

Budapest University of Technology and Economics



AI Working Group

The Journey to the New World

– Experiences and Assumptions

Dr. GÁBOR MAGYAR

BME

Budapest University of Technology and Economics

HEAD OF AI WG

NTCA & OTHER GOV INSTITUTIONS
ARTIFICIAL INTELLIGENCE
WORKING GROUP

- Inter-agency working group, established by Gov Decree in Hungary - brings together ministries, gov agencies and academia
- The aim of the AI WG is
 - to exploit the values existing in the data assets of the NTSC and other gov agencies
 - put the synergy of scientific methodologies and domain experiences at the service of public good

NTCA & OTHER GOV INSTITUTIONS
ARTIFICIAL INTELLIGENCE
WORKING GROUP

- **AI WG** makes proposals, reviews, develops approaches, models and algorithms
- **Collaborative work** in smaller groups by experts from various member institutions and academics
 - dedicated, protected research environment



WHAT BENEFITS DO WE GET USING AI ?

- Fraud risk may increase
 - faster, more efficient detection
 - better targeted controls and measures
- Better services
 - automated processes, reduced waiting times
 - personalized customer contact
 - serving new age cohorts and increasing expectations



(MAIN) RISKS OF USING AI TOOLS AND METHODS

- False AI outputs, indications
- Lack of transparency (“black/grey” box decisions)
- Privacy, legal compliance
- Ethical issues
- Lack of infrastructure and human knowledge, unpreparedness

SPEED

(quasi) real-time.



High frequency data,
proper IT,
adequate workflow

AUTOMATION

Repetitive, time
consuming tasks.



New workflows,
coded, but flexible
methods

EFFICIENCY

value creation



Data value,
Purpose limitation

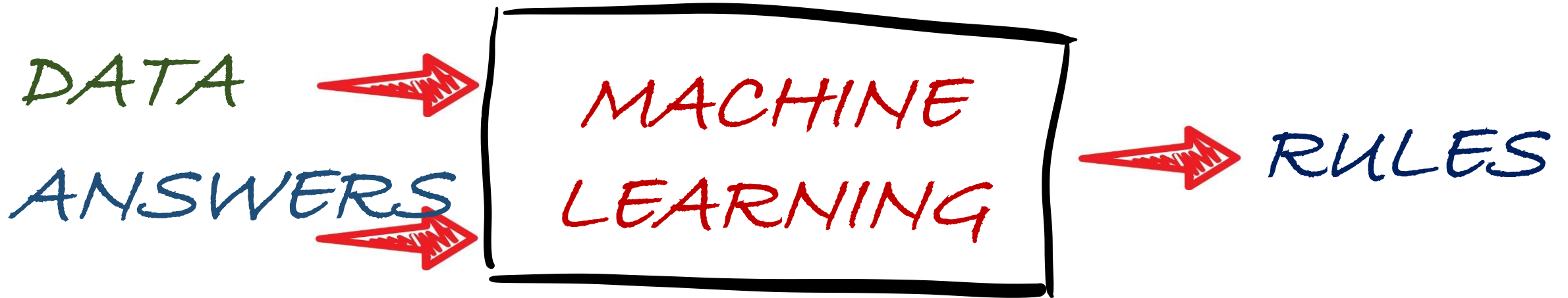
(In order to find a common voice and interpretation ... :)

BASICS ... :



TRADITIONAL RULE-BASED OPERATION

BASICS ... :



*E.g.: legal practice, experience,
taxpayer issues and questions*

AI-BASED OPERATION

Time horizon of software tasks different LLMs can complete 50% of the time



Task duration (for humans)
where logistic regression of our data
predicts the AI has a 50% chance of succeeding



Time Horizon 1.1 (Current) ▾

Log Scale

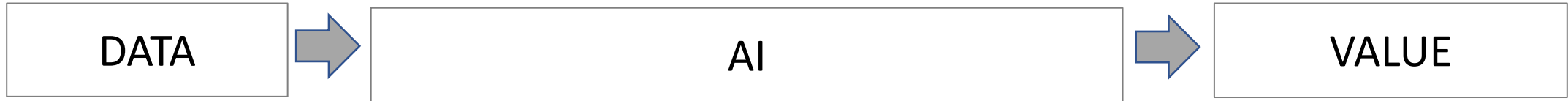
Linear Scale

50% Success

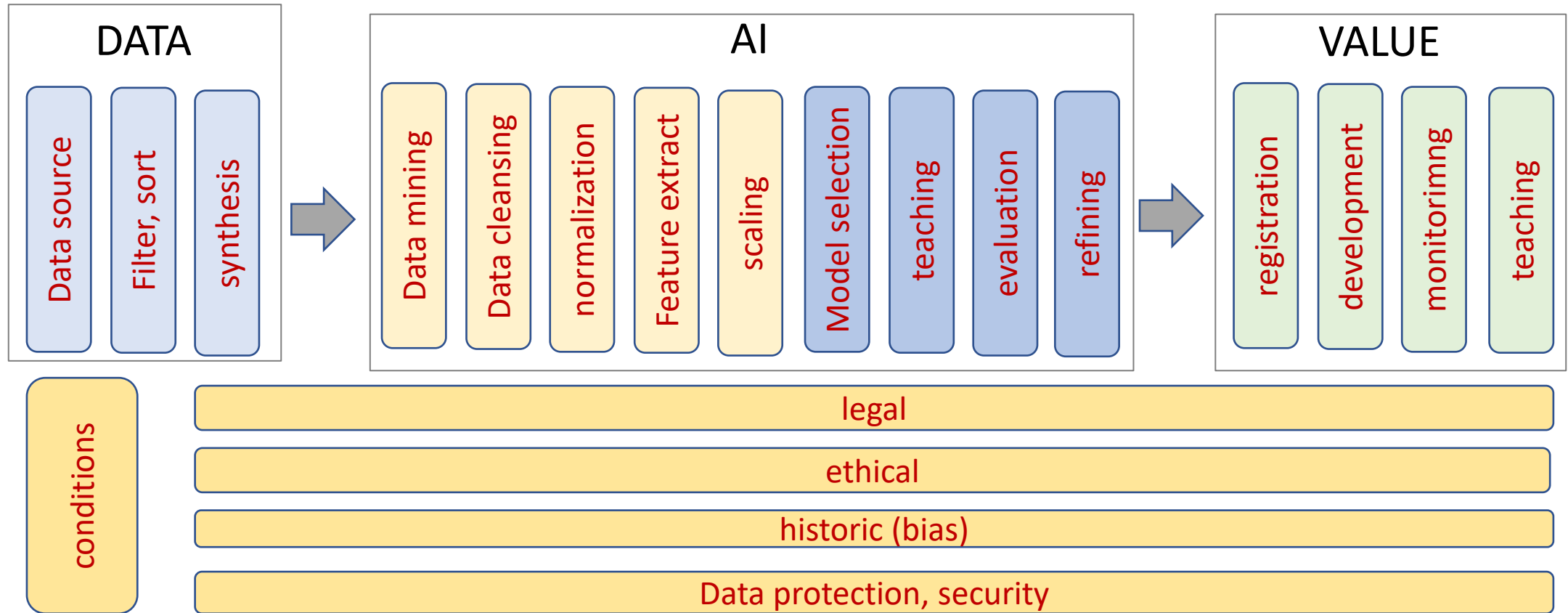
80% Success

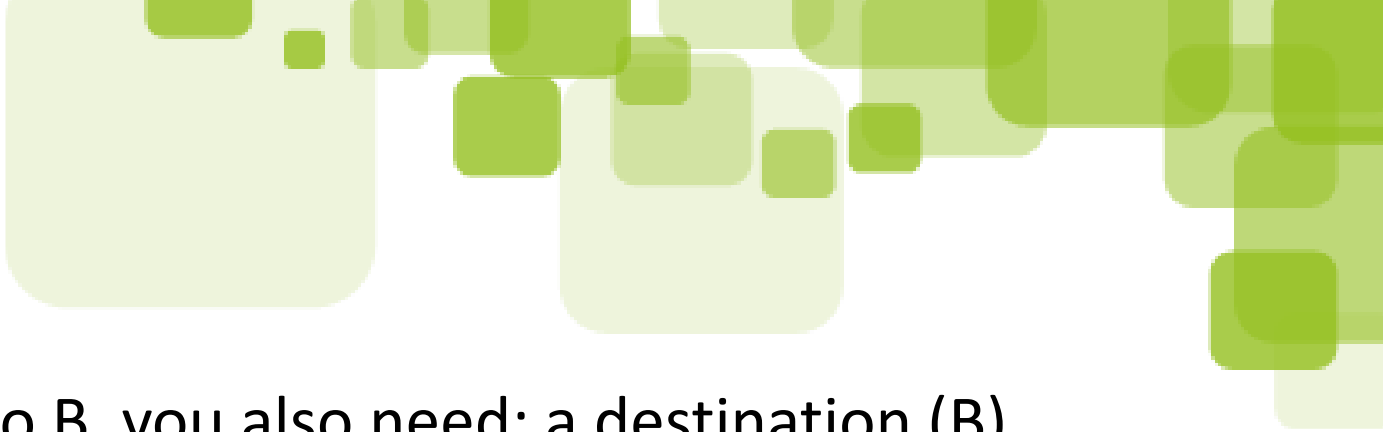


How organizations envision AI ...



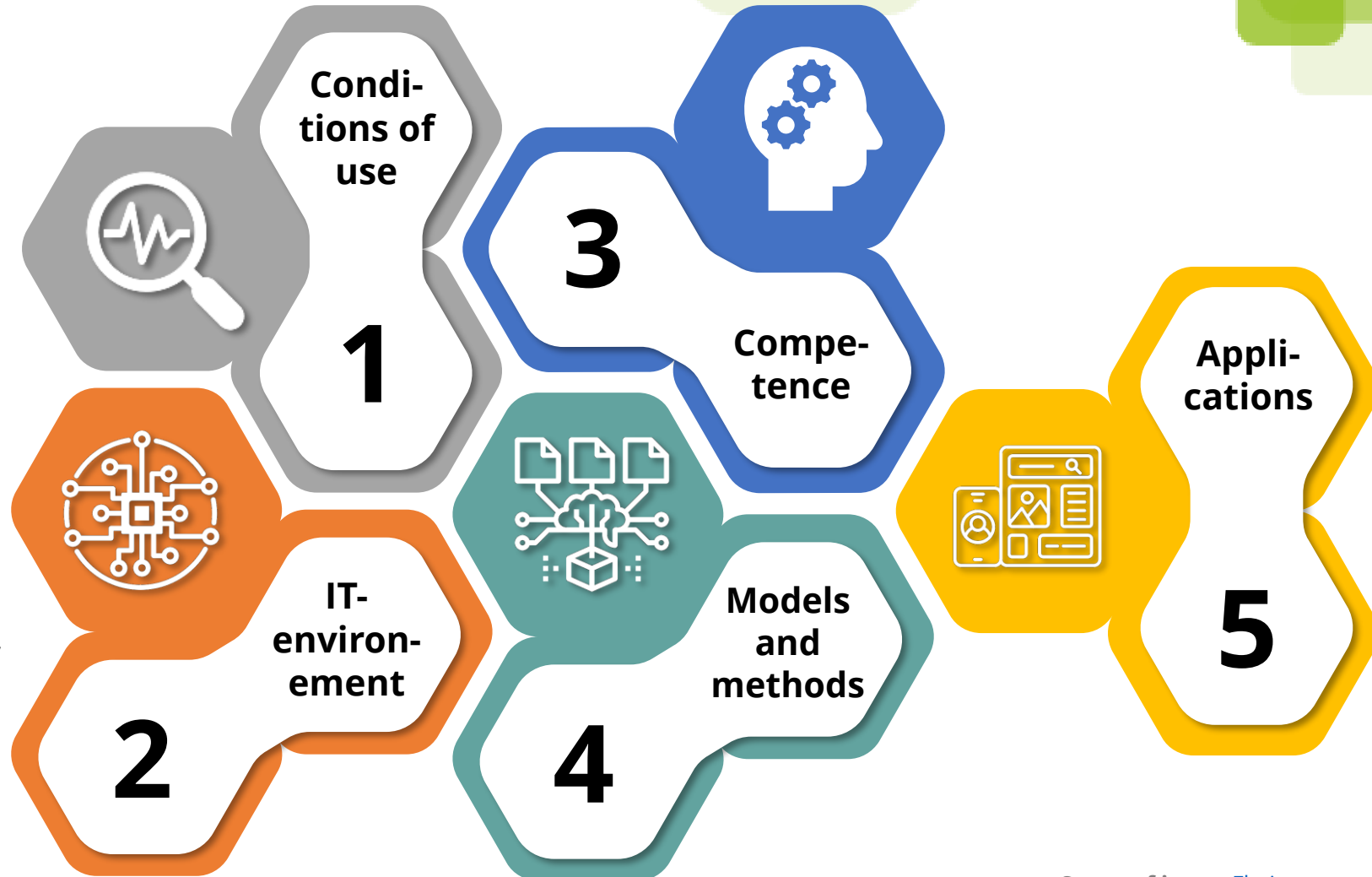
... AND AS IT REALLY IS



- 
- You buy a car. To get you from A to B, you also need: a destination (B) (where you want to get to with this technology), a road, traffic rules, and a driver.
 - You buy AI tool (application, service) ... you need to build a data-driven system in which the application of AI leads to the goal
 - E.g. (in short)
 - Data ownership (someone has to be accountable when the AI gets it wrong. Not the vendor. A named person, with real authority.
 - Measurement (you need to know if it's working before you can prove it's worth keeping. "It seems useful" is not a result).
 - Governance (Who decides when something needs to change? Who can stop it if it causes harm?)

Our road with AI (NTCA HU)

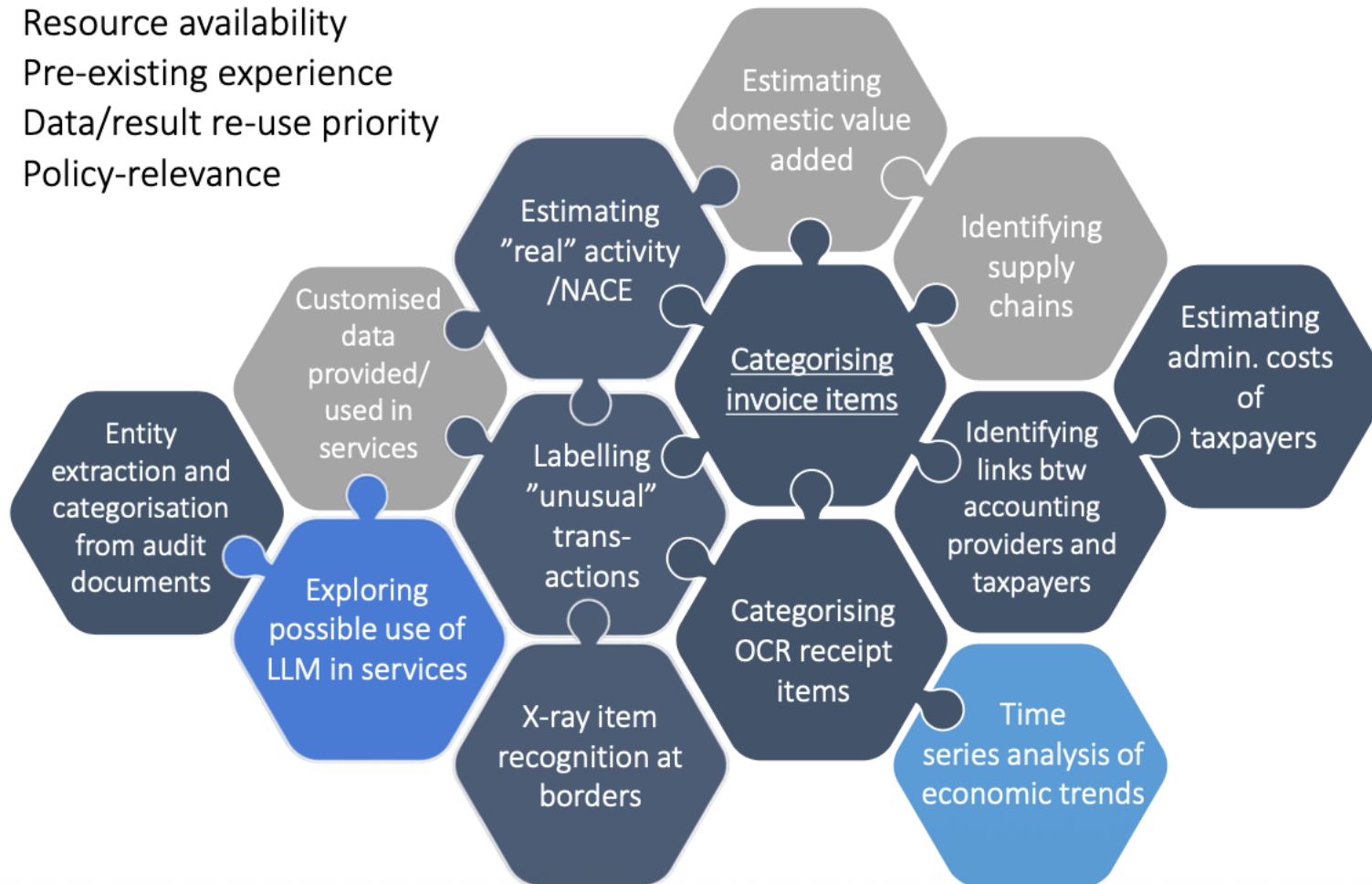
- **Increase efficiency** in repetitive, routine tasks, so skilled workforce can deal with essential tasks.
- Transition **from declaration-based to event-based operation**: real-time analytics on big data.
- **Serving taxpayers**: adaptive, well-targeted information (deadlines, duties, options).
- **Impact assessments and forecasts**: make the most of data and react faster. Data-rich tax policy analyses.
- **It does not replace domain expertise.**



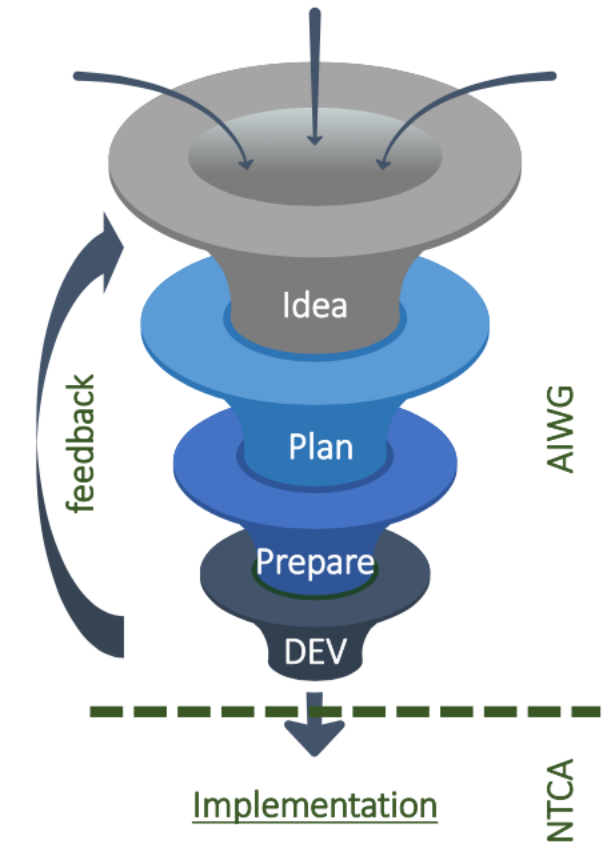
Projects building on each other

Drivers:

- Resource availability
- Pre-existing experience
- Data/result re-use priority
- Policy-relevance



Development pipeline



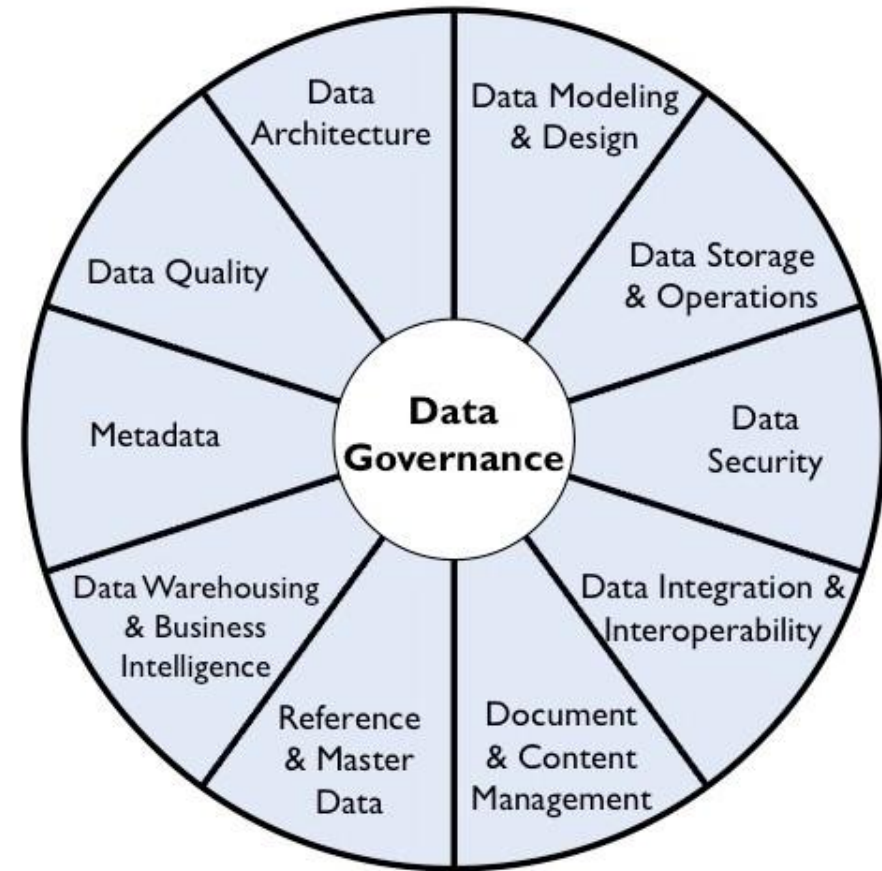


'DAMA''
DATA MANAGEMENT
FRAMEWORK FOR VALUE CREATION

DATA MANAGEMENT

In order that data doesn't just "exist", but is also utilized, in a sustainable way.

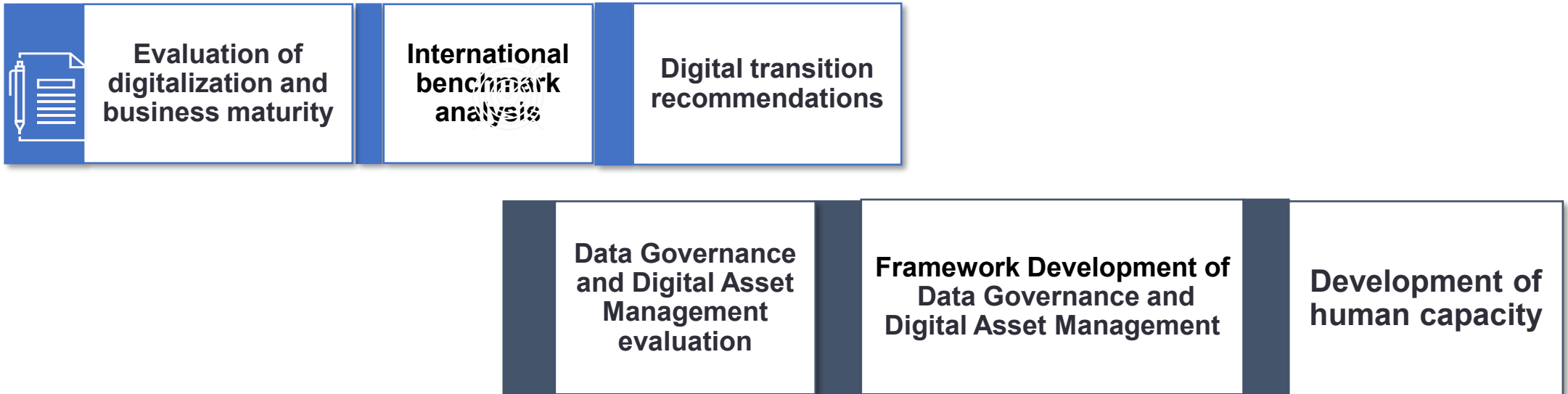
The DAMA wheel is a framework for how to collect, protect, organize and use data. In a way that creates value, and in accordance with the law.



NTCA's journey to the New World

DIGITAL TRANSITION **and** DATA ASSET MANAGEMENT DEVELOPMENT

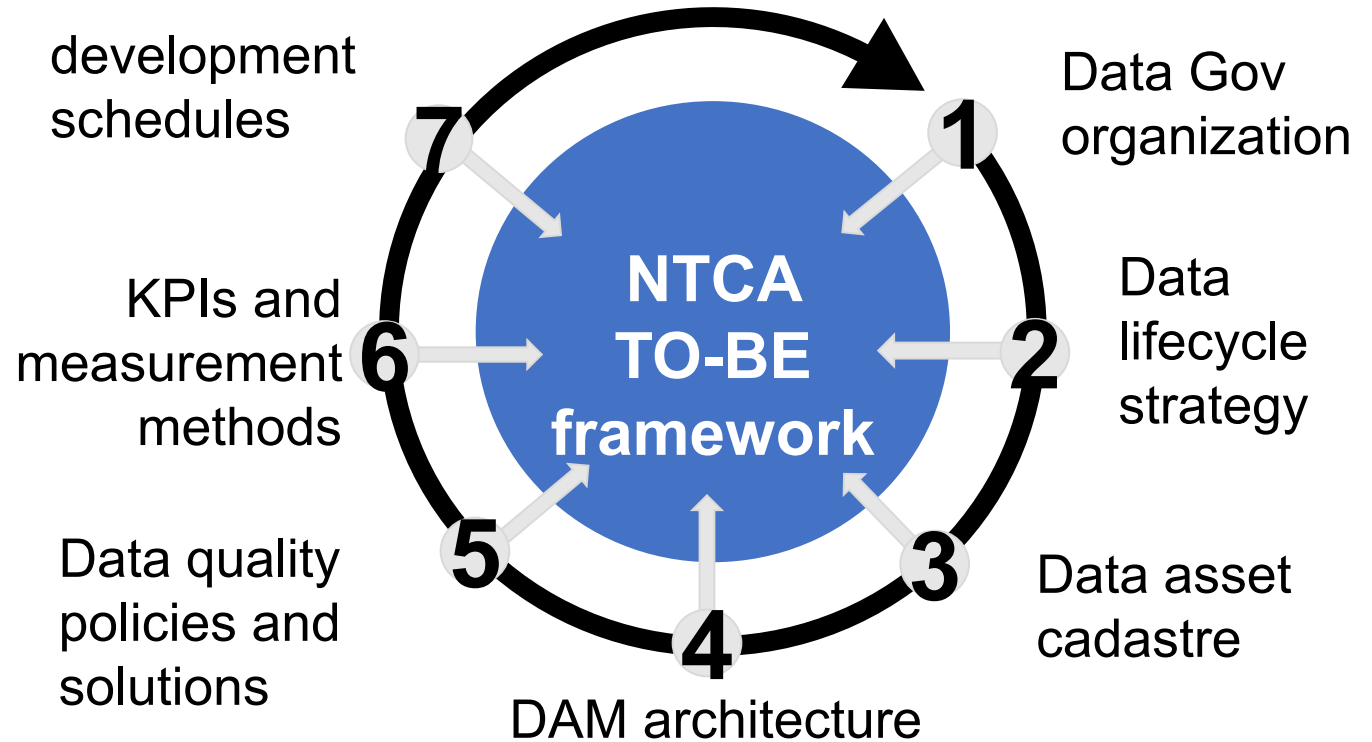
TECHNICAL SUPPORT INSTRUMENT PROJECT, FUNDED BY EU

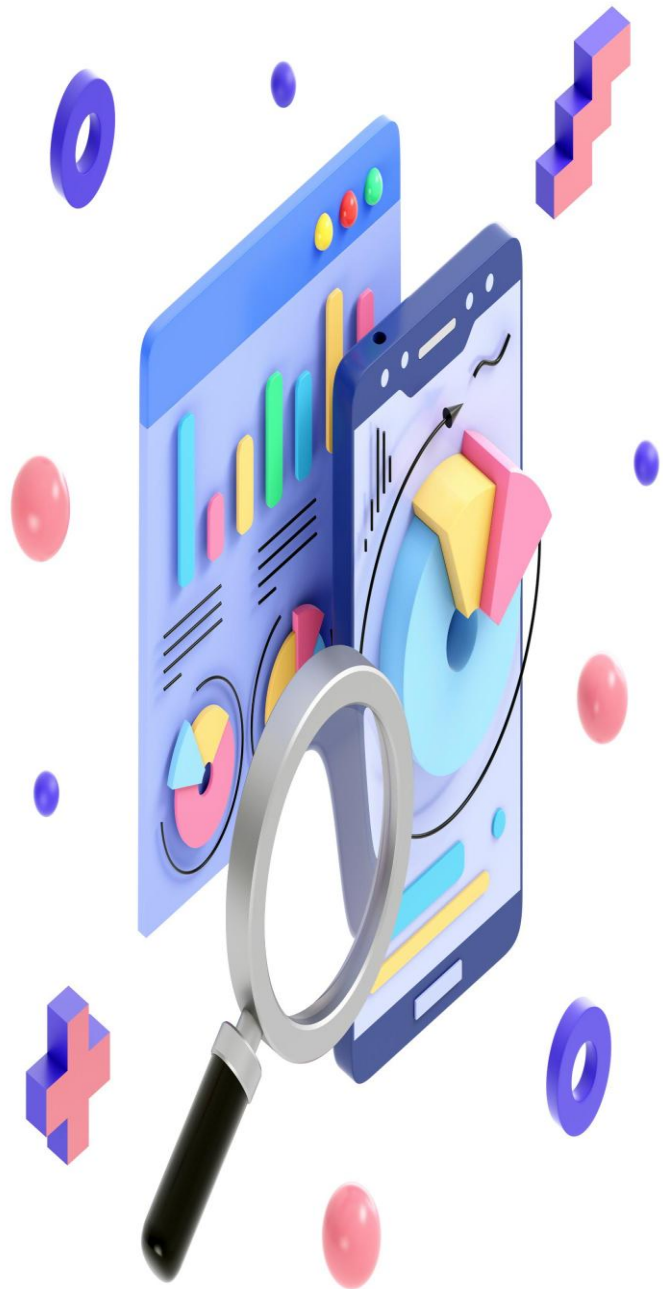


DAMA

FRAMEWORK FOR NTCA

a unified framework for managing data lifecycle, data governance, data quality





use-cases (examples)
at NTCA AI WG

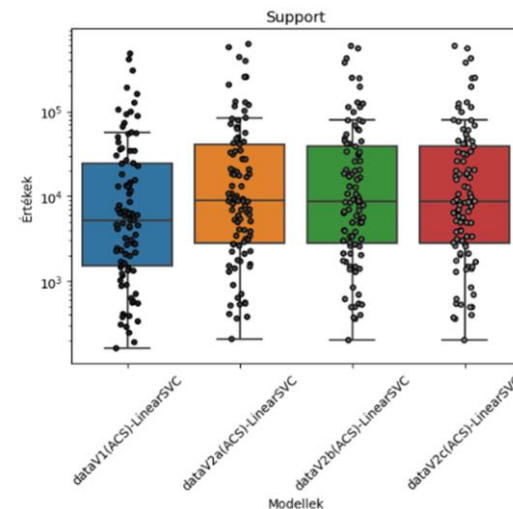
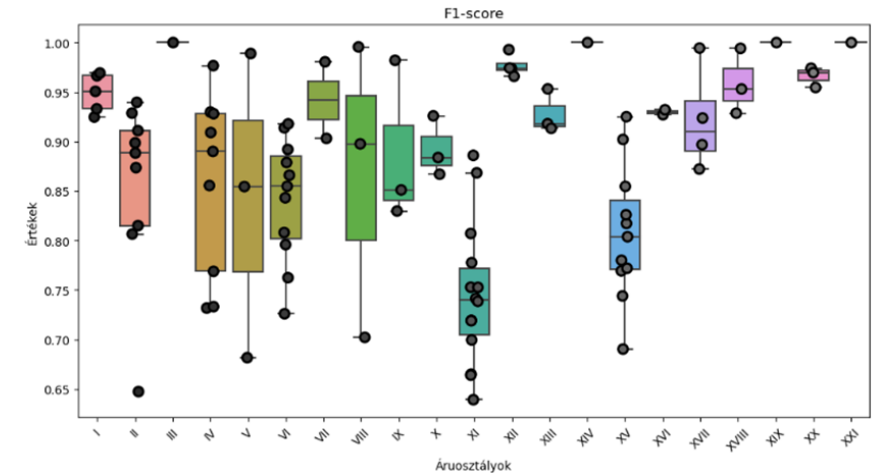


Online invoice item categorization

GOAL:

recognition of product or service content in online invoices, and matching to tariff codes.

- Data extraction
- Discover and correct
 - false and outdated tariff classification
 - false service codes



Multi data-set input:

- Online invoice
- Online cash register
- Customs export/import data
- Public Road Trade Control data
- Taric db, code lists

Checking for "unusualness" of invoice data

The goods and services described on the invoices can be recognized „unusual“ in some way (related to the taxpayers involved).

In service to taxpayers: drawing attention to the unusual nature of the invoice data

risk analysis: faster response, emerging new risk indicators

„Unusual“

- in values
- by filed business activity
- in time-patterns
- by unusualness of the good/service
- e.t.c.

- **DESCRIPTIVE STATISTICAL METHODS**
- Statistical analysis of the taxpayer's previous invoices („habits“)
- Expert methods for clustering
- **AI-BASED METHODS**
- Supervised classification
- Unsupervised classification
- Account "expected value" estimation (supervised regression)

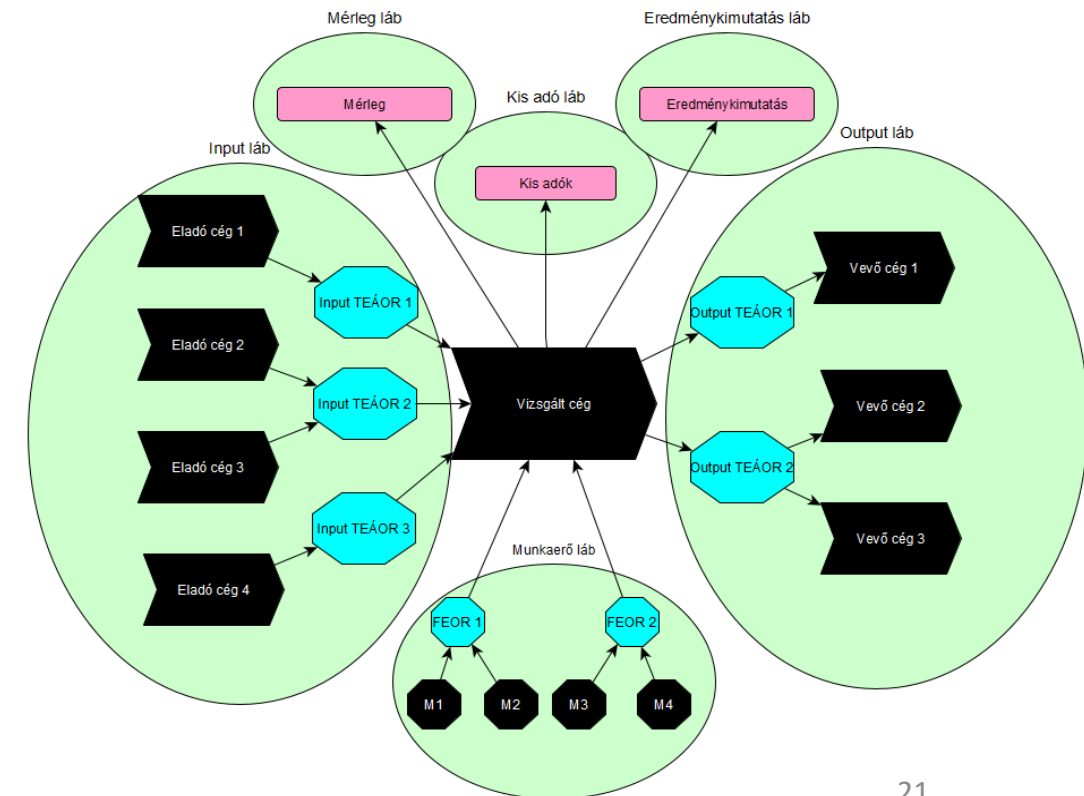
Main activity (TEÁOR compliance)

GOAL:

Verification of the adequacy of the declared main activity and economic activity data. *Recommendation app of TEÁOR (NACE)*

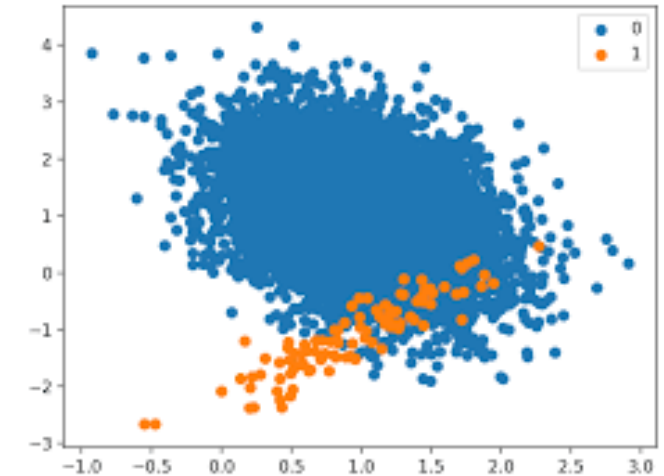
Based on

- Accounts received
- Recipients of issued invoices
- Workforce admin data
- Sectoral taxes characterising activities



Nowcasting based on retail data

- GOAL:
time-series analysis of real-time retail data (impact assessment, forecasts, decision support)
- Analysis of online cash register data using machine learning methods
- Cleaning and classification of product names are required:
normalization and hiding company-specific data
- Building in-house experience with AI/deep learning-based methods



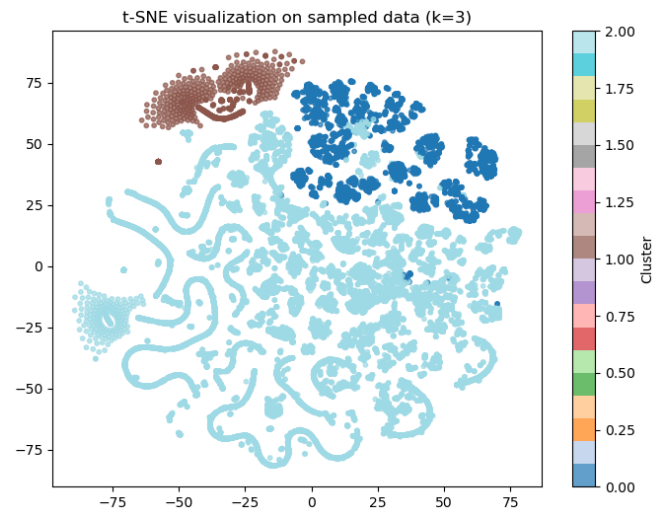
Identify the clientele of accountants/auditors

GOAL:

impact analysis of accountants, tax advisors and the characteristics of the related taxpayers.

Approach:

Looking for tax compliance indicators and tax evasion structures among accountants and auditors based on taxpayer behaviour patterns. Elaboration of proposals and knowledge rules for taxpayer groups based on certain behavioural patterns in order to ensure targeted and proportionate tax authority action.



Network analysis of references to court decisions in tax litigation

GOAL:

support of legislators and law enforcers to navigate in the legal corpus,

Approach:

- introduction of legal tech in taxation when interpreting legislation,
- development of objective, systemic and logical interpretation of the law.
- data-based search, reduce cognitive biases in the application and interpretation of the law

Achievements:

- Emphatic and complex judgments can be identified, which serve as a strong legal precedent
- 660 clusters were isolated, each covering a sub-problem
- Organizational changes (e.g. 2010 and 2015-2016) significantly influenced the number of clusters
- Judgments that play the role of bridges (betweenness centrality) play a particularly important role
- NLP examination methods reveal more profound, linguistic logical connections

Network analysis and graph-based data mining to detect fraudulent activities

GOAL:

data-driven methodology that is able to identify certain suspicious patterns of VAT fraud from transaction data between economic actors with the help of graph models.

Methodology: graph and data mining techniques.

Achievements:

A unified data model has been prepared for the interpreted (invoice and VAT return) data tables, their training codes, the Python codes for graph structure formation, the analysis and graph traversal codes.

Generation of synthetic datasets with MCMC algorithm

GOAL:

to preserve the statistical structure, dependencies and rare events of the original data (to some extent), to make the generated data available for public research purposes.

Methodology: Monte Carlo Markov chain (MCMC) Gibbs sampling method.

(calculation of full conditional distributions of attributes, generation of synthetic stock with chunked data processing - optimized for large data sets -, identification and modelling of extremal data, evaluation metrics).

Basic risk categories in implementing trustworthy AI

WHAT CAN HELP US ... ?

- Privacy Concerns
- Accountability and Responsibility
- Transparency and Explainability
- Societal Impact
- Bias and Discrimination

- Robust legal and ethical frameworks
- Guidelines and Standards
- Regulatory Compliance, Audits and Certifications
- Involving the Public (consultations, feedback, research)
- Data Governance, transparency in data usage
- Tech: data anonymization, encryption, privacy-preserving AI Techniques
- Public model documentation, open-source

Public trust

How to explain if AI is working the way we want it to

- “Interpretation methods” try to shed light on how machine learning models make predictions. (But caution is needed...)
- Deep learning models achieved superhuman results (e.g. beating world-class board game players, outperforming doctors in diagnosing breast cancer, e.t.c.)
 - based on artificial neural networks, (proposed in the 1940s) – a model learns to process data using layers of interconnected nodes.
 - deep learning models consist of millions/billions of interconnected nodes, in many layers, trained to perform detection or classification tasks using vast amounts of data.
 - models are complex, no one can fully understand how they work. (whether they are working properly).

Explanatory methods

Local explanatory method: focuses on explaining how the model made a specific prediction

- attribute assignment: which input variables were most important when the model made a specific decision. (E.g. which columns in tabular data).
- counterfactual explanation: how to change the input so that it falls into a different class
- sample importance explanation: (this requires access to the training data) which training sample the model relied on most to make a specific prediction


Global explanatory method: attempts to describe the general behavior of an entire model.

- Deep learning models operate in inherently complex and nonlinear ways, developing an effective global explanatory model is a major challenge.
 - attribute assignment: which attributes (input variables) were most important when the model made a specific decision. (E.g. which columns in tabular data).

Assumptions



- The pace of progress isn't determined solely by technology — organisational and human factors are also crucial.
- Don't let the machine be the only one learning! People and technology move forward together.
- It's not just about IT: understanding, skill development, and continuous feedback are key across all areas.
- Humans remain indispensable, and always will be! AI won't take our jobs – it transforms them.

- 
- Artificial intelligence will never be “finished” —what seems impossible today may become commonplace tomorrow, while what we regard as revolutionary now may soon become obsolete.
 - What looks solvable in a few years might remain just as unattainable — innovation is never guaranteed.
 - Data is the new engine of efficiency—enabling leaps we couldn’t achieve by other methods.
 - Progress is step-by-step: first we understand, then we apply, and ultimately we fully leverage new technologies.

DIGITAL TRANSFORMATION BASED ON DATA



DATA
COLLECTION



DATA
ANALYSIS



DECISIONS
BASED ON DATA



DATA ANALYSIS OPENS NEW PERSPECTIVES

customers' behaviour

innovative possibilities

personalised contact

deviancy screening

automated processes

fewer errors

freed up human capacity

THIS IS A MARATHON, NOT A SPRINT.

data management practice

data protection

security

utilization of new technologies

value creation



**THANK YOU
FOR YOUR ATTENTION !**

