



How **MATLAB** & **MV** are transforming Shell

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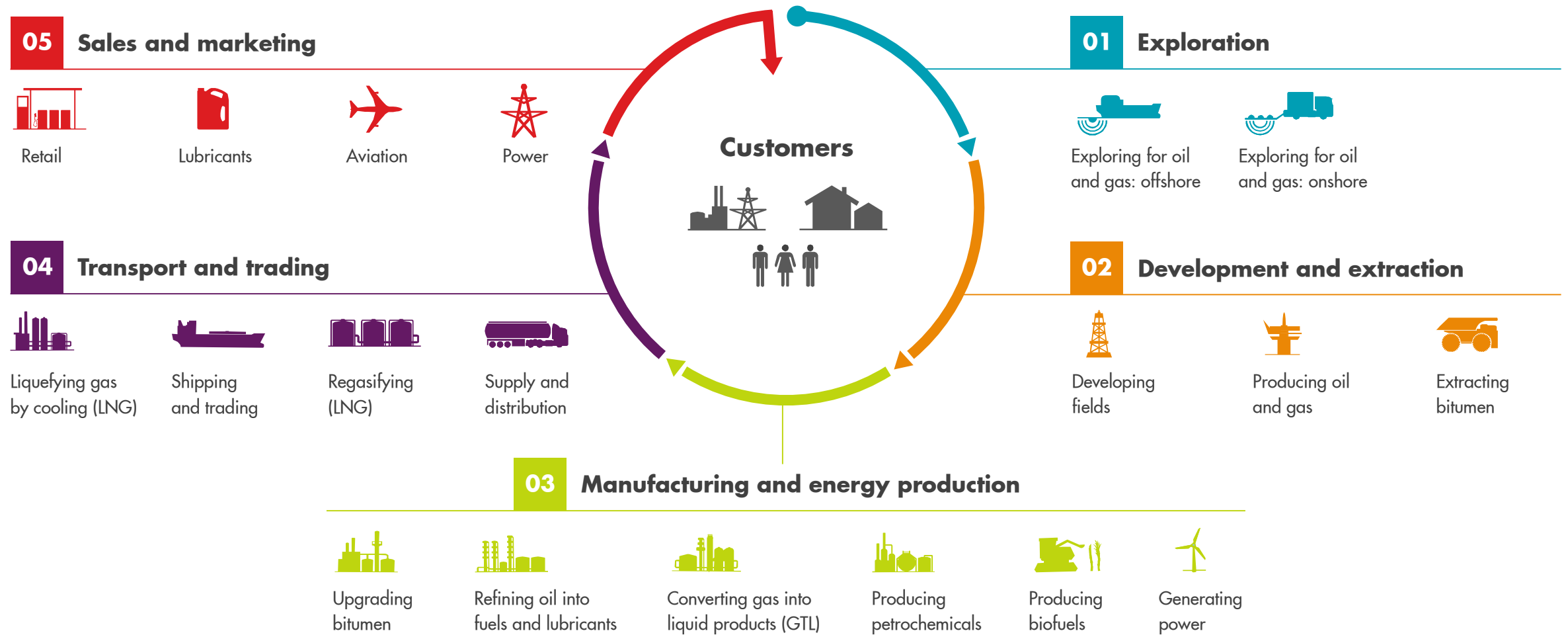
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Agenda

- About Shell
- Innovation and delivery pipeline
- MATLAB to accelerate innovation
- Example use case: Tag recognition in 'street-view' imagery
- Example use case: Terrain recognition in hyper-spectral satellite imagery
- Planned Next Steps

Shell business overview



We serve Shell's value chain, focused on value delivery via analytics

EXPLORATION & DEVELOPMENT

Inspection, Monitoring & Surveillance
Imaging & Interpretation
Visualisation
Drilling optimisation
Training
Prospect Analysis

PRODUCTION & MANUFACTURING

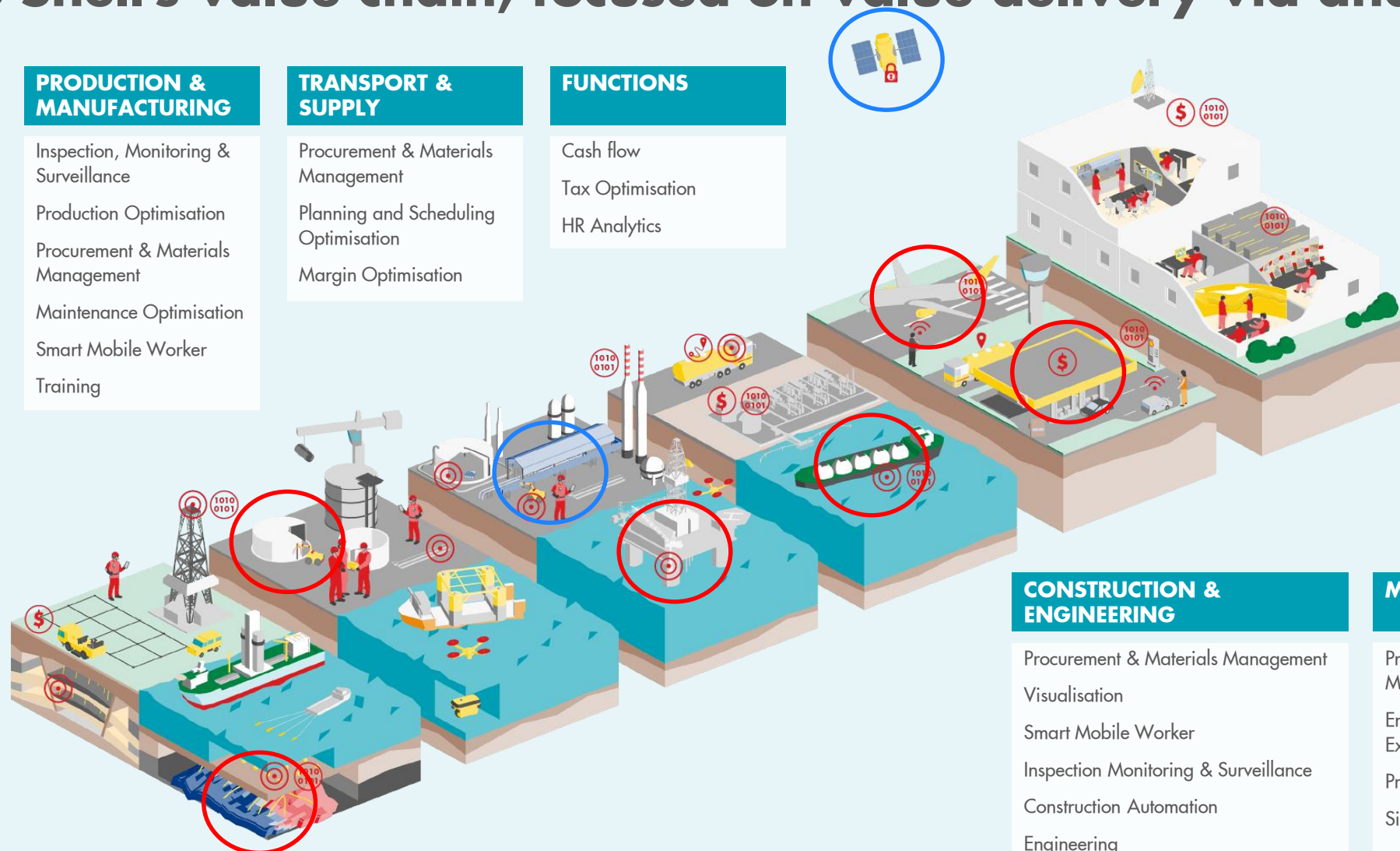
Inspection, Monitoring & Surveillance
Production Optimisation
Procurement & Materials Management
Maintenance Optimisation
Smart Mobile Worker
Training

TRANSPORT & SUPPLY

Procurement & Materials Management
Planning and Scheduling Optimisation
Margin Optimisation

FUNCTIONS

Cash flow
Tax Optimisation
HR Analytics



CONSTRUCTION & ENGINEERING

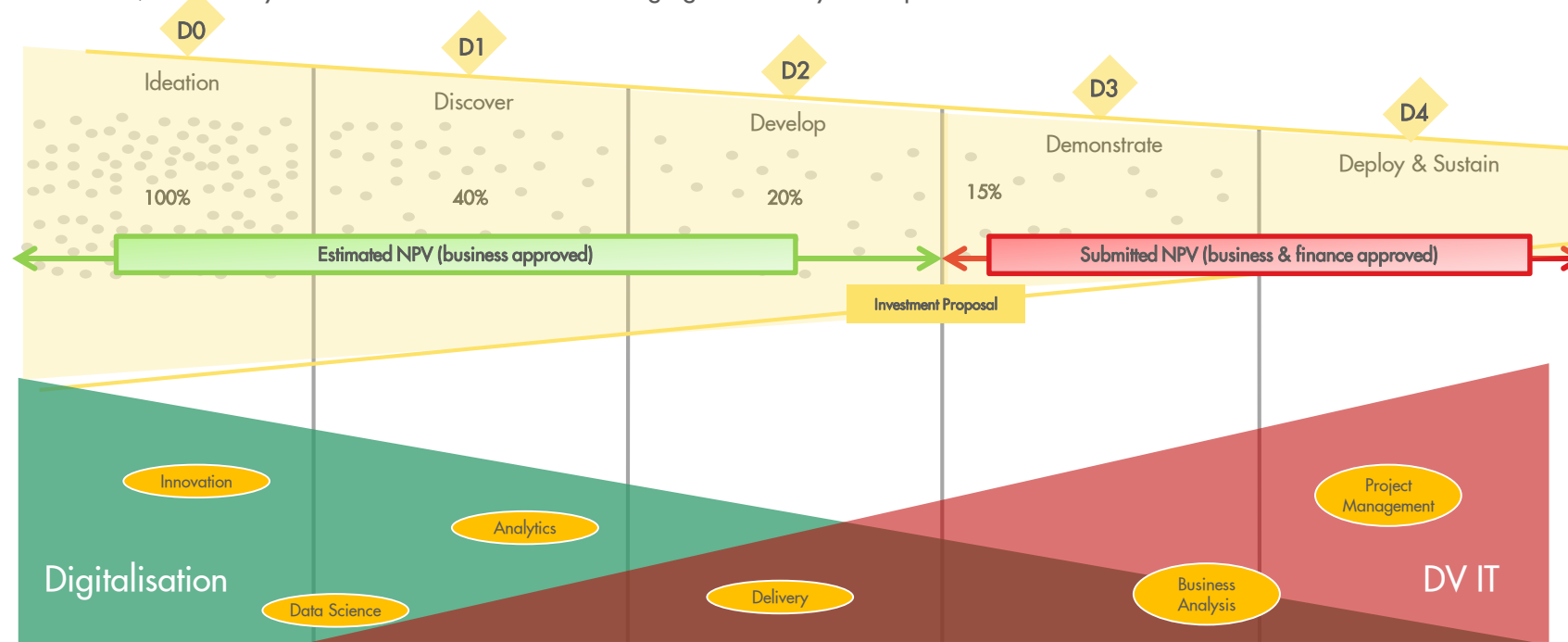
Procurement & Materials Management
Visualisation
Smart Mobile Worker
Inspection Monitoring & Surveillance
Construction Automation
Engineering

MARKETING

Procurement & Materials Management
Enhanced Customer Experience
Pricing
Site Management

How We Work – Data Science CoE Use Case

Our delivery pipeline transitions from Value Identification to Value Delivery and finally Value Enablement. Initial ideas can come from Conferences, universities, external visits, business problems, and innovation within the Data Science CoE. Using our breadth of data science & analytics skills, we deliver POCs and pilot projects which prove the value potential. Once investment is obtained, the delivery verticals take a lead role in managing the delivery of the pilot into 'Run and Maintain' mode.

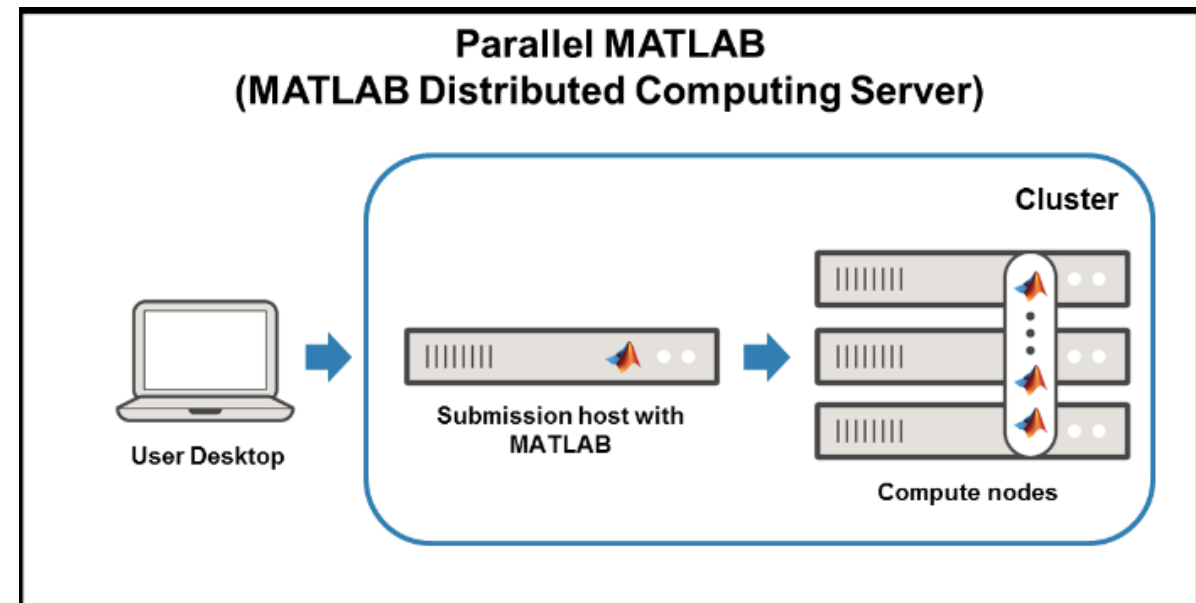
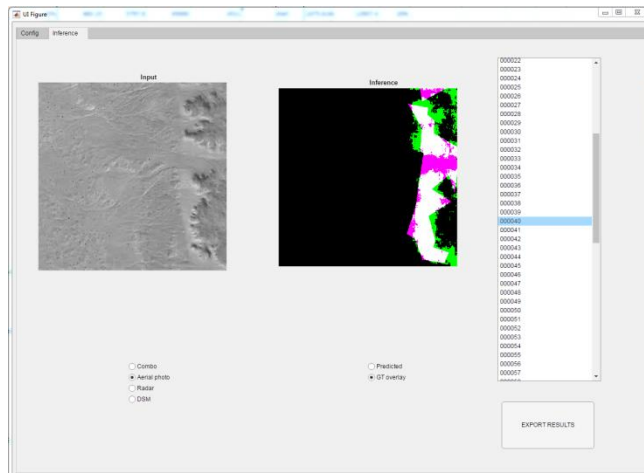
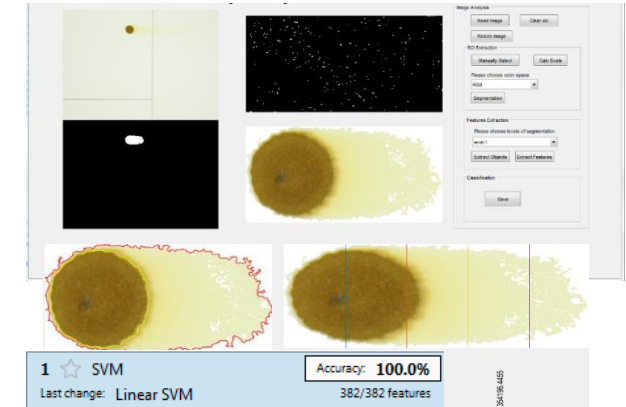


Key Responsibilities

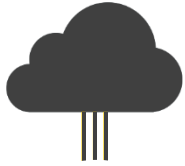
Accelerate Incubation and Integrate Delivery	Build New Capabilities
- Integrate and deliver Shell's strategic technologies. - Move quickly to get value proven tech scaled up - Deliver tech in a focused, fast and cost effective way	Maintain specialist core capabilities of hybrid technical discipline and IT staff across hubs Develop new capabilities which are required to be competitive in the new emerging tech world of digital

Where does MATLAB add value?

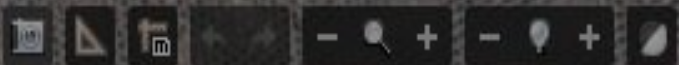
- Fast prototyping.
- Specialist support if needed.
- Growing deep learning toolkit to integrate with existing modules
- Huge set of examples and documentation for rapid experimentation
- WebApp delivery to clients
- Scalable cloud compute via MDCS



Shell & MATLAB milestones

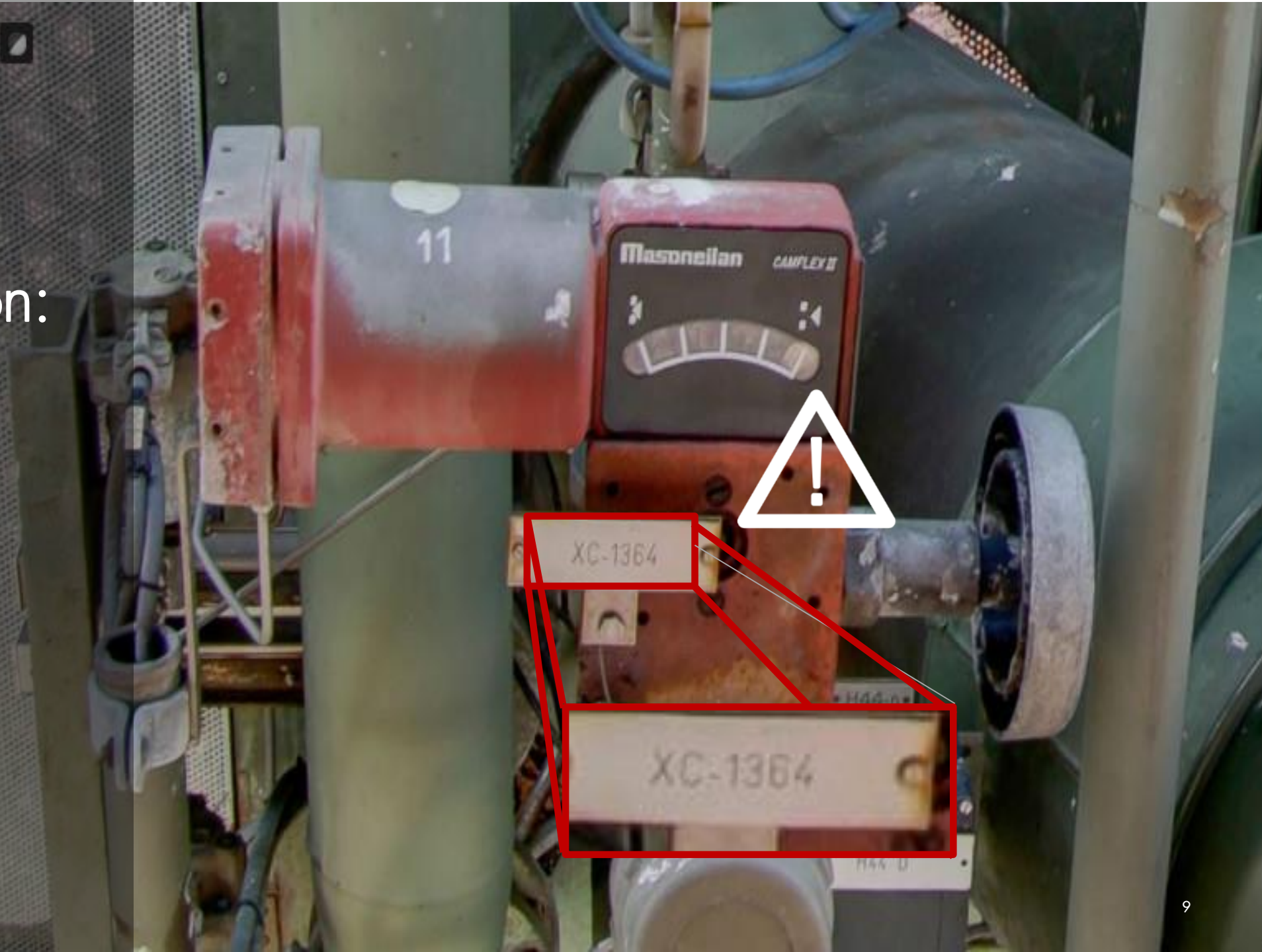


- Enterprise-wise deal with MATLAB
- Achieved 2nd MPS license
- Currently onboarding MDCS service (ongoing)
- Improving productivity with Mathworks consulting
- Expanding use of India-hubs



Tag recognition:

Identifying
Machinery at
Location



Regional Convolutional Neural Networks

R-CNN: *Regions with CNN features*

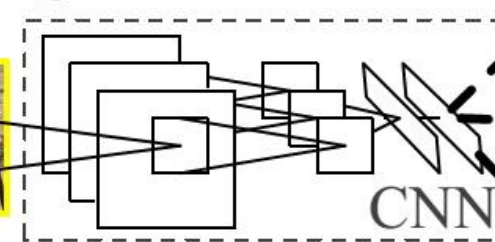


1. Input image

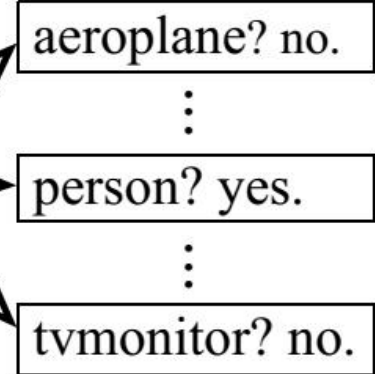


2. Extract region proposals (~2k)

warped region



3. Compute CNN features



4. Classify regions

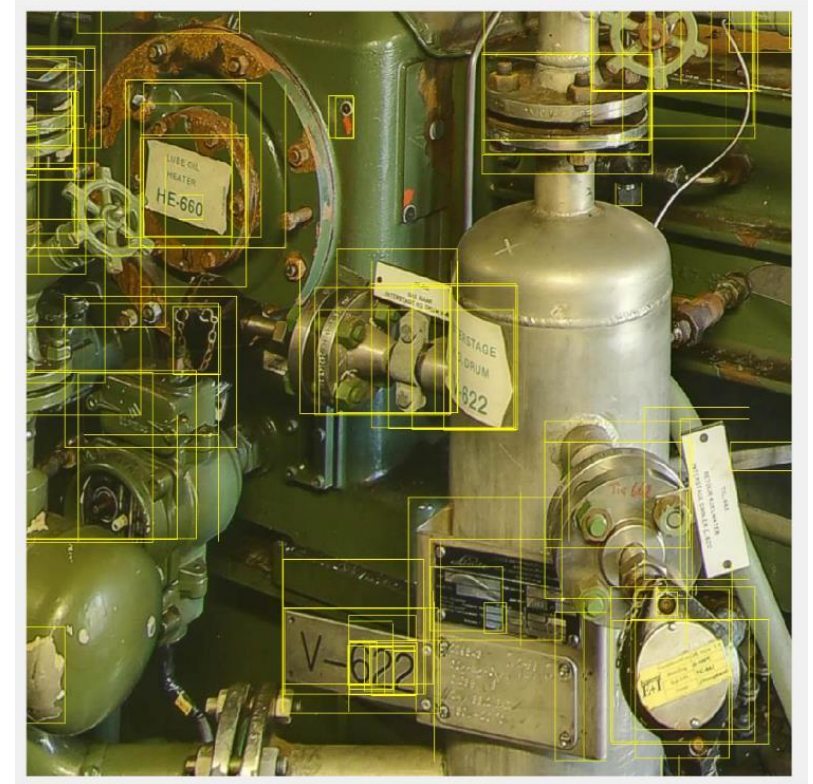
Region proposal:
Use a standard
method

Use pre-trained Neural Network, and
adapt to our specific task using
“transfer learning”

Region proposals

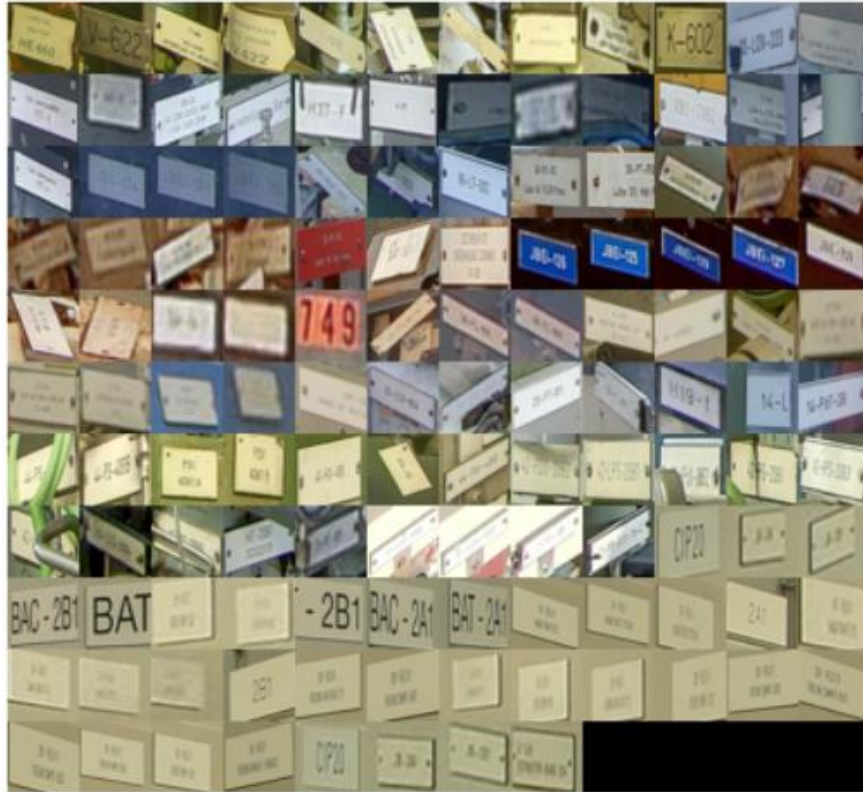


Fish-eye correction



Pdollar's EdgeBoxes

Training labels and 'attention' areas



Training dataset

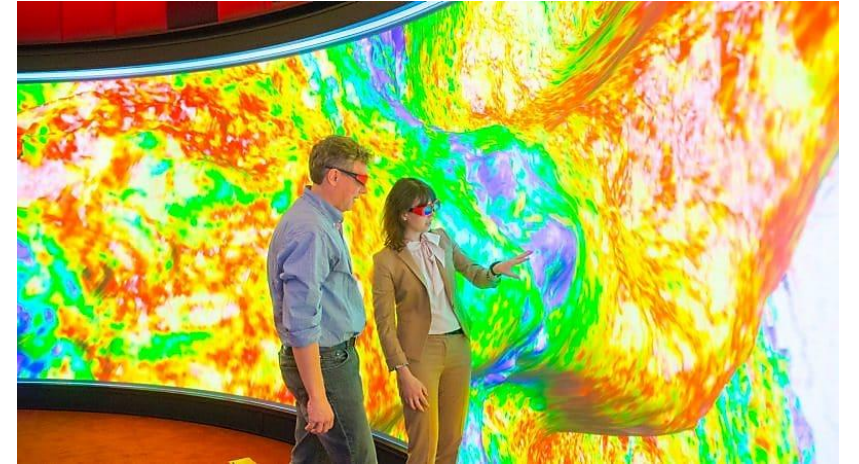


Identified tags ready for OCR and integration into SAP



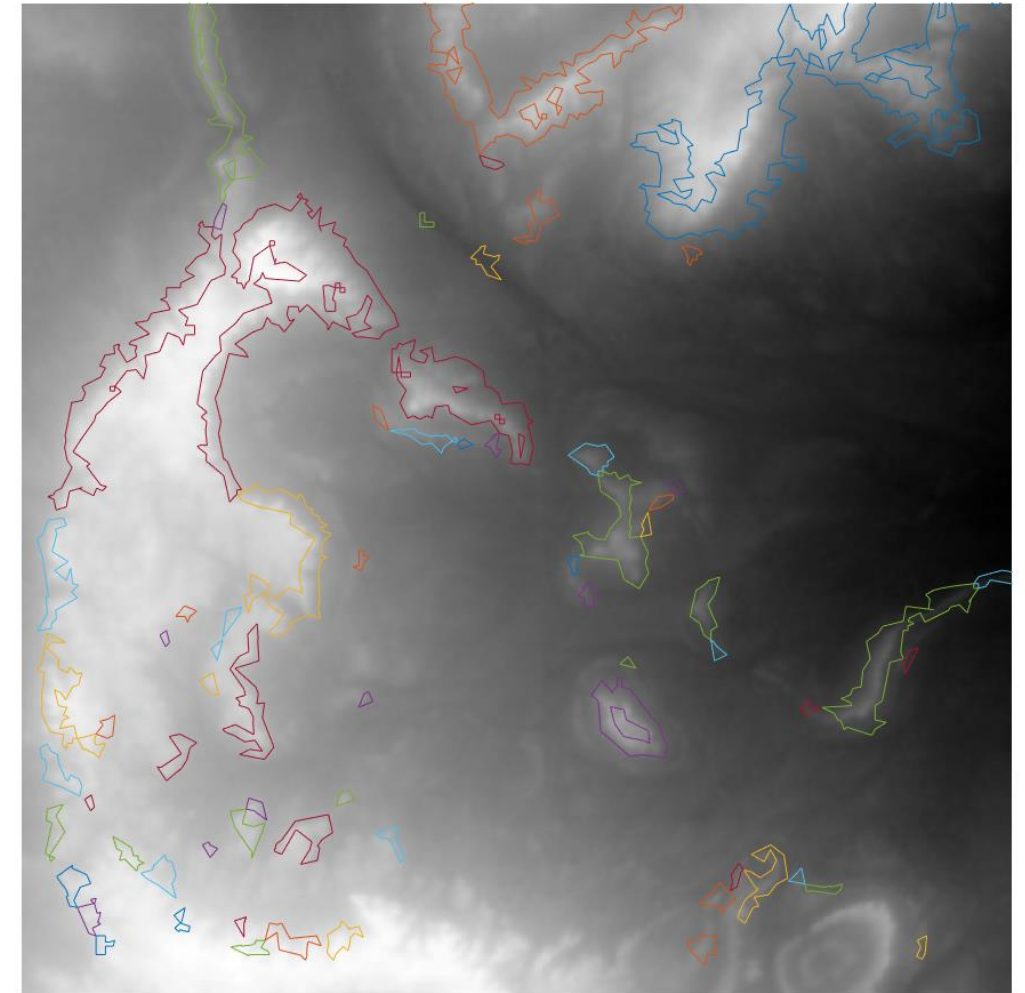
Tag recognition – next steps

- Transfer learning used to identify tags in industrial images.
- OCR to extract SAP codes.
- Currently 3-4 minutes detection, considering Fast RCNN for 100x improvement.
- Use larger GPU to increase image size of network (VGG16).
- Ready to experiment with augmented reality overlay of information.
- Further interest from European and Asian business units.



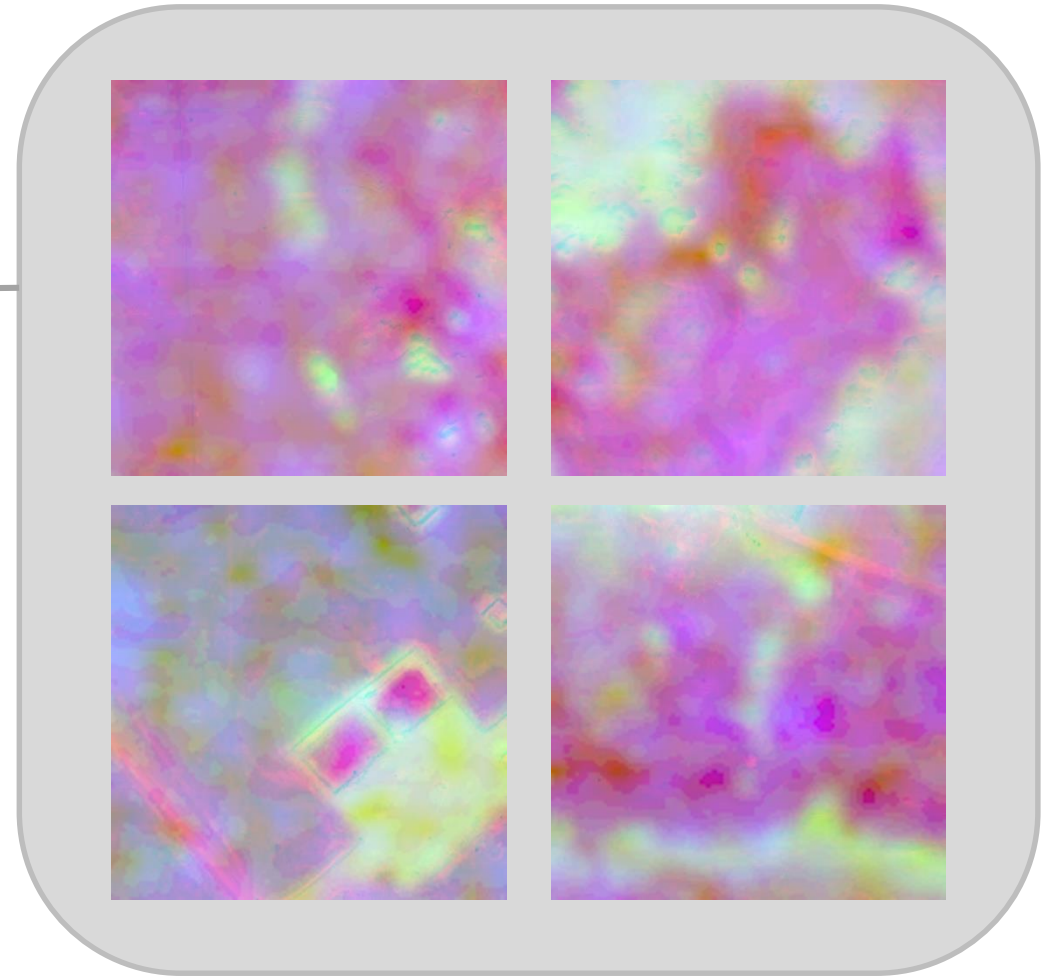
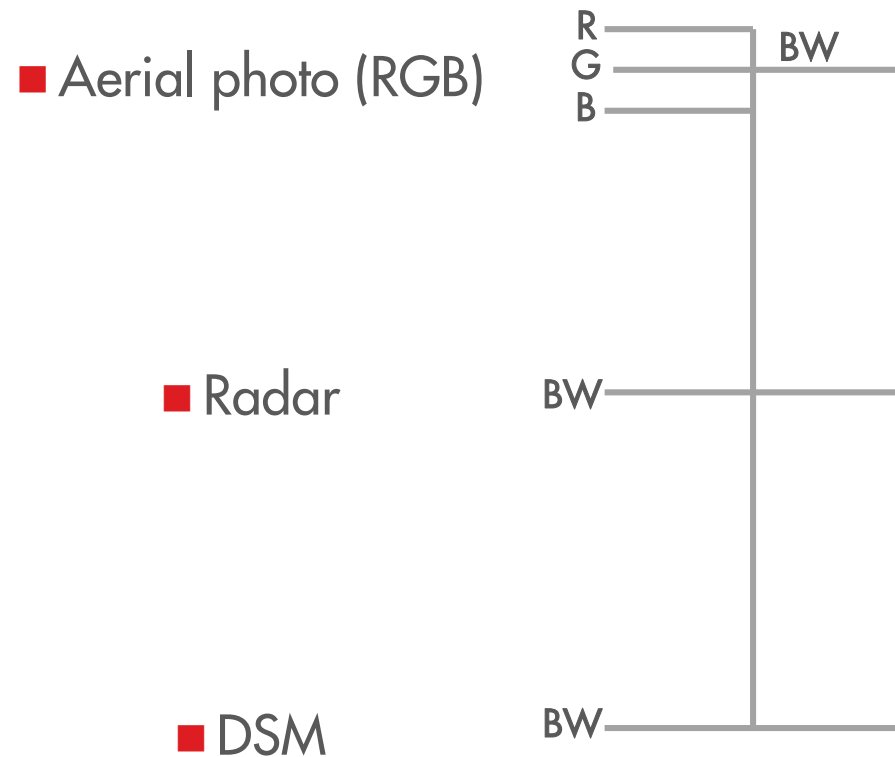
Terrain recognition in hyper-spectral satellite data

- \$10m's spent on land seismic acquisition each year.
- Terrain type very important to daily shot target.
- Currently manually drawn polygons on satellite/drone images + direct site visits - weeks.
- We replace whole workflow with DL semantic segmentation approach (segnet).

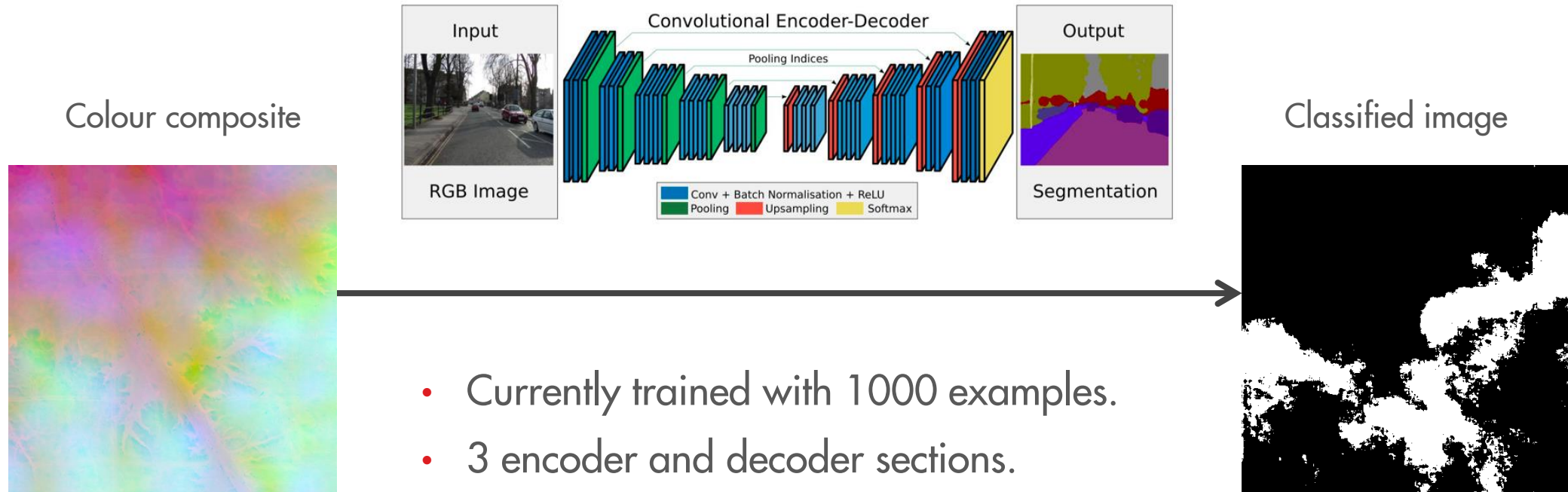


Radar image with rough polygons overlaid

Data prep – colour composite images

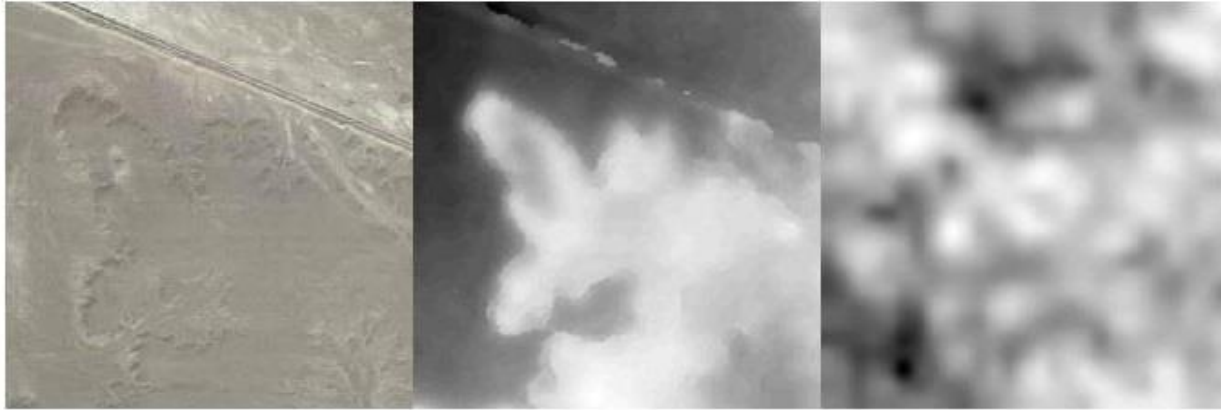


Network (SegNet)



Prediction (Semantic segmentation)

Input imagery



Actual



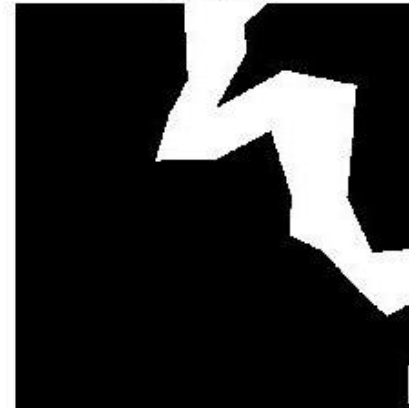
Predicted



Input imagery



Actual

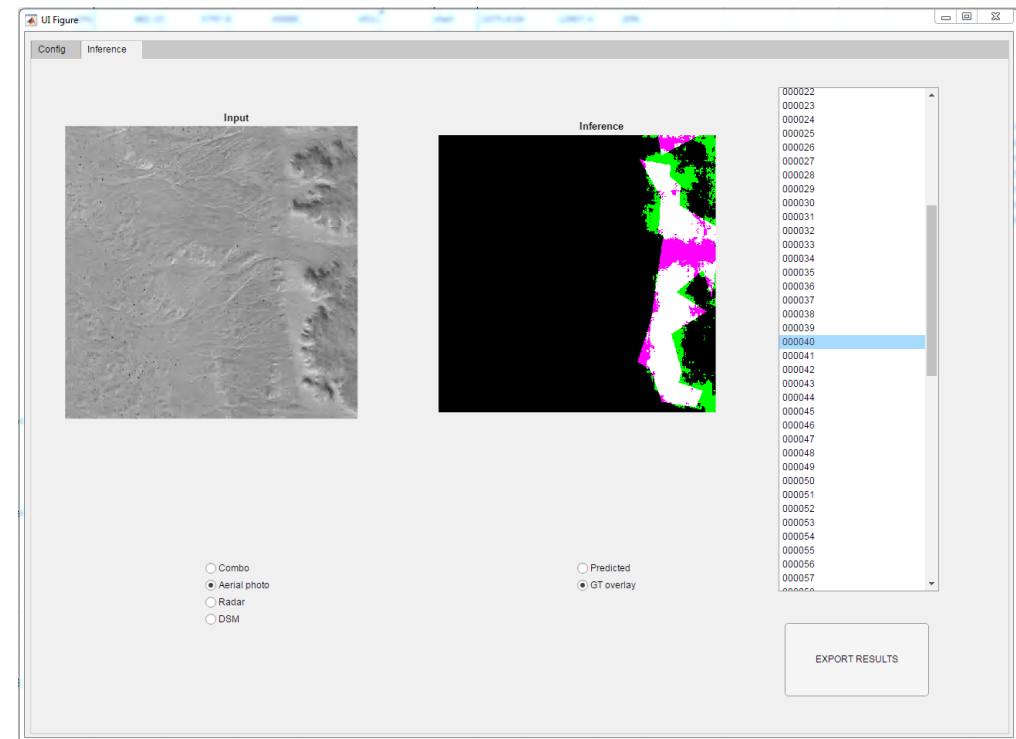
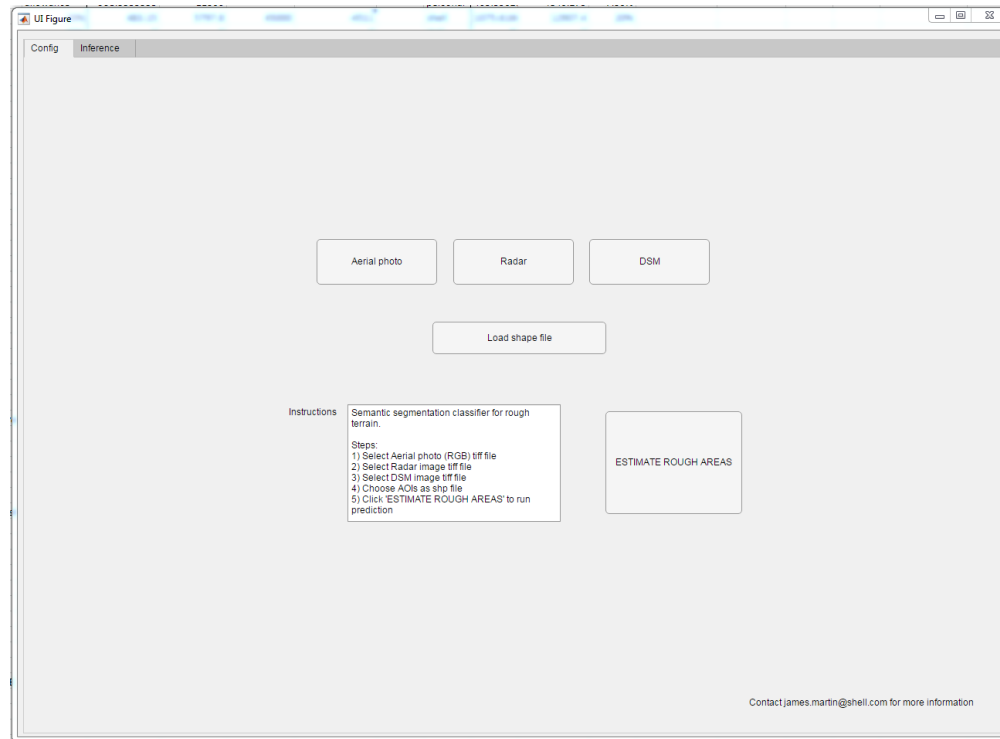


Predicted



Delivery via WebApp

- Customers interaction via WebApp tool.
- Can upload new data and regions of interest.



Terrain recognition – next steps

- Optimise network and training parameters.
- Increase training data.
- Add more modalities and classes.
- Tailor app to business demands.
- Business wants technology integration + upskilling staff.
- Potential for further work with Middle East and Asian business units.



Facilities class



Additional drone data

Shell & MATLAB, the Future?

More explicit linkage to other Digital Themes:

- **Everything to the cloud** - Edge computing
- **High Performance Computing** - Distributive computation and scalable GPU for training.
- **Advanced Analytics** - Smart apps development/management

■ Immediate Priorities for 2018

- Continued deployment through MPS and MDCS
- Prove the business value of current Mathworks projects in innovation pipeline:
 - Expand on terrain recognition work and tailored solutions.
 - Ultrafast hydrocarbon attribute calculation from seismic with DL.
 - Augmented overlay of SAP information during warehouse inspections.

