.pdf [Accessed 18 June 2020].

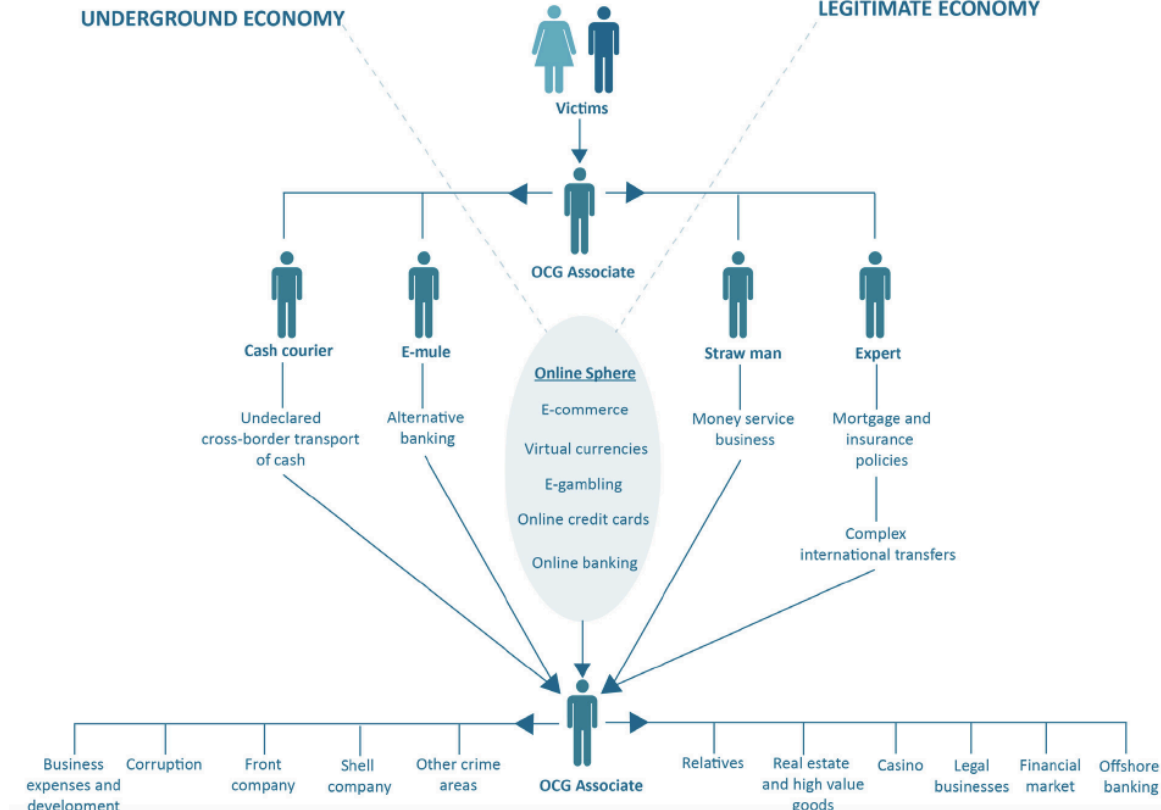
⁶³ Financial Action Task Force (FATF), (2011). *Money Laundering Risks Arising from Trafficking in Human Beings and Smuggling of Migrants*. [Online] Available at: <https://www.fatf-gafi.org/media/fatf/documents/reports/Trafficking%20in%20Human%20Beings%20and%20Smuggling%20of%20Migrants.pdf> [Accessed 19 June 2020].

⁶⁴ Tamburro, D., (2019). *Detecting Human Trafficking? Your Anti-Money Laundering Program & SAS® Visual Investigator Can Help*. [Online]. SAS. Available at: <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2019/3382-2019.pdf> [Accessed 19 June 2020].

⁶⁵ May, C., (2017). *Transnational Crime and the Developing World*. [Online]. Global Financial Integrity. Available at: https://secureservercdn.net/45.40.149.159/34n.8bd.myftpupload.com/wp-content/uploads/2017/03/Transnational_Crime-final.pdf [Accessed 19 June 2020].

When these numbers are not just looked at as pure numbers, but as the actually people that stand behind them, the statistics are even more devastating. Nowadays, “21 million men, women, and children around the world are currently thought to be victims of human trafficking”, with this crime being considered as one of the fastest-growing transnational crime markets, in addition to having the greatest impact on individuals and their lives.⁶⁶ Because human trafficking is considered to be a part of modern slavery and just one of the methods how one becomes a slave in today’s world, human trafficking supports the even bigger problem, affecting even more lives. It is estimated that there is currently 40 million people forced to be slaves, with 71% being women and girls. These numbers translate into one in every 200 people living in some form of modern slavery.⁶⁷ The following figure represents the flows of money from human trafficking.

Figure 11: Trafficking of human beings money flows



Source: Europol, (2015). *The THB Business Model*. [Online] Available at: https://www.europol.europa.eu/sites/default/files/documents/europol_thb_financial_business_model_2015.pdf [Accessed 19 June 2020].

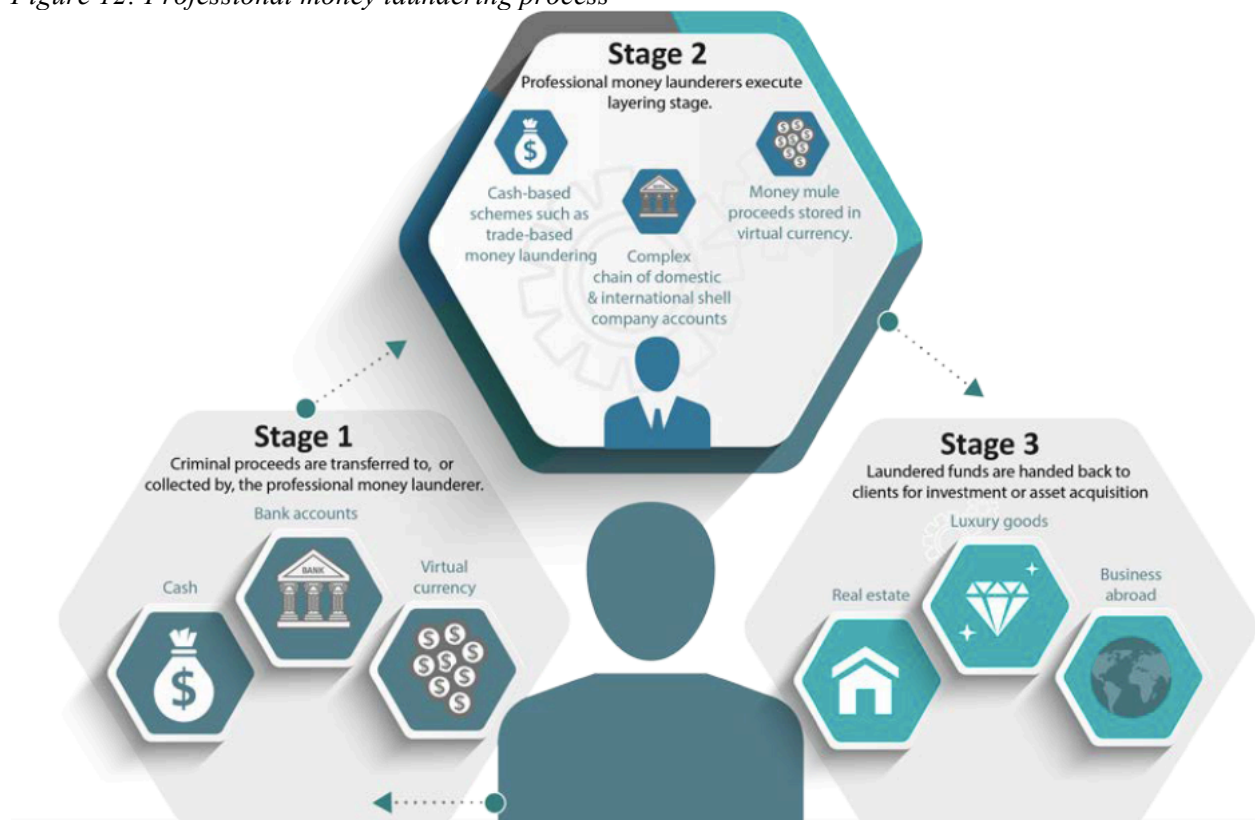
⁶⁶ May, C., (2017). *Transnational Crime and the Developing World*. [Online]. Global Financial Integrity. Available at: https://secureservercdn.net/45.40.149.159/34n.8bd.myftpupload.com/wp-content/uploads/2017/03/Transnational_Crime-final.pdf [Accessed 19 June 2020].

⁶⁷ Hodal, K., (2019). *One in 200 people is a slave. Why?*. [Online]. The Guardian. Available at: <https://www.theguardian.com/news/2019/feb/25/modern-slavery-trafficking-persons-one-in-200> [Accessed 19 June 2020].

2.6 Professional money laundering

Even though many criminals choose to launder their proceeds by themselves, there are also ones that decide to trust someone else to do their laundering for them, which is where professional money launderers come in. “Professional money laundering (PML) is considered to be a subset of third-party money laundering”, meaning that the process of cleaning funds is done by someone that is not involved in the initial crime. However, the most distinguishing feature of professional money laundering is the fact that the criminals who performed the original crime are willing to pay a fee, commission or some other type of profit to the professionals in order to get their money washed. Even though the professional launderers are not involved in the predicted offence, and possibly do not even care where the money came from, they are well aware that the funds come from an illegal activity. Due to the fact that they are laundering money which is illegal, they are also considered to be criminals. The following figure represents the process of professional laundering.⁶⁸

Figure 12: Professional money laundering process



Source: Financial Action Task Force (FATF), (2018). *Professional Money Laundering*. [Online] Available at: <http://www.fatf-gafi.org/media/fatf/documents/Professional-Money-Laundering.pdf> [Accessed 20 June 2020].

⁶⁸ Financial Action Task Force (FATF), (2018). *Professional Money Laundering*. [Online] Available at: <http://www.fatf-gafi.org/media/fatf/documents/Professional-Money-Laundering.pdf> [Accessed 20 June 2020].

2.7 Biggest money laundering scandals

Because money laundering has existed for centuries now, some extremely big scandals have occurred, laundering hundreds of billions of dollars each. It is also worth noting that these are only the cases that have been discovered so far, implying that some equally big or even bigger schemes could also have been happening but have simply not been exposed yet. The three largest money laundering cases known so far are Danske Bank, Standard Chartered Bank, and Wachovia Bank.⁶⁹

Danske Bank

The third biggest money laundering scandal in history is the Danske Bank case in which \$229 billion was laundered. The case is also known to be the largest uncovered laundering scandal in Europe up to date. The troubles for Denmark's largest lender, Danske Bank, started way back in 2007 after acquiring their first and only Estonian branch. Shortly after the acquisition, the bank started receiving warnings from Russia about their Estonian branch being used for unusually large transactions. Since no action was taken, the transactions kept on going through the branch. By 2010, Danske Bank's executive board was well aware of these large transactions coming from non-residents, but again chose not to react to them. By 2013, only 1% of profits came from residents, while 99% came from non-residents, mostly Russian or from ex-Soviet countries. Even though this triggered a whistleblower in 2013, it took the bank another three years to stop these large transactions and face what was happening. Although there was a team of employees trying to figure out who was behind these anonymous corporate vehicles that keep on transferring large sums of through the branch, they were unsuccessful. Eventually, in 2017 the bank was forced to stop doing business in Estonia, and was fined \$2 million so far, with other fines still pending at the time of writing. Furthermore, Deutsche Bank is also under investigation about possibly being involved in this money laundering scheme. Even though some questions about the scheme still stand unanswered, it is confirmed that "the scandal involved 32 different currencies, and companies from Cyprus, the British Virgin Islands and the Seychelles."^{70 71}

^{69 71} Blockchain Content, (2019). *The 5 Largest Money Laundering Scandals of All Time...So Far*. [Online]. Medium. Available at: <https://medium.com/kyc-io-scalable-kyc-management-solutions/the-5-largest-money-laundering-scandals-of-all-time-so-far-d30ff4abee10> [Accessed 20 June 2020].

⁷⁰ Garside, J., (2018). *Is money-laundering scandal at Danske Bank the largest in history?*. [Online]. The Guardian. Available at: <https://www.theguardian.com/business/2018/sep/21/is-money-laundering-scandal-at-danske-bank-the-largest-in-history> [Accessed 20 June 2020].

Standard Chartered Bank

The money laundering case of Standard Chartered Bank is considered to be the second largest one known so far with laundering proceeds of \$250 billion. Standard Chartered bank is a British institution headquartered in London but focused on Asia, the Middle East and Africa. The first problems for the bank arose in 2004 due to the lack of anti-money laundering practices. However, during 2005 and 2006 the bank disregarded the previous complains and the agreement to improve its AML practices, and was breaking sanctions against Iran by working with Iranian customers.

Following these actions, the bank was fined \$670 million in 2012 for its wrongdoings while continuing its illegal practices. Finally, in 2019, the bank was told to pay \$1.1 billion in fines by US and UK authorities due to poor money laundering controls together with poor counter-terrorism finance controls in the Middle East, and breaching sanctions against certain countries. The authorities explained that the bank has been processing “hundreds of millions of dollars in transactions from countries that were barred from participating in the American financial system, including Cuba, Iran, Sudan, Syria, Burma, and Zimbabwe”.⁷² Furthermore, the US treasury department also stated that Standard Chartered has processes about worth \$438 million between 2009 and 2014 in transactions, with the majority of them having ties to accounts from its Dubai branch and payments coming through or to some of US-based banks or its New York office. An example of the bank’s gross misconduct is an event that happened in the bank’s United Arab Emirates branch. In this case, a branch employee accepted hundreds of thousands of dollars brought in a suitcase with no legitimate explanation standing behind them.⁷³

⁷² Flitter, E., (2019). *Standard Chartered Fined \$1.1 Billion for Violating Sanctions and Anti-Money Laundering Laws*. [Online]. The New York Times. Available at: <https://www.nytimes.com/2019/04/09/business/standard-chartered-sanctions-violations.html> [Accessed 20 June 2020].

⁷³ Case is based on:

1. Blockchain Content, (2019). *The 5 Largest Money Laundering Scandals of All Time...So Far*. [Online]. Medium. Available at: <https://medium.com/kyc-io-scalable-kyc-management-solutions/the-5-largest-money-laundering-scandals-of-all-time-so-far-d30ff4abee10> [Accessed 20 June 2020].
2. Flitter, E., (2019). *Standard Chartered Fined \$1.1 Billion for Violating Sanctions and Anti-Money Laundering Laws*. [Online]. The New York Times. Available at: <https://www.nytimes.com/2019/04/09/business/standard-chartered-sanctions-violations.html> [Accessed 20 June 2020].
3. Makortoff, K., (2019). *Standard Chartered fined \$1.1bn for money-laundering and sanctions breaches*. [Online]. The Guardian. Available at: <https://www.theguardian.com/business/2019/apr/09/standard-chartered-fined-money-laundering-sanctions-breaches#:~:text=Standard%20Chartered%20has%20been%20ordered,sanctions%20against%20countries%20including%20Iran.&text=It%20is%20the%20second%2Dlargest,anti%2Dmoney%2Dlaundering%20failures.> [Accessed 20 June 2020].

Wachovia Bank

The biggest uncovered money laundering scandal of all times is by far the Wachovia Bank case in which \$380 billion was successfully laundered. Wachovia Bank used to be one of the largest US banks before being bought by Wells Fargo in 2008. Nonetheless, the laundering problems for the bank arose a few years prior to the acquisition. Everything started in 2004 when Wachovia started conducting business with currency exchange houses in Mexico. Due to their nature of allowing someone to bring in cash and send it to a bank account along with exchanging currencies, these Mexican money exchange houses were considered to be risky due to their potential for facilitating money laundering. Even though the other financial institutions acknowledged this risk and were lowering the amount of business they were doing with these money exchange houses, Wachovia Bank was doing the opposite. Nevertheless, in 2005 and 2006 there was suspicion that something illegal was taking place, possibly involving Mexican drug cartels, due to the number of suspicious transactions occurring along with the lack of know your customer (KYC) information.⁷⁴

However, the real trouble for the bank started on 10 April 2006, when “Mexican soldiers found 5.7 tons of cocaine, valued at \$100 million” in a jet that had landed. But the cocaine was not the most important thing that was discovered; “the paper trail of the purchase of the plane by the Sinaloa narco-trafficking cartel” was also exposed. This paper trail evolved into a 22-month investigation that eventually led to Wachovia Bank. It was determined that the cocaine smugglers had acquired the plane by laundering their dirty proceeds through Wachovia. The investigators also found “billions of dollars in wire transfers, traveler’s cheques, and cash shipments in Wachovia accounts” all coming from Mexican exchange houses, particularly from 2004 onwards. Due to their actions, Wachovia had to face numerous consequences. Firstly, the bank had to pay “\$110 million in forfeiture due to allowing transactions connected to drug trafficking to take place”. Next, it also “had to pay a \$50 million fine for failing to monitor cash that was used to transfer 22 tons of cocaine”. Lastly, Wachovia was also sanctioned for not having the suitable anti-money laundering measures, thus transferring \$380 billion of dirty money, equating to a third of Mexico’s GDP.⁷⁵

⁷⁴ Blockchain Content, (2019). *The 5 Largest Money Laundering Scandals of All Time...So Far*. [Online]. Medium. Available at: <https://medium.com/kyc-io-scalable-kyc-management-solutions/the-5-largest-money-laundering-scandals-of-all-time-so-far-d30ff4abee10> [Accessed 20 June 2020].

⁷⁵ Vulliamy, E., (2011). *How a big US bank laundered billions from Mexico's murderous drug gangs*. [Online]. The Guardian. Available at: <https://www.theguardian.com/world/2011/apr/03/us-bank-mexico-drug-gangs> [Accessed 21 June 2020].

3. Digital technologies for anti-money laundering

3.1 Literature review on the use of digital technologies for anti-money laundering

Given the fact that using emerging digital technologies for the purpose of combating money laundering is a niche topic, the number of works related to it corresponds to the size of the field. However, during my research, I have come across several sources that precisely focus on some anti-money laundering solutions that utilize one or more emerging technologies. For example, Infosys has issued such reports on the application of machine learning in anti-money laundering⁷⁶ and utilization of robotic process automation on a select part of the anti-money laundering operations.⁷⁷ In each of these reports readers are first introduced to the emerging technology talked about, followed by detail analysis of the need to implement them into anti-money laundering processes and their respective benefits. Similarly, Deloitte's report focuses on using knowledge graphs in financial services among which is their use for combating money laundering.⁷⁸

Although some companies such as McKinsey & Company, Deloitte, and Accenture have issued reports on topics related to anti-money laundering and mitigating it with some technologies, I have found that the most relevant and detailed sources come from the leaders of providing anti-money laundering solutions including NICE Actimize, SAS, and BAE Systems. Each one of these companies offers freely-accessible resources on every aspect of anti-money laundering programs and how they in particular are approaching it, what technologies they are utilizing, and ultimately how they are helping their clients achieve better results. Nevertheless, SAS has also published a report that incorporates how numerous different technologies can be used for anti-money laundering, therefore not just focusing on a particular case.⁷⁹ Overall, I believe that good amount of online resources is available, whether regarding a specific topic or general industry information.

⁷⁶ Kumar, A. & Vishwanath, P., (2019). *Application of machine learning in AML transaction filtering*. [Online]. Infosys. Available at: <https://www.infosys.com/industries/financial-services/insights/documents/aml-transaction-filtering.pdf> [Accessed 9 August 2020].

⁷⁷ Vysya, V. N. & Shah, K., (2018). *Robotic process automation (RPA) in AML and KYC*. [Online]. Infosys. Available at: <https://www.infosys.com/industries/financial-services/white-papers/documents/robotic-process-automation-aml-kyc.pdf> [Accessed 3 August 2020].

⁷⁸ Khalili, A., Oberoi, S., Jessurun, J. & Zwam, M. v., (2020). *Knowledge Graphs for Financial Services*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/risk/deloitte-nl-risk-knowledge-graphs-financial-services.pdf> [Accessed 3 August 2020].

⁷⁹ SAS, (n.d.). *Fight money laundering with these 5 game changers from SAS*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/marketing-whitepapers-ebooks/ebooks/en/fight-money-laundering-111220.pdf> [Accessed 1 August 2020].

3.2 Introduction to digital technologies

Every year, our world is becoming increasingly dependent on numerous different kinds of technologies, with “the global IT industry expected to reach \$5.2 trillion in 2020”. It is worth noting that 46% of the total IT industry revenue growth is attributed to emerging technologies.⁸⁰ This paper is precisely focused on some of those emerging digital technologies including artificial intelligence (AI), data analytics, robotic process automation, and blockchain as they are all becoming increasingly used by companies and organizations across various sectors, including those needing anti-money laundering solutions.⁸¹

Artificial intelligence

Even though the term artificial intelligence (AI) has been around for some time now, in the past few years, the AI market has started to grow rapidly with many new applications being constantly invented and improved upon. In 2018, the total global AI market was valued to be \$20.67 billion, with the estimated value of “\$202.57 billion for 2026, therefore demonstrating a compound annual growth rate (CAGR) of 33.1% during the forecast period”.⁸² Artificial intelligence is defined to be “the ability of a machine to perform cognitive functions we associate with human minds, such as perceiving, reasoning, learning, interacting with the environment, problem solving, and even exercising creativity”.⁸³ It is also considered as a broad field of science that includes psychology, philosophy, linguistics, and other areas besides computer science.⁸⁴ Some of the most well-known examples of AI that are being used nowadays include Apple’s Siri, Amazon’s Alexa, Tesla’s self driving feature, and Netflix’s recommender system. To demonstrate the full scope of artificial intelligence and all of the technology connected to it, consider the figure on the next page.

⁸⁰ Computing Technology Industry Association (CompTIA), (2019). *IT industry outlook 2020*. [Online] Available at: <https://www.comptia.org/content/research/it-industry-trends-analysis#:~:text=Industry%20Overview,trends%20discussed%20in%20this%20report>. [Accessed 1 July 2020].

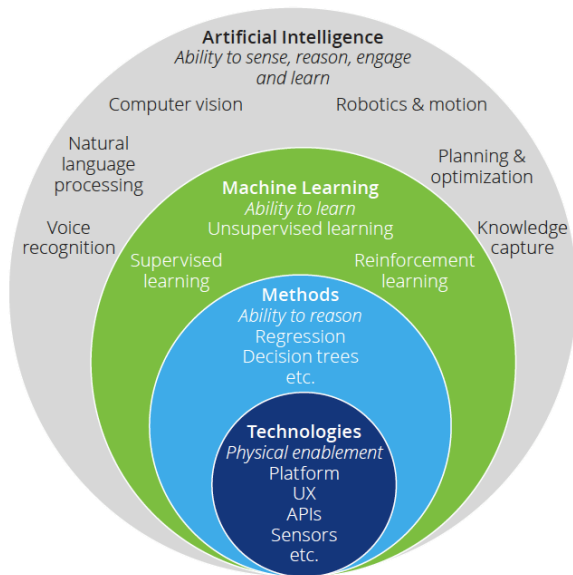
⁸¹ United Nations, (2019). *Digital economy report 2019*. [Online] Available at: https://unctad.org/en/PublicationsLibrary/der2019_overview_en.pdf [Accessed 1 July 2020].

⁸² Fortune Business Insights, (2020). *Artificial intelligence market*. [Online] Available at: <https://www.fortunebusinessinsights.com/industry-reports/artificial-intelligence-market-100114> [Accessed 1 July 2020].

⁸³ McKinsey & Company, (n.d.). *An executive's guide to AI*. [Online] Available at: <https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/an-executives-guide-to-ai> [Accessed 1 July 2020].

⁸⁴ Duin, S. v., Bakhshi, N., (2018). *Artificial Intelligence*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/deloitte-analytics/deloitte-nl-data-analytics-artificial-intelligence-whitepaper-eng.pdf> [Accessed 1 July 2020].

Figure 13: Relationship between AI, machine learning and underlying methods and infrastructure



Source: Duin, S. v., Bakhshi, N., (2018). *Artificial Intelligence*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/deloitte-analytics/deloitte-nl-data-analytics-artificial-intelligence-whitepaper-eng.pdf> [Accessed 1 July 2020].

Machine learning

The field of AI has many subfields, but the most notable one is machine learning, as it is considered to be the most used and the most successful AI approach. Machine learning is defined as a process in which computers are able to learn from data by generating and refining rules, as well as improve without explicitly being programmed to do so. The main difference between machine learning and some traditional techniques is that in machine learning the user is allowing the data to guide the computer in developing rules, rather than giving it an explicit set of rules to follow.⁸⁵ Like AI, it also has several types including supervised and unsupervised learning. One of the most used types is deep learning which is able to “process a wider range of data resources with less help from humans, and is also described as being able to provide more accurate results than some traditional machine learning approaches”. It is built on “interconnected layers of software-based calculators or neurons that form a neural network”. This network is then capable of taking in large amounts of data, processing them through its multiple layers, and determining common rules and features.⁸⁶

⁸⁵ Boisseau, J. & Wilson, L., (2019). *Enterprise AI: Data Analytics, Data Science and Machine Learning*. [Online]. CIO. Available at: <https://www.cio.com/article/3342421/enterprise-ai-data-analytics-data-science-and-machine-learning.html> [Accessed 1 July 2020].

⁸⁶ McKinsey & Company, (n.d.). *An executive's guide to AI*. [Online] Available at: <https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/an-executives-guide-to-ai> [Accessed 1 July 2020].

Robotic process automation

Robotic process automation (RPA) is a technology developed for the purpose of automating tedious and time-consuming business processes that are traditionally performed by human workers. RPA tools are governed by business logic and structured inputs, and are in fact configurable softwares or “robots” that have the ability “to capture and interpret applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems”. Organizations can use these tools for some simple tasks such as having an automated email response, but can also further enhance their RPA by pairing it up with some advanced “technologies such as machine learning, speech recognition, and natural language processing”, thus automating some higher-order tasks that previously needed human perception and judgement.⁸⁷ Therefore, as all these tasks are traditionally being done by people, implementing automation can be considered as both a positive and a negative event. To elaborate, applying RPA to a business process can significantly reduce costs for a company, but this will then translate into many individuals losing their jobs and being replaced by machines. According to the World Economic Forum, 5.1 million jobs will be lost in 2020 in 15 major countries, with two thirds in the office and administrative sectors, all due to automation.⁸⁸

Big data

Big data refers to the dynamic, diverse, and huge amounts of data that are being created by people, tools, and machines at ever-increasing rates. To show just how enormous big data actually is, consider the following statistics. In 2016, it was calculated that “people generate 2.5 quintillion bytes of data on a daily basis”, while in 2019 it was predicted that “more than 150 zettabytes (150 trillion gigabytes) of data will need analysis by 2025”. Furthermore, it was also established that in “2019 about 95% of businesses faced some kind of need to manage their unstructured data”.⁸⁹ Therefore, due to big data’s massive scale, it requires new, innovative, and scalable emerging

⁸⁷ Boulton, C., (2018). *What is RPA? A revolution in business process automation*. [Online]. CIO. Available at: <https://www.cio.com/article/3236451/what-is-rpa-robotic-process-automation-explained.html> [Accessed 3 July 2020].

⁸⁸ Sengupta, R., Mehta, R. & Dadu, A., (2017). *The Digital Workforce is here*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/in/Documents/strategy/in-strategy-innovation-rpa-digital-workforce-noexp.pdf> [Accessed 3 July 2020].

⁸⁹ Zangre, A., (2019). *44 Noteworthy Big Data Statistics in 2019*. [Online]. Learning Hub. Available at: <https://learn.g2.com/big-data-statistics> [Accessed 1 July 2020].

technology in order to collect it, host it, and ultimately analyze it as to acquire useful real-time information about an aspect of a business such as customers, risk, profit, performance, shareholder value, and productivity. The term big data incorporates both structured and unstructured data including images, video, audio, text files, and emails, just to name a few. It is usually characterized by having the four “Vs”, precisely volume, variety, velocity, and veracity. Because of these four features, having big data is crucial for the success of many businesses that tend to utilize it on a daily basis. According to EY, “Big data will fundamentally change the way businesses compete and operate. Companies that invest in and successfully derive value from their data will have a distinct advantage over their competitors — a performance gap that will continue to grow as more relevant data is generated, emerging technologies and digital channels offer better acquisition and delivery mechanisms, and the technologies that enable faster, easier data analysis continue to develop.”⁹⁰

Advanced analytics

Before defining advanced analytics, whose “market size is projected to reach \$59.1 billion by 2027”, it is crucial to note what data analytics is.⁹¹ In the simplest terms, data analytics is a broad term that includes using various techniques with the final goal of finding meaningful trends and patterns in data, therefore transforming data into useful information. By utilizing data analytics, one can gather information about the past and present, and even future with some techniques.⁹² Data analytics is also closely related to data science as analytics actually represents a component of data science, the practice that takes the output of analytics to solve some real-life problem. Therefore, data science is more concerned with problem-solving, whilst analytics is focused on examining the data.⁹³ On the other hand, advanced analytics serves as an umbrella term for only a

⁹⁰ EY, (2014). *Big data*. [Online] Available at: [https://www.ey.com/Publication/vwLUAssets/EY_-_Big_data:_changing_the_way_businesses_operate/\\$FILE/EY-Insights-on-GRC-Big-data.pdf](https://www.ey.com/Publication/vwLUAssets/EY_-_Big_data:_changing_the_way_businesses_operate/$FILE/EY-Insights-on-GRC-Big-data.pdf) [Accessed 3 July 2020].

⁹¹ Grand View Research, Inc., (2020). *Advanced Analytics Market Size Worth \$59.1 Billion by 2027 | CAGR: 25.3%*: Grand View Research, Inc.. [Online] Available at: <https://www.prnewswire.com/news-releases/advanced-analytics-market-size-worth-59-1-billion-by-2027--cagr-25-3-grand-view-research-inc-301027996.html> [Accessed 1 July 2020].

⁹² Boisseau, J. & Wilson, L., (2019). Enterprise AI: Data Analytics, Data Science and Machine Learning. [Online]. CIO. Available at: <https://www.cio.com/article/3342421/enterprise-ai-data-analytics-data-science-and-machine-learning.html> [Accessed 1 July 2020].

⁹³ Olavsrud, T., (2019). *What is data science? Transforming data into value*. [Online]. CIO. Available at: <https://www.cio.com/article/3285108/what-is-data-science-a-method-for-turning-data-into-value.html> [Accessed 1 July 2020].

portion of all the data analytics subfields that work together in order to generate future trends, events, and behaviours. The three major areas in advanced analytics that work together to make predictions are data mining, big data analytics, and predictive data analytics. The key to obtaining data that will be used in the process is data mining as it is a practice of providing the raw data that is to be analyzed. Next come big data analytics with the ability of finding the already existing trends, connections, and patterns in the data, in addition to cleaning the datasets. Finally, predictive analytics is implemented in order to make predictions about future happenings.⁹⁴ Due to its nature, advanced analytics is also considered to be “autonomous or semi-autonomous examination of data that can utilize very sophisticated tools and techniques such as machine learning, pattern matching, forecasting, visualization, semantic analysis, sentiment analysis, cluster analysis, multivariate statistics, graph analysis, simulation, complex event processing, and neural networks”.⁹⁵

Graph analytics

Graph analytics, also known as network analysis, is an emerging form of data analysis that analyzes relations between different entities such as customers, products, devices, and operations.⁹⁶ This technique is particularly useful when dealing with complex relationships as it provides a visual representation of them that is easy to follow. Graph analytics works in a way that it moves data points and relationships into a graph format which then allows for connecting distant entities together or analyzing data based on parameters such as strength or quality of relationship. However, this type of analytics has proven to be the most effective in searching for indirect relationships between some data points, representing a complex structure that needs to be unveiled and understood.⁹⁷ A real life example of using graph analytics that has proven to be extremely useful

⁹⁴ Sisense, (n.d.). *Advanced analytics*. [Online] Available at: <https://www.sisense.com/glossary/advanced-analytics/#:~:text=Big%20data%20analytics%20are%20useful,as%20well%20as%20cleaning%20data.&text=Advanced%20analytics%20also%20include%20newer,visualizations%2C%20and%20even%20neural%20networks>. [Accessed 1 July 2020].

⁹⁵ Gartner, (n.d.). *Advanced Analytics*. [Online] Available at: <https://www.gartner.com/en/information-technology/glossary/advanced-analytics#:~:text=Advanced%20Analytics%20is%20the%20autonomous,make%20predictions%2C%20or%20generate%20recommendations>. [Accessed 1 July 2020].

⁹⁶ AIMultiple, (2020). *Graph Analytics in 2020: Gain business insights from networks*. [Online] Available at: <https://research.aimultiple.com/graph-analytics/#:~:text=Graph%20analytics%2C%20also%20called%20network,Many%20businesses%20work%20with%20graphs>. [Accessed 1 July 2020].

⁹⁷ Oracle, (n.d.). *What Is Graph Analytics?*. [Online] Available at: <https://www.oracle.com/big-data/what-is-graph-analytics.html> [Accessed 1 July 2020].

during the COVID-19 pandemic is making social network graphs in order to know which people to quarantine in case some of their contacts catch the virus, so that the further spread of the disease is prevented. In a simplified version of a network graph that is shown in Figure 14, people are represented as nodes, while lines between them signify their respective relationships.⁹⁸

Figure 14: Network analysis example



Source: Gonçalves, R., (2020). *Performing Social Network Analysis to Fight the Spread of COVID-19*. [Online]. Sisense. Available at: <https://www.sisense.com/blog/performing-social-network-analysis-to-fight-the-spread-of-covid-19/> [Accessed 1 July 2020].

Blockchain

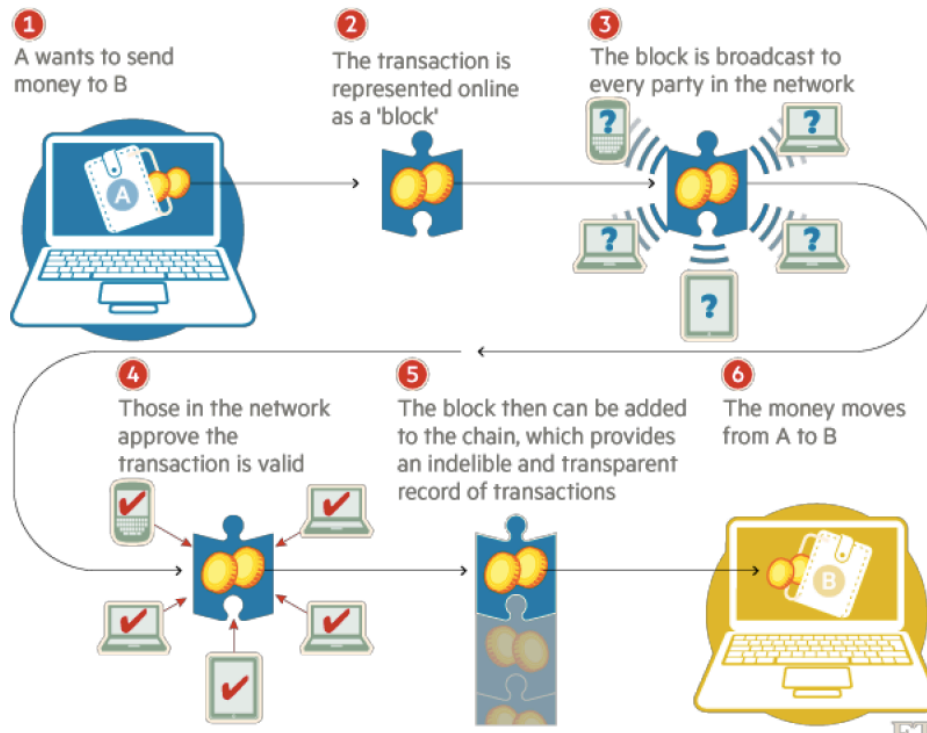
Another emerging technology that has been generating a lot of talk, particularly during the last few years is blockchain. As a proof that blockchain is gaining momentum and is being increasingly used by many businesses across sectors, consider the following facts: the global blockchain market is expected to reach \$39.7 billion by 2025, meaning that it is “estimated to have a compound annual growth rate (CAGR) of striking 67.3%, as it’s market size in 2020 is \$3 billion”.⁹⁹ At its core, blockchain is a digital, public ledger that records online transactions in a secure way as it uses cryptography to do so, in addition to every transaction automatically being linked to the previous

⁹⁸ Gonçalves, R., (2020). *Performing Social Network Analysis to Fight the Spread of COVID-19*. [Online]. Sisense. Available at: <https://www.sisense.com/blog/performing-social-network-analysis-to-fight-the-spread-of-covid-19/> [Accessed 1 July 2020].

⁹⁹ Markets and Markets, (2020). *Blockchain market*. [Online] Available at: <https://www.marketsandmarkets.com/Market-Reports/blockchain-technology-market-90100890.html#:~:text=What%20is%20the%20Blockchain%20market,67.3%25%20during%202020%E2%80%93025.> [Accessed 3 July 2020].

one. Therefore, "blockchain is a type of distributed ledger that stores and transmits data in so called "blocks" or packages that are connected to one another in order to form a digital "chain" ".¹⁰⁰ Even though blockchain is currently being utilized in numerous industries and has various real life applications including capital markets, insurance, real estate, healthcare, energy, voting, cybersecurity, and many more, its most known use case is cryptocurrency, in particular Bitcoin.¹⁰¹ The following figure explains the process of how a blockchain works on an example of conducting an online transaction between two parties. However, note that the general process and the logic behind it stay the same for any use case.

Figure 15: Blockchain process



Source: Houben, R. & Snyers, A., (2018). *Cryptocurrencies and blockchain*. [Online]. European Parliament. Available at: <https://www.europarl.europa.eu/cmsdata/150761/TAX3%20Study%20on%20cryptocurrencies%20and%20blockchain.pdf> [Accessed 3 July 2020].

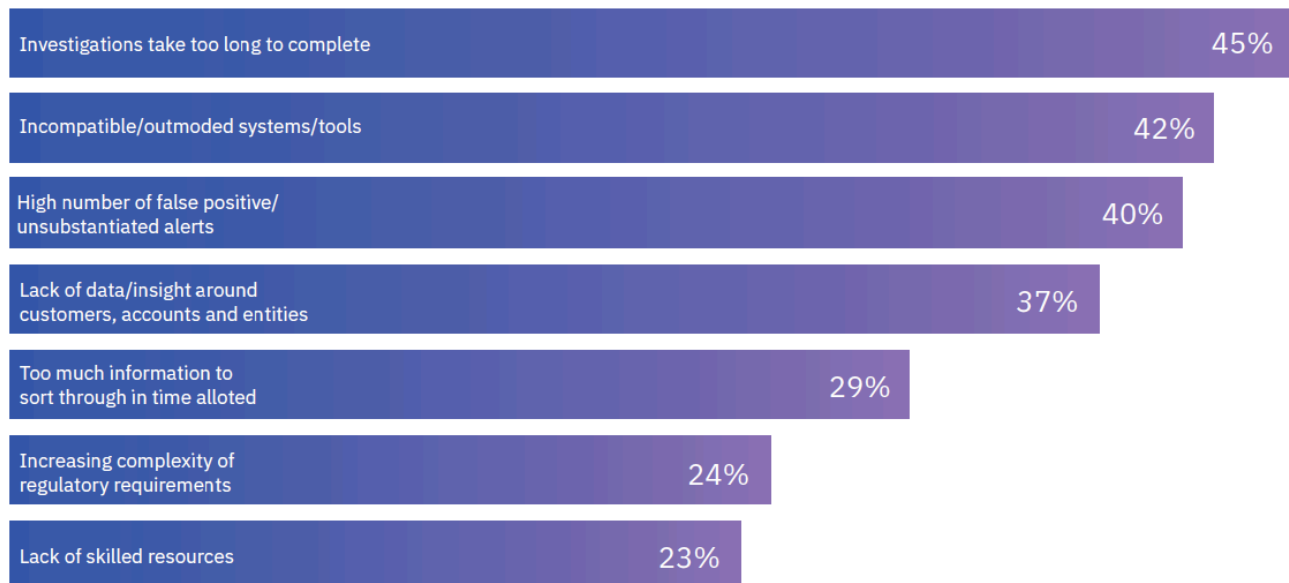
¹⁰⁰ World Bank, (2017). *Distributed Ledger Technology (DLT) and Blockchain*. [Online] Available at: <http://documents1.worldbank.org/curated/en/177911513714062215/pdf/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf> [Accessed 3 July 2020].

¹⁰¹ Business Insider Intelligence, 2020. *The growing list of applications and use cases of blockchain technology in business and life*. [Online]. Business Insider. Available at: <https://www.businessinsider.com/blockchain-technology-applications-use-cases> [Accessed 3 July 2020].

3.3 Using digital technologies for anti-money laundering

Prior to going into depth of how some digital technologies are being utilized for the purpose of combating money laundering, it is imperative to note why they are becoming a necessity for anti-money laundering solutions. In other words, it is crucial to recognize the need to change the traditional solutions as they are failing to keep up with launderers who are becoming more sophisticated and innovative on a daily basis. However, in order to be able to acknowledge this need for change, some high-level understanding of these traditional anti-money laundering (AML) solutions is necessary, as otherwise one could not fully see their flaws. The following figure shows the main AML challenges that financial institutions face on a daily basis when striving to prevent money laundering through their institution as well as adhere to strict regulatory requirements in order to avoid the ever-increasingly fines.

Figure 16: Main AML challenges faces by financial institutions



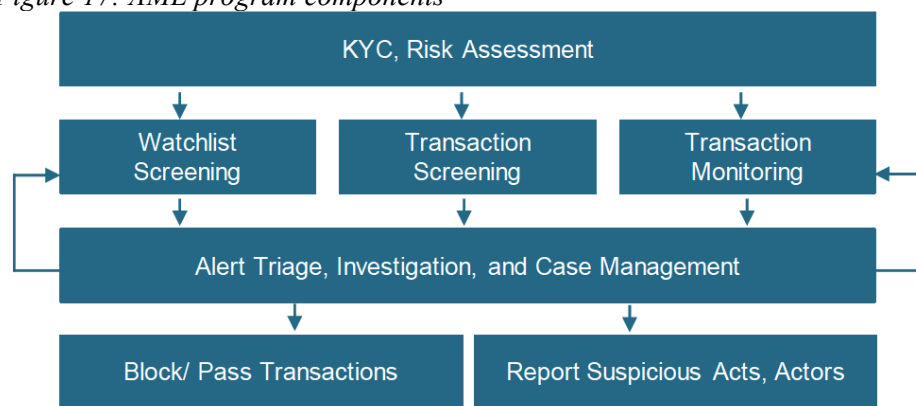
Source: IBM, (2019). *Fighting financial crime with AI*. [Online]
Available at: <https://www.ibm.com/downloads/cas/WKLQKD3W> [Accessed 1 August 2020].

Even though there are numerous high-level and low-level challenges and difficulties present at every AML stage, IBM research focusing on fighting financial crimes shows that the investigators' biggest problem is that the investigations take too long to complete, with 45% of respondents listing that as their main challenge, as seen in Figure 16. Moreover, their second biggest concern is having incompatible or outmoded systems or tools, as 42% of respondents said that was their biggest concern. However, the most well-known characteristic of an inefficient AML program is having

high false positives, which ranked third with 40%.¹⁰² A typical range of false positives for a bank is 90-99% of all alerts, meaning that countless hours of many professionals are wasted, thus significantly decreasing their efficiency and not allowing them to focus on more meaningful tasks. For example, if a bank's false positive rate is 95%, and the bank has 1 million transactions a day, generating alerts on 0.1% of all transactions, this translates into its employees having to investigate 1000 alerts a day, out of which only 50 will be true positives.¹⁰³ Therefore, by having to battle all these challenges, in addition to many more smaller but still notable ones, financial institutions have traditionally been employing more investigators to try to tackle all these potential money laundering cases. This is due to the fact that too much of an employee's time is wasted on tedious and repetitive tasks, while simultaneously having to encounter numerous problems caused by poor data management and ineffective use of technology. Precisely because of all this have companies started to develop next-generation AML solutions relying more on some emerging technologies, and therefore increasing employees' productivity, reducing costs and human error, and ultimately being able to stop more laundering attempts.

When looking at the whole span of AML operations that can be found in financial institutions, they incorporate both client and transaction lifecycles, and consist of several different components as can be seen in the following figure.

Figure 17: AML program components



Source: Ray, A., (2018). *Fighting financial crime amidst growing complexity*. [Online]. Celent. Available at: https://www.sas.com/content/dam/SAS/en_us/doc/whitepaper2/celent-fighting-financial-crime-109657.pdf [Accessed 1 August 2020]

¹⁰² IBM, (2019). *Fighting financial crime with AI*. [Online] Available at: <https://www.ibm.com/downloads/cas/WKLQKD3W> [Accessed 1 August 2020].

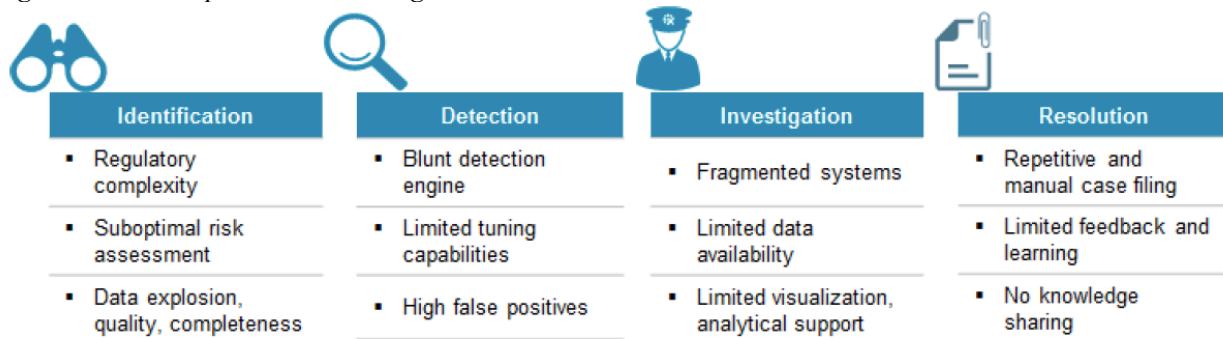
¹⁰³ Katkov, N., (2019). *The path to modern AML compliance*. [Online]. Celent. Available at: <https://www.aba.com/-/media/documents/industry-insights/guardian-analytics-path-to-modern-aml-compliance.pdf?rev=fe32dbf3148d47e289271425d7e2e0d1> [Accessed 1 August 2020].

Moreover, the overall effectiveness of AML operations is thought to be dependent on four different factors or stages of AML operations, more precisely:

1. *identification* of risky actors, activities, or jurisdictions according to the institution's policies and risk appetite
2. *detection* of suspicious or bad actors or activities that involve the institution's customers and counterparties
3. *investigation* of detected cases in order to either escalate or reject them
4. *resolution* by allowing acceptable cases, blocking unacceptable cases, and reporting them to internal and external stakeholders.¹⁰⁴

The following figure follows these four respective stages and lists all the main AML challenges that are met at every stage.

Figure 18: AML operations challenges



Source: Ray, A., (2018). *Dawn of a new era in AML technology*. [Online]. Celent. Available at: <http://www.oracle.com/us/industries/financial-services/celent-aml-dawn-tech-report-5038809.pdf> [Accessed 1 August 2020].

However, according to SAS, there exist four basic types of anti-money laundering (AML) software that are used by financial institutions with the aim of preventing money laundering through their institution, namely:

1. *customer due diligence/ know your customer systems* that gather knowledge about customers, their respective relationships and risks
2. *watchlist screening* that recognize suspicious or sanctioned people and organizations

¹⁰⁴ Ray, A., (2018). *Dawn of a new era in AML technology*. [Online]. Celent. Available at: <http://www.oracle.com/us/industries/financial-services/celent-aml-dawn-tech-report-5038809.pdf> [Accessed 1 August 2020].

3. *transaction monitoring systems* that flag patterns of transactions that could potentially indicate a suspicious activity taking place
4. *currency transaction reporting systems* that report all large cash transactions.¹⁰⁵

Since emerging digital technologies are being utilized for improving know your customer systems, watchlist screening, and transaction monitoring systems, the following part of this report will focus precisely on these three types of procedures and their respective enhancements that are made possible by implementing various new technologies.

Know Your Customer

The first step in anti-money laundering operations is performing know your customer (KYC) risk-based procedures that include taking detailed onboarding precautions and gathering all customer information necessary to review the potential risk of doing business with that particular customer. Assessing, analyzing and scoring customer risk is known as customer due diligence (CDD) and it includes various risk categories such as products and services, customer and entity demographics, and geographic location. However, if a potential customer shows an elevated risk potential in customer due diligence, another process known as enhanced customer due diligence is performed, involving a deeper risk analysis. Therefore, the main goal of this AML phase is to assess all the possible risk tied to doing business with potential customers and therefore to quantify a customer's ability to commit financial crime.¹⁰⁶ Unfortunately, even though financial institutions are heavily investing into their KYC processes, many of them are still greatly manual and full of possibilities for improvement, as they tend to have many inefficiencies.

As KYC processes are full of manual, repetitive tasks, high-volume work, and rule-based decisions that increase the probability of errors, they are a perfect candidate for automatization with robotic process automation (RPA). One of the first steps in KYC procedures is setting up customer data, a manual activity in which analysts refer to scanned customer documents and input it into a customer

¹⁰⁵ SAS, (2019). *What is next-generation AML?*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/marketing-whitepapers-ebooks/sas-whitepapers/en/next-generation-aml-110644.pdf> [Accessed 1 August 2020].

¹⁰⁶ Overton, S., (2020). *Enhance Customer Risk Scoring by Quantifying the Opportunity to Commit Financial Crime*. [Online]. SAS. Available at: <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2020/4724-2020.pdf> [Accessed 3 August 2020].

relationship management (CRM) system. As these documents are usually standardized government-issued IDs, it is possible to utilize RPA in order to automate this process. Similarly, RPA can also be used to validate existing customer information of any form and collect information “by accessing different databases, extracting data from documents and social media, merging data from different sources, and ultimately filling in the necessary forms”. Moreover, since customer data is oftentimes scattered across different systems, RPA can be applied in order to gather all the information, and thus create a holistic view of a customer. Because getting a full picture of a customer is crucial, customer screening is also performed against numerous different internal and external watch lists, and since the information to be verified from customer information against these databases is standard, this process can too be automated by RPA. Likewise, RPA can also be used in gathering customer information from external internal and external sources for risk assessment such as different websites and regulatory bodies. Consequently, much of employees’ time can now be redirected onto more meaningful tasks, in addition to reducing human error and optimizing the KYC process.¹⁰⁷

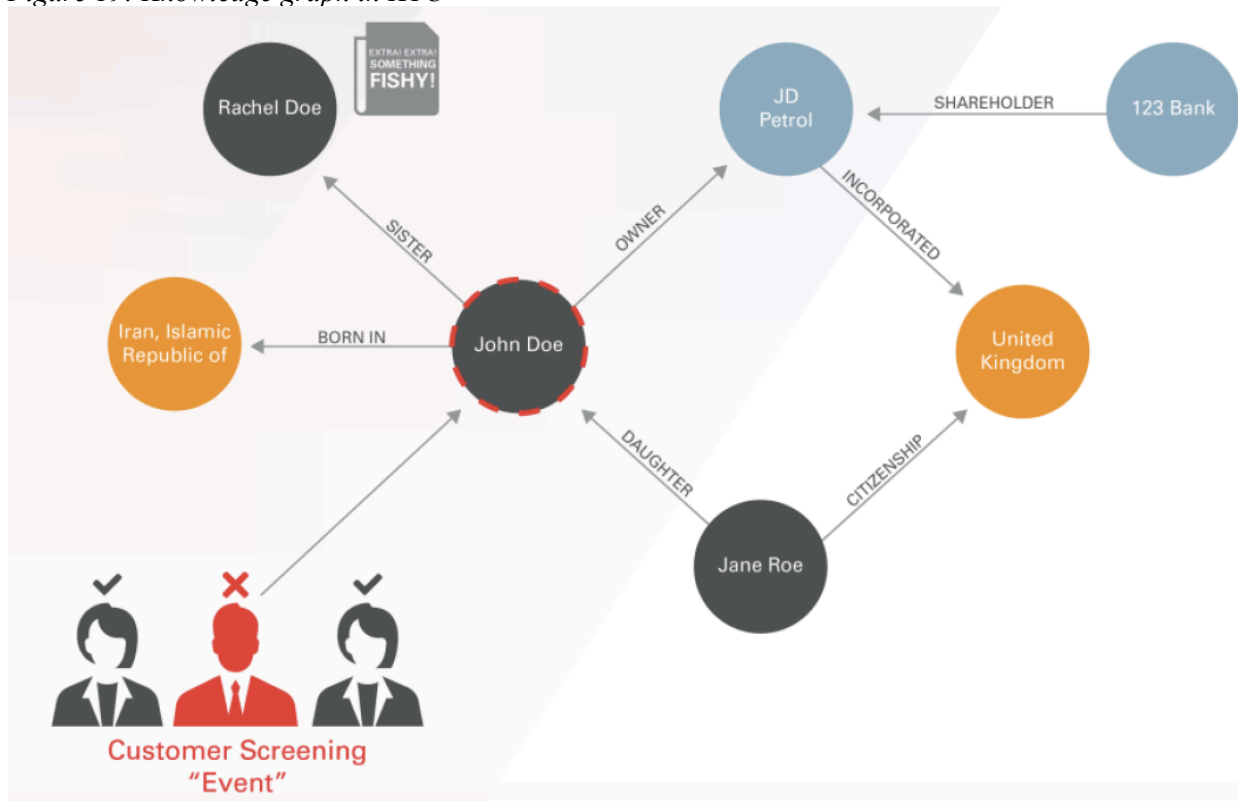
Nevertheless, one of the biggest flaws of traditional KYC processes is that they are solely focused on a particular customer, therefore creating a mono-dimensional, static and backwards-looking image without incorporating their connections to other relevant parties, and thus not building the bigger picture. Hence, it is evident that a paradigm shift is necessary for KYC processes in which individuals will not just be looked as individual entities, but rather as a part of a multi-dimensional, dynamic, and forward-looking network.¹⁰⁸ Since this concept is fairly new, some emerging technologies are necessary in order to be able to realize it, as many different technological challenges are present. Recently, companies have started utilizing knowledge graphs exactly for this purpose, as they allow them to get the full view of their customers. Knowledge graphs bring together different technologies such as machine learning and graph analytics in order to provide AI with the context it needs. These graphs are typically built on top of already existing databases, combining information from both structured and unstructured data, and then representing a

¹⁰⁷ Vysya, V. N. & Shah, K., (2018). *Robotic process automation (RPA) in AML and KYC*. [Online]. Infosys. Available at: <https://www.infosys.com/industries/financial-services/white-papers/documents/robotic-process-automation-aml-kyc.pdf> [Accessed 3 August 2020].

¹⁰⁸ Emelyanov, G. & Frunza, M.-C., (2020). *From Know Your Customer to Know Your Network: A Paradigm Shift Empowered by Neo4j*. [Online]. Neo4j. Available at: <https://neo4j.com/blog/from-know-your-customer-to-know-your-network-a-paradigm-shift-empowered-by-neo4j/> [Accessed 3 August 2020].

complex network of information in a meaningful, easy-to-understand way. Because they are taking information from a wide array of data silos, big data technologies are also present in the process, due to their ability to take in significant volumes of data and then store it in multiple data silos. Therefore, by combining all these emerging technologies, “knowledge graphs enable companies to semantically integrate diverse data and draw connections at an unprecedented scale. They also allow users to connect external sources of data efficiently, regardless of their underlying data formats and models. Using a knowledge graph, a bank can see all the customers information, risk dimensions, and regulations that are relevant for their specific goal, linked together based on their meaning, in one place for deep analysis.”¹⁰⁹ Consider the following figure as an example of a knowledge graph of a customer consisting of both internal and external data.

Figure 19: Knowledge graph in KYC



Source: Long, M., (2018). *Next-gen customer screening & transaction filtering*. [Online]. Oracle. Available at: <http://www.oracle.com/us/industries/financial-services/fs-next-gen-customer-screen-br-5139633.pdf> [Accessed 3 August 2020]

¹⁰⁹ Khalili, A., Oberoi, S., Jessurun, J. & Zwam, M. v., (2020). *Knowledge Graphs for Financial Services*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/risk/deloitte-nl-risk-knowledge-graphs-financial-services.pdf> [Accessed 3 August 2020].

Know your customer should be considered an ongoing process that starts with customer onboarding, and aims to make sure an organization knows who their customers are, their expected activity, and the overall risk connected to them. Unfortunately, some unnecessary actions tend to be present in the process such as duplication of efforts between banks and other third parties, as well as 30 to 50 day delays in transactions due to KYC requests taking too long to complete. On the other hand, both of these problems, in addition to some similar ones, are solvable using the blockchain technology as a storing method for KYC statements. Once a bank performs a KYC check on a particular customer, they can put the KYC statement along with all the necessary documents on a blockchain which can then be accessed by other banks and accredited organizations. This way the need to start the whole KYC process is eliminated, and therefore administrative costs and tasks will be reduced. In addition, since information stored on blockchain is irreversible due to the nature of blockchain, it would represent a single and reliable source of truth. An added benefit of utilizing this emerging technology is that customers need to submit their KYC documents only once as all the other institutions will rely on the blockchain verification.¹¹⁰

Watchlist Screening

The second stage of the AML operations is the detection stage in which financial institutions screen both transactions and clients for possible sanction violations. Transactions and customers are screened against “a number of international, government or regulators sanction databases that identify individuals who are prohibited from certain activities or industries”. These individuals are typically specifically designated nationals, money launderers, parties subject varying from sanctions programs, human traffickers, drug traffickers, arms traffickers to the proliferation of weapons of mass destruction.¹¹¹ Due to the increasing number of transactions, watchlist screening has become the most scrutinized area of AML compliance with extremely high penalties for misconduct. However, as watchlists are constantly changing, it is becoming increasingly difficult for financial institutions to identify and block suspicious transactions while simultaneously processing large amounts of legitimate transactions with great accuracy and without any unwanted

¹¹⁰ Murphy, D., (2018). *Four blockchain use cases for banks*. [Online]. FinTech Network. Available at: https://germanyfintech.org/wp-content/uploads/2018/01/fintech_blockchain_report_fintech_network.pdf [Accessed 4 August 2020].

¹¹¹ Sanction Scanner, (n.d.). *What is Watchlist Screening?*. [Online] Available at: <https://sanctionscanner.com/knowledge-base/watchlist-screening-58> [Accessed 9 August 2020].

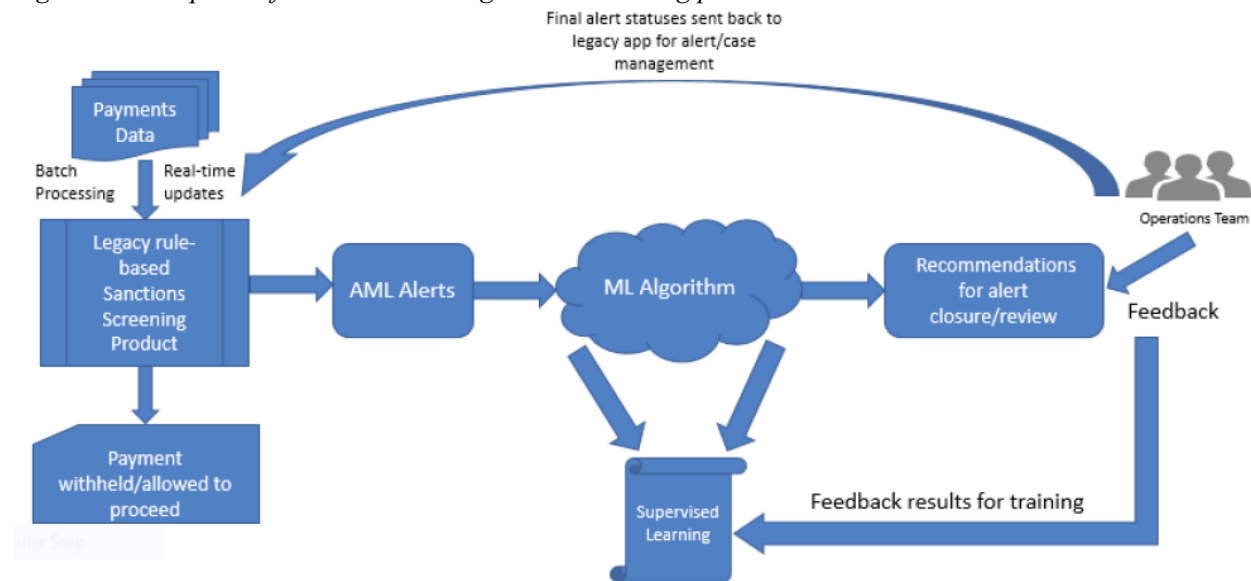
delays. Moreover, screenings are highly prone to high false positives due to the number of lists, name variations, and several data quality issues such as partial and corrupted names. Even though there are typically not as many false negatives as false positives, false negatives can have an even worse impact on the financial institution, including high fines and reputational damage.¹¹²

On the bright side, the newest advancements in AI and machine learning are able to help financial institutions lower the amount of falsely classified cases, and therefore decrease the number of false positives generated. This then translates into financial institutions having better detection systems that know how to recognize sanctioned individuals, and ultimately lowers the amount of money laundered through the financial system. Before implementing machine learning, financial institutions need to provide approximately 1 years' worth of prior alerts data, and the sanctions lists used, in order for the AML specialists as well as data scientists to be able to understand the logic behind the institution's classification practices. In addition, they also need to realize the main reasons for false positives as otherwise they could not "teach" it to the machines. Once they have all the relevant information, a form of machine learning called supervised learning can take place, in which the algorithms are tuned so that the system "learns" to distinguish false positives and genuine alerts with minimum error. Apart from learning from previously wrongly classified instances, machine learning algorithm can also learn to cancel alerts that have already been proven to be false positives, to match instances to a combination of fields such as Name and Customer type, and ultimately learn from all past actions. Therefore, by utilizing machine learning, financial institutions are able to reduce false positive alerts, and thus focus more on the actual positives as well as reduce the number of alerts that need to be investigated. The figure on the next page shows how machine learning algorithms are incorporated into the already existing AML process.¹¹³

¹¹² SAS, (2020). *Minimize false positives, maximize efficiency and control compliance costs with SAS® Real-Time Screening*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/briefs/solution-brief/en/sas-real-time-screening-111047.pdf> [Accessed 9 August 2020].

¹¹³ Kumar, A. & Vishwanath, P., (2019). *Application of machine learning in AML transaction filtering*. [Online]. Infosys. Available at: <https://www.infosys.com/industries/financial-services/insights/documents/aml-transaction-filtering.pdf> [Accessed 9 August 2020].

Figure 20: Adoption of machine learning in AML alerting process



Source: Kumar, A. & Vishwanath, P., (2019). *Application of machine learning in AML transaction filtering*. [Online]. Infosys. Available at: <https://www.infosys.com/industries/financial-services/insights/documents/aml-transaction-filtering.pdf> [Accessed 9 August 2020].

Transaction Monitoring

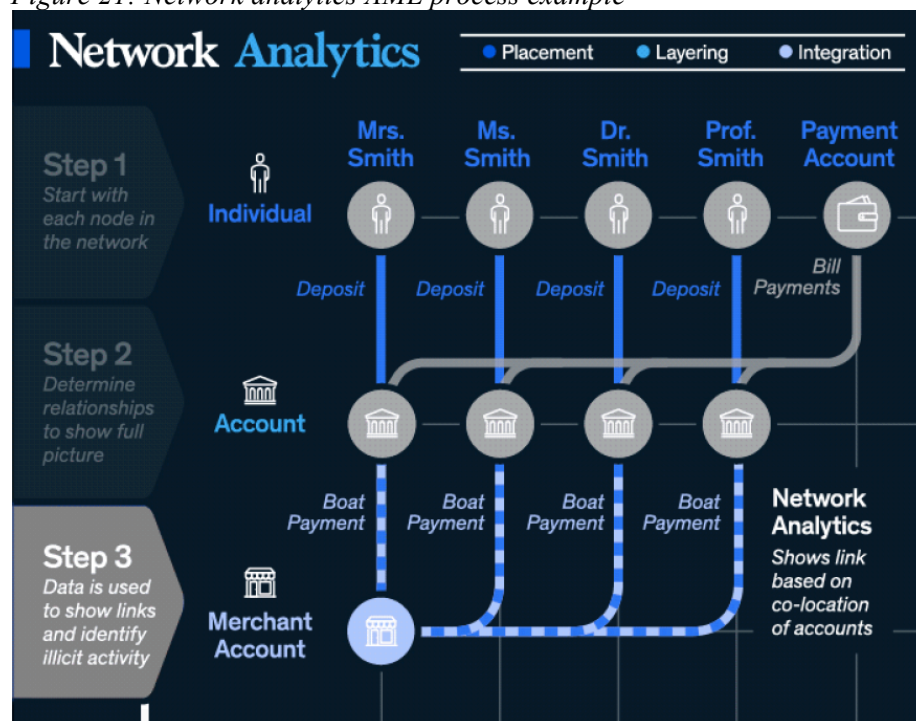
“Transaction monitoring refers to the monitoring of customer transactions, including assessing historical/current customer information and interactions to provide a complete picture of customer activity. This can include transfers, deposits, and withdrawals.”¹¹⁴ The main purpose of transaction monitoring is therefore to protect a financial institution from facilitating any transactions that might lead to launderers washing money through the institution. Like any other component of AML, transaction monitoring is not perfect and has some flaws that drive up the costs for financial institutions, in addition to not working effectively.

For example, traditional AML solutions use customer’s profile and transaction history for generating risk ratings and flagging suspicious behaviour that needs to be further investigated, such as depositing amounts of more than \$10 000 at a time. Even though this rule-based approach is fairly good, it does not flag deposits that actually represent dirty money that is laundered through a network of different individuals as they usually come in smaller, non-rounded dollar amounts

¹¹⁴ Bristow, C., (n.d.). *What is transaction monitoring in AML?*. [Online]. SAS. Available at: https://www.sas.com/en_gb/insights/articles/risk-fraud/what-is-transaction-monitoring-in-aml.html [Accessed 10 August 2020].

with the purpose of evading any detection. Fortunately, network analytics can be utilized precisely for this purpose. It can be employed in a way that it complements the already existing machine learning and fuzzy logic based transaction monitoring approaches and examines the connections among different entities to better understand their respective relationships. The main difference between the network analytics approach and the traditional one is that network analytics analyzes subcomponents of a network, while the traditional methods examine individual behaviour while making comparisons to the already known laundering methods and atypical behaviour. The formed networks are based on links between customers and related activities, which can be internal data such as account transfers or joint ownerships, and external data such as a shared address or frequent use of the same ATM. Due to its capabilities, network analytics not only improves the effectiveness of already existing transaction monitoring methods, but also provides investigators with new abilities such as identifying the presence of criminal behaviour of a certain customer group. An example of how a laundering group can be discovered by network analytics is shown below.¹¹⁵

Figure 21: Network analytics AML process example

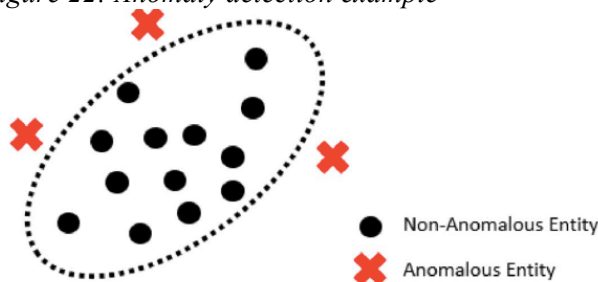


Source: Richardson, B., Williams, D. & Mikkels, D., (2019). *Network analytics and the fight against money laundering*. [Online]. McKinsey & Company. Available at: <https://www.mckinsey.com/business-functions/risk/our-insights/transforming-approaches-to-aml-and-financial-crime> [Accessed 10 August 2020].

¹¹⁵ Richardson, B., Williams, D. & Mikkels, D., (2019). *Network analytics and the fight against money laundering*. [Online]. McKinsey & Company. Available at: <https://www.mckinsey.com/business-functions/risk/our-insights/transforming-approaches-to-aml-and-financial-crime> [Accessed 10 August 2020].

Since the main goal of transaction monitoring is to find suspicious trends and patterns in transaction records that could indicate money laundering is currently not fully met, financial institutions should start turning to several machine learning methods that are capable of improving the already existing detection mechanisms. The traditional methods are rule-based with limited number of cases, thus not allowing for any deviations from the already recognized incidents. On the other hand, machine learning algorithms are able to detect new patterns that are not included in the known cases by taking advantage of large pools of data and heightened computing power. In addition, machine learning algorithms are able to adjust their behaviour by themselves based on past data, while human intervention is necessary in the traditional approaches whilst searching for suspicious activities.¹¹⁶ However, even though transaction monitoring is based around the concept of finding suspicious activities that could represent money laundering, there is no clear, objective definition of what a suspicious activity is. Fortunately, anomaly detection techniques using machine learning are able to surpass this issue by identifying observations that appear to be mathematically “distant” from the majority of the other ones. These other observations can either be historical data from the same case or current behaviour of other, similar entities. Therefore, without any labelled data or direction given, anomaly detection methods are able to find the outliers, that is the potentially suspicious activities not defined by any rule.¹¹⁷ The following figure represents a simple example in which several outliers are found based on their respective attributes.

Figure 22: Anomaly detection example



Source: SAS, (2019). *How AI and Machine Learning Are Redefining Anti-Money Laundering*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/marketing-whitepapers-ebooks/sas-whitepapers/en/ai-machine-learning-redefining-aml-110762.pdf> [Accessed 15 August 2020].

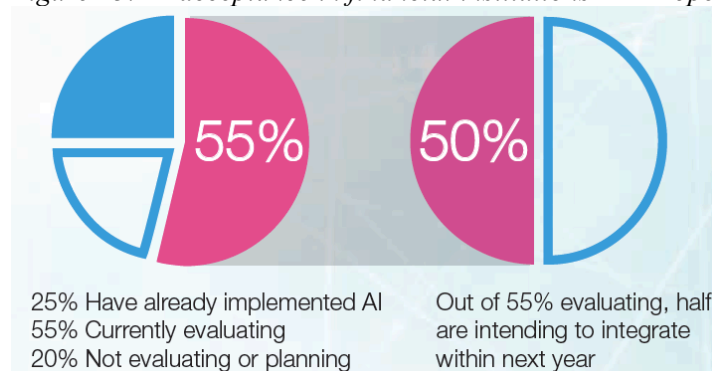
¹¹⁶ Breslow, S., Hagstroem, M., Mikkelsen, D. & Robu, K., (2017). *The new frontier in anti-money laundering*. [Online]. McKinsey & Company. Available at: <https://www.mckinsey.com/~media/McKinsey/Business%20Functions/Risk/Our%20Insights/The%20new%20frontier%20in%20anti%20money%20laundering/The-new-frontier-in-anti-money-laundering.ashx> [Accessed 15 August 2020].

¹¹⁷ SAS, (2019). *How AI and Machine Learning Are Redefining Anti-Money Laundering*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/marketing-whitepapers-ebooks/sas-whitepapers/en/ai-machine-learning-redefining-aml-110762.pdf> [Accessed 15 August 2020].

Like demonstrated throughout this chapter, by utilizing select emerging digital technologies for their AML programs, financial institutions are able to significantly improve their performance regarding detecting any money laundering attempts through their organization. By utilizing robotic process automation and blockchain technologies, many AML processes are taking less time to complete with less human error, ultimately reducing the need for human intervention and simultaneously allowing employees to focus on more important, less tedious aspects of their roles. While these technologies are reducing the burden that has traditionally been put on the AML staff, other technologies such as knowledge graphs and network analytics are providing employees with full and better representations of their customers and their respective activities, therefore allowing them to see the big pictures that are not traditionally available to them.

Moreover, artificial intelligence, in particular machine learning, is also having a great impact on financial institution's AML practices as it allows for hidden patterns to be found, in addition to truly understanding customer behaviour of different customer types, therefore not treating everyone the same but generating diverse customer groups based on their similarities and differences. Hence, the number of alerts generated is greatly reduced, specifically the amount of false positives, which is one of the biggest challenges faces by financial institutions in their AML operations. However, the acceptance of artificial intelligence tools in AML operations in financial institutions has not yet become the norm, as NICE Actimize reports that 25% of financial institution AML solutions have employed artificial intelligence thus far, as can be seen in the following figure. Overall, even though these technologies have not yet been fully acceptance in the AML operations, they show immense potential for combating money laundering, and should be further explored.

Figure 23: AI acceptance in financial institutions' AML operations

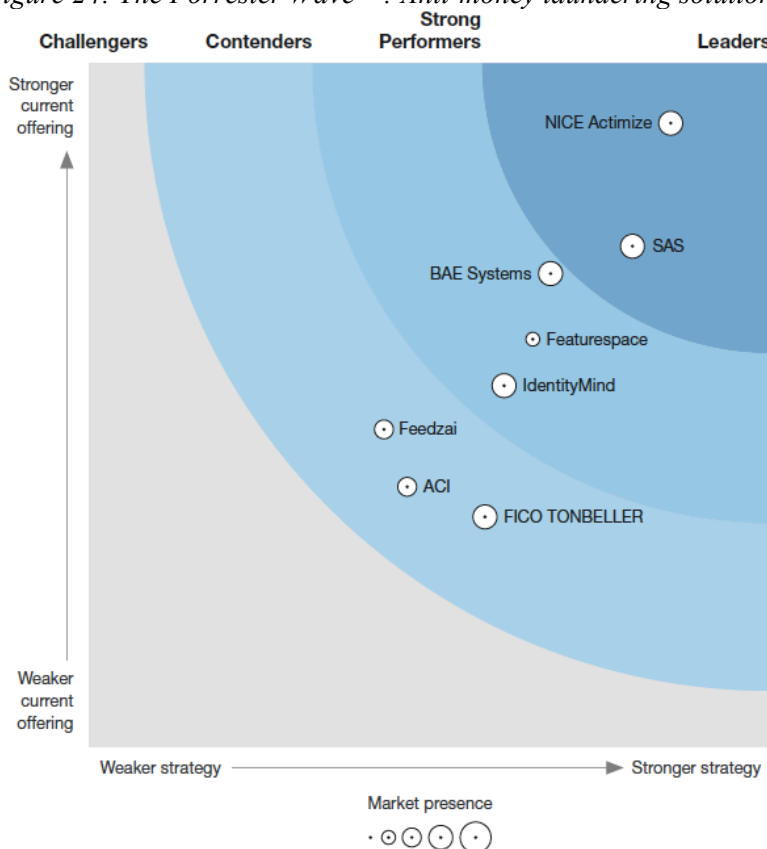


Source: Sausen, T. & Liegel, A., (2020). *AI in AML: The Shift is Underway*. [Online]. NICE Actimize. Available at: https://info.nice.com/rs/338-EJP-431/images/AML_AI%20in%20AML%20Insights%20Report_6MAY20_2.pdf [Accessed 18 August 2020].

3.4 Anti-money laundering solutions

“The global anti-money laundering solution market size is expected to grow from \$1.5 billion in 2019 to \$3.6 billion in 2024, therefore having a CAGR of 19.5%.” This immense growth is a consequence of numerous different “factors such as exponential rise in money laundering activities and vast losses caused by these activities to the banking, financial services and insurance sector”. Additionally, compliance requirements are getting more rigorous, fines are ever-increasing, more transactions are occurring online due to the adoption of digital payment methods, and advanced analytics are increasingly being used to provide proactive risk alerts. However, even though there are a lot of market drivers, the main market restraint is the lack of skilled AML professionals.¹¹⁸ On a positive note, numerous companies are delivering superior AML solutions, with market leaders being NICE Actimize and SAS, followed by BAE Systems as seen in the figure below.

Figure 24: The Forrester Wave™: Anti-money laundering solutions Q3 2019



Source: Cser, A., (2019). *The Forrester Wave™: Anti-Money Laundering Solutions, Q3 2019*. [Online]. Forrester. Available at: <https://reprints.forrester.com/#/assets/2/202/RES144895/reports> [Accessed 19 August 2020].

¹¹⁸ Research and Markets, (2019). *Global Anti-Money Laundering Solution Market Report 2019-2024* [Online]. Business Wire. Available at: <https://www.businesswire.com/news/home/20190912005427/en/Global-Anti-Money-Laundering-Solution-Market-Report-2019-2024> [Accessed 19 August 2020].

NICE Actimize

“NICE is considered to be the largest and broadest provider of financial crime, risk and compliance solutions for both regional and global financial institutions”, in addition to numerous government regulators. Operating in over 150 countries and delivering services to more than 85% of Fortune 100 Customers, “the company provides real-time, cross-channel fraud prevention, anti-money laundering detection, and trading surveillance solutions” by combining innovative technologies with expert knowledge. It exploits the power of both structured and unstructured data by applying analytic, thus transforming it into meaningful information about both the present and the future.¹¹⁹

NICE Actimize’s AML program is successfully responding to today’s dynamic threats by providing its users with a consolidated AML platform that creates a single view of the customer. The solution brings together AI, machine learning, domain expertise, and robotic process automation in order to better combat money laundering while simultaneously remaining compliant and reducing compliant costs. “This consolidated AML platform includes customer due diligence, suspicious activity monitoring, watch list filtering, suspicious transaction activity reporting, and currency transaction reporting”, all powered by operational excellence that evolves with changing criminal typologies. Some of the more notable features of this solutions involve customer profile enrichment and monitoring, fast, frictionless onboarding, comprehensive out-of-the box coverage and ongoing, AI powered tuning, customer segmentation, and efficient customer reviews and alert investigations leveraging advanced automation. As a result, higher quality alerts are created, the number of “false positives is reduced, and effortless tuning, testing, data acquisition, and model deployment is possible”.¹²⁰

An example of a successful NICE Actimize customer story with superb results is a top tier bank serving millions of accounts with hundreds of branches. Before turning to NICE Actimize, the bank’s AML processes had some significant drawbacks that needed to be addressed as the process’ efficiency depended on them. Some of the biggest downsides included having very manual, labour-intensive currency transaction process, using outdated, inflexible technology with inefficient,

¹¹⁹ NICE, (n.d.). *A brief introduction to NICE*. [Online]

Available at: <https://www.nice.com/about-nice/company-overview/> [Accessed 19 August 2020].

¹²⁰ NICE Actimize, (2020). *Protect, Govern, and Empower Your Business*. [Online]

Available at: https://www.niceactimize.com/Documents/aml_suite_brochure.pdf [Accessed 19 August 2020].

costly paper-based workflow, and struggling to keep up with the constantly changing regulatory requirements and expectations. However, after implementing NICE Actimize's solution for currency transaction monitoring the bank AML team was able to eliminate paper-based processes and improve operational efficiency, all while cutting their costs. Moreover, they enforced a standardized workflow to enforce both internal and mandated policies, in addition to achieving a 60% auto-completion rate of currency transaction reports and monetary instrument logs.¹²¹

SAS

According to the Forrester Wave, SAS is the other industry leader besides NICE Actimize, as can be seen in Figure 24 on page 50. SAS is a trusted analytical powerhouse with over 40 years of analytical innovation, "serving more than 83 000 business, government, and university sites as well as 92 of the top 100 companies on the 2018 Fortune Global 1000". It "operates as a business analytics and service company by providing software applications including business intelligence, data integration, fraud management, financial intelligence, and IT management". The company's tagline, "The Power to Know", further emphasizes their drive for discovering insights from data and making sense of it all, therefore allowing for more intelligent decisions to be made.¹²²

The anti-money laundering solution from SAS is "a sophisticated, end-to-end anti-money laundering solution, delivering unprecedented prediction and detection capabilities, lowest false positives and reduced investigation times, all while decreasing overall compliance costs". In order to stay ahead of emerging risks and ever-changing regulations, SAS Anti-Money Laundering solution relies on technologies such as AI, machine learning, robotic process automation, and advanced network analytics. Like the solution from NICE Actimize, SAS has also developed a comprehensive solution that includes "transaction monitoring, customer due diligence, customer onboarding, real-time watchlist screening, case management and regulatory reporting capabilities on a single, integrated platform". With SAS Anti-Money Laundering organizations can quickly discover emerging, complex money laundering threats with network and entity generation

¹²¹ NICE Actimize, (n.d.). *Top Tier Bank Achieves Results Through Automation*. [Online] Available at: https://www.niceactimize.com/Lists/CustomerSuccesses/Attachments/36/AML_CTR_SuccessStory_TopBank.pdf [Accessed 20 August 2020].

¹²² SAS, (n.d.). *About SAS*. [Online] Available at: https://www.sas.com/en_us/company-information/profile.html [Accessed 20 August 2020].

processes that automatically build network diagrams and reveal hidden relationships that could otherwise not get uncovered. Moreover, its users also have the ability to gain a more comprehensive risk coverage with a transaction monitoring approach that combines the traditional rule-based methods for detecting risk and hidden relationships with advanced analytics techniques such as AI, machine learning, and deep learning. Another notable feature of the solution is that it allows for real-time transaction screening against numerous watchlists and is powered by “organization-specific filtering rules, unique name matching analytics, multilingual screening capability and alert consolidation, therefore generating high-quality hits with low false positive rates”. Some other solution characteristics include improved operational efficiency, complying with customer due diligence and beneficial ownership rules, and gaining full transparency regarding triggers for red flags and alerts generated. By creating this AML solution, “SAS has helped financial institutions achieve more than 90% model accuracy, reduced false positives by up to 80% and improved the suspicious activity reporting conversion rate fourfold”.¹²³

One of the many success stories of SAS’ customers is the one of Landsbankinn, the bank holding a 39% market share in Iceland with approximately 23 300 retail customers and 13 600 corporate customers. The bank’s biggest AML problem was the generating too many false positives while searching for suspicious activity. To be more precise, the bank was generating roughly 1000 alerts a day with 95% being false positives, due to their previous weak AML system. As this bank is relatively small when compared to some of the global ones, Landsbankinn did not have the resources to analyze all the alerts that were being generated while simultaneously having to adhere to the strict regulatory practices. This is when the bank turned to SAS as it recognized it was in a need for a sophisticated and robust AML solution. Upon implementing SAS Anti-Money Laundering, Landsbankinn was able to exhibit a 90% reduction in false positives, hence allowing their employees to focus on true positives as well as improving the overall team efficiency. The bank’s head of risk solutions stated “We can change the parameters of the scenarios so that the bank can flag things more effectively. Our team can run more efficiently, and people who were once sifting through false positives can work on other things.”¹²⁴

¹²³ SAS, (n.d.). *SAS®Anti-Money Laundering*. [Online]
Available at: https://www.sas.com/en_us/software/anti-money-laundering.html [Accessed 20 August 2020].

¹²⁴ SAS, (n.d.). *Analytics powers anti-money laundering efforts*. [Online]
Available at: https://www.sas.com/en_us/customers/landsbankinn.html [Accessed 20 August 2020].

BAE Systems

One of the companies characterized as strong performers by the Forrester Wave is “BAE Systems, a global defence, aerospace and security company employing around 83 100 people worldwide”. The company is also “a globally established, expert provider of market-proven financial crime detection and prevention technology that offers a wide variety of products and service covering air, land and naval forces, as well as advanced electronics, security, information technology, and support services”. As part of their cyber security and intelligence products and services, BAE Systems has developed an end-to-end set of enterprise-grade solutions called NetReveal that is focused on helping institutions combat money laundering and stay compliant.¹²⁵

NetReveal AML solutions include transaction monitoring, optimization, managed analytics service, customer due diligence/ know your customer, sanctions and politically exposed persons screening, transaction filtering, regulatory reporting, and enterprise case management solutions. Like the previously discussed solutions, BAE System’s NetReveal also utilizes advanced analytics capabilities with machine learning techniques to drive up efficiency and effectiveness by reducing the number of false positives generated. Additionally, the solution also employs robotic process automation in automating routine tasks with the goal of enabling investigators to focus more on the high value strategic investigative work.¹²⁶

Similar to the first two solutions discussed, NetReveal has also improved the efficiency of many organizations, in addition to changing their AML practices for the better. One of examples of customer success stories is the one of Nordics Financial Group that was struggling with their transaction filtering processes as they were generating too many false positive alerts. As the Group was not scanning their transactions for sanctions and embargo lists violations efficiently, they were exposing themselves to a great deal of risk as well as high costs. However, after partnering up with BAE Systems, they were able to analyze their past data and decision to find the best solution for the Group. The final result was the reduction of false positive alerts by up to 83%.¹²⁷

¹²⁵ BAE Systems, (n.d.). *Our Company*. [Online]

Available at: <https://www.baesystems.com/en/our-company> [Accessed 20 August 2020].

¹²⁶ BAE Systems, (n.d.). *AML Regulatory Compliance*. [Online]

Available at: <https://www.baesystems.com/en/capability/aml-compliance> [Accessed 20 August 2020].

¹²⁷ BAE Systems, (n.d.). *Customer success*. [Online] Available at: <https://www.baesystems.com/en-financialservices/recognition/customer-success> [Accessed 20 August 2020].

4. Critical reflection on the current situation and future outlook

4.1 Examples and case studies

As our world is becoming increasingly dependent on various types of technology, more of our daily activities are starting to take different forms. Even though many technological advancements that greatly benefit our society are being achieved on almost a daily basis, criminals have also started to increasingly take advantage of them while conducting their crimes. This includes money laundering as well as some of its predicate crimes, in particular cybercrimes. Additionally, criminals are also turning to laundering via cryptocurrencies and money mules found through some social media platforms, hence demonstrating how money laundering techniques evolve over time. This section of the paper will therefore aim to demonstrate these concepts on real life cases that have recently been happening around the globe.

Cryptocurrency laundering as-a-service case

Back in “2017, Europol stated that an increasing number of individual criminal entrepreneurs offer crime as a service that enables individual criminals to operate their own criminal business without the need for the infrastructures” like the ones of organised crime groups. A real-life example of providing laundering services is the case investigated by Europol and Spain in which it was determined that criminals were carrying out several money laundering schemes that involved transferring fiat currencies to the crypto ones, in order to disguise the true origins of the funds. In particular, the group was using smurfing as well as crypto ATMs that allow for purchase of cryptocurrency by using cash or debit cards. Upon investigation, the authorities established that the criminal group was indeed receiving criminal proceeds and laundering them by the means of cryptocurrencies with estimated €9 million being washed in one year. In addition, one cannabis cultivation facility was dismantled, nine people were detained and 16 charged, and numerous assets were seized including four real estates, more than 200 bank accounts, 11 vehicles, €18 000 in cash, 30 mobile devices, two crypto ATMs, jewelry, documents, and identity cards used for structuring purposes.¹²⁸

¹²⁸ Europol, (2020). *Enterprising criminals*. [Online] Available at: https://www.europol.europa.eu/sites/default/files/documents/efecc_-_enterprising_criminals_-_europes_fight_against_the_global_networks_of_financial_and_economic_crime_.pdf [Accessed 24 August 2020].

Cyber fraud ring case

Prior to discussing the cyber fraud ring case, it is imperative to note the definition of a type of money laundering called money muling. “A money mule is a person who receives money from a third party in their bank account and transfers it to another one or takes it out in cash and gives it to someone else, obtaining a commission for it. Even if money mules are not directly involved in the crimes that generate the money (cybercrime, payment and on-line fraud, drugs, human trafficking, etc.), they are accomplices, as they launder the proceeds of such crimes. Simply put, money mules help criminal syndicates to remain anonymous while moving funds around the world.”¹²⁹

In the cyber fraud ring case, a criminal group was using a network comprised of numerous money mules in Italy that was originally created to launder illegally gotten funds from a wide array of different cybercrime activities. Some of these activities included financial frauds and cyber scams such as rental fraud in which fraud is committed by advertising non-existent properties for renting, and CEO fraud that involves impersonating a company official in order to initiate large money transfers to fake accounts. With these frauds, the criminal group was able to trick many European victims into wiring their money to several Italian bank accounts that were in fact owned by the previously recruited money mules. Since the victims were targets of various scams, they did not know they were essentially transferring their funds to money launderers, instead of to whatever cause the launderers made them believe the money was for. Evidently, the criminal group was very effective in their fraudulent pursuits as the victims across Europe lost about €20 million a year due to the group’s scams. Upon taking down the criminal group, Italian and Romanian law enforcement “authorities carried out 12 house searches and arrested 12 individuals (8 in Italy and 4 in Romania), seizes numerous personal computers, credit cards, properties, vehicles and other assets with an overall estimated value of over €1.5 million”.¹³⁰

¹²⁹ Europol, (n.d.). *Money muling*. [Online] Available at: <https://www.europol.europa.eu/activities-services/public-awareness-and-prevention-guides/money-muling> [Accessed 24 August 2020].

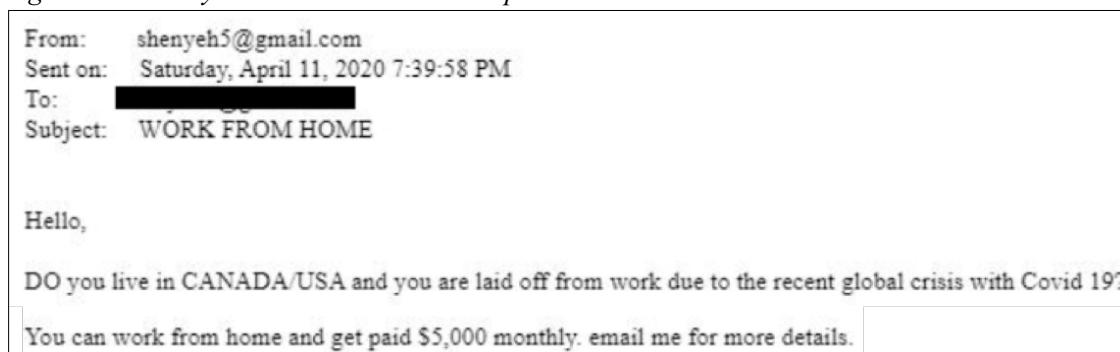
¹³⁰ Europol, (2020). *Italy and Romania take down cyber fraud ring generating €20 million per year in criminal profits*. [Online] Available at: <https://www.europol.europa.eu/newsroom/news/italy-and-romania-take-down-cyber-fraud-ring-generating-%E2%82%AC20-million-year-in-criminal-profits> [Accessed 24 August 2020].

Money muling examples

In 2018, Europol, Eurojust, the European Banking Federation (EBF), and police forces from over 20 countries collaborate in a joint action to uncover money mules helping to launder millions of euros of dirty proceeds across Europe and beyond. During the action that involved opening 837 criminal investigations, a total of 1504 money mules were identified with 168 of them being arrested, and 140 money mule organisers. In addition, due to the good work of “more than 300 banks, 20 bank associations and other financial institutions, a total loss of €36,1 million” was prevented as the institutions were able to recognize and report 26 376 fraudulent money mule transactions. Thus, this case is an excellent example of what financial institutions with good anti-money laundering programs and law enforcement can achieve when working together.¹³¹

However, even though there are numerous campaigns going on with the goal of raising awareness of money laundering, money muling, and how criminals tend to lure people into becoming mules, many people still fall victim and engage in the illegal process. Since 2020 is the year in which many people are forced to work remotely due to the pandemic, many launderers are successfully taking advantage of this situation. In particular, they are preying on the individuals highly effected by the COVID-19 as they are offering them fake employment opportunities that are in fact money muling for a criminal organization. Consider the following money muling recruitment example.¹³²

Figure 25: Money mules recruitment example



Source: Ellis, J., (2020). *COVID-19 Phishing Update: Money Mule Scams Use Remote Opportunities to Entice Victims*. [Online]. PhishLabs. Available at: <https://info.phishlabs.com/blog/covid-19-phishing-update-money-mule-scams-use-remote-opportunities-to-entice-victims> [Accessed 25 August 2020].

¹³¹ Europol, (2018). *Over 1500 money mules identified in worldwide money laundering sting*. [Online] Available at: <https://www.europol.europa.eu/newsroom/news/over-1500-money-mules-identified-in-worldwide-money-laundering-sting> [Accessed 25 August 2020].

¹³² Ellis, J., (2020). *COVID-19 Phishing Update: Money Mule Scams Use Remote Opportunities to Entice Victims*. [Online]. PhishLabs. Available at: <https://info.phishlabs.com/blog/covid-19-phishing-update-money-mule-scams-use-remote-opportunities-to-entice-victims> [Accessed 25 August 2020].

Face masks scam

Like already demonstrated, criminals tend to adjust their operations or engage in new criminal activities in order to make the most out of every situation. As in 2020 the whole world was hit by the pandemic, many criminals opted to take advantage of people's fears and anxieties by defrauding them and thus taking their money, personal or financial information. Some of these new scams include "phishing emails, fake investment opportunities, fake text messages, fake profiles on social media sites are used to manipulate victims into handing over their money, fake adverts for non-existent coronavirus-related products", and many more.¹³³

An example of advertising a fake, non-existent coronavirus-related product is offering to supply someone with a great deal of surgical face masks that in fact do not exist. The victim of such a scam was a French pharmaceutical company that had been defrauded of €6.64 million by an individual from Singapore. The scam began by the individual advertising the fast delivery of FFP2 surgical masks and hand sanitizers while taking the identity of a legitimate company. After both parties came to an agreement regarding the sale and delivery of products, the French company transferred the funds to a bank in Singapore. However, after the transaction was made the individual became uncontactable, while the items were never delivered to the French company. As the French company was clearly defrauded, all available channels for urgent international police cooperation were used with EU authorities informing the Singaporean ones of the case. Fortunately, since the recipient bank's anti-money laundering system was able to characterize the transaction as a suspicious one, the authorities managed to block part of the payment. In addition, the man behind the scam was identified and subsequently arrested "for his suspected involvement in money laundering offences linked to a business email scam-related to COVID-19".¹³⁴ Therefore, like many other cases, this incident is another example of how important cooperation between different organizations is, as well as how crucial it is to have a good anti-money laundering program in place.

¹³³ Read, S., (2020). *Fraud: Banks reveal the 10 coronavirus scams to be wary of*. [Online]. BBC. Available at: <https://www.bbc.com/news/business-53573408> [Accessed 26 August 2020].

¹³⁴ Europol, (2020). Corona crimes: Suspect behind €6 million face masks and hand sanitizers scam arrested thanks to international police cooperation. [Online] Available at: <https://www.europol.europa.eu/newsroom/news/corona-crimes-suspect-behind-%E2%82%AC6-million-face-masks-and-hand-sanitisers-scam-arrested-thanks-to-international-police-cooperation> [Accessed 25 August 2020].

4.2 Discussion on COVID-19's impact on money laundering

The COVID-19 pandemic has had a great impact on everyone's lives as well as the world economy. During this unprecedented crisis, governments are trying their best to combat the spread of the virus, and therefore save countless human lives by implementing various restrictive measures such as practising social distancing, restricting travel, temporarily closing down some public places, and switching to online learning and remote working, just to name a few. Even though many of our daily activities have been cancelled or postponed, criminals have not stopped in their pursuits of illegally generating their earnings, with some types of crimes even having an increased trend during the pandemic. Since numerous criminal acts that have been somehow affected by the COVID-19 pandemic are in fact requirements for money laundering, the sole practice of money laundering is also likely to be affected as a result. In addition, the pandemic itself and all the restrictive measures put in place by the governments have also had an impact on money laundering as well as anti-money laundering practices around the globe.

Impact on predicate crimes

As already mentioned in section 2.5 of this paper, corruption is one of the top offences linked to the use of cash in money laundering schemes. Because governments are playing a greater role in the economy to combat the pandemic and help both people and firms to survive, this highly increases the risks of corruption taking place. Unfortunately, many corruption prevention and enforcement mechanisms have been suspended due to the pandemic, only adding on to the already high corruption risks. Both these facts in addition to several more are precisely the reason why it has been said that this pandemic represents a “perfect storm” for corruption.¹³⁵

Another offence that takes one of the highest places as to the amount of cash used in money laundering schemes is drug trafficking. Since drug trafficking is present almost everywhere on the globe, the COVID-19 pandemic has so far had a mixed impact on the whole drug supply chain. Overall, organized crime groups are modifying their operations to the current situation, further developing secure communications and adjusting transportation models, trafficking routes and

¹³⁵ World Justice Project, (2020). *Corruption and the COVID-19 Pandemic*. [Online] Available at: <https://worldjusticeproject.org/sites/default/files/documents/Corruption%20Design%20File%20V4.pdf> [Accessed 27 August 2020].

concealment methods. Moreover, those groups that were previously connected to drug trafficking are starting to carry out different crimes due to the pandemic, such as trafficking in forged goods and cybercrime.¹³⁶

Correspondingly, cybercrime has been evolving and growing constantly due to the pandemic and is predicted to keep doing so. Due to numerous individuals remotely working, the potential cybercrime victim-pool has been greatly increased as people tend to take bigger online risks when at home as opposed to the office, therefore exposing the corporate IT to cybercriminals. Furthermore, it has been reported that they started to use the pandemic as a tool for social engineering attacks centered around the COVID-19 crisis.¹³⁷

Similarly, criminals have also been progressively using the pandemic to adapt their well-known fraud schemes in order to capitalize on their victims' fears and worries about the coronavirus, hence increasing the overall fraud profits and creating new, coronavirus-related scams. Some of the examples include impersonation of officials, counterfeiting including essential goods such as medical supplies and medicines, fundraising for fake charities, and fraudulent investment scams with more schemes expected to arise with time.¹³⁸

Likewise, human traffickers are also increasingly taking advantage of the COVID-19 crisis. This is possible because some previously vulnerable groups are getting even more vulnerable as unemployment is increasing, and income is decreasing for many individuals of low wage and informal sector workers. This then translates into people working in these sectors, in which human trafficking is usually detected, to possibly face even more exploitation due to their financial struggles. Moreover, another consequence of this pandemic is that authorities and non-

¹³⁶ Europol, (2020). *EU Drug Markets Impact of COVID-19*. [Online] Available at: https://www.europol.europa.eu/sites/default/files/documents/eu_drug_markets_covid19_impact_final.pdf [Accessed 30 August 2020].

¹³⁷ United Nations Office on Drugs and Crime, (2020). *Cybercrime and COVID19: Risks and responses*. [Online] Available at: https://www.unodc.org/documents/Advocacy-Section/UNODC_-_CYBERCRIME_AND_COVID19_-_Risks_and_Responses_v1.2_-_14-04-2020_-_CMLS-COVID19-CYBER1_-_UNCLASSIFIED_BRANDED.pdf [Accessed 30 August 2020]

¹³⁸ Financial Action Task Force (FATF), (2020). *COVID-19-related Money Laundering and Terrorist Financing*. [Online] Available at: <https://www.fatf-gafi.org/media/fatf/documents/COVID-19-AML-CFT.pdf> [Accessed 30 August 2020].

governmental organizations are having a harder time detecting human trafficking which is already hard to uncover without the pandemic.¹³⁹

Impact on money laundering

Even though the direct consequences of all the discussed predicate crimes on money laundering might not yet be fully visible because of the relatively early stage of the coronavirus crisis, they will undeniably have an impact on laundering as they are closely connected. To elaborate, since all the discussed crimes generate money in some way, and since those funds are not “clean” as they are illegally obtained, criminals will need to turn to money laundering at some point as to wash their “dirty” money and ultimately be able to use it. Additionally, as the majority of these crimes has been reported to have been exhibiting increasing trends, eventually the total amount to be laundered as proceedings of those crimes is likely to increase.

Moreover, the COVID-19 pandemic is also impacting the way illegal money is laundered as some of the more traditional methods with physical cash are demonstrating decreasing trends while the other, more prone to technology are getting utilized more. For example, using online financial services and virtual assets for laundering has been utilized more, but physical cash smuggling has been effectively ceased at some locations and significantly reduced at other as a result of border closures and travel restrictions. However, at the time of writing it is still unclear if criminal groups using cash smuggling are opting to wait for reopening of borders or if they are turning to laundering via other methods, such as cryptocurrencies.¹⁴⁰

During the pandemic, criminal groups have been noted to be turning to moving money through the method of money muling. Since unemployment is booming due to COVID-19, many people are left vulnerable, in a desperate need to make some money. This is the point at which criminals tend to take advantage of these people by offering them fake remote jobs, such as processing donations

¹³⁹ United Nations Office on Drugs and Crime, (2020). *Impact of the COVID-19 pandemic on trafficking in persons*. [Online] Available at: https://www.unodc.org/documents/Advocacy-Section/HTMSS_Thematic_Brief_on_COVID-19.pdf [Accessed 30 August 2020].

¹⁴⁰ United Nations Office on Drugs and Crime, (2020). *Money-laundering and COVID19: Profit and loss*. [Online] Available at: <https://www.unodc.org/documents/Advocacy-Section/EN - UNODC - MONEY LAUNDERING AND COVID19 - Profit and Loss v1.1 - 14-04-2020 - CMLS-COVID19-GPML1 - UNCLASSIFIED - BRANDED.pdf> [Accessed 31 August 2020].

for COVID-19 relief, that are in fact just money muling jobs that involve transferring criminal funds from one account to another. Similarly, they tend to capitalize on loneliness of people during the pandemic by using romance-scams to trick people in transferring money between accounts for them, thus essentially becoming the launderers' money mules.¹⁴¹

To the contrary of money muling that is being increasingly used, launderers are having a harder time washing their proceeds through cash-front businesses including casinos and other gambling venues. Due to numerous non-essential businesses such as small shops, restaurants, bars, and clubs being closed or having smaller revenue streams, it has become harder for launderers to mimic the everyday activities of such places and mix their illegally-gotten money with legitimate business revenues. Similarly, as many bank branches also had to temporarily close down, it has become more difficult for launderers to wash their funds through structuring, i.e. several individuals depositing larger amounts of cash.¹⁴²

Impact on anti-money laundering

Like just demonstrated, the impact of the coronavirus pandemic on money laundering has not been unique as it affects each laundering technique differently, in addition to the full scope of consequences not being clear yet. Conversely, the pandemic's impact on anti-money laundering practices has so far been uniform, for the vast majority of programs have been negatively impacted by the crisis, therefore reducing their effectiveness. Even though money laundering risks are increasing, numerous anti-money laundering programs are lagging behind these new threats and are losing on their efficiency.

One of the causes of this efficiency drop, as well as lower employee productivity, is remote working implemented as a coronavirus precaution measure. While adapting to the new normal can take an emotional toll on employees in this time of crisis, it can also cause added stress, which together with other factors, leads to decreased productivity. Moreover, because employees are working from

¹⁴¹ RiskScreen, (2020). *Criminals using Covid-19 crisis to recruit money laundering mules via social media, experts warn*. [Online] Available at: <https://www.riskscreen.com/kyc360/news/criminals-using-covid-19-crisis-to-recruit-money-laundering-mules-via-social-media-experts-warn/> [Accessed 31 August 2020].

¹⁴² Heaven, W. D., (2020). *The pandemic has changed how criminals hide their cash—and AI tools are trying to sniff it out*. [Online] Available at: <https://www.technologyreview.com/2020/08/06/1006104/covid-pandemic-criminals-cash-money-laundering-financial-crime-ai-machine-learning/> [Accessed 31 August 2020].

home with varying levels of availability, some financial institutions are having a hard time keeping their anti-money laundering processes at the level they typically are. This lower standard of anti-money laundering operations can also be a consequence of employees having troubles accessing secure systems that are used within their organizations. Furthermore, if an institution's anti-money laundering operations are reliant on numerous manual processes and the institution is not able to adapt their business practices to the new normal, some of its processes such as "investigative workflows, risk assessments, and reporting potentially fraudulent or suspicious behavior" might get compromised and take longer to complete, thus falling behind potential risks.¹⁴³

Another factor besides remote working that is taking a toll on anti-money laundering programs is changing customer behaviour. Since the measure of social distancing has been implemented in various parts of the world, people have been altering their behaviour and the way they conduct some everyday activities. Due to numerous bank branches being temporarily closed as well as individuals following social distancing recommendations, people have been turning to digital banking and online transactions as opposed to physical in-person ones. This new behaviour creates a wide array of problems for anti-money laundering solutions as they were built for a different environment. For example, transaction monitoring systems are having trouble recognizing truly suspicious or unusual activities as many customers have changed their behaviour pattern recently, which may lead to generating too many false positive alerts. Similarly, customers have started to withdraw more cash than usual which may trouble currency transaction reporting systems if not careful. To meet these customer demands for more cash withdrawals as well as card purchases and transfers during the pandemic, many financial institutions have opted for increasing daily transaction limits in order to support their customers through this difficult time. Nevertheless, financial institutions need to make sure they are not being taken advantage of, or in other words, that no illegal activity is taking place due to their new daily limits.¹⁴⁴

Analogous to increasing daily limits to make provide better customer experience, some financial institutions have relaxed their know your customer processes in order to make it easier for

¹⁴³ ¹⁴³ Verafin, (2020). *Impact of COVID-19 Crisis on Financial Crime Management Programs*. [Online] Available at: <https://verafin.com/2020/04/impact-of-covid-19-crisis-on-financial-crime-management-programs/> [Accessed 1 September 2020].

newcomers to register with the institution and therefore enhance the customer experience during this time of crisis. This act might prove to be extremely useful as more than 1 billion people around the world are unable to prove their identity and hence get access to some basic services such as banking, education, and healthcare. On the other hand, this relaxation of KYC processes might also lead to creation of huge criminal activity opportunities, including laundering money and not getting caught. It is also important to note that financial institutions that previously started to digitalize at least a part of their KYC processes have not been hit during this time as hard as the ones that kept relying on the older methods.¹⁴⁵

In the same manner that financial institutions with already updated KYC systems are having an easier time during the COVID-19 pandemic, are financial institutions that have enhanced their AML programs with some emerging technologies better equipped to handle the money laundering problem than those with traditional solutions. As explained in section 3.3 of this paper, these conventional solutions are typically based on rules that then lead to alerts creation and raising flags. Even though these solutions already exhibit numerous weaknesses in standard times, during this pandemic their flaws have become more visible, and thus made it harder to combat money laundering at financial institutions utilizing them. For instance, as customer behaviour is changing rapidly, institutions are not able to alter their rule-based system so quickly and keep up with their customers, including bad actors that are increasingly taking advantage of the pandemic and everything that has come with it. Moreover, financial regulators around the world have been releasing new guidelines as to what to look out for in terms of money laundering activity with many institutions not being able to follow. As a response, the head of financial crime at Featurespace stated that new technology is necessary in order to keep up with these happenings in real time as “Otherwise by the time you’ve detected something and alerted the people who need to know, the money is gone.”¹⁴⁶ Therefore, this pandemic has proven that implementing emerging technologies such as artificial intelligence into AML programs is a necessity as they are more adaptable and thus perform better, even under uncertain situations such as this pandemic.

¹⁴⁵ KYC-Chain, (2020). *How is COVID-19 Impacting KYC?*. [Online]

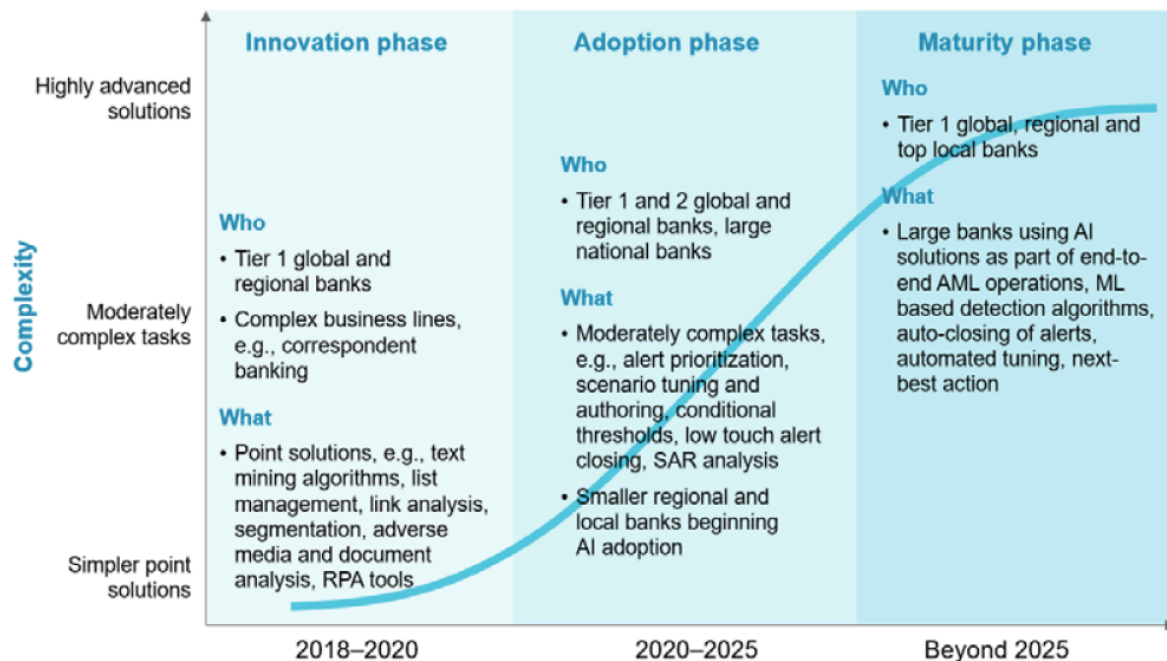
Available at: <https://kyc-chain.com/how-is-covid-19-impacting-kyc/> [Accessed 1 September 2020].

¹⁴⁶ Heaven, W. D., (2020). *The pandemic has changed how criminals hide their cash—and AI tools are trying to sniff it out*. [Online]. MIT Technology Review. Available at: <https://www.technologyreview.com/2020/08/06/1006104/covid-pandemic-criminals-cash-money-laundering-financial-crime-ai-machine-learning/> [Accessed 31 August 2020].

4.3 Discussion on the future of anti-money laundering solutions

“In 2018, the global anti-money laundering market size was estimated to be worth a total of \$857.2 million, with projected compound annual growth rate (CAGR) of 13.6% from 2019 to 2025”. This translates into the market expected to reach \$1028.3 million in 2020.¹⁴⁷ During the last several years, some financial institutions have started enhancing their AML operations with emerging technologies such as artificial intelligence, machine learning, and robotic process automation as well as several data analytics tools. However, until 2020 the industry was still thought to be in the innovation phase, starting to enter the adoption phase and ultimately reaching the maturity phase beyond 2025, as seen in Figure 26 below. Like shown in the graph, more institutions will be incorporating some more advanced AML solutions into their operations during the following years, hence demonstrating the need to modernize the AML practices and enhance their effectiveness.¹⁴⁸

Figure 26: Adoption of advanced anti-money laundering solutions



Source: Ray, A., (2018). *Enhancing AML efficiency and effectiveness*. [Online]. Celent. Available at: https://www.sas.com/content/dam/SAS/en_us/doc/whitepaper2/celent-aml-efficiency-effectiveness-109856.pdf [Accessed 3 September 2020].

¹⁴⁷ Grand View Research, (2019). *Anti Money Laundering Market Size, Share & Trends Analysis Report By Component (Software, Services), By Product Type, By Deployment, By End Use (BFSI, Government, Healthcare, IT & Telecom), And Segment Forecasts, 2019 - 2025*. [Online] Available at: <https://www.grandviewresearch.com/industry-analysis/anti-money-laundering-market> [Accessed 3 September 2020].

¹⁴⁸ Ray, A., (2018). *Enhancing AML efficiency and effectiveness*. [Online]. Celent. Available at: https://www.sas.com/content/dam/SAS/en_us/doc/whitepaper2/celent-aml-efficiency-effectiveness-109856.pdf [Accessed 3 September 2020].

In addition, NICE Actimize's survey with respondents from a diverse set of financial service organizations, ranging from Tier 1 banks, mid-size banks, and banks with assets under \$10 billion, predicts using another emerging technology for their AML solutions. More precisely, the report states that while only 4% of respondents were using public cloud-based AML software and services in 2019, in the following two years the number is expected to grow to 50%. The report explains this by stating that the need for cloud-based solutions will stem from the increasing use of large amounts of data, in combination with two main drivers for cloud; ease of integration with other technologies and its scalability. Moreover, organizations turning to cloud also enjoy some additional benefits such as reduced costs, better options for computing performance with increased agility, data science resources such as those offered as a service by third-party providers, and collective intelligence from data leveraged across multiple organizations. Some other predictions for the future of AML activities involve private-to-private information sharing, increased adoption of contextualized financial crime, real-time AML monitoring, quality not quantity impacts, and greater alignment of standards.¹⁴⁹

However, all of these predictions were made prior to the coronavirus pandemic striking the world, changing the way we live our daily lives and perform different undertakings, not excluding the bad actors who are trying to profit from this crisis. During this time, numerous financial institutions are struggling with keeping their AML operations at a decent level and continuing to fight money laundering attempts through their institutions. On the other hand, this pandemic has managed to highlight all the flaws of the traditional AML systems that are still used by the institutions, prove that the need for change truly exists and that it is imperative financial institutions utilize new emerging technologies. Furthermore, many experts in the field believe that the crisis has only accelerated the implementation of advanced technologies into AML with high degree urgency. As stated by an AML expert from a Sanction Scanner report, "While the financial conduct authorities further emphasize the need for advanced AML compliance in its business plan of 2020/21, the tinescapable fact is that it will become even a more significant concern post-COVID-19."¹⁵⁰

¹⁴⁹ Sausen, T. & Liegel, A., (2020). *AI in AML: The Shift is Underway*. [Online]. NICE Actimize. Available at: https://info.nice.com/rs/338-EJP-431/images/AML_AI%20in%20AML%20Insights%20Report_6MAY20_2.pdf [Accessed 18 August 2020].

¹⁵⁰ Sanction Scanner, (2020). *Expected Changes in AML After COVID-19*. [Online] Available at: <https://sanctionsscanner.com/Static/Ebooks/Expected-Changes-in-AML-after-COVID-19.pdf> [Accessed 3 September 2020].

5. Conclusion

The main goal of this master thesis was to thoroughly examine the practice of money laundering as well as demonstrate how some emerging digital technologies can be utilized for the purpose of combating it. As already stated in the paper, it is estimated that between \$800 million and \$2 trillion is lost annually around the globe due to money laundering, implying just how important it is to try to combat it and educate as many individuals as possible about this topic since anyone can fall victim to money laundering or another crime connected to it in some way.

Money laundering is typically a three-step process with countless ways of performing each phase of the procedure as the number of methods is ultimately limited by launderers' imagination. Some of the most common techniques discussed in this paper include cash smuggling, structuring, casinos and other gambling venues, shell corporations, real estate, and cryptocurrency. However, laundering money would not be necessary unless some crimes occur that generate illegal or "dirty" money that needs to be turned into "clean" funds, i.e., to make it look like it comes from legitimate sources. Even though there are various predicate crimes that eventually lead to money laundering, this paper focused on the three main ones involving cash, namely drug trafficking, corruption, and human trafficking. Next, after briefly explaining the concept of professional money laundering, three of the biggest money laundering scandals uncovered so far were discussed, in which several hundreds of billions of dollars were laundered through various financial institutions. These cases just prove the scope that money laundering can take if not detected in its early stages, hence further justifying the need for premium anti-money laundering programs.

Moving onto the next big part of the paper, selected digital technologies were discussed and explained including artificial intelligence, machine learning, robotic process automation, big data, graph analytics, blockchain, and advanced analytics. Prior to going into detail of how these technologies are utilized for the purpose of combating money laundering, the main anti-money laundering concepts and components were briefly explained, while simultaneously highlighting their main weaknesses and opportunities for improvement. When describing how each of the mentioned technologies is used to improve AML programs, the focus was on know your customer, watchlist screening, and transaction monitoring systems as most advancements are being done in their respective areas. Throughout this chapter, it was demonstrated how know your customer

systems can be enhanced by employing robotic process automation, big data, blockchain, and knowledge graphs. Moreover, it was also explained how artificial intelligence, and machine learning, in particular supervised learning, can be utilized for improving watchlist screening, in addition to presenting the use of network analytics and machine learning techniques to better transaction monitoring. Since these explanations were mostly of a theoretical nature, they were followed by real life success stories of the three leading AML solutions providers, that are in fact using some of the talked about technologies in their solutions. The case studies were from NICE Actimize, SAS, and BAE Systems and were accompanied by specifics of them utilizing these different technologies in order to provide their customers with the optimal AML solutions that assist stopping as many money laundering attempts as possible.

The final major chapter of this master thesis was focused on the current situation regarding money laundering as well as the future of anti-money laundering solutions. Firstly, to demonstrate some of the recent happenings, several case studies and examples were presented, some of them including new criminal schemes appearing as a result of the coronavirus pandemic. Following these real-life examples that have been happening recently, the overall impact of the COVID-19 pandemic on offences leading to money laundering, anti-money laundering programs, and the sole practice of money laundering was discussed and thoroughly analyzed. It was crucial to cover all these different topics as they are all indeed closely connected and changes in one area directly affect the other. In this chapter, it was concluded that the coronavirus pandemic has mostly caused a rise in predicate offences, hence eventually leading to the overall rise in the amount of money to be laundered from these crimes. In addition, the pandemic has also led to changing customer behaviour which, in combination with working remotely, negatively impacted AML programs in numerous financial institutions. However, it is important to note that AML solutions based on emerging technologies did not suffer nearly as much as the traditional ones, hence only proving the need for change in AML solution techniques. Furthermore, it was also established that many experts believe that this pandemic has made the importance of updating the traditional AML solutions with emerging technologies even more visible and urgent, as the true benefits of the next-generation AML solutions have become more visible than ever. In addition, it is also probable that this crisis has fast-tracked the utilization of emerging technologies into AML which can only be fully proven with time.

In conclusion, supporting the laundering process of illicit proceeds directly impacts criminals and encourages them to keep on defying the law by engaging in different criminal activities including, but not limited to, drugs trafficking, corruption, human trafficking, cybercrimes, various frauds and scams, and even terrorism. This is due to the fact that if not battling money laundering on a daily basis, it essentially presents criminals with incentives to perform various types of crimes because it provides them with an assurance that they will eventually be able to enjoy their illicit proceeds. However, prior to using their proceeds, they cause damage to their crimes' individual victims as well as the entire economy as billions if not trillions of dollars are lost, in addition to possibly ruining countless human lives. Hence, it is crucial to employ the best possible efforts into creating and implementing advanced anti-money laundering solutions that will be able to stop money laundering attempts while keeping the legitimate transactions going. Like demonstrated throughout this paper, this can and should be done by utilizing different emerging technologies. Therefore, by successfully implementing select emerging digital technologies into their AML operations, financial institutions will be able to prevent money laundering attempts from happening, which will thereafter influence the rate of criminal offences taking place, hence decreasing the total amount of illegal action and ultimately benefit the society as a whole.

References

1. AIMultiple, (2020). *Graph Analytics in 2020: Gain business insights from networks*. [Online] Available at: <https://research.aimultiple.com/graph-analytics/#:~:text=Graph%20analytics%2C%20also%20called%20network,Many%20businesses%20work%20with%20graphs>. [Accessed 1 July 2020].
2. Association of Certified Anti-Money Laundering Specialists (ACAMS), (2012). *Study Guide for CAMS the Certification Examination*. [Online] Available at: http://higherlogicdownload.s3.amazonaws.com/ACAMS/e91557e6-bbb6-4fc9-9b7c-eef66256706a/UploadedImages/pdf%20downloads/StudyGuides/2012_English_Study_Guide.pdf [Accessed 13 June 2020].
3. BAE Systems, (n.d.). *AML Regulatory Compliance*. [Online] Available at: <https://www.baesystems.com/en/capability/aml-compliance> [Accessed 20 August 2020].
4. BAE Systems, (n.d.). *Customer success*. [Online] Available at: <https://www.baesystems.com/en-financialservices/recognition/customer-success> [Accessed 20 August 2020].
5. BAE Systems, (n.d.). *Our Company*. [Online] Available at: <https://www.baesystems.com/en/our-company> [Accessed 20 August 2020].
6. Boisseau, J. & Wilson, L., (2019). *Enterprise AI: Data Analytics, Data Science and Machine Learning*. [Online]. CIO. Available at: <https://www.cio.com/article/3342421/enterprise-ai-data-analytics-data-science-and-machine-learning.html> [Accessed 1 July 2020].
7. Boulton, C., (2018). *What is RPA? A revolution in business process automation*. [Online]. CIO. Available at: <https://www.cio.com/article/3236451/what-is-rpa-robotic-process-automation-explained.html> [Accessed 3 July 2020].
8. Bristow, C., (n.d.). *What is transaction monitoring in AML?*. [Online]. SAS. Available at: https://www.sas.com/en_gb/insights/articles/risk-fraud/what-is-transaction-monitoring-in-aml.html [Accessed 10 August 2020].
9. Business Insider Intelligence, (2020). *The growing list of applications and use cases of blockchain technology in business and life*. [Online]. Business Insider. Available at: <https://www.businessinsider.com/blockchain-technology-applications-use-cases> [Accessed 3 July 2020].

10. Computing Technology Industry Association (CompTIA), (2019). *IT industry outlook 2020*. [Online] Available at: <https://www.comptia.org/content/research/it-industry-trends-analysis#:~:text=Industry%20Overview,trends%20discussed%20in%20this%20report>. [Accessed 1 July 2020].
11. Cox, D., (2014). *Handbook of Anti-Money Laundering*. [Online]. ProQuest. Available at: https://ebookcentral.proquest.com/lib/efzg/detail.action?docID=1809740&query=Anti-money+lauding#goto_toc [Accessed 12 June 2020].
12. Cser, A., (2019). *The Forrester Wave™: Anti-Money Laundering Solutions, Q3 2019*. [Online]. Forrester. Available at: <https://reprints.forrester.com/#/assets/2/202/RES144895/reports> [Accessed 19 August 2020].
13. Sengupta, R., Mehta, R. & Dadu, A., (2017). *The Digital Workforce is here*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/in/Documents/strategy/in-strategy-innovation-rpa-digital-workforce-noexp.pdf> [Accessed 3 July 2020].
14. Duin, S. v., Bakhshi, N., (2018). *Artificial Intelligence*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/deloitte-analytics/deloitte-nl-data-analytics-artificial-intelligence-whitepaper-eng.pdf> [Accessed 1 July 2020].
15. Khalili, A., Oberoi, S., Jessurun, J. & Zwam, M. v., (2020). *Knowledge Graphs for Financial Services*. [Online]. Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/risk/deloitte-nl-risk-knowledge-graphs-financial-services.pdf> [Accessed 3 August 2020].
16. Ellis, J., (2020). *COVID-19 Phishing Update: Money Mule Scams Use Remote Opportunities to Entice Victims*. [Online]. PhishLabs. Available at: <https://info.phishlabs.com/blog/covid-19-phishing-update-money-mule-scams-use-remote-opportunities-to-entice-victims> [Accessed 25 August 2020].
17. Emelyanov, G. & Frunza, M.-C., (2020). *From Know Your Customer to Know Your Network: A Paradigm Shift Empowered by Neo4j*. [Online]. Neo4j. Available at: <https://neo4j.com/blog/from-know-your-customer-to-know-your-network-a-paradigm-shift-empowered-by-neo4j/> [Accessed 3 August 2020].

18. Europol, (2015). *Why is cash still king?*. [Online] Available at:
<https://www.europol.europa.eu/sites/default/files/documents/europolcik%20%281%29.pdf>
[Accessed 14 June 2020].
19. Europol, (2017). *How Illegal Drugs Sustain Organized Crime in the EU*. [Online] Available
at:[https://www.europol.europa.eu/sites/default/files/documents/business_fundamentals_how
illegal_drugs_sustain_organised_crime_in_europe.pdf](https://www.europol.europa.eu/sites/default/files/documents/business_fundamentals_how_illegal_drugs_sustain_organised_crime_in_europe.pdf) [Accessed 18 June 2020].
20. Europol, (2018). *Over 1500 money mules identified in worldwide money laundering sting*.
[Online] Available at: [https://www.europol.europa.eu/newsroom/news/over-1500-money-
mules-identified-in-worldwide-money-laundering-sting](https://www.europol.europa.eu/newsroom/news/over-1500-money-mules-identified-in-worldwide-money-laundering-sting) [Accessed 25 August 2020].
21. Europol, (2020). *Corona crimes: Suspect behind €6 million face masks and hand sanitizers
scam arrested thanks to international police cooperation*. [Online] Available at:
[https://www.europol.europa.eu/newsroom/news/corona-crimes-suspect-behind-
%E2%82%AC6-million-face-masks-and-hand-sanitisers-scam-arrested-thanks-to-
international-police-cooperation](https://www.europol.europa.eu/newsroom/news/corona-crimes-suspect-behind-%E2%82%AC6-million-face-masks-and-hand-sanitisers-scam-arrested-thanks-to-international-police-cooperation) [Accessed 25 August 2020].
22. Europol, (2020). *Enterprising criminals*. [Online]
Available at: [https://www.europol.europa.eu/sites/default/files/documents/efecc_-_
enterprising_criminals_-_
europes_fight_against_the_global_networks_of_financial_and_economic_crime.pdf](https://www.europol.europa.eu/sites/default/files/documents/efecc_-_enterprising_criminals_-_europes_fight_against_the_global_networks_of_financial_and_economic_crime.pdf)
[Accessed 24 August 2020].
23. European Monitoring Centre for Drugs and Drug Addiction and Europol, (2020). *EU Drug
Markets Impact of COVID-19*. [Online] Available at:
[https://www.europol.europa.eu/sites/default/files/documents/eu_drug_markets_covid19_impact_](https://www.europol.europa.eu/sites/default/files/documents/eu_drug_markets_covid19_impact_final.pdf)
[final.pdf](https://www.europol.europa.eu/sites/default/files/documents/eu_drug_markets_covid19_impact_final.pdf) [Accessed 30 August 2020].
24. Europol, (2020). *Italy and Romania take down cyber fraud ring generating €20 million per
year in criminal profits*. [Online]
Available at: [https://www.europol.europa.eu/newsroom/news/italy-and-romania-take-down-
cyber-fraud-ring-generating-%E2%82%AC20-million-year-in-criminal-profits](https://www.europol.europa.eu/newsroom/news/italy-and-romania-take-down-cyber-fraud-ring-generating-%E2%82%AC20-million-year-in-criminal-profits)
[Accessed 24 August 2020].
25. Europol, (n.d.). *Money muling*. [Online]
Available at: [https://www.europol.europa.eu/activities-services/public-awareness-and-
prevention-guides/money-muling](https://www.europol.europa.eu/activities-services/public-awareness-and-prevention-guides/money-muling) [Accessed 24 August 2020].

26. EY, (2014). *Big data*. [Online]
Available at: [https://www.ey.com/Publication/vwLUAssets/EY -
Big data: changing the way businesses operate/\\$FILE/EY-Insights-on-GRC-Big-
data.pdf](https://www.ey.com/Publication/vwLUAssets/EY_-_Big_data:_changing_the_way_businesses_operate/$FILE/EY-Insights-on-GRC-Big-data.pdf) [Accessed 3 July 2020].
27. Federal Bureau of Investigation (FBI), (2016). *White-Collar Crime*. [Online]
Available at: [https://www.fbi.gov/investigate/white-collar-
crime#:~:text=Reportedly%20coined%20in%201939%2C%20the,of%20physical%20force%
20or%20violence.](https://www.fbi.gov/investigate/white-collar-crime#:~:text=Reportedly%20coined%20in%201939%2C%20the,of%20physical%20force%20or%20violence.) [Accessed 17 June 2020].
28. Financial Action Task Force (FATF), (2010). *Money Laundering Using Trust and Company Service Providers*. [Online] Available at: [https://www.fatf-
gafi.org/media/fatf/documents/reports/Money%20Laundering%20Using%20Trust%20and%2
0Company%20Service%20Providers..pdf](https://www.fatf-gafi.org/media/fatf/documents/reports/Money%20Laundering%20Using%20Trust%20and%20Company%20Service%20Providers..pdf) [Accessed 16 June 2020].
29. Financial Action Task Force (FATF), (2011). *Money Laundering Risks Arising from Trafficking in Human Beings and Smuggling of Migrants*. [Online]
Available at: [https://www.fatf-
gafi.org/media/fatf/documents/reports/Trafficking%20in%20Human%20Beings%20and%20
Smuggling%20of%20Migrants.pdf](https://www.fatf-gafi.org/media/fatf/documents/reports/Trafficking%20in%20Human%20Beings%20and%20Smuggling%20of%20Migrants.pdf) [Accessed 19 June 2020].
30. Financial Action Task Force (FATF), (2018). *Professional Money Laundering*. [Online].
FATF. Available at: [http://www.fatf-gafi.org/media/fatf/documents/Professional-Money-
Laundering.pdf](http://www.fatf-gafi.org/media/fatf/documents/Professional-Money-Laundering.pdf) [Accessed 20 June 2020].
31. Financial Action Task Force (FATF), (2019). *Money Laundering*. [Online]
Available at: <https://www.fatf-gafi.org/faq/moneylaundering/> [Accessed 17 June 2020].
32. Financial Action Task Force (FATF), (2020). *COVID-19-related Money Laundering and Terrorist Financing*. [Online]. FATF. Available at: [https://www.fatf-
gafi.org/media/fatf/documents/COVID-19-AML-CFT.pdf](https://www.fatf-gafi.org/media/fatf/documents/COVID-19-AML-CFT.pdf) [Accessed 30 August 2020].
33. Murphy, D., (2018). *Four blockchain use cases for banks*. [Online]. FinTech Network.
Available at: [https://germanyfintech.org/wp-
content/uploads/2018/01/fintech_blockchain_report_fintech_network.pdf](https://germanyfintech.org/wp-content/uploads/2018/01/fintech_blockchain_report_fintech_network.pdf)
[Accessed 4 August 2020].
34. Flitter, E., (2019). *Standard Chartered Fined \$1.1 Billion for Violating Sanctions and Anti-Money Laundering Laws*. [Online]. The New York Times. Available at:

<https://www.nytimes.com/2019/04/09/business/standard-chartered-sanctions-violations.html>
[Accessed 20 June 2020].

35. Fortune Business Insights, (2020). *Artificial intelligence market*. [Online] Available at: <https://www.fortunebusinessinsights.com/industry-reports/artificial-intelligence-market-100114> [Accessed 1 July 2020].
36. Garside, J., (2018). *Is money-laundering scandal at Danske Bank the largest in history?*. [Online]. The Guardian. Available at: <https://www.theguardian.com/business/2018/sep/21/is-money-laundering-scandal-at-danske-bank-the-largest-in-history> [Accessed 20 June 2020].
37. Gartner, (n.d.). *Advanced Analytics*. [Online] Available at: <https://www.gartner.com/en/information-technology/glossary/advanced-analytics#:~:text=Advanced%20Analytics%20is%20the%20autonomous,make%20prediction%2C%20or%20generate%20recommendations>. [Accessed 1 July 2020].
38. Global Organization of Parliamentarians Against Corruption (GOPAC), (2012). *Anti-Money Laundering Action Guide for Parliamentarians*. [Online]. GOPAC Network. Available at: http://www.gopacnetwork.org/Docs/GOPAC_AML_ActionGuide_EN.pdf [Accessed 13 June 2020].
39. Gonçalves, R., (2020). *Performing Social Network Analysis to Fight the Spread of COVID-19*. [Online]. Sisense. Available at: <https://www.sisense.com/blog/performing-social-network-analysis-to-fight-the-spread-of-covid-19/> [Accessed 1 July 2020].
40. Grand View Research, Inc., (2020). *Advanced Analytics Market Size Worth \$59.1 Billion by 2027 | CAGR: 25.3%: Grand View Research, Inc.* [Online] Available at: <https://www.prnewswire.com/news-releases/advanced-analytics-market-size-worth-59-1-billion-by-2027--cagr-25-3-grand-view-research-inc-301027996.html>[Accessed 1 July 2020].
41. Grand View Research, (2019). *Anti Money Laundering Market Size, Share & Trends Analysis Report By Component (Software, Services), By Product Type, By Deployment, By End Use (BFSI, Government, Healthcare, IT & Telecom), And Segment Forecasts, 2019 - 2025*. [Online] Available at: <https://www.grandviewresearch.com/industry-analysis/anti-money-laundering-market> [Accessed 3 September 2020].
42. Heaven, W. D., (2020). *The pandemic has changed how criminals hide their cash—and AI tools are trying to sniff it out*. [Online]. MIT Technology Review. Available at:

- <https://www.technologyreview.com/2020/08/06/1006104/covid-pandemic-criminals-cash-money-laundering-financial-crime-ai-machine-learning/> [Accessed 31 August 2020].
43. Hodal, K., (2019). *One in 200 people is a slave. Why?*. [Online]. The Guardian. Available at: <https://www.theguardian.com/news/2019/feb/25/modern-slavery-trafficking-persons-one-in-200> [Accessed 19 June 2020].
44. Houben, R. & Snyers, A., (2018). *Cryptocurrencies and blockchain*. [Online]. European Parliament. Available at: <https://www.europarl.europa.eu/cmsdata/150761/TAX3%20Study%20on%20cryptocurrencies%20and%20blockchain.pdf> [Accessed 3 July 2020].
45. IBM, (2019). *Fighting financial crime with AI*. [Online] Available at: <https://www.ibm.com/downloads/cas/WKLQKD3W> [Accessed 1 August 2020].
46. International Compliance Organization, (n.d.). *What is Money Laundering?*. [Online] Available at: <https://www.int-comp.org/careers/your-career-in-aml/what-is-money-laundering/> [Accessed 12 June 2020].
47. Katkov, N., (2019). *The path to modern AML compliance*. [Online]. Celent. Available at: <https://www.aba.com/-/media/documents/industry-insights/guardian-analytics-path-to-modern-aml-compliance.pdf?rev=fe32dbf3148d47e289271425d7e2e0d1> [Accessed 1 August 2020].
48. Kumar, A. & Vishwanath, P., (2019). *Application of machine learning in AML transaction filtering*. [Online]. Infosys. Available at: <https://www.infosys.com/industries/financial-services/insights/documents/aml-transaction-filtering.pdf> [Accessed 9 August 2020].
49. KYC-Chain, (2020). *How is COVID-19 Impacting KYC?*. [Online] Available at: <https://kyc-chain.com/how-is-covid-19-impacting-kyc/> [Accessed 1 September 2020].
50. Kyriakos-Saad, N., Esposito, G. & Schwarz, N., (2012). *The Incestuous Relationship Between Corruption and Money Laundering*. [Online]. Cairn.info. Available at: <https://www.cairn.info/revue-internationale-de-droit-penal-2012-1-page-161.htm#:~:text=Corruption%20and%20money%20laundering%20are,without%20the%20stigma%20of%20illegality.> [Accessed 18 June 2020].
51. Legal Information Institute, Cornell Law School, (n.d.). *Money Laundering*. [Online] Available at: https://www.law.cornell.edu/wex/money_laundering#:~:text=To%20launder%20money%2C

- %20the%20shell,to%20often%20pay%20with%20cash.&text=The%20launderer%20then%20deposits%20the,to%20account%20for%20the%20cash. [Accessed 16 June 2020].
52. Makortoff, K., (2019). *Standard Chartered fined \$1.1bn for money-laundering and sanctions breaches*. [Online]. The Guardian. Available at:
<https://www.theguardian.com/business/2019/apr/09/standard-chartered-fined-money-laundering-sanctions-breaches#:~:text=Standard%20Chartered%20has%20been%20ordered,sanctions%20against%20countries%20including%20Iran.&text=It%20is%20the%20second%2Dlargest,anti%2Dmoney%2Dlaundering%20failures>. [Accessed 20 June 2020].
53. Maloney, M., Somerville, T. & Unger, B., (2019). *Combatting Money Laundering in BC Real Estate*. [Online]. Expert Panel on Money Laundering in BC Real Estate. Available at:
<https://www2.gov.bc.ca/assets/gov/housing-and-tenancy/real-estate-in-bc/combating-money-laundering-report.pdf> [Accessed 16 June 2020].
54. Markets and Markets, (2020). *Blockchain market*. [Online] Available at:
<https://www.marketsandmarkets.com/Market-Reports/blockchain-technology-market-90100890.html#:~:text=What%20is%20the%20Blockchain%20market,67.3%25%20during%202020%E2%80%932025>. [Accessed 3 July 2020].
55. May, C., (2017). *Transnational Crime and the Developing World*. [Online]. Global Financial Integrity. Available at:
https://secureservercdn.net/45.40.149.159/34n.8bd.myftpupload.com/wp-content/uploads/2017/03/Transnational_Crime-final.pdf [Accessed 19 June 2020].
56. Breslow, S., Hagstroem, M., Mikkelsen, D. & Robu, K., (2017). *The new frontier in anti-money laundering*. [Online]. McKinsey & Company. Available at:
<https://www.mckinsey.com/~media/McKinsey/Business%20Functions/Risk/Our%20Insights/The%20new%20frontier%20in%20anti%20money%20laundering/The-new-frontier-in-anti-money-laundering.ashx> [Accessed 15 August 2020].
57. McKinsey & Company, (n.d.). *An executive's guide to AI*. [Online] Available at:
<https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/an-executives-guide-to-ai> [Accessed 1 July 2020].

58. Blockchain Content, (2019). *The 5 Largest Money Laundering Scandals of All Time...So Far*. [Online]. Medium. Available at: <https://medium.com/kyc-io-scalable-kyc-management-solutions/the-5-largest-money-laundering-scandals-of-all-time-so-far-d30ff4abee10> [Accessed 20 June 2020].
59. Merriam-Webster, (n.d.). *Cryptocurrency*. [Online] Available at: <https://www.merriam-webster.com/dictionary/cryptocurrency> [Accessed 16 June 2020].
60. NICE Actimize, (2020). *Protect, Govern, and Empower Your Business*. [Online] Available at: https://www.niceactimize.com/Documents/aml_suite_brochure.pdf [Accessed 19 August 2020].
61. NICE Actimize, (n.d.). *Top Tier Bank Achieves Results Through Automation*. [Online] Available at: https://www.niceactimize.com/Lists/CustomSuccesses/Attachments/36/AML_CTR_SuccessStory_TopBank.pdf [Accessed 20 August 2020].
62. NICE, (n.d.). *A brief introduction to NICE*. [Online] Available at: <https://www.nice.com/about-nice/company-overview/> [Accessed 19 August 2020].
63. Olavsrud, T., (2019). *What is data science? Transforming data into value*. [Online]. CIO. Available at: <https://www.cio.com/article/3285108/what-is-data-science-a-method-for-turning-data-into-value.html> [Accessed 1 July 2020].
64. Oracle, (n.d.). *What Is Graph Analytics?*. [Online] Available at: <https://www.oracle.com/big-data/what-is-graph-analytics.html> [Accessed 1 July 2020].
65. Organisation for Economic Co-operation and Development (OECD), (2001). *Behind the Corporate Veil*. [Online]. OECD Publications. Available at: <http://www.oecd.org/daf/ca/43703185.pdf> [Accessed 16 June 2020].
66. Overton, S., (2020). *Enhance Customer Risk Scoring by Quantifying the Opportunity to Commit Financial Crime*. [Online]. SAS. Available at: <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2020/4724-2020.pdf> [Accessed 3 August 2020].
67. Presse, A. F., (2012). *The International Organized Crime Industry Is Worth \$870 Billion*. [Online]. Business Insider. Available at: <https://www.businessinsider.com/the-international-organized-crime-industry-is-worth-870-billion-2012-10> [Accessed 18 June 2020].

68. RAND Corporation, (2019). *Spending on illicit drugs in US nears \$150 billion annually*. [Online]. Science Daily. Available at: <https://www.sciencedaily.com/releases/2019/08/190820081846.htm>[Accessed 18 June 2020].
69. Ray, A., (2018). *Dawn of a new era in AML technology*. [Online]. Celent. Available at: <http://www.oracle.com/us/industries/financial-services/celent-aml-dawn-tech-report-5038809.pdf> [Accessed 1 August 2020].
70. Ray, A., (2018). *Enhancing AML efficiency and effectiveness*. [Online]. Celent. Available at: https://www.sas.com/content/dam/SAS/en_us/doc/whitepaper2/celent-aml-efficiency-effectiveness-109856.pdf [Accessed 3 September 2020].
71. Ray, A., (2018). *Fighting financial crime amidst growing complexity*. [Online]. Celent. Available at: https://www.sas.com/content/dam/SAS/en_us/doc/whitepaper2/celent-fighting-financial-crime-109657.pdf [Accessed 1 August 2020].
72. Read, S., (2020). *Fraud: Banks reveal the 10 coronavirus scams to be wary of*. [Online]. BBC. Available at: <https://www.bbc.com/news/business-53573408> [Accessed 26 August 2020].
73. Rebora, A., (2019). *The Use of Cryptocurrency for Money Laundering*. [Online]. Medium. Available at: <https://medium.com/@andrearebora/the-use-of-cryptocurrency-for-money-laundering-e94131748cc7> [Accessed 16 June 2020].
74. Research and Markets, (2019). *Global Anti-Money Laundering Solution Market Report 2019-2024: KYC Systems, Transaction Monitoring, Case Management, Compliance Management, Auditing and Reporting - ResearchAndMarkets.com*. [Online]. Business Wire. Available at: <https://www.businesswire.com/news/home/20190912005427/en/Global-Anti-Money-Laundering-Solution-Market-Report-2019-2024> [Accessed 19 August 2020].
75. Reuter, P. & Truman, E. M., (2004). *Chasing Dirty Money*. [Online]. Peterson Institute for International Economics. Available at: <https://www.piie.com/bookstore/chasing-dirty-money-fight-against-money-laundering>. [Accessed 14 June 2020].
76. Richardson, B., Williams, D. & Mikkels, D., (2019). *Network analytics and the fight against money laundering*. [Online]. McKinsey & Company. Available at: <https://www.mckinsey.com/business-functions/risk/our-insights/transforming-approaches-to-aml-and-financial-crime> [Accessed 10 August 2020].

77. RiskScreen, (2020). *Criminals using Covid-19 crisis to recruit money laundering mules via social media, experts warn*. [Online] Available at: <https://www.riskscreen.com/kyc360/news/criminals-using-covid-19-crisis-to-recruit-money-laundering-mules-via-social-media-experts-warn/> [Accessed 31 August 2020].
78. Roberts, J. J., (2020). *How shadowy brokers allegedly launder billions for crypto criminals*. [Online]. Fortune. Available at: <https://fortune.com/2020/01/15/crypto-criminals-brokers-launder-billions/> [Accessed 16 June 2020].
79. Roser, M. & Ortiz-Ospina , E., (2019). *Corruption*. [Online]. Our World in Data. Available at: <https://ourworldindata.org/corruption> [Accessed 18 June 2020].
80. Sanction Scanner, (2020). *Expected Changes in AML After COVID-19*. [Online] Available at: <https://sanctionscanner.com/Static/Ebooks/Expected-Changes-in-AML-after-COVID-19.pdf> [Accessed 3 September 2020].
81. Sanction Scanner, (n.d.). *What is Watchlist Screening?*. [Online] Available at: <https://sanctionscanner.com/knowledge-base/watchlist-screening-58> [Accessed 9 August 2020].
82. SAS, (2019). *How AI and Machine Learning Are Redefining Anti-Money Laundering*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/marketing-whitepapers-ebooks/sas-whitepapers/en/ai-machine-learning-redefining-aml-110762.pdf> [Accessed 15 August 2020].
83. SAS, (2019). *What is next-generation AML?*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/marketing-whitepapers-ebooks/sas-whitepapers/en/next-generation-aml-110644.pdf> [Accessed 1 August 2020].
84. SAS, (2020). *Minimize false positives, maximize efficiency and control compliance costs with SAS® Real-Time Screening*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/briefs/solution-brief/en/sas-real-time-screening-111047.pdf> [Accessed 9 August 2020].
85. SAS, (n.d.). *About SAS*. [Online] Available at: https://www.sas.com/en_us/company-information/profile.html [Accessed 20 August 2020].
86. SAS, (n.d.). *Analytics powers anti-money laundering efforts*. [Online] Available at: https://www.sas.com/en_us/customers/landsbankinn.html [Accessed 20 August 2020].

87. SAS, (n.d.). *Fight money laundering with these 5 game changers from SAS*. [Online] Available at: <https://www.sas.com/content/dam/SAS/documents/marketing-whitepapers-ebooks/ebooks/en/fight-money-laundering-111220.pdf> [Accessed 1 August 2020].
88. SAS, (n.d.). *SAS®Anti-Money Laundering*. [Online] Available at: https://www.sas.com/en_us/software/anti-money-laundering.html[Accessed 20 August 2020].
89. Sausen, T. & Liegel, A., (2020). *AI in AML: The Shift is Underway*. [Online]. NICE Actimize. Available at: https://info.nice.com/rs/338-EJP-431/images/AML_AI%20in%20AML%20Insights%20Report_6MAY20_2.pdf [Accessed 18 August 2020].
90. Schneider, S., (2004). *Money Laundering in Canada: An Analysis of RCMP Cases*. [Online]. Nathanson Centre. Available at: <http://old.csd.bg/fileSrc.php?id=560> [Accessed 16 June 2020].
91. Schott, P. A., (2006). *Reference Guide to Anti-Money Laundering and Combating the Financing of Terrorism*. [Online]. World Bank. Available at: http://siteresources.worldbank.org/EXTAML/Resources/396511-1146581427871/Reference_Guide_AMLCFT_2ndSupplement.pdf [Accessed 13 June 2020].
92. Sisense, (n.d.). *Advanced analytics*. [Online] Available at: <https://www.sisense.com/glossary/advanced-analytics/#:~:text=Big%20data%20analytics%20are%20useful,as%20well%20as%20cleaning%20data.&text=Advanced%20analytics%20also%20include%20newer,visualizations%2C%20and%20even%20neural%20networks>. [Accessed 1 July 2020].
93. Sullivan, K., (2015). *Anti-Money Laundering in a Nutshell*. [Online]. Apress. Available at: <http://2.droppdf.com/files/QHjVk/anti-money-laundering-in-a-nutshell.pdf> [Accessed 12 June 2020].
94. Tamburro, D., (2019). *Detecting Human Trafficking? Your Anti-Money Laundering Program & SAS® Visual Investigator Can Help*. [Online]. SAS. Available at: <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2019/3382-2019.pdf> [Accessed 19 June 2020].
95. U.S. Immigration and Customs Enforcement, (2018). *Combating Bulk Cash Smuggling*. [Online] Available at: <https://www.ice.gov/bulk-cash-smuggling-center/faq> [Accessed 14 June 2020].

96. Bisogno, E. et al., (2013). *Business, corruption and crime in Croatia: The impact of bribery and other crime on private enterprise*. [Online]. United Nations Office on Drugs and Crime. Available at: https://www.unodc.org/documents/data-and-analysis/statistics/corruption/Croatia_Business_corruption_report.pdf [Accessed 18 June 2020].
97. United Nations Office on Drugs and Crime, (2020). *Cybercrime and COVID19: Risks and responses*. [Online] Available at: [https://www.unodc.org/documents/Advocacy-Section/UNODC - CYBERCRIME AND COVID19 - Risks and Responses v1.2 - 14-04-2020 - CMLS-COVID19-CYBER1 - UNCLASSIFIED BRANDED.pdf](https://www.unodc.org/documents/Advocacy-Section/UNODC_-_CYBERCRIME_AND_COVID19_-_Risks_and_Responses_v1.2_-_14-04-2020_-_CMLS-COVID19-CYBER1_-_UNCLASSIFIED_BRANDED.pdf) [Accessed 30 August 2020].
98. United Nations Office on Drugs and Crime, (2020). *Impact of the COVID-19 pandemic on trafficking in persons*. [Online] Available at: [https://www.unodc.org/documents/Advocacy-Section/HTMSS Thematic Brief on COVID-19.pdf](https://www.unodc.org/documents/Advocacy-Section/HTMSS_Thematic_Brief_on_COVID-19.pdf) [Accessed 30 August 2020].
99. United Nations Office on Drugs and Crime, (2020). *Money-laundering and COVID19: Profit and loss*. [Online] Available at: [https://www.unodc.org/documents/Advocacy-Section/EN - UNODC - MONEY LAUNDERING AND COVID19 - Profit and Loss v1.1 - 14-04-2020 - CMLS-COVID19-GPML1 - UNCLASSIFIED - BRANDED.pdf](https://www.unodc.org/documents/Advocacy-Section/EN_-_UNODC_-_MONEY_LAUNDERING_AND_COVID19_-_Profit_and_Loss_v1.1_-_14-04-2020_-_CMLS-COVID19-GPML1_-_UNCLASSIFIED_-_BRANDED.pdf) [Accessed 31 August 2020].
100. United Nations Office on Drugs and Crime, (n.d.). *Corruption*. [Online] Available at: <https://www.unodc.org/unodc/data-and-analysis/corruption.html> [Accessed 18 June 2020].
101. United Nations Office on Drugs and Crime, (n.d.). *Drug trafficking*. [Online] Available at: <https://www.unodc.org/unodc/en/drug-trafficking/index.html#:~:text=Drug%20trafficking%20is%20a%20global,comprehensive%20understanding%20of%20their%20dynamics>. [Accessed 18 June 2020].
102. United Nations Office on Drugs and Crime, (n.d.). *Money-Laundering and Globalization*. [Online] Available at: <https://www.unodc.org/unodc/en/money-laundering/globalization.html> [Accessed 12 June 2020].
103. United Nations, (2018). *The costs of corruption: values, economic development under assault, trillions lost, says Guterres*. [Online] Available at: <https://news.un.org/en/story/2018/12/1027971> [Accessed 18 June 2020].

104. United Nations, (2019). *Digital economy report 2019*. [Online]
Available at: https://unctad.org/en/PublicationsLibrary/der2019_overview_en.pdf
[Accessed 1 July 2020].
105. Verafin, (2020). *Impact of COVID-19 Crisis on Financial Crime Management Programs*.
[Online] Available at: <https://verafin.com/2020/04/impact-of-covid-19-crisis-on-financial-crime-management-programs/> [Accessed 1 September 2020].
106. Vulliamy, E., (2011). *How a big US bank laundered billions from Mexico's murderous drug gangs*. [Online]. The Guardian. Available at:
<https://www.theguardian.com/world/2011/apr/03/us-bank-mexico-drug-gangs>
[Accessed 21 June 2020].
107. Vysya, V. N. & Shah, K., (2018). *Robotic process automation (RPA) in AML and KYC*.
[Online]. Infosys. Available at: <https://www.infosys.com/industries/financial-services/white-papers/documents/robotic-process-automation-aml-kyc.pdf> [Accessed 3 August 2020].
108. World Bank, (2017). *Distributed Ledger Technology (DLT) and Blockchain*. [Online]
Available at: <http://documents1.worldbank.org/curated/en/177911513714062215/pdf/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf>
[Accessed 3 July 2020].
109. World Justice Project, (2020). *Corruption and the COVID-19 Pandemic*. [Online]
Available at:
<https://worldjusticeproject.org/sites/default/files/documents/Corruption%20Design%20File%20V4.pdf> [Accessed 27 August 2020].
110. Zangre, A., (2019). *44 Noteworthy Big Data Statistics in 2019*. [Online]. Learning Hub.
Available at: <https://learn.g2.com/big-data-statistics> [Accessed 1 July 2020].

Table of Figures

<i>Figure 1: Money laundering cycle</i>	7
<i>Figure 2: Money laundering options example</i>	11
<i>Figure 3: Cash-based business laundering example</i>	12
<i>Figure 4: Money laundering methods</i>	13
<i>Figure 5: Structuring example</i>	15
<i>Figure 6: Types of properties purchased</i>	20
<i>Figure 7: Laundering techniques for real estate</i>	18
<i>Figure 8: Predicate offences most closely linked to the use of cash in money laundering</i>	21
<i>Figure 9: Real life example of drug trafficking money laundering</i>	22
<i>Figure 10: Perception of corruption by institution</i>	23
<i>Figure 11: Trafficking of human beings money flows</i>	25
<i>Figure 12: Professional money laundering process</i>	26
<i>Figure 13: Relationship between AI, machine learning and underlying methods and infrastructure</i>	32
<i>Figure 14: Network analysis example</i>	36
<i>Figure 15: Blockchain process</i>	37
<i>Figure 16: Main AML challenges faces by financial institutions</i>	38
<i>Figure 16: AML program components</i>	39
<i>Figure 17: AML operations challenges</i>	40
<i>Figure 18: Knowledge graph in KYC</i>	43
<i>Figure 19: Adoption of machine learning in AML alerting process</i>	46
<i>Figure 20: Network analytics AML process example</i>	47
<i>Figure 21: Anomaly detection example</i>	48
<i>Figure 23: AI acceptance in financial institutions' AML operations</i>	49
<i>Figure 24: The Forrester Wave™: Anti-money laundering solutions Q3 2019</i>	50
<i>Figure 25: Money mules recruitment example</i>	57
<i>Figure 26: Adoption of advanced anti-money laundering solutions</i>	65