



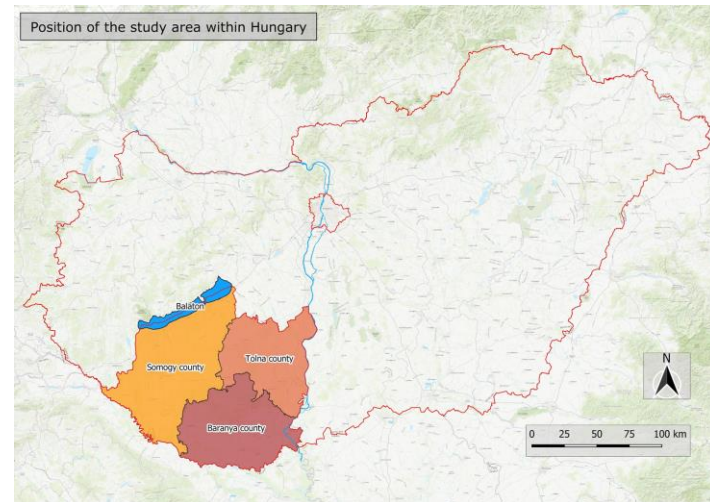
Sentinel data fusion for official agriculture statistics in Hungary

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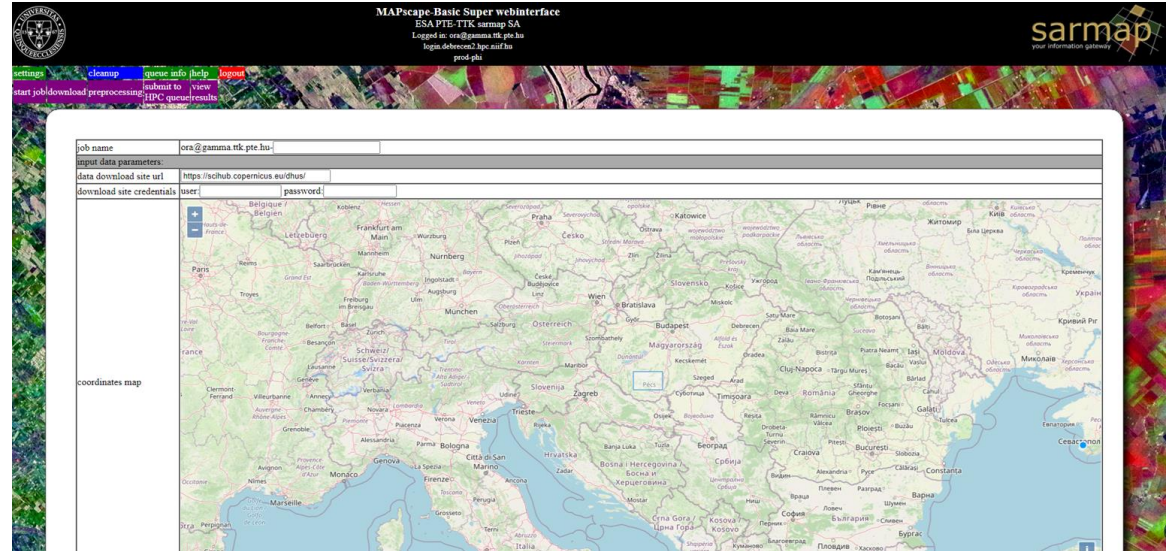
Introduction

- Objectives:
 - Demonstration of the crop mapping capabilities of Sentinel data
 - Grassland detection
 - Winter cereal separation
 - Wheat
 - Barley
- Study area: HU23 region - Southern Transdanubia, Hungary
 - 14 197.86 km²
 - 3 counties as statistical subunits (Baranya - HU231, Somogy - HU232, Tolna - HU233)
- Joint efforts:
 - Hungarian Central Statistical Office / sarmap SA, Switzerland / University of Pécs, Hungary
- ESA financed tender
 - "Sentinel data integration into the official statistics of the Hungarian Central Statistical Office (HCSO)".



Data and methods I.

- Sentinel-1 data
 - GRD files for intensity
 - 02/09 - 13/12, 2019
 - 01/06 - 07/10, 2020
 - SLC files for coherence
 - 02/09 - 20/10, 2019
 - 06/03 - 28/06, 2020
- Sentinel-2 data
 - March - August 2020.
- Region boundaries: NUTS
- CLC50 - Refined version of CLC100, available for Hungary
 - Built-up area and water bodies
- Semi-automated workflow (Hungarian HPC system)

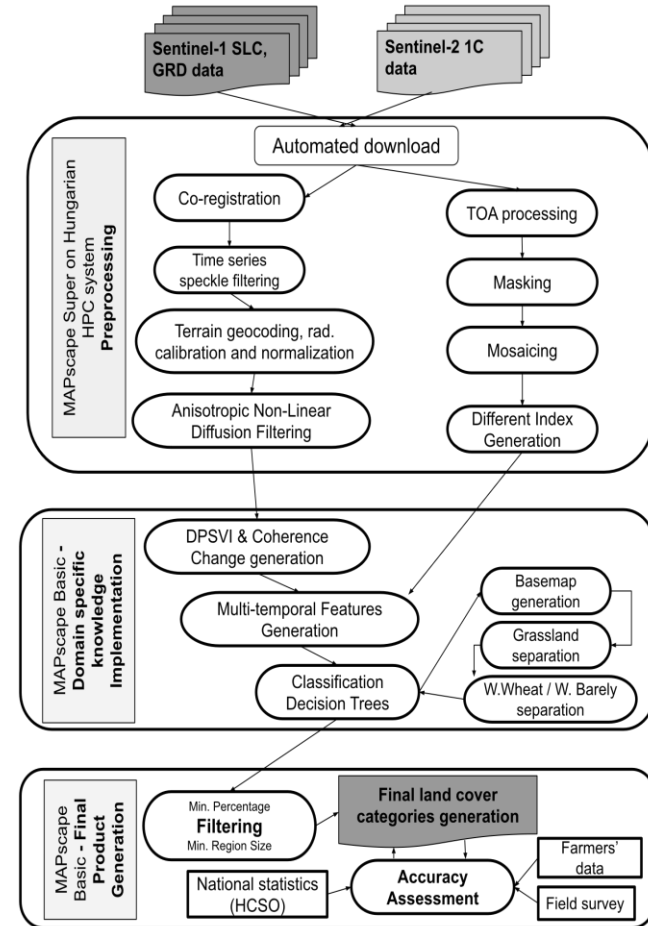


MAPscape®



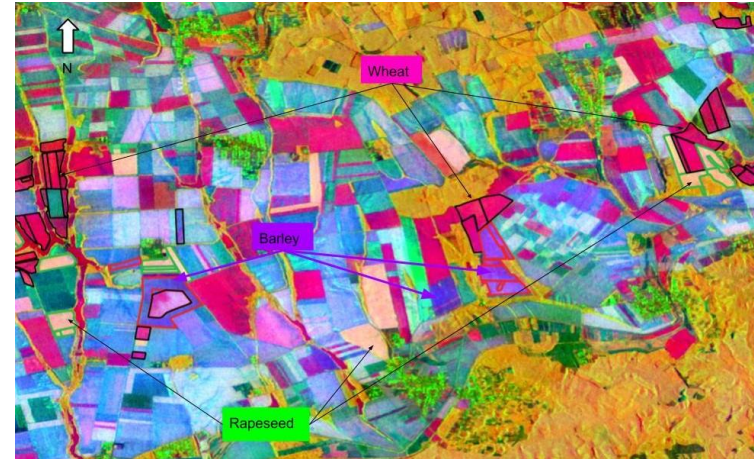
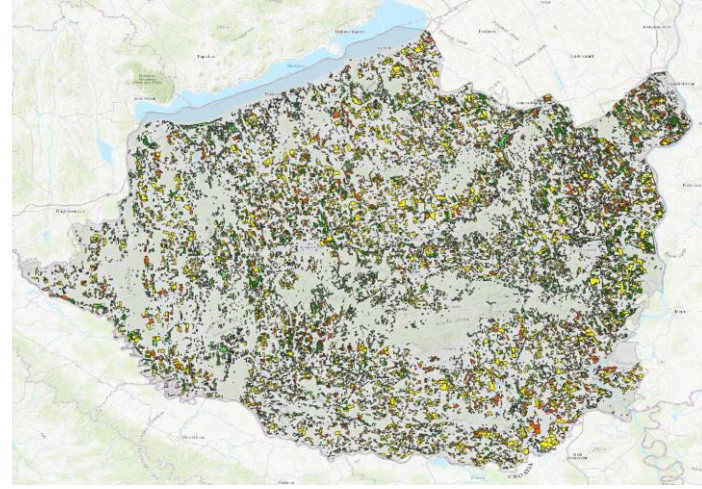
Data and methods II.

- Preprocessing phase - Mapscape 5.2. (semi-automated)
 - Sentinel-1 - processing to DPSVI
 - Sentinel-2 - processing to NDVI
- Manual (main) phase - Mapscape Basic
 - Fusion of DPSVI & NDVI components (20 meters resolution)
 - Implementation of user datasets
 - Decision tree generation (Boolean logic)
 - Further refinements, pixel-based filtering.
- Post-processing in QGIS 3.10.
- Field level validation, using mobile GIS applications (QField, Mergin)
- Different approach in our methods and the processes of the HCSO.
 - Remote sensing vs. surveys and farm subsidies.



Preliminary results

- Base map of land cover types
 - Water bodies
 - Permanent vegetation
 - Settlements
 - Croplands
- Croplands - Winter - Summer crop separation
 - Mean NDVI values from April and June
 - Different markers (SoS, PoS, EoS)
- Winter crop identification
 - Based on sowing dates
 - Distinct ripeness dates
- Grasslands
 - Remaining unmasked area

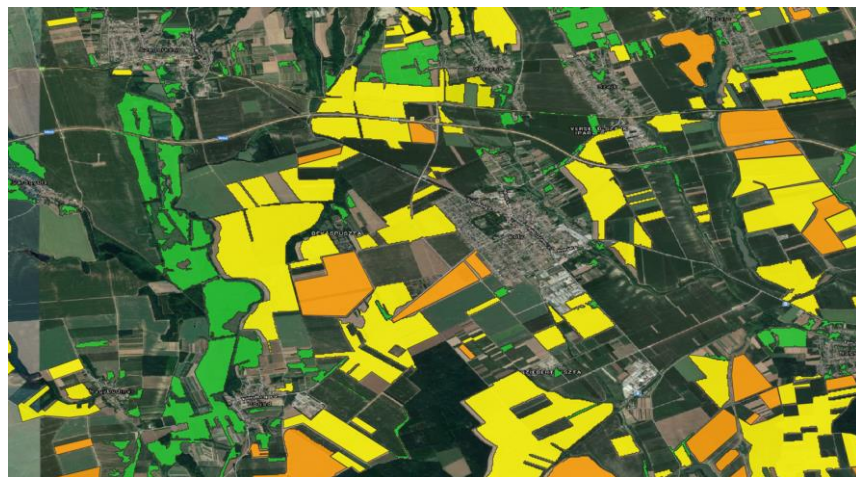


Results - Winter wheat and barley

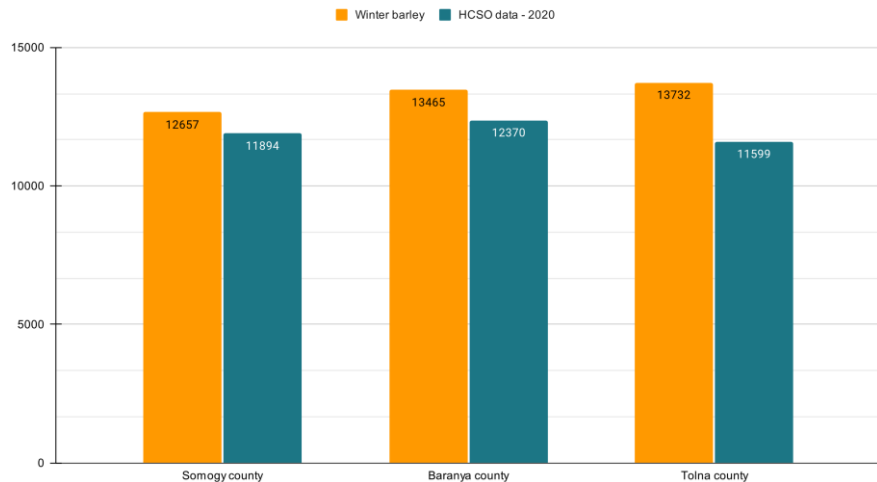


- *Summer-winter crop separation* -> winter wheat / winter barley identification
- Rapeseed fields are also easy to detect by this method
- 8000 fields of wheat, 3000 fields of barley



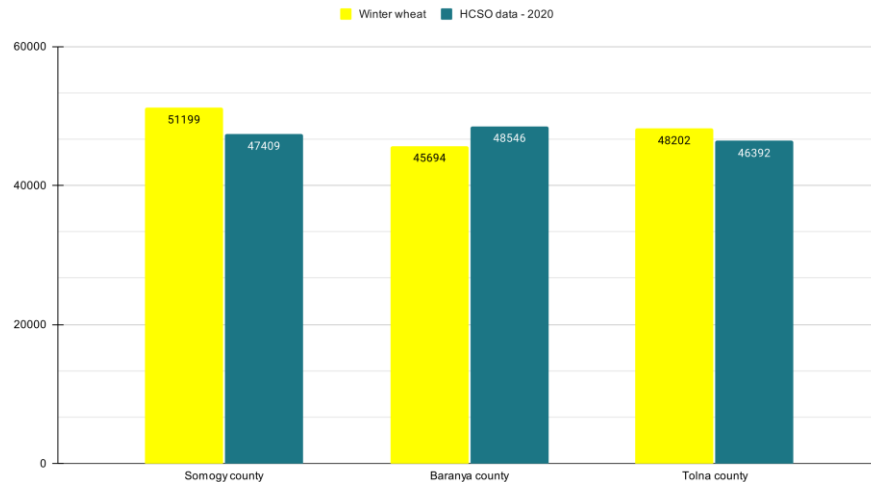


Acreage of winter barley in hectares - 2020



- Best result:
 - Wheat: 3.9% difference in Tolna county
 - Barley: 6.4% difference in Somogy county
- Regional average figures:
 - Surplus - Wheat: 1.9%, Barley: 10%

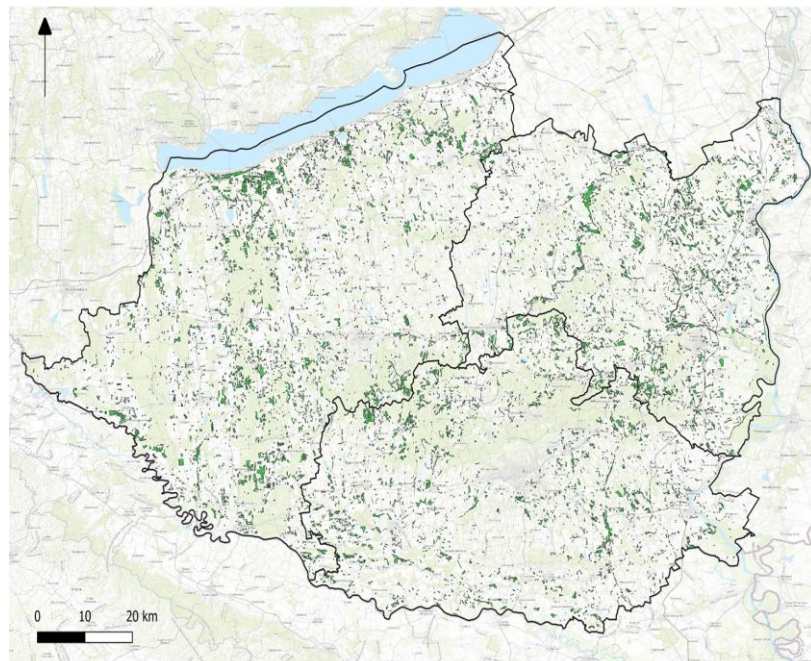
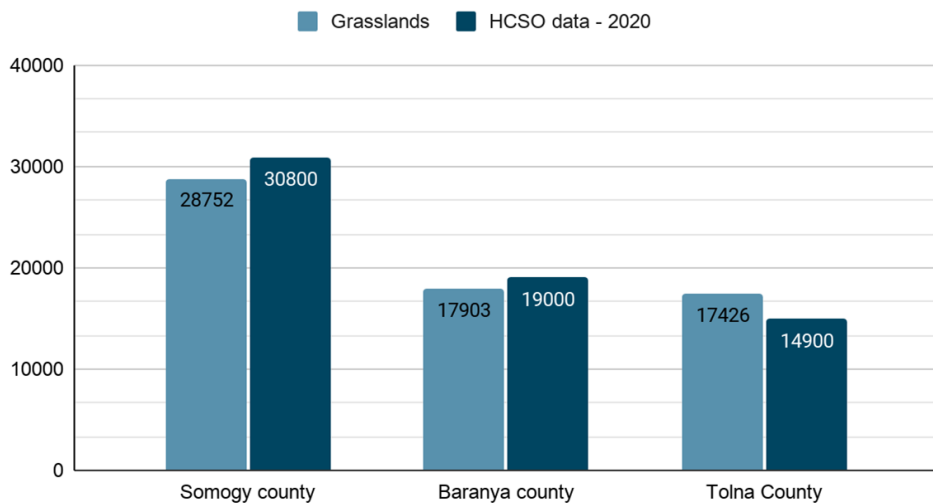
Acreage of winter wheat in hectares - 2020

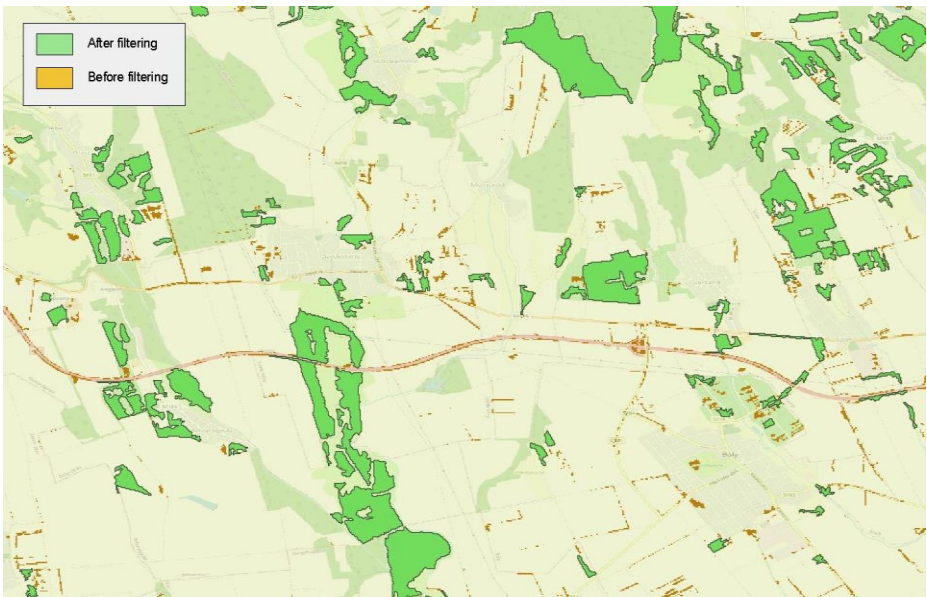


Results - grasslands

- 7500 separate polygons (meadows, grazing lands, fallow lands and abandoned fields)
- ~1500 ha regional deficit in our calculations (~2%)

Grassland areas in hectares - 2020

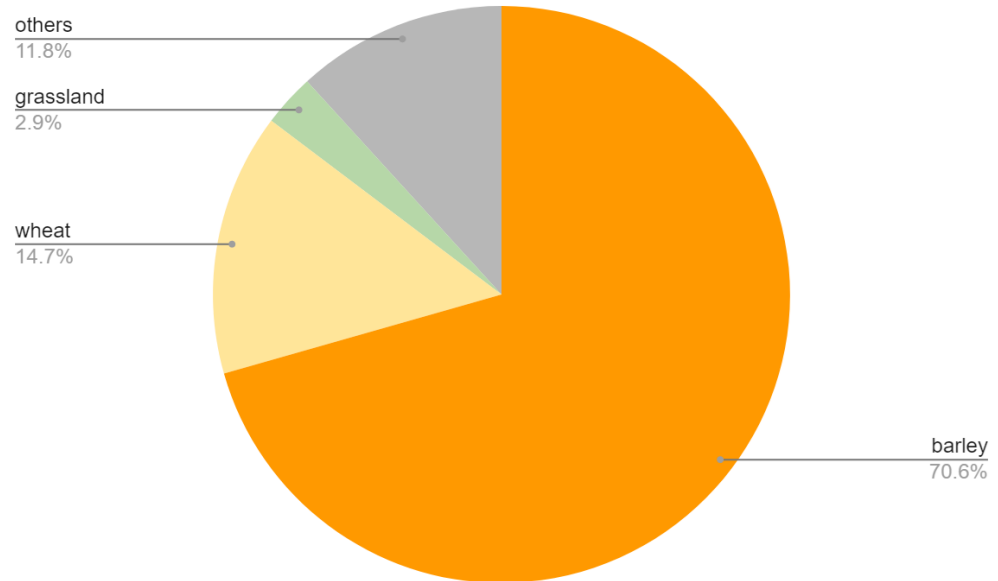




Accuracy assessment - cereals



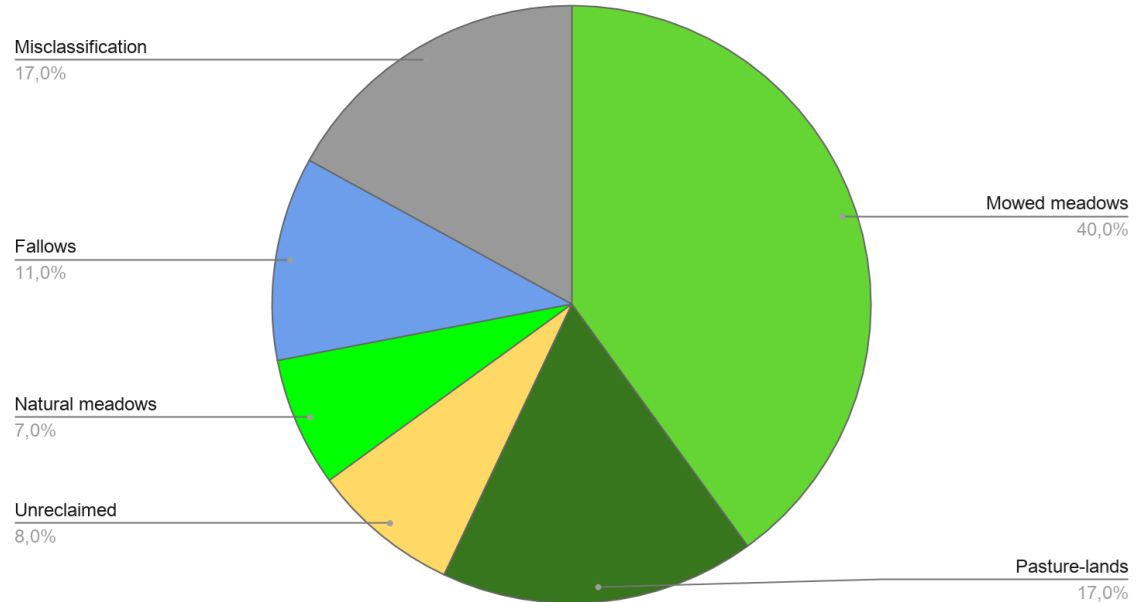
- Based on a dataset from a farm operator
- 68 winter cereal fields checked
 - 48 Barley
 - 10 Wheat
 - 10 other (e.g. fallows)
- Possible errors:
 - Grassland with very peculiar cultivation (temporal similarity to cereals)
 - Errors in farmers' data
- Validation difficulties and limitation in off-season



Accuracy assessment - grasslands

- 100 randomly selected polygons throughout the region
- Individual on-site confirmation
- Errors:
 - Alfalfa
 - Fennel
 - Millet

Grassland validation - distribution of results (accuracy: 83%)



Summary



- Pilot project with overall promising results
- Harmonization of land cover categories and HSCO nomenclature
- When optimized, it can be a viable solution for aiding agricultural statistics at HSCO
- Implementing a dynamic crop mapping would benefit the detection of cereals
- Multi-year datasets could improve the accuracy of the grassland detection
- Implementation of auxiliary datasets (parcels boundaries)
- Limitations and errors:
 - The effect of cloud cover on S-2 images
 - The spatial limitation of the sensors

Outlook

- New promising approach with ML algorithm
 - Exclusivity to SAR data, possible full-automation
- Nationwide monitoring is possible
- Finalised uptake process:
 - Sufficient financial background
 - Adequate human resources
 - Proper infrastructure
 - End-user engagement





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Thank You for your attention!