United Nations | Department of Economic and Social Affairs

ESCAP Economic and Social Commission for Asia and the Pacific

GLOBAL TOOLKIT ON REGULATORY SANDBOX FOR CENTRAL BANK DIGITAL CURRENCY AND FINTECH

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The ESCAP secretariat supports inclusive, resilient and sustainable development in the region by generating action-oriented knowledge, and by providing technical assistance and capacity-building services in support of national development objectives, regional agreements and the implementation of the 2030 Agenda for Sustainable Development. ESCAP also provides support to partners at the national level. ESCAP's national offer is rooted in and linked with the implementation of global and regional intergovernmental frameworks, agreements, and other instruments.

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Glossary of Terms

Term	Definition
AML/CFT or AMLT	Measures for Anti Money Laundering and Countering the Financing of Terrorism
API	Application Programming Interface – a connection between systems that allows one system to communicate with another via request-response dialogues
ASEAN	The Association of South East Asian Nations – an economic community of 10 countries in South East Asia
BIS	Bank for International Settlements, located in Basel, Switzerland is the forum used by Central Banks for agreeing standards. The payment standards body in BIS is known as CPMI – Committee on Payments and Market Infrastructures
Blockchain	Term used to describe a particular type of Distributed Ledger Technology (DLT), in which the transaction ledger for a system is created step by step as a series of "blocks" by a cryptographic process, so that the ledger is shared and validated by participants rather than one central authority. Blockchains used for CBDCs, however are usually under Central Bank governance, with access limited by permissions granted to specific financial organizations
Caricom	Caribbean Community – an economic co-operation arrangement between the Caribbean countries
CBDC	Central Bank Digital Currency – a digital currency issued and redeemed by a Central Bank, which may or may not use blockchain infrastructure
CBoB	Central Bank of the Bahamas
CFTC	The US Commodities and Futures Trading Commission – the US Regulator for the commodities trading industry
crypto-asset	A digital token representing an asset with a value whose ownership and transactions in which it has been involved is recorded on a blockchain database, which may also contain, in 'smart contracts' the instructions and rules for how the asset can be transferred or otherwise used or manipulated. Such assets may include cryptocurrencies, CBDCs, securities (potentially equities and bonds) and Non-Fungible Tokens' (NFTs), such as unique title documents and works of art

DApp	A computer application hosted in each node of a blockchain
DLT	Distributed Ledger Technology – see Blockchain
Dollarization	The extent of use of the USD for domestic transactions and savings
DvP	Delvert versus Payment – methods to ensure that when a transaction to sell an asset take place, the transfer of ownership title for the asset takes place virtually simultaneously with the funds transfer for payment, protecting both the buyer and the seller.
ECB	The European Central Bank
ECCB	Eastern Caribbean Central Bank
ERC	The label for the set of technical standards used to define digital tokens based on Ethereum protocols
ESCAP	The United Nations Economic and Social Commission for Asia and the Pacific
Ethereum	The second largest cryptocurrency blockchain (after bitcoin), developed to provide a means for any organization to develop blockchain applications. Smart contracts were invented to support programmability on the Ethereum blockchain and are now widely used in the crypto-markets and for CBDC experimentation
e-wallet	A software facility that enables customers to keep cryptocurrencies or CBDCs – effectively a financial account
FCA	The UK Financial Conduct Authority
FinTech	Financial Technology company providing on-line financial services products that compete with the traditional banking sector
Financial Inclusion	The proportion of the population holding accounts with banks and other licensed financial institutions
FMI	Financial Market Infrastructure – a national payment system
FSB	The Financial Stability Board - an international body that monitors and makes recommendations about the global financial system under the auspices of the G20
Grey Economy	Economic activity not recorded by the authorities because it is conducted in cash
ICT	Information and Communications Technology – and the related Department of a Central Bank or Commercial Bank
IMF	International Monetary Fund – one of the world's major aid agencies

IOSCO	The International Organization of Securities Commissions, which works with BIS on payment and settlement standards
IPS Instant Payment System	A payment system that enables inter-bank payments to be made in real-time via mobile handsets or internet banking, regardless of which mobile network is used
Interoperability	The ability for any mobile payment system user to transact with any other user regardless of bank, Payment Service Provider or mobile network used
KYC	Know Your Customer – measures to check the identity of a customer applying for banking or payment services
M_0, M_1, M_2	Different measures of money in circulation used by economists. M_0 consists of cash in circulation plus certain commercial bank reserves at the Central Bank (Central Bank money) CBDCs fall into this category; M_1 is the sum of currency in circulation, demand deposits at commercial banks, and other liquid deposits; M_2 is a measure of the money supply that includes cash, cheque account deposits, and other types of deposits that are readily convertible to cash such as Certificates of Deposit. Commercial bank business mainly depends on customer deposits in the M_1 and M_2 categories.
making whole	Correcting any financial error due to an experimental system, so that no party loses money
MAS	Monetary Authority of Singapore - the Singaporean Central Bank
MNO	Mobile Network Operator
Mobile App	A computer program that resides on a mobile handset either in the SIM card or as a stand-alone application
Mobile money	Payment systems based on mobile network operator platforms
MPSP	Mobile Payment Service Provider
National Roll-out	A stage after a Pilot CBDC Project, and subject to its success, in which the Digital Currency would be rolled out across the country step by step
Pilot Project or Pilot Trial	An initial private launch of the CBDC with a limited set of real users to test assumptions, systems, acceptance and impact
PoC	Proof of Concept
PoS	Point of Sale
PRS	Policy and Regulatory Sandbox

PSP	Payment Service Provider – an organization that provides payment services to end-customers, which may be a bank or a non-bank such as a mobile network operator or FinTech
QR code	Quick Response code that allows information about a merchant (and transaction price in some cases) to be read by a payment App on a mobile handset in order to set up a payment
Remittances	Incoming fund transfers sent to recipients in The Maldives or vice versa
RFI	Request for Information – often the first phase of a tender process, asking potential suppliers for information about their credentials and products, leading to a shortlist of suppliers
RFP	Request for Proposal – the stage of a tender in which shortlisted suppliers are requested to provide a costed proposal for goods and services
RTGS	Real-Time Gross Settlement System. The heart of the payment system in most countries, run by the Central Bank, that ensures settlement of obligations between financial institutions transaction by transaction in real-time, thus eliminating much settlement risk
SAARC	South Asian Association for Regional Cooperation
SADC	The Southern African Development Community
SEC	The US Securities and Exchange Commission – the US regulator for the securities industry
Smart contract	A piece of program code embedded in a blockchain. Smart contracts are simply programs stored on a blockchain that run when predetermined conditions are met. They typically are used to automate the execution of an agreement so that all participants can be immediately certain of the outcome, without any intermediary's involvement or time loss. They can also automate a workflow, triggering the next action when conditions are met.
UAE	United Arab Emirates
Web3	The latest version of internet protocols which supports transfer of value across the internet been both users and devices - the Internet of Value
WEF	World Economic Forum - the group of government and business leaders that meets at Davos each winter to discuss global economic policy issues

1. Introduction

The Division for Public Institutions and Digital Government (DPIDG) of the United Nations Department of Economic and Social Affairs (DESA), together with the Information and Communications Technology and Disaster Risk Reduction Division (IDD) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), is collaborating with the Ministry of Environment, Climate Change and Technology, and the Maldives Monetary Authority (MMA) to develop a regulatory sandbox framework for testing Central Bank Digital Currency (CBDC) and FinTech in the Maldives.

A regulatory sandbox is established by a regulator to facilitate small-scale testing of innovative products and services under special conditions. These conditions often include exemptions from specific regulatory requirements, while the regulator closely supervises the testing process. Sandboxes function as regulatory laboratories that enable regulatory authorities to observe and evaluate the outcomes of small-scale tests, allowing them to make data-and evidence-informed decisions when developing relevant legislation.

The objective of this global guidance toolkit is to map out the necessary steps and key elements for the designing and operationalizing policy regulatory sandbox on CBDC and FinTech. The global toolkit builds on the previous studies conducted by ESCAP and UNDESA on this area as well as lessons learned from other countries who have adopted a Sandbox approach for their digital currency and FinTech experiments.

The global toolkit starts with background analysis on FinTechs and regulations, Central Banks as innovation facilitators, potential stakeholders for CBDC, and digital payment trends. The next section discusses the nature of sandboxes, including implementation and operation of such a Sandbox. The document ends with a conclusion suggesting how Central Banks could consider adopting a Sandbox approach for digital currency development.

2. Background

a) FinTechs and regulation

Financial sector technologies have developed rapidly over the past few years, enabling innovative services and new business models. As well as licensed financial institutions, many innovative companies – known as FinTechs – are working in these frontier areas, in some cases outside the range of conventional regulation.

Some FinTechs have great ideas, but they are not always familiar with the regulatory protections needed for consumers and business users of financial services products. The biggest investments in FinTech companies have been in those involved in the crypto-asset markets, and as a result huge losses have been sustained by individuals and businesses, as no regulatory protection was available to prevent exploitation of naïve customers. On the other hand, many FinTechs operate as mobile payment service providers (MPSPs) which are generally governed by Central Bank regulations on Payment Service Providers (PSPs). FinTech concept experimentation with CBDCs falls between these two areas.

This rapidly evolving innovative environment has challenged Regulators with new types of risk which they have sought ways to manage without constraining beneficial innovation. The term *"Regulatory Sandbox"* has emerged to describe regimes set up by Regulators to enable pseudo-live trialling of FinTech products (often called Pilot Trials) under the close supervision of the Regulator. This type of regime has the added potential to enable innovators and Regulators to understand each other's needs in more depth. Since the spearhead of FinTech concept innovation has been around banking and payment products, the Regulator involved has normally been a Central Bank.

b) Central Banks as Innovation Facilitators

Central Banks and other Financial Regulators are not generally thought of as innovators, but, under pressure from the growth in the crypto-asset world, many have become expert at internal innovation and have assisted their national banking and FinTech industries to make the most of powerful emerging technologies. Indeed, by encouraging a dialogue between Regulators and frontier Innovators, Central Banks have begun to take on the unusual guise of friends of innovation.

Financial Regulators must balance the potential benefits of developing innovations in their markets with the risks associated with new types of FinTech concepts, products, services and technologies. Technologies such as blockchain, smart contracts and cloud services potentially deliver material benefits to the providers of financial services products and to their customers, including new functionalities, lower costs, less risk and better performance in terms of both speed and convenience can be achieved.

Different countries have responded to financial technology innovation in different ways. Some have chosen to restrict the provision of new services. For example in Nepal and Saudi Arabia constraints had been imposed until recently on FinTech service provision by

companies outside the banking sector and in China and eight other countries[1] cryptocurrency activity was prohibited completely.

Others have tried to develop specific regulations and issue guidance on the regulatory frameworks applying to innovations, like many African Central Banks did in the wake of the sudden rise of mobile network operator (MNO) led payment products in the 2000s.

However, the restriction of FinTech services often has the same result as lack of regulation; the development of unregulated markets, and cross-border delivery of poorly-tested products leaving customers without adequate regulatory protection.

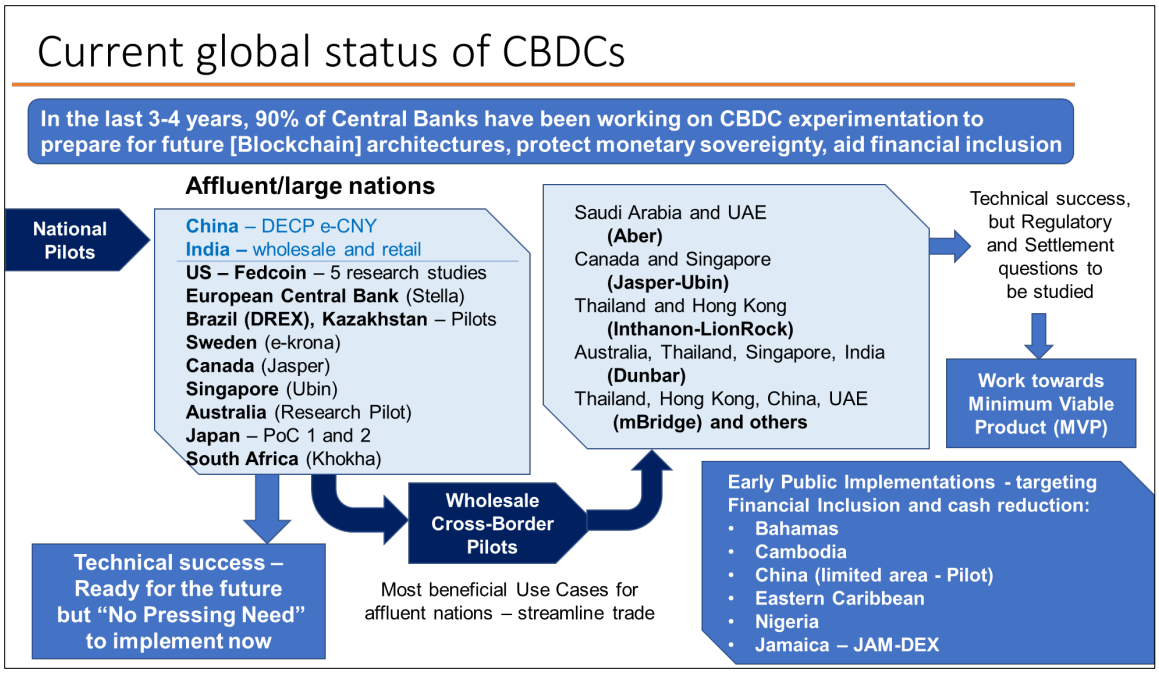
To devise new regulations and make guidance effective and practical, Regulators have to understand the new technologies, functionalities and business models, and this means taking innovative regulatory approaches through the launch of "*regulatory Sandboxes*," "*innovation hubs*" and other mechanisms for the facilitation of innovation, which will be described in this paper.

A recent shift has been taking place in the way in which Central Banks have addressed the specific technologies for digital currencies, as opposed to Sandbox environments for FinTech products in general. Several Central Banks (such as the Fed, the ECB, Sverige Riksbank, Bank of Canada, Bank of Japan, and MAS in Singapore) have been experimenting for a number of years with CBDCs, but others have recently established "Innovation Hubs". The purpose of these is to enable experimentation in a secure private environment in order to build a set of internal skills at least equal to those of the FinTechs and Financial Institutions who develop frontier technology products for commercial reasons. This paper reflects on some national experiences and puts forward the types of Sandbox regime or innovation support that Central Banks could usefully deploy to support their banking and FinTech industries in the context of digital currency developments and digital assets projects.

c) Levels of maturity with respect to digital currency by Country

It has been noted over the past couple of years that Central Banks of different types of countries have different objectives for developing CBDCs or other forms of digital currency. The differences are illustrated below.

[1] Algeria, Bangladesh, Egypt, Iraq, Morocco, Nepal, Qatar and Tunisia.



(Source: eMcREY[2], Monetics from Atlantic Council CBDC tracker[3] and Kiffmeister Chronicles[4])

We can characterize these approaches as follows:

- **Highly developed countries** are experimenting to learn about the new technologies but do not plan to launch in the near future. Despite concerns about the destabilizing effects of cryptocurrency use in domestic markets, Central Banks do not want to create unnecessary risks. In particular to risk disadvantaging their constituency of banks as the effect of CBDC issue on existing banking business, especially domestic deposits, domestic transfers, Foreign Exchange business and correspondent banking could be considerable. Almost all affluent country CBDC experimentation pertains to getting to grips with blockchain systems, not anticipating a fast launch. Cross-border payment is likely to be the first area in which affluent country CBDCs are used live – as in BIS Project mBridge.
- **The largest countries** - China and India – have, respectively, launched or are planning systems based on conventional technology, not blockchain; perhaps because of concerns about performance in very high-volume systems. India has not yet made a decision on the technology approach, but officials have been negative about blockchain technology. Furthermore, even in China where a very high volume of digital Yuan transactions have already been successfully processed, in 23 pilot cities, this represents less than 1% of digital payments in the country, which are dominated by AliPay and WeChat Pay.
- **Many emerging market nations**, in particular smaller ones, have serious and urgent financial inclusion and cash dependence problems to address, which are not important in

[2] A major Middle Eastern integrator of payment systems based in Lebanon and Saudi Arabia

[3] https://www.atlanticcouncil.org/cbdctracker/; a regularly updated review of CBDC and related global progress on digital currencies

[4] https://kiffmeister.com/; another regularly updated review of CBDC and related global progress

higher income countries. The small Caribbean countries who have launched CBDCs have not so far been able to achieve reasonable levels of usage. Larger developing nations such as Nigeria have launched a CBDC service to address financial inclusion and cash dependence, but its level of usage is low, and its precipitate launch has created political problems, even some protests.

- **More advanced nations** such as Brazil, Kazakhstan and UAE seem to be close to a launch, but Brazil, for example, already has a strong instant payment system (PIX) which is already addressing financial inclusion and cash dependence, so their CBDC needs a clearer rationale.

In general, benefits versus risks are much more favourable for small and/or emerging economies with significant financial inclusion needs and high cash dependence than in the more advanced economies. Hence the need for safe experimentation environments where the propositions for CBDC can be tested without disturbing monetary or financial stability.

d) The potential stakeholders in CBDC and Stablecoin initiatives

The Central Bank is typically the sponsor of the digital currency programme, as it has the responsibility for the integrity of the payment system and for monetary policy. Hence Central Banks normally wish to keep the early stages of digital currency experimentation firmly within their own control. They will consult with Technology providers and set up test systems - providers may include more than one firm (for central CBDC Issuance, for blockchain infrastructure, for telecoms, and for front-end technology such as mobile Apps, QR code registry, directory services, PoS technology).

However, as progress is made, the use of an Innovation Hub or a Sandbox environment allows external parties to participate and test concepts and systems with the Central Bank. As the participation becomes broader, the stakeholders in CBDC projects usually expand to include the following:

- *The Licensed Financial Institutions* – who will normally act as distributors of the currency to the public – and certain types of FinTech company who are involved in digital payments
- *Businesses*, especially a small selection of merchants, who will be major acceptors and users of the CBDC and will be responsible for front-end systems at PoS
- *Government Agencies*, which will have an input to the potential uses of the CBDC or other digital instruments for the benefit of the country and its people

The public, community and consumer groups, will be concerned about matters such as safeguarding of customer funds, privacy and data protection. Under Sandbox conditions, a small set of real users may be recruited to take part in Pilot trialling with real transactions involving real funds. To do this, a mechanism for 'making whole' for merchants and users in the event of any errors, has to be in place.

Regional groupings of Central Banks, such as Caricom, ASEAN, SAARC, SADC and many others may have an interest in potential cross-border payment and collateral arrangements and will wish to share learning about the uses of new technologies.

e) Global and regional trends in digital payment and its regulation

The cryptocurrency and digital assets industries operate almost entirely outside financial regulations, but the situation is changing. The Biden Executive Order on cryptoasset regulation (March 2022) proposed that the US government agencies work towards creating a regulatory framework for the crypto-asset markets, but no outcome yet. A federal regulatory structure is likely, but there is still confusion about the definition of instruments and the role of different Regulators. The US Regulators, of which there are at least four plus the States, seem to be addressing the issues by testing certain matters in the courts.

EU Markets in Crypto Assets (MiCA) Regulations is being put in place in a more structured fashion. The Regulations currently appear to offer the potential for regulated exchanges and for European commercial banks to offer stablecoins for Use Cases such as global treasury and supply chain integration.

But some Regulators have suggested that the crypto world be left outside financial regulation, with a loud *'buyer beware'* warning being regularly issued by Regulators. The MAS (Singapore) view in the wake of the FTX meltdown was: *"As MAS has repeatedly stated, there is no protection for customers who deal in cryptocurrencies. They can lose all their money."*

MAS uses the definitions in the Singapore Payment Services Act, 2019, to regulate specific activities, which is an approach that seems to be working but does leave certain areas outside regulation and naïve customers at risk. Hence MAS has imposed a crypto advertising ban and is proposing regulations for cryptocurrency trading and stablecoins that already fall under the Payment Services Act.

The Financial Stability Board (FSB - a body that meets under the auspices of the BIS) has been tasked by the G20 with developing a Roadmap for global cryptocurrency regulation – including stablecoins.

The current uncertainty in the overall position makes it imperative for Central Banks to examine the policy and regulatory implications of innovative products using new types of technology, and *the Innovation Hub and Sandbox* mechanisms are valuable tools to help them do so. The nature of the tools that can be used will now be discussed.

3. The Nature of a Policy Regulatory Sandbox (PRS)

a) The concept of Sandboxes

The idea of Sandboxes arose in the IT industry, when, for example, companies explored computer viruses in a ring-fenced testing environment known as a "*Sandbox*" or "*digital Sandbox*." They have been used in various industries, but the financial industry has taken a lead. The Financial Conduct Authority Innovation Hub in the UK launched the first **regulatory Sandbox**[5], in 2016, with the intention of providing:

- "the ability to test products and services in a controlled environment
- the opportunity to find out whether a business model is attractive to consumers, or how a particular technology works in the market
- a reduced time to market at potentially lower cost
- support in identifying consumer protection safeguards that can be built into new products and services."

The FCA defined the Sandbox succinctly as being "*a 'safe space' in which businesses can test innovative products, services, business models and delivery mechanisms while ensuring that consumers are appropriately protected*."

This has led to Banking Regulatory Authorities (in most countries, the Central Bank) being seen as the home of the Sandbox at least for the banking and payments part of the FinTech industry. Insurance and the securities market have their own specialised needs. In some countries, the Regulators for different aspects of financial services have collaborated on establishing Sandbox regimes for trialling various types of FinTech products. A description of different types of Sandbox regimes is provided in Annex 1.

However, conducting proofs of concept (PoCs), prototyping or setting up Pilot environments for CBDCs rather than third party FinTech products is a different matter. CBDCs nearly always fall under the sole authority of the Central Bank because of its exclusive role in regulating payment systems. CBDCs are intended purely as payment instruments and not as digital assets. It is, so far, rare for such environments to be referred to as Sandboxes, but the term has become more widely used recently, for example in Saudi Arabia, Kazakhstan, Norway and Barbados. Some of the major suppliers of CBDC and blockchain platforms also offer a "Sandbox" environment as part of their product support and testing service. This seems to us to be a change of terminology rather than a change of substance.

We have noted a distinction in the use of the terminology between, on the one hand "Regulatory Sandboxes" for FinTech products and on the other hand "CBDC Sandboxes." Regulatory Sandboxes are intended to allow a FinTech some leeway in the usual regulatory requirements for launching a public financial product. That leeway, however, is usually only in respect of administrative requirements like capital backing, the length of time a company has been in business, its Directors' credentials and its other lines of service. Nevertheless, as commercial bank products related to CBDCs, such as e-wallets, come to be trialled alongside

[5] https://www.fca.org.uk/news/press-releases/financial-conduct-authority%E2%80%99s-regulatory-Sandbox-opens-applications (May 2016)

the Central Bank's own CBDC issuing system, and on a technical platform run by the Central Bank, the Regulatory Sandbox angle is becoming relevant and the terminology more apt.

For a CBDC Pilot Project, a Central Bank is likely to focus on experimentation with the CBDC itself and then exploit the CBDC's public potential by interfacing the CBDC-related products of banks and FinTechs into the CBDC testing environment for controlled trialling. In which case, the term "Sandbox" is appropriate, as defined above. It's important to be clear that these relaxations are normally administrative ones. Controls to do with security, consumer protection and data protection are not normally relaxed. Risk-based control and proportionality of regulation are key factors. The relaxation of administrative regulations to enable low-risk public trials would fit this framework. For example:

- relaxation of "fit and proper persons" criteria, as many FinTechs are start-ups, and their Directors may not have a great deal of experience;
- limited relaxation of some consumer protection requirements in parallel with imposition of limits and compensation arrangements for losses (although at least one person must be appointed to deal with consumer complaints);
- capital requirements may also be relaxed.

There may also be tightening in some areas such as transaction and volume limits and the number of customers onboarded in total or onboarded per month.

However, Sandbox regimes are not just about relaxing regulations, but about '**regulatory discovery**' for both the Regulator - the Central Bank – and the innovators. There is great value in exploring the gaps in regulations to identify "Conflict between rapidly changing technology and a reactive rule-making process"[6]

During the testing of innovations, Regulators should aim to study risks and explore the possibility of amending legislation, considering the results of tests; or refining regulations by - making the rules more appropriate to the specific risks encountered.

b) How CBDC Sandboxes have been used

Results of experiments so far show that Central Bank control of CBDC/digital currency Sandbox regimes has been successful in confirming the capabilities of blockchain systems in the CBDC context and especially the potential for use of smart contracts and programmable money. The Norwegian experiences suggests that the open-source approach can add some flexibility and, as in all the cases, shows that early collaboration with the banking and FinTech industries is likely to deliver the richest streams of innovations that can add value to CBDCs.

The emphasis on specific Use Cases, as in Kazakhstan and Saudi Arabia, shows how important it is to identify where the benefits of smart contracts and the extra security associated with blockchain systems lie. All these experiments use private, permissioned blockchains with a degree of centralized governance – which is incumbent on the Central Banks. However the range of Use Cases explored shows that this is not a restriction but rather an opportunity to

[6] WEF_Digital_Currency_Governance_Consortium_White_Paper_Series_2021 p45

enable high performance blockchain systems with reliable, integrated governance and enhancement mechanisms to be deployed.

The identification of specific beneficial Use Cases is vital going forward, as most Central Banks in the more advanced nations have little problem with financial inclusion and have already assured reduction in cash usage by the deployment of instant payment systems. Thus, such Central Banks can only justify domestic CBDCs for other Use Cases which show major benefit at low risk. As we have seen, this situation is different for emerging economies.

There is a tension for Central Banks as they must be confident that the adoption of CBDC will be substantial, or the exercise will be a failure. However, it must not be so substantial that it will be seen as a threat by commercial banks as a shift of deposits from M2 and M1 to M0 , thus undermining conventional banking business. It is vital to focus on Use Cases that enable banks to offer value added services via CBDC wallets as well as meeting Central Banks' aims for monetary policy etc.

Sandbox regimes also provide an opportunity to test the characteristics of Use Cases and related products to ensure this balance can be conserved in a way that benefits all parties - Central banks, commercial banks, businesses, consumers and government.

i. The CBDC/blockchain Sandbox in Saudi Arabia

Saudi Arabia is a member of the G20 and the leading country in electronic payments in the Middle East. The Central Bank, SAMA, has a history of innovation and was the first Central Bank to introduce RTGS in the region. In recent years it has implemented an Instant Payment System and has been a major participant in two regional payment systems – AFAQ and Buna. The payment system operations in Saudi Arabia are run by Saudi Payments, at present a wholly-owned subsidiary of SAMA.

SAMA and Saudi Payments are each establishing Sandbox environments with different platform suppliers in order to test CBDC issuing software and to enable commercial banks to test CBDC-based products. Many of the commercial banks are also taking the opportunity to work with blockchain platforms, which may offer solutions to some intractable problems in bank systems, such as effective automated reconciliation, whether or not a CBDC is eventually launched.

Results so far have confirmed that a CBDC solution can be designed for issuance and redemption of Central Bank money in tokenized form to provide wholesale settlement for banks and in due course non-banks/FinTechs, where the programmable features of CBDC can help to broaden secure access to Central Bank money without compromising central bank limits and controls.

SAMA sees substantial opportunities in the smart contract and programmability capabilities of digital currencies, for example in securities settlement with automated DvP. Work continues on the design of a suitable regulatory framework for CBDC and virtual assets.

ii. Kazakhstan – CBDC and the Astana International Financial Centre

The National Bank of Kazakhstan (NBK) together with the industry has been experimenting with CBDC (the digital-Tenge) since their White Paper was published in 2021. A Sandbox environment was set up on the R3 Corda platform which offers a range of Sandbox tools[7].

As part of a Pilot study, the NBK was looking at special scenarios - special purpose tokens and configurable anonymity. The question of whether the Regulatory position was strong enough to support a CBDC has also been explored. The Regulatory framework will be developed according to the Sandbox results, it is said, and will need consultation with the industry.

The development team has been working in the Sandbox on smart contracts for various Use Cases to test whether the digital Tenge is worthwhile in terms of meeting the goals set, which are:

- increased competition
- increased cashless payments
- integration with national payments system
- increased efficiency of payments.

The Pilot has now (2023) moved on to test Use Cases for the Digital Tenge involving applications from banks and FinTech companies, with the Central Bank conducting the due diligence to identify any regulatory problems for the CBDC and its interaction with third party products.

The Digital Tenge is now being trialled with a limited set of end users in the controlled environment of Central Bank canteens etc.. The Pilot activities are all run by the Central Bank, so the Central Bank will have to define the exit strategy for all the Use Cases (which may require individual conditions for specific Use Cases).

iii. The e-Naira Project in Nigeria

Nigeria has a sound financial ecosystem with several kinds of digital payments with high volumes of usage, and cash use is steadily declining. The objectives set for the e-Naira are wide ranging and include financial inclusion, automated tax collection, reduced corruption by use of programmable money, and poverty reduction via targeted social welfare. The Central Bank of Nigeria (CBN) is also seeking to identify and implement improved monetary and financial stability policies as well as an improved FX position. Within these objectives the characteristics needed include privacy, data protection, and AML compliance[8].

Unusually, the e-Naira was introduced to the market without any formal piloting and following a re-issue of the physical currency by the Central Bank intended to reduce cash hoarding, which has now raised political issues within the country. The Bitt CBDC issuing system used does provide a Sandbox environment, although it is not clear whether third party

[7] Several papers are available on the web site of the National Bank of Kazakhstan. See https://www.nationalbank.kz/en/page/cifrovoy-tenge-pilotnyy-proekt

[8] The Bank of Nigeria, "Design Paper for the eNaira," https://enaira.gov.ng/assets/download/eNaira_Design_Paper.pdf, accessed December 11, 2022.

products were tested in the Sandbox environment before the launch. The system provides a central mobile App, so bank-issued wallets may not be vital.

Despite this the CBN was careful to ensure early collaboration with other financial institutions. A financial ID (a bank verification number) was organized before the launch, with the collaboration of the banks. This emphasizes the tight connection that exists between CBDC and digital ID. Public use of CBDC will always require some kind of secure digital identity.

iv. Norges Bank, Norway

Norway is already a country with sharply declining cash usage because of ubiquitous instant payment systems. The share of cash payments in Norway is *probably*, according to Norges Bank (the Central Bank), the lowest of any country in the world.

After a period of desk research, Norges Bank launched a programme of testing for a potential CBDC around mid-2021, saying that it planned to examine various technical solutions for a potential digital Norwegian krone over a two-year period. A Norwegian blockchain company, Nahmii, was commissioned to create a 'Sandbox environment' to support CBDC experimentation.

Norges Bank elected to use open-source software as a good starting-point for learning as much as possible in collaboration with developers and alliance partners. It has also been reported as having incorporated software from US Project Hamilton[9] into some of its test streams. As an Open-Source project, the technical Sandbox allows developers to engage either independently or in collaboration with Norges Bank.

The focus of the Sandbox phase is on testing possible technical solutions combined with analysis of the need for a CBDC and consequences if a CBDC is introduced. Nahmii will build, maintain and train Norges Bank users and partners in the Sandbox environment. The expectation is that all major Norwegian banks will take part. The Sandbox, according to Nahmii, 'allows for the testing of basic token management Use Cases, including minting, burning and transferring ERC-20 tokens.'[10]

v. Lessons learned from CBDC Sandbox experiences.

Results of experiments so far show that Central Bank control of CBDC/digital currency Sandbox regimes has been successful in confirming the capabilities of blockchain systems in the CBDC context and especially the potential for use of smart contracts and programmable money. The Norwegian experiences suggests that the open-source approach can add some flexibility and, as in all the cases, shows that early collaboration with the banking and FinTech industries is likely to deliver the richest streams of innovations that can add value to CBDCs.

[9] A project to design a High-Performance Transaction Processor for Central Bank Digital Currencies, by the Federal Reserve Bank of Boston and the 'Digital Currency Initiative' - a research community at the MIT Media Lab focused on cryptocurrency and blockchain technology

[10] ERC20 is the technical standard normally used for Ethereum-based fungible digital currency tokens.

The emphasis on specific Use Cases, as in Kazakhstan and Saudi Arabia, shows how important it is to identify where the benefits of smart contracts and the extra security associated with blockchain systems lie. All these experiments use private, permissioned blockchains with a degree of centralized governance – which is incumbent on the Central Banks. However the range of Use Cases explored shows that this is not a restriction but rather an opportunity to enable high performance blockchain systems with reliable, integrated governance and enhancement mechanisms to be deployed.

The identification of specific beneficial Use Cases is vital going forward, as most Central Banks in the more advanced nations have little problem with financial inclusion and have already assured reduction in cash usage by the deployment of instant payment systems. Thus, such Central Banks can only justify domestic CBDCs for other Use Cases which show major benefit at low risk. As we have seen, this situation is different for emerging economies.

There is a tension for Central Banks as they must be confident that the adoption of CBDC will be substantial, or the exercise will be a failure. However, it must not be so substantial that it will be seen as a threat by commercial banks as a shift of deposits from M_2 and M_1 to M_0, thus undermining conventional banking business. It is vital to focus on Use Cases that enable banks to offer value added services via CBDC wallets as well as meeting Central Banks' aims for monetary policy etc.

Sandbox regimes also provide an opportunity to test the characteristics of Use Cases and related products to ensure this balance can be conserved in a way that benefits all parties - Central banks, commercial banks, businesses, consumers and government.

c) Objectives and Scope for a Central Bank Sandbox regime

Experience from the examples above shows us that the inclusion of stakeholders from the start of any CBDC project is a major contribution to its ultimate success. It is of great importance to keep all incumbent financial institutions such as banks, payment service providers and local or even international FinTech companies involved with the CBDC project from its outset.

However, testing individual FinTech products in a more traditional "regulatory Sandbox" environment is not the same as testing such products and banks' products for that matter in a CBDC testing ecosystem set up by the Central Bank – a 'CBDC Sandbox.'

The participation of relevant Governmental Departments early on is also highly recommended as there may need to be legal changes and changes to government payment processes which can be incorporated into the CBDC scheme. Indeed, negotiating the inclusion of government payments in the CBDC program may be vital in gaining critical mass and could be one of the vital Use Cases discussed above.

It is crucial to encourage financial institutions (banks and FinTechs) to build overlay services on to basic e-wallet products and to integrate the CBDC with their existing financial services products and activities. To achieve this, Central Bank can usefully invoke the "CBDC Sandbox" concept to describe its testing ecosystem. This will not be a "regulatory Sandbox" in the sense of a regime in which FinTechs can road-test their products under the watchful eye of the Regulator, but a collaborative testing environment in which all parties in the banking and payments industry can understand each other's products, needs and expectations before any

product is exposed to end-users. It is in this Sandbox environment that the components of the ecosystems can be tested working together, and that the rules and regulations needed to protect customers and guarantee the safety of data can be worked out. Only then can Pilot trials commence involving real customers and real money.

The CBDC Sandbox thus becomes an integral part of developing the CBDC ecosystem for the country. PoCs for the central system and for the bank products can be conducted in preparation for the Pilot program involving a limited range of locations and a small group of pioneer users. The Sandbox ecosystems should be designed to ensure that the Central Bank can on-board as many stakeholders as needed at the various stages.

In general, therefore, we anticipate four stages of Sandbox deployment specifically for CBDCs and other digital currency experiments:

- a Proof-of-Concept testbed as part of the CBDC vendor selection exercise;
- once the selection is made, use of the successful vendor's testbed as a CBDC Sandbox for testing the CBDC central systems, connectivity to the participants, basic inter-bank payment and DvP settlement functions and security and performance issues;
- PoC and detailed testing of CBDC-related products from the banking and FinTech industry; and
- subsequent trialling with a small, selected group of live users within a Pilot Project.

We anticipate that the CBDC Sandbox will be deployed on Central Bank premises with technology provided by the successful CBDC Bidder or in a cloud environment with suitable security safeguards under Central Bank control. The Central Bank is thus very much in the middle of the Sandbox process.

d) Application, eligibility and exit processes.

The eligibility criteria and application process for both Sandbox participants and products for a Fintech Sandbox and for a CBDC Sandbox are essentially similar, but in the current context of the CBDC Project led by the Central Bank, we are assuming that any Sandbox regime established will be related to the CBDC. Hence, what follows applies primarily to a CBDC Sandbox, but a similar procedure would apply for a FinTech Sandbox regime. We have suggested a standardised process for eligibility assessment and application procedures in Annex 2, with an example in Annex 3.

The main issue about eligibility is whether there is genuine and worthwhile innovation which will generate real benefits; and the main concern about the application process is transparency. This means that the rules are clear and fully disclosed; that the product is seen to be sufficiently mature for a Sandbox process to be useful; and that due diligence on the product and the firm offering it has been done by the Central Bank.

Exit processes, however, will be much more variable as they will depend on the degree of success achieved in the various stages of the Sandbox testing – PoC, functional and technical experimentation, operational testing and potential Pilot trialling with real customers. The exit criteria for each product will likely be different and must be outlined at the start. What would count as success must be defined, which may include functional, security and

performance criteria as well as whether there are any regulatory problems, how the product is received in the trial market and hence its likely commercial viability.

The main concerns will be consumer safety, data protection, regulatory acceptability and market attractiveness, so the criteria for these must be agreed as part of the Sandbox testing initiation for each product.

e) Key questions about a PRS

In this section, some of the questions that will arise for Central Banks and stakeholders will be explored considering the use of a Sandbox regime as a vehicle for a CBDC program. The Sandbox is intended to provide a testing environment in which participants can work alongside the Central Bank to test out not only technical and operational issues but also those concerned with Policy and regulation. Regarding policy, these include what types of activities and functions could or should be encouraged or discouraged within a digital currency eco-system; and regarding regulation, what specific rules should be in place to ensure that the CBDC systems, products and procedures run efficiently and safely for all parties.

i. What does 'policy experimentation' involve?

The policy parameters that a Central Bank might wish to explore using a CBDC Sandbox environment include, among others, issues to do with participation and those to do with operational risk management.

Participation issues that can be explored could include the involvement of FinTechs in the CBDC environment. FinTech companies and products can be included in the Sandbox regime in order to check technical security issues and interoperability, which may reveal some types of product or business approach that do not comfortably sit within current policies and regulations. For example, products that may disintermediate the banking system in a way that exposes customers to risks that are not controllable by the Central Bank. It may be decided as a matter of policy that such products will not be accepted within the CBDC environment.

Another participation matter is whether and how CBDCs can be used to enable financial institutions that do not fall within the banking regulations (and are thus not RTGS members) or non-bank providers to settle among themselves and with the banks on a 24x7 basis. These institutions would currently be settling positions via an agency relationship with an RTGS member bank. Thus, replacing 2-tier settlement with a tokenized settlement regime tested successfully in the Sandbox could then enable policy to be changed regarding safe settlement for such institutions.

Successful experimentation with CBDC-based products in the Sandbox would also enable the Central Bank to revise guidelines and devise new guidelines for bank and FinTech product design and operations.

ii. How should functional and technical experimentation be conducted?

The usual approach is for the Central Bank to set up the CBDC environment as a separate testing environment within their IT infrastructure or specifically as a Sandbox environment in which other entities can be involved. The testing of the issuing and redemption of digital

currency can be done by the Central Bank alone first, and then testing of the distribution of digital currency to the banks' nodes on the blockchain, where wholesale Use Cases such as interbank funds settlement and DvP settlement can be tested. These areas of functionality are by now well understood.

There are still questions, however, about where and how the bank nodes are hosted. In the Bahamas Sand Dollar implementation - the first live national CBDC - the Central Bank hosts and operates the entire CBDC system. No nodes are hosted at commercial banks. The banks and PSPs are connected to the system via APIs similar to those used for other payment rails. The banks do not need their own blockchain environments.

In other CBDC systems there are proposed architectures where the Central Bank and a couple of large banks each own a full node of the CBDC blockchain and may be part of the consensus mechanism, with the Central Bank playing the role of trusted entity. This is triggering data privacy concerns since those banks will have access to all transactions not only to their own clients transactions. To alleviate this concern, system architectures have emerged where the Central Bank is the only node who hosts all transactions, but large banks and PSPs host a node which contains only transactions involving their own clients. On a blockchain it is reasonably simple to create such a configuration.

From commercial bank perspective there are two main approaches regarding connectivity:

- large banks have created a separate payment hub for CBDC and/or instant payments, in order to address the low latency/fast response time requirements.
- smaller banks have added the CBDC transactions to existing payment hubs.

In these cases, the CBDC is accessed via APIs or a messaging interface and is treated like any other payment rail, regardless of whether it is hosted at the Central Bank or within a commercial bank.

As described above, Sandbox experimentation reduces the exposure of the bank to public reputational risk, although the eligibility and application procedures (see Annexes 2 and 3) will expose the bank to examination of its policies and product plans by the Central Bank.

Several central banks have established Regulatory Sandbox initiatives for CBDCs, in a similar manner to Sandbox testing environments used for new Fintech products. Examples include Kazakhstan, Norway, and others who have worked with special testing environments provided by CBDC and blockchain infrastructure suppliers.

CBDC Sandboxes provide a mechanism for central banks to enable CBDC related products from commercial organizations - banks and FinTechs - to be tested together with the central minting and accounting systems, which could even evolve to limited Pilot trials with real customers.

Source: Authors' illustration.

iii. How can licensed banks, financial institutions and non-banks be fairly treated?

Regarding Sandbox entry and exit, dangers to be avoided include the government seeming to empower certain companies at the expense of others, or opening the door to favouritism or conflicts of interest in the regulatory process which could muddy the market, making it unclear for consumers and investors which products are reliable—and which are unduly propped up by government.

Regulators can take steps to make Sandboxes as fair and productive as possible. The suggestions below come from the Mercatus Policy Research Centre[11]:

- "Establish liberal procedural qualifications for entry. This would allow as many qualified firms as possible to participate.
- Permit third parties (such as industry groups) to manage Sandbox entry for their members. This would help many firms to benefit from the Sandbox and minimize government favouritism.
- Institute well-defined Sandbox terms and guidelines at the outset so that firms are all regulated by the same standards. This would help eliminate Regulator bias.
- Ensure the duration of the Sandbox is no longer than necessary to achieve its goals.
- Publish detailed reports of all Sandbox findings. This would both help the public learn more about Sandboxes and add an extra layer of transparency.
- Clarify that nonparticipation in a Sandbox is not cause for suspicion or for different treatment on the part of regulators."

Much of this advice involves full disclosure of the way the Sandbox operates, what it is intended to do and what it means to enter and exit the Sandbox.

iv. What regulatory measures should be relaxed in the Sandbox?

The aim is to avoid 'Conflict between rapidly changing technology and a reactive rule-making process' (WEF paper[12] p45). Note, however, that the aim is **regulatory discovery** not relaxation. The intention is to identify where there are gaps in the regulatory framework that do not cover aspects of the innovative product. Examples that have been identified include:

- the on-ramp/off-ramp for a stablecoin. How to ensure assets that have been tokenized are frozen in their original form
- the borrowing and lending of cryptocurrencies – how market risk is evaluated and managed. For example, Bitcoin borrowing in a falling market – what the rules should be to protect customers
- Gaps and inconsistencies created by the overlapping jurisdictions of different regulatory agencies (eg US regulatory debates) causes inconsistencies in regulatory

[11] Steps quoted from Mercatus paper – Maldives paper annex 6

[12] https://www3.weforum.org/docs/WEF_Digital_Currency_Governance_Consortium_White_Paper_Series_2021.pdf p43

scope eg in the US SEC vs CFTC regulations – it should be made clear which rules each specific product offering is supposed to be following (see WEF paper p46)

- Gaps and inconsistencies created by lack of global coordination (eg problems found by BIS projects Dunbar, mBridge and Icebreaker)
- Gaps and inconsistencies due to the similarities between retail CBDCs and stablecoins (borrowing and lending Central Bank vs commercial bank money).

Where actual relaxations in regulation are proposed, the question is 'for what purposes and in what way?' It's important to be clear that these relaxations are normally administrative ones - eg the rules about length of time a company has been in existence before it can provide payment services, or the degree of experience of its Directors. As explained before, controls must be risk-based and proportionate; and security, consumer protection and data protection cannot normally be relaxed.

Note that in most countries, Central Bank Laws do not currently allow the public issuance of digital currencies[13]. Hence, for a broad public launch it is very likely that legislative change will be needed. However for Sandbox programs and limited Pilots substantial change is not necessary, as long as it is clear where liabilities will end up if problems arise, but nevertheless all Central Banks contemplating the issue of a CBDC must look into the necessary changes in Law while experimentation is going on.

v. How can consumers, businesses and government be involved as customers?

It is usually only in the later stages of Sandbox experimentation on a product that extension of facilities to real uses would take place. Normally, practice has been to recruit from within the project stakeholders and to use environments such as bank canteens for PoS experiments

Consumers can be protected when using Sandbox products by ensuring that there is a mechanism for 'making whole' - ensuring that no financial losses are incurred by Pilot users - consumers or merchants. This means there must be detailed tracking of spending and receiving of digital currency for each user, and reconciliation of positions. Reconciliation can be achieved almost automatically in a blockchain system as the positions altered by each transaction can be confirmed in real-time. If there are financial errors, there must be compensation arrangements in place, as follows[14].

- In certain jurisdictions, regulators ask Sandbox applicants to provide compensation arrangements that can be used to take remedial steps if any harm to clients occurs during the tests.

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[13] https://www.imf.org/en/Publications/WP/Issues/2020/11/20/Legal-Aspects-of-Central-Bank-Digital-Currency-Central-Bank-and-Monetary-Law-Considerations-49827

[14] Assylbek Davletov - Sandbox policy paper for the Maldives (UN ESCAP, 2022) *–p16* https://www.unescap.org/kp/2023/regulatory-sandbox-framework-central-bank-digital-currency-maldives

- The compensation arrangement requirement may be optional and is often used to protect retail clients who do not fully understand the risks of using innovative services/products.
- Compensation may take the form of insurance or a dedicated bank account with a fixed amount of funds that can be used to make compensation payments for harmed retail clients.

However, the compensation arrangement requirement is often difficult to comply with since it may be too costly for start-ups. In addition, few insurance companies agree to insure tests due to little knowledge of risks being available for testing of innovative products. It makes sense, therefore, for the Regulator itself to oversee compensation arrangements and to contribute resources for setting them up

The provision of extensive compensation arrangements reduces potential harm that can be caused during the test, and Regulators may agree to relax testing parameters (e.g., increase the number of clients or raise transaction limits) if compensation arrangements are in place.

For example, the Regulator of a sectoral Sandbox in Berlin required AutoNOMOS company to contract with an insurance company to allow the use of autopilot vehicles on Berlin public roads. Unfortunately, the search for the insurance company was very complex since neither insurance companies nor AutoNOMOS had enough data or knowledge of the risks of piloting autopilot vehicles. Finally, however, one insurance company agreed to insure the innovations and costs were covered by the vehicle advertising payments. NB This is a very different kind of risk – a direct life or death risk – compared to a FinTech product or CBDC. Thus ,the risk management needs to be proportionate.

Testing parameters can also be adjusted to manage risks (for example, transaction or aggregate limits, restrictions to offer services to specific customers, number of customers). Setting appropriate testing parameters is a critical part of the testing regime. Compliance with testing parameters must be enforced strictly. Violation may lead to regulatory sanctions and, in serious cases ceasing of testing and licence withdrawal.

Depending on the applicant's maturity level of compliance and risk management, testing parameters are developed individually on a case-by-case basis. Such parameters are discussed with the applicant, and the final decision on testing parameters is at the regulator's discretion.

f) Monitoring and control of PRS activities by the Central Bank

Central Banks are the overseers of payment systems, so the control of the CBDC Sandbox regime is under the control of the Central Bank. There may be exceptions in countries where the operational management of the payment systems is delegated to a separate entity (as in Saudi Arabia or Romania), but the responsibility for the CBDC activity must remain with the Central Bank as the only issuer of the national currency.

There may be some controversy over where the CBDC team is located for the implementation of a Sandbox regime – is it best in ICT, Currency Department, Payment Systems, or Monetary

Policy for example. This is discussed below under 'Organization of Sandbox activities.' We take the view that the reporting line for the team is probably less important than the team members being drawn from all the relevant departments. The team may not need to be large. For instance, some small Central Banks have successfully established Regulatory Sandbox regimes for FinTech companies and products with a small staff contingent of 2 or 3, involving a close connection with Payment Systems Oversight. The Sandbox would need to be permanently manned but may require no more than two or three well trained full-time staff members and designated contact points in ITC and the other relevant departments.

According to the IMF[15], the number of staff at Central Banks involved in CBDC projects varies mainly with the degree of outsourcing to private vendors. For example, the Central Bank of the Bahamas (CBOB) and the Eastern Caribbean Central Bank (ECCB), both running CBDC projects in small countries and teaming up with a main contractor, have needed relatively small teams to conduct the studies, PoCs, Pilots and live launches. At its peak during the launch, the Bahamas Sand Dollar CBDC project, the first national live CBDC, employed 35 people mainly part-time. Currently, 15 people work full-time on the Sand Dollar. The ECCB is currently managing its DCash project with 12 people, all of whom have other duties.

The CBoB Bahamas Sand Dollar team has also built up an Adoption Unit consisting of 5 people to improve the marketing and take up of the CBDC.

Regarding monitoring and control of Sandbox activities, the Central Bank with its technology providers have specific responsibilities[16]:

The Central Bank responsibilities are:

- Issuer and redeemer of Digital Currency, responsible for putting currency into circulation and guarantor of the Digital Currency in accordance with the relevant Laws, notably the Central Bank Law;
- Supervisory/Oversight authority for the compliance of the system and payment transactions made with the Digital Currency.
- Owner of certification authority for digital certificates associated with the Digital Currency
- Responsible for the communication policy around the Digital Currency.

The Technology Solutions Provider responsibilities include:

- Provide technical assistance to other Stakeholders (Central Bank, commercial Banks and non-bank PSPs, merchants, cooperatives, end users.)
- Assure
    - Infrastructure and payment security;
    - The resilience and reliability of the platform and the digital currency;

[15] IMF FinTech Report March 2022 FTNEA2022004 p20

[16] UN ESCAP National Study on Central Bank Digital Currency and Stablecoin in The Maldives, 2022 Annex 7

- Monitor the platform throughout the development, proof of concept, pilot and roll-out phases as needed;
- Guarantee integrity of online and offline use of the Digital Currency;
- Provide transaction traceability solutions and AML/CFT compliance;
- Provide and monitor the effectiveness of the technological solutions necessary for the interconnection between the Digital Currency system and that of the local PSPs, in order to facilitate end-user services – for merchants, businesses, government and the public;

g) Financing and risk management for PRS activities

The key issues revolve around ensuring the stability and security of the CBDC system while managing financial risks effectively. The most important considerations include:

- **Funding for Sandbox Operations**: Setting up and operating a CBDC Sandbox requires covering the costs associated with technology infrastructure, personnel, legal compliance, among other operational expenses. It will normally be the responsibility of the Central Bank to procure the financing for the CBDC Sandbox from its own resources, government allocations or the international aid agencies. Although some vendors have been prepared to offer partnership deals with Central Banks at low cost, this could give rise to conflicts of interest in such an innovative situation.
- **Managing Financial Risks:** CBDC Sandboxes involve testing and experimenting with new technologies and systems, which will require a risk management framework to identify, assess, monitor, and mitigate risks effectively. Potential risks may include cybersecurity threats, fraud risks, operational risks, and legal and regulatory compliance risks.
- **Collaboration with Financial Institutions**: CBDC Sandboxes involve numerous participants (mainly banks and FinTechs) and other stakeholders. Establishing clear guidelines and protocols for cooperation, data sharing, and risk management is crucial to ensure transparency and accountability while managing potential financial risks.
- **Regulatory Compliance:** Exploring regulatory compliance needs for innovative products is a major reason for using the Sandbox approach for CBDC. The Sandbox environment provides the opportunity to work out what the appropriate regulations and legal frameworks should be to assure smooth operations and manage potential risks. Consumer safety, data protection, cybersecurity, AML and KYC requirements are likely to be important aspects. How the CBDC regime and the innovative products fit within existing laws and regulations on payments needs to be assessed case by case to identify regulatory underlaps and areas where the wording and restrictions inherent in existing regulations are not appropriate or necessary for digital currency.
- **Testing and Evaluation:** CBDC Sandbox activities involve testing the CBDC system in real-world scenarios. This may involve limited groups of real users in Pilot programs. A comprehensive testing and evaluation framework should be established to assess the performance, scalability, security, and interoperability of the CBDC system. This includes simulating various risk scenarios and conducting thorough audits to identify and address

vulnerabilities. We have already discussed the need for compensation arrangements to ensure no Pilot users suffer financial harm.

- **Stakeholder Engagement and Communication:** Effective communication and collaboration with various stakeholders, including regulators, financial institutions, technology providers, and the public, are crucial for the success of CBDC Sandbox activities. Clear and transparent communication channels should be established to manage expectations, address concerns, and share information about the Sandbox's progress and outcomes.
- **Exit Strategy:** CBDC Sandbox activities are typically time-limited and each product under test needs to have a predefined exit strategy. It is important to plan for the smooth transition of operations, data security, and risk management practices when the Sandbox period ends. It will be important to ensure that valuable insights, lessons learned and best practices from the Sandbox activities are integrated into the broader implementation of the CBDC system itself and the products designed for use within the system.
- **Business Continuity Planning:** The most obvious security facility need for any ICT system is a fallback environment to assure continuity of processing. A full disaster recovery site may not be necessary in the early stages of setting up a PRS regime, but as soon as multiple products are under test and multiple participants are involved, the integrity and availability of the Sandbox environment must be assured. Basic disaster recovery disciplines must therefore be put in place for the Sandbox.

h) What counts as success?

It is important that assessment criteria for the success of Sandbox initiatives are set objectively and in advance, including the crucial financial integrity, security and performance criteria. Otherwise, subjective assessment criteria may lead to adverse outcomes for the Regulator and tarnish national image. For example, certain regulators may prioritize the development of the FinTech industry and innovations at the cost of consumer protection, which may result in the acceptance of firms with poor compliance culture and customer safeguards. The basic criteria must be clear, and if there are points to debate, they can be objectively debated case by case.

Test criteria should be set up in advance in the style of User Acceptance Tests in conventional FMIs, covering functional conformity with the specification, interface functions and technical performance expectations. Successful testing means meeting these criteria.

Furthermore when the Regulator agrees that the product can exit from the Sandbox regime, it must be clear that the regulatory requirements have been met, whether via adaptation of the product and its operating rules or by amendment of Regulations. It must be clear that the exit is clean, so that there is no imminent regulatory or customer problem waiting just down the road.

No product may exit the Sandbox and become publicly available until all financial integrity, security and performance criteria have been met.

4. Implementation considerations

This section explains how the Policy and Regulatory Sandbox can be established and used to assist the design, testing, pilot trialling and eventual launch of a CBDC. We have already discussed the Governance structure for the PRS within the Central Bank, so in this section we focus on the practical activities and risks involved.

a) Participant readiness - risks and challenges

The most difficult part of most Financial Market Infrastructure implementations is preparing the participants to take part. For RTGS implementations, for example, participating banks (which normally includes all the licensed banks in a country) must prepare their technical infrastructure to connect with the RTGS central system at the Central Bank, and must prepare new procedures for inter-bank settlement, including treasury procedures that enable real-time management of cash flows. Banks will also be able to offer new products to customers, which must be designed and tested while the RTGS is being implemented.

For the participants and stakeholders in a CBDC program, similar needs and challenges apply. It is vital that the Central Bank consults the participants about the design of the CBDC and how it will be used, by which types of customer, and explains what functionalities and benefits can be provided. The Central Bank will also have to stem any fears banks have about the CBDC eating into their deposit base and show that the opportunities for added value services are likely to outweigh any impact on banking business from Central Bank money in digital form.

Similarly public communication is very important. Misleading information or even conspiracy theories concerning the potential for CBDCs to be used by governments as a surveillance and control method need to be quickly and convincingly countered. The positive benefits of CBDCs for financial inclusion, cash reduction and specific types of transactions need to be explained.

The Central Bank and its vendors must devote the necessary resources to providing technical and management level guidance to all types of Participants – the banks, non-bank PSPs and other FinTechs – and stakeholders such as government, business associations and consumer groups. Introducing a CBDC via a well-paced Sandbox process simplifies this. The Central Bank must have a technical team ready to assist banks to make and maintain the technical connections to the system and to advise about introducing products into the Sandbox environment for testing.

The consultation process with stakeholders and the public can proceed in parallel with the development of the Sandbox environment, so that the design of the CBDC can be tuned to the needs of businesses, consumers and government as revealed through consultation. Many Central Banks, for example the Bank of England, have issued consultation papers (often in the form of official White Papers, setting out expectations for policy), and have allowed a substantial period for the collection of responses.

Once the Sandbox environment is operational, then the opportunities can be grasped for the Central Bank and the participant innovators to explore the capabilities of the system and a range of Use Cases which then lead to the development of the products that can work within a CBDC eco-system. This offers the chance to get to grips with policy and regulatory challenges in a very practical way as well as fine-tuning the functionality.

b) Capacity development and awareness training for stakeholders

Awareness training for the Central Bank and for commercial banks is needed at several levels, for example: – C-Suite, senior management, operations management and technical levels. It will be the responsibility of the Central Bank's Digital Currency team and its advisors to devise and deliver training courses. Courses should include an introduction to Central Bank Digital Currencies in the context of the Central Bank's role in currency issue and in monetary policy and control of the money supply.

Training should cover the objectives of the Central Bank and the nation for CBDC issue in the context of government digitalization plans, describe the reasons for digital currency issue and outline the pros and cons of Central Bank issued digital currency (as Central bank money) versus cryptocurrencies and monetary tokens issued by private issuers – both banks and non-banks. The characteristics and capabilities of blockchain-based currencies should be covered, explaining the distinction between public blockchains without central governance that are accessible to anyone versus private, permissioned blockchains used for Central Bank Digital Currencies, with centralised governance and a system of access control.

The functions and benefits of smart contracts and programmable money must be explored along with the risks. The way in which the CBDC will be used by businesses, individual customers and government entities must be explained, together with the Use Cases that CBDCs can offer over and above Instant Payment Systems or physical Cash. The requirements for this kind of training are discussed below.

It may well be necessary for the Central Bank as well as commercial banks to recruit experienced people to lead their digital currency and blockchain related developments as specific experience and skills will be beneficial. For example, the characteristics of an effective Team Leader may include the following:

Requirements for Team Leader/Project Manager role:

- Extensive experience in technical consulting, frontier technology architecture, project management and technical team leadership.
- Specific expertise in Payments, Central Bank Digital Currencies (CBDC), Blockchain technologies, Distributed Ledger Technology (DLT), and FinTech concepts.
- Experience of project managing large complex ICT projects with multiple stakeholders, with a track record of having guided critical multimillion-dollar projects to success.
- Specific experience of managing CBDC projects and/or other Blockchain projects in the financial sector.

- Experience in advising central banks and /or commercial banks navigating digital currencies and blockchain technologies.
- Flexible architecture, design and delivery management skills.
- Ideally certified on a relevant blockchain platform or with certifications in similar relevant technologies.
- Must be able to work and write fluently in English as most of the materials are only available in English and many of the projects will be conducted in English.

c) Development of Data Centre infrastructure for a Sandbox

Setting up the Data Centre for a CBDC Sandbox is not greatly different from any banking-standard data centre. Banking-level security and performance standards need to be met and the overall system should be compliant with the BIS/IOSCO Principles for Financial Market infrastructures and relevant ISO data security standards. However, since a Sandbox focuses on experimentation or pilot trials and does not involve a public launch of a CBDC, which may imply changes in Banking and Payment Laws and/or regulations, it is not necessarily the case that a local physical data centre environment is a prerequisite.

There are thus three basic approaches:

- Domestic physical data centre
- Offshore physical data centre
- Cloud data centre

The functional and technical requirements are very similar in each case, but the approaches have different pros and cons. Other things being equal, most Central Banks would wish to use a physical data centre in their own territory for the CBDC Sandbox, but there may be political, security or cost reasons why that is not a desirable option, in which case the other options are available.

The second option - an offshore centre - requires an agreement between the Central Bank owning the Sandbox and the host country's Central Bank to ensure that any liabilities and risks are appropriately handled. Such agreements are commonly made under BIS guidelines when offshore processing of payments occurs (eg for card payments), so this should not be an obstacle. A further consideration is whether the Sandbox-owner country has data residency laws in place which require personal data to be kept only on servers based in the home country. This would be a concern for a live public CBDC service, but for experimentation and pilot services not involving personally identifiable data, it is not likely to prevent the option being possible.

The third option – a cloud service – can be very desirable from the cost point of view especially when the needs for fallback and disaster recovery are considered. Physical data centres need separate Disaster Recovery sites at a reasonable distance from the primary site. Cloud services, on the other hand are set up to be resilient with servers in a range of locations. Performance requirements can be readily met in a cloud environment by purchasing additional amounts of capacity and hence provide scalable solutions which can also enable the transition from Pilot to live service to be more easily managed. Several of the well-known

commercial cloud environments could be used and indeed have already taken part in digital currency experiments for Central Banks. Other private services have been used successfully in FMI implementations.

One specific consideration for a CBDC program run on a cloud service, however, is that the physical hardware used for the CDBC, digital currency and virtual asset Sandbox must be segregated from other systems and programs. This is important from both the security and performance points of view. This may involve a little extra cost, but in general, cloud solutions offer substantially lower cost than physical premises and equipment and also less staff need to be recruited, trained and dedicated to the Sandbox, because most of the basic technical functions can be supported by the cloud provider.

For both option 2 and 3, it is important that highly reliable and fully secure connections are available from the data centres (primary and back-up / cloud as necessary) to the home Central Bank, the distribution systems for digital currency and the banks, FIs and FinTechs who are taking part in the experimental and pilot programs. Experience in FMI implementations, several of which have been carried out on remote or cloud platforms, indicates that this is perfectly feasible, but has to be carefully arranged and monitored. In our experience the providers of CBDC issuing systems are happy to work with offshore or virtual environments and indeed often suggest such arrangements for ease of management.

Cloud providers can also be asked to respond to tender invitations with or alongside the CBDC system providers to ensure a consistent and integrated solution.

d) Requirements for different aspects of PRS activity

To keep the terminology simple, three main stages of activity orchestrated by the Central Bank will be discussed here – the 'Innovation Hub,' the 'Policy and Regulatory Sandbox,' and Pilot trials.

As a broad approach, Sandbox activities come towards the later stages of development of digital currency products, once the product is at a mature stage of development and can reasonably be tested as potentially viable. This means it must be approaching readiness for trials with real users and, if appropriate, real merchants, although as a product enters the Sandbox it will still typically require further technical testing.

Several Central Banks have invested in an Innovation Hub, which is a technical and research environment set up to explore new technologies and at a later stage product Use Cases using the new technologies. This fills the gap between raw ideas and technologies and products and Use Cases that can feasibly be tested in a Sandbox. The objective is to enable the Central Bank as the Regulator and operator of national payment and settlement systems to understand fully the benefits and risks of the new technologies.

In general, experimentation in the Innovation Hub leads on to use of a Policy/Regulatory Sandbox to test the functionalities and infrastructure for digital currency products planned to be offered by banks, other FIs and FinTechs and to understand the policy and regulatory implications of such products, as we have discussed. The Sandbox activities would typically concern products in the later stages of development, such as the CBDC itself and products designed to work with the CBDC, whereas the Innovation Hub would be looking more at

underlying technologies, such as blockchain, with smart contracts and programmable payments and what can be achieved with them.

e) Organization of Sandbox activities.

CBDC Operations could reasonably be centred in the Currency Department of a Central Bank since CBDC is a cash replacement and Currency Departments are responsible for the total cash (M_0) in circulation and the operational side of monetary policy implementation as it affects cash. A CBDC minting and accounting system is not really a Payment System in the same way as an RTGS or an Instant Payment System. In those cases, the Payment and Settlement Department is the usual administrator, because they deal with managing the daily processing cycle, relationships/liaison with the banks, troubleshooting etc, but the transactions being processed are in commercial bank money. The accounting is all done by the commercial banks. It is only settlement that is in Central Bank money. For CBDCs, everything is Central Bank money and therefore has to be handled in parallel with physical cash. The Currency Department must know at all times how much digital cash is in issue and which banks have it in their customers' accounts.

However, this is very different from the traditional role of Currency Departments, whose job is usually highly physical - handling cash movements in and out of secure vaults, physically loading cash onto armoured trucks for commercial banks and receiving worn-out notes, as well as the more intellectual tasks of currency design and arranging the printing of notes (and minting of coins in some cases). Hence the Currency Department will need support from IT, Payment Departments and Monetary Policy Departments (and others) in conducting their CBDC activities; and will have to recruit and train specialists to run CBDC minting and accounting systems.

- The *Payment Systems Oversight Unit* will also have a role in overseeing the transactional aspects of the system - chiefly the way that commercial banks manage wallets and overlay services as part of the CBDC system.
- The *ICT Department* will have to operate the system from the technical point of view and to manage the network connections with the banks, which are likely to be the same as those used for the conventional payment systems.
- The *Monetary Policy Department* will need to be deeply involved in terms of determining the amounts of digital currency that can be issued and the use of directed monetary interventions.
- The *Legal Department* will have an important role in identifying any legal or regulatory problems and gaps. It usually takes a long time to reform legislation and regulations, so these tasks must start early even if they do not need to be fully resolved until the live national launch of the CBDC is imminent.
- *Security/Risk Management Departments* will need to provide cybersecurity assessment, design assistance, review and support to ensure the overall integrity of the CBDC processes.
- The *Central Bank's Communications Department* will have a vital role in designing and delivering a major public education campaign about the CBDC and ensuring that any misunderstandings are quickly handled.

For Innovation Hub and Sandbox activities, leading up to the launch of a Pilot CBDC program involving real users and real money, it will be best to establish a special, separate unit including representatives from, at least, the Departments mentioned above, which will be overseen by a senior management representative who is familiar with payment systems and/or monetary policy and economics. This Unit might require the involvement of between 5 and 10 people depending upon the degree of time commitment. Certainly, there should be a full-time team leader and 2-3 full-time staff. This Unit will not only manage the experimental and introductory activities, but will be responsible for policy formulation, regulatory analysis, supplier selection, public consultation, public education, training and onboarding of the banks and designing, with the Communications Department, much of the public education materials.

f) Selection of Sandbox suppliers and their role.

There are already a wide range of CBDC issuance suppliers in the market. However, many of the suppliers are niche product vendors who have emerged from blockchain development and do not have the scope to provide all the elements of a CBDC eco-system. It is important in the tender process to ensure that the basic CBDC system providers are linked up with those who can offer the infrastructure, including communications and front-end aspects of the service such as mobile Apps and PoS systems.

As the market is large and growing, it is worthwhile to carry out an RFI/shortlisting process leading to the full RFP. The main RFI criteria should include:

- Experience of the company – length of time in business, which CBDC and payment systems implementations in which countries have they carried out, with, say, 3 reference sites, and whether local support is available in the region
- Aspects of the CBDC product – whether it is ready to implement, the approach to key security functions; and whether the key policy objectives and design issues are supported such as multi-tier function with banks, mobile payments, QR codes, off-line payments etc.
- Whether a Sandbox environment can be provided with a Proof-of-Concept version of the system, and whether this can be scaled up to support Sandbox experimentation with participants and eventually a national system. Additionally, how quickly could the Sandbox be set up ?
- Whether the system can extend to cross-border as well as domestic payment and settlement.
- How the company will work with the central bank to ensure knowledge transfer, operational training, full documentation, and training and onboarding of the Participants.

For the RFP/ Invitation to Tender process itself, the main areas of assessment will include:

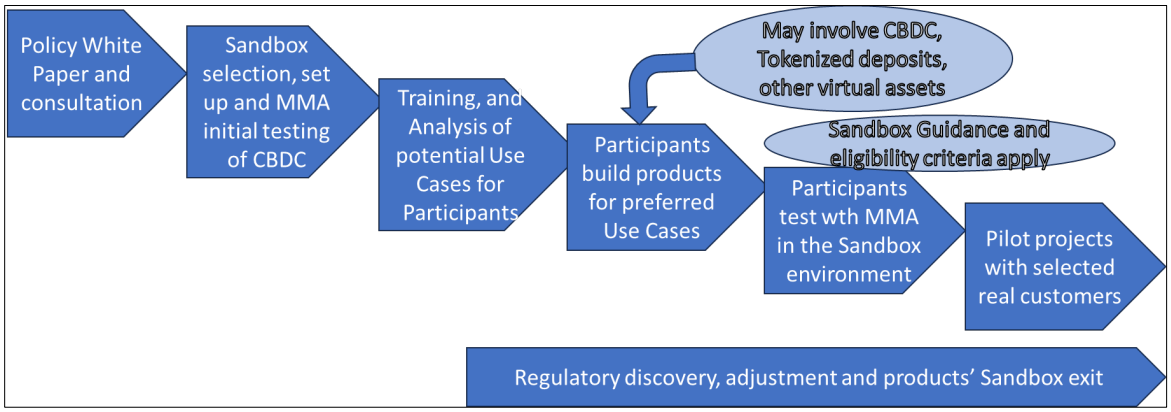
- Adherence to guiding principles for the project and systems
- Vendor criteria – due diligence questions on vendor status and experience

- Functional needs of the digital currency
- System housekeeping for the Sandbox regime and pilot trial systems
- Technical and non-functional requirements of the digital currency
- Project execution and implementation requirements

The context will encompass the delivery of written responses and a Proof-of-Concept exercise as part of the selection process, the provision of the Sandbox environment and its operating rules. It will also include the process for transition to Pilot trials, and an indication of the tasks involved in live roll-out of a national CBDC. Support for an 'Innovation Hub' environment may also be included.

g) Outline of implementation steps.

The implementation steps involved in setting up a CBDC program and a CBDC Sandbox in the context described are quite similar to those for conventional FMI projects, except that a lot more policy formulation and consultation has to be done at the start and the idea of Proof-of-Concept and Sandbox programs are additional features. Once the Central Bank has selected a CBDC product and established a testing environment in the form of a Sandbox, then banks and FinTechs can be brought into the environment via development of products to meet beneficial use cases. Regulatory Discovery can be a continuous process. The main steps are as follows:



Source: Authors' illustration

1. **Policy Formulation and White Paper:** As well as working through the formulation of the necessary policies and objectives for a CBDC, and assessing any legal hurdles, it is worthwhile to develop a White Paper for public consultation purposes - describing the policy and functional objectives for the CBDC as well as the concept of the Sandbox environment which banks and FinTechs will need to understand. The aims of a Sandbox for testing policies as well as products, and for regulatory discovery are to identify gaps and/or incompatibilities between the new CBDC eco-system and the existing regulatory framework. These will need to be addressed in the White Paper. The Paper must explain:

    - how Proof-of-Concept exercises will be used,

- how the Sandbox regime will contribute to the process,
- what is envisioned for Pilot programs, and who will be involved in them,
- what will be done to manage consumer protection, privacy rules, criteria for success, funding, resource and implementation needs, and
- what will be the next steps for products exiting the Sandbox.

The White Paper can be used to assist consultation with the banks, who need to be brought on board, FinTechs who may be sources of useful innovations, government agencies to be involved and the public - businesses and consumers.

2. **Requirements and design**. Informed by reaction to the White Paper, business and systems analysis must be conducted and documented so that the information can be used in the selection of suppliers. It is important to examine the CBDC objectives cited by other Central Banks in their experiments and to be clear on the key objectives from the nation's point of view as explored for preparation of the White Paper. It is important to determine whether the prime objectives are cash reduction, financial inclusion and controlling dollarization or whether monetary policy opportunities or protection of currency stability in the face of cryptocurrency use are more significant. The role of the banks also needs to be clarified, as they will wish to be assured that the CBDC will provide opportunities rather than risks for their businesses. Once objectives are clear then requirements become easier to document.

   The system and instrument requirements to meet each objective should be documented, explaining how each objective will be met. Devising specific Use Cases and identifying their benefits and implications can provide a useful framework for identifying detailed requirements. Design features can be suggested in the RFP, but it is often best to ask potential suppliers to propose the design and how it meets the requirements, as they know best how their system can be configured. One crucial design feature that must be clear for the RFP is whether the system is to be token-based (like cash) or account based (like an instant payment system). In token-based systems, e-wallets issued by banks and owned by customers play the part of an account. Most CBDC designs assume a token-based approach, which is easier to manage from the privacy point of view, although the provision of e-wallets by banks effectively enables account-like functions. At this stage, the Central Bank can also consider whether to set up the CBDC installation in a domestic data centre or to use an external or cloud environment (as discussed earlier in this paper).

3. **Selection exercises**. Central Banks must conduct tendering and selection exercises for software and infrastructure. The first step is for the Central Bank to explore the market, types and scope of suppliers, suppliers' current track record, covering suppliers of suitable secure infrastructure as well as CBDC minting suppliers. An RFI/Shortlisting exercise should be conducted to reduce the list of possible prime suppliers to no more than 4 or 5 (as described earlier in this paper). Then an RFP exercise can be carried out, focussed on the requirements formulated as described above. IMF recommends that a Proof of Concept should be conducted with preferred suppliers before the final choice is made not only to test functionality but also how

the system can be integrated into the Central Bank's ICT environment and the banking and payments eco-system of the country. The PoC installation for the successful bidder can become the basis of the Sandbox environment.

4. **System customization**. Customization, as always, needs to be kept to a minimum, hence the value of solutions with specific adjustable parameters. The more a system can be adjusted to support specific Use Cases via configuration options rather than customization the more efficient implementation will be, and unforeseen faults and errors can be avoided. The degree of flexibility built into the core system design should be explored in the RFP process.

5. **Testbed deployment and system integration testing**. If a PoC is set up within the Central Bank's own environment or in a virtual environment as part of the RFP process, it should be possible to extend the PoC to meet specific Use Cases required under Sandbox conditions. Connectivity with the banks must be organized at this stage, the nature of which will depend on what data centre infrastructure is used and what type of products commercial banks expect to deploy. There may be a need to include technical cybersecurity elements at that stage. Despite the inbuilt security of blockchain systems, it is still transaction origination and transmission to the payment system that introduces the greatest risks.

6. **Design of Use Cases.** Identifying beneficial and feasible Use Cases for PoCs, experimentation and Pilot programs to be run within or alongside the Sandbox is vital for the successful design of new products. The initial Use Cases will have been defined earlier in the program in conjunction with the setting of policy objectives and functional requirements. However, the exact form and function of Use Cases will have to be revisited during the test phases, first internally by the Central Bank and participating institutions and then with a selected group of end users - consumers and businesses including merchants. Ideally, government agencies who will use the CBDC for both distribution and collection of funds should also be involved. These Pilot exercises will enable the definitions of the Use Cases to be refined and, potentially, further Cases can be added.

7. **Operational design – who does what and when**. The role of the Central Bank as System Operator needs to be fully documented and such material should be integrated within the training programs described below. In addition, any separate Technical Operators, such as virtual ICT environment providers, the banks as distributors of the CBDC via programmable customer wallets for each type of transaction and Use Cases should also be fully documented and integrated within the training programs.

8. **Documentation and training**. Training of operations and administrative teams at the Central Bank, based on robust system documentation is necessary as always. There are several levels of training needed. First a general level of awareness training for Central Bank staff and for staff involved at participating institutions. This can be conducted at C-Suite level, management level and operational level with varying degrees of detail and tailored content. Specialized training will be needed for the ICT team covering the nature of blockchain systems and the challenges of interoperability

with the conventional payment systems. The content will vary for the Central Bank, commercial banks and any FinTechs involved. The training for user and technical operation of the CBDC system and the available instruments will usually be provided by the supplier but will need to be refined by the Central Bank to clarify how the agreed Use Cases will operate.

9. **Participant Readiness**. This is always the most difficult aspect of an FMI implementation, as we have already mentioned. All such implementations involve cost and tie up scarce resources for the commercial banks, which will be resisted unless the commercial benefits for them are clear. There will need to be a committee of bank representatives (and perhaps a separate one for FinTechs who have somewhat different needs and expectations). The Participant Committees provide a forum for reporting project progress, explaining to the participants what they have to do and what the benefits are, and receiving feedback on problems and concerns. Training of Participants and other stakeholders who have operational roles has to be conducted as discussed above.

   Finally commercial banks and FinTechs will have to develop the new products, test them in the CBDC Sandbox and devise how to market them to customers. Firms and products will need to pass the eligibility criteria and go through an equitable application process as described in Annexes 2 and 3. At the appropriate point, they must provide training materials for their customers to ensure they can use the new facilities correctly and in a beneficial way. The Central Bank will need to support these efforts and ensure that are done effectively.

10. **Objective security review.** Conducting an independent security review before live operations commence is now often a matter of course for new payment system implementations. It should also be the case for CBDC implementations, even at Pilot stage. The review should cover at least cybersecurity, business continuity and customer related risks. Any significant security weaknesses will be much more difficult to fix once Pilot operations have begun, even if only a small number of real users are involved. Any risks related to backup and recovery, intrusion detection, consumer protection and data protection must be detected and eliminated before Pilot Trial activities involving real customers begin.

11. **Launch of the Pilot Trials.** Design and launch of a Pilot version of a CBDC and other products, such as asset-backed stablecoins for specific purposes, is a necessary step towards a national digital currency program. The impact of digital currencies on financial and currency stability is unpredictable, so Pilot trials with real customers may be the only way to reveal the risks and opportunities. We anticipate that the functionality, safety and performance of the CBDC minting/redeeming processes and bank/FinTech products with which the CBDC will be used by customers will have been fully tested within the Sandbox environment. As such products are launched into Pilot operation, there may still be some regulatory questions to be resolved which will have to be addressed before the Pilot operations migrate to live mode. Recruitment of users and merchants for the Pilot exercises would normally be restricted to individuals within the Central Bank and participants, with merchants being bank canteens or similar internal merchants. Compensation arrangements as described

above will need to be in place to ensure liabilities related to each product used end up in the right place.

i) Resources and key decisions needed.

We have already suggested the level of resources needed by the Central Bank to run the CBDC initiative and facilities such as the CBDC Sandbox. However, the participants will also need to devote resources to the program. For each Use Case that a participant wishes to pursue, which will ultimately become part of a product offered to customers, there will need to be a team to manage not only the technical aspects, but also the product design and marketing requirements.

For each product, aspects of different Use Cases may be involved. For example, most banks will need to create a Use Case that includes the provision of an e-wallet to contain CBDCs for each customer. There will be overlay services built into the wallet, such as payments, information services, reconciliation, loyalty programs, perhaps even credit or interest facilities. Each of these overlays is itself a Use Case that will need to go through a PoC stage in the Sandbox before it can move on to become a service offered in a Pilot scheme to real customers.

Every Use Case to be explored and ultimately implemented will need a small, dedicated team, whose size will vary according to the complexity of the Use Case and the product into which it is being built. This will add up to a significant commitment of resources for any participant who wishes to become actively involved in the CBDC program. Banks who consider issuing their own digital assets such as stablecoins for Use Cases such as treasury management or cross-border supply chain automation, will need more substantial resources, as they will not be sharing the effort with the Central Bank and their peers.

Regarding decisions needed for a successful program, it is the participants' product ambitions and consequent resource commitments which are crucial. A new CBDC eco-system with no products to offer customers other than basic wallet to wallet transfer functionality adds little to an environment where instant payments on mobile handsets already exist. It will be the programmable features of the blockchain-based CBDC that will enable banks to come up with convincing innovative products that will attract customers, adding to bank revenues rather than disrupting their traditional business models. It is in this area that the hard thinking and decision making needs to be done. The Central Bank can assist by suggesting Use Cases and facilitating their refinement in the Sandbox, but ultimately commercial decisions made by participants will determine whether or not adoption rates justify the effort expended by the industry.

Over and above this, the policy decisions made by the Central Bank regarding national objectives at the start of the digital currency initiative will also drive the success of the CBDC program. If a Central Bank issues CBDC largely as a monetary policy measure, then popular take up may be less crucial to success. However, in a country with no Instant Payment System, a CBDC introduced purely as an instant payment service – both on and offline - should meet policy objectives regarding financial inclusion and reduction of cash dependence; although it would need to be widely adopted to succeed. The implications of policy decisions like these need to be thought through before large investments are made in digital currencies.

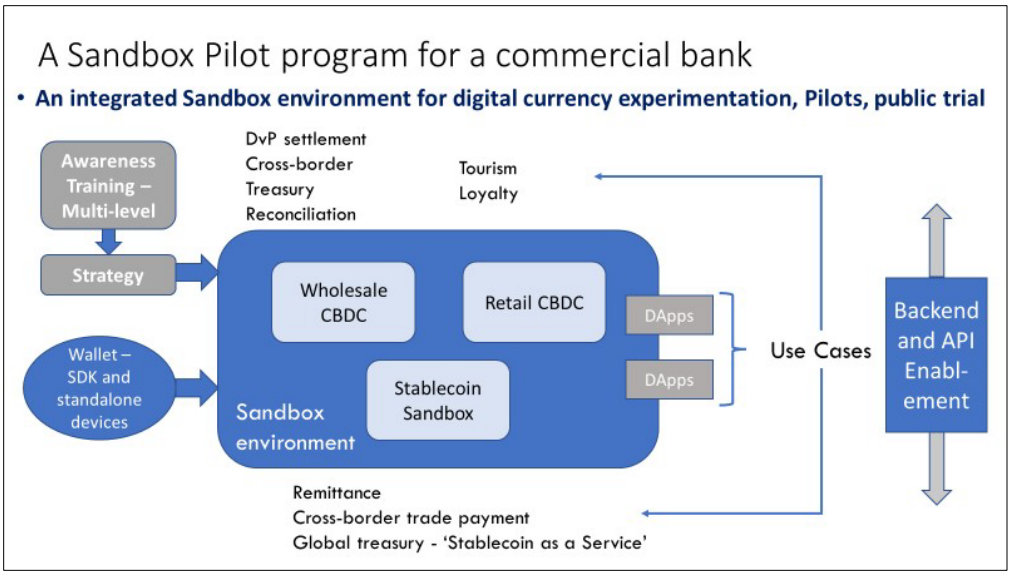
j) Activities, roles of the parties and responsibilities

As the regulator and overseer of national payment systems, the Central Bank must take the lead for the CBDC project and the set up and operations of a CBDC Sandbox. Banks and FinTechs must play their part and be proactive, for example to prepare e-wallet products and Distributed Applications (DApps) etc.

Government may have a more specific role in the encouragement of digitalization via the domestic FinTech industry and may wish to promote the inclusion of Fintech products in the Sandbox. This could involve the partnering of local FinTechs with more experienced international companies to gain experience and knowledge transfer.

For commercial banks taking part in Central Bank CBDC Sandbox activities, the illustration below shows some of the steps involved:

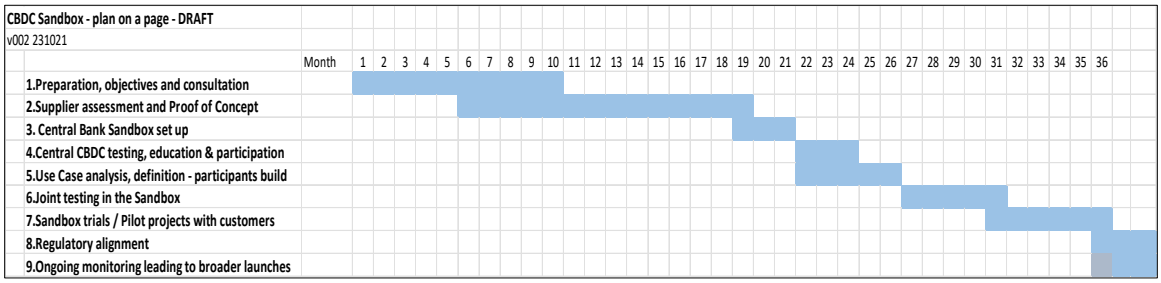
- Internal awareness training at several levels
- Discussion on business and technology strategy for the bank on CBDC and blockchain implementation and identification of the most worthwhile Use Cases, which may be internal or CBDC related.
- For most Use Cases involving customers, an e-wallet product will be the fundamental starting point, on which overlay services will be built and accessed. The design and plan for such a base product will need to be drawn up - it could be based on an SDK implementation on SIM cards or a standalone App. Some CBDC suppliers may themselves be able to provide a centralized e-wallet App that several institutions can use as a starting point.
- Once design, development and implementation work begin on internal blockchain systems or on Apps that will be used to give customers access to CBDC, the Sandbox comes into play. For some banks, especially those with significant internal projects such as inter-system reconciliation and settlement between partner entities, it may be worthwhile to install an internal Sandbox, using facilities from one of several possible vendors.
- For products related to the CBDC and intended for customers or settlement with other Financial Institutions, taking part in a national Sandbox led by the Central Bank is attractive. It may be that the products are developed using conventional technology and are connected with the CBDC Sandbox via special 'web3' APIs, or they may be designed as Distributed Applications (DApps) integrated into the fabric of the CBDC Sandbox Blockchain. The nature of the application may dictate which is best.
- There may now be a stage in which Pilot trials with real customers can take place using the Sandbox infrastructure and running under interim rules. This gives the Banks and FinTechs the chance to see how their innovative products are accepted by customers and potentially to make changes to improve their value.
- The final step is to interface the new products or DApps with the core banking systems of the Bank, so that the blockchain and CBDC activities are seamlessly connected with the Bank's accounting and customer systems. The stage is set for live launch once the national CBDC is available.



(Source: eMcREY[17], Monetics from Atlantic Council CBDC tracker[18])

k) The factors affecting possible timelines.

It is always wise to ask: 'what could possibly go wrong?' to cause delays or failure of CBDC projects. The main causes of delays are not so different from FMI projects. We note that implementing the new technologies involved does not seem to represent a substantially greater degree of difficulty than conventional technologies, but Participant Readiness is the most common problem. In most modern FMI systems, the amount of technical work needed at participants' level is relatively small, as interfacing modules can usually be downloaded. Instant payment systems are more demanding as the internal interfaces to confirm the validity of target accounts can be more complex. A possible timeline for CBDC sandbox development, moving through to Pilot trials and subsequent wider launches is shown below.



Source: Authors' illustration

However, for CBDC systems, there are many more unknowns, which is one of the reasons for the attractiveness of experimental Sandbox environments. Participants must work with new

[17] A major Middle Eastern integrator of payment systems based in Lebanon and Saudi Arabia

[18] https://www.atlanticcouncil.org/cbdctracker/; a regularly updated review of CBDC and related global progress on digital currencies

technologies and different kinds of interfaces such a web.3 APIs, about which few commercial banks would have in-house expertise. Coupled with the challenge of designing profitable products exploiting entirely new kinds of instruments and concepts like programmable money, the participant side of a CBDC project is likely to be much more prone to delays and setbacks than the Central Bank side. We note further that most of the CBDC projects conducted by developed country Central Banks have involved only the Central Banks and their suppliers. Few commercial banks have participated, with the exception of one or two of the BISIH cross-border projects such as project mBridge. Hence, the stock of digital currency experience among commercial banks globally is very limited. It is mainly major banks like JP Morgan, MUFG and Commerzbank who have developed their own digital assets that have the necessary expertise. Most banks will have to buy in expertise from consulting firms or recruit specialists, which is potentially a long process.

Regarding other possible reasons for delay, technical difficulties with the new technologies may arise, especially regarding testing of smart contracts and DApps. Once these pieces of code are embedded in the CBDC blockchain, they are very hard to change, so it is important that they are fully tested with formal test scripts and methods before they are committed to the chain.

The other common problem with large system implementations at Central Banks, especially smaller ones, is that resources are always constrained, so the commitment of specific specialists to the project must be confirmed at a high level. It is especially important that people who have been trained to work on the CBDC project are not then transferred elsewhere while the project is still in progress.

l) What lies beyond the Sandbox period and Pilot experimentation?

We have suggested above that successful Pilot trials may bring a commercial bank or a FinTech company to the point where launching the new product is attractive as it looks to be profitable and likely to appeal to customers. To do these two main prerequisites have to be in place;

- For CBDC related products the CBDC itself must be ready for launch. For a Central Bank, this is a strategic and political decision not a technical or commercial decision and many factors must be considered. The decision process for a developed country Central Bank, where the risks may be perceived to outweigh the benefits, may be very different from those of an emerging market Central Bank where pressing problems of financial inclusion and cash use reduction promise more immediate benefits. This reticence has led some major commercial banks to issue their own virtual currencies in the form of a firmly backed stablecoin which is then used to offer 'stablecoins as a service' to major customers for example for international treasury management purposes.
- The Pilot Trial must have resolved any questions about the viability of the product in both commercial and regulatory terms. Hence the product must have been able to exit the Sandbox regime with a clear regulatory framework in place so that it is clear which regulations apply and which do not, what can and can't be done with the product, who can use it and how it is to be utilised, how consumer protection principles are applied and that there is a guarantee of technical security as well as financial accuracy.

5. Conclusion

a) Costs, benefits, and risks of the PRS program

The major benefits of a CBDC Sandbox programs are much as described by the UK FCA when FinTech Sandboxes were first introduced, as mentioned earlier: "*a 'safe space' in which businesses can test innovative products, services, business models and delivery mechanisms while ensuring that consumers are appropriately protected*."

This applies equally to Central Banks exploring the potential of CBDCs and to commercial banks and FinTechs testing CBDC Uses Cases and products to be offered to customers. We have noted that both the Central Bank and the participants can avoid reputational risk by thoroughly 'road-testing' a product concept in the Sandbox before letting it interact with real customers. The additional benefits of Policy experimentation and Regulatory Discovery offer major additional benefits over and above the pure testing aspects of a Sandbox regime. This is what distinguishes a Sandbox from a standard testing environment.

Designing Sandbox environments so that it is relatively simple to extend them to support Pilot trials with real customers and real money adds a further benefit. This brings the additional values of gaining knowledge on the response of customers to the product before the investment in a major launch has been made.

The risks of Sandbox projects are comparable to those of conventional FMI projects and mainly revolve around preparing the participants for managing Sandbox, Pilot and eventually live operations with new products. Since we are dealing here with innovative technologies which may be challenging to the banks, the technical risks may be higher, but the Sandbox approach reduces the risk to customers and to the financial system as a whole.

Regarding costs, the market for CBDC products and blockchain infrastructures generally is much less mature than that for FMI products, so prices are less predictable. Setting up a CBDC environment for a Central Bank will likely involve costs of USD 1-2 million with annual maintenance costs of up to USD500,000. Every Use Case that has to be added into the Sandbox for participant experimentation and testing will involve additional costs, which may be borne by the respective participants. Preparing for Pilot trialling will also add costs as connectivity may have to be enhanced, merchants brought on board with QR code facilities and PoS devices, users recruited, and compensation arrangements put in place.

b) Circumstances where PoC and Pilot programs as well as a PRS regime are needed.

We have painted a picture in which CBDC Sandbox regime is used to prepare for market products related to CBDC in a step-by-step fashion. These steps are:

- First a PoC approach is used as part of the selection process for the CBDC issuing system and hence the Sandbox infrastructure, since most CBDC platforms provide a Sandbox environment.

- Secondly, the Sandbox is used to test the basic capabilities of the CBDC platform to issue tokenised currencies securely.
- Then banks (and FinTechs) are brought in to enable testing of settlement functions.
- Next, PoC and more detailed testing of products from the financial institutions, based on specific beneficial Use Cases built for use with the CBDC.
- When key criteria have been met, then the CBDC and related products can be released for limited Pilot trials with real money for use with a small, selected group of users and merchants, usually in-house staff of the Central Bank and stakeholders.

Hence, we see PoCs, Sandboxes and Pilot trials as valuable tools for use in different stages of the experimental process towards national launch of a digital currency.

c) Immediate actions for a country to assess the progress of a PRS implementation.

i. Set up a project team including the relevant Central Bank departments and prepare a concept paper - what are policies, what are the principles to be adopted, what are the specific objectives with an assessment of their viability.
ii. Talk to other central banks who have done similar projects to assess lessons learned
iii. Formulate policy objectives involving Central Bank and Government
iv. Write a consultation paper for the industry and the public (the White Paper) explaining the scope and objectives
v. Talk to leading suppliers
vi. Write a functional, technical and implementation requirements paper
vii. Conduct supplier shortlisting
viii. Work out how Sandbox and Pilot projects will be hosted – onshore, offshore, outsourcing, cloud etc.
ix. Conduct full RFP exercise with the shortlisted suppliers, to include a PoC exercise and establish the Sandbox testing environment from the winning bidder's product.

The Guidelines contained in this report will not cover every circumstance that a Central Bank may encounter when embarking on or engaged in the CBDC journey, but it is hoped that the Guideline will provide a basic Toolkit to eliminate some of the pitfalls and suggest worthwhile approaches to pursue. Only time will tell how the CBDC, cryptocurrency and stablecoin landscape will evolve, but the indications are that Central Banks will need to take a leading role to ensure that these powerful new technologies ultimately deliver benefits rather than problems.

Managing the risks depends first on understanding them, which hopefully this paper will help Central Banks to do. The Sandbox approach combined with well-planned Pilot Trials seems to offer significant promise for identifying valuable opportunities at policy, regulatory and product level as well as proving a powerful tool for managing risks to financial and currency stability that may arise from wide use of digital currencies and virtual assets.

Annex 1 - Types of Sandbox Environment

While it may not be worthwhile to list the wide range of variations on the Sandbox theme[19] that have been used worldwide in the last few years, we describe here approaches and terminology which could be generally relevant.

Regulatory Sandbox

- A R*egulatory Sandbox* is a regulatory regime set up by a Regulator that allows small-scale testing of innovative products and services, and which may include trialling with real customers under specific conditions. There is likely to be some relaxation of regulatory requirements – mainly administrative ones like company experience and expertise of Directors and also capital requirements. There will be close supervision by the Regulator.
- The Regulator is also a participant in the sense that it will be trying to understand products better in order to address regulatory gaps. Sandboxes provide a kind of regulatory laboratory allowing small-scale tests with the aim of facilitating and making evidence-based decisions in the development of legislation and regulations for innovative services.
- In many cases special conditions will have to be set out for specific cases so as to offer a tailored regulatory environment that fits the functionality and mode of operation of FinTech firms and their products.

Global Sandbox

- A global Sandbox is a regime designed for cross-border testing of FinTech products and has been used in the context of Cross-Border CBDCs. The idea of a cross-border Sandbox was proposed by the UK FCA in their Consultation Document of August 2018, with the aim of providing a framework that allows firms to trial and scale new technologies, products, or business models in multiple jurisdictions.
- Participants of the global Sandbox are able to use a single application process, so that only one application is necessary to gain access to multiple jurisdictions for trialling cross-border products. This does not mean, however, that regulations would be the same in each jurisdiction. Hence, the BIS cross border CBDC projects such as Project Jura, Project Dunbar and Project mBridge have still had to find ways to handle different regulations and national requirements in testing cross-border settlement processes.
- The concept of a global Sandbox also enables Regulators to exchange ideas and experience and provides an information resource for firms about each regulator's specific requirements for cross-border testing.

Jurisdictional Sandboxes

- Around the world, there are a number of "International Financial Centre" (IFC) jurisdictions which employ different laws from the country in which they are situated. Thus, the Dubai International Financial Centre and the Abu Dhabi Global Market in the

[19] See e.g. "International experience in the use of "Sandboxes"
http://www.eurasiancommission.org/ru/act/dmi/workgroup/materials/Documents/Международный%20опыт%20применения%20песочниц.pdf

UAE both use English Law, as English Law has a rich structure and a large body of precedent to go by in the context of financial services. Similarly, the AIFC Court - a major feature of Kazakhstan's AIFC, is completely independent of Kazakhstan's judicial system and operates using English civil law overseen by UK judges. These can be considered as 'jurisdictional Sandboxes.'

- IFCs may enable innovative products to be piloted alongside the development of corresponding legislation, which could be adapted and implemented in mainstream jurisdictions later. IFCs and smaller jurisdictions are in a position to be more flexible in responding to changes and in approaches to, for example, corporate structures, simple taxation, and appropriate regulation, provided that they do not breach international rules on AML/CFT etc.
- Although International Financial Centres and small jurisdictions with a focus on financial services would not regard themselves as Sandboxes, there are FinTech businesses operating in eg the Virgin Islands, the Cayman Islands, Guernsey and Jersey, under lighter regulatory regimes than they would experience in major jurisdictions. For example, In 2014, the Jersey Financial Services Commission introduced Bitcoin as an asset class by licensing the first regulated fund for Bitcoin. This attracted a surge in crypto/FinTech funds, and Jersey began to be seen as a location to develop expertise in raising capital through innovative tools[20].

[20] A recent example under Jersey's pioneering regulation is the launch of Coinshares Fund 1, an Ethereum venture capital fund.

Annex 2: Eligibility criteria and application process for a Sandbox

Introduction

The eligibility criteria and application process for a Fintech Sandbox and for a CBDC Sandbox are essentially similar, but we are focussing here on the processes for a CBDC Sandbox, for which the base product – the CBDC issuance system - is owned by the Central Bank. Hence, it will be the Central Bank who decides which commercial bank or FinTech digital currency products will be able to proceed to live operation and, in consultation with the provider, exactly how the Regulatory framework will operate.

As for FinTech Sandboxes, the applicant firm would have to include in the application process plans for exiting the Sandbox and establishing operations under normal Regulatory oversight.

We now set out a potential process for a product entering the Sandbox regime. The first step is to determine whether the product is eligible for this kind of treatment.

Eligibility criteria

The most critical eligibility criterion is **genuine innovation**, which means that firms must demonstrate that their product brings either innovative technology, a new/more-effective business model, or a new product/service to the market. In our context, specifically how the innovation will complement the CBDC and add to its market potential and attractiveness.

In some jurisdictions, the Sandbox is only open for new financial products unavailable in their market. Generally, for reasons of fair competition, a Sandbox regime cannot support a product which may be competitive in terms of its innovations with a similar product in the same market.

Other eligibility criteria may include the following:

- **Status of company -** Legally registered as a company and financially stable, complies with relevant regulations, has the necessary expertise
- **Benefits to consumers and the financial system**. The proposed product/service should bring better outcomes for the consumers or the market overall (for example, new functionality, cost efficiency, more availability, market stability)
- **Background research**. The applicant firm must demonstrate that it has explored the regulatory framework and understands how its products fit or do not fit existing regulatory requirements. Certain regulators, for example, MAS in Singapore, ask applicants to define test and outcome scenarios and proposed boundary conditions, including limits.
- **Project maturity**. The product, including the IT system, compliance controls and human resources, should be ready to be tested with real consumers. Firms at an earlier stage of development should work informally with the Central Bank or via the Central Bank's

Innovation Hub (if such a body has been established) to refine the functional, technical and regulatory needs before embarking on a specific Sandbox program.

- **Need for support/testing**. The product genuinely needs help from the regulator: the firm cannot fully meet regulatory requirements, or the FinTech product does not fit into the existing regulatory framework. In the CBDC case, the fit of the product to support Use Cases within the national strategy for CBDC roll-out and the anticipated Regulatory Framework will be an important criterion.
- **Risk mitigation.** Risks underlying the proposed product and technology should be adequately assessed and mitigated. For example, an applicant should be able to demonstrate preliminary testing results and show how substantial risks can be mitigated. In addition, Regulators may well ask for results and assessment of cybersecurity tests of the technology.
- **Investor protection and compliance.** An applicant must demonstrate commitment to protecting consumers and investors and explain the firm's compliance culture. Also, exit and transitional strategies in case of discontinuation of operations must be outlined.
- **Serve the domestic market.** An applicant should plan to offer its services in the domestic market as a value-added component of the CBDC program, or if the product is intended to be primarily offered cross-border, there should be a demonstrable benefit to the domestic financial services industry, for example via training of experts, development of IT ecosystems, creating a Centre of Excellence.

Assessment of the firm and product against these criteria has a subjective element and can leave significant space for interpretation by the Regulator. Therefore, the assessment process should be disclosed in detail, for example on the Central Bank web site, and the procedures for review of Sandbox applications should be designed to be as objective as possible. A potential process is defined below.

Application and Approval Process

In this section, we set out an example application process based on what has been used in various countries. An example of an application is set out in Annex 3 for illustration. Once eligibility has been established, the starting point is for the Bank or FinTech firm who wishes to submit a new product for the Sandbox process to present an outline of their product and plans for commercialization.

The Application and Approval process has three stages after eligibility has been established and a formal application (for which a Template should be provided by the Central Bank) to submit the product for testing under the Sandbox regime has been submitted:

(1) Application Stage

The Central Bank will assess the application and will endeavour to inform the applicant of the potential suitability or otherwise for a Sandbox within 10 working days of receiving all information necessary for making the assessment.

(2) Evaluation and Preparation Stage

The Central Bank will examine the application in detail, the timeline for which will depend on the complexity of the application, the completeness of the information and the specific legal and regulatory requirements involved.

The Central Bank will work with the applicant on any further refinements that might need to be made to the application during this phase. Applicants will then be informed in writing whether they will be able to proceed with the Sandbox activities. If the application is rejected, the applicant may re-apply when the reasons for rejection have been addressed.

(3) Testing and Experimentation Stage

Once approved, the product can be interfaced with the CBDC Sandbox and the Sandbox program for the product is launched. The testing stage then begins, which will consist of at least two major steps – testing of the product by internal testers from the Central Bank and the product suppliers, as a type of Operational Acceptance Test; then the release of the product to a selected group of end-users for a 'semi-public' Pilot trial, which will, in the CBDC case, involve staff of the Central Bank and stakeholders, operating within the overall rules of the Pilot Project.

At the beginning of this semi-public stage, the Sandbox entity must make it clear to the end-users that they are offering their services in a Sandbox, explain key risks associated with it, as well as obtain customer acknowledgement that these risks have been understood.

The Central Bank must take a view on any restrictions to be applied to the customer base in terms of numbers and types of customers, and time and value limits to be set. Customers must be forewarned if the product may not continue to operate after a certain time period. In general, the Central Bank would train end-users about CBDC as part of the user-onboarding process, so the product supplier must be ready to support such training.

During the semi-public stage, If the Sandbox entity intends to make material changes to the service a formal application should be made to the Central Bank at least 30 days in advance with reasons for the change. Unless the change concerns a security issue, the Sandbox entity may continue with the existing service while the Central Bank reviews the request.

The Central Bank must publish all relevant information regarding Sandbox entities on its website for the purposes of informing the industry and the general public and to meet the necessity for full disclosure. This should be done together with a public education program to ensure that misleading information is rapidly countered[21].

[21] Conspiracy theories are already beginning to crop up regarding CBDCs as a means of social control. Such rumours will disturb the stakeholders as well as the public, so full disclosure of plans is highly desirable.

Annex 3: Example of a Sandbox Application

Scenario

- A company has developed a new prototype that can offer a financial service of a type regulated by the Central Bank in a more efficient, functionally rich or more customer-friendly manner than currently available in the local market. In the context of the CBDC, this would be a product intended to add value to the CBDC proposition. It might be, for example a loyalty program based on a CBDC e-wallet.
- By providing the financial product through this new prototype, some existing gaps regarding such services can be addressed.
- The company has performed its own research and due diligence on the prototype in its testing environment, has established adequate technical knowledge and has taken into account the evolving landscape of the financial sector, so that the product can be expected to have a sustainable future.
- However, the company has limited experience in the financial sector, and is not staffed up adequately to apply for a financial services licence to offer the product publicly – the FinTech believes it may not be able to fully comply with the existing legal and regulatory requirements, especially the administrative ones.
- The company is looking for certain exemptions from the Central Bank in order to transition the product into the market. In the CBDC context, the company will be seeking integration of its product into the overall CBDC program on a competitive basis.

Sandbox Approach

- The FinTech firm checks the eligibility criteria for itself and the product and submits an application in accordance with the Sandbox guidelines (see Annex 2). In the case of a bank product submitted by a licensed entity for the CBDC Sandbox, a formal application will still be needed, with a description of the Use Cases proposed.
- The Central Bank receives the application, assesses it against the Sandbox evaluation criteria and gives an initial view of suitability within 10 days.
- The Central Bank examines the application in detail, including the credentials and experience of the FinTech firm and, together with information from the Fintech's own assessment, confirms the specific legal and regulatory requirements to be relaxed for the Sandbox process. Administrative relaxations are less likely to be needed for licensed entities proposing value-added Use Cases for the CBDC ecosystem.
- The Central Bank informs the Applicant firm in writing whether it can proceed with the Sandbox process. Via ongoing discussions, details can be agreed including the physical location of the production software and the access that the Central Bank will need to the testing environment and processes, and any potential trialling with real customers.
- A monitoring and reporting regime with be agreed.

The following table shows the type of evaluation criteria which may be applied and the related questions which could be asked by the Regulator. Some example answers are provided to illustrate the kind of information expected in a first pass. It is likely that the Regulator will ask for further clarifications before completing its evaluation.

Evaluation Criteria	Assessment (illustrative and non-exhaustive)
Is the proposed product genuinely innovative in the local market: i. Does it improve accessibility, efficiency, security and/or quality in the provision of a specific financial service; ii. Does it enhance the efficiency and effectiveness of risk management; iii. Does it deploy new or emerging technology, or use existing technology in an innovative way; or iv. Does it lead, directly or indirectly, to a better deal for the customer ?	The proposed financial service is not available in the country. It utilizes a new technology, and/or an innovative business model or process to improve customer experience and streamline operations. It would add value to the CBDC customer proposition.
Is the proposed product unique in the local market ?*	There is no other provider who is currently offering a very similar product in a similar way in the domestic market.
Does the applicant have the intention and ability to deploy the proposed financial service in the country (or cross-border) on a broader scale after exiting the Sandbox?	The applicant has recently secured $1m funding. It has doubled its headcount over the last year and has provided a business plan and roadmap to deploy the proposed financial service in the country on a broader scale.
Which regulatory constraints does the Firm wish the Regulator to relax in order to offer the Product to a set of domestic trial customers	Requested relaxations are *[details would be provided]*: For example, admin requirements such as[22] • Capital requirements for this type of product • Length of time the Firm has been in business • Location of major shareholders This will require dialogue between the Applicant company and **Central Bank** so that the Regulators and the innovators can fully understand each other's needs.
Are the test scenarios and expected outcomes clear?	A set of test scenarios, criteria and scripts have been provided, with the results of internal tests and expected results in the Sandbox environment.

[22] In this example. But relaxation of security, AML, KYC or consumer protection requirements would not normally be permitted

What are the expectations for trialling with real customers while the Product is under the Sandbox regime, and what customer safeguards will be involved	(Limitations for each case would be a matter of agreement between the Applicant and the Regulator): In this example: Regarding trialling with real customers, the Sandbox trial will be limited to 50 customers and run for a period of 6 months. The intention will be to measure improvements in customer experience and growth in transaction volumes and to validate expectations of the risk exposure and mitigation measures.
Are the boundary conditions and limits appropriate?	Participating Users will be made aware that they are taking part in a product trial. KYC criteria will be strictly applied, and full 2-factor authentication of users will be in place, so that only the official trial participants can take part. The Regulator will have on line access to the system statistics and incident logs. All customer complaints will be reported immediately to the Regulator.
Are significant risks assessed and mitigated?	The proposed financial service has been tested under various risk scenarios in an internal test environment and the risks have been documented.
Is there a clear exit and transition strategy?	In the event that the proposed financial service has to be discontinued, the Sandbox customers will be informed in advance to ensure a smooth exit.

*This question is to help avoid any potential risk that the Applicant firm could gain an advantage over a competitor by using the Sandbox program.