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2025

SiMFE (Issuers Tax Monitoring System): Using Prescriptive Analytics to Prevent Electronic Invoice Fraud

Lhugo Tanaka Junior, Tax Auditor

Marlon Jorge Liebel, Tax Auditor

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Lhugo Tanaka Junior

Paraná State Tax Administration
Tax Auditor



Marlon Jorge Liebel

Paraná State Tax Administration
Tax Auditor



Paraná State Tax Administration

Finance Secretary **Norberto Anacleto Ortigara**

Tax Administration Director **Suzane Aparecida Gambetta Dobjenski**

Tax Enforcement Coordinator **Alexandre de Souza**

Chief Data/Analytics Officer **David Saraiva Farias Fernandes**

Paraná State, Brazil



5th

largest economy in Brazil

(São Paulo, Minas Gerais, Rio de Janeiro, Rio Grande do Sul)

4th

largest in electronic invoicing

(São Paulo, Minas Gerais, Rio Grande do Sul)

11.6M

in population

5.5% of the country

420K

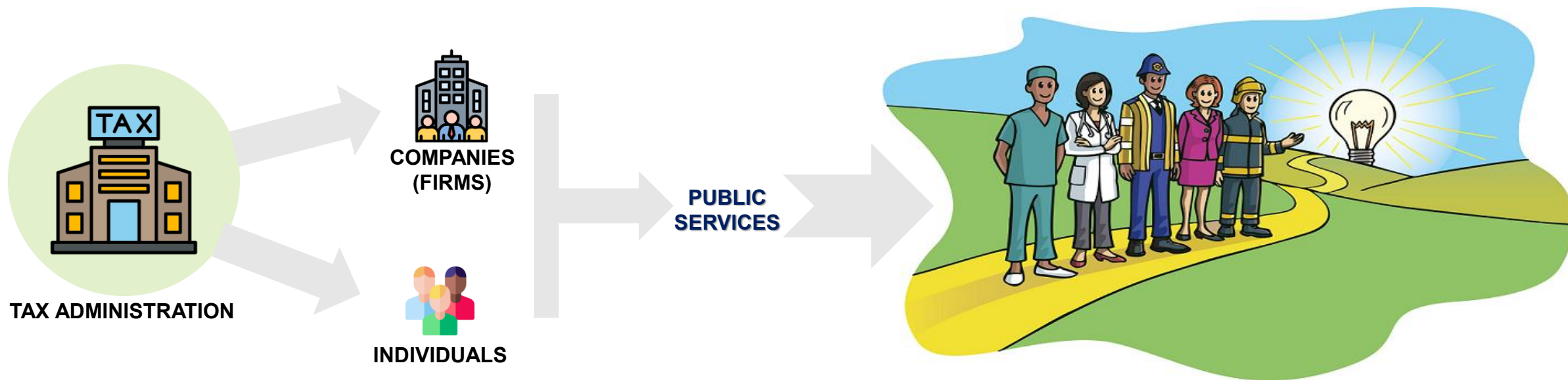
corporate taxpayers

(VAT taxpayers)

State Capital:
Curitiba

What does a tax administration do?

The role of tax administrations is to **collect the revenue that helps to pay for public spending by governments**. This might include support for education, welfare, pensions, health services, transport infrastructure, and defense, among many other areas. To maintain public confidence, tax systems must be seen to be fair, efficient, and effective, an area where international cooperation between administrations can play an important role.¹



¹ <https://www.oecd.org/en/topics/tax-administration.html>

The Paraná State Tax Administration

The **State Revenue Service of Paraná (Receita Estadual do Paraná)** is a government agency with special status. Although it is formally connected to the Finance Secretariat, it works independently. It functions as the state's tax administration.

Main responsibilities

- ➔ Monitor and collect state taxes (ICMS, IPVA, ITCMD)
- ➔ Promote voluntary tax compliance
- ➔ Combat tax evasion (fraud) and tax avoidance
- ➔ Ensure the proper interpretation and enforcement of the tax code



~500 tax auditors

Impact on society

- ➔ Funding essential areas such as health, education, and public security
- ➔ Promoting tax justice and fair competition among businesses
- ➔ Innovating tax governance through data and automation

The composition of state taxes

ICMS → State VAT tax
ICMS yearly revenue
~USD 10 billion



How a VAT works

Company A
Taxpayer A

Sells a product to Taxpayer B

Price: \$ 1.000,00
ICMS (12%): \$ 120,00

Debit: \$ 120,00



Company B
Taxpayer B

Resells the product to Taxpayer C

Price: \$ 1.200,00
ICMS (12%): \$ 144,00

Debit: \$ 144,00
Credit: \$ 120,00

Amount to be collected: \$ 24,00



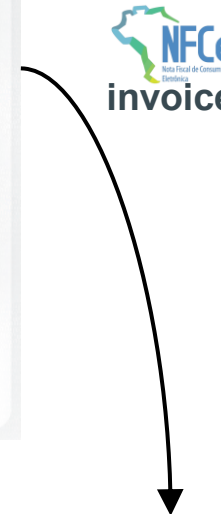
Company C
Taxpayer C

Resells the product to end customer

Price: \$ 1.500,00
ICMS (12%): \$ 292,50

Debit: \$ 292,50
Credit: \$ 144,00

Amount to be collected: \$ 148,50



Customer
End Customer

Price: \$ 1.500,00
ICMS (12%): \$ 292,50

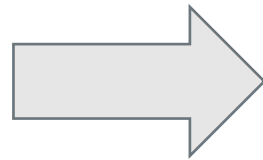
Fund Collection
Summary

Details

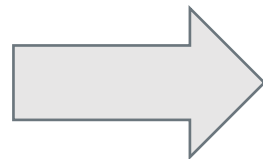
Company A:	\$ 120,00
Company B:	\$ 24,00
Company C:	\$ 148,50

Amount to be collected: \$ 292,50

How a VAT works

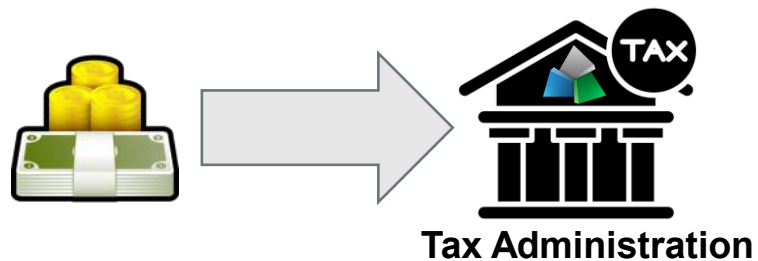


(+) VAT credit



(-) VAT debit

= Monthly VAT to pay



Challenge #1: Shell companies and illegal tax credits

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Challenge #1

In a VAT tax, the tax debit of the transaction for the seller of a product generates a tax credit for the buyer. With shell companies and fraudulent transactions, you have no real tax debit (since there's no real seller), but the buyer (a real company) uses the (illegal) tax credit.



Illegal tax credits are generated to buyers (businesses) who then offset their VAT debits and therefore pay less taxes (or no taxes at all).



A shell company is created with the sole intention of generating fraudulent transactions

Example of a real transaction between corporate (VAT) taxpayers

A sells \$1M in products (180K in tax credits) to B



COMPANY A
Seller

An electronic invoice is issued by the seller and authorized by the tax administration



The product is legal and it is shipped from the seller to the buyer



COMPANY B
Buyer

The buyer is entitled to 180K in tax credits

Example of a fraudulent transaction between corporate (VAT) taxpayers

A fakes a \$1M product sale to B (180K in tax credits)



**SHELL
COMPANY A
Seller**

An electronic invoice is issued by the seller and authorized by the tax administration

FRAUD



**COMPANY B
Buyer**

NO products were shipped

Tax auditors take a long time to identify this behavior and by the time they do, significant damage is already done.

The buyer is not entitled to 180K in tax credits, but they get an invoice to use the credits

Challenge #2: Real companies, illegal products

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Challenge #2

Companies that sell counterfeit or contraband products and use their electronic invoices to create an appearance of legitimacy for the illicit transaction.

Contraband:

Genuine, legally manufactured, products that are smuggled because they are illegal or restricted to sell (in violation of tax, duty, or other laws)

Counterfeit:

An imitation or forgery of a genuine product, produced or sold by a party other than the original manufacturer



A real company issues an invoice (without taxes) for illegal products to make the transaction appear legitimate

Example of a fraudulent transaction involving counterfeit or contrabands goods

A sells a product to another company or directly to an end consumer



COMPANY A
Seller

An electronic invoice is issued by the seller and authorized by the tax administration

FRAUD

The transaction is real, but the product is either a contraband (e.g., electronics) or a counterfeit (e.g., fake cigarettes)



COMPANY B
Buyer



END CONSUMER
Buyer

The solution: SiMFE

Sistema de Monitoramento Fiscal de Emissores
(Issuers Tax Monitoring System)

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The solution

SIMFE

Sistema de Monitoramento Fiscal de Emissores
Issuers Tax Monitoring System

Analytics automation monitors all electronic invoices issued to identify the frauds presented.



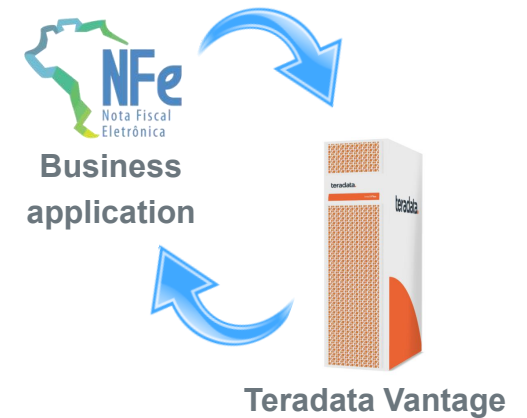
Why seven days?

DATA CRUNCH

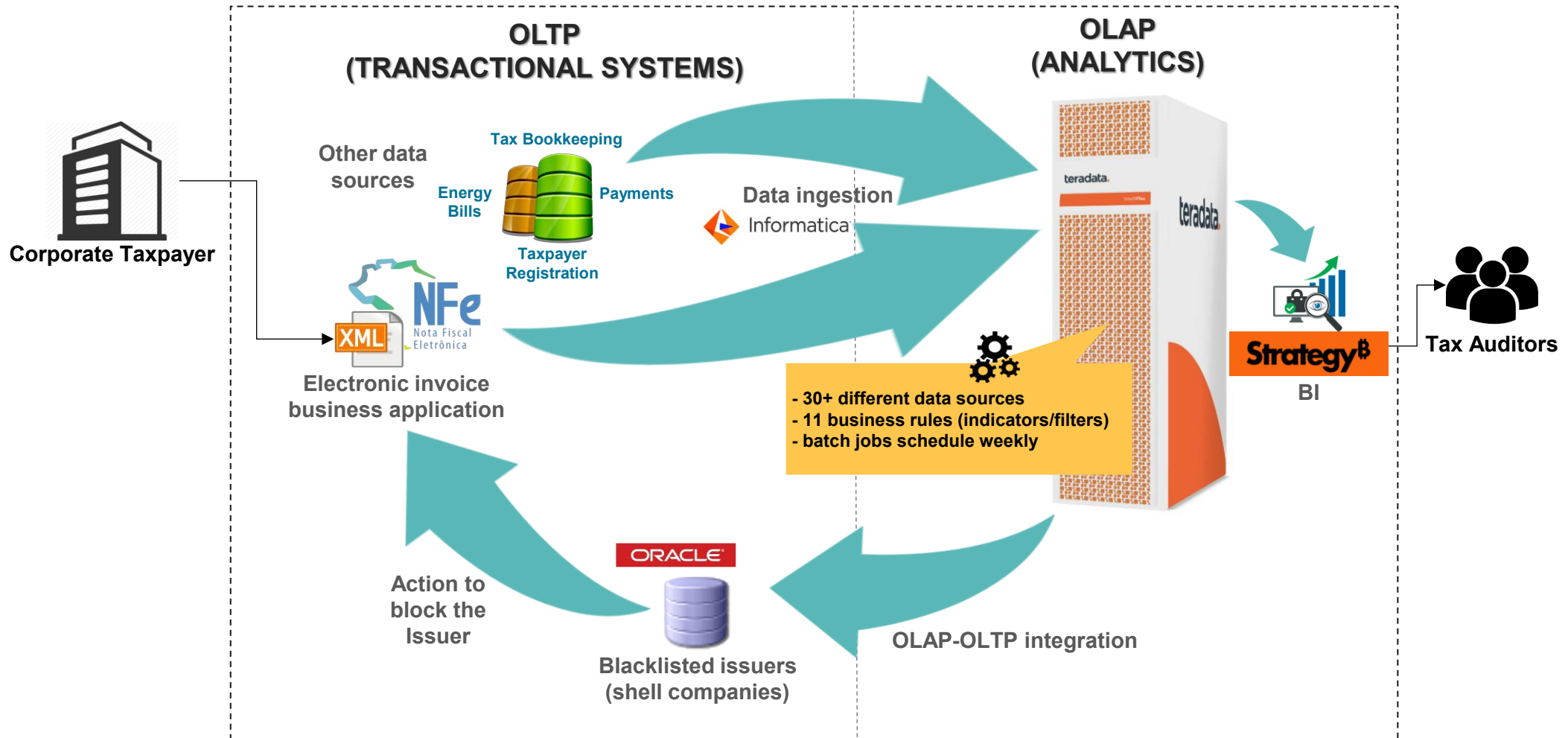


Data from **200+** millions of electronic invoices are processed and analyzed every week to find fraudulent transactions and the VAT taxpayer responsible.

Access blocked: Teradata Vantage® sends the fraudulent company registration number to the business application that authorizes/rejects the electronic invoices.



How SiMFE works



The company (issuer) has a...



MAXIMUM OF TWO OWNERS/PARTNERS

In the last seven days...



BRL 80K (USD 15K)

In the last twelve months...



NO FIRE DEPARTMENT INSPECTION FEE

In the last six months...



NO ELECTRIC BILL RECEIVED

In the last six months...



> 10

SALES PURCHASES



THE FIVE MOST IMPORTANT BUSINESS RULES

Step 1:

Execution of a massive data cross-referencing in electronic invoices and other data, applying the business rules



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Step 2:

Loading target tables in Teradata with the final results

- > ERL_MALHA_FISC_DET_SI001
- > ERL_MALHA_FISC_DET_SI002
- > ERL_MALHA_FISC_SI001
- > ERL_MALHA_FISC_SI002

Step 3:

Sending the "blacklist" to Oracle (electronic invoicing system)

Blacklisted taxpayers (invoice issuer's VAT registration number)

Step 4:

Loading data into Teradata's control tables (governance)

- > P_CTLDB
 - > Indexes
 - > Tables
 - > Views



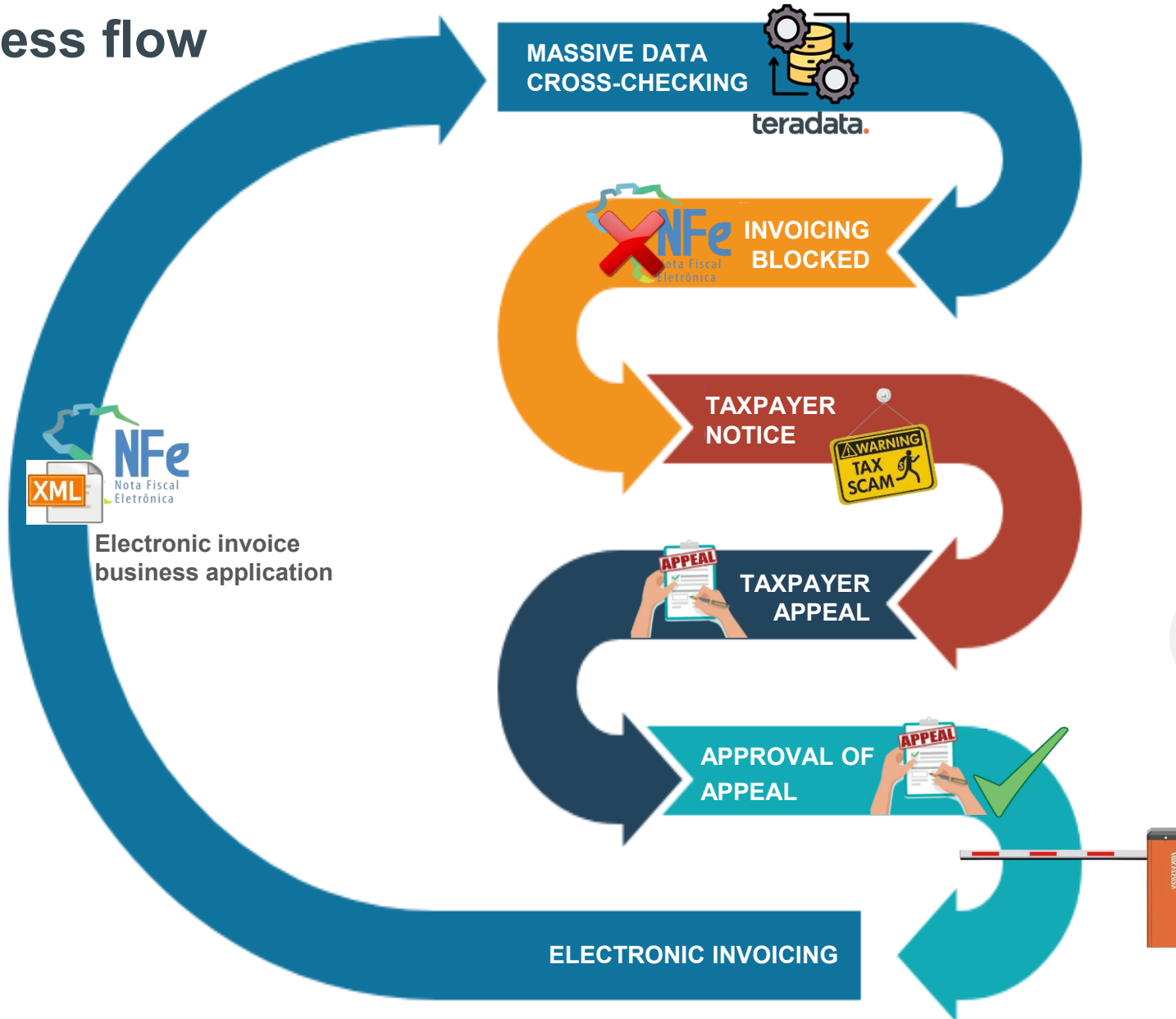
Corporate Taxpayer

Taxpayer attempts to issue an invoice but it's rejected



Every Monday

General process flow



“ We are leaving them [fraudsters] inoperative until they prove operational regularity, which **rarely happens**.
Eglius Colognesi de Sa,
Tax Auditor, 8th Prescint

Taxpayer appeal review

Using the tax administration portal (ReceitaPR), taxpayers that were blocked from the invoicing system can make an appeal. A tax auditor reviews the appeal and, if deemed appropriate, approves it.

Receita PR
ESTADO DO PARANÁ
SECRETARIA DE ESTADO DA FAZENDA

Página Inicial | Acesse Sua Caixa Postal | Boletim Informativo | Contato | Mapa do Site | Sair

Último acesso 28/08/2025 12:46:24 | Usuário(a) [Redacted]

Pesquisar... >

- SIGEF7 >
- Simple Nacional >
- SISCRED >
- SPED >
- SPR - PRODUTOR RURAL >
- Tabela de Preços >
- Taxas Hídricas e Minerais >
- Transação Tributária - Classificação DA e CAPAG >
- UPD >
- Cadastro de Fornecedor >
- Sistema >
- Autorização de Uso >
- Consultas >
- Relatórios >
- SiMFE >**
- Cadastro de Exceção >
- Consulta SiMFE >
- Consulta de Exceções >
- Homologação de Defesa >
- Manutenção da Carga >

Consulta do SiMFE

Dados do Contribuinte

Identificação

CAD/ICMS: [Redacted] Inscrição CNPJ: [Redacted]
Nome Empresarial: [Redacted]

Dados do SiMFE

Situação: Homologação de Defesa
Data da Inclusão: 18/08/2025
Marca DFE: 55
Id da Malha: SI001
Versão da Malha:
Data da Malha: 17/08/2025

Homologação de Defesa

Data da Defesa: 21/08/2025
Descrição da Defesa: O CONTRIBUINTE TEVE SUA AUTORIZAÇÃO DE USO DE SISTEMA SUSPENSA POR APRESENTAR UM MONTANTE DE ENTRADAS DE R\$ 0,00 E DE SAÍDAS DE R\$ 138.339,00. VERIFICAMOS EM NOSSOS SISTEMAS QUE O MESMO NÃO POSSUI NFES DE ENTRADAS E TÃO SOMENTE UMA NFE DE SAÍDAS PARA ENTREGA FUTURA. ISTO POSTO RETIRAMOS A SUSPENSÃO DE USO.
CPF do Responsável pela Defesa: [Redacted]
Nome do Responsável pela Defesa: [Redacted]

Voltar

Taxpayer appeal review

Using our BI Strategy (former MicroStrategy), the tax auditor can access all relevant data to review the appeal.



DRR	CPF/CNPJ14	Nome	Valor Impedido (1)	Valor ICMS Impedido (2)	Valor ICMS Impedido (Médio)	Detalhe
202508	11* DRR	0	RS 9.581.941,44	RS 1.149.832,97	RS 1.149.832,97	Detalhe
202508	11* DRR	4	RS 97.253.677,44	RS 0,00	RS 0,00	Detalhe
202508	11* DRR	5	RS 8.732.160,00	RS 0,00	RS 0,00	Detalhe
202508	11* DRR	6	RS 46.353.167,04	RS 5.562.380,04	RS 5.562.380,04	Detalhe
202508	11* DRR	6	RS 95.199.378,24	RS 11.423.925,39	RS 11.423.925,39	Detalhe
202508	11* DRR	6	RS 12.000.960,00	RS 1.440.115,20	RS 1.440.115,20	Detalhe
202508	11* DRR	6	RS 26.229.302,40	RS 0,00	RS 0,00	Detalhe
202508	6* DRR	5	RS 101.377.325,71	RS 0,00	RS 0,00	Detalhe
202508	6* DRR	6	RS 23.632.896,00	RS 2.835.947,52	RS 2.835.947,52	Detalhe
202508	6* DRR	6	RS 33.002.505,60	RS 3.960.300,67	RS 3.960.300,67	Detalhe
202508	13* DRR	1	RS 26.412.227,18	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	3	RS 80.419.200,00	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	4	RS 31.926.944,64	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	5	RS 19.200.000,00	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	5	RS 26.201.728,32	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	5	RS 72.013.092,48	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	6	RS 24.558.728,64	RS 2.947.047,44	RS 2.947.047,44	Detalhe
202508	13* DRR	6	RS 46.589.154,24	RS 5.590.698,51	RS 5.590.698,51	Detalhe
202508	13* DRR	6	RS 12.016.800,00	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	6	RS 20.160.000,00	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	6	RS 29.136.033,60	RS 0,00	RS 0,00	Detalhe
202508	13* DRR	6	RS 13.354.694,40	RS 0,00	RS 0,00	Detalhe



Ano/Mês Referência	Data de Referência	CNPJ/CPF Contrib	Inscrição Estadual	CNAE	SRP	Indicador Ajuste EFD 180D	Indicador CV15 180D	Indicador Entrada 180D	Indicador PGDAS		
202508	10/8/2025	61792381000183	9116092155	4723700	COMÉRCIO VAREJISTA DE BEBIDAS	10	REGIME NORMAL	NÃO	NÃO	NÃO	NÃO

Indicador Saída 180D	Indicador Taxa Bombeiro	Indicador Produção Primária Própria	Qtde Sócios	Valor Capital Social	Valor Entradas 180D	Valor Receita Apuração Compensação	Valor Saídas 180D	Valor Saídas 7D	Saídas 180D vs Entradas 180D	Saídas 7D vs Saídas 180D	Saídas 180D vs PGDAS
SIM	NÃO	NÃO	1	RS 100.000,00	RS 0,00	RS 0,00	RS 223.003,80	RS 223.003,80	0,00%	100,00%	0,00%



Data de Emissão Documento Fiscal	Documento Auxiliar (Danfe, Dacte, etc)	Nº do Documento Fiscal	CNPJ/CPF - Destinatário - Nota Fiscal	Nome - Destinatário - Nota Fiscal	CFOP	Item Docur Fiscal	Descrição do Item	Valor Total do Documento Fiscal	Valor Total dos Produtos	Valor Total do Item	Quantidade Comercial do Item	Valor Unitário Comercial Item	Valor ICMS do Item	Valor Total do ICMS			
Total								RS 482.845,49	RS 482.845,49	RS 482.845,49	49,061,78000	RS 1.616,60000	RS 30.212,54	RS 30.212,54			
24/7/2025	412	14378220	1	8			BO E ANIMAL	6102	1	ACIDO GRAXO	RS 122.500,00	RS 122.500,00	RS 122.500,00	35,00000000	RS 3,500000000	RS 14.700,00	RS 14.700,00
24/7/2025	412	22133828	3	5			F	6102	1	CARTUCHO DE TONER CE285A	RS 506,00	RS 506,00	RS 506,00	22,000000	RS 23,00000000	RS 60,72	RS 60,72
24/7/2025	412	05516897	4	2			M	6102	1	CARTUCHO DE TONER CE285A	RS 546,00	RS 546,00	RS 546,00	26,000000	RS 21,00000000	RS 65,52	RS 65,52
24/7/2025	412	48252886	5	14			F	5102	1	COURO ACABADOS DIVERSOS	RS 78.037,44	RS 78.037,44	RS 78.037,44	1,625,78000	RS 48,00000000	RS 15.217,30	RS 15.217,30
24/7/2025	412	39798366	6	12			C	6102	1	ROLAMENTOS	RS 1.000,00	RS 1.000,00	RS 1.000,00	100,000000	RS 10,00000000	RS 70,00	RS 70,00
24/7/2025	412	82284329	8	6			C	5405	1	MARTIN DOG ORIGINAL 07 KG	RS 46.060,00	RS 46.060,00	RS 46.060,00	2,350,00000	RS 19,60000000	RS 0,00	RS 0,00
24/7/2025	412	55984204	9	6			C	5405	1	MARTIN DOG ORIGINAL 07 KG	RS 47.182,50	RS 47.182,50	RS 21.560,00	1,100,00000	RS 19,60000000	RS 0,00	RS 0,00
24/7/2025	412	55984204	9	6			C	5405	2	MARTIN DOG ORIGINAL 05 KG	RS 47.182,50	RS 47.182,50	RS 25.622,50	1,850,00000	RS 13,85000000	RS 0,00	RS 0,00
24/7/2025	412	02529339	10	6			C	5405	1	MARTIN DOG ORIGINAL 05 KG	RS 42.935,00	RS 42.935,00	RS 42.935,00	3,100,00000	RS 13,85000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	1	GORDOK FILHOTES MIX 25 KG	RS 51.454,50	RS 51.454,50	RS 518,50	5,000000	RS 103,7000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	2	GORDOK MIX ADULTO 07 KG	RS 51.454,50	RS 51.454,50	RS 1.339,00	65,000000	RS 20,60000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	3	GORDOK MIX ADULTO 15 KG	RS 51.454,50	RS 51.454,50	RS 12.832,50	295,000000	RS 43,50000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	4	GORDOK MIX ADULTO 25 KG	RS 51.454,50	RS 51.454,50	RS 13.338,50	185,000000	RS 72,10000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	5	ISMAR DOG MIX 07 KG	RS 51.454,50	RS 51.454,50	RS 618,00	30,000000	RS 20,60000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	6	ISMAR DOG MIX 25 KG	RS 51.454,50	RS 51.454,50	RS 2.884,00	40,000000	RS 72,10000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	7	MARTIN DOG FILHOTES MIX 08 KG	RS 51.454,50	RS 51.454,50	RS 842,50	25,000000	RS 33,70000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	8	MARTIN DOG FILHOTES MIX 10X1 KG	RS 51.454,50	RS 51.454,50	RS 6.620,00	100,000000	RS 66,20000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	9	MARTIN DOG FILHOTES MIX 25 KG	RS 51.454,50	RS 51.454,50	RS 2.074,00	20,000000	RS 103,7000000	RS 0,00	RS 0,00
24/7/2025	412	79022821	11	6			C	5405	10	MARTIN DOG ORIGINAL 05 KG	RS 51.454,50	RS 51.454,50	RS 518,50	5,000000	RS 103,7000000	RS 0,00	RS 0,00

Recap: SiMFE in a nutshell



How the tax administration "kills" a fraudulent transaction at its source

- 1** | The seller is identified as a shell company or the transaction is identified as contraband or counterfeit.
- 2** | Vantage sends the seller company's VAT registration number to the invoice application.
- 3** | The invoice application blocks the fraudulent company, preventing it from issuing more electronic invoices.
- 4** | SiMFE has a **93.6% accuracy**. But for those companies wrongfully blocked, the taxpayer may make an appeal to the tax administration.

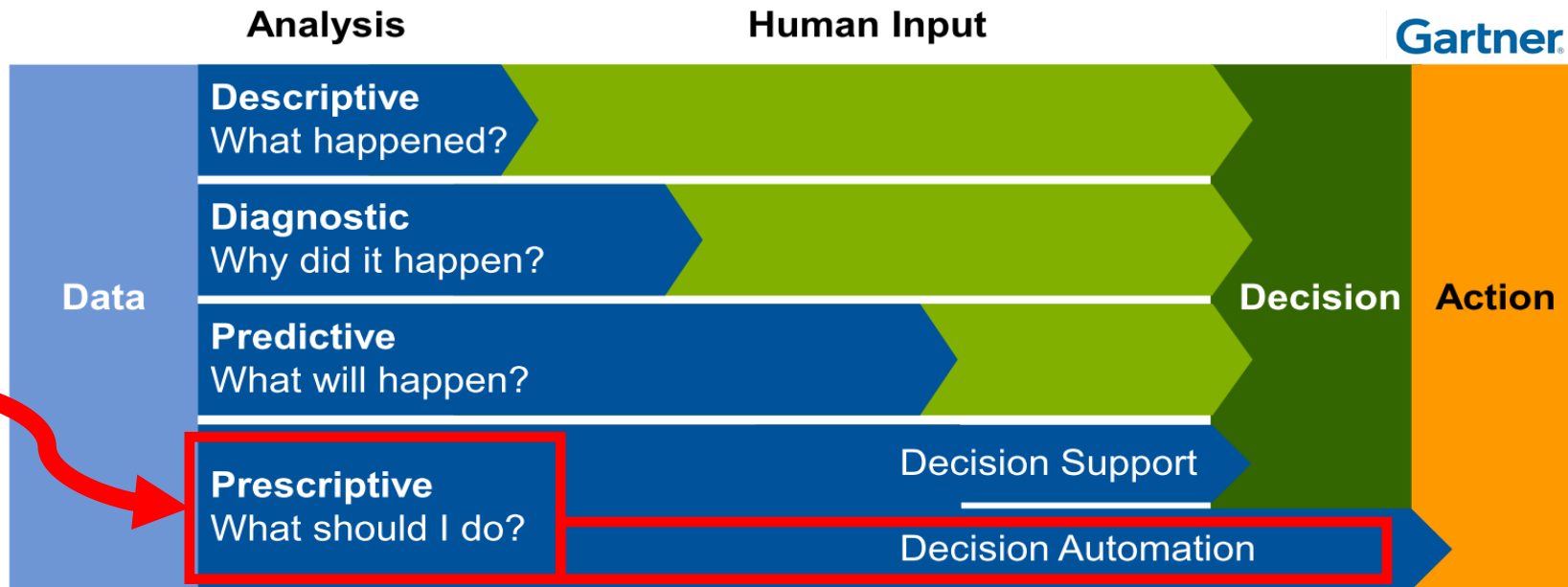
Key takeaways and business outcomes

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Key takeaways



#1 Automation

Prescriptive analytics

#2 Pioneering

Paraná led the way in Brazil in implementing an automated system to block fraudulent companies from issuing electronic invoices. Other states are beginning to follow.



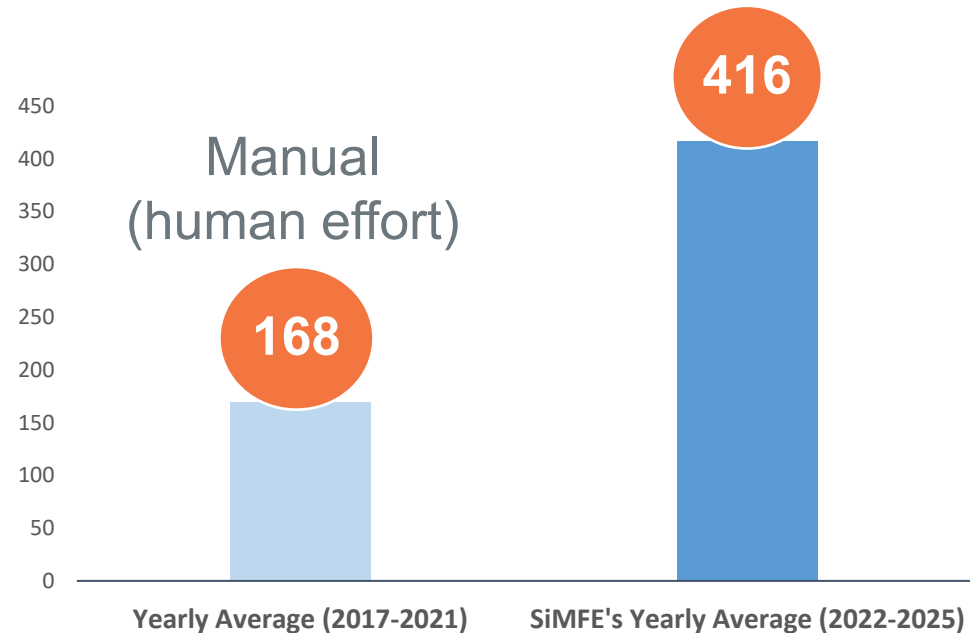
“ [SiMFE] is an [automated] **action** to stop the spread of these fraudulent transactions, reducing the tax evasion.
 Alexandre de Souza,
 Tax Enforcement Coordinator

Business outcomes

147%

We've seen an increase of 147% (!) in the number of fraudulent companies identified and blocked after SiMFE

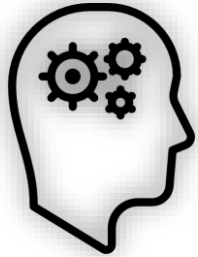
Automatic
(prescriptive analytics)



US\$ 3.8B

Based on the electronic invoices issued before blocking, we've estimated a **3.8 billion dollars** in tax credits that were prevented from being generated.

What's next?



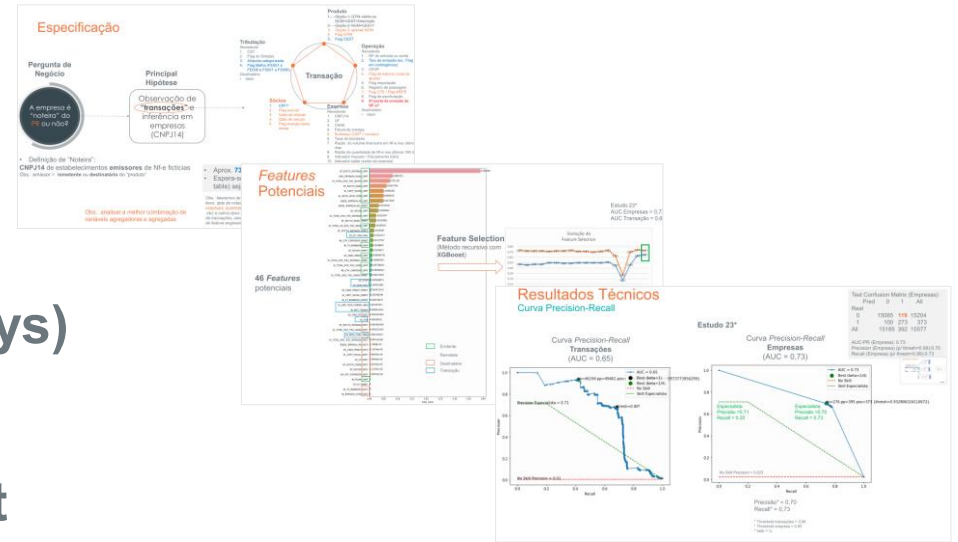
Applying machine learning to identify the fraud



Reduce the current frequency (seven days)



Increase the current accuracy (93.6%)

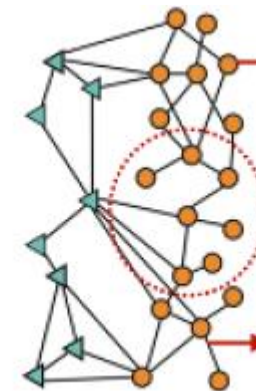
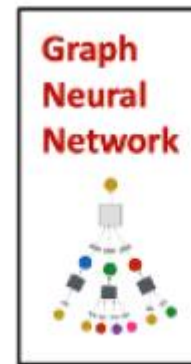


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        [4., 0., 4., ..., 2., 2., 1.],  
        [4., 4., 0., ..., 2., 2., 1.],  
        ...,  
        [2., 2., 2., ..., 0., 4., 2.],  
        [2., 2., 2., ..., 4., 0., 2.],  
        [1., 1., 1., ..., 2., 2., 0.]])
```

Select models that favor network analysis



Input: transactions network



Node-level: Fraudsters, ...

Subgraph-level: Money laundering subnetworks, ...

Edge-level: fraudulent/anomalous transactions, ...

Output: prediction of shell companies

Thank you



BRAZIL



PARANÁ
STATE



FINANCE
SECRETARIAT



STATE TAX
ADMINISTRATION

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