INTERNATIONAL WEBINAR ON
DIGITALIZATION AND AUTOMATIZATION OF
CURRENCY MANAGEMENT

Jakarta, Indonesia,
13th-15th October 2020

Jakarta
December, 2021
International Webinar on Digitalization and Automatization of Currency Management
© Bank Indonesia Institute – 2021

Editor:
- Solikin M. Juhro
- Bambang Arianto

Steering Committees:
- Hernowo Koentoadji
- Elsa Dyahpitaloka

Organizing Committees:
- Himawan Putranto
- Herdatara Ratu Anindyta
- Rizky Ayu Novita Sari
- Rani Hapsari
- Ray Amirul Mukminin
- Sri Wahyuni

Session Moderator:
- Wahyu Yuwana
- Hernowo Koentoadji
- Rini Kusumastuti

Reviewer:
- Bambang Arianto
- Hernowo Koentoadji
- Elsa Dyahpitaloka

Published by
Bank Indonesia Institute - December 2021

ISBN 978-623-5662-09-1 (Printed)
ISBN 978-623-5662-10-7 (EPUB)
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE OF CONTENTS</td>
<td>iii</td>
</tr>
<tr>
<td>TABLE OF FIGURES</td>
<td>iv</td>
</tr>
<tr>
<td>FOREWORD</td>
<td>v</td>
</tr>
<tr>
<td>OPENING REMARKS AND KEYNOTE SPEECH</td>
<td>vii</td>
</tr>
<tr>
<td><strong>SESSION 1- THE USE OF DATA IN THE MANAGEMENT OF CURRENCY OPERATIONS</strong></td>
<td>1</td>
</tr>
<tr>
<td>Speaker 1: Victoria Pymm, Senior Manager at Strategy and Engagement Division, Reserve Bank of Australia</td>
<td>2</td>
</tr>
<tr>
<td>Speaker 2: Mark Onikul, Senior Manager at Business Systems and Support Division, Reserve Bank of Australia</td>
<td>7</td>
</tr>
<tr>
<td>Q&amp;A SESSION 1</td>
<td>25</td>
</tr>
<tr>
<td><strong>SESSION 2- ARTIFICIAL INTELLIGENCE IN FINANCIAL SERVICES</strong></td>
<td>39</td>
</tr>
<tr>
<td>Speaker: Yam Ki Chan, Head of Financial Services Public Policy, JAPAC, Google Cloud</td>
<td>39</td>
</tr>
<tr>
<td>Q&amp;A SESSION 2</td>
<td>51</td>
</tr>
<tr>
<td><strong>SESSION 3- HOW THE CENTRAL BANK MITIGATES COVID-19 THROUGH THE CURRENCY MANAGEMENT COMMAND CENTER</strong></td>
<td>63</td>
</tr>
<tr>
<td>Speaker: Yudi Harymukti, Director at Currency Management Department, Bank Indonesia</td>
<td>64</td>
</tr>
<tr>
<td>Q&amp;A SESSION 3</td>
<td>75</td>
</tr>
</tbody>
</table>
**TABLE OF FIGURES**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Data Examples on Banknotes (1)</td>
<td>11</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Data Examples on Banknotes (2)</td>
<td>12</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Data Examples on Warehouse Control System</td>
<td>14</td>
</tr>
<tr>
<td>Figure 4</td>
<td>Area Time Frame</td>
<td>20</td>
</tr>
</tbody>
</table>
Central banks are facing unprecedented new pressures: on the one hand from the rising costs of banknote production and management and on the other, from the general drive towards digitalization and the “less-cash” society; and all in a pervading climate of public sector accountability. As a result, many are redefining their role in the cash cycle.

Globally cash cycle models at central banks are being reengineered. The impact of these changes is being felt across the board, from infrastructure through to currency department competencies and the roles of different partners and third parties across the value chain.

A growing number of central banks have access to serial number data on their banknote sorting machines, making it possible to move beyond traditional aggregated data techniques and run both big data and data analytic software. When this happens, the use of averages, with the resulting margins of error, compared with tracking actual banknotes using their serial numbers, is not necessary.

The banknote industry is sitting at the start of a revolution in its approach to currency management. The key to unlocking this new era is the ability to gather and analyze banknotes based on their serial number data. Based on survey, it appears around 5-10% of Central Banks currently have access to serial number data. For the reminder, we estimate around 25-30% of Central Banks have machines with serial number reading capability but we cannot have access to the data for contractual or other reasons with their equipment supplier. Now that serial number reader capability is available to effectively analyze the data, thus access to serial number data is the priority.

That data is used to determine the life cycle, life time, circulation age and tracking systems of money. Big data can support Central Bank analysis in currency management policies. Digitalization of currency management can support digital inventory at banknotes printing, which is use a barcode recording end to end. Furthermore, digital inventory and digital logistics are expected to be able to support digital tracking in distribution of money. Digital tracking can detect cash service
locations and digital logistic can optimize the logistic path by using machine learning technology. Cash with a serial bank note reader will make it easy to identify at the time of the distribution of money. The serial number of banknote can be used to show tracking money mutations, money durability and knowing people’s behavior in using money.

Data analytics is a new technology that is gaining acceptance and growing to fulfil its potential in the world of banknotes and the cash cycle. Central Banks have always collected and used data to model, forecast and manage their banknote needs. The serial number data of banknotes can used to answer well questions about topics such as cash cycle velocity and flows, cash performance in circulation, quality levels, specification performance and optimisation, supplier performance, etc. The ability to access information on banknote performance and the cash cycle based on high quality, high volume, detailed data down to the level of individual banknotes captured from the cash cycle is a new development allowing the full capability of data analytics. The use of Serial Number Reading (SNR) linked to sensor data. This is possible now due to the widespread use of optical cameras as part of the core technology platform in a very wide range of banknote handling equipment.

Central banks have reacted differently to these pressures. The “controlled” style central banks (e.g. Germany, Belgium and several eastern European countries) have reinforced their dominant role in the cycle by keeping processes in-house and negating the need for high-volume processing systems at commercial banks and Cash in Transit companies (CITs). At the other end of the spectrum, the “minimalist” central banks have withdrawn from the daily cash cycle entirely by delegating to the commercial sector. The “utility” and “hybrid” models sit in between these two poles, with varying degrees of process outsourcing, automation and digitalization.

Jakarta, December 2021

Dr. Solikin M. Juhro
Head of Bank Indonesia Institute
Distinguished speakers, Mr. Mark Onikul and Mrs. Victoria Pymm from Reserve Bank of Australia, Mr. Yam Ki Chan from Google Asia, my fellow Central Bankers from Asia Pacific Countries, my colleague from Bank Indonesia; The Head of Bank Indonesia Institute, Mr. Solikin M. Juho, PhD; Bank Indonesia Officials; and the entire committee members and all parties with whom we collaborate to hold this event. Thank you for attending the Flagship Webinar on Digitalization and Automatization of Currency Management held by Bank of Indonesia.

Assalamualaikum Warahmatullahi Wabarakatuh, Syaloom

First, let us extend our praise and gratitude to Allah SWT, God Almighty, since only with His blessing and mercy, we all can attend the Flagship Program of Currency Management held by Bank Indonesia on “Digitalization and Automatization of Currency Management”. On behalf of Bank Indonesia, we would like to extend our sincere gratitude to all speakers and guests for attending this important event. I am honored to speak to all of you about the issue of Digitalization and Automatization of Currency Management. For centuries, currencies in the form of coin or banknotes, or cash, have facilitated economic transactions and have become an expression of wealth. These rules are still relevant in today’s world. The form of currency is transforming along with advancements in digital technology, but people are still using cash in their daily activities. In our country and other parts of the world, demand for cash is still showing growth. In our case, the geographical condition and infrastructure development also require strategic management for cash distribution. Therefore, currency management is an integral part of Bank Indonesia’s transformation in the digital era.
In today's world, digitalization has already integrated in every aspect of our lives. This was effectively summed up by Amazon's founder and CEO, Jeff Bezos, who said: “There is no alternative to digital transformation. Visionary companies will carve out new strategic options for themselves – those that don’t adapt, will fail.” This has challenged us to transform our work here, including our mindset and how central banking implements its rules. Despite the disruptive nature of digitalization, we believe it can still be beneficial to the economy and our people. I hope that this webinar will give us new approaches and perspectives on advanced issues relating to the digitalization of currency management. We have participants from a variety of different institutions including central banks, policymakers, academics, banking sector, cash-in-transit companies and members of public. I truly hope the discussion will be fruitful and beneficial from a multidimensional point of view. This event can also be optimized as an opportunity for networking and knowledge sharing among all participants.

Bank Indonesia has already set up a vision towards 2025 and started transforming that vision into reality. We want to be a leading digital central bank, give a tangible contribution to Indonesia’s economy as well as become the best among emerging market countries. In short, our vision is to be first and the best central bank 4.0. To transform this vision into action, we have developed framework for every aspect of our policies, including the policy on currency management. In the currency management policy framework, we aim for three milestones towards our 2025 vision, namely: (i) centralized distribution, (ii) additional business models, and (iii) digitalization.

At this opportunity, I want to emphasize more on the digitalization of currency management in Bank Indonesia. Digitalization will be applied through the currency management process, from planning and implementing, to distribution and the destruction of banknotes. We have milestones in place for each process of currency management, which will result in more effective and efficient business processes. We have already started the milestones and within the last two years, we have seen some progress. We have also implemented an Inventory Management and Warehouse Management System, which will soon be integrated into a cash management module in our Core Banking System to better manage the banks’ need for cash. We are in the process of upgrading our cash-processing infrastructure with the latest technology. In the near future, we will also have a modern cash processing center and cash depots, which will distribute to all 46 branches of Bank Indonesia. This will utilize advanced technologies with less human intervention. We have also developed
a Command Center for the currency, which overseas and coordinates the overall currency management process in real time.

Currently, Bank Indonesia is developing an omni-experience platform, which will equip the Command Center with big data analytic capabilities in the future. Digitalization will be a continuous process. Therefore, we want to learn from the speakers and participants in order to enhance our business model. In this webinar, we hope that we can learn from the Reserve Bank of Australia regarding the use of data in currency management operations and policy formulation. Furthermore, we also want to learn from Google about innovation in active artificial intelligence in banking and financial services.

We are currently in the middle of the Covid-19 pandemic, where policymakers around the world have issued a number of extraordinary policies to dampen the virus impact on the economy and hasten the recovery. Bank Indonesia continues to maintain an accommodative policy mix stance. On the other hand, the Covid-19 pandemic has also affected cash management activities around the world. There are public concerns about the hygiene of used banknotes and coins in the economy. Central banks, including Bank Indonesia, have already established protocols in order to prepare for this. My colleagues from Bank Indonesia now have an opportunity to share their experiences and issues during the COVID-19 pandemic. We will have a fruitful discussion regarding that matter and it will become our priority to formulate cash management policies in the new normal era. In that era, cash management policy has to be agile, adaptive and innovative, while still prioritizing health protocol.

Before closing my remarks, on behalf of Bank Indonesia I would like to thank all participants and speakers for sharing their expertise and knowledge. Finally, I am delighted to announce that the flagship seminar on Digitalization and Automatization of Currency Management is officially open.
- SESSION 1 -
THE USE OF DATA IN THE MANAGEMENT OF CURRENCY OPERATIONS AND POLICIES

Moderator: Wahyu Yuwana, Deputy Director at Currency Management Department, Bank Indonesia

Welcome to the first session of the Bank Indonesia international webinar flagship on Digitalization and Automatization of Currency Management. Thank you for joining us today in this seminar. In this first session we will discuss the topic about the use of data in the management of currency operations and policies. I believe that we will have an interesting presentation for our prominent speakers from the RBA and enrich our inside knowledge on how the Reserve Bank of Australia next uses a wide range of data to help manage its currency responsibilities. This includes detailed data on production, banknote circulation including on the quality of banknote circulation, counterfeiting and ultimately data on banknote, and life and destruction.

Currently we already have two speakers who will speak about this interesting topic, but first let me introduce them to all the audience. First, we have Mrs. Victoria Pymm, she is a Senior Manager in the Strategy and Engagement Division of the Reserve Bank of Australia. Victoria is a highly experienced public policy professional with a range of government experience in both Australia and the United Kingdom. Victoria is currently responsible for developing the future strategic approach to banknotes, managing current banknote production orders and formulating the strategic approach to data management. Second, we have Mr. Mark Onikul. Mark is a Senior Manager in the Business Systems and Support Division of the Reserve Bank of Australia. Mark has worked at the RBA for over 20 years, and been in Note Issue for 12 years, covering a wide range of responsibilities. Mark’s current portfolio covers risk, contingency, legal, and technology process.
Speaker 1: Victoria Pymm, Senior Manager at Strategy and Engagement Division, Reserve Bank of Australia

I am going to introduce this presentation and give you a high-level overview of the different ways we use and manage data, but Mark will follow that up with a bit more detail around the specific systems of data visualizations that we have developed. First of all, I want to thank all of you for attending this session. We are going to cover the management of our currency operations and policies. As we were introduced, Mark and I are from the Note Issue Department at the Reserve Bank of Australia. Together, we are responsible for providing strategic oversight of a wide range of currency and performance related data that Note Issue generates and manages. This presentation is going to cover our strategic approach to data, data infrastructure, our future ambitions moving forward, challenges and lessons, followed by an opportunity to ask questions in the end.

DATA STRATEGY

First, I am going to outline the broader strategy, why Note Issue collects data. The Note Issue Department is responsible for the production, distribution and quality of Australian banknotes. Those banknotes are innovative, high quality and counterfeit resistant. We must ensure that Australians have confidence in their banknotes as a means of payment and a store of wealth. This underlines our data purpose. How does data help us meet this objective? Data collection, management and analysis help us understand our business and form strategic decision-making about our future. This also helps us run our operations. We collect data on quality-tested results on each production run of notes that Note Printing Australia (NPA) produces. We collect data on a number of notes that we send into circulation and we collect data on the quality of the banknotes that are returned to us. In terms of performance measures, we measure the numbers of notes operators process per day and we understand the numbers of containers that are moved into circulation every day. As many of you may be aware, in terms of a compliance framework, Note Issue manages a Note Quality Reward Scheme (NQRS) through the data we collect and we understand which banks order which denominations and how well they are able to quality sort the notes in circulation. We also use data to manage the banks’ reputation. In fact, data collection and analysis help Note Issue and the broader bank manage our reputation as a reliable and transparent source of information. Finally, we use data to communicate, such as how cash demand has changed over time, and to
understand which periods put demands on our business. This global pandemic has inspired consumers to withdraw cash to store.

**Our Data Vision**

“Data are ever more important to doing our job well, so we need to manage data as a strategic asset. We want to ensure that the data we use are trusted, secure and appropriately accessible across the bank.” That is a vision I am sure everyone here shares. How do we harness the power of data? Like most assets, data management requires a confluence of three elements, people, process and technology. I will expand on these as we move forward. In the next part of the presentation, I will talk about how we try to maximize the benefits of data collection and management. The first way we do this is to embed a common approach to working with data. As we are currently doing that, embedding a common approach to working with data, we are able to standardize across the department the way we source, store and transform data as much as possible. This is an ongoing challenge for us as we use a range of tools for analyzing data, with such a range of connection points, creating a standardized process to embed good management practices. The second way, data enables us to use the latest technologies and methods, to refresh the core technology platform, improve usability and governance of the end user tools for analyzing data, improve the way we acquire data and provide training programs and support so that staff are skilled and empowered to generate useful insights from data. For instance, one project we recently started is developing a dashboard reporting template so that all sections of the department can use a streamlined basic management reporting template to provide visibility and advanced management capabilities. This third principle is to improve data literacy, focusing on the people element. Note Issue, and the Bank generally, is committed to providing training and support to employees to ensure people are capable of using these systems and able to generate meaningful information. This is a key role for the data steward who has been identifying relevant courses and identifying relevant members of the team to attend.

**Data Management**

This describes the five stages of data management and it starts at the point of **capture** because data quality starts here too. How do we ensure we are reducing room for error? We provide structured entry points with the aim of creating
consistency across the department and consistency of reporting. Then there is **processing**, which is aligned with the application of business rules, including regulatory and legal requirements. We ensure our data is fit for purpose and meets audit standards and informs departmental business questions. An example of the regulatory requirements is the Privacy Act. We make sure that our data is appropriately accessed and stored. Similarly, in terms of **retention**, we must not only process and interpret the information the data gives us, but we also have to make sure we have retention and storage facilities to meet those regulatory and business needs I just spoke about. Of course, how we manage raw data is different to how we manage transformed data or reports. What do we do with our results? How do we **distribute** them? We use reports to inform our business decisions both at a departmental level and to document support for decision-making at a broader executive level across the bank. And finally, **disposal**. This ensures that any data erased is in accordance with those regulatory requirements and then what we do maintains a representation of the corporate memory.

This next slide shows seven data management principles, which guide our data management approach at Note Issue at the Reserve Bank. I will just go over these at a high level because my colleague Mark will provide some examples of the way that the system meets these principles. First, **governance**. It is incredibly important to ensure a structure that the data system sits within. It is also important to establish roles, be clear about responsibilities and understand where they sit within a framework. The second is **quality**, which ensures our data meets quality standards in the way it is received, stored and utilized. The third is **metadata management**, which ensures we have a common understanding across the department about how we name and categorize our data so that all people (the corporate body in general) can locate data. Similarly, with **reference** and **master data**, it is incredibly important that the data framework is meaningful, consistent and accessible. In terms of **warehousing**, we have been constructing a platform to enable people to utilize and store a wide range of data that can be manipulated by different analytical packages. Obviously, **security** is a key principle for those of us who work at central banks. Securing the Bank’s assets in an appropriate way is an incredibly important part of any data framework. And finally, there is the **architecture** of the system, namely structuring stores of data to ensure they are easily accessed and responsibly managed.
Note Issue Data Management

Here we have a couple of points, or challenges, that are a part of our data management activity.

- Data is sourced from a range of entities and even where it is self-generated, it comes from a variety of processes. This makes reporting consistency a significant challenge.

- The same data is used in different policy and operational areas. A simple example is the banknote control system, which allows two separate teams to facilitate day-to-day banknote distribution and to measure broader trends over time. People are an important contributor to any data management system. People who are interacting with the data must understand the context, including how it is being generated and possible anomalies that might occur.

Data Identification

These are some key questions that we are continually trying to answer. What data do we have and need? What is missing? What do we need to properly interpret and use the data? How do we convey what the data is showing? How do we tell people what that message is?

What have we learned?

While utilizing data to inform our work is a key part of our function, it is not by itself a solution to all our business needs. Data is an input that informs decision-making but it cannot make a decision for you and it will not make decisions by itself or solve all your problems. Data will help with decision-making but it will not make decisions for you. It should be understood within the limitations of the systems that generate and store that data. Data will help you identify where you have problems within your business but generally will not help you solve them. You will need to develop those solutions yourself. Within your government’s framework, you will need to ask questions and hopefully reach sound conclusions. Nonetheless, uncertainty and risk will remain.
DATA INFRASTRUCTURE

Having given you an overview of our strategic approach to the collection and use of data, I will now focus on systems as well as an overview before Mark gives you more detail. In this section we will focus on the technological infrastructure that helps us manage our data and realize the information outcomes I have talked about. It might seem surprising, but the first element of this infrastructure is people, our Note Issue team. While the technology and various software packages are important, the critical element that will be the difference between success and failure of any data management system is the people working with your data. Any system relies on people to accurately enter information, to extract the information, and to interpret what that data means. A data management system will not succeed without capable, informed people.

Let us get back to technology. I will now give a brief overview of the systems we have in Note Issue. Obviously, Excel is a foundational tool for the collection and reporting of data. In addition, the Bank has established a BI platform, which is using Microsoft’s Business Information System to provide a propose-built central repository that enables the bank to store, process and transform data in a cost effective and secure way. We also use the power BI tools that come with that package for analytical and data visualization purposes. Our data analysts use SQL, R and Python coding languages that help us accurately collect and make sense of data. One example is we use Python to sieve through references to counterfeits in the media and make sure we have visibility of any outbreaks that have been reported on. We then compare this information to our counterfeiting log to understand any gaps and, typically, to confirm we are aware of any counterfeiting outbreak. As I mentioned, the systems aim to respond to the needs the Note Issue team has identified. They are not created by IT out of thin air and here are some examples listed by the functions they perform. We have transactional databases which record and drive the day-to-day banknote flows. We also have operation databases that send and receive data from external systems. Additionally, we have a stock management database that records data about our holdings and monitors the value of those notes. We also have audits and analysis systems that store data about banknote characteristics.

The transactional database is called the banknote control system and Mark will talk about that particular system later on. The operational database is called the Warehouse Control System and we also have one called the Processing Quality Data System. The stock management system is called Secure Item Tracker. We also have
very long titles for our audit and analytical system, namely the Counterfeit Examination Laboratory Analysis Resource and Banknote Evaluation Laboratory Analysis Database. Our systems are used together by technology platforms. Technology helps data analysis and transformation, but people drive the process.

Data Visualization

I would now like to talk about data visualization because the point about people is incredibly important when it comes to data visualization. It is a key element of communication and can be the difference between an uninformed decision and poor outcome and an informed decision and a great outcome. It also allows complex information with many data points to be represented clearly to convey complex ideas simply and powerfully. It allows trends and patterns over the long term to be more easily seen. Our data visualizations have evolved over time and Mark will show some of them to you later on. Using the Power BI platform, we have been able to increase the range of our reporting and Mark will give you some examples when he comes to talk about those with some of our systems. We have also increased our focus on using data visualizations for reporting purposes rather than just limiting our use of systems to data entry and storage capability. One of the things we are always conscious of is the simplicity of our visualizations. Simple is often harder to achieve but will generally result in better comprehension and, therefore, better outcomes. This gives you an introductory overview of our approach to data utilization. I will now hand over to Mark to continue with some of the specific examples that I mentioned.

Speaker 2: Mark Onikul, Senior Manager at Business Systems and Support Division, Reserve Bank of Australia

Banknote Control System

Thank you, Victoria. As Victoria said, what we will do is run through the different systems that we have and ask a number of questions about them. You will see a theme through what I am talking about. Let us start out with the banknote control system, which is a central system that drives our transactions. It controls the transactions we have with the banks who purchase our banknotes and their cash-in-transit (CIT) companies. We have set up a web portal where the banks and cash-in-transit companies can enter the information. Again, that simplifies our processes, reduces
our risk, reduces the compliance framework because the data are entered straight away. We get one type of flow there, the flow going in and out of our distribution sites to the banks and cash-in-transit companies. The other flow that we record in the banknote control system is the output of our banknote processing systems (BPS). On a high level, that is how many banknotes have been destroyed and of what denomination. There you can see you have flows and obviously from flows, we get stocks. The BCS is our central holding point or our central source of truth for the banknotes that are issuable into circulation. And we break this up by distribution site, by denomination, by year of print and by whole a whole range of factors that allows us to drill down and really understand what our holdings are at a given point in time. Finally, the system manages our damaged banknotes process. Like many central banks, we offer a facility to the public where they can return damaged banknotes to us. We think this is a very important process because it has a direct impact on people. At a high level, that is what the BCS does.

**What do we want to understand with the data?**

The BCS is absolutely critical for running our operations. Without the BCS, we are back to pen and paper. It is critical for our operations, therefore, but on a higher level it helps us meet some other goals. Obviously, if we have flows going in and out, we can track banknote circulation. Clearly, over this current pandemic period, that has been very important. We can examine our unfit return levels. We are about to issue the fifth and final denomination of our next generation banknote series. In fact, over the past five years, we have been issuing our new series and watching the returns of the existing series come back to us. The monitoring of those flows is critical so we can understand the saturation rate of the existing series as well as being able to focus on what is happening with National Banking Group (NBG). Again, damaged banknote volumes and values are very important for us so we can understand if there has been a spike in return levels or if there is something going on that we need to monitor. We also look at it by type of return. For example, because we are working with polymer banknotes, heat effects polymer banknotes in a specific way, such as shrinking. Therefore, we keep details on the type of damage, which helps us understand what is happening. We can decide whether we need to run a public education campaign.

Taking a step back, we can also look at banknote life and do interesting calculations to effectively determine how durable our banknotes are and how long
they will last in circulation. This is a question we are regularly asking ourselves and looking at from many different angles through many different vectors. We will look at that together through a couple of different points later in my presentation. Finally, at a very high level is public access to banknotes. We are currently going through a change in the way people use banknotes, certainly in Australia. The use of transactional denominations is decreasing. One impact of that is some members of the public may have reduced access to banknotes due to maybe closures of bank branches. One element we are focusing on is public access to banknotes.

**Business Benefits**

The second question I am going to ask for each of these systems is what are the benefits? We have looked at what the system does, we have asked ourselves about the types of questions and we are going to drill down and look at some specific business benefits that we can achieve from these systems. We have all seen a big increase in banknote demand due to Covid-19. In Australia, there was a very large increase in high denomination banknote demand. Likely, it was precautionary demand because of these uncertain times. We have clearly seen a large ramp up in demand but the question that we are pondering is, what happens next? Certainly, there is a huge volume of banknotes in circulation. Are these banknotes going to come back? Are they going to stay in circulation? We have people asking these questions using the data. For example, we are comparing it to what happened around the year 2000 with the Y2K issue and what happened in 2008 and 2009 with the global financial crisis (GFC). We do not have any answers yet, but it is certainly helping us in this strategic decision-making space. It is helping us make better decisions. You may have seen in Australia in late 2019 and early 2020 there were significant bushfires that ripped through massive areas of the country. That caused untold devastation, loss of life, as well as loss of property. Amongst the property lost were banknotes. There were people who stored banknotes on their properties and those properties suffered extreme fire damage. As a result, we have been receiving damaged banknotes. We are prioritizing this service and the only way we can prioritize this service to provide the banknotes to the public is through the use of data. We track exactly what is coming back to us and what damaged banknotes are coming back to us. We also make sure we prioritize those and track each claim so that we have great visibility on what is coming back in order to prioritize these claims.
Altogether, all this data helps to give us a much deeper understanding of the cash industry. In Australia the cash industry is changing, and it will continue to change. By using this data, we can ask ourselves how it is changing and what is it changing into? The data itself is just one step in that though. It is asking ourselves all the questions and having that data help us with that process. Stepping back from that very high-level view, at a very micro level the data will also help us with questions about staffing for operational days. How many team members do we need onsite for a typical operational day? Again, the data will not spit out a definitive answer, it just helps the leaders of the team understand what sort of buffer they should be thinking about. How many people should they potentially have on site?

Data Examples

I am going to run through a series of example visualizations that we do. We start out with banknote issuance, and you can see massive increase during the GFC and now in 2020, which dwarfs the GFC. We look at unfit returns and that helps us understand the flows. You will notice the different colors on that unfit return chart, the gold is our largest $50 banknote in circulation by value and volume. What we try to do is use these same colors in all the charts where we are talking about denominations. That makes the cognitive load on people easier, and they do not necessarily have to delve into the data as much because they know the gold represents the $50s. We look at things like banknotes in circulation over history to give us context on where we are today in comparison to where we have been. We think about our damaged banknote claims and we also look through the volatility to look at those trends. We think about it at a very micro-operational level. How many consignments, how many movements, and how many transactions do we have at our automated national banknote site? Divvy that up by time, by the cash-in-transit company to help us understand our flows for our workforce planning and to help us ensure the site operates effectively.
We have also done interesting analysis on access to banknotes. We have also done sophisticated visualizations where we have looked at each of the points of presence, whether it is a bank branch, an automated teller machine or a post office that performs banking transactions, allowing us to get a higher level of indication of where people can gain access to banknotes. We have done other work that has mapped population density to those to gain a further deeper understanding of the cash industry in Australia. We have also looked at how the CIT depot works and how our cash-in-transit companies work. How do they move banknotes around Australia? How do they move them between the states? How do they move them between each of their depots? This information has been invaluable to us during Covid-19 because in Australia we had border lockdowns and massive transport dislocations. Many airlines completely stopped flying and we had a massive reduction in the capacity of the cash-in-transit companies to move their banknotes around Australia. By having this sort of information, however, it helped us in our conversations with the cash-in-transit industry and the banks to understand where they are placed.
Victoria mentioned simplicity, the charts I have spoken about are pretty simple. On the other hand, we have done a bulletin article, which is our formal publication on banknote life. This graph is not as simple as the others but it is showing some interesting factors about survival rates for banknotes. The point is you have to aim for simplicity but at times complexity does help, depending on the audience and the type of the message you are trying to send.

**Operational Systems**

I will now move on to our operational systems. The banknote control system looks after the flows but these systems are a step more micro, a step closer to our physical processes. The first one of these is the **warehouse control system** and this is the brains, the heart of our automated national banknote site. The warehouse control system drives the robotics, it drives the conveyers, it sends messages out to the automated guided vehicles and driverless forklifts. Without the warehouse control system, none of the automation would work. The warehouse control system is also responsible for the automated strongroom. It uses its own logic with our business rules to store banknotes appropriately in the strongroom. It lies at the heart of our banknote distribution process. What do we want to understand? Uptime is critical for any automated system. How effective is it? How is it running? Is it operational enough, does it meet our standards? We then go through and analyze that data. We also look at the use of the strongroom. It is a very large strongroom but very large is not infinite, so we have to keep on top of the capacity of the strongroom. Finally,
we look at system errors. Any automated process will generate errors. Ideally, most of them are pretty minor and inconsequential. Some of them may foreshadow other issues, so we delve into those errors. What are the business benefits? Clearly, we are in a lengthy and strong partnership with the provider of the automated system. It is important for us to work with them to understand their preventative maintenance. We have set aside considerable time over the week to enable them to undertake the necessary preventative maintenance to keep the system operational. And we have certain benchmarks they need to meet. By working in partnership with them and analyzing the data, we can understand the efficacy of their preventative maintenance. As I mentioned, the strongroom is very large but it is not infinite so by analyzing the data, we can get early notice of capacity issues. Manual measures to manage capacity take time and resources so by being ahead of the curve, by analyzing the data, we can start making decisions. We can start thinking about operational decisions and strategic decisions about what we might need to do to manage capacity constraints. Finally, people. While the site is automated, people drive the system. Without skilled people the system would not operate, so it is very important that the team members are trained effectively, that they are experienced, that they know how the system should operate and that they know when to recognize questions from the logs or messages from the system to respond appropriately.

Data Examples

Again, a couple of data examples. We delved down into uptime and a number of issues were raised. We have operational dashboards that help us track the system’s efficacy and how we are working with our partner. We track the transactions over very small periods so that we can clearly understand what is happening on the site. We can start from that helicopter view and then work our way down and really understand what is happening with our site. The system itself helps us, it tells us what is happening with its equipment, what is happening with its automatic guided vehicles and its conveyers. It generates heat maps to help us understand strongroom capacity, help us to start thinking about whether or not we are getting to the point where manual intervention needs to be considered.
Digitalization and Automatization of Currency Management

Figure 3 Data Examples on Warehouse Control System

**Processing Quality Data System**

This takes other data from the processing machines. The banknote control system takes volumes of banknotes, this takes quality data. As Victoria mentioned, we have a quality system in place. This system takes the quality data, namely information about defects. We categorize our quality from best to worst, one is best and eight is worst. That data gets stored in this system and the system is agnostic across our systems. We have both, Germany’s Giesecke+Devrient (G+D) and the UK’s CPS machine, which feed data into the system. Again, asking that same question, what do we want to understand? Clearly, we want to understand the quality of circulating banknotes. We have a number of different systems in place to do that and we sample both banknotes that are near to circulation as well as banknotes that are being processed by the cash-in-transit companies. That gives us a really good indication of what is happening with quality. We obviously want to understand what the types of defects are that we see in banknotes. Finally, we have a legal agreement with our banks that govern the banknote quality framework because there is payments associated
with it. At the simplest level, if the banks perform at their best, we will pay them up to $15 million per year for their efforts. If, however, the quality falls to a completely unacceptable level, they will pay us $30 million a year. There is a big legal framework around that and it is very important that we understand the quality of banknotes because we then make payments or expect to see payments based on the quality.

**Business Benefits**

That directly ties into meeting our obligations to the banks, there is a critical business benefit here. It is absolutely important from a reputational basis that we get these payments right. Having a system that works effectively, that is usable and that it is quick is critical, but it is also the people. Each time we run those banknotes or a sample of banknotes through, we spend a lot of time analyzing the data. The system can provide hints, outliers and suggestions on whether there may be an issue, but the people have to go through and do it. Therefore, having a system that helps is critical, but the people drive that process. As I said, we make payments to the banks and cash-in-transit (CIT) companies, so we can see the value add and we can see the processing efforts that the cash-in-transit companies put in and how much better they are making the quality of banknotes after they have come out of circulation. We also ask ourselves about inkwear. Given that we are out on polymer, inkwear is one of our major defects so by focusing on inkwear and asking ourselves questions about inkwear we can look to see how the banknotes are circulating. We can look to see if there is information, we can provide back to Note Printing Australia (NPA) in order for us to understand the different inkwear patterns. It is very important for us to understand quality across Australia. We are very different than Indonesia in terms of how our landmass is structured but we have very different areas in Australia. As a result, we focus on quality across those different areas.

Finally, we have dabbled in machine learning. This was some work we did with an overseas central bank to run a competition to look at discrepancies, namely the difference between what comes in on a said-to-contain basis and what we actually processed. We did some work in the machine learning space, but we are very much in the embryonic stage there. I would not even say we are at the start of the journey yet; we are just now only thinking about starting the journey. For example, we could look at quality by denomination, where again you will see the $50 dollar is in gold, which instantly helps people understand that is the denomination we are looking at. When looking at quality across Australia, we can delve down and look at the
types of defects we see in banknotes over time. We can see how they change over time, link them through other issues in terms of changed polices and different pre-trials. Then finally looking at machine learning, there is maybe an inkling of a start of something we can look at but we have a long way to go before we can really start entering that field strongly.

**Stock Management System - Secure Item Tracker**

We also use a stock management system, which we call the *Secure Item Tracker.* The difference here is that the Banknote Control System I spoke about initially focuses on circulating banknotes. These are banknotes that we can issue to the public or banknotes that come back to us as unfit, whereas the secure item tracker is focused on non-circulating material, such as work in progress, namely banknote sheets as they come from our printer and the different stages of the banknote printing process. We have elements of the banknotes. Our banknotes have spark or foil on them, so those components of banknotes as well as older historic banknotes. All of these have got value and are important for us to track. Our secure item tracker helps us keep on top of these types of non-circulating material. What do we want to understand? We want to understand the types of material held, how many of them are sheets, how many of them are small parts of banknotes? Which team is holding them? Are they held in Sydney? Are they held in Melbourne? We also want to understand changes in holdings. Changes are important. If a team is constantly building up their holdings, we want to understand why. Is there a reason for that? Understandably, we have limits on holdings. Therefore, the secure item tracker helps us to keep on top of those types of questions. Fundamentally, the secure item tracker is all about reducing risk. The bulk banknotes, the issuable banknotes, the circulating banknotes that we are talking about in the banknote control system, because they are held in large volumes in strongrooms, they are easier to track in bulk. On the other hand, when you are talking about a single sheet or when you are talking about a part of a banknote, the risk is arguably higher there, so we want to try and mitigate and reduce the risk there if the banknotes are lost or there is some form of fraud that occurs. By having a robust system in place, it helps us provide management oversight. Then the leadership teams can examine the information that comes out of the secure item tracker to understand what is happening with those holdings. Who is holding them? Are they changing appropriately? Is a team with a lot of them running them down? This system helps us to answer those types of risk-based questions. That leads
to team member confidence. The people holding these parts of banknotes or these sheets are personally responsible for that material. By having a system that helps them track, enter their holdings and notify them if something goes wrong really builds up their confidence that they can undertake their day-to-day work effectively.

We have dashboards that help team leadership and the broader executive of Note Issue to understand exactly where we are placed with holdings, what is happening with the quantities of them, what is happening with the value of them, and what status they are. This really helps people by a simple glance to know whether there are any emerging risks. The data is helping inform decisions. This report itself will not give us an answer, it will not say we have a problem even if it flags that something has gone over a threshold. There may very well be some good reasons for that. That is where the people come in, the individuals analyzing it and making decisions.

**Audit and Analysis - Counterfeit Examination Laboratory Analysis Resource & Banknote Evaluation Laboratory Analysis Database**

Moving on to our final two systems, which are a bit of a mouthful. We like long acronyms. We have the Counterfeit Examination Laboratory Analysis Resource (CELAR) and the Banknote Evaluation Laboratory Analysis Database (BELAD). Please forgive me if I use the acronyms. The counterfeit system is fundamental to our processing and tracking of counterfeits. We work closely with the police in Australia to receive counterfeits, to catalogue them, process them and provide data back to the police for evidentiary purposes, and the CELAR allows us to do that. This is a critical system for us to reduce the economy-wide risk of counterfeiting by having that data stored in the system and keeping on top of what is happening with counterfeiting in the economy. Clearly, we want to understand the types of counterfeits out there, what is happening with the counterfeits, and whether they in any specific regional areas? From this data, we can work out parts per million and the number seized. This is all about helping the police. Concerning the business benefits, we delve down into a particular denomination, we determine the threat level of that particular denomination and then we then provide this data to the police so that they can use their resources to achieve arrests and convictions. We have had a lot of success there and we have a very strong collaborative relationship with both our state and federal police forces. Through that collaborative work, through the data, and through the use of people analyzing the data and providing information back, we have been
able to shut down counterfeiting attacks. We are going to be publishing an article later this year in the Reserve Bank Bulletin that talks about a counterfeiting incident from start to end, highlighting how we worked cooperatively as well as how the data helped the police shut down that counterfeiting attack.

We have dashboards. We spent a long time thinking about how we can develop elegant dashboards that allow people to quickly get an indication of what is happening with counterfeiting across multiple dimensions. Additionally, we send out a report each quarter to the police forces, which contain summaries of what is happening with counterfeiting. That helps the police with their efforts, which is clearly one of our main focuses for a strong currency to have a low level of counterfeiting.

The final system is the Banknote Evaluation Laboratory Analysis Database (BELAD), which deals with newly printed banknotes as they come out of our carbon printer. It contains observations on those print runs, and it contains data for a long history of those print runs. This allows us to understand where we are in comparison to specifications. We know what happened in a specific print run and how to compare that to the agreed specifications. We also understand what has happened with different features over time through one print run and in comparison, with previous print runs. This really helps us with our acceptance process, but it does not drive the acceptance process, people drive the acceptance process. It gives us information to help with that acceptance process and to help us coordinate with our printer.

We have sophisticated systems that allow us to delve down into all the different data aspects we see from each print run over time and by specific type. Again, multiple different types of dashboard to help the analyst provide a recommendation on a specific printer.

**MOVING FORWARD**

I have spoken about where we are, the interesting question is what is next or what are we looking at going forward? Currently, there are four areas we are looking at that I will briefly touch on, I will not go into them in great detail. As we touched on earlier, we are looking at serial number tracking, we are looking at how we can continue to strengthen that interaction without our banknote printer. We also have a formal continuous improvement program in place aimed at how we can continue to improve our visualizations.
Serial Number Tracking

Starting with serial number tracking, an obvious one is linking the defects to a serial number. With our system, if we had our druthers, we would be able to track as the printer prints it, as they are placed into a container, when the container leaves one of our sites, when the banknote comes back to us, the details we get when it is processed, if it is destroyed or re-issuable, and then link all that data together. In the end, that would give us a tremendous understanding of banknote life and the types of wear characteristics we see. This is not simple, however. If nothing else, collecting serial number data is very complex. As you can understand the banknotes are whizzing through the processing machines at a very high speed so they are not going to collect 100% of the serial numbers, they simply cannot do that. There are issues where they can occasionally mix letters, mix up the numbers or the serial number can be obscured by a folded corner. Therefore, we are never going to get the entire population of numbers. This leads us into the big data issue, which we touched on earlier. There are huge volumes of data in this space. One thing that we are working on and emphasizing to our team is that big data is not necessarily better data. It is just bigger and when you have more data, you have more complexity. We still have a lot more work to do in this area. Talking about our interaction with the banknote printer, we do have a formal program in place with a steering committee to look at how we can achieve our deliverables in a more effective fashion. We are also looking at how we can increase banknote life, how we can reduce spoilage and how we can become more efficient. This is all data driven. We collect data, the printer collects data, we share the data, and we talk about the data because the data helps us understand the various paths we have to improve our interaction. Again, the data is not making decisions for us, the steering committee makes decisions based on the data and the recommendations from the analysts.

We have also instituted a formal Lean Six Sigma program and that is a process engineering system used primarily in manufacturing to help identify efficiencies and improve them. Data is critical to this process because it is impossible to improve performance until you have measured it. Therefore, one of our key challenges is to measure performance and so we are collecting huge volumes of data so that we can measure and then improve performance. Here, we are starting with our damaged banknote process because that touches across many elements of the department as well as interaction with many teams.
I have shown examples of visualizations. We are not experts in this space, but are constantly learning, experimenting and trying new things. Earlier, Victoria spoke about our standardized management reporting so, here is a mockup of one.

The information will be in roughly the same place on each page with similar colors and similar fonts to help ease the cognitive burden on people as they read through the presentation. That leads to better dashboards, some of which are static and some are interactive. Ideally, we end up in a situation where we have management by exception rather than having to look at every decision.

**CHALLENGES AND LESSONS**

We have learned many things on this long journey and here are some of those challenges and lessons we have got out of this. There are five key points which I will not belabor, but there is a risk of poor-quality data. With poor-quality data, staff can become disengaged, they can become frustrated if it takes too long to obtain the data and that leads to excess effort. We have all seen examples where people have spent 90% of their time just gathering the data rather than analyzing the data. Breaking down silos is critical to getting good quality data, not to have key person risk, not to have data widely available, and to communicate what the data is. Also, to help people find the data because if you have poor-quality data, you are going to errors and you are going to make mistakes, which can lead to reputational issues.
Data is complicated and here are just a few things to think about over this process that we are still learning about. When you start on a data project, it is important to understand the scope, what you want to achieve. Do not try to achieve everything at once because you will fail. At the same time, ask yourself what you want to prioritize, what should come first, thinking about the prioritization, thinking about what will deliver the biggest win. Is it starting out with something small to prove that the new data analysis system works or is it starting out big and achieving that big win? Both are entirely acceptable. Just make a conscious decision about which path to go down. When you have made that decision, set the expectations of the users and the leadership team so that the people will understand what will be delivered. Make sure the systems are appropriate, use the appropriate system for the right type of data. Have dedicated systems if necessary and have the right tools, but all of this will fall down without people. People lie at the heart of this process. People and technology are an interesting dichotomy. What is the change driver? People and technology teams have to work hand in hand. The business and technology have to work together. One cannot move without the other, otherwise the results will not be good. In that space, technology can be costly. It is important to keep in mind that having effective technology that works across an organization is costly. That has to be kept on mind. It is also important that resourcing is effective on the technology and people sides. If people are asked to do new things with data, it is important they are given the resources, the time and the capacity to do it. But it is also critical to understand that failure may be an option in that space. A project may not work but think about stage gates, think about something that has not worked. For example, these are the wordings, but we will not progress anymore. Finally, data security has to be kept in mind through all these processes. Thinking about what data can be shared and what data should not be shared. For example, circulation data should absolutely be shared, whereas banknote specification is probably one that needs to be very tightly held. The other factor is that this leads to a whole new world of data. As you are looking at security, you get into the world of data analytics in the security space. Who has access to the data? How many times have they accessed the data? There are user access reviews. Data about security is a whole new world that can be looked at as well.
Thinking About Data

There is an interesting example to finish off this section, where two groups of university students were given data on body mass index (BMI), which is a mathematical link between a person’s weight and height, as well as the number of steps those people walked on a given day. One group was given three specific hypotheses to answer and the second group was just asked to come up with a conclusion from the data. Basically, the students that came in with an open mind saw a monkey waving at them in the data. This is all about keeping an open mind with data, thinking about the dimensions of your data, thinking about what you can discover.

“Let your fantasies run wild...There could be gorillas hiding in your data.”

WRAP UP

To wrap up, data itself is not the answer, technology is not the answer, they work together with people and people will provide the answer. People need to ask good questions and make good judgements. Without that, the best data in the world is irrelevant; it is all about people. Even in that world, however, uncertainly and risk will remain. The data world is complex, it is time consuming and it is costly, but it helps you make much better decisions.

“The problem though with data, or ‘evidence’ is that often something has to happen before the evidence exists. For the most important decisions, the event that produces evidence is the one thing you are trying to make a decision about.”

Moderator: Thank you very much for interesting and enlightening presentations. Before we begin the Q&A, I would like to comment. My first point is about the strategic approach to data, data collection, management and analysis. The second point concerns managing data as a strategic asset where the data is trusted, secured and appropriately accessible. Data technology innovation has delivered ways to help decision-making but good judgement is still necessary to analyze and interpret data. We use a control system to capture trends regarding banknotes in circulation for transactions. For operations, our control system is used to control automation and processing quality data to understand the quality of circulating banknotes processed by CIT, stock management as well as auditing and analyzing. You mentioned so
many things, including how the RBA is making many improvements and mitigating many issues moving forward. Also, the issue of counterfeiting, which could harm the economy. You mentioned many good points in your presentation.
Q: The first question is on the importance of a digital mindset. How do we prepare for the transformation in a central bank, especially the process of changing the mindset of your employees and local citizens when implementing and accepting digitalization? How is this mindset beneficial to data management?

A: Victoria Pymm

Education is incredibly important when looking at any change management program but particularly in terms of introducing new ways of managing data. What you really have to focus on is giving people a very clear explanation of why a new system, new process or approach is important as well as what the benefit will be for them because sometimes those benefits are not be immediately obvious. They are things that take time to become obvious and they may mean additional work at the front end of a process for you to realize benefits towards the end. But we found with introducing new approaches, for example dashboard reporting, that it has simplified the process for people so, while there is a process of learning, adapting and change, it actually has a benefit for them. Therefore, once they have bothered to learn and establish a new routine, there has actually been a positive result of that. And that is a direct result of more buy-in to that approach.

I also think that making the context clearer is important as well. As the leadership team, we often talk about how we are going to communicate our decisions on a strategic level to our teams, while at the same time our head department is very conscious about providing that information very broadly across our whole department because it is a mindset. Getting frequent updates and strategic commitments from the leadership team really helps people understand why change is occurring, which is incredibly important to create buy-in as well.
A: Mark Onikul

The only thing I might add is that we found benefit in having change champions, having an individual who is extremely passionate about the change and having them drive the process. Rather than it being driven by management, have it driven by a team member. That is very powerful because then it is colleagues working with each other to achieve that outcome and to achieve that change. That agile mindset is very difficult but it is actually something we have seen in great detail through Covid-19 because we have had to change the way we work and the way we operate. That has required everyone to do things differently. We have all been working from home since mid-March and that has been a whole new way of thinking. Everyone has had to adapt by coming up with new ways of thinking so in that circumstance we have all had to become agile. The way we worked before was simply incompatible with the new environment. In such circumstances, there is great learning that we have taken out of this horrendous situation.

Q: There is no doubt that data in currency management is a strategic asset. How can we deal with the confidentiality issue and degrees of openness because the data is occasionally subject to being published?

A: Mark Onikul

Confidentiality comes down to that security question I was talking about. It is important that access is tightly controlled and tracked. That allows the overarching technological framework to protect the data and then once it is in that strong system, do the regular reviews of who has access, do the regular reviews of who has been looking at what particular data. You need to have that done independently. That will give a degree of strength about the confidentiality of the data, and it is ingrained into team members that this data is confidential. We have to think about it not just in terms of what we are doing with the data but how you are talking about the data and where you store the data.

A: Victoria Pymm

I will add a general comment about the natural tension between transparency and confidentiality. We do try to provide as much information in a public forum as we can without compromising our business processes. For example, on our banknote
micro site, which is a subset of the broader Reserve Bank of Australia (RBA) site, we publish saturation rates for our new banknote series and the idea is to keep the public and the industry updated about the saturation of the new series across the market or industry. That is a general interest and benefit to them in terms of managing their resources. It is something we can easily provide, so what that does is help establish a culture of transparency but it also means that people are not looking for negative stories or trying to access confidential information because the information they are looking for is already available.

**A: Mark Onikul**

In a lot of the visualizations, I had anonymized the data and that is because there was that tension Victoria spoke about, we absolutely wanted to share this information with you but some of this data is confidential to us. Therefore, some of the times series information or values were hidden and that is just because this data is confidential to us that we do not share externally. You would not share it either, but it was important that we still conveyed the information. How can we still participate in this forum and still show what we are doing but do it in such a way that our confidentiality is kept and we can still have a meaningful discussion about the data.

**Q: According to the currency in circulation data, sometimes we are curious about its lifecycle, as related to digitalization in the process of printing money and sorting banknotes by tracking serial numbers or money. To my understanding, the banknote inspection machines from GND and the PSX9 make it possible to capture serial numbers but Bank Indonesia’s GND sorting machines, such as The BPS M7 and C4s banknote processing system, this is still not possible. Is it still possible to do research on banknote lifecycle and quality with the existing information?**

**A: Mark Onikul**

On the third question about serial numbers and banknote life tracking, that is a very complex issue. I am not an expert in that field but we have published a number of formal articles about this. If you go to the Reserve Bank of Australia’s website and have a look, we published a research discussion paper four or five years ago about banknote life. We recently published another one about that complex graph that
I showed earlier looking at banknote life. Those were done without serial number tracking. They were done using various assumptions about when various banknote series were issued. Yes, there are assumptions in there, which means the data may not be 100% accurate but it certainly gives us a really good idea of what is happening with banknote life. For those of you who are interested in those sorts of questions, have a read of those two papers and if you are interested in delving into that, we can put you in contact with team members who know that information in much more detail.

**Q: Are you using unstructured or structured data to set up the policy? How do you manage the high risk of cybercrime attacks?**

**A: Mark Onikul**

In terms of cybersecurity, that is something that occupies our technology team, and we have a large number of people operating in that space to keep the bank secure. That is a key risk for our organization, to make sure we are kept secure. One thing I take comfort from is that the government’s audit office went through and did an audit for a number of different government organizations, looking at their ability to withstand cyber-attacks and their skill level. The Reserve Bank rated well in that audit. That does not mean we rest on our laurels or sit back. It is all about making sure we have the appropriate resources and team members to adequately look at and study the latest environment as well as adapt. We are always making changes. One thing the Reserve Bank is doing now is altering its password policy by making passwords more complex to reduce the risk of someone cracking passwords. It is all about adapting, changing, responding and having skilled people in place.

In terms of structured verses unstructured, we have every type of data. Certainly, structured data fits nicely into our systems because that is what they are set up to do. We have got rows and columns, time series; it all fits in there. In my mind, however, unstructured data is the value that people bring to the system. They bring their insights, their knowledge and their experience. They pull together all the different threads of data and help us to understand what the data means and how we can best make decisions from the data.
A: Victoria Pymm

I think you are absolutely right; we use both types. We have such a huge range of different kinds of inputs, but it does make it infinitely easier for people using the data for the analytical work once it has been structured. Whatever tool they use, that actually provides some significant benefits in terms of time saving and accuracy.

Q: Mark, if we look at the evolution of money, the emergence of new forms of money has not replaced the old ones; it has only diversified the means of payment. I would like to talk about central bank digital currency, especially in my country. In Indonesia’s case, financial literacy is quite low compared to other countries. Would it be possible for central bank digital currency to become popular and accepted by the public because I believe CBDC will provide simplicity and efficiency? How do we convince people to trust this currency?

A: Mark Onikul

On the question of a digital currency, this is still something the Bank is thinking about. We have done a number of papers and speeches about this. Rather than me doing a poor job in summarizing the extensive literature we have on the website; I would recommend that people go have a look at the information in great detail and go from there. The governor has spoken about it, the head of our payments policy has spoken about it, and they do a lot better justice to the question than I will.

Q: Do you experience any hike in currency circulation during festive seasons, such as Christmas in Australia, or does RBA suspend the exchange facility of small denomination currency during the festive period?

A: Mark Onikul

I am happy to answer the seasonality question. In Australia, we have two peak periods, the first of those is Christmas. We always see a very large pickup from the first week of December as people withdraw money to spend. We also see a shorter pick up a couple of weeks prior to Easter. Our Easter holiday is a four-day break and people withdraw large amounts of money for food shopping over that period.
rather than gifts. After both of those periods, Easter and Christmas, there is a large increase in banknotes in circulation. In our interaction with the banks and CITs, we only allow them to return fit banknotes twice a year, which is after Christmas and after Easter. This is because there is such a large amount of banknotes in circulation at that point. Throughout the rest of the year, we will not accept fit banknote returns. Therefore, for us the seasonalities are around Christmas and Easter. Generally, it is in our higher denominations. We do see some pickups in the lower denominations but it is generally concentrated in our higher denominations.

Q: In a globalized world, financial shocks quickly reverberate across national boundaries. Currently, we are witnessing the slowing if not collapse of the world economy due to the pandemic. Will the evolving global financial system transmit shock more quickly? How can we utilize big data to strengthen our resilience?

A: Mark Onikul

In terms of the big data resilience, that is a really interesting one. I think Covid has shown the value of that. All the work that the scientists are doing to understand the behavior of Covid, analyzing its effect, shows the value of big data. But it is not the data itself driving the analysis, it is the people making the decisions. I was reading about the benefits of masks and there was research done about that initially. If people had waited until all the data was available, a decision would have never been made. It comes back to my last quote about seeking the evidence and the data is the evidence that you are after. Here, we pulled together large amounts of data and said yes, on the balance of probabilities, it looks like mask wearing is effective. In our world, we do not really have a lot of big data in Note Issue, we are still on that path. We are starting to generate it in terms of the output from our banknote processing machines. That did not really come into our thinking during Covid, it was all about analyzing those trends from banknote demand. Talking with people, communication with the industry and communication with the cash-in-transit companies were absolutely critical to our success during this period.
Q: In the early stage of data integration and implementation, data collection and processing, what are the main challenges? I assume RBA finally has robust data quality to support the decision-making process.

A: Mark Onikul

In terms of data quality, that is a work in progress for us. We have a long way to go. We are broadly happy with most of our data but there is always more we can do and so we have a full plan in place on how we need to work in that area. I do not think that anyone ever says that their data is perfect. There is always more that can be done and there is always more work that can be done. One of my ideas is that the absence of specific data should not stop you from making a decision. If you do not have complete data on circulation or complete data on quality, what are some other proxies, what are some other ways you can think about it to help in your decision-making? There are always additional questions that can be asked and there are always other paths that can be gone down if you are not fully happy with your data. Talk to people and do micro samples just to help fill in some gaps to help you understand where you might be placed so that you can make those good decisions.

Q: I am not too familiar with digitalization and automation in terms of banking but what came to mind is about cashless digital banknotes. Most people in Moscow are practicing cashless and touchless transactions because of convenience. I am sure the speakers have some understanding on these issues within Indonesia. What is the future of printed banknotes if we are going digital? Will there only be collectibles and what is your recommendation for Indonesian banks as far as successful digitalization and automation? What are a few strong points and challenges you foresee?

A: Victoria Pymm

I think we see the future of cash in a number of ways because of the trends we currently see now. I do not think it will become a collectible item that people just put on display. We see that banknotes continue to be used quite strongly by different groups within Australia and for different purposes than maybe they were used ten or twenty years ago. For example, we see regional parts of Australia where cash transactions are used much more than tap-and-go. Also, people in the older age
bracket are more likely to use cash than the younger generation as well as non-English speakers. Those are groups who we know still think cash is important. People are using large-denomination banknotes as a store of value. We see the future of cash as being more subtle.

Q: Your presentation on the banknote control system was very interesting and enlightening. You mentioned about the changing trends of note usability and how the banknote control system assists the Reserve Bank of Australia to monitor access to banknote circulation usage as well as the return level of damaged banknotes. However, if you look at the bigger picture presently and the near future, I believe digital banking and e-commerce transaction will replace cash transaction or banknotes. What is your view on this trend? Will bank control systems still matter in the future? How will RBA control and manage digital currency or money in circulation?

A: Mark Onikul

Bringing it back to that data piece, we do a survey every few years to gauge use of cash and this is a very detailed survey where individuals fill out a metaphorical book. They record their transactions, and they record exactly what they bought as well as what payment mechanism they used. This gives us a wealth of data about the use of payment mechanisms, including cash. We published an article about this recently in our Bulletin and it breaks down this type of cash usage. That is a really interesting piece of data that is helping us understand where we are in the world of changing cash use.

More broadly, in terms of digital currencies, I do not think it is appropriate to provide any advice. Everyone is different and every economy works differently but I would say communication with experts in other central banks is the way to go, learning off others because there are going to be a lot of challenges in this space. You can almost think about it as a massive data project. There are all those same sorts of questions and points that I raised about the scope; is it a wholesale currency or is it a retail currency? How do you maintain security? How do you inform end users on what they will be getting? What is the technology underpinning it? All those similar sorts of questions that I raised come up again in that digital currency world, yet magnified thousands of times because physical forms of payments have been
used ever since people exchanged shells as a form of payment. This will be a massive change. Personally, I do not think banknotes will go away. I see them working in parallel with some form of digital payments. Talking about digital payments, during Covid we saw two interesting trends going on in Australia. As I mentioned, the high-denomination banknotes were in massive demand, showing a phenomenal growth rate of 17%. On the other hand, the use of transactional banknotes and use of spending cash in person declined significantly as a result of lockdowns and businesses choosing not to accept banknotes but using electronic payments. We certainly saw a change in public use of payment mechanisms over the past nine months. What is going to happen going forward? We do not know the answer to that question. That is the sort of question we are asking ourselves. We are thinking about what could happen from here. That is where those questions about analyzing the data come into the picture so we can have options. It is important for us to think about different scenarios, to think about what might happen if we continue down this path or what happens if we go down a more normal path, what would happen if cash demand changes massively? This way, we can be prepared while looking at a range of different possibilities and use the data to come up with options in that space so we are prepared, and we can have those strategic discussions about what could be next.

Q: How do you see the future of cash in your country and globally? Will digitalization end cash as we know it and over what time horizon?

A: Mark Onikul

I do not think cash is going to go away anytime soon. There are key demographics who continue to use it. In Australia, we have seen a move away from cash in transactions and I think on average it is now used in less than 20% of all transactions. There has been a big change over the past decade or so in terms of the use of cash and that analysis is detailed in the paper I spoke about where we do the big survey. You can see that change over time. Where it goes from here is a really interesting question. Have we reached a plateau? Is it going to keep declining? We are thinking about all these different outcomes because it affects us directly. It affects what we do, how we work, how we interact with our printer, and it affects the industry. Therefore, each of those potential outcomes is something we are examining and working through so that we are not caught unaware. That is the benefit of this data, namely looking
at the possibilities and options. The data helps us to lay out cards and it is then up
to the skilled analysts and leadership teams to take that and decide the possible and
probable outcomes. We will prepare these to be in a position where we can advise
the Bank’s leadership team the things they should do in specific outcomes.

Q: How much data is related to currency management and how do you
generate the data? When you collect the data, is it collected by RBA or other
agencies? How frequent is the collection? Which data do you feel is most
important to support your work in currency management and policy?

A: Mark Onikul

Concerning the amount of data that we have; people occasionally complain we have
too much data and that is even before we talk about big data. We self-generate
data, we get data through each of those systems that I spoke about, including
our transactions and damaged banknotes. We get quality data from our banknote
processing machines and so on. We get overwhelming volumes of self-generated
data. We also rely and use data from the central statistics agency, Australian Bureau
of Statistics, that helps us understand economic growth, inflation and those types
of concepts. We also get data from other areas of the Bank in terms of payment
system questions. We have huge volumes of data. It is probably fair to say that the
majority of data is self-generated, coming through our own systems and processes.

A: Victoria Pymm

I just had a quick look at our data inventory and we have around 100 data sources,
not data points, just sources. The majority of those are internal but there are some
that are externally generated as well.

Q: What are RBAs main challenges in currency management?

A: Mark Onikul

I think the main challenge that we face today is how are we going to come out of
Covid. How do we keep team members’ faith? How do we get people back to the
office and how do we ensure we can continue to perform our core function? That
is a very micro question and a very short-term answer but that is something within our leadership team meetings that is absorbing our time. What is happening in that space? We certainly have longer-term issues. We are thinking about our strategy moving forward but, in that space, it is taking a lot of my time and thinking about how do we keep people safe.

**A: Victoria Pym**

In terms of the industry more broadly, we have been thinking about how we communicate with parts of the industry we rely on in terms of cash distribution. As a result, we have been working very closely with cash-in-transit companies and also the banks. Whether we are meeting demand during Covid, ensuring that the banknotes going out in circulation have been in storage for two weeks and maintaining the isolation period.

**Q: The problem with remote areas in Indonesia, in terms of digitalization, currency and payment services, is that the people live so far away from the city with no access to technology. Does this problem occur in Australia as well?**

**A: Mark Onikul**

In terms of technology, it is a really interesting question. Most areas in Australia have access to telecom systems but not all. There are remote areas where the telecommunication system is not great. If we move to a more digital world with the understanding of how we can be inclusive, namely that people are not left behind because they do not have access to technology. In that world, it is not just the remote areas, there are older people who do not use technology. There are also people on lower incomes who have less access to technology. We have to understand what is happening in that world. We are not necessarily guiding it in any way, at least in Note Issue, but it is using that data to understand what is happening so that we can provide advice where appropriate.
A: Victoria Pymm

One of things I would like to add is on maintaining quality of currency in rural areas. That is a real challenge, and our data shows that the quality is not as good in rural areas. What we have done in the past is have education campaigns around counterfeiting by providing information on genuine banknotes. For example, directing people to different features that exist on our current banknotes that are very difficult to counterfeit and therefore easier for people to ascertain that a note is genuine. Part of that messaging also helps with banknote quality as well because there have been occasions where particularly worn banknotes have come back to our site to be tested as a counterfeit. That shows people expect a certain level of quality from their banknotes and they will question them when they do not have that level of quality.

Q: How does RBA maintain the visibility of banknotes within remote areas?

A: Mark Onikul

Our distribution system is a wholesale system, and it is up to the banks and cash-in-transit companies to distribute banknotes around Australia. We have one prime distribution site, namely the National Banknote Site (NBS) at Craigieburn in Victoria, serving the whole of Australia. We have a contingency site, but all banknotes are issued from NBS. The cash-in-transit companies have around 60 depots in Australia. Banknotes are moved from that central location all around Australia. In one of the diagrams, I showed the flows and the interrelationships. CIT move the banknotes around. The Reserve Bank is not responsible for the retail distribution, we only work on a wholesale basis, it is up to the commercial banks and cash-in-transit companies to distribute the banknotes around Australia. That has worked really well up to now but obviously one of the things we are thinking about is the public's continuing access to banknotes. If the use of banknotes changes, we will need to be very mindful to make sure the public still has access to banknotes in an appropriate fashion.
**Q:** In what way does RBA utilize the data obtained from banknote validation or the inspection system?

**A: Victoria Pymm**

We have both G&D 1000 as well as CPS 7000, and we use the sensors on those through various means to detect the defects. We also have our note quality rewards scheme and those pistons are able to detect the defects we need to make those payments and to be able to categorize the banknotes. That world about detection and award scheme is a full seminar in and of itself so if people are interested, please feel free to reach out to me. I can put you in touch with the technical people at our banknote processing site to delve down into the details of the machines or to our analysis area, who can run through how the note quality reward scheme works. We are more than happy to have discussions about this because it is a very interesting area.
Moderator: Hernowo Koentoadji, Deputy Director at Bank Indonesia Institute, Bank Indonesia

Welcome to the second panel discussion of this webinar. In this session, we will have a discussion on the artificial intelligence in financial services. Let me introduce to all of you our distinguished speakers today. We have Mr. Yam Ki Chan. Currently, Mr. Yam Ki Chan is the Head of Government Affairs and Public Policy, Southeast Asia, and Head of Government Affairs and Public Policy, Financial Services, Asia Pacific, Google Cloud. Mr. Yam Ki Chan works with governments and stakeholders to accelerate economic growth and digital transformation across Asia. His work covers policies related to economic impact, cybersecurity, technology risk management, outsourcing, and the use of artificial intelligence and machine learning. Prior to Google, Yam Ki served as the Director at the White House National Security Council and a member of the U.S. Sherpa team for the G-20 and the G-7 in the Obama Administration. Before the White House, Yam Ki was with the U.S. Department of the Treasury’s Office of the US-China Strategic and Economic Dialogue and the Committee on Foreign Investment in the United States. Earlier in his career, Yam Ki was a technology investment banker at Jefferies in Silicon Valley.

Speaker: Yam Ki Chan, Head of Financial Services Public Policy, JAPAC, Google Cloud

Thank you so much for inviting me to share with you some of our experiences at Google and Google Cloud. It is an honor to be here and it is an honor to speak with you. Normally, I would travel to Jakarta to meet you in person but due to the current circumstances, we are all a little travel restricted so, I hope you can make do with me doing this virtually from Singapore. What I am going to do today is walk through a couple of ideas around how we think about cloud services and AI in particular.
What I am going to walk you through is a little background on what artificial intelligence is and machine learning to have a little baseline. And then, a little insight into how Google incorporates this because people talk about artificial intelligence (AI) and machine learning (ML) a lot. How is that brought into the products? And then a little sharing on how financial services could use AI and ML. Also, we will close with a couple points around the ethical questions surrounding AI and machine learning, which is something that has been in the discussion quite a lot around the world. I will then try to leave as much time as possible for Q&A and answer your questions about the use of AI and machine learning in financial services or in your context.

What is AI and Machine Learning?

When you think about artificial intelligence, we call that the science of making things smart. That is the big circle that is AI. The development of this really started in different parts, actually in the 1970s, but the advancement that we see today is really around a smaller part of that. It is what we call machine learning and it really is a subset of artificial intelligence. Not all of it, just a small part of it. It really is about training a machine to learn from data itself and to be able to solve certain types of problem. Let me give you a sense of what that looks like. Traditionally, you would ask “if then” statements in computer programing. The idea of machine learning now is essentially to provide certain input and ask the computer what is the best output. Let me try to put that into context. Think of search, something you are probably very familiar with, Google search. You may even turn to it every day. The way that somebody searches on the internet today is very different from how they may have searched a year ago, five years ago, or even 22 years ago when Google started. If you look back and think back 20 years, you may have searched on very simple terms, certain key words that you thought were there. Nowadays, we see questions that go into the search bar. Things like, what time is it today? Where do I get a vaccine? How many cases of Covid are in Jakarta, Malaysia, or wherever it may be? These are question-based questions and not keyword space. If you were to look at how things were programmed in the past, it would have been “if then” statements. If you ask A, we give you B, if you ask C, we give you D, and so on. Machine learning kind of changes that.

A way to think about this how we deal with spam detection. Many of you may be users of Gmail and there are many reasons why people use Gmail. Some of you use it because it has a lot of storage and other people use it because it is

40
good for searching through documents. But one main reason why our users like to use Gmail is because it has very little spam, you do not get a lot of spam messages in your inbox account. In your other system you may, and one reason for that is because Google applies machine learning to spam detection. In a traditional way, you may want a program: if the email contains this sort of word then you mark it as spam, if it contains this sort of word then you mark it as spam. The problem is that the spammers keep on getting smarter and keep on changing. They use different words, different techniques and different ways to try and trick the system in working around the rules. Now, there is learning from data. This is what we do, we take the computer and say here are spam emails and here are not spam emails. Computer, you come up with the model of what is considered spam instead of us programing in every potential type of spam. This is a different type of process and a different way of thinking.

There are a couple of different ways machine learning is done today. You may come into these terms, neural nets, algorithms, or statistical models and we use all of these within Google. But I want to take a little time to talk about neural nets, which is just one method, because that is where we have seen the most impact and innovation over the last five to ten years.

**Neural Network Models**

How does it work? Neural nets are a way of doing machine learning that let us provide a set of inputs though a set of mathematical neural net models, which come out with a certain set of outputs. Each one of these is a sort of statistical model on its own, every one of those circles is a type of node. Think of it like a mathematical computation in each of those circles and you are passing the input through these models to come up with an answer on the other side.

How is it actually done? Well, let us take image processing. What we would do, for example, is train the model. How do you go about doing this? You would use data, in this case a set of photos, and a set of labels to classify the data. In this case, it is in the pictures themselves. We would have the cat and a picture of a cat. The dog with a picture of the dog, a car with a picture of a car, an apple with a picture of an apple, a flower with a picture of a flower and so on. The idea is that we will train the model using a set of data. The data will then go through and it will tell what the output will look like. Ideally, it will come back with images when you ask for a particular term with a set of images that matches that or vice versa.
Once you have a model that has been trained, you will want to test the model. You want to try it out to see if it does what it is supposed to do. You take an unlabeled photo that was not part of the data training set and you send that photo through the system that is not labeled. If it works, it will come and say it is a cat. If it does not work, we will go back, add more photos, reclassify, let the model learn and do better in terms of coming out with the right answer. And you do this over time. You would do this by putting in a picture of a cat and it would come out with the word cat. Now, all the pictures of cats that you have seen so far are actually different types of cat. They are different colors and different sizes. In a traditional way, you may program that the cat has two eyes, two ears, it is about that tall, this wide and so on. But in this scenario, it does not really matter, you are not going to come up with every permutation of a cat. Instead, you are letting the computer figure out what they think a cat will look like and come out with that output. Then you will feed it another piece and it will come up and ideally it will say taxi or in this case a stop sign. It will be able to recognize that it is a stop sign. No matter what angle you take the picture from, you will be able to get to the right answer.

Within Google, we have also been using these neural nets internally at an exponential rate. It is increasing very quickly across various products. You will wonder how we are doing it and actually you may be using a lot of these products day-to-day that are already using AI. The most common example I can give you is Google Assistant, where you are asking about the time or setting an alarm that is voice based, which has a lot of AI built into it. You may also get Video recommendations in YouTube, which is AI powered. Gmail is another place where you would get a spam notification or Smart Reply options. Smart Reply is where it will give you recommended reply options at the bottom because most of the emails could probably be set in thank you, noted or something really simple and easy. Another one is Google Photos and there you can use the search function of Google Photos to identify certain pictures within your phone or your album. An example of this is this scenario. You could go into your Google Photos account and actually do a search for example, the word boat, and it will find within your library of photos things like boats. This is done without you having to label anything ahead of time, such as this is a boat or that is a car. Instead, the computer is picking a model and applying your photo to it and then applying your search to that particular question. Not only is this useful for particular things, but also for more descriptive activities and actions like hugs or dancing. Google will find images that match that term within your library.
This is also done in voice recognition. As I mentioned, in Google Assistant, someone may ask “what is the traffic like?” How do I get from here to the office? There is processing work done in terms of recognizing the voice, the signals and translating that into a query and then performing a search within the system. It may also be in a language other than English, translating that into English and doing a query from that. An example that we have been seeing significant improvements in is Google Translate. We changed the underlying algorithms within Google Translate, where if you were to use, for example, the Chinese to English on the left-hand side for those who read Chinese it is 洗手間耐力? Or Qingwen, xīshǒujiān nài lì? Which means, excuse me, where is the toilet? In the old model it would have given you, where will the restroom? Which is not the right translation. In the new model, however, it would actually translate it the right way, and we would see improvements in refining these models.

In Gmail, there is a feature known as Smart Compose. In this instance, you may see this already in your Gmail services. When you are sending an email to someone it may give you a suggestion. Usually, the first line is, hello followed by a blank spot for you to fill in the blanks for whoever you are addressing. It will give you that suggestion to help save you time from typing. It is also used in a lot of computational photography. For those of you with an Android Pixel phone, which is made by Google, on the camera app, we have done tremendous amounts of improvement. For example, when you take an underexposed picture, AI can be used to improve the quality of that picture because it is training on a series of photos that are taken just before the button is clicked. It is then able to compile those photos and use AI to guess what the image is supposed to look like so that it can then improve the lighting and colors of the photo.

You may be familiar with Google Street View. If you go to Google Maps you are able to use street view and see what the view from the ground looks like. We actually use a lot of those photos to help improve the map service itself, including improving addresses and the names of small and medium enterprises. You may wonder when you search for a small or medium enterprise how it got there. This is an example in Brazil where the street view photo was taken and the computer was able to guess with 93% confidence that this is a particular type of store named Agropecuária Galão. That is the type of store it was able to pull out the name of the business just from the photo, even though the photo is not quite clear where the language starts and ends as well as what type of characters. The computer is doing all of that on its
own. In the photos piece, you can search for not just items but even descriptions. Things like a person on a beach flying a kite and this was an actual photo that came back without labeling every single photo a priori or ahead of time.

**Machine Learning Requires Four Ingredients**

How do you actually do machine learning? How is that done? Well, you require four ingredients. First, have enough of the right kind of data to develop the training model. In the example I gave at the beginning, it was a set of photos and a set of labels associated with it if that is the type of data you are training on. For some, it may be training for Chinese and English or Bahasa Indonesia and English when doing a translation model. You need some data as well as enough of that data to be able to do the training. Then you need a set of algorithms and tools to build the model itself and that is the technology around the computations. Third, you need computer power. You need really advanced machines to actually crunch through the numbers to improve the models themselves and I will give you a little sense of what that looks like. Fourth, you need people to design and operate these models. These are people with technology skills, data skills or some business expertise to know what you are trying to solve for. Those are the four ingredients needed to have a successful machine learning program. I touched on computing here and I want to give you a sense of what we do at Google. This was such a tremendously large problem that we designed completely different types of computer chip sets to solve it, namely an advanced chip that we call a Tensor Processing Unit (TPU) instead of a central processing unit (CPU). These are tailored for machine learning and they are really good at doing very repetitive computations on modeling. We are not the only ones with these sorts of chips, there are other companies as well but this is what has allowed us to make advancements in machine learning at Google. A lot of the algorithms themselves already existed back in the 1970s and 80s. There were PhD profiles created a long time ago. What has been possible today is to take those models that were developed and put them on these advanced chip sets to operate and improve on their models, which was not possible before.

**Beyond Google**

Beyond Google products, what else can you do. It turns out that things like image recognition have implications outside of your Google photos. One of the ways that
we have used the service is something called diabetic retinopathy, which is essentially a disease from diabetes that leads to blindness. It is something that if detected early can be mitigated, but if detected late, it is irreversible and the person will go blind. It turns out that one of the ways to assess whether someone had or could be on a scale for diabetic retinopathy is to look at an image of the retina of the eye. This is because the eye retina on the veins will be able to tell you if there are certain lesions, certain lines that are not blood vessels per se but they are some form of early signs of diabetic retinopathy. What we were able to do was to train a model using a set of these retina images and the computer will come up with an assessment of whether or not that particular eye or that patient is at risk of diabetic retinopathy, which then allows the person to go see an eye doctor and a general practitioner. This is particularly important in developing markets because doctors are limited. How do you help process and help manage a large population as well as decipher who may be at risk? This is essentially the way to do it. The algorithm we developed has an accuracy of 95%, whereas an ophthalmologist on average had an accuracy or F-score of 91%. The machine system was slightly more accurate than some of the existing ophthalmologists and this was something we published in Nature Magazine as research findings.

**AI is Being Used Around the World**

That was just one example, there are other uses of artificial intelligence around the world. Some are used by doctors, farmers, local governments and environmentalists. They are used not just for translation and search ranking image processing but also solving problems in their specific domain. Some environmentalists are using AI to track illegal logging in the Amazon. It can detect the sound of a chainsaw and identify that sound separately from other types of sounds in the rainforest. They are then able to figure out the coordinates of illegal logging activity and get authorities there right away.

**How Could Financial Services Institutions use AI/ML?**

The next part of this entails diving into how we think of AI/ML in the case of financial services. This technology that Google has pioneered and really accelerated the Valoplan, how do we apply it specifically in the financial services domain? Google Cloud is the enterprise part of Google. We serve what we call enterprise customers,
it could be banks, insurance companies, capital market companies, securities firms, and so on. We also see a couple of areas where cloud and AI are particularly helpful to financial services in three broad buckets. First, to transform and modernize the customer experience through their journey with the financial services firm, while also increasing customer satisfaction at the bank to improve retention and longer-term value for the bank. How do you make sure the end customer is happier with you, how do you improve their experience? Second, providing banks and financial firms with flexible services to solve business problems quickly. How do they analyze in such a way as to improve operations that are core to running that particular institution or bank? Third, the financial institutions’ ability to detect and manage risk. This is perhaps one where we have seen a lot of interest around the use of AI because every single bank at the end of the day is a risk management institution. They are trying to figure out what types of risk, credit risk, counterparty risk, operational risk, cybersecurity risk or capital risk, they may be fighting. They are trying to use artificial intelligence to help them crunch through their numbers and have some prediction of what the future may look like.

At Google Cloud, we provide an array of AI services or machine learning services, not just one or two things, a whole suite of different options. We have very custom solutions for firms that are sophisticated. They will have machine learning scientists, AI scientists and data scientists, and what they are trying to do is build their own model. They are also trying to train up and create their own models and use services like Compute Engine or Cloud ML Engine to really build that out on their own.

On the other end of the spectrum, we have trained models as APIs. These are essentially a way for an institution to use the internet and call the model that we have developed and apply it in their context. These are like Google Translate APIs, Google Speech Recognition APIs, Google Natural Language Processing APIs, Video Intelligence APIs, Image Recognition APIs, or even Data Loss Prevention APIs to be able to detect what kind of data you have. That can all be done through APIs without very complicated programming by the institution. These are for firms that want to deploy quickly, they may not have a lot of data scientists and they may not have a lot of machine learning engineers. This is as simple as doing any sort of API call and they are trained on the models we have built.

In the middle is something a little more unique and it is really special. It is something we call AutoML and essentially, we are able to have the computer come up with a model for your specific set of data. What do I mean by that? Let us take the
context of you are a health insurance company and you specialize in clients speaking Indonesian. The existing API for translating Indonesian to English is pretty good but not that great for health-specific terms because those are unique to the healthcare world. You need that for your insurance company because you are trying to figure out how to process whether it is a dental application or heart surgery verses lung surgery. That means there are very specific terms for those. On the other hand, you do not have a lot of AI specialist. You cannot build your own custom models. Well, what we can do using AutoML is for you to provide the data and then the computer will create a special model using your data focused on what you need. Instead of the regular Indonesian to English or English to Indonesian model for language translation, we would train the model that is specific for learning medical words from English to Indonesian that you could use, and that is your model. You could then use that on your own platform, you could even monetize that and actually have other companies use it and charge them for it. Basically, AutoML can build a model specific to your particular needs.

Flexible AI Solutions

We also have a set of what we call Flexible AI Solutions. These are AI solutions that can be used across a lot of industries. I will talk a little about why they are useful for financial services, in particular around Contact Center AI and Document Understanding AI, which are two common ones we are seeing. Contact Center AI is essentially a very advanced assistant that works over the phone. This is used by a lot of financial services firms because they are getting an increased volume of phone calls from customers, whether that is individual borrowers, small and medium enterprises, or even large enterprises, especially during this time in Covid when branches may be closed, operating on different hours or they may have to ask if they are able to get an extension on their loan. They might also ask if they are able to come in on a certain day or if their loan officer is available at the bank branch they are going to. These are all legitimate questions and the banks do not have the staff to answer those calls in the midst of a crisis they were unprepared for. What Contact Center AI is able to do is to use artificial intelligence (AI) to process a lot of those conversations for them and triage and sort out answers for particular questions. Also, to really route the most complicated cases to a human specialist that may need to cater to that particular request. Simple questions like, when is the bank open, where is the branch, and so on can be sorted out by a contact AI service. As
a result, it reduces the wait time for customers at a bank, reduces the backlog and it can also help the bank improve and reskill their agents so that they are serving higher-level, higher-value requests, whether it be a new loan, new mortgage, or new borrowing as opposed to answering calls that are on the lower level of the value chain. This can also help reduce churn, namely when customer is routed through multiple different people to get an answer. Maybe a lot of that can be handled by the AI agent. That is how Contact Center AI is being deployed in some of the banks and financial services around the world.

The second piece is around the processing of documents. Banks are large producers and consumers of documents, especially in emerging markets where banks are handling applications almost all by paper. This is particularly true in areas that may not be as digitized, the process is not yet digitized, or the intake process is not yet digitized. Document AI is a tool that can help not just through character recognition but to also be able to read it, understand it and help process it for a particular use for the banking customer. Oftentimes, a lot of financial services firms, 80% of documents may be unstructured. They are not in a particular format and they may be scribbled in different ways. A lot of the writing, especially for names and addresses, is in freeform text, they are not even typed on a typewriter. Therefore, recognition is a big part of it.

Then there is the context, after you recognize it, how do you process the language, what is the natural language processing that we can apply machine learning to? How do you move the application across various processes within the bank itself? How do you manage the workflow and get to an outcome that is satisfactory for the banking customer? This is particularly true around Covid, where we are seeing a massive influx of loan applications into the bank. Customers have to apply to either get loans extended, new loans, or changes to loan terms. This is creating a lot of work for the banks and the speed of the economic recovery will depend on the banks’ ability to process that information in document form quickly.

**Responsible AI**

Before I move to questions, I wanted to close with this, how do we think about the ethics of AI? This is such a new technology and has such a way of transforming how we work as well as what the possibilities are, it is important to keep in mind that we need to think carefully about how we are going to deploy it. At Google and Google
Cloud, we have been thinking very hard on this question and we have developed a set of principles for us as a company and for our customers who are using our AI service. This has been very helpful for our financial services customers because they may not have thought about this and are looking to us for thought leadership and expertise. Maybe I will start with what we have said publicly that we will not do with AI. We will not work on applications that will cause overall harm. We will not use machine learning to develop weapons or those that can lead to direct injury to an individual. We will not develop AI applications that are aimed at surveillance that violate international norms. And we will not pursue AI applications whose purpose is to contravene international law and human rights. Those are our redline areas that we will not go into.

Where are the areas that we are trying to aim for machine learning and AI to go towards? Number one, we want to make sure that when we are using technology it is socially beneficial. That is the overall aim, we are not applying AI for AI sake. There has to be a reason why we are using it and it has to be for the benefit of society. Second is one you will want to keep in mind, especially in the case of financial services, namely to avoid creating or reinforcing unfair biases. In the case of credit application, for example, to make sure that, in the case of the United States, an African American applicant will get the same treatment as a Caucasian or Asian applicant. It is important that the model itself does not reinforce certain biases in society. Third, we want to make sure we build the AI and test for safety. How do we make sure the right safety concerns are in place? Fourth, which is an important one, machine learning is ultimately accountable to people. We want to make sure that an individual can make a decision on either the development or the deployment of the AI technology. Just because we have automated a lot the processing with a computer, it does not mean that no one is responsible. It has to be accountable to people. That is a core tenet of how we look at AI. Five, incorporate privacy design principles into the AI models themselves. Six, uphold higher standards of scientific excellence as we are developing and doing research with artificial intelligence and machine learning. And seven, make AI available for uses that accord with these principles. We want to share this AI invention and innovation but in cases that are consistent with the principles we have, not against these principles overall. Within Google, we look at AI responsibility across four major areas, namely fairness, privacy, security and explainability. How do you explain an AI model to users and potentially to regulators as well? There are some resources at the bottom that you can go to that really go into depth in each of these areas on how we look at responsible AI.
Q: As you know, predicting cash demand is challenging because of the unpredictability of macroeconomic variables and commercial banks. For us at the office, data of currency demand for a commercial bank is important to be generative in demand for currency forecasting. Commercial banks have difficulty in managing their cash demand for the need of ATM networks, thus helpful to develop advanced algorithms to accurately predict cash management for ATMs and cash flow forecasting. How will machine learning help central banks predict currency demand forecasting based on historic data and macroeconomic variables, cash management data and cash demand data from commercial bank withdrawals and seasonal conditions? Would you please explain more on artificial neural networks that are used in machine learning applications for time series forecasting?

A: Yam Ki Chan

The part on commercial banks having difficulty in managing their cash demand for the need of an ATM network. How crucial is it to develop advanced algorithms to accurately predict cash demand for each ATM and cashflow forecasting? This is up to the bank itself and how they think about this. This is something the bank is probably able to do on its own with or without AI. They probably have or they should have sufficient data around how many banknotes they are using at each one of the ATMs as well as how fast they are depleted if they are checking on it regularly. They can then match that against particular events in the calendar. Usually, right before holidays, major weekends or three-day weekends is where demand can be significantly larger. Normally, a bank would already be able to manage this. The question becomes more interesting in terms of how you try to use machine learning to forecast that or predict what that would look like and that is certainly doable. You would essentially have to design the model to include individual ATMs if that data was available, depending on how large an individual model you would want; what is the depletion rate, and then feed that into a machine learning model.
together with a time series as you mentioned around maybe dates and other things. The computer would come up with how much cash is needed. You have to match that with how much cash is being deposited at the ATM itself, which could be used for disbursement as well. Thus, you would develop a model that includes money coming out as well as money coming back into the ATM and then mapping that across the various locations and where potentially populations may be or particular large events may be. It is doable but you would definitely need a machine learning specialist to help provide that.

Q: I do believe that Google has a lot of data from their customers by developing AutoML, is it possible for Google to develop their own currency?

A: Yam Ki Chan

The second question is around data for customers and whether or not we use the data from our customers. I want to be clear that the machine learning models that Google develops are generally based on publicly available information or on data we have received the consent from the user in order to develop the model, we do not use and process customer data to develop such models. That is not what we do. I also want to be clear that there is also a difference between Google as a consumer-focused company and Google Cloud as an enterprise company. On the Google Cloud side, we make it very clear that we do not use customer data for other purposes aside from processing their data for them. Also, we do not have insights into that data, and we do not use data for advertising. On the Google Cloud side, customer data, whether that is a bank, securities firm or insurance company, that is their data. We do not do anything with that data unless they are asking something specific about that data. We do not use that data to generate models for ourselves. For models that we are developing on the consumer side, oftentimes we are using public data. An example of that would be on translation. One of the earlier iterations of Google Translate used UN documents because UN documents usually have several versions in English, French, Spanish and Chinese. They are official translations of UN documents. We were taking those public documents to develop the translation model. It turned out that those were really good for formal language or diplomatic language but not as good for health-related cases or something else. That is where we would have to go and work with other providers to understand what data they may have as public or that we can purchase to be able to do the learning itself. We
provide a lot of these. When we develop the models, we usually publish in scientific journals how it came about, where the data source is and others can usually replicate that themselves.

Q: My question is about Google's AI system, Google has made a big investment for using AI for support, particularly activities regarding the financial sector. As we know in SE Asia, including Indonesia, there is a technology gap and many people in villages do not use a smartphone or have an internet connection. What is Google’s plan to minimize this technology gap, especially in modern financial surfaces?

A: Yam Ki Chan

The third question is around villages not having smartphones and it really is a question about what we call the digital divide and that is a real issue in some emerging market countries. What we have seen in our experience is that every country’s digitalization model is different. There is no one way of doing it. How you do it in Germany, Spain or France is going to be different than in Japan and very different in Indonesia. In the case of Indonesia, what we have seen is that a bank like Bank Rakyat Indonesia (BRI) have had a huge push into financial inclusion and they used Google Cloud Services to essentially identify customers to become their agents on the ground. Those agents are the ones holding a smartphone, they are able to go into different villages and help other people who may not have a mobile device or may not be as digitally savvy to transact with the bank. That is a way of addressing that, what we call the last mile. It is where the user may not have a computing device and may not be technologically savvy. Therefore, the bank created a way where the agents are able to network and answer that demand on the far end. Again, every country, every bank and every institution will think about it differently but that I felt was an interesting solution in the case of financial inclusion in Indonesia.
Q: What are the main differences between AI and machine learning? There were a few AI being developed as a base for machine learning and programming. Please explain how to choose the best fit to suit our needs. Please also explain the status in implementing AI or machine learning for banknote and coin forecasting.

A: Yam Ki Chan

I will answer two of those questions together because they deal with data protection and data security. On the data protection piece, it is very important there are clear data protection laws. This is something we have been encouraging within Indonesia to make sure the right rules and regulations are consistent with business use but also protect the consumer and citizen as well. All the institutions, including financial services firms, must abide by these privacy rules. I also want to emphasize that the privacy rules are around the data, not necessarily where they reside, which I sometimes think people mix up. They think it is about where the data is located but it has nothing to do with that, it is around whether or not the institution has control over that data, which then brings the question around to security. This is an area where we are working to bring a lot of innovation to financial services firms to improve the overall security posture. Oftentimes, banks are sitting on a lot of legacy, or old, technology or systems that may not be patched, have not been upgraded in some time or they are simply running as they did in the past. What we are bringing to the table with the latest technology is to improve the overall posture, improve how data is handled and give the bank greater visibility and control over that data. For example, oftentimes, maybe not in Indonesia, banks may not have encryption built into the data. They may only be encrypting data sometimes but not all the time. They may only be encrypting part of the data but not all the data. We have built Google Cloud differently. From the ground up, we have built it in such a way that everything that touches Google is encrypted. It is encrypted at rest when it is in storage as well as in transit when it moves between data centers and outside of the data centers. That is built-in by default, that cannot be turned off. Not only that, all the data that comes into Google and is stored on Google Cloud is encrypted with two encryption keys.

Let me give you an example of what that looks like. Imagine a sheet of paper that you would send into the system virtually, we take that sheet of paper and shred it into 100 different pieces and then encrypt each of the strips of paper with an encryption key. That is the first piece of encryption. We then encrypt the encryption
key with a second encryption key and then store that together within the system. What does that mean? Imagine if a nefarious actor were to come in and take a hard drive, assuming they know its location. They first have to break the encryption on the hard drive, which itself is encrypted. After breaking that encryption key, they have to break two more encryption keys in order to get to one sliver of a document. They then have to go find the other ninety-nine pieces on different hard drives and break two more additional encryption keys on each of those in order to decrypt that. After that, they would have to bring all the sections together to be able to see what the whole document looks like. The time it takes to break each of these encryption keys individually is in the hundreds of years. In fact, you have to break two to get to one sliver of paper and break many of them in order to put the whole piece back together. This holds true for all the data that enters Google in terms of encryption at rest in storage. This is probably really hard to do for a lot of institutions, even sophisticated banks, which is why we are seeing many banks and financial services choosing to use cloud, or Google Cloud in particular, because they have that automatically turned on without them having to do anything. They can bring the encryption key to the story as well and have additional control around that encryption and access to that data with their own encryption key. How that brings into AI is really around the bank having the right controls around what the AI input and output looks like. Then be able to do testing on the model. In addition to building the model itself, it is important to do regular testing just like any sort of system. For example, when you put a particular input in, do you get the output that you expect? If it does not, then it is worth doing a little investigating to understand why the AI models are behaving in that way.

Then the question regarding the difference between AI and machine learning. At the very beginning of the presentation, I talked about AI as a broad category that looks at how to make things smart, whereas machine learning is a subset, a minor part of artificial intelligence. Machine learning is about the machine learning to make better decisions based on the data. That is the major difference. Outside of that, in AI the machine may be making decisions without the data or even making predictions separate from the data. Machine learning is very much focused on the data because that is what you are training the model on. Outside of that, it becomes more of a theoretical AI concept, that at the moment is fairly too theoretical and not in practice.
The question on explaining the stages of AI and machine learning for cash demand and forecasting. There are a couple of ways to think about this. For example, in manufacturing, we have a customer in South Korea called LG who makes LCD screens for TVs, monitors, etc. They use machine learning, image recognition in particular, to detect defects, problems and damages on the LCD screens and use that to improve their manufacturing process as well as triage the good LCD screens from the bad LCDs. That is what they use for manufacturing. You can envision something like that for cash management in terms of banknotes. Banknotes are fairly standard; you have different currency types along with an array of different prints of them, but they are largely standard, and you can train a machine learning model for example to recognize good banknotes verses damaged or dirty banknotes. That will be able to triage those banknotes and sort them in terms of helping to manage the physical cash flow itself. You can use AI to do any sort of readings from it, to be able to pick up serial numbers and to be able to do processing around the layout and the contours of that particular note that may be important for some reason that is needed for cash management. That is then fed into understanding how many banknotes you would get that are in good shape, what the average lifetime is of a banknote in use, how many times it comes into an ATM or how many times it comes through a central bank before you have to degrade that banknote, take it out of circulation and then issue a new one. This would be a model that they can build out and perhaps help with cash demand forecasting.

Q: Could you explain to us the big steps prior to considering AI implementation?

Q: Financial stability implications critically depend on the use of artificial intelligence and machine learning. To process this implication, what artificial intelligence and machine learning tools are being used to make specific decisions and on what timescales to address which financial functions and at what level of integration? How can economic actors, banks and central banks, implement artificial intelligence and machine learning in accordance with the conditions in the industry?
Q: AI and machine learning are being adopted for a number of purposes across the financial system. How can machine learning and artificial intelligence address problems in sentiment indicators, for example anti-money laundering, combating the financing of terrorism and fraud protection in the financial industry?

Q: Yesterday, the Bank of Australia taught us about the use data obtained by recording the serial number of currency and notes in and out of circulation to better analyze the pattern and distribution of notes. Based on your knowledge, is there a better way to analyze the demand and supply of currency notes using available data or AI models that combine serial number data, consumption data, payment patterns, etc.?

A: Yam Ki Chan

These are some great questions. Let me start with what the big step is before considering the implementation of AI. I think the first part is understanding what the business problem is you are trying to solve. Just scoping out that problem and identifying it is important before you apply any tools to it. Defining the problem clearly, defining the parameters and really scoping that out is key. That is the first piece. The second piece is understanding whether it is a problem that AI/ML can solve. Not every problem can be solved by machine learning, and you have to think about whether you have a set of data that can help understand or help address this problem. Do you know what you want to categorize and think through? Second, you need to think about whether you have the modeling expertise? Is it an image recognition model that you need, for example, or a natural language processing model? What is the problem that you are trying to solve and what is the right AI model for it? The third piece is, do you have access to the computing to develop that model? That means access to the cloud where you have almost unlimited computing power to develop and refine the model. Think of the model as just iterative regressions that get better and better and you need a lot of computing power to do that. Therefore, access to the cloud is critical. The fourth piece is the people. Do you have people with the right talent to help you deploy that model, develop that model and understand that model? If not, where can you get that support from outside of your organization or technology partners that can help solve that for you? I would think about it in those ways. The first being the question, what are you trying to solve for? You have
to know what that is. The other questions to ask yourself are, do you have the right data? Do you have the right algorithm? Do you have accessible computing power? And do you have the talent to develop it?

The second question is a great question but again machine learning is not the answer to all problems. There are very complex systems to really try to understand the macroeconomic scenarios and as an economist myself, a lot of the macro data tend to be aggregate data that are low frequency. Even high frequency data are quarterly or monthly. They are, at best, an okay predictor but they are not that great in terms of having finer controls and that is why a lot of the research in economics has been on the microeconomics side, where they are looking at data that is a little more finer control, more granular and use that as a proxy for larger macroeconomic events or questions. I think that remains the case here where you are looking for lots of data. Generally, having some micro level data will help improve the machine learning tool than a general macroeconomic type of data.

The next question asked was AI and machine learning are being adopted for a number of purposes across the financial system, how can AI and machine learning address problems in sentiment indicators, trade signals, anti-money laundering, financing of terrorism and fraud? This is an area of a lot of conversation and research, especially around anti-money laundering, financing of terrorism and fraud detection. What we know is that from speaking with a lot of financial institutions, their existing AML systems and fraud detection systems are not working. They are seeing soft negatives in the ninety and ninety-five percentile range, which means that every time they get a red flag they have to put a lot of human power to reevaluate it. Nine-and-a-half times out of ten, the system spits out a false negative where it is not a fraud situation. This slows everything down. It slows down the transactions from the customer, it slows down the processing at the bank and it uses a lot of resources. As a result, there is a lot of research being done right now on applying machine learning to the question of anti-money laundering. Instead of using a rules-based system, where for example, if you are person A, B or C, you may be committing fraud or if you have transactions that match this particular pattern, such as money over $10,000 USD or transactions that are in exact amounts every week to a specific account, you may be laundering money. These patterns that are being hard coded are not a good way to do it. What has been tried or is in the process of development is to really look at the transaction data and see whether a machine learning model can create some framework or pattern recognition of what fraud
Digitalization and Automatization of Currency Management

would be? And then give some level of confidence of whether fraud exists. Then it would apply human analysis to it. This is still in the works; we are in conversations with some institutions about that. Again, having that granular data to try to work through a fit-for-purpose for solving that particular problem. It is a bit of a research area at the moment.

The next question revolves around recording the serial numbers of currency notes in and out of circulation. Is there any better way to analyze demand and supply of currency notes? The answer is yes. This alludes to my response to an earlier question. You can use and apply machine learning to your banknotes in terms of recognizing serial numbers or other things as you are processing those. You can apply those in an AI model with other consumption data you may have as well as payment patterns. It depends on what data you have. Machine learning is applying a model to your data, so it is around what data you have as an organization. Do you have data around the serial numbers and where they are circulating? Do you have data consumption data that you can apply? Do you have a particular payment patterns that you want to feed into the model? The model can then attempt to give you an estimate depending on if you are measuring supply and demand and what that would look like. You can ask the model a question to do the prediction part. If we were to see an extra day of holiday, what additional demand on the currency might that have? That would be something you would be able to ask.

Q: Currently, AI continues to be integrated slowly into our daily lives, especially through personal banking. What kind of strategy do you think is most appropriate and approachable for Indonesian banks, while educating the differences in technological know-how amongst Indonesians as well as addressing the difficulties associated with accessing this technology for them to have collaboration between their banking programs and customers? Also, taking advantage of AI/ML without neglecting the safety and security of the customer data?

Q: The Customer Management Department has a lot of data that is scattered but we would like to make it structured to be accessed in real time. How can we utilize AI and what are the initial steps to help prepare for this change?
A: Yam Ki Chan

The first question is a great question, I think there is a lot of work that Indonesian banks can do right now in terms of digitalization. We are seeing what we call native companies moving into financial services as well as some banks being built on a cloud now. We are also seeing traditional banks making that transition and leveraging more cloud services, including AI. I think the strategy for them will be different for each of the categories, but it is important that as they are designing the machine learning model to have safety and security in mind. Some of the principles that I laid out earlier in the presentation touched on that and we provide resources to our customers in terms of how to deal with anonymization or de-masking before you do the training of the model in some way. Applying the model only to certain types of data where we know it is appropriate or maybe only in a particular context. There is no easy answer. It is about the particular use case, namely how a particular bank is applying the AI model to a particular function. Therefore, the level of scrutiny is different depending on what that function is. In terms of a bank that is using AI to improve its marketing, for example, the scrutiny may not need to be that high because it is around external marketing or improving and selling particular products to customers. On the other hand, if the bank is developing a credit risk model and this is where credit decisions are being made, there should be closer scrutiny and conservation on how the model works, what are the expected specifications for the range of outputs and then really testing the model itself to see if it behaves as it is meant to.

The next question is about the currency management department and its scattered data. That is a great question. This is what we are seeing in a lot of not only banks but also in government institutions. A lot of government institutions are in different silos and even in one particular grouping, there could be different silos across the different departments in a particular institution. There are a couple of ways to address this. Traditionally, the answer has been to take everything and put it all in one place but this is not necessary. There are technologies that can essentially use an API that will link that database or set of data into a datalink. We have a datalink service called BigQuery within Google Cloud where you can feed different types of data into it, structured or unstructured, and then process that data using the computing power at Google Cloud to help make sense of it as well as help analyze it. This is a simple system that can process petabytes of data in seconds. This is not your average type of computer; it can really do a lot of high intensity and large data
processing in real-time. There are also services that can link in real-time data into the database, which are called Cloud Pub/Sub (publishing and subscriptions). For example, you can imagine a scenario where there may be ATMs around the city and those are providing a real readout on how many banknotes are being disbursed or deposited. That data can flow into a database for the bank to process in some way. I think it is around understanding what kind of data you are looking to consolidate. You do not have to change existing datasets, but you want to figure out how to bring that into our datalink. A tool like BigQuery can help with that while also feeding in real-time data as well.

I just want to close with thanking you so much for joining this session and making yourselves available. I know how important your day is and I hope I was able to give you a little bit of a glimpse on what the latest around machine learning looks like. I not only wanted to share on how we apply it within Google but also how some of the financial services firms are using AI in the cloud, particularly around the contact center and document AI processing. Those are just some examples of that.
Moderator: Rini Kusumastuti, Deputy Director at Risk Management Department, Bank Indonesia

Thank you for being here on the third day of the flagship webinar organized by Bank Indonesia Institute. And this session we will have the session regarding Bank Indonesia experience mitigating covid-19 through Command Center of currency management. As you all know this yet unfortunately, we witnessed unprecedented Covid-19 Pandemic with cases are still the right thing at the moment. In response to this, which has triggered the National Economic Recovery program under government coordination, Bank Indonesia has three developed three key strategies by strengthening policies mix including monetary, macro-prudential, and payment system policy, strengthening policy coordination particularing with the government in this recovery program and strengthening International institutional framework and business operations. Regarding payment system policy, Bank Indonesia has put a lot of effort to maintain the smooth and reliable payment system to support quick national economic recovery both by promoting a digital payment and also hygienic money circulation under currency management operational activities. Today, we will focus on how Bank Indonesia uses the Command Center as one of effective tools to control the currency management operational activities including coordinating various policies implementation to mitigate impacts due to covid-19. Today, we have Mr. Yudi Harymukti, Director in the Currency Management Department in Bank Indonesia. Mr Yudi is a prominent Central Banker who has 16 years of experience in the currency management area and currently is responsible for Currency Management Department policy.
**Speaker: Yudi Harymukti, Director at Currency Management Department, Bank Indonesia**

I will share my experience on how we are mitigating Covid-19 in our currency management operation. Also, we would like to highlight how we utilize information system development as well as digitalization to improve our policymaking as a means of providing the highest quality products and services to the community or public.

**Indonesia at a Glance**

For those of you that are new to Indonesia, we are the largest archipelago in the world with over 17,845 islands, 34 provinces, 98 cities and a width of 5,120km, similar to Europe. Indonesia has a population of approximately 265 million, making us the fourth largest population in the world. In 2018, we ranked 46th in the Infrastructure Performance Index. As of Q2/2020, economic indicators contracted -5.32% in our economy although we do hope and expect a better future for Q3 and Q4. Deflation in August stood at 0.05% (mtm) or inflation of 1.32% (yoy) annually, which is currently stable and under control. Regarding the currency management distribution network, we have 45 representative offices and 94 cash custodies in cities without representative offices. Recent statistics also show that the currency in circulation itself since Q3 2020 is Rp762 trillion, equivalent to USD52.8 billion (20.8 billion banknotes), with growth of 4.6% (ytd) as of Q3/2020. I will explain the growth of currency in circulation in the next slide. Given this demographical situation, currency distribution is very challenging. As Indonesians, we can say we are still a very cash society, referring to some parameters that I mentioned before, but again, distribution is very challenging to us, especially when it comes to fulfilling the public’s needs in remote areas and maintain the quality of banknotes in circulation.

**Currency Management in Indonesia**

Bank Indonesia is the only authority mandated to manage the currency in accordance with Act No. 7/2011 regarding Currency. In our vision, we have to ensure the availability of Rupiah currency that is fit for circulation throughout the Republic of Indonesia as a manifestation of the country’s sovereignty. The reason why this sovereignty issue is emphasized in the vision is because we still have some issues with the use of foreign currency in some provinces and islands. We also have six business processes in our currency management, as stipulated in the Currency Act,
Digitalization and Automatization of Currency Management

namely planning, printing, issuance, distribution, revocation and withdrawal as well as destruction at the end of the banknote’s lifecycle. In accordance with this act, I will explain how we conduct these business processes compared with other central banks in other regions around the world.

Currency Management Stages

Our currency management stages include planning, printing, issuance, distribution as well as revocation and withdrawal. In the end, there is destruction. In general, this whole process is highly controlled by our central bank, where planning, printing and issuance are fully controlled. The printing is done by a state-owned enterprise. After the money is printed, we issue the money and distribute it throughout our distribution network. We partially delegate but still highly control the process. We utilize banks to distribute money to the public through ATMs and bank tellers. We also provide some direct cash services to the public, such as mobile cash services, exchange of damaged notes, and we also utilize and maximize cash custody. In addition, we also cooperate with commercial banks in cities and regions where we do not have a representative present. Additionally, we offer services at our 46 Bank Indonesia Representative Offices where people can exchange their damaged notes and authenticate to see if their banknotes are genuine. We then begin revocation and withdrawal of certain denominations or counterfeit notes. In the end, we destroy unfit currency and revoked currency to maintain better quality within society. Although we are in almost full control of the business process, we continue to review policies according to the policies of the government and central bank.

Current Currency Distribution Network

Carrying out its mandate, Bank Indonesia distributes currency throughout the archipelago utilizing all transportation modes given the geographical and demographical challenges we face. We use land transport and ships, including cargo and passenger ships. We also use trains as well as aircrafts under certain conditions. In a year, we typically carry out this distribution effort over 150 times throughout the country. Besides our representative offices and cash custody with the banks, we also have a program (BI Jangkau) which aims to expand the range of our distribution and cash services to reach rural areas, where it is quite difficult to get money in sufficient amounts and of good quality. By utilizing the banks’ distribution networks, we can
collect unfit money from the public and at the same time we can distribute new, fresh or fit money back into the public to keep the quality in good condition.

**Currency in Circulation**

I would like to highlight some figures of our currency in circulation. Despite rapid development of non-cash payment instruments along with digitalization, we can see currency in circulation is still growing positively at 4.6% (ytd) even though the annual growth has declined slightly over the past five years. Growth of currency in circulation is 8.5% this year but during the same timespan the growth of inflow and outflow have decreased as a result of the pandemic. You can see from the figures that Indonesia is a cash society despite rapid development of the payment system and digitalization. Maybe this is due to the fact that information system infrastructure and noncash payment infrastructure are not widely available throughout the country. They are only available in big cities and specific areas. We can also see the unbanked population is above 60%, which is a big reason why cash still plays a very important role in our daily economic transactions.

**Development of Covid-19 in Indonesia**

I will tell you how Covid-19 has impacted our cash management operations. I will start with the statistics from 12th October 2020. At that time, we had over 336,000 confirmed cases and sadly almost 12,000 deaths, placing Indonesia in 21st position in the world in terms of having the highest Covid-19 community transmissions, which was quite dangerous. These figures have been increasing ever since the first cases were officially declared by the Government at the beginning of March. Most cases were reported in the Special Capital Region of Jakarta, followed by other highly populated provinces throughout Java, as well as South Sulawesi.

**Covid-19 Impact on Currency Management Operations**

How has Covid-19 impacted our currency management operations and what mitigation measures have been taken? First, I would like to emphasize that the pandemic impacted not only the economic environment (economic growth) and businesses but also our central bank operations. In fact, currency management was one of the most affected operations because we serve the public directly. One of
the main issues we faced within society was the safety of using cash. There were health issues concerning cash, namely the fear of exchanging banknotes and coins, the fear that the virus is spread though the handling of money. Currently, there are debates on whether cash or money has the highest rate of transmission. Some argue money or cash is just as dangerous as any other common items, such as door handles, shopping carts, mobile phones, credit cards and so on. This impact also comes with operational impacts, such as cash distribution, cash services and cash processing. This directly affects our mission to provide currency throughout the country in sufficient amounts, right denominations, good condition and in a timely manner. The main issue in cash distribution are the large-scale social restrictions, or half-lockdown policy, implemented by the Government, which resulted in closures and lack of access to some areas. This also affected the availability of different transportation modes throughout the country, which raised distribution costs. For cash services, there was a limited number of human resources available as a result of physical distancing and work-from-home policy. Again, there were limited cash services due to the large-scale social restrictions as well as closure to offices in selected areas. In cash processing, there were issues around health considerations when working in a cash processing work environment. Additionally, there was an increase in backlogs due to insufficient human resources to do the operations.

Currency Management Command Center

The main responsibility of our Command Center is ensuring cash availability and sufficiency throughout Indonesia, a task which is very easy to say but in fact quite difficult to fulfill because of the geographical and demographical conditions and now Covid-19 issues, which we are still facing today. To tackle the Covid-19 issues regarding public reluctance and the operational aspects, it is important to know the role of the Currency Management Command Center besides the main responsibilities. One of those things we do is policy implementation monitoring to ensure that our policy at head office is implemented by all cash representative offices in the country. We also have early warning monitoring, where all problems and prospective issues are detected early in order to take the necessary measures or policy actions to address the problem. We also act as a business solver and center of information. This is quite operational but when the cash offices throughout the country have issues with human resources, a lack of people, problems with capacity in the vault, problems with the cash they have to hold to accommodate certain holidays, such
as Eid ul-Fitr or Christmas, or problems with machines, we act as a business solver and center of information for all of the offices. Importantly, we also give feedback for the policymaking of our department by ensuring all information we gather is also available for the improvement of policymaking to tackle the problems. In this context, the most important role of the Command Center is crisis control. This is especially true when we are facing a pandemic like this or other disasters that affect our country, such as earthquakes, tsunamis, floods or riots. These five functions will provide outcomes that maintain public confidence in using cash because cash plays an important function within our economy. We ensure the availability of cash and efficiency. With these measures comes health and safety in cash operations to make sure the public feels safe when using cash.

**Role of Command Center in Mitigating Covid-19**

Here are some of the ways to help the public remain confident in cash. As I mentioned before, public reluctancy to use cash due to the fear of Covid-19 still exists. Some feel that any virus, including Covid-19, can live on banknotes and banknotes are frequently exchanged between hands throughout the public. One of the ways we assure the public the money is safe to use is by applying Covid-19 protocols, namely to maintain the hygiene of cash infrastructure. We disinfect all our machines and infrastructure, including working areas, any equipment our employees use, and we also use personal protection equipment (PPE), such as face masks, gloves, face shields and hand sanitizer in all of our daily operations. We also provide guidance for protocol implementation in banks and CIT, which help the banks in their daily operations. Additionally, we also conduct regular rapid tests for all our employees and keep a medical practitioner on standby if needed. In spite of some debates regarding Covid-19 transmission through banknotes, just two weeks after people were beginning to get infected by the virus in the middle of March, we implemented money quarantine to assure society that our money was safe before being redistributed back into the public and the banks.

The most important aspect to mention, other than the policy and quarantine of the money, is public communication, which plays a critical role. We communicate our policies to the public through various communication channels, including our website, social media, print media and others. We do this in conjunction with the banking industry. On the policy side, we published guidelines for new normal operations on how banks should conduct their cash services to their customers and the public. We tested cash processing protocols conducted by banks, CIT companies
and protocols on cash activities carried out by banks and CIT when they operate outside their premises.

**Money Quarantine Benchmark**

With all these measures taken, we can finally assure the public and society that cash use is still safe. In terms of the money quarantine or cash quarantine process, we did some benchmarking with central banks in the region and around the world to get the best practices from them. We also communicated and consulted with research institutions, such as the Eijkman Institute, which teaches molecular biology and biotechnology in Jakarta, Indonesia. We also studied some literature on Neeltje van Doremalen and Del La Rue Report 2020. The quarantine policy originally required a 14-day quarantine for our money. Instead of debating, we accepted this policy because the incubation period was 14 days. At that time, along with other central banks, like Bangko Sentral ng Pilipinas (BSP), Bank of Thailand, Bank of Korea and Hungary’s National Bank (MNB), we implemented the 14-day quarantine. But during that time, we evaluated these policies as well as the number of backlogs that increased in our cash processing, along with the consultations and research by others. We also saw that some central banks quarantined their money for between 7 and 14 days, such as the US Federal Reserve. In highly affected areas, the Peoples Bank of China (PBOC) quarantined the money for 14 days but only 7 days for less affected areas. We also saw that some banks did not declare quarantine, such as Bank of Japan, Monetary Authority of Singapore (MAS), Bank of England, Bundesbank, Bank of Canada and the South African Reserve Bank (SARB). We also read an article from the Daily Telegraph in 2020 saying that cash has the same risks as other things that we touch in our daily lives, such as our mobile phone, our glasses, elevator buttons, door handles and so on. This is why on 15th July we revised our policy to seven days based on our confidence that it does not matter how long you keep the money in your vault before it is redistributed to the public but rather how we take protective measures, such as washing hands regularly, especially before eating, not touching your face, wearing a mask and keeping your distance from other people.

**Maintaining an Effective Cash Distribution Operation**

In terms of the issues affecting the cash distribution operation and our mission to provide available and sufficient amounts of money throughout the country, what
we do first is implement our front-loading strategy. Based on our normal delivery schedule in certain offices and areas, we would only have to deliver a certain amount of money, but we will double or triple that amount in case there is an emergency to ensure there is already a sufficient amount in the region. Relating to this, we also have to adjust our schedule, our modes and routes of transportation due to closures of certain areas, lockdowns in provinces and also the availability of transportation modes. Also, it can be dangerous to use cargo or passenger ships because clusters of Covid contamination on ships is quite high. For instance, sometimes during Christmas and Eid ul-Fitr, we use chartered flights/planes to deliver the money to certain areas. We ask commercial banks and CIT companies to ensure they have sufficient amounts of cash as well as provide sufficient amounts of cash though their networks (branch/ATMs). Together with that, we issue policy guidelines for money distribution as a reference for incidental cash services to avoid Covid transmission. Most importantly, we publish policy implementation guidelines for cash services under new normal operations. As mentioned earlier, all the activities are performed in the banks, commercial banks or CIT companies.

Some of you may already know we celebrate our Independence Day in August, which is when we also launched a commemorative banknote for our 75th Anniversary of Indonesian Independence. Maintaining the availability of cash services during the pandemic is not an easy job but due to several policies that we have implemented we can still conduct the job successfully.

**Maintaining Availability of Cash Services**

The last issue is on how we can tackle the impact of Covid in our cash services. This is important because there are a finite number of human resources, therefore, we reduce our service level of cash services, and the large-scale social restrictions implemented by the Government also impacted our ability to provide the services. What we did to tackle this situation was first implemented a split operation at an alternate location. For instance, for our head office we have an alternate location in Cilangkap only 30 kilometers from Jakarta. They are continuously on standby 365 days a year due to some safety concerns, such as demonstrations around our offices. As some of you know, one of Bank Indonesia’s office locations is less than 1km away from the Presidential Office, which is a popular spot for demonstrators to protest. During this pandemic situation, where we face the possibility of having to evacuate the premises, we use the alternate location as well as requesting the 45
Digitalization and Automatization of Currency Management

Cash offices throughout the country to also serve the banks from alternate locations. Second, we are also optimizing our service operating hours to reduce the frequency of meeting between the banks’ people and our people. We have also established a special task force at our head office. The special task force is always on standby to be deployed to any area or any office in the country that cannot operate in a normal mode. Recently, we deployed 20% of our personnel as a task force. As a precautionary measure, we have also divided the cash services division into two teams, who never come into contact with each other. If something were to happen to one of the teams, the other team would still be available for servicing as well as normal operations as a Business Continuity Plan (BCP). Lastly, we adjusted our cash custody limit by adding additional cash into our cash custody, so we are prepared for a worst-case scenario in each area. Of course, we follow certain guidelines when implementing this.

Maintaining Effective Cash Processing

We are continuing to strengthen our occupational health and safety aspects, not only for people at Bank Indonesia, the banking industry and cash-in-transit companies, but we also regulate how the public or people who visit our banks or the central bank implement safety protocols when they are dealing with us. We also adjusted the withdrawal and deposit policies to reduce the frequency of people coming from the banks or CITs to our offices. This next one is important too. We tackle the backlog’s burden sharing to ensure that offices facing issues will be helped by offices with fewer issues or sufficiently adequate capacity in terms of people. This way, offices will not have any backlogs of over 30 days, which is the normal standard.

Currency Management Digitalization

In accordance with the currency management framework towards Bank Indonesia’s 2025 Blueprint, which was already mentioned by our Deputy Governor, Bank Indonesia continues to utilize innovation, information technology and digitalization. Our currency management has three key elements to help us towards the 2025 goal, namely centralized distribution, digitalization and automation, as well as improving efficiency in our business processes. Digitalization and automation of currency management is a new trend bringing efficiency and effectiveness to improve policymaking and create better services for society. In terms of automation, we are
in the process of upgrading our cash infrastructure at all 45 branches with the latest technology.

I will go into detail about how we utilize digitalization throughout our entire business processes. This includes everything from planning to printing, issuing and distribution to destruction. In the near future, Bank Indonesia will utilize big data for currency management and omni-experience platform technology that utilizes data from internal sources, such as the information systems we already have in place. Systems like our Enterprise Data Warehouse (EDW), Human Resource Information System (HRIS), BISILK, which is our cash services information system for the banks, and also Bank Indonesia’s Counterfeit Analysis Center (BICAC), as well as from external sources and stakeholders, including the Ministry of Finance, printing works, shipping companies, railway companies, Ministry of Social Welfare, and also from institutions like the Census and Economic Information Center (CEIC). This information from inside and outside the organization will be utilized in our digitalization space and I can mention some examples. For planning, we did a currency demand forecast with some macroeconomic models in cooperation with our macroeconomic policy department, using time series analysis. For forecasting money demand and infrastructures, we use our digital forecasting as well as digital currency design for designing all of our banknotes and coins. Additionally, our state printing company also utilizes digital quality assurance via the banknote inspection system throughout all production lines. The digital production planning and inventory control (PPIC) using Enterprise Resource Planning (ERP) is already host-to-host with our own ERP at Bank Indonesia. Recently, we started using serial number reading and barcode scanning.

For issuance, we use project management tools to make sure issuance is in accordance with the needs of the public and economy. We also utilize our ERP-Inventory Management and also our Warehouse Management System (WMS). We keep the metadata of banknote specimens. For distribution, in the near future, we will be able to implement the core banking system (CBS) for cash management and provide e-banking services to banks and CIT companies. We then have serial number reading, cash distribution forecasting, ERP–Inventory and Warehouse Management System (WMS), and a BI Counterfeit Analysis Center supported by a central bank in Europe. We have a Cash Services Application and a tracking system to ensure all our infrastructure and mobile vehicles that deliver money to the country and can be monitored from our command center. All this innovation provided by the systems would be accessible from our Currency Management Command Center. We are
sure digitalization will give us the capabilities to generate reports, predictions, policy recommendations, early warning system alerts, decisions and repository. Therefore, digitalization enables real-time currency management, tracked and traced, to support research-based policymaking or decision-making in our department. This also answers one of the questions from our colleagues from the Ministry of Foreign Affairs in the first session on how regulators and central banks should respond to the digitalization and automation of currency management. We believe the central bank, especially the currency management department, should benefit from digitalization to improve the quality of products and services we provide to society. In the development of the non-cash payment system, we hope it will continue to grow rapidly. As long as people are still using cash, we will do our best to ensure digitalization and automation will continue to provide the best products and services.
Moderator: Thank you for your clear and comprehensive presentation regarding Bank Indonesia’s mitigation measures for the impact of Covid-19, especially in currency management using a command center. I would like to go over a few important points you made in your presentation regarding Indonesia’s demographic complexity during this pandemic. It has affected money distribution quite significantly causing people to be reluctant towards the use of cash. This has decreased our distribution capabilities, our service level, as well as our cash processing capacity. However, Bank of Indonesia is always on standby and ready to mitigate these types of issues. You also mentioned we have split operations and optimization of service operating hours. We also have a special task force to ensure money is available and of good quality. We also have a technology-based command center, which is constantly being developed and enhanced through digitalization and automation, in particular, early warning, policy implementation monitoring, business solver and center of information, policy feedback and most importantly, crisis control.

Q: Due to the prevalent cash society in Indonesia, how can we reach the cashless society target, especially to maximize cashless usage at traditional markets in Indonesia?

A: Yudi Harymukti

This question would be hard for me to answer since I do not have the authority to answer it. Just for your information, we are promoting Quick Response Code Indonesia Standard (QRIS) and expanding acceptance amongst merchants and the public as a cashless payment. QR is easy, fast and a very safe transaction. We expect it to be accessible to the public across all demographics. At the same time, we are developing the infrastructure and penetrating different parts of the economy, such as sellers in the wet market or those who are selling food in the street. Bank Indonesia will utilize this penetration to expand the use of QRIS to all of Indonesia. Again, that is the best answer I can give because I do not have the authority to answer it. It could be answered better by my colleagues in the Payment System Policy Department.
Q: In the early 2000s, Jambi University conducted research in conjunction with Bank Indonesia Jambi, which found business players, from big to small, had difficulty to accept coins for payment transactions. At the end of 2019, they conducted the same research and the findings were no different than 20 years ago. What is your view on this phenomenon?

A: Yudi Harymukti

This is a very interesting question. Coin issues or problems not only occur in Indonesia, but I believe they happen around the world to some extent. We know that coins in general have very low value but it is very difficult and not economical to only use notes for all denominations. Various studies have shown that at a certain point, coins become more efficient than notes but a country should be using notes to achieve the highest value for the economy as well as the currency department who prints the money. We faced some coin shortages during Covid and other periods. One of the main issues all countries face is that people tend to hoard coins. They keep coins in their homes, drawers, cars and so on and this causes a recirculation problem. It keeps flowing out of the central bank, but does not return. We continue to mint coins even though they are hardly used in transactions. In certain parts of Indonesia, however, coins are still used a lot for transactions to buy goods, pay parking, donate to charity or give a tip.

Most importantly, the absence of coins will cause a very high cost to our economy because when a certain type of denomination, such as a 100 Rupiah or 500 Rupiah coins are not available in the economy, the economic actors, like sellers or companies, run up prices that raise the price level or inflation. We feel it is our obligation to always ensure that coins remain available to the public. To minimize or optimize the printing cost together with society and retail associations, we make certain that the circulation runs seamlessly so we do not have to mint so many coins every year together with non-cash payment activities, like coin machines that allow people to exchange coins for a voucher or e-money. In this way, we also promote a less cash payment system. More importantly, we are encouraging retailers to accept coins because they are still needed for exchange and retailers, such as Alfamart or Indomart, are growing very rapidly with a target of 1,000 outlets opening every year, so we can see 4-5 outlets on the same street and they are also the biggest users of coins. Other than providing coins, we also have to take action to reduce demand for coins by encouraging people to use cashless instruments.
Q: What determines how much money supply is printed and circulated?

A: Yudi Harymukti

Bank Indonesia does not print or circulate currency without very robust and thorough planning. Therefore, to determine currency demand to support economic activities we take two approaches. First, we use a top-down approach where we use macroeconomic models (error correction models) developed by our colleagues in our macroeconomic department to capture the aggregate demand in the economy for cash. On the other hand, we also use a bottom-up approach because the top-down method using a macroeconomic approach only captures aggregate demand, it does not capture the denominations or special requirements for each region in the country. In other words, it only captures the additional money or cash that we have to supply overall to the market or economy. To address these issues, we use a bottom-up approach (decomposition) and we have been keeping the data collected since 2003 regarding outflow and inflow. Outflow is money coming out of Bank Indonesia into the economy, public or banks. Inflow is the money being returned from the economy, public or banks to Bank Indonesia. We keep that data, we do some calculations using Excel as well as other tools to create a composition and predict the needs for each denomination in every region in the country.

We also use the numbers and figures produced by the macroeconomic models (ECM) as a benchmark or anchor. If our calculations or predictions regarding demand for currency by denomination in every region are in the range of aggregate demand from the macroeconomic models, we can be very sure the figures can accurately capture the needs of the economy as a whole. That is how we calculate the needs for cash or currency to facilitate economic transactions. In terms of printing, after we get the figures of currency demand, we decide the minimal level of cash to stock based on inventory, computations and forecasting.
Q: What is the jurisdiction of the Command Center and how does the Command Center report to the board?

A: Yudi Harymukti

I already explained the function and the role of the Command Center in great detail through my slides. We have the role of policy implementation monitoring to ensure our policies are implemented by all the cash offices around the country and then we implement an early warning function to ensure that all problems at every cash center are resolved immediately and properly. We act as a business solver and center of information for all the parties involved, not only for our cash offices but for the industry and banks as required. We also provide policy feedback to improve our policymaking process based on our findings and from monitoring the processes. During the pandemic and other crises, we act as a crisis control center to ensure the public remains confident in cash and to achieve our main mission, namely to keep cash available in every region. We also want to ensure public health and safety in cash operations throughout the country.

In terms of reporting to the board, we have a weekly board report that the risk-management department together with other operational departments submits, including our Command Center. In the board meeting, we usually report cash availability, how our cash operations are doing, how we are tackling issues, considerations, limitations of services, limitations of our distribution channels and so on. We also report the policies or actions we take to resolve any situation.

Q: Due to new research coming out from Australia, have you considered a longer quarantine period?

A: Yudi Harymukti

Like I already mentioned earlier, we believe it is not a matter of how long we keep the notes in quarantine. The important thing is that we educate people to ensure all the operational equipment and procedures are done based on occupational health and safety guidelines to mitigate the risks associated with the virus.
Q: Are you rethinking your planned settings for the cash center as a consequence of the lessons learned from Covid?

A: Yudi Harymukti

Our new cash center is still being refined to ensure the sustainability of Bank Indonesia’s cash management operations. The reason for this is because the location of our head office is very close to the Presidential Office, thus a high-risk area when there are safety concerns, such as protests, lockdowns or some type of demonstration. This is why we are looking for an alternative location. Also, our capacity here is already overloaded, so we have to find bigger and better locations. Lastly, it is not possible for us to move and develop a new cash center without utilizing the latest state-of-the-art technology and digitalization in every aspect of our business processes.

Q: Related to money circulation and printing, how is Bank Indonesia calculating the need for new money for Eid-ul-Fitr in each region’s representative office during the pandemic?

A: Yudi Harymukti

We have two approaches (ECM) using our macroeconomic models, with variables such as economic growth, as the main parameter or contributor, inflation, exchange rates and interest rate, which affects the supply and demand of money. From our decomposition approach, known as bottom-up, the requirements or needs during specific periods, such as Eid-ul-Fitr, Christmas or Ramadan, even events such as the general election, are all captured in our macroeconomic models. That means we capture the seasonality and trends that happen. This is all captured in our macroeconomic models and statistical models, which has the outflow and the inflow of the currency. Once captured, we make appropriate calculations to ensure that all needs during all periods are fulfilled sufficiently.
Q: Recently, Bank Indonesia published regulations amending the implementation of several provisions as a result of the pandemic. How is that affecting currency management and distribution as well as demand for cash?

A: Yudi Harymukti

This regulation was issued by the central bank to streamline the licensing process, reduce the reports submitted by commercial banks, reassure the public through communication and correspondence with BI, and especially how to mitigate the impact of Covid on aspects of currency management. With these goals, I believe the regulations help to improve the quality of our services to the public and banking industry. This regulation will help us maintain public confidence in cash. It also provides guidance for all parties involved in the industry to conduct their operations efficiently, safely and effectively during these restricted conditions.

Q: Last question regarding the cash transfer system from head office or representative office to the currency custodians. Could you elaborate more on that and what about the insurance policy for currency theft and loss from natural calamities. Also, have you found any incidents where the coronavirus was transferred through a cash transaction?

A: Yudi Harymukti

We distribute cash from our vault to our custodian banks and cash offices throughout the country using our distribution vehicles along with a police escort to ensure safe delivery. This procedure applies to all distribution activities. To avoid loss from theft we ask the custodian banks to meet certain security standards in terms of their vault infrastructure. All cash is fully insured, with the insurance cost borne by Bank Indonesia. We also provide incentives to the custodian banks. When they do the cash processing, especially for unfit notes, we give them an incentive because the purpose of setting the cash custody is to make the cash available in regional areas without a representative. This also ensures that unfit money is returned immediately to the central bank.

The answer to the last question on finding any evidence for the transmission of coronavirus through currency use is no. There has been no direct link discovered. Like I said earlier, we know protocols like washing hands, wearing a mask, and social
distancing prevent the spread of coronavirus. Most Covid cases are linked back to social activities, such as eating in restaurants, gathering with friends or family, going to hospital without a mask, not washing your hands and so on. It is possible to get coronavirus through handling money but the same is true for doorknobs, windows, handheld devices, computers and everything else in our daily lives. There are certain things people need in their daily lives and cash is one of them. If any of you have any questions please feel free to email me, I am happy to answer your questions. Thank you.