Improving Fiscal Transparency in Macedonia: Machine Learning, Social Media and Blockchain

2018 ICGFM Case Competition

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

GDP per Capita, Current USD

Open Budget Index
Fiscal transparency has been linked to other factors inducive to economic development.

- Improved macro-economic and fiscal stability
- Increased credit ratings and lower borrowing costs
- Healthier fiscal discipline
- Reduced levels of corruption
- Higher rates of economic growth

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

<table>
<thead>
<tr>
<th>Budget Process</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td>A</td>
</tr>
<tr>
<td>Quality of timeliness</td>
<td>D+</td>
</tr>
<tr>
<td>Expenditures</td>
<td>B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fiscal Management</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-year perspective in fiscal planning</td>
<td>C+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External Audit</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of internal audit</td>
<td>C+</td>
</tr>
<tr>
<td>Scope, nature, and follow-up of external audit</td>
<td>D+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accessibility</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public access to key fiscal information</td>
<td>A</td>
</tr>
</tbody>
</table>
### Macedonia Overview:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Government type</strong></td>
<td>Parliamentary Republic</td>
</tr>
<tr>
<td><strong>President</strong></td>
<td>Gjorge Ivanov (2009)</td>
</tr>
<tr>
<td><strong>Prime Minister</strong></td>
<td>Zoran Zaev (2017)</td>
</tr>
<tr>
<td><strong>Currency</strong></td>
<td>Macedonian Denar</td>
</tr>
<tr>
<td><strong>Nominal GDP</strong></td>
<td>11.0 bn USD</td>
</tr>
<tr>
<td><strong>GDP per Capita</strong></td>
<td>5.5 bn USD</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>2.074 mn</td>
</tr>
</tbody>
</table>

Nominal GDP: 11.0 bn USD
GDP per Capita: 5.5 bn USD
Population: 2.074 mn
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.

<table>
<thead>
<tr>
<th>Case: Macedonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal GDP (bn MKD)</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>10.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>(3.9%)</td>
<td>(4.0%)</td>
<td>(4.2%)</td>
<td>(3.4%)</td>
<td>(2.7%)</td>
<td>(2.8%)</td>
<td>(3.5%)</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>26.6%</td>
<td>29.4%</td>
<td>33.2%</td>
<td>36.4%</td>
<td>38.2%</td>
<td>40.1%</td>
<td>42.8%</td>
<td></td>
</tr>
</tbody>
</table>
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

Method

- Machine learning
- Social media, website
- Blockchain

Objectives

- Trace spending
- Visualize program process
- “Open Account”

Budget Items

Expenditure Results
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 strengthen 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
**Budget items**
- Budget proposals

**Natural Language Processing**

**Features:**
- Total budget, Program α, X MKD
- 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: 88% in Developed Countries, 55% in Emerging and Developing Countries
- Pull approach: 12% in Developed Countries, 45% in Emerging and Developing Countries

Popular push approaches

- Social Media: 35% in Developed Countries, 31% in E&D Countries
- Town hall meetings: 17% in E&D Countries
- Legislation: 18% in Developed Countries
- Mobile app or text: 2% in Developed Countries, 4% in E&D Countries
- Emails: 4% in Developed Countries

Citizens prefer “push approach”

Social media is a popular “push approach”

Sources: Citizen engagement and public financial management, Grant Thorton and ICGFM, 2017
Which digital communication channels are you using to increase transparency for your citizens?

- Website: 75%
- Social Media: 43%
- Electronic Direct Mail: 37%
- Other: 12%

Sources: Global financial management leaders survey 2015, GrantThorton, ICGFM, MIT CFP
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

Sources: Digital Revolutions in Public Finance, IMF
Connecting inter-government cash flow through banks.

- **Blockchain**
- Approval
- Confirmation
- Command
- Report

Contractor

Blockchain network

Bank

Level I Government

Level II Government
Connecting governments and contractors through banks.
Data management integration and transparency enhancement.

- Confirmation
- Approval
- Transaction history
- Cash flow

- No currency risks
- Increased transparency
- Integrated data management
6C Blockchain

User-friendliness, security clearance, transparency.

- Transaction history available to citizens, foreign investors, EU and the IMF; - No requirements for password
- Transaction history available to all levels of governments; - Password requirements for access
- Transaction history available to certain level of governments - Password requirements for access

IAM(AWS Identity and Access Management)
While not a substitute for human auditors, machine learning can improve the efficiency and accuracy of auditing processes in Macedonia.

**Current Process**

Financial Reports, Transactions, etc… → Macedonian Auditors → Auditor Recommendations

**Process with Machine Learning**

Financial Reports, Transactions, etc… → Macedonian Auditors + Data Scientists → Machine Learning Processes → Analytics on input documents → Macedonian Auditors → Auditor Recommendations
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
For more government procurement and transaction details, please check our local and national government account address…

Because the transaction is made in banks, the currency will be fiat money instead of bitcoin
### Cost Analysis: Machine Learning

#### Estimated Development Cost ($)

<table>
<thead>
<tr>
<th>Staffing</th>
<th>#</th>
<th>Salary*</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Manager</td>
<td>1</td>
<td>$13,163</td>
<td>$13,163</td>
</tr>
<tr>
<td>Accountants</td>
<td>3</td>
<td>$5,127</td>
<td>$15,381</td>
</tr>
<tr>
<td>Data Scientists</td>
<td>8</td>
<td>$4,767</td>
<td>$38,136</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$66,680</strong></td>
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<table>
<thead>
<tr>
<th>Technology</th>
<th>#</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZURE Machine Learning Studio</td>
<td>9</td>
<td>$720</td>
<td>$6,479</td>
</tr>
<tr>
<td>AZURE Cloud Storage (10 TB)</td>
<td>1</td>
<td>$600</td>
<td>$600</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$7,079</strong></td>
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</table>

**Estimated Cost** $73,759

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

#### Operational & Maintenance Cost ($)

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<tr>
<td>Data Scientists</td>
<td>5</td>
<td>$4,767</td>
<td>$23,835</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$36,998</strong></td>
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<td>$600</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$4,919</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Estimated Cost** $41,917
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

* Salaries are based on median estimates for Skopje, Macedonia from Teleport.
### Blockchain: Cost Analysis

#### Development Cost ($)

<table>
<thead>
<tr>
<th>Outsourcing project team</th>
<th>Total</th>
<th>$70,000~$90,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Cost</td>
<td></td>
<td>$70,000~$90,000</td>
</tr>
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#### Operational & Maintenance Cost ($)

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<td>6</td>
<td>$4,767</td>
<td>$28,602</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Technology</th>
<th>#</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage resource</td>
<td>5</td>
<td>$50</td>
<td>$250</td>
</tr>
</tbody>
</table>

| Estimated Cost   |     |       | $42,015 |

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

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.
Path of Action

Year 1:
- Begin development of audit machine learning algorithms
- Begin development of Blockchain network

Years 2-3:
- Pilot machine learning to enhance existing fiscal and budgeting audit processes
- Begin training national government officials on use of Blockchain contracts

Years 4-5:
- Roll out machine learning audit processes to all national government agencies
- Pilot use of Blockchain in national government agencies

Year 10:
- Feed budget and fiscal information capture by Blockchain into machine learning processes to inform audit process
## Digital Technology Solutions: Benefits and Challenges

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Government Budget Planners</th>
<th>Government Budget Users</th>
<th>Citizens</th>
<th>International PFM Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Machine Learning</strong></td>
<td>• Strengthen capacity of accounting; • Enhance budget monitoring • Improve budget execution analysis and prediction</td>
<td>• Increase the corruption risks and costs • Better understand problems in the budget execution</td>
<td>• Easier to understand detailed budget execution</td>
<td>• A new way of technical assistance • External monitoring and auditing tool</td>
</tr>
<tr>
<td><strong>Social Media</strong></td>
<td>• Feedback channel to communicate with citizens</td>
<td>• Increase the corruption risks and costs • Better communicate with citizens</td>
<td>• Easier to monitor project implementation • Engage in PFM</td>
<td>• Another budget monitoring channel</td>
</tr>
<tr>
<td><strong>Blockchain</strong></td>
<td>• Monitor cash flow between various levels of governments and agencies</td>
<td>• Increase the corruption risks and costs • Manage and monitor transaction chains across government and private sectors</td>
<td>• Directly check government transaction history • Increase citizen engagement</td>
<td>• Easier to check and audit government expenditures</td>
</tr>
</tbody>
</table>
## Digital Technology Solutions: Benefits and Challenges

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Government Budget Planners</th>
<th>Government Budget Users</th>
<th>Citizens</th>
<th>International PFM Organizations</th>
</tr>
</thead>
</table>
| **Machine Learning** | • Transfer paper records into digital records  
• Data collection and system building | • Transfer paper records into digital records |         |                                  |
| **Social Media** |                            | • Possible to sacrifice the project quality to catch implementation |         |                                  |
| **Blockchain** | • Protect personal information in salary payment | • In some departments, full information disclosure is impossible: e.g. armies |         |                                  |
Bibliography


