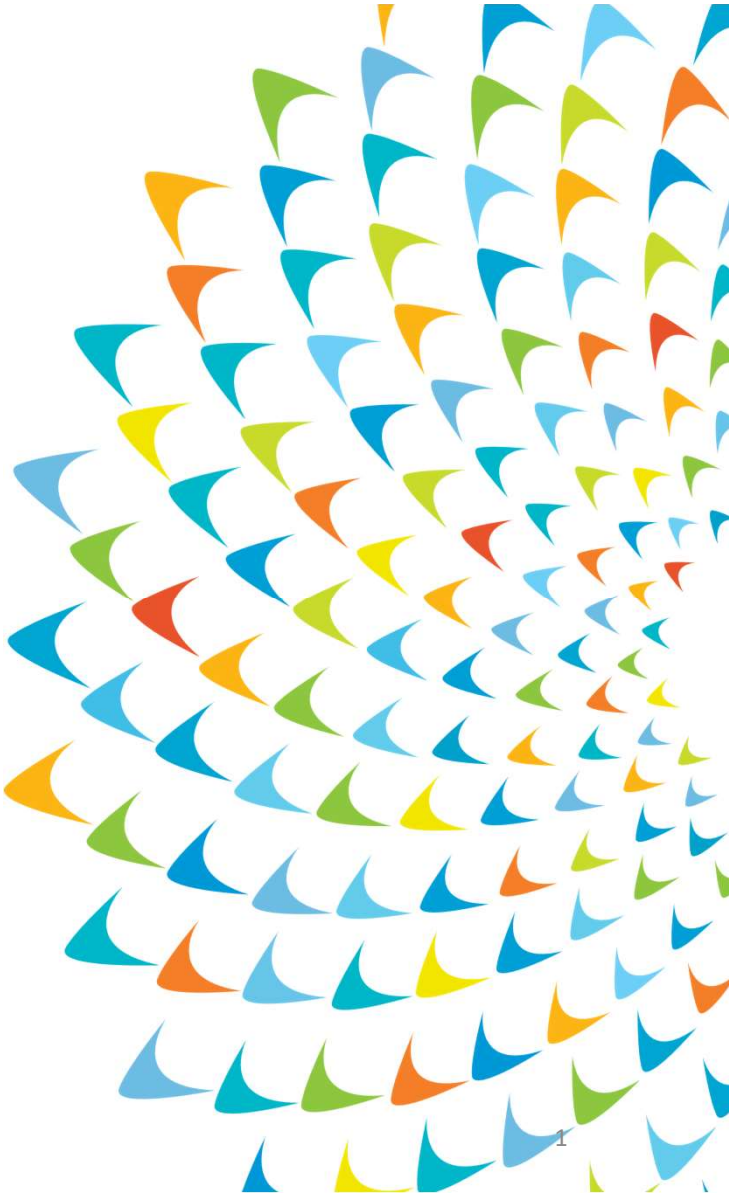
IIA Indonesia
Success and Failure from Experimenting with Technology in Audit

2 September 2020



Audit Application	Technology
Country Priority Assessment : Prioritising countries for country portfolio audit	Unsupervised Machine Learning with Sentiment Analysis
Verifying implementation status of infrastructure projects https://www.youtube.com/watch?v=-70_LYoITAU&feature=youtu.be	Drone
Continuous Monitoring Tool on Treasury Transactions	Rule-based and Supervised Machine Learning
ARGUS: Analysing consistency of clauses recorded for private sector projects	Contract analysis software
Covenants Validation Tool: Examining completeness of covenant clauses recorded for sovereign projects	Robotic process automation (bots)

2

Country Priority Assessment

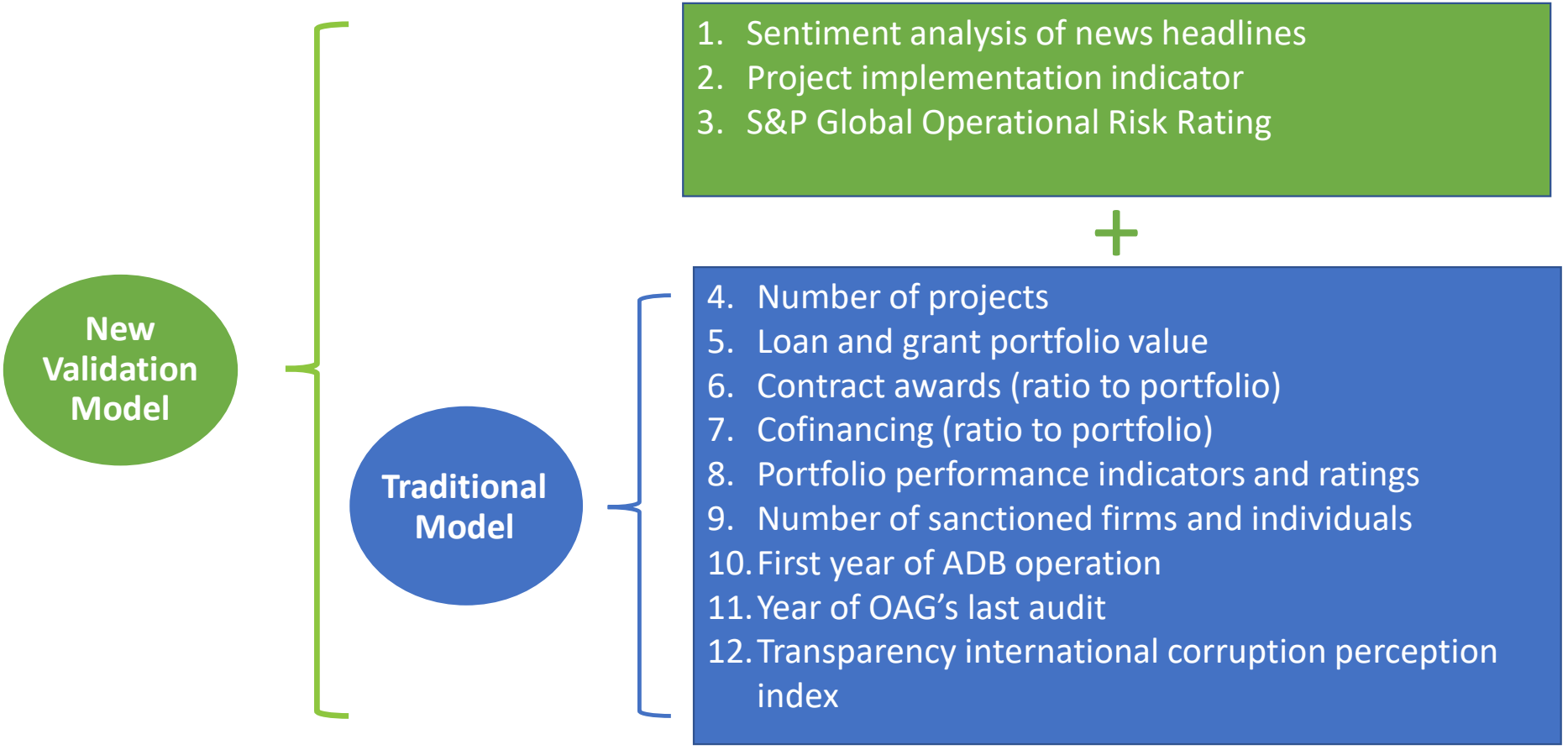
Traditional Model

- **Assess audit priority** of ADB field offices and portfolios
- Utilizes **9 indicators** with assigned weights
- **Auditors' judgment** clustering
- **Static** data source
- Performed **once or twice a year**

New Validation Model

- **Validate results** of the traditional model
- Utilize **12 indicators** with no assigned weights
- **Sentiment analysis and machine-based** clustering
- **Dynamic** data source
- Could be performed **as frequent as needed**

12 Priority Indicators - hidden



Sentiment Analysis using News Titles

"The process of computationally identifying and categorizing opinions expressed in a piece of text, especially in order to determine whether the writer's attitude towards a particular topic, product, etc. is positive, negative, or neutral." - https://www.lexico.com/en/definition/sentiment_analysis

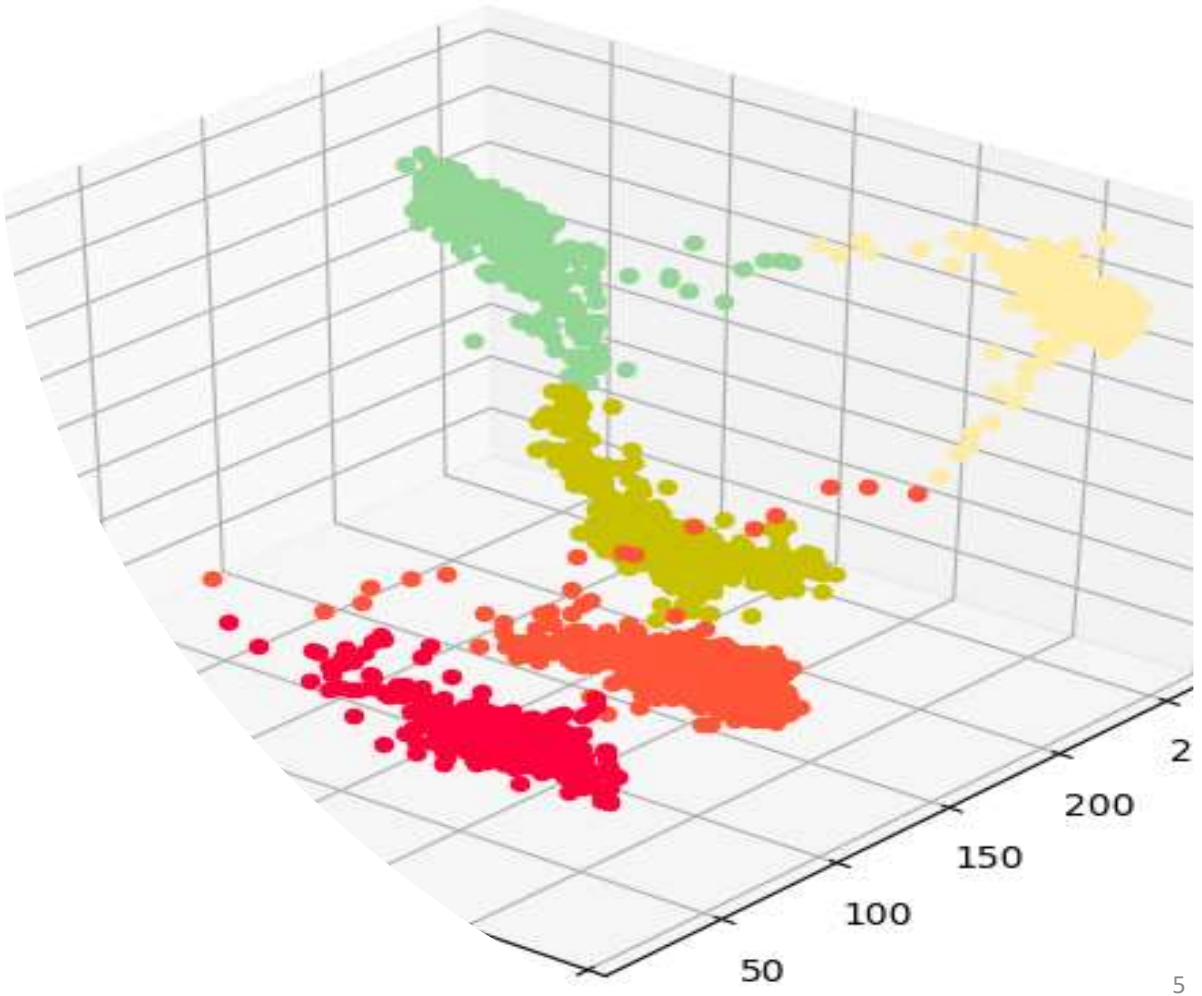
Philippines hit by deadly earthquake in south - BBC News

India's IndiGo, Qatar Airways to announce strategic deal - Reuters

K-Means Clustering

Definition CB7

"K-means clustering is a simple unsupervised learning algorithm that is used to solve clustering problems. It follows a simple procedure of classifying a given data set into a number of clusters, defined by the letter "k," which is fixed beforehand. The clusters are then positioned as points and all observations or data points are associated with the nearest cluster, computed, adjusted and then the process starts overusing the new adjustments until a desired result is reached."
https://www.techopedia.com/definition/32057/k-means-clustering



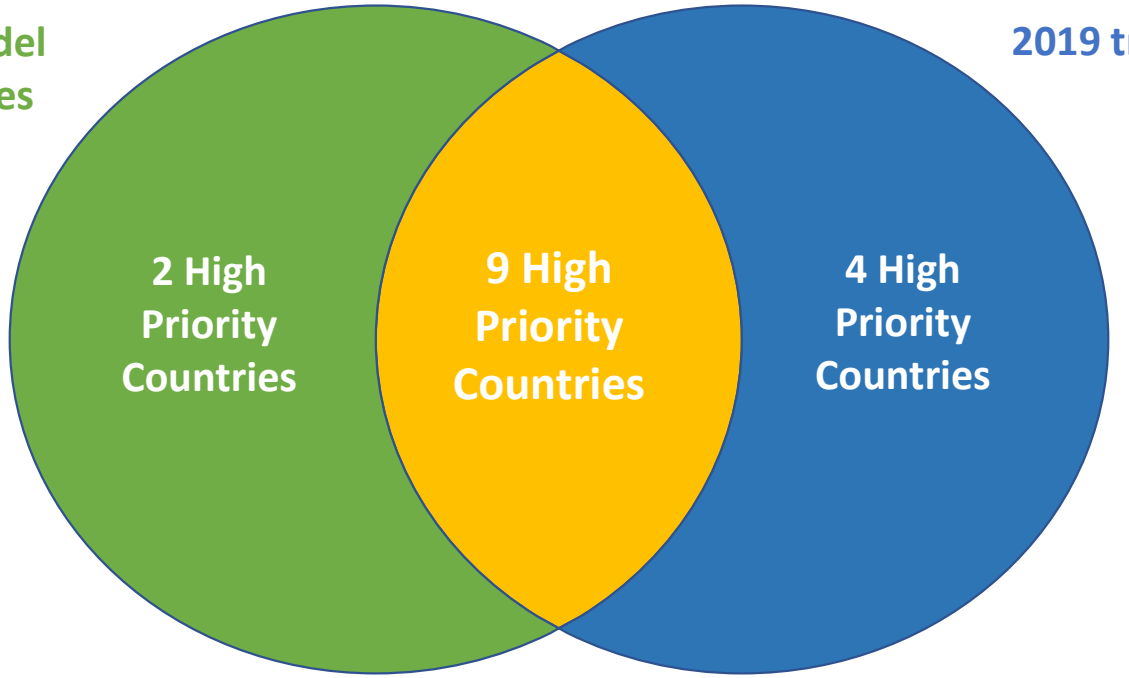
Slide 6

CB7 propose to shorten definition to :
"K-means clustering is a simple unsupervised learning algorithm that is used to classify a given data set into "k" clusters/groups, which is fixed beforehand."
Christ Ian B. Badana, 20/07/2020

Outputs from K-Means Clustering

K-means clustering model
11 high priority countries

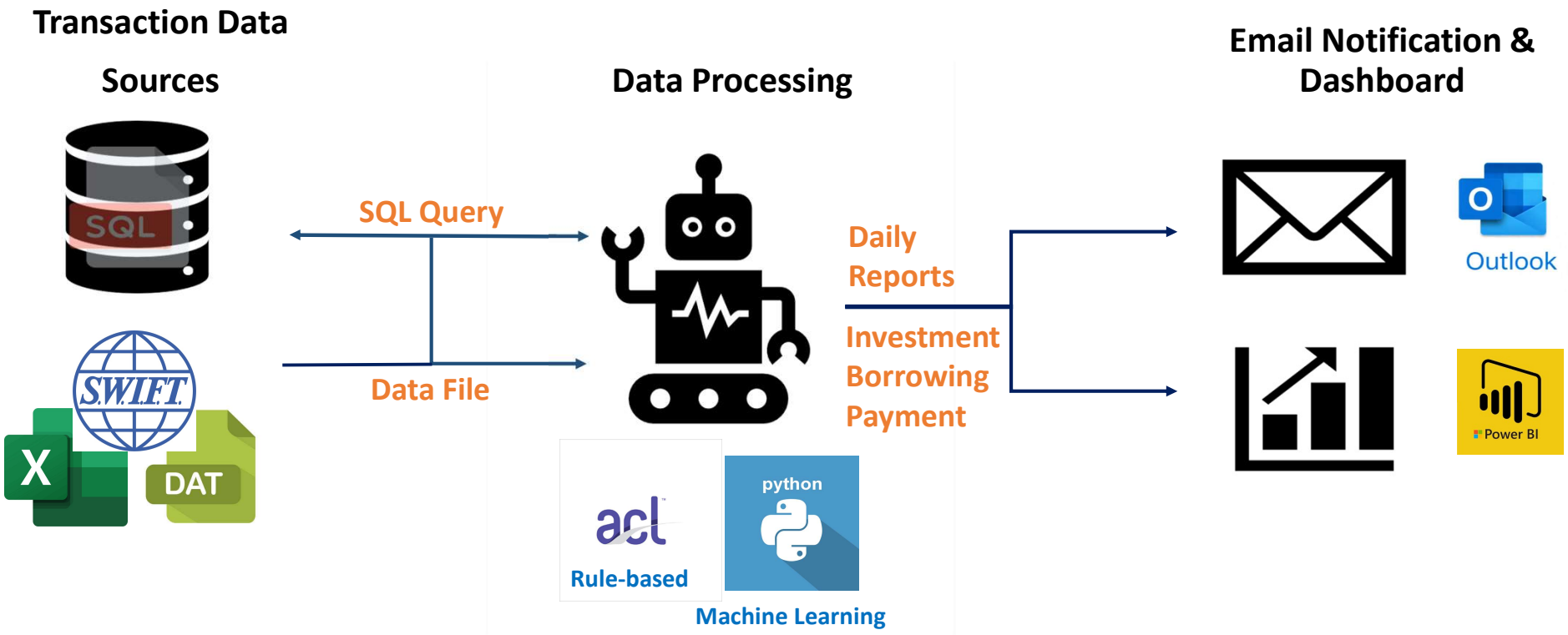
2019 traditional risk assessment
13 high priority countries



Key Benefits of the Country Priority Model

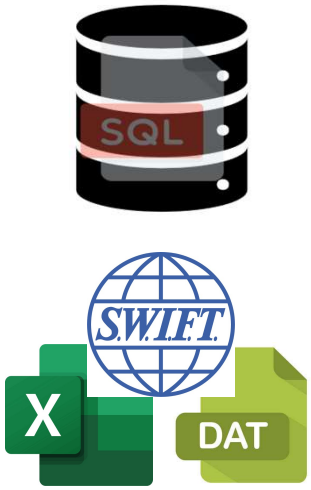
Once or twice a year		As frequently as needed
Mostly internal and static data		Expanded to include external and dynamic data
Auditor judgement		Validation model

Continuous Monitoring Tool on Treasury Transactions



Rules-Based Tests

Input



Tests Based on Business Rules

- Mismatch in Trade Details
- Timeliness of Transactions Processing
- Segregation of Duties
- Trade Anomalies

acl

Output

Outlook

Power BI

Machine Learning Tests

Algorithm: Long Short-Term Memory (LSTM)

Use Cases: An artificial recurrent neural network (RNN), LSTM is used on *chatbots, sentiment analysis*, *speech and handwriting recognition*, and *more.*

Continuous Monitoring Application: Sequence of last 40 audit actions on a certain trade were used to train the model and no maintenance of criteria. 300K+ transactions with more than 1 million actions were used to train the LSTM model which will determine if a trade is Verified or NOT.

Rule-based Criteria

```
IF AUDIT_ACTION<>"ACCEPT" AND AUDIT_ACTION<>"REJECT" AND AUDIT_ACTION<>"MKLIVE"
IF AUDIT_ACTION="ACCEPT" OR AUDIT_ACTION="REJECT" OR AUDIT_ACTION="MKLIVE" OR A

IF AUDIT_ACTION<>"ACCEPT" AND AUDIT_ACTION<>"REJECT" AND AUDIT_ACTION<>"MKLIVE"
IF AUDIT_ACTION="ACCEPT" OR AUDIT_ACTION="REJECT" OR AUDIT_ACTION="MKLIVE" OR A

AND AUDIT_ACTION<>"IMPEDT" AND AUDIT_ACTION<>"IMLIVE" AND AUDIT_ACTION
DIT_ACTION="IMPEDT" OR AUDIT_ACTION="IMLIVE" OR AUDIT_ACTION="INTMKL"

AND AUDIT_ACTION<>"IMPEDT" AND AUDIT_ACTION<>"IMLIVE" AND AUDIT_ACTION
DIT_ACTION="IMPEDT" OR AUDIT_ACTION="IMLIVE" OR AUDIT_ACTION="INTMKL"

TO "M07_Action_Not_Verified" IF AUDIT_ACTION <> "ARESET"
```

VS

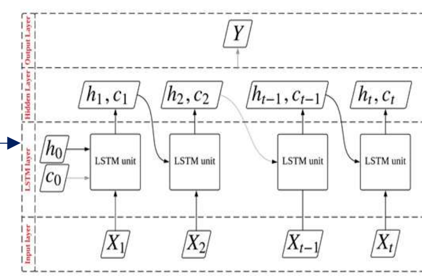
LSTM Approach

	Lable	TID	A	B	C	D	E	F	G
0	0	SWAP277502OC	DO	MKLIVE	ARESET	SAVE	ACCEPT	ARESET	SAVE
1	0	SWAP254325OC	DO	MKLIVE	SSIASN	ACCEPT	SSIASN	REJECT	SSIASN
2	0	SWAP253732OC	DO	MKLIVE	SAVE	ACCEPT	SSIASN	REJECT	SSIASN
3	0	SWAP253603OC	DO	SAVE	MKLIVE	SSIASN	REJECT	0	0
4	0	SWAP266180OC	DO	MKLIVE	ARESET	SAVE	ACCEPT	ARESET	SAVE

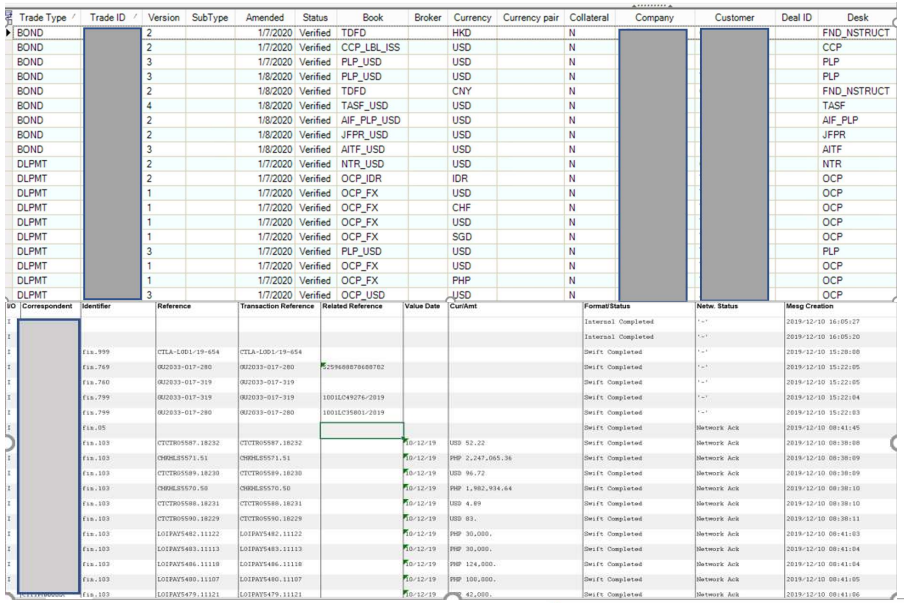
Encoding

ACTION_STRING	M07_TAG
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 21 4	1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 21 21	1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 21 21 21	1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 21 21 21 12 4	1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 21 21 12 18	1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 1	0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 16	0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 20 12 4 1	0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 18 12	0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 18 20 12 20 1 20 1	0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 12 20 1 20 1 20 1 20 1 20 1 20 1 20 1 20 1 20 1	0

Training



Email Notification



Trade Type	Trade ID	Version	SubType	Amended	Status	Book	Broker	Currency	Currency pair	Collateral	Company	Customer	Deal ID	Desk
BOND		2		1/7/2020	Verified	TDFD		HKD		N				FND_NSTRUCT
BOND		2		1/7/2020	Verified	CCP_LBL_ISS		USD		N				CCP
BOND		3		1/7/2020	Verified	PLP_USD		USD		N				PLP
BOND		3		1/8/2020	Verified	PLP_USD		USD		N				PLP
BOND		2		1/8/2020	Verified	TDFD		CNY		N				FND_NSTRUCT
BOND		4		1/8/2020	Verified	TASF_USD		USD		N				TASF
BOND		2		1/8/2020	Verified	AIF_PLP_USD		USD		N				AIF_PLP
BOND		2		1/8/2020	Verified	JFPR_USD		USD		N				JFPR
BOND		3		1/8/2020	Verified	AITF_USD		USD		N				AITF
DLPMT		2		1/7/2020	Verified	NTR_USD		USD		N				NTR
DLPMT		2		1/7/2020	Verified	OCP_IDR		IDR		N				OCP
DLPMT		1		1/7/2020	Verified	OCP_FX		USD		N				OCP
DLPMT		1		1/7/2020	Verified	OCP_FX		CHF		N				OCP
DLPMT		1		1/7/2020	Verified	OCP_FX		USD		N				OCP
DLPMT		1		1/7/2020	Verified	OCP_FX		SGD		N				OCP
DLPMT		3		1/7/2020	Verified	PLP_USD		USD		N				PLP
DLPMT		1		1/7/2020	Verified	OCP_FX		USD		N				OCP
DLPMT		1		1/7/2020	Verified	OCP_FX		PHP		N				OCP
DLPMT		3		1/7/2020	Verified	OCP_USD		USD		N				OCP

I/O	Correspondent	Identifier	Reference	Transaction Reference	Related Reference	Value Date	Curr/Amt	Format/Status	Netw. Status	Mesg Creation
I								Internal Completed	'--'	2019-12-10 16:05:27
I								Internal Completed	'--'	2019-12-10 16:05:20
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I		fin.760	GU2033-017-319	GU2033-017-319				Swift Completed	'--'	2019-12-10 15:22:05
I		fin.799	GU2033-017-319	GU2033-017-319	1001LC49276/2019			Swift Completed	'--'	2019-12-10 15:22:04
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I		fin.05						Swift Completed	Network Ack	2019-12-10 08:41:45
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I		fin.103	CTCTR05589.18230	CTCTR05589.18230		0-12-19	USD 96.72	Swift Completed	Network Ack	2019-12-10 08:38:09
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BTPS-20191209.txt - Notepad

File Edit Format View Help

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26-NOV-19`LNASI-26NOV19-LOI-2`26-NOV-19`26-NOV-19`LOI`159-700-138628-6`PHP`8258258.86`LNASI`Treasury Services Divi
26-NOV-19`LNASI-26NOV19-LOI-2`26-NOV-19`26-NOV-19`LOI`159-700-138628-6`PHP`8258258.86`LNASI`Treasury Services Divi
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26-NOV-19`LNASI-26NOV19-CHECK-1`26-NOV-19`26-NOV-19`CHECK`2-159-01146-6`USD`6503`LNASI`Treasury Services Division
26-NOV-19`LNASI-26NOV19-LOI-2`26-NOV-19`26-NOV-19`LOI`159-700-138628-6`PHP`8258258.86`LNASI`Treasury Services Divi
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01A69173D~REF: TA 9660-REG CONTR B19760 ADB STAFF,ADVANCE FOR TRAVEL EXPENSE,STAKEHOLDERS MEET
01A69185D~REF: TA 9758-REG CONTR S26363 INDIVIDUAL,ADB CONSULTANT,ADVANCE FOR TRAVEL EXPENSES,
01D07359D~LN NO. 2961-VIE APPL NO: HP022 ADVANCE-PROVISION OF FUNDS TO PROJE CT'S ADVANCE ACCO
01D07377D~LN NO. 3396-IND APPL NO: WA059 REIMBURSEMENT TO GOVT ACCOUNT FOR EXPENDITURES FOR JU
01D07415D~LN NO. 3780-BAN APPL NO: CT016 DIRECT PAYMENT, FIRM, WORKS FOR AUG-OCT 2019 PER IPC
01D07443D~LN NO. 3780-BAN APPL NO: CM022 DIRECT PAYMENT, FIRM, WORKS PER IPC NO. 11 AND REF: S
01D07470D~LN NO. 3803-GEO APPL NO: 00005 FIRM, ADVANCE PAYMENT FOR CIVIL WORKS PER INVOICE NO.
01D07474D~LN NO. 3539-IND APPL NO: RP001 PROVISION OF FUND TO THE GOVERNMENT ADVANCE ACCOUNT F
01D07478D~LN NO. 3803-GEO APPL NO: 00006 FIRM, ADVANCE PAYMENT FOR CIVIL WORKS PER INVOICE NO.
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01D07484D~LN NO. 3803-GEO APPL NO: 00008 FIRM, ADVANCE PAYMENT FOR CIVIL WORKS PER INVOICE NO.
01D07487D~LN NO. 3704-PRC APPL NO: 00001 ADVANCE PROVISION OF INITIAL ADVANCE TO THE PROJECT A
```

ACL Investment Related Transactions Report for : 20200803

(OAG-ACL_Analytics via adb.org)OAG-ACL_Analytics

[redacted]

The actual sender of this message is different than the normal sender. Click here to learn more.

M07_Action_Not_Verified.XLSX 11 KB

I06_LSTM_Action_Not_Verified.XLSX 10 KB

This is a computer-generated message. You may forward your concern to OAG Continuous Monitoring Team.

ACL Investment Related Transactions Report for : 20200803

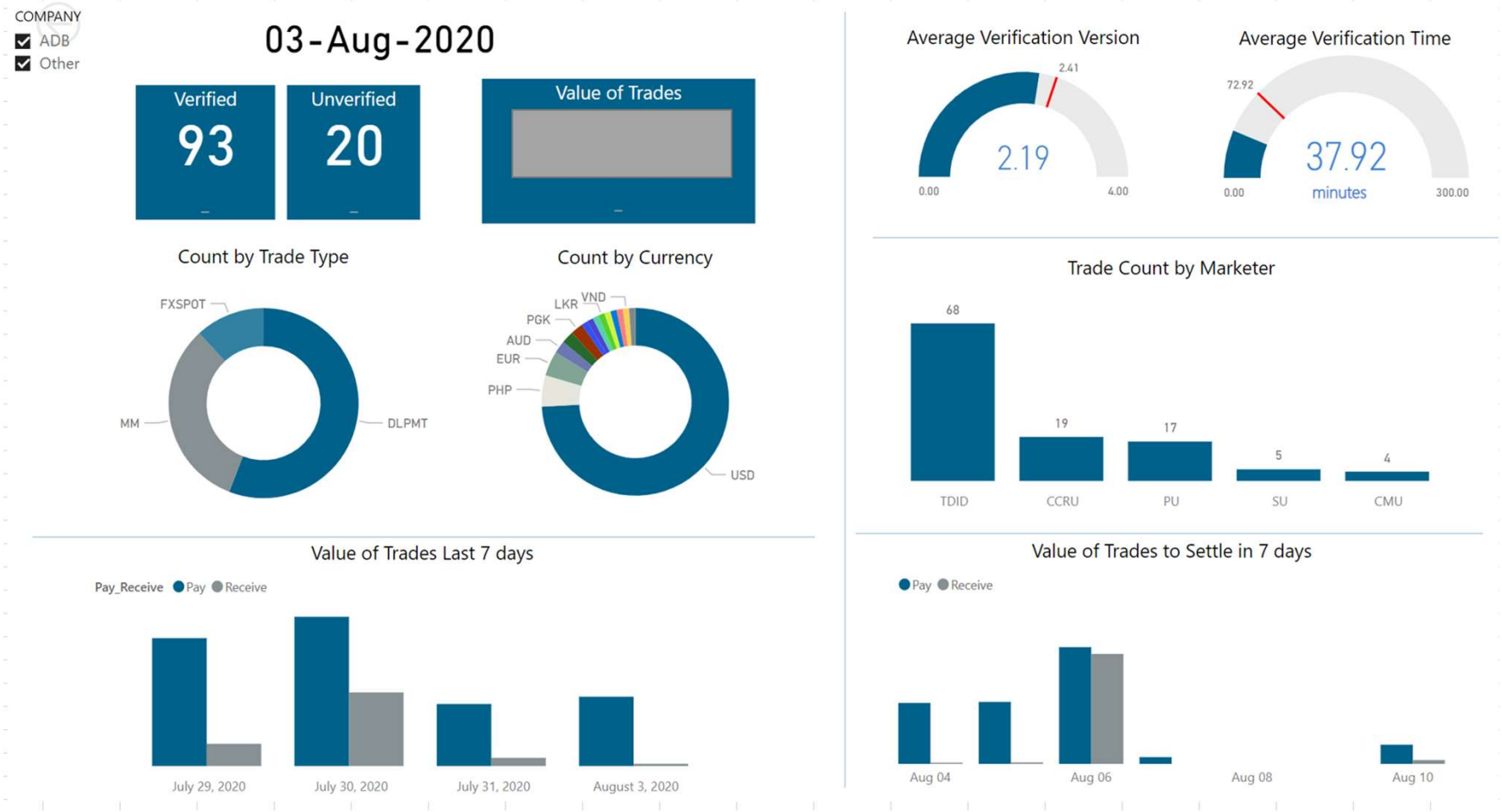
Test Results:

M01 Verified by Non BackOffice:	0
M02 DP Irregular Verifier:	0
M03 Action by SSDMU OIST:	0
M04 Trade done by non TDID:	0
M05 Trade Entry After Settle:	0
M06 Verify After Settlement:	0
M07 Action Not Verified:	21
M08 SSI Assign After SettleDay:	0
M09 Mismatched Structured Trades:	0
M10 SSI SOD Exception:	0

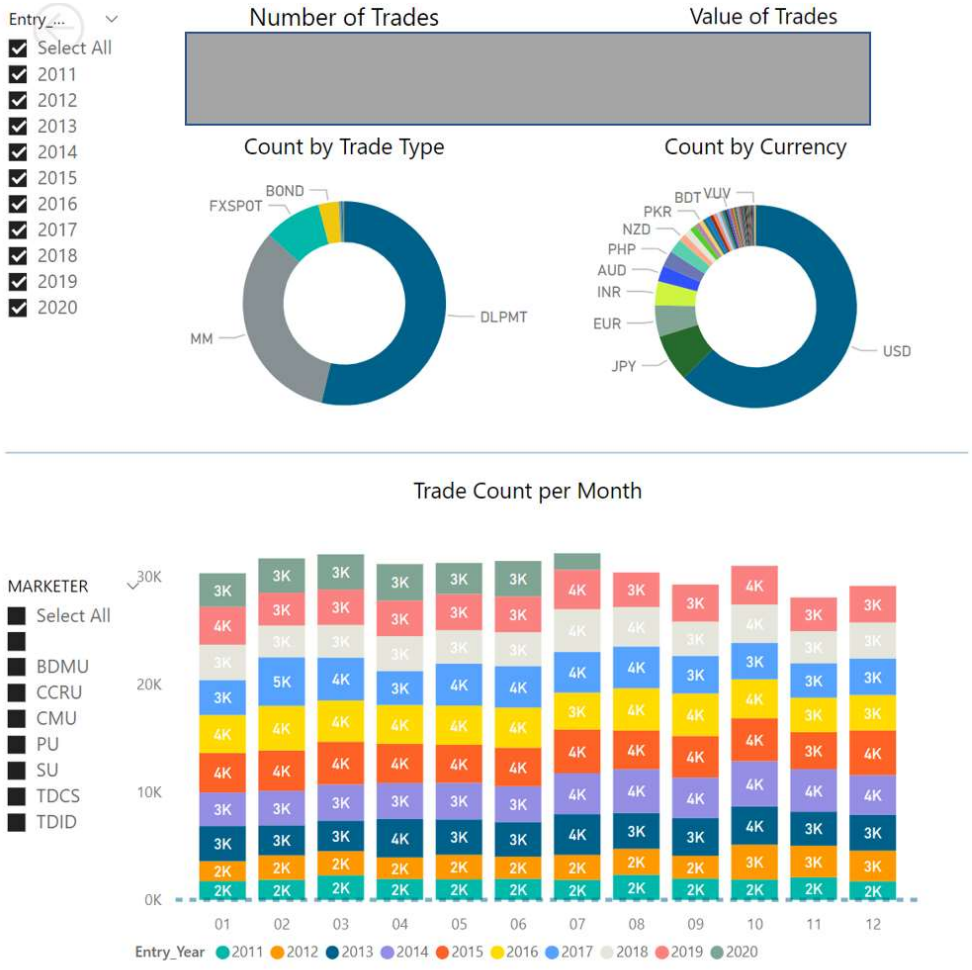
Information purpose reports:

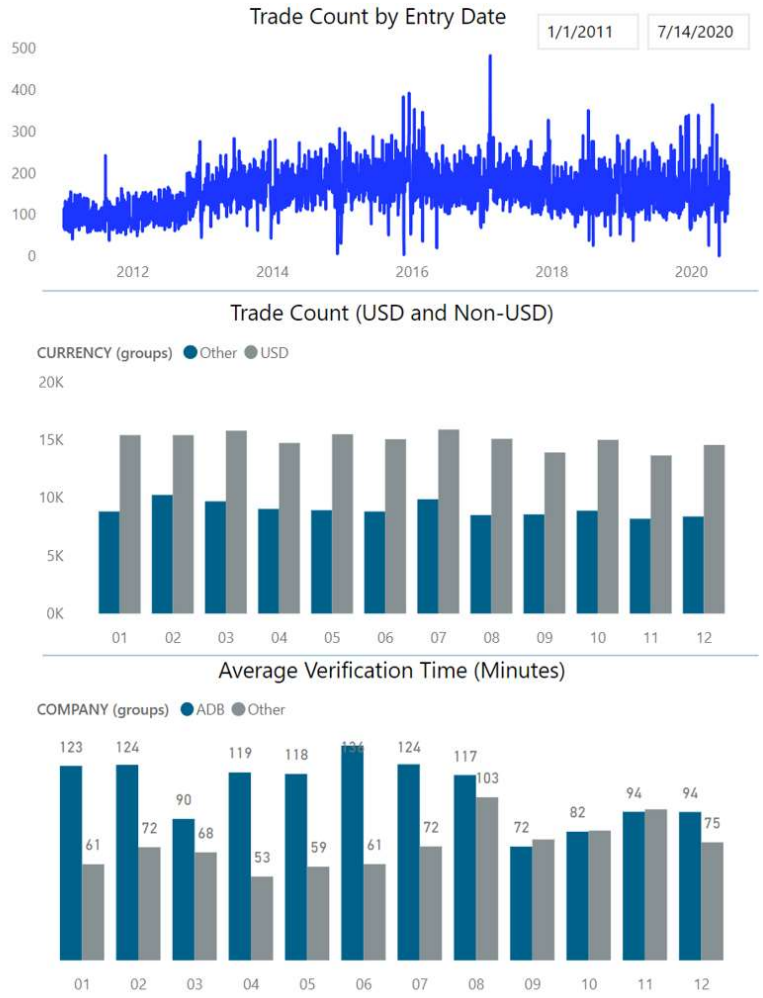
I01 Delayed Trade Entry:	0
I02 Trade without Trader:	0
I03 Trade without StructureID:	0
I04 INTERPORT SETTLEMENT DAY:	0
I05 INTERFUND TRADES:	0
I06 LSTM Action Not Verified:	21

Dashboard – Trade Profile (Daily)

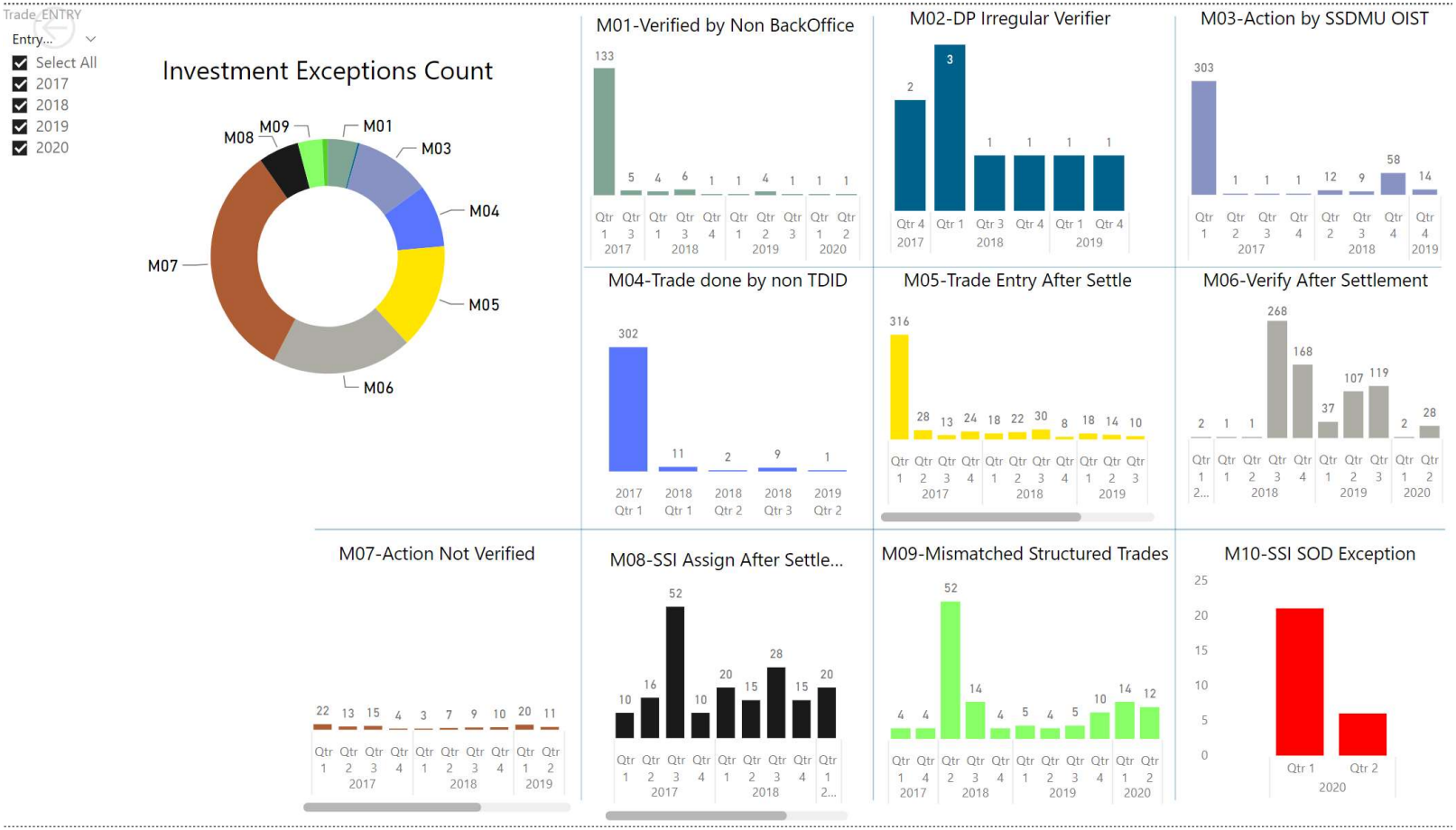


Dashboard – Trade Profile (Historical)





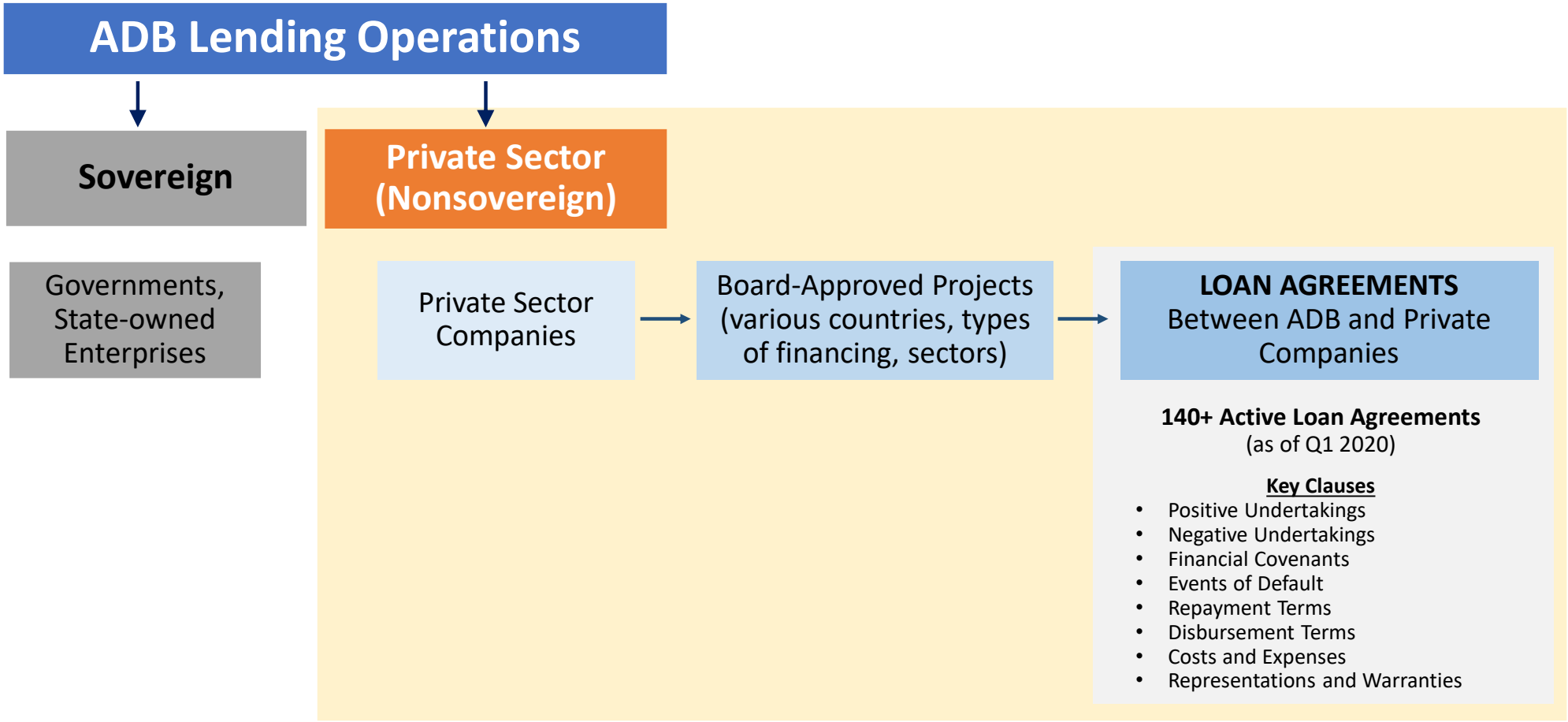
Dashboard – Investment Transaction Exception History



Key Benefits of the Continuous Monitoring Tool

3-year delayed testing		Daily testing and timely information
30 sample test		Population test
3rd line of defense		1st line of defense

Overview of ADB Lending Operations



Challenges for Internal Audit on Private Sector Projects

- No standard template for loan agreements
- No system for covenant monitoring
- Various deal specific structures in different sectors

CURRENT APPROACH

- Agreements are read and analyzed by auditors for key clauses
- Relevant clauses are identified and reviewed at least 3 hours per agreement (average of 50 pages per agreement)
- No assurance of completeness of key clauses
- Data is re-typed or copied to an Excel or Word -type database

Potential Solution

OAG partnered with Deloitte to experiment with the contract analysis software **ARGUS**.

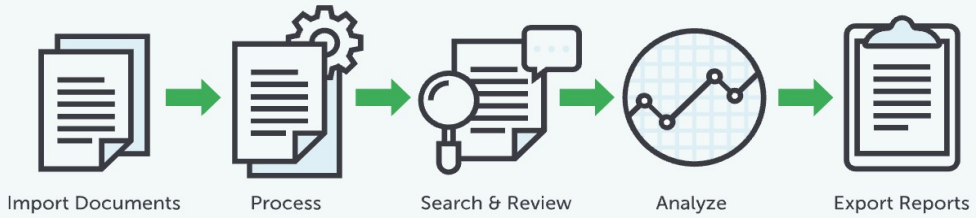
Nonsovereign Loan Agreements

↓

Machine Learning Contract Data Extraction Application

ARGUS

Identifies, extracts, and analyzes text in contracts and other documents



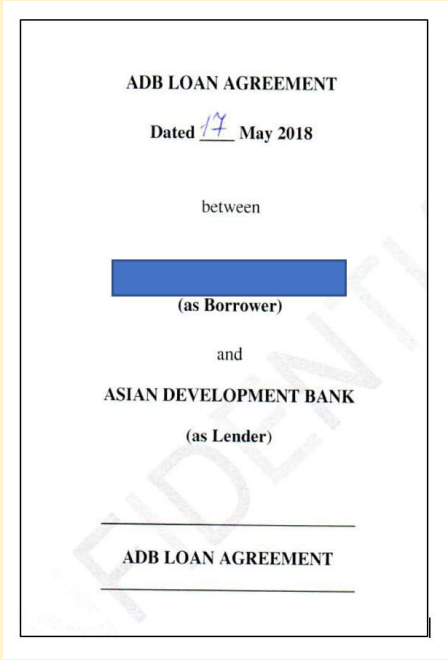
Slide 19

CB6 propose to change to "contract analysis software" or "cognitive audit application" instead of "machine learning algorithm"
Christ Ian B. Badana, 20/07/2020

MR1 Thanks, Christ. Will change to "contract analysis software"
Marisol B. Del Rosario, 14/08/2020

Sample Input

Agreements in pdf or any format



ADB LOAN AGREEMENT

Dated 17 May 2018

between

[redacted]

(as Borrower)

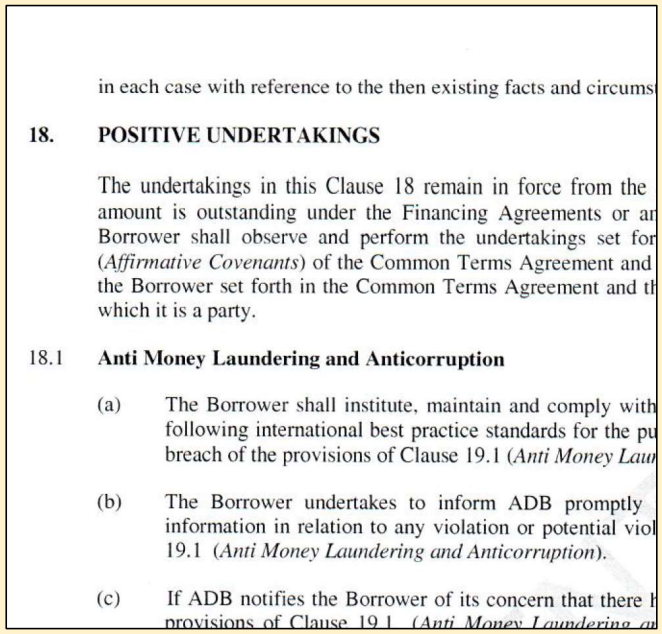
and

ASIAN DEVELOPMENT BANK

(as Lender)

ADB LOAN AGREEMENT

ARGUS automatically converts files into machine readable form, and then uses machine learning to identify the concepts and clauses the auditor specifies.



in each case with reference to the then existing facts and circums

18. POSITIVE UNDERTAKINGS

The undertakings in this Clause 18 remain in force from the amount is outstanding under the Financing Agreements or ar Borrower shall observe and perform the undertakings set for (*Affirmative Covenants*) of the Common Terms Agreement and the Borrower set forth in the Common Terms Agreement and th which it is a party.

18.1 **Anti Money Laundering and Anticorruption**

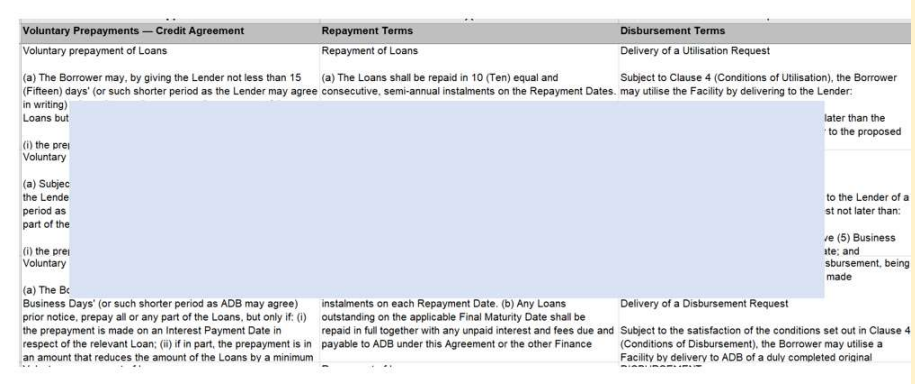
(a) The Borrower shall institute, maintain and comply with following international best practice standards for the pu breach of the provisions of Clause 19.1 (*Anti Money Lau*

(b) The Borrower undertakes to inform ADB promptly information in relation to any violation or potential viol 19.1 (*Anti Money Laundering and Anticorruption*).

(c) If ADB notifies the Borrower of its concern that there h provisions of Clause 19.1 (*Anti Money Laundering a*

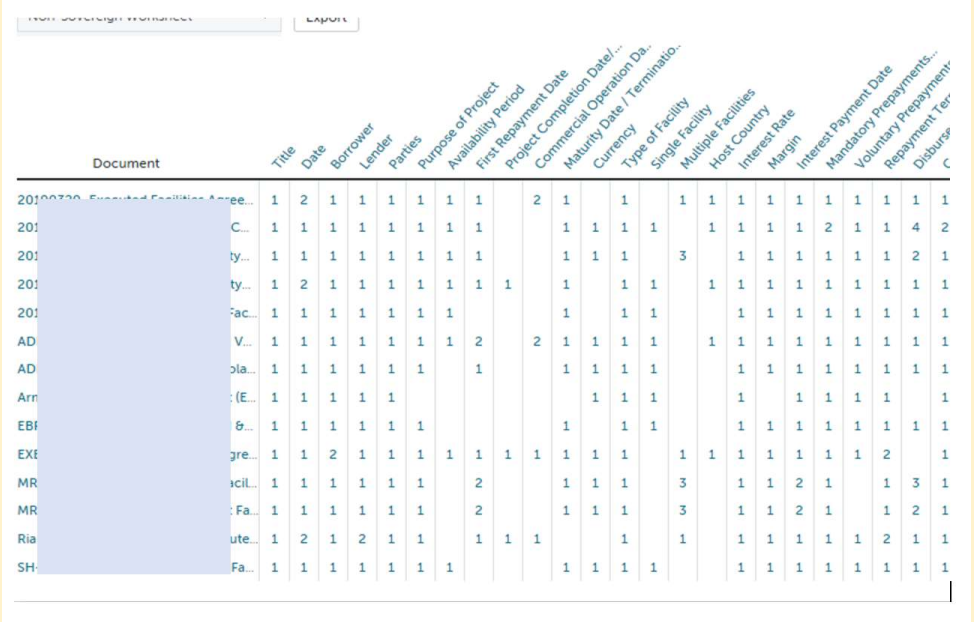
Sample Output

Extracted clauses in excel format



Voluntary Prepayments — Credit Agreement	Repayment Terms	Disbursement Terms
Voluntary prepayment of Loans	Repayment of Loans	Delivery of a Utilisation Request
(a) The Borrower may, by giving the Lender not less than 15 (Fifteen) days' (or such shorter period as the Lender may agree in writing)	(a) The Loans shall be repaid in 10 (Ten) equal and consecutive, semi-annual instalments on the Repayment Dates.	Subject to Clause 4 (Conditions of Utilisation), the Borrower may utilise the Facility by delivering to the Lender:
Business Days' (or such shorter period as ADB may agree) prior notice, prepay all or any part of the Loans, but only if: (i) the prepayment is made on an Interest Payment Date in respect of the relevant Loan; (ii) if in part, the prepayment is in an amount that reduces the amount of the Loans by a minimum	instalments on each Repayment Date. (b) Any Loans outstanding on the applicable Final Maturity Date shall be repaid in full together with any unpaid interest and fees due and payable to ADB under this Agreement or the other Finance	Delivery of a Disbursement Request Subject to the satisfaction of the conditions set out in Clause 4 (Conditions of Disbursement), the Borrower may utilise a Facility by delivery to ADB of a duly completed original

Sample analysis chart: Summary of clause present for comparison and analysis across multiple agreements



Document	Title	Date	Borrower	Lender	Parties	Purpose of Project	Availability Period	First Repayment Date	Project Completion Date/...	Commercial Operation Da...	Maturity Date / Terminatio...	Currency	Type of Facility	Single Facility	Multiple Facilities	Host Country	Interest Rate	Margin	Interest Payment Date	Mandatory Prepayments...	Voluntary Prepayment	Repayment Ter...	Disburs...
20190730...Executed Facilities Agree...	1	2	1	1	1	1	1	1		2	1		1		1	1	1	1	1	1	1	1	1
201...C...	1	1	1	1	1	1	1	1			1	1	1	1		1	1	1	1	2	1	1	4	2
201...ty...	1	1	1	1	1	1	1	1			1	1	1		3		1	1	1	1	1	1	2	1
201...ty...	1	2	1	1	1	1	1	1	1		1		1	1		1	1	1	1	1	1	1	1	1
201...Fac...	1	1	1	1	1	1	1				1		1	1			1	1	1	1	1	1	1	1
AD...V...	1	1	1	1	1	1	1	2		2	1	1	1	1		1	1	1	1	1	1	1	1	1
AD...bla...	1	1	1	1	1	1		1			1	1	1	1			1	1	1	1	1	1	1	1
Arr...: (E...	1	1	1	1	1							1	1	1			1		1	1	1	1		1
EBF...&...	1	1	1	1	1	1					1		1	1			1	1	1	1	1	1	1	1
EXE...gre...	1	1	2	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	2		1
MR...cil...	1	1	1	1	1	1		2			1	1	1		3		1	1	2	1		1	3	1
MR...: Fa...	1	1	1	1	1	1		2			1	1	1		3		1	1	2	1		1	2	1
Ria...ute...	1	2	1	2	1	1		1	1	1			1		1		1	1	1	1	1	2	1	1
SH...Fa...	1	1	1	1	1	1	1				1	1	1	1			1	1	1	1	1	1	1	1

Uses of the Application

Review of compliance with relevant agreement requirements

Analysis and comparison of agreement clauses(by country/region, risk rating, sector)

Data warehousing (loan agreements) for further analysis

Key Benefits of the Contract Analysis Software

Sample test		Population test
Eyeball test		Automated testing
Slow process		Hours saved

Covenants Validation Tool

Automated data extraction:

- Original loan or grant agreement in PDF is downloaded from www.adb.org
- Corresponding covenant monitoring document is downloaded from ADB's information system (eOPS)

Converting PDF files:

Original loan or grant agreement in PDF is converted to text using Python with Optical Character Recognition (OCR)

Covenant Matching:

- Covenants are extracted from a specific section in the loan or grant agreement.
- Apply fuzzy matching to check the covenants' existence and completeness in eOps.

Sample Output

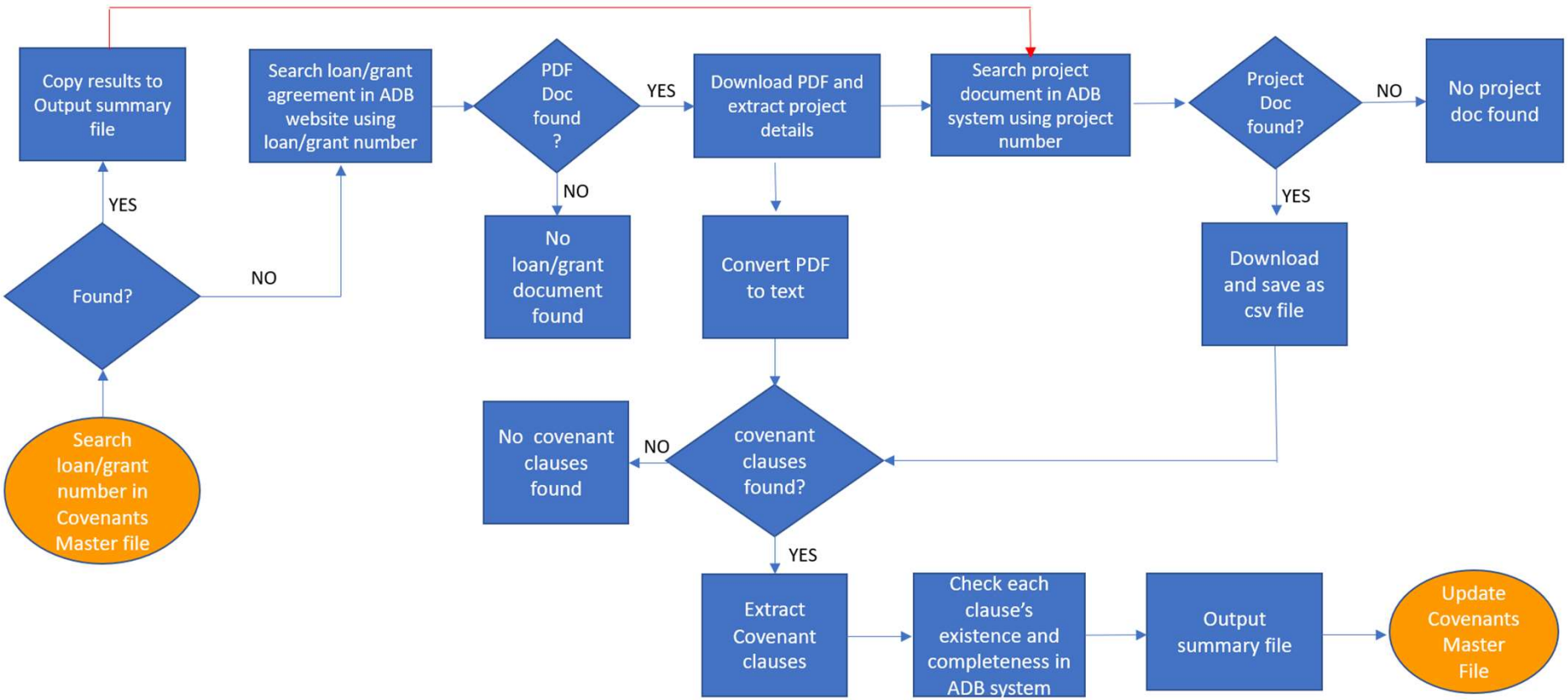
Summary sheet

Approval No	Project No	Existence	Completeness	Para_Matched
0195	38628-022	13/23	55.3	YES
0316	40190-023	19/19	96.7	YES
2936	40190-023	19/19	96.7	YES
0242	40253-023	5/14	29.5	NO
0488	40253-036	14/14	99.8	YES
0257	40368-022	13/13	99.1	NO
0234	41444-013	26/26	96.1	NO
8255	41444-013	28/28	98.4	NO
8310	41444-013	28/28	98.4	NO
0534	42203-025	22/22	99.9	YES
0503	42278-024	11/13	83.1	NO
0546	43120-026	10/10	99.8	YES
0297	43316-012	25/27	91.3	NO
2876	43316-012	25/27	91.3	NO
0313	43319-022	12/13	87.5	YES

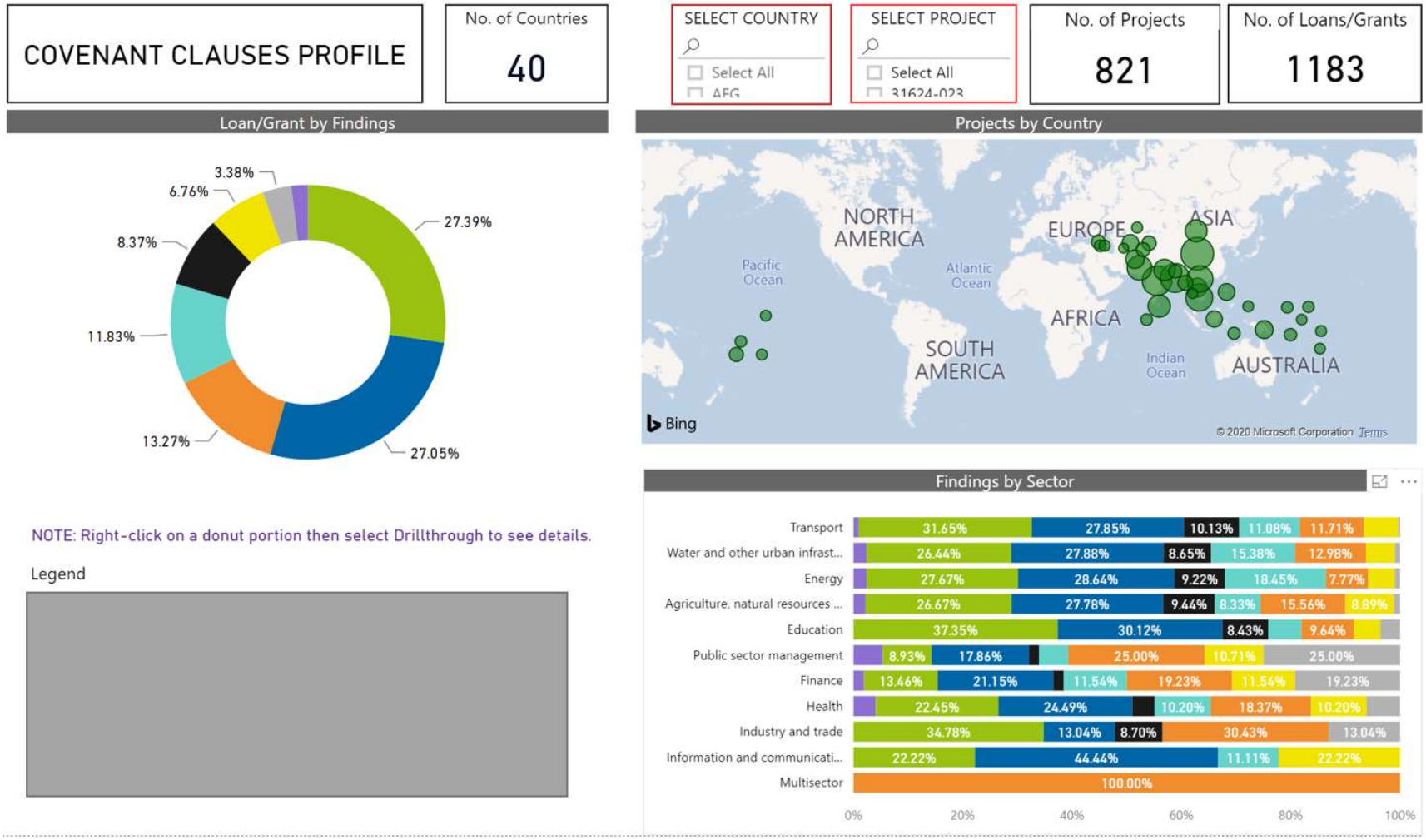
Individual loan or grant level results (covenant level)

Clauses	Clause_Number_PDF	Clause_Number_EOPS	Completeness
The Borrower shall ensure that the Project is impleme	1	1	100
The Borrower shall ensure that before disbursement	2	2	100
The Borrower shall ensure that the NPMO is staffed w	3	3	100
The Borrower shall ensure or cause the Project Provin	4	4	100
The Borrower shall further ensure that no Subproject	5	5	100
The Borrower shall ensure or cause the Project Provin	6	6	100
- The Borrower shall further ensure or cause the Proje	7	7	100
Without limiting the application of the Involuntary Re	8	8	99
The Borrower shalt ensure or cause the Project Provir	9	9	99
The Borrower shall make available or cause the Projec	10	10	96
The Borrower shall ensure or cause the Project Provin	11	11	98
. The Borrower shall do or cause the Project Provinces	12	12	100
The Borrower shall ensure or cause the Project Provin	13	13	98
The Borrower, through MAF, shall ensure that the GA	14	14	100
The Borrower, through the Project Provinces, shall ens	15	15	100
The Borrower shall comply and cause the Project Prov	16	16	100
The Borrower shall disclose, through the Project's web	17	17	100
The Borrower shall ensure that only candidate subpro	18	18	100
The Borrower, through MAF, shall ensure that Project	19	19	99
The Borrower shall ensure that, before the physical co	20	20	100

Flow of the Tool



Power BI Dashboard



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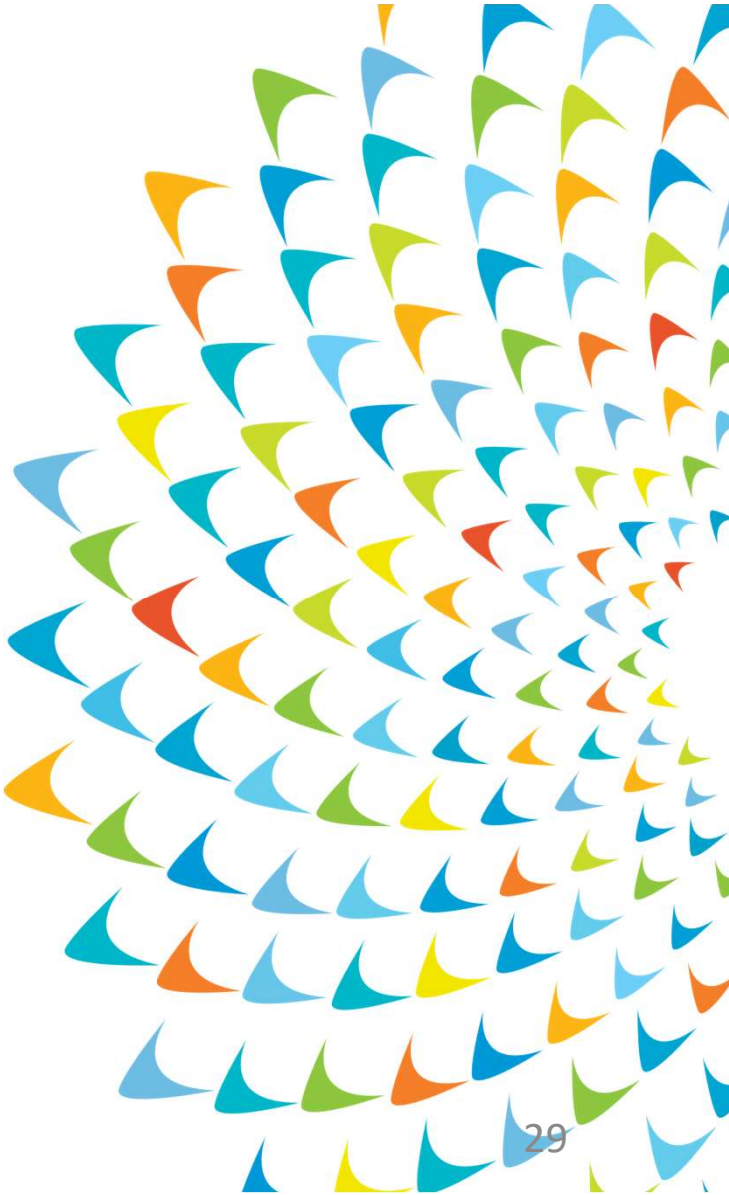
Q & A Session