

Improving Fiscal Transparency in Macedonia:

Machine Learning, Social Media and Blockchain

2018 ICGFM Case Competition

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GEORGETOWN UNIVERSITY

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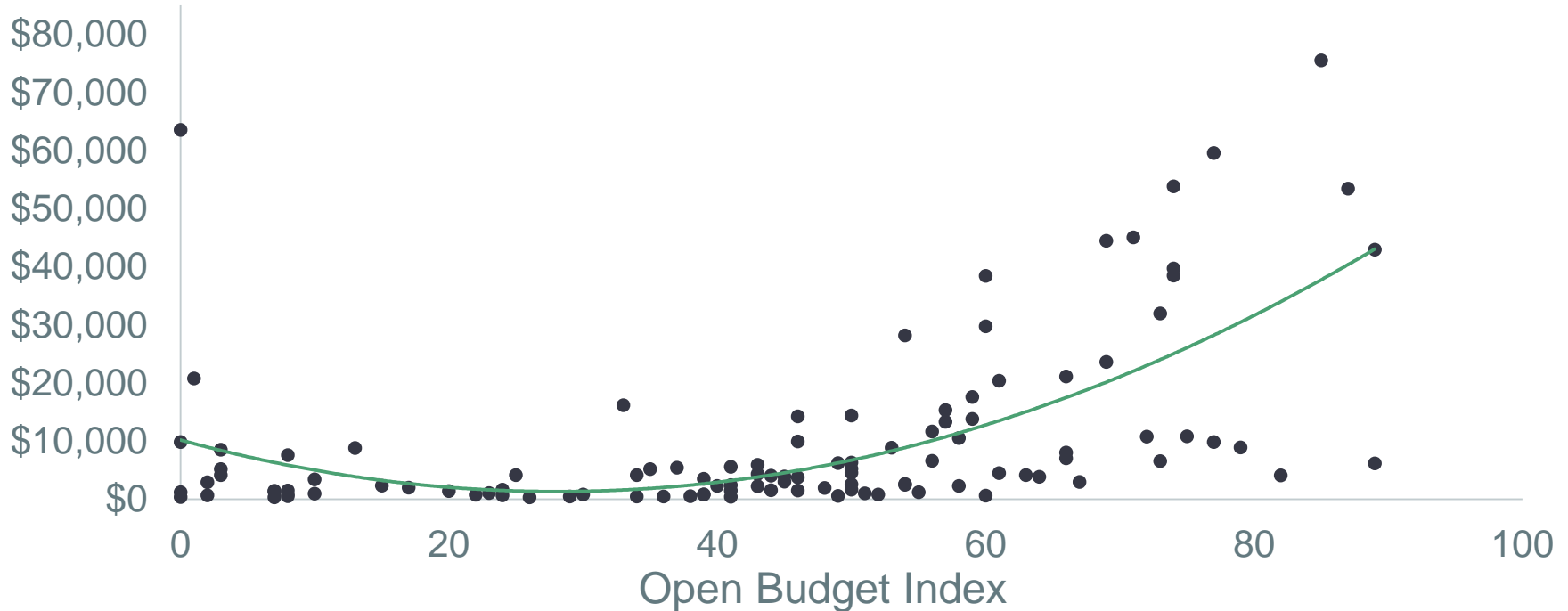
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1A Fiscal Transparency and Economic Development

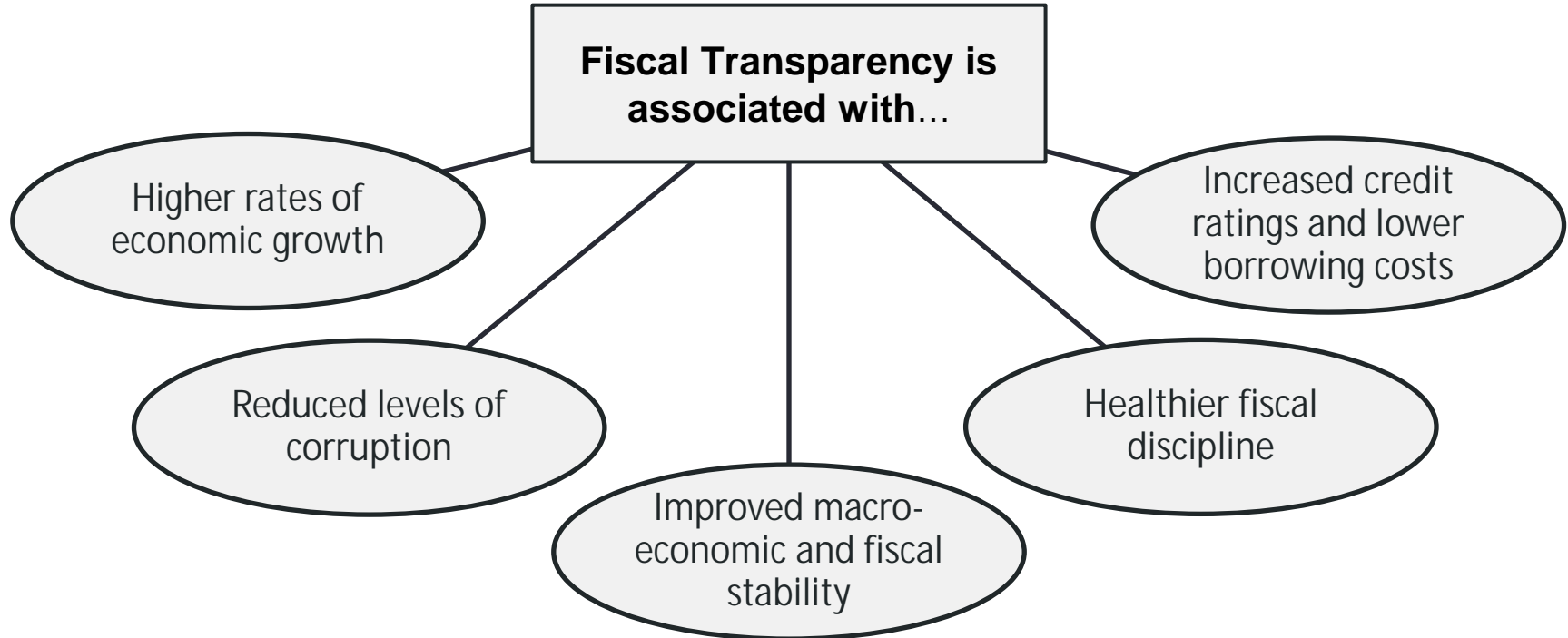
Higher degrees of fiscal transparency tends to be associated with more economically developed nations.

GDP per Capita, Current USD



1B Fiscal Transparency and Economic Development

Fiscal transparency has been linked to other factors conducive to economic development.



1C Fiscal Transparency and Economic Development

In 2015, the Public Expenditures and Financial Accountability Initiative accessed the public financial management processes of Macedonia.

Budget Process	
Classification	A
Quality of timeliness	D+
Expenditures	B
Fiscal Management	
Multi-year perspective in fiscal planning	C+
External Audit	
Effectiveness of internal audit	C+
Scope, nature, and follow-up of external audit	D+
Accessibility	
Public access to key fiscal information	A

2A Case: Macedonia


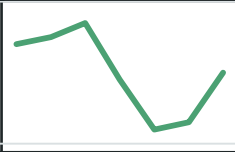

Macedonia Overview:

- § Government type: Parliamentary Republic
- § President: Gjorge Ivanov (2009)
- § Prime Minister: Zoran Zaev (2017)
- § Currency: Macedonian Denar
- § Nominal GDP: 11.0 bn USD
- § GDP per Capita: 5.5 bn USD
- § Population: 2.074 mn



2B Case: Macedonia

Macedonia has seen an increasing trend in the debt level, partnered with a consistent fiscal deficit. In accordance with this trend, S&P lowered nation's credit rating to BB- from BB in 2013, affirming this rating earlier this year.

	2012	2013	2014	2015	2016	2017	2018	
Nominal GDP (bn MKD)	10.0	11.0	11.0	10.0	11.0	11.0	12.0	
Balance / GDP	(3.9%)	(4.0%)	(4.2%)	(3.4%)	(2.7%)	(2.8%)	(3.5%)	
Net Debt / GDP	26.6%	29.4%	33.2%	36.4%	38.2%	40.1%	42.8%	

2C Case: Macedonia

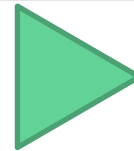
Causes:

- Lack of institutional capacity
- Inadequate auditing systems
- Limited technology capacity
- Political corruption



Direct Effects:

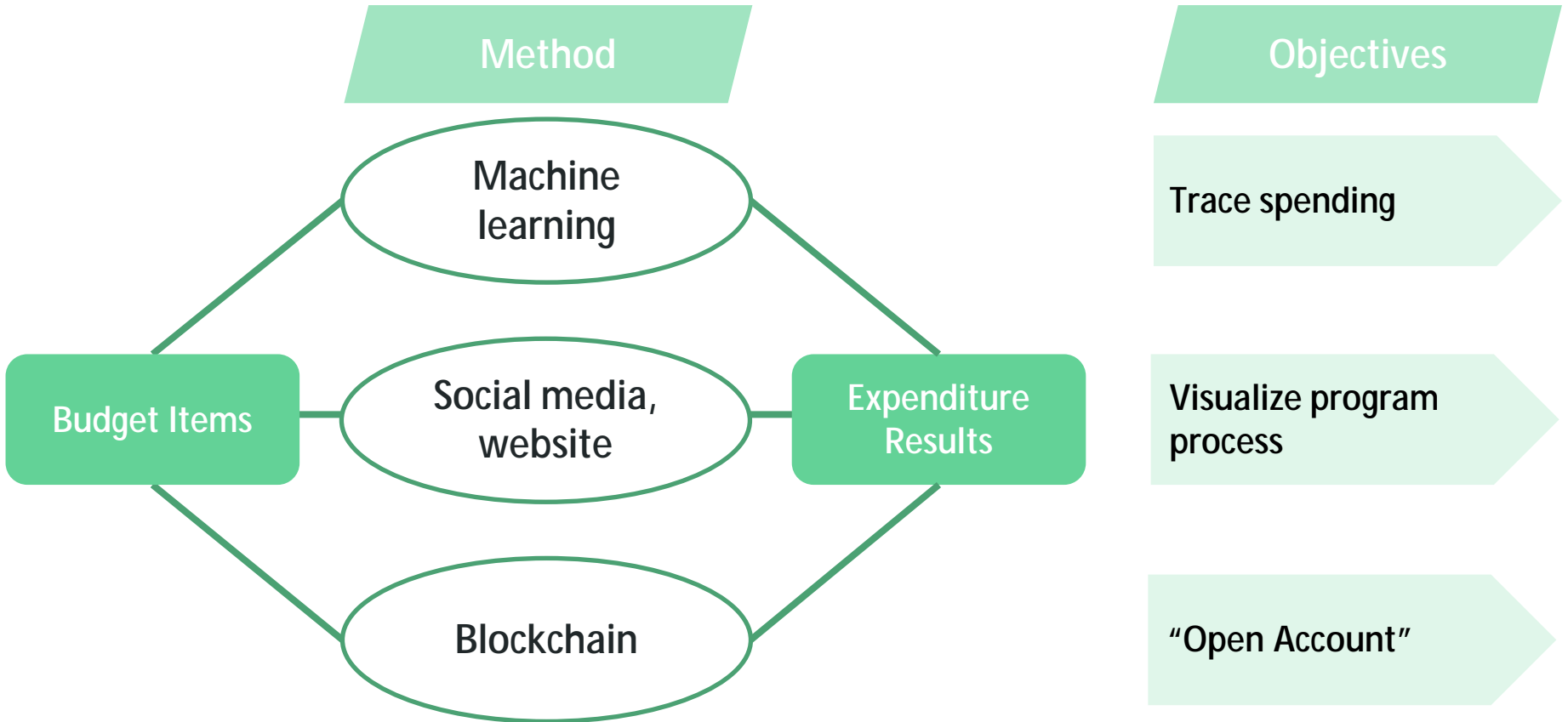
- Poor Quality
- Poor Reliability
- Poor Access



Broader Implications:

- Weaker civic engagement
- Tainted trust globally
- Decreased foreign investment
- Increased borrowing costs

3A Digital Technology Solutions: Overview



4A Machine Learning: Introduction

Apply machine learning to match budgets with final accounts to trace and publish expenditures, thus improving citizen engagement and budget monitoring.

Why machine learning

- Time-saving to handle massive data
- Cost-efficient to strength capacity
- Historical pattern for future prediction

Tools

Natural Language Processing

Transfer words as **strings** into machine-readable **features**

- Dictionary-based or rule-based matching algorithm

Match features into combinations based on a dictionary or a set of rules;
Rules can be set through machine learning

4B Machine Learning: Technology

Budget items

Budget proposals

String: “total budget for program α is X MKD”

String : “ In phase A, we spent y MKD. In phase B we spent z MKD...”

Natural Language Processing

Features:
Total budget,
Program α , X MKD

Features:
phase A, y MKD;
phase B, z MKD

Matching Algorithm

Matched outcomes:

The budget of program α is X MKD. The expenditures in phase A spent y MKD; In phase B, z MKD were spent

PFM prediction:

The recognized pattern can predict budget execution in the future

Expenditure Results:

Invoices, Financial Statements, Budget Execution...

5A Social Media & Website

Utilize social media and websites to visualize program implementation, enhancing citizen engagement for fiscal transparency and a citizen-driven budget.



Pull Approach:

Citizens “pull” information from governments

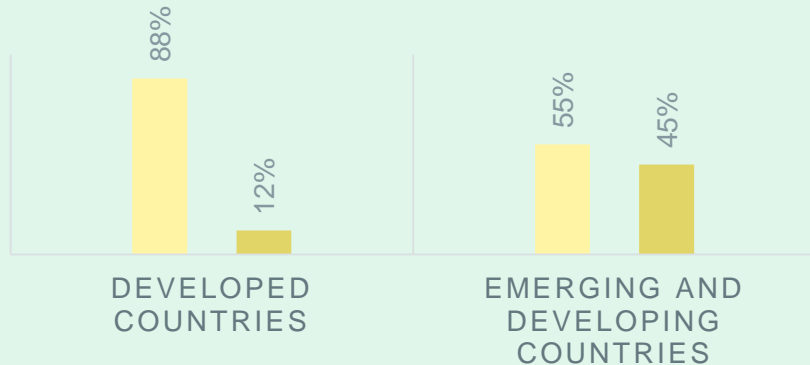


Push Approach:

Governments “push” information to citizens

PULL OR PUSH?

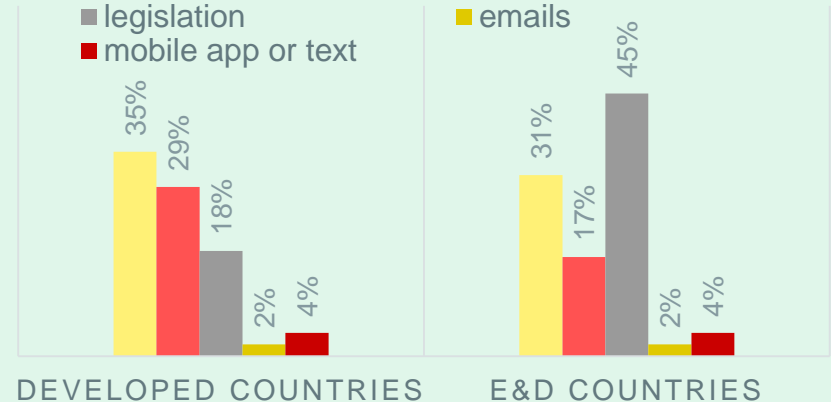
Push approach Pull approach



Citizens prefer “push approach”

Popular push approaches

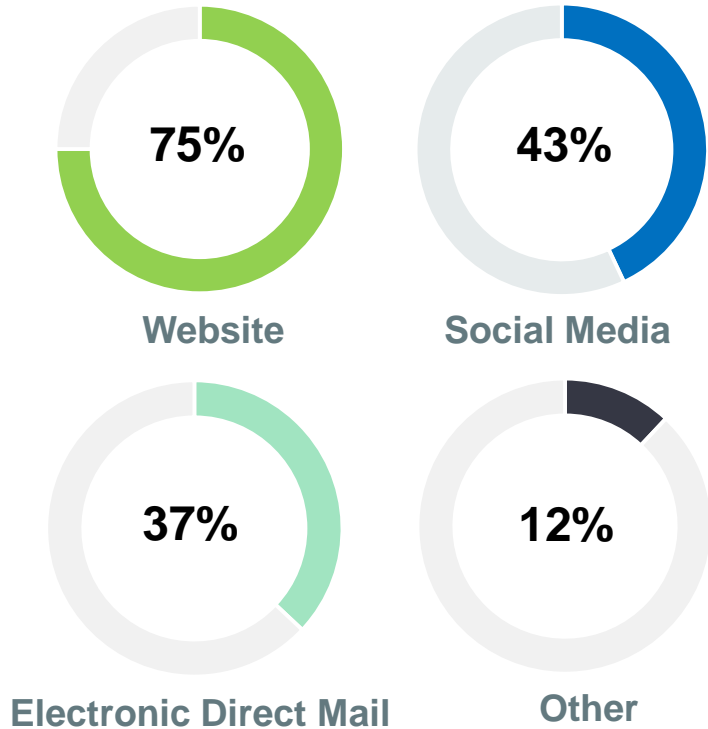
Social Media
legislation
mobile app or text
Town hall meetings
emails



Social media is a popular “push approach”

5B Social Media & Website

Which digital communication channels are you using to increase transparency for your citizens?



6A Blockchain

Employ blockchain as an open account book to improve auditability and regulatory oversight.

Blockchain Technology

- An account book open to every eligible users
- Public ledger vs. private ledger

Examples

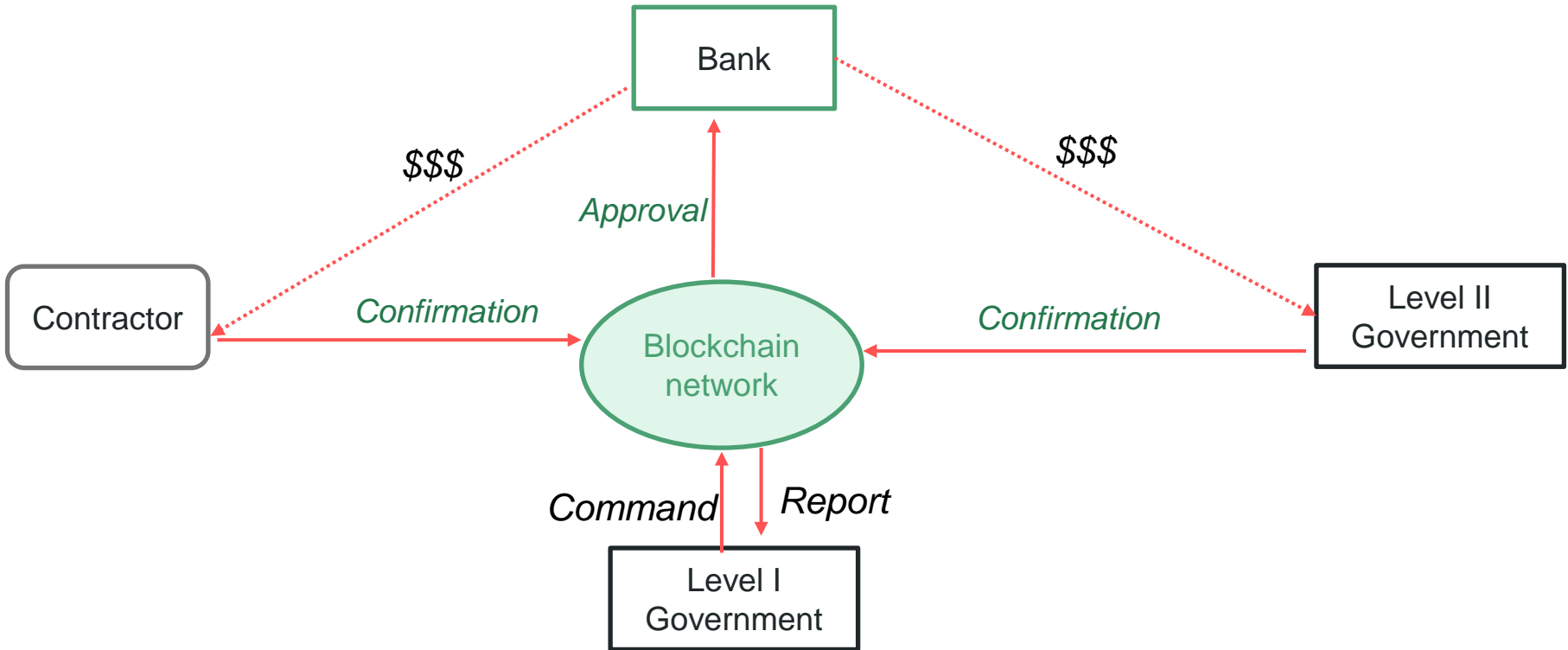
- **Delaware, USA** - Smart blockchain contracts, public archives
- **Singapore** - Blockchain interbank payments
- **Estonia** - Blockchain identity management, e-health records
- **Georgia** – Blockchain Land Registry

Advantages

- Increased transparency
- Outside auditing and regulatory reviews are made easier
- Immutable chain of transactions establish provenance

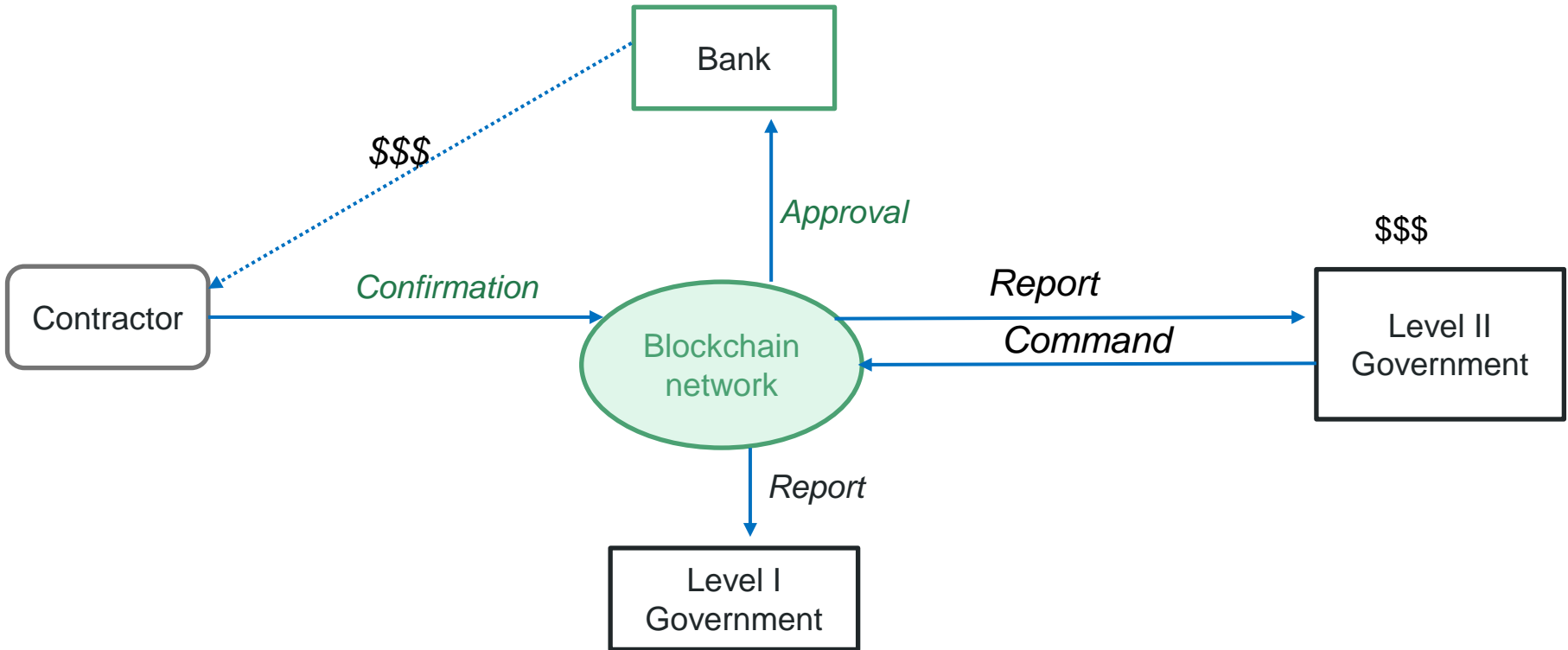
6B Blockchain

Connecting inter-government cash flow through banks.



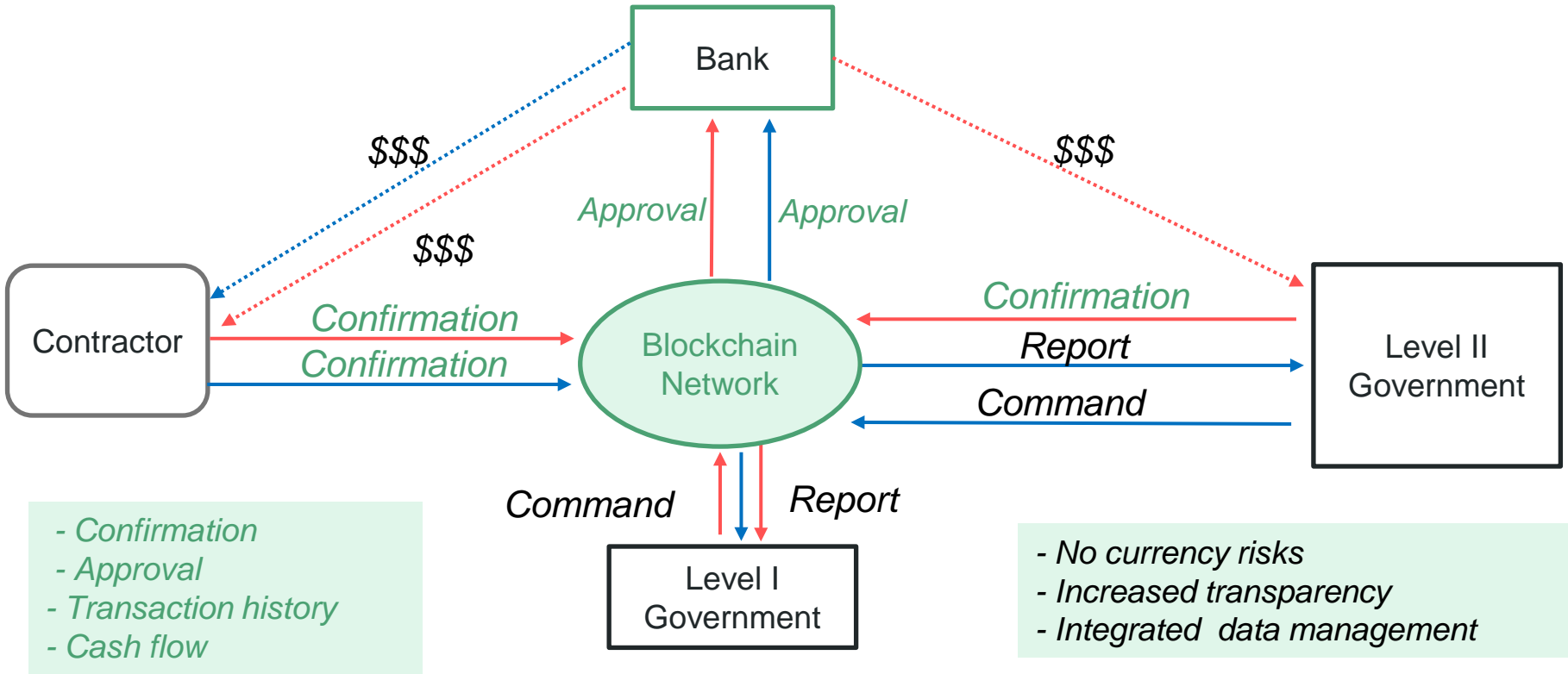
6B Blockchain

Connecting governments and contractors through banks.



6B Blockchain

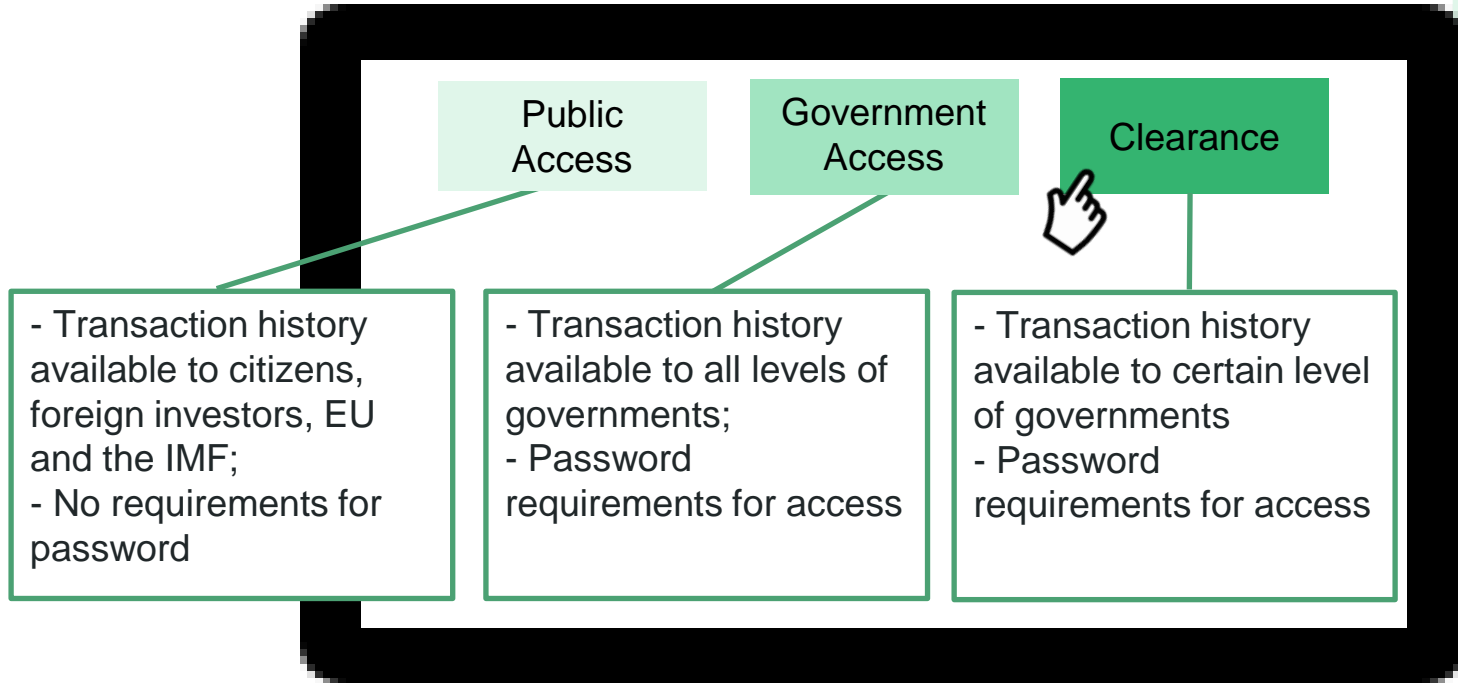
Data management integration and transparency enhancement.



6C Blockchain

User-friendliness, security clearance, transparency.

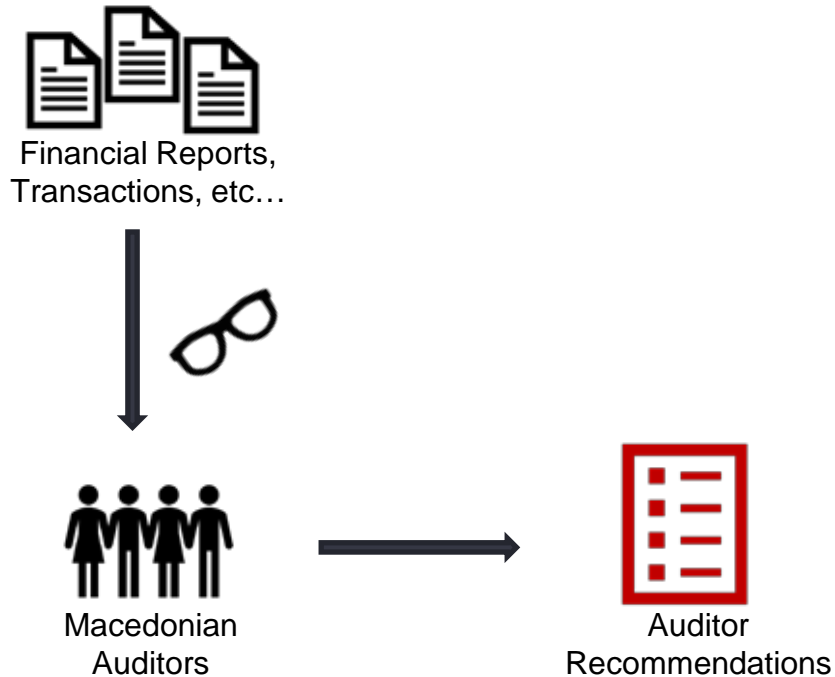
IAM(AWS Identity and Access Management)



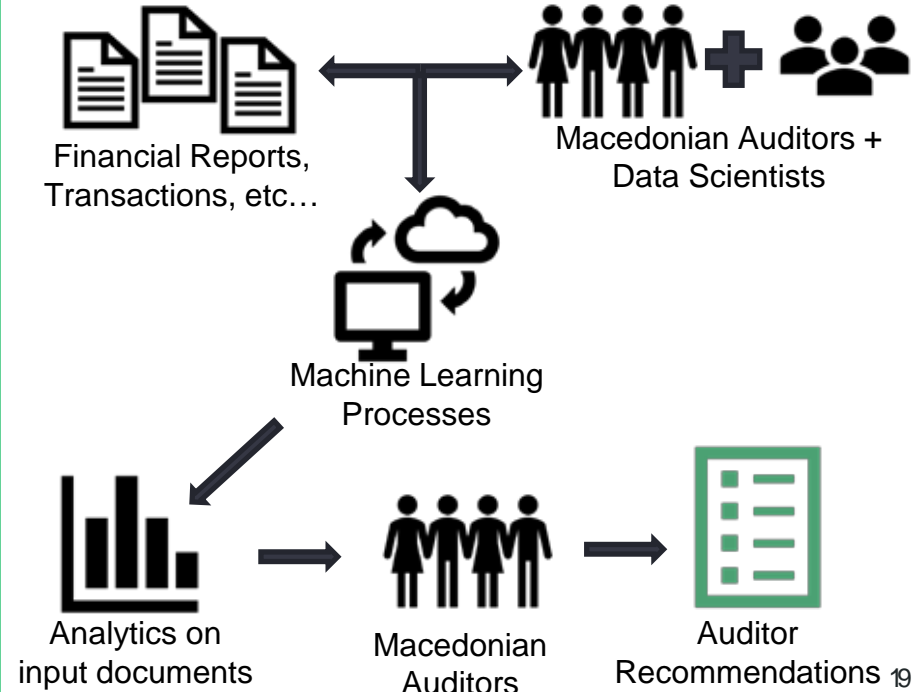
7A Application in Macedonia: Machine Learning

While not a substitute for human auditors, machine learning can improve the efficiency and accuracy of auditing processes in Macedonia.

Current Process



Process with Machine Learning



7B Application in Macedonia: Social Media

Simulation: Social media and website application in government E-platforms.



Budget executioner

We spent y MKD for the project in phase A. Here is the project implementation.



**Visualize budget items
with expenditure results**

**Citizens engage to build
citizen-driven PFM**

7C Application in Macedonia: Blockchain

For more government procurement and transaction details, please check our local and national government account address...

19f86e0323c5d8d5dc87a1df537c909357a9b9cf7f5dd327230d234cf5e7e203

2017-05-30 11:00:19

GovernmentExpenditures123



ContracterAccount123

285.80882276 BTC

-1.1 BTC

1f628d154023158f674919397f9694d3dc33f0adcb51e0cc9b07fcaa48284e9

2017-05-30 10:32:31

BudgetAccount123



GovernmentExpenditures123

1.1 BTC

1.1 BTC

Because the transaction is made in banks, the currency will be fiat money instead of bitcoin

8A Cost Analysis: Machine Learning

Estimated Development Cost (\$)

Staffing	#	Salary*	Total
IT Manager	1	\$13,163	\$13,163
Accountants	3	\$5,127	\$15,381
Data Scientists	8	\$4,767	\$38,136
			\$66,680
Technology	#	Cost	Total
AZURE Machine Learning Studio	9	\$720	\$6,479
AZURE Cloud Storage (10 TB)	1	\$600	\$600
			\$7,079
Estimated Cost			\$73,759

Operational & Maintenance Cost (\$)

Staffing	#	Salary*	Total
IT Manager	1	\$13,163	\$13,163
Accountants	0	\$5,127	\$0
Data Scientists	5	\$4,767	\$23,835
			\$36,998
Technology	#	Cost	Total
AZURE Machine Learning Studio	6	\$720	\$4,319
AZURE Cloud Storage (10 TB)	1	\$600	\$600
			\$4,919
Estimated Cost			\$41,917

* Salaries are based on median estimates for Skopje, Macedonia from Teleport.

8B Social Media & Website: Cost Analysis

Establish a social media & website office

- Update the government budget information to the public
- Update photos of tangible projects
- Update the budget implementation process of intangible projects
- Information sources can be budget proposals and budget execution reports, produced by machine learning and blockchain platform
- 1~5 offices in total, depending on the needs

Operational & Maintenance Cost (\$)

Staffing	#	Salary*	Total
Office manager	5	\$3,376	\$16,880
			\$16,880
Estimated Cost			\$16,880

* Salaries are based on median estimates for Skopje, Macedonia from Teleport.

8C Blockchain: Cost Analysis

Development Cost (\$)

Outsourcing project team	Total
	\$70,000~\$90,000
Estimated Cost	\$70,000~\$90,000

By hiring a development team with a similar and mature project, we can greatly lower development costs.

The estimated average size of transaction file is 100kb. One storage resource can be used for more than 1 year, so the total cost actually will be lower than \$42,015.

Operational & Maintenance Cost (\$)

Staffing	#	Salary*	Total
IT Manager	1	\$13,163	\$13,163
Data Scientists	6	\$4,767	\$28,602
			\$41,765
Technology	#	Cost	Total
Storage resource	5	\$50	\$250
			\$250
Estimated Cost			\$42,015

* Salaries are based on median estimates for Skopje, Macedonia from Teleport.

9A Path of Action

Year 1:

- Begin development of audit machine learning algorithms
- Begin development of Blockchain network

Years 4-5:

- Roll out machine learning audit processes to all national government agencies
- Pilot use of Blockchain in national government agencies

Years 2-3:

- Pilot machine learning to enhance existing fiscal and budgeting audit processes
- Begin training national government officials on use of Blockchain contracts

Year 10:

- Feed budget and fiscal information capture by Blockchain into machine learning processes to inform audit process

10A Digital Technology Solutions: Benefits and Challenges

Benefits	Government Budget Planners	Government Budget Users	Citizens	International PFM Organizations
Machine Learning	<ul style="list-style-type: none"> Strengthen capacity of accounting; Enhance budget monitoring Improve budget execution analysis and prediction 	<ul style="list-style-type: none"> Increase the corruption risks and costs Better understand problems in the budget execution 	<ul style="list-style-type: none"> Easier to understand detailed budget execution 	<ul style="list-style-type: none"> A new way of technical assistance External monitoring and auditing tool
Social Media	<ul style="list-style-type: none"> Feedback channel to communicate with citizens 	<ul style="list-style-type: none"> Increase the corruption risks and costs Better communicate with citizens 	<ul style="list-style-type: none"> Easier to monitor project implementation Engage in PFM 	<ul style="list-style-type: none"> Another budget monitoring channel
Blockchain	<ul style="list-style-type: none"> Monitor cash flow between various levels of governments and agencies 	<ul style="list-style-type: none"> Increase the corruption risks and costs Manage and monitor transaction chains across government and private sectors 	<ul style="list-style-type: none"> Directly check government transaction history Increase citizen engagement 	<ul style="list-style-type: none"> Easier to check and audit government expenditures

10B Digital Technology Solutions: Benefits and Challenges

Challenges	Government Budget Planners	Government Budget Users	Citizens	International PFM Organizations
Machine Learning	<ul style="list-style-type: none"> • Transfer paper records into digital records • Data collection and system building 	<ul style="list-style-type: none"> • Transfer paper records into digital records 		
Social Media		<ul style="list-style-type: none"> • Possible to sacrifice the project quality to catch implementation 		
Blockchain	<ul style="list-style-type: none"> • Protect personal information in salary payment 	<ul style="list-style-type: none"> • In some departments, full information disclosure is impossible: e.g. armies 		

Contact

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Questions?

Thank you!

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