METICOS

A Data Analytics Framework for Monitoring Technology Acceptance of SBC Technologies

EAB Research Projects Conference 2022

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ICCS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 883075.

METICOS

- Increasing demand for traveller clearance at border crossing points (BCPs)
- METICOS project aims to address:

1. The need for **more efficient** solutions.
   Automated Border Control (ABC) emerging solution for convenience, throughput of BCPs, and national security.
2. The need for gaining the travellers' **societal and political acceptance** and satisfaction on the use of Smart Borders technologies.

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Data Analytics in METICOS

Harmonize data from heterogenous sources, by developing a data model

Provide a portfolio of Machine Learning, and Statistical algorithms as well as Data Analytics techniques,

Uncover patterns regarding acceptance and efficiency of Smart Border Control Technologies

Expose the results of the analysis to end-users through an interactive dashboard.

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Technologies & Tools

METICOS

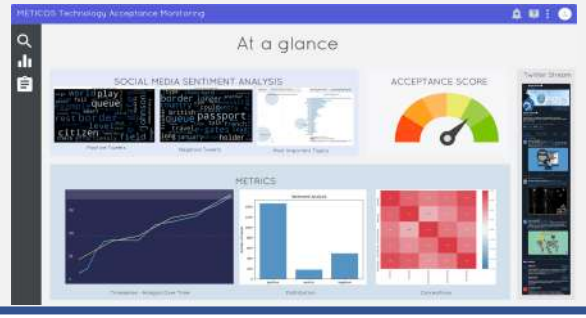
Data Visualization

seaborn

matplotlib

POLICY MAKERS

BORDER AUTHORITIES



plotly | Dash

Apache Superset

plotly

Big Data Analytics Engine

docker

Keras

TensorFlow

TextBlob

pandas

Shap

Bias mitigation

Pipeline
For Unstructured Data

Pipeline
For Structured Data

Advanced Data Mining Engines

GENSIM
topic modelling for humans

scikit learn

Data Preprocessing

mongoDB.

JSON

DATA FUSION — DATA STORAGE — DATA CLEANING — DATA TRANSFORMATION

FI-WARE

Data Model

Data collection

Data Layer

Structured Data

API

METICOS tablet app

METICOS web app

BCP performance indicators

Questionnaires

Unstructured Data

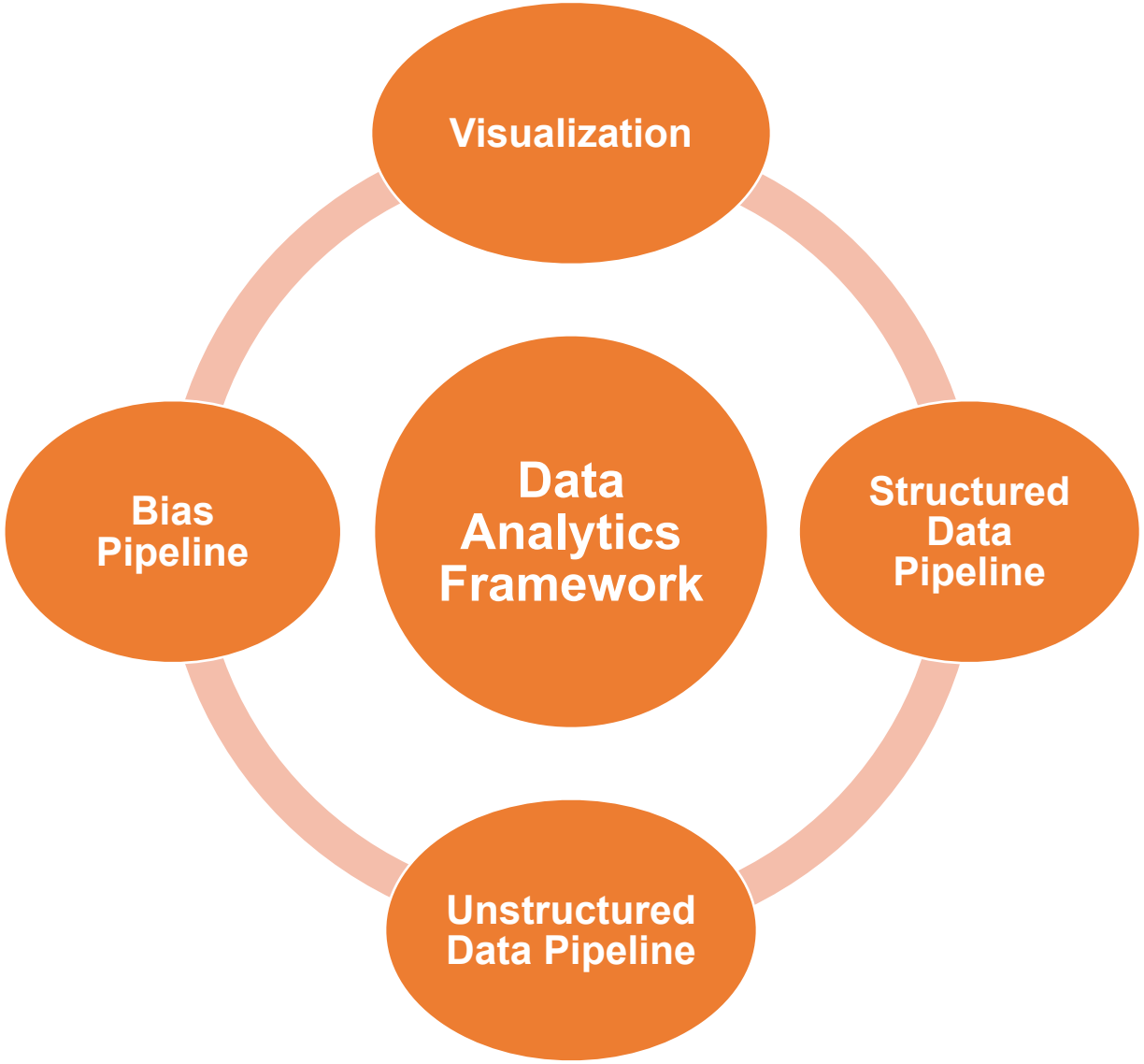
Online Reviews

Twitter

CSV

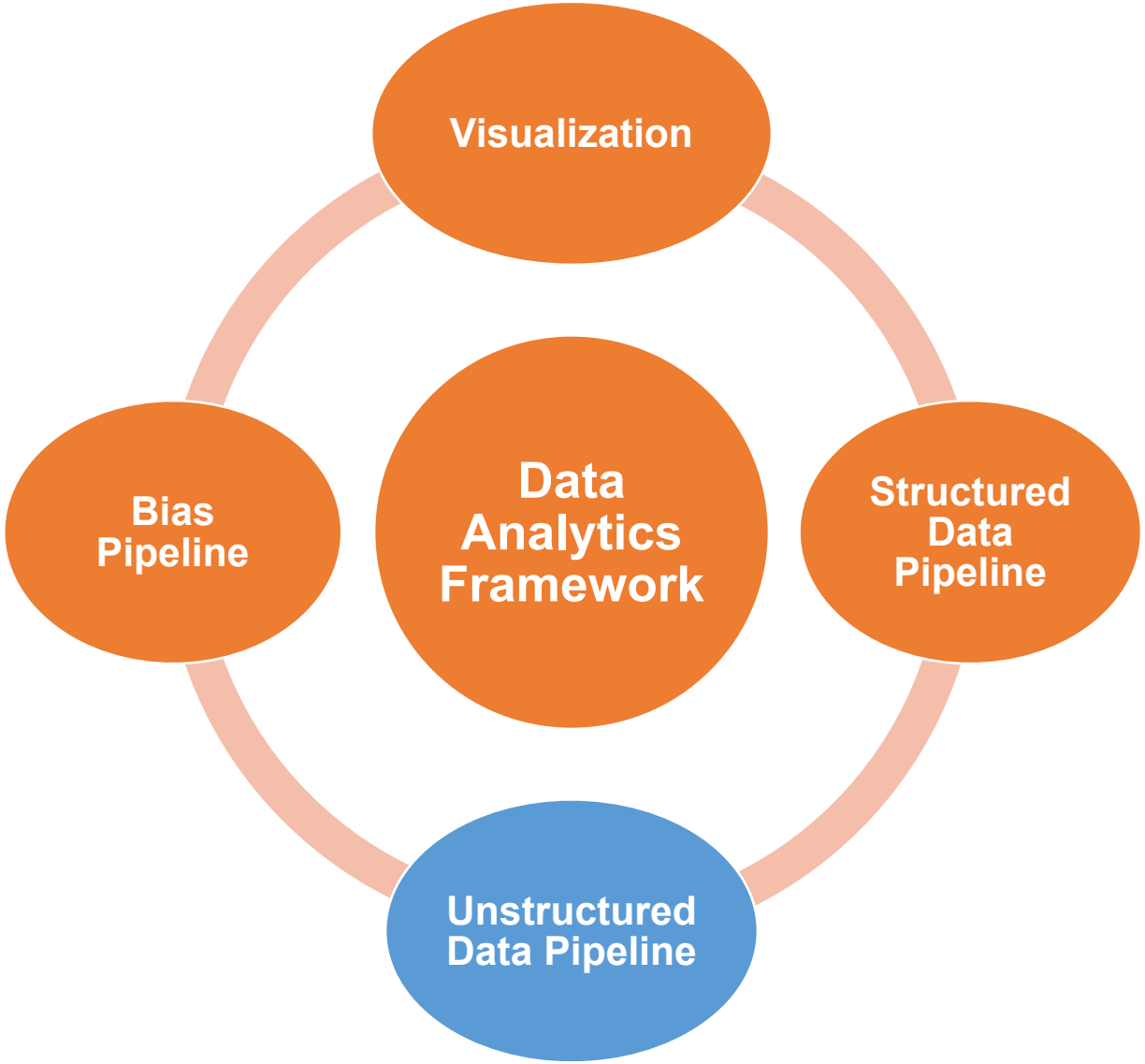
Data Analytics Framework

METICOS

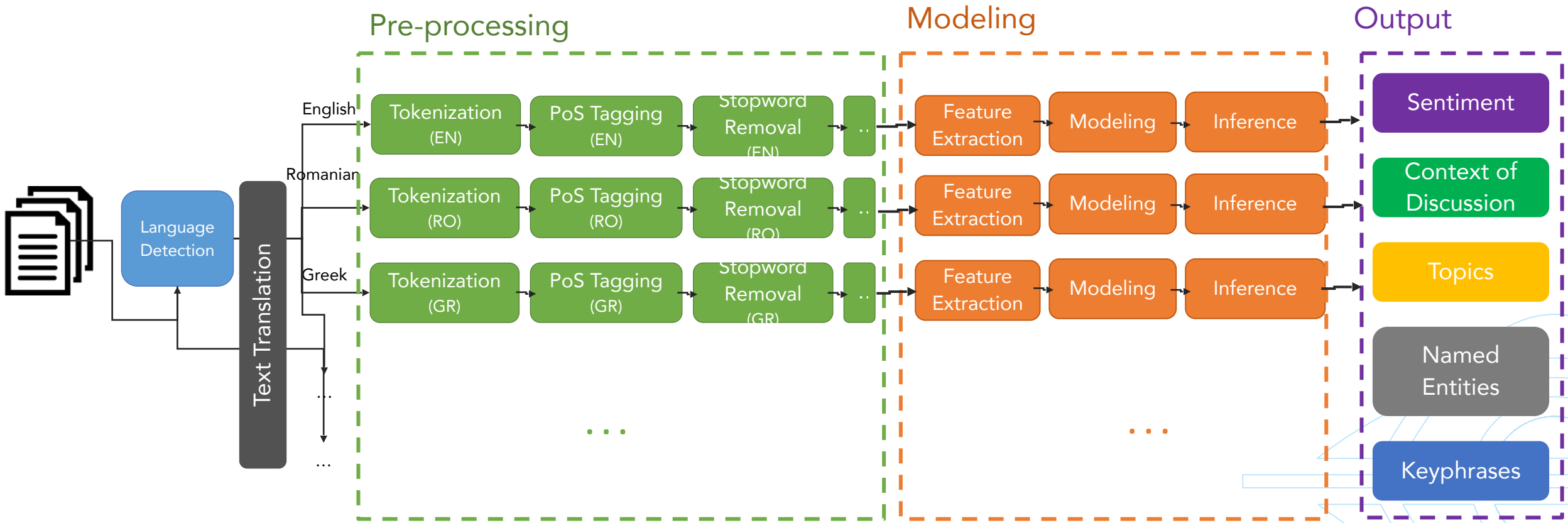


Data Analytics Framework

METICOS



Pipeline for Unstructured Data



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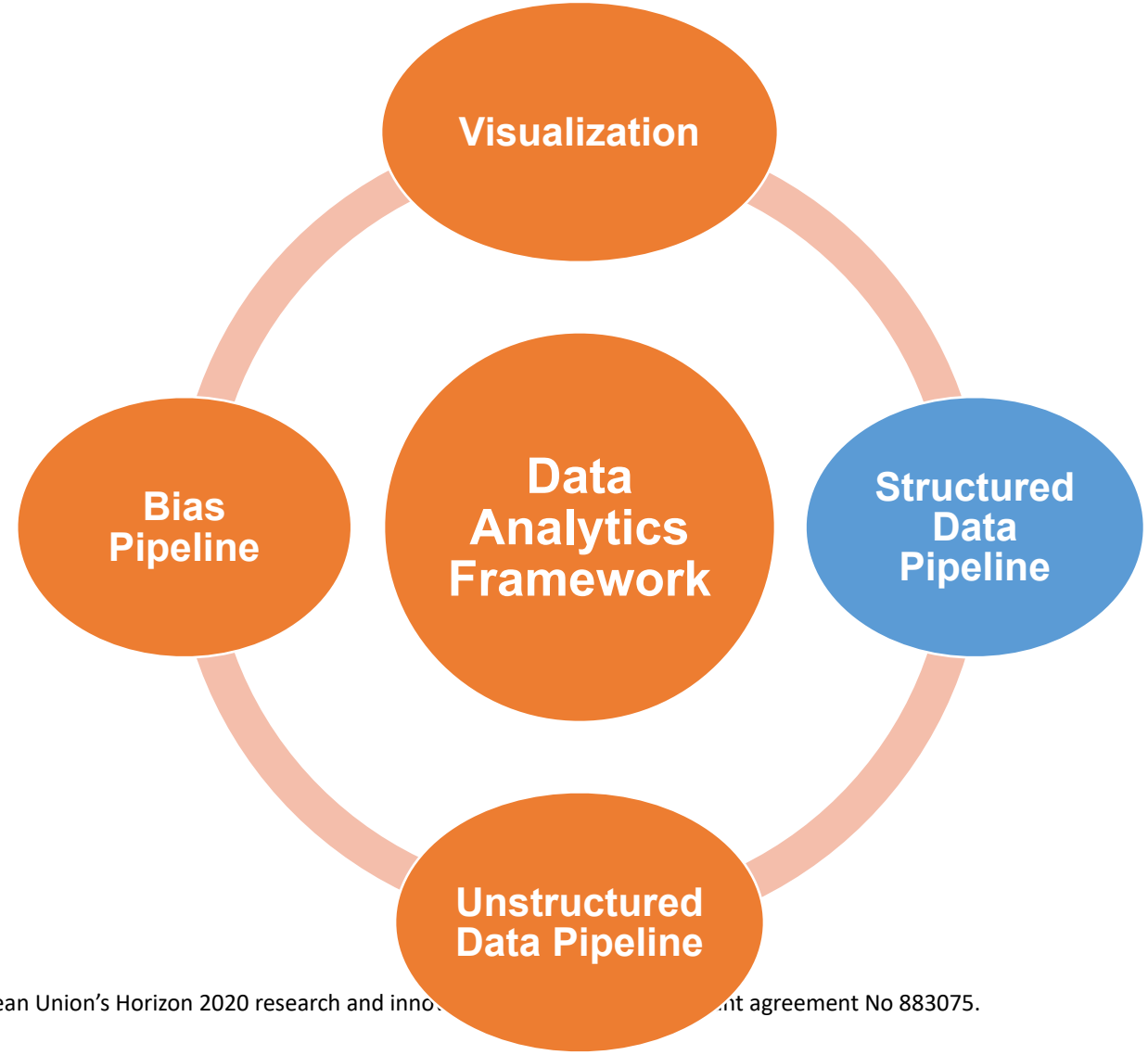

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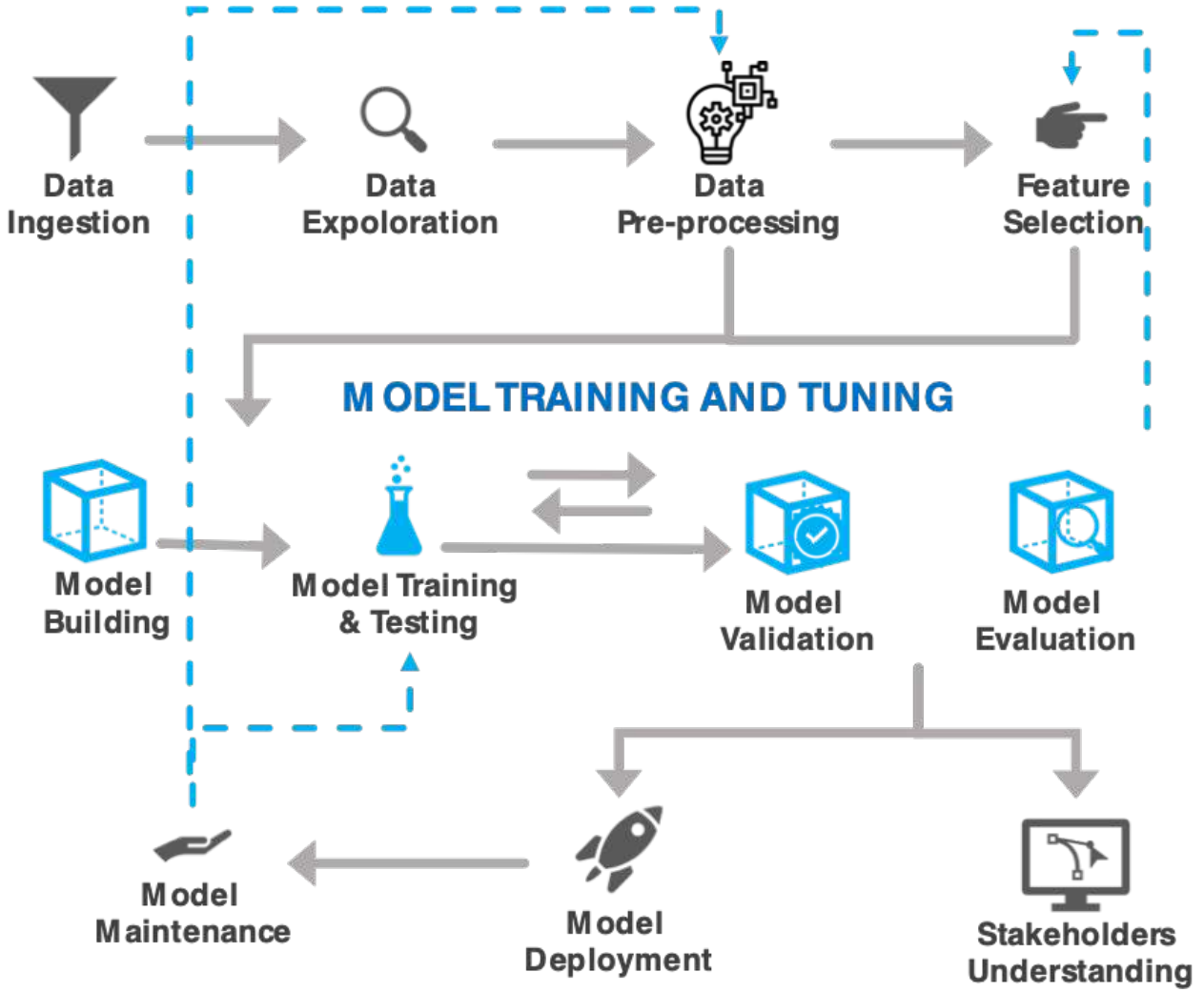
Machine Learning Pipeline for Structured Data



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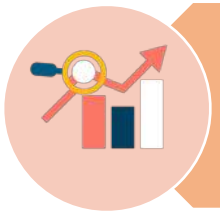
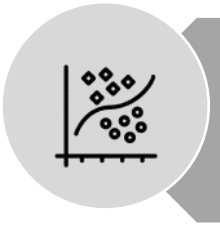
Algorithm Categories



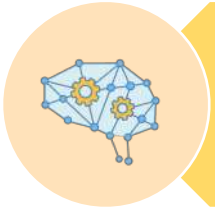
Descriptive

- Data filtering and aggregations



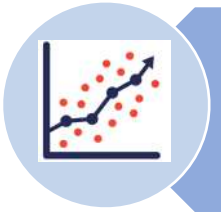
Classifiers

- ML models for classification



Deep Learning

- Neural Networks for Deep Learning



Regressors

- ML models for regression

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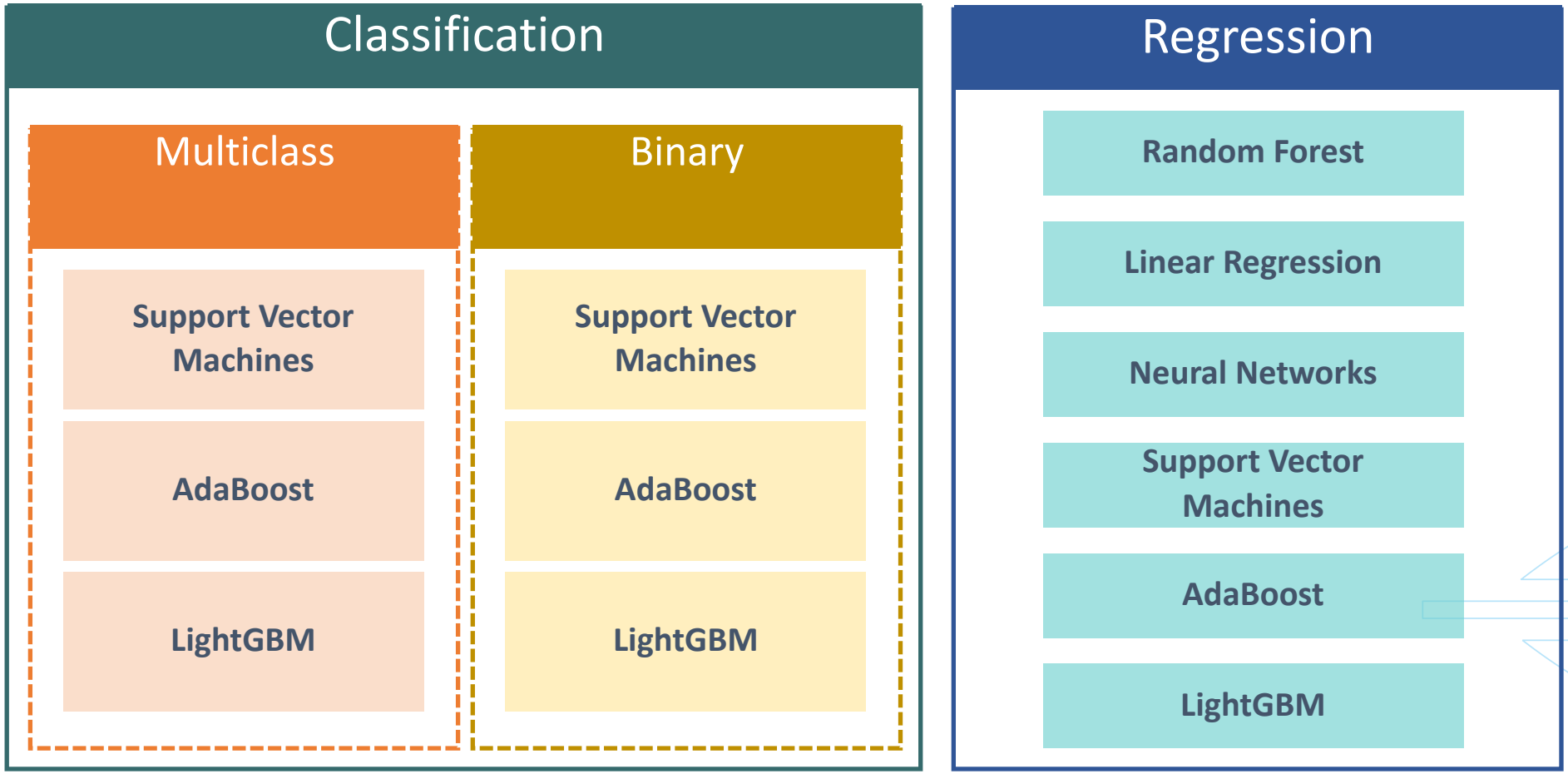
Algorithms Implemented



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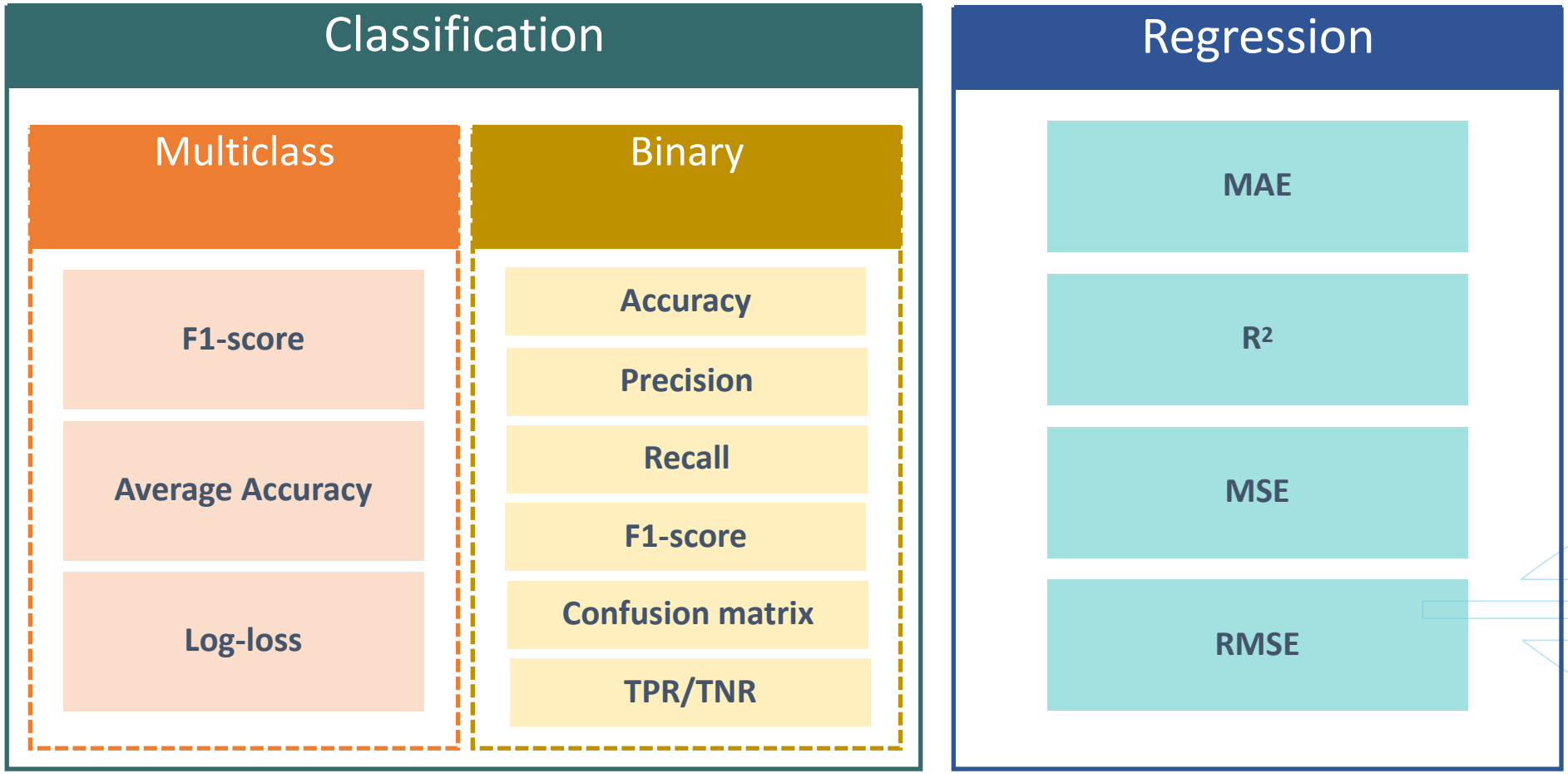
Metrics for evaluation



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Structured Data Pipeline - Outputs

- Types of Outputs:
  - Correlations between demographics & profile (age, gender, education, travel habits, cultural background etc.), operational data (e.g. waiting time, time to cross, queue length, system errors, FAR, flight delays…) and acceptance/efficiency of SBCT.
  - Clustering of profiles of travelers and border guards
  - Cross-tabular statistics
  - Predictions based on ML and DL models
  - Importance and weight of influencing factors

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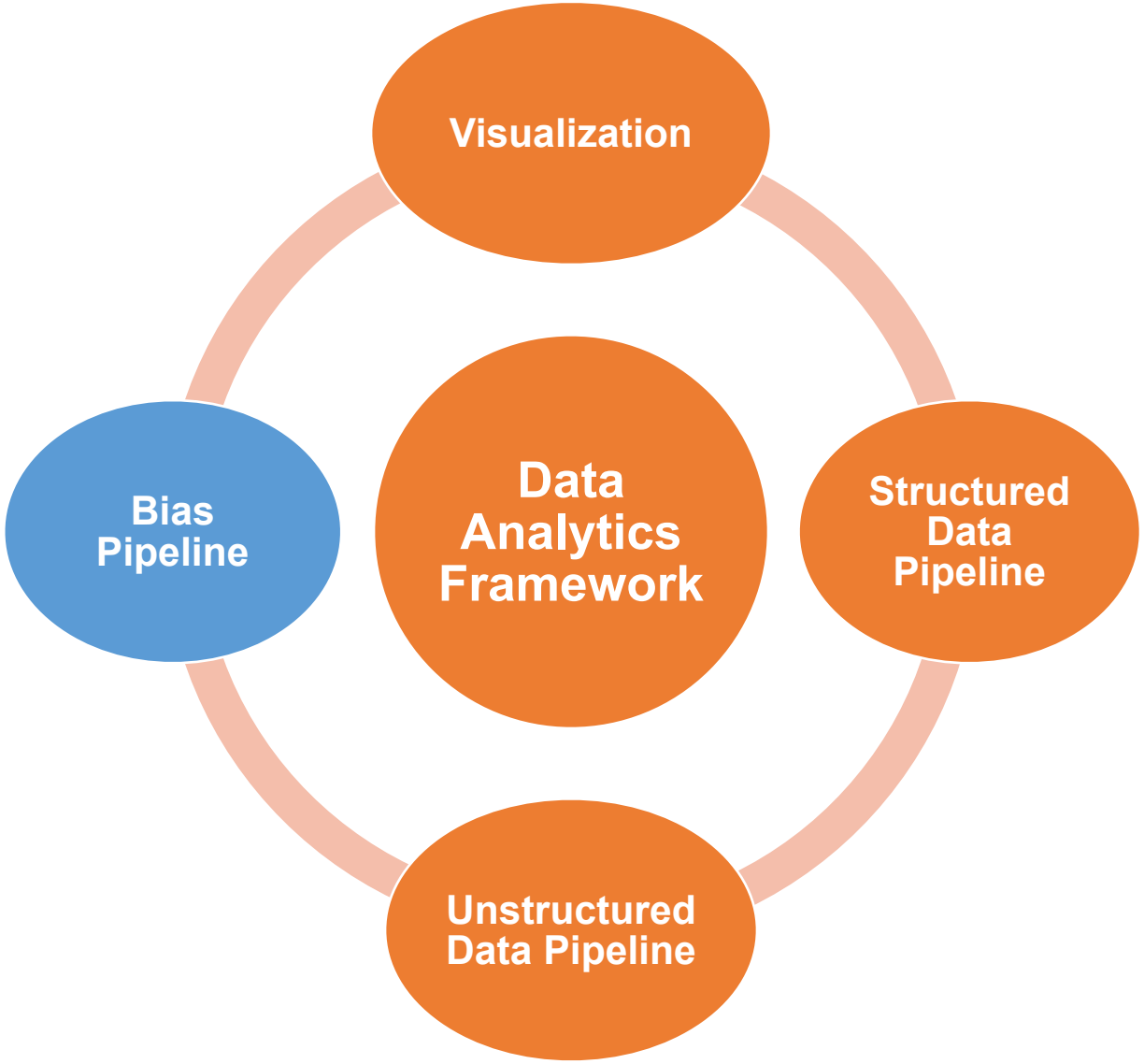
Visualization
Bias Pipeline
Data Analytics Framework
Structured Data Pipeline
Unstructured Data Pipeline

Mitigating Bias in the Pipeline

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Data collection

- Check for balance in the protected attributes

Data pre-processing

- Handling of noise and data cleaning
- Selection of appropriate approach (e.g. deletion, data imputation….)

Data analytics and model selection

- Implementation of various algorithms
- Calibration of models (k-fold cross-validation, hyperparameter tuning..)

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Bias identification tool and metrics

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The Tool

The AI Fairness 360 Python package includes a comprehensive set of metrics for datasets and models to test for biases, explanations for these metrics, and algorithms to mitigate bias in datasets and models.

Bias Metrics

Disparate Impact	comparision of the proportion of individuals that receive a favorable outcome for two groups
Equal Opportunity Difference (EOD)	deviation from equality of opportunity *(probability of being wrongly assigned the unfavorable label)*
Average Absolute Odds Difference (AAOD)	use of the false positive rate and true positive rate.

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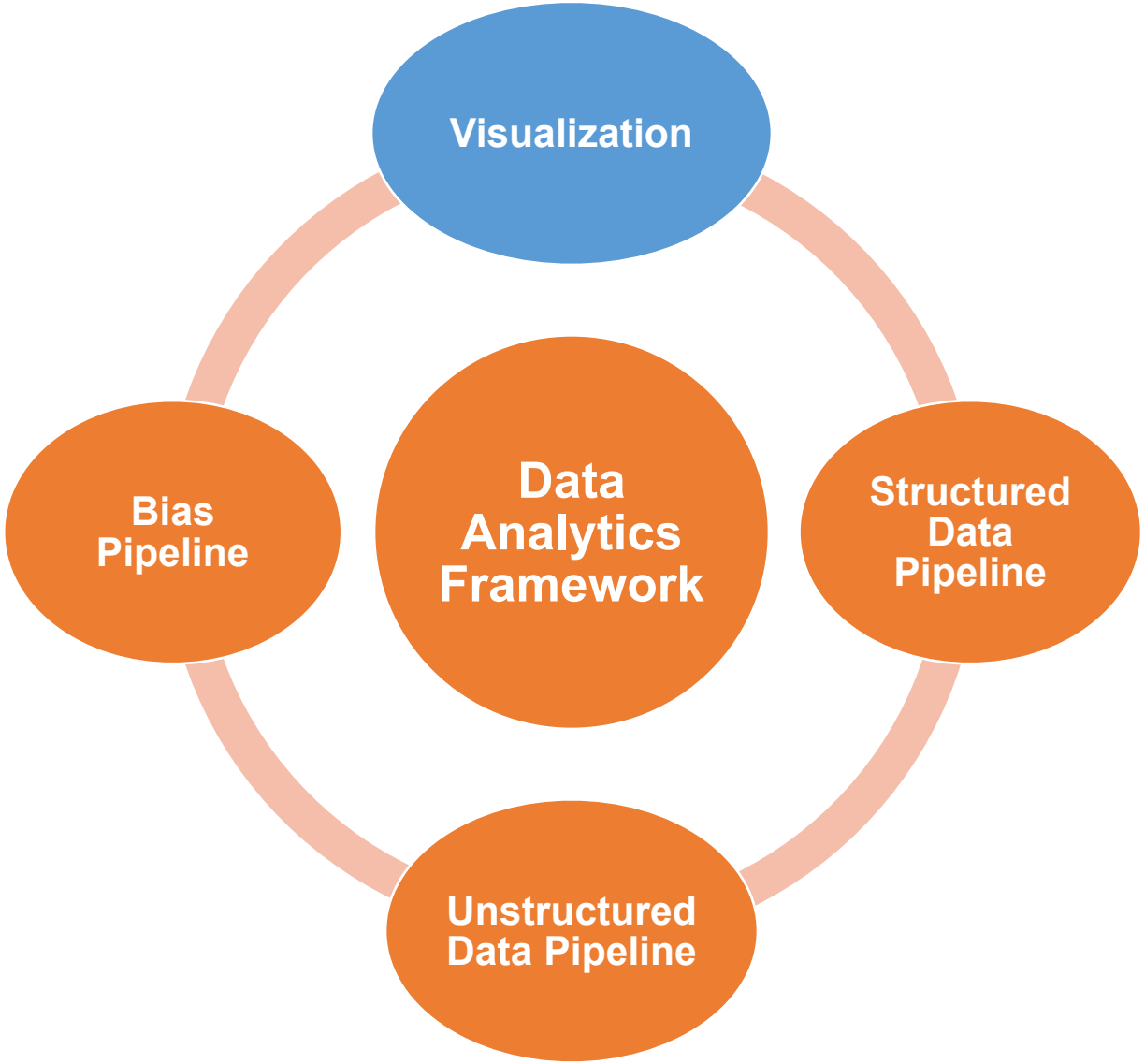
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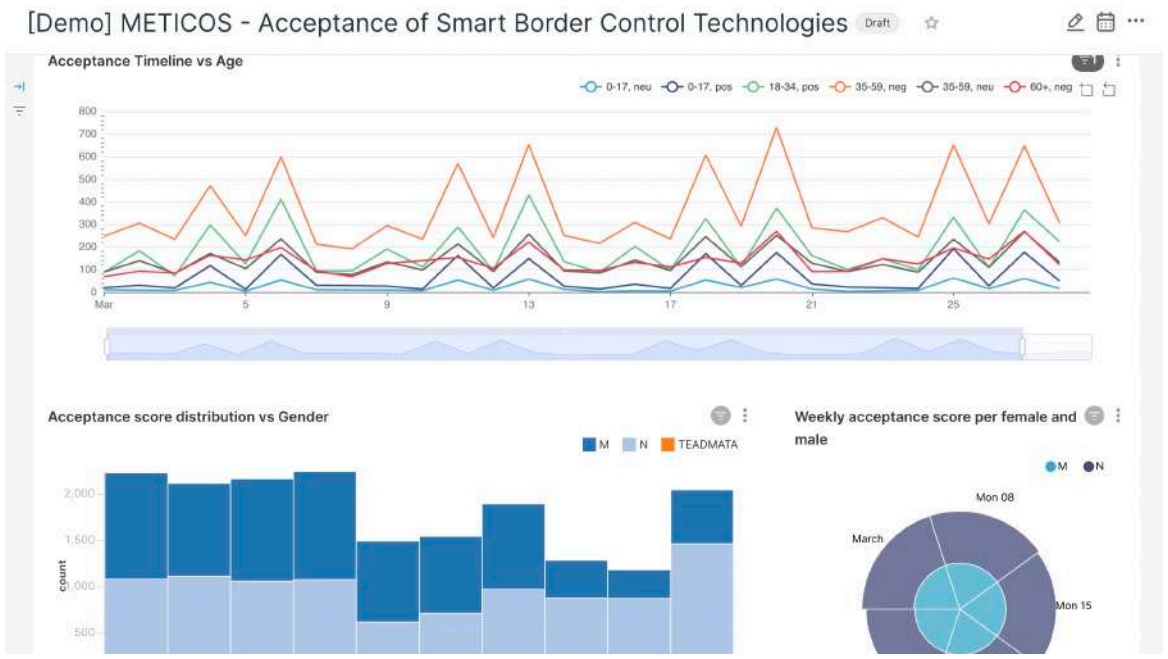
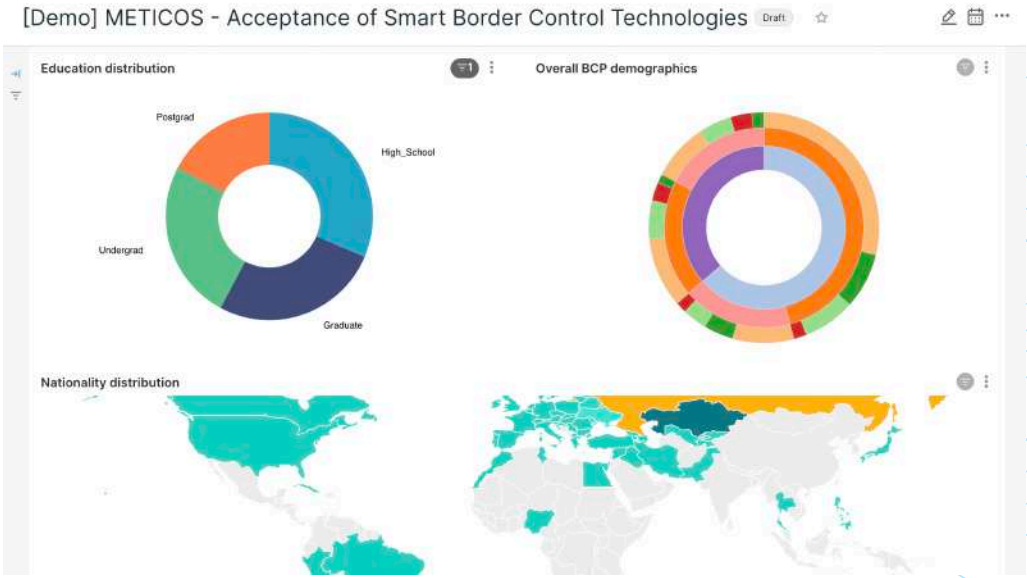
Visualisation





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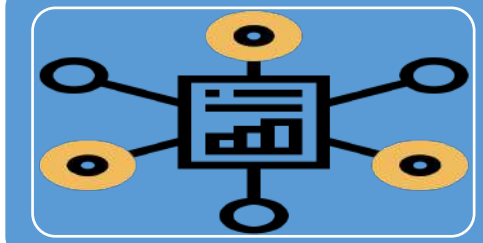
Conclusions



Our proposed framework encompasses the lifecycle of data from the moment they are collected until their presentation to the stakeholders.

When the data collection is finalized and the functionalities of the system are fully implemented, the solution is going to be evaluated by domain experts.

We expect that the insights and findings will enable evidence-based policy and decision support regarding the acceptance monitoring of SBC technologies.

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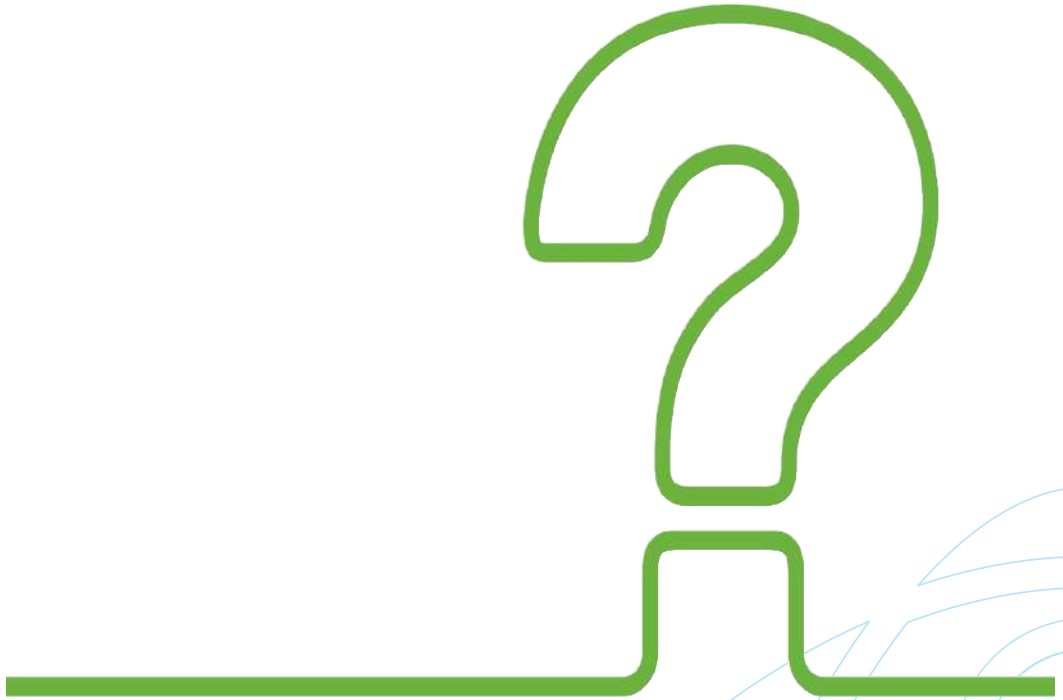
Thank you!!



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