METIS®

THE METIS® 2020 FIELD PILOT
TOTAL and ADNOC pave the way for oil & gas exploration 4.0

METIS®

Multiphysics Exploration
Technology Integrated System

**INNOVATIVE
ACQUISITION DESIGN**
- A very dense grid of sources and receivers
- Quality of recorded data is optimal for ultra high-density 3D imaging

**4 000 DARTs®
(DOWNFALL AIR RECEIVER
TECHNOLOGY)**
- Innovative wireless sensor technology
- Real-time data transmission
- Specially re-designed for the desert environment

6 METIS® DRONES
- Automatic fleet overseen by a single operator on the ground
- Artificial intelligence
- Optimized design

**1 METIS® UGV
(UNMANNED GROUND
VEHICLE)**
- Autonomous recovery of DARTs® planted in the ground
- Design tailored to the desert environment

COMMAND & CONTROL
- Real-time tracking of ground personnel and equipment
- Nerve center of the Safety Clearance system
- Real-time communication with the Ground Control Station (GCS) in charge of airborne drone fleet

LABORATORY
- Seismic data is streamed in real time
- Real-time QA/QC of data during survey operations
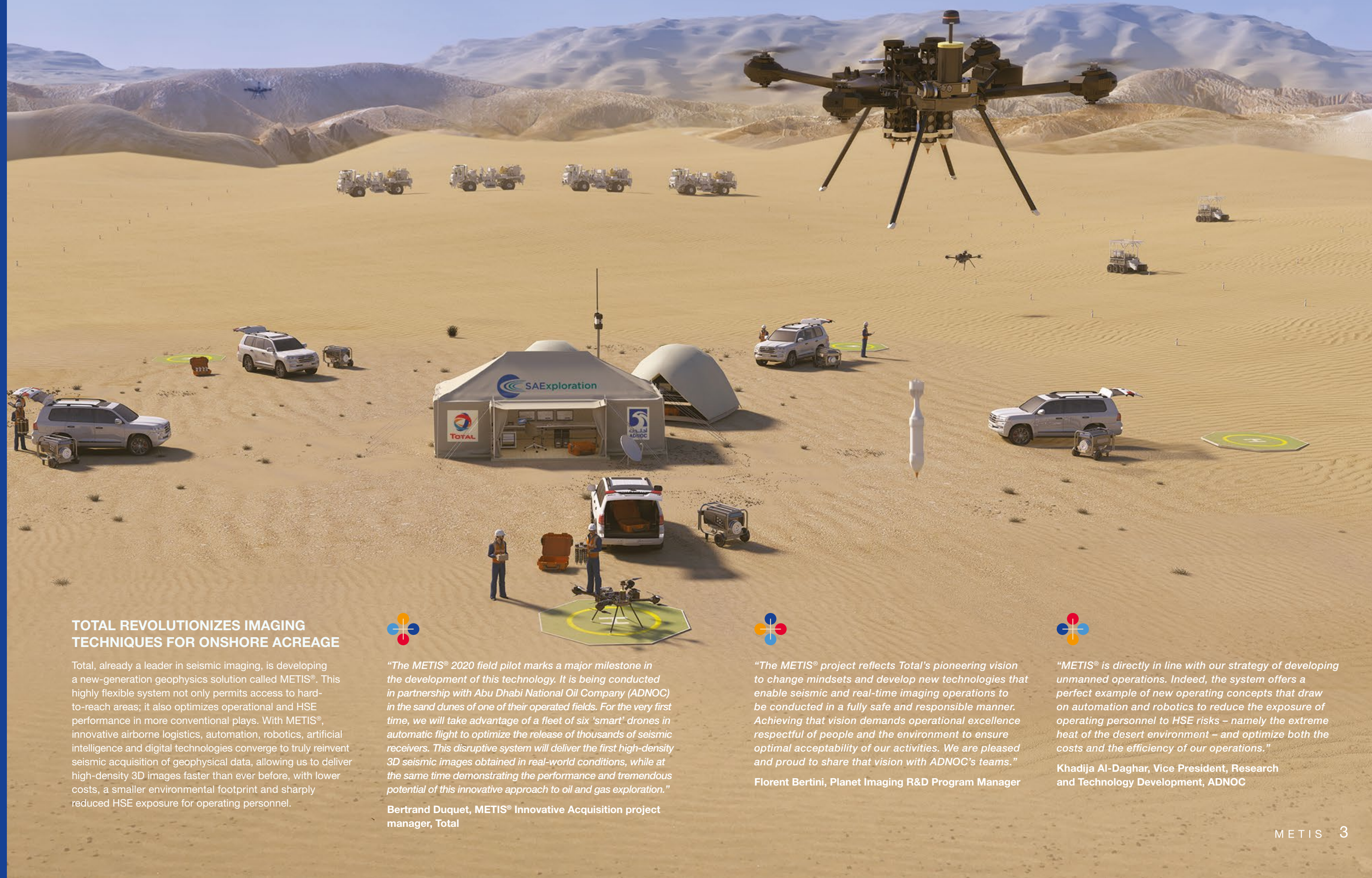
TOTAL REVOLUTIONIZES IMAGING TECHNIQUES FOR ONSHORE ACREAGE

Total, already a leader in seismic imaging, is developing a new-generation geophysics solution called METIS®. This highly flexible system not only permits access to hard-to-reach areas; it also optimizes operational and HSE performance in more conventional plays. With METIS®, innovative airborne logistics, automation, robotics, artificial intelligence and digital technologies converge to truly reinvent seismic acquisition of geophysical data, allowing us to deliver high-density 3D images faster than ever before, with lower costs, a smaller environmental footprint and sharply reduced HSE exposure for operating personnel.

"The METIS® 2020 field pilot marks a major milestone in the development of this technology. It is being conducted in partnership with Abu Dhabi National Oil Company (ADNOC) in the sand dunes of one of their operated fields. For the very first time, we will take advantage of a fleet of six 'smart' drones in automatic flight to optimize the release of thousands of seismic receivers. This disruptive system will deliver the first high-density 3D seismic images obtained in real-world conditions, while at the same time demonstrating the performance and tremendous potential of this innovative approach to oil and gas exploration."

Bertrand Duquet, METIS® Innovative Acquisition project manager, Total

"The METIS® project reflects Total's pioneering vision to change mindsets and develop new technologies that enable seismic and real-time imaging operations to be conducted in a fully safe and responsible manner. Achieving that vision demands operational excellence respectful of people and the environment to ensure optimal acceptability of our activities. We are pleased and proud to share that vision with ADNOC's teams."

Florent Bertini, Planet Imaging R&D Program Manager

"METIS® is directly in line with our strategy of developing unmanned operations. Indeed, the system offers a perfect example of new operating concepts that draw on automation and robotics to reduce the exposure of operating personnel to HSE risks – namely the extreme heat of the desert environment – and optimize both the costs and the efficiency of our operations."

Khadija Al-Daghar, Vice President, Research and Technology Development, ADNOC

FIRST AUTONOMOUS AIRBORNE DRONE FLEET

Command & Control Center

The METIS® 2020 field pilot will be the first test of an intelligent and modular system with an autonomous airborne drone fleet and optimized DART® deployment in real time, safely.

SMART DRONES

A system overseen by a single operator from a Ground Control Station (GCS) coordinates the fleet of smart drones in autonomous flight. For the METIS® 2020 field pilot, the fleet consists of five "DART®-dropping" drones and one surveillance drone. The drones communicate with each other to:

- automatically determine the best flight paths to maximize the efficiency of DART® deployment,

- permit each drone to adapt autonomously to changing conditions in its environment both in the air (e.g., an unforeseen aerial intrusion) and on the ground (e.g., detection of human or animal presence) integrating real time updating of their flight paths and the DART® drop-zone layout.

COMMAND & CONTROL

The drone missions (flight path, range, number of DARTs® to drop, etc.) are defined based on the information supplied by Command & Control, the nerve center that tracks all ground personnel, vehicles and equipment in real time. The Safety Clearance procedure associated with Command & Control is a state-of-the-art system developed for METIS® to supplement the sight-based aerial Safety Clearance system built into the drones. The safety system manages the 3D geofencing, which establishes an exclusion perimeter around each person, vehicle, building (e.g., base camp) or infrastructure (e.g., pipeline) to prohibit overflight by the drones.
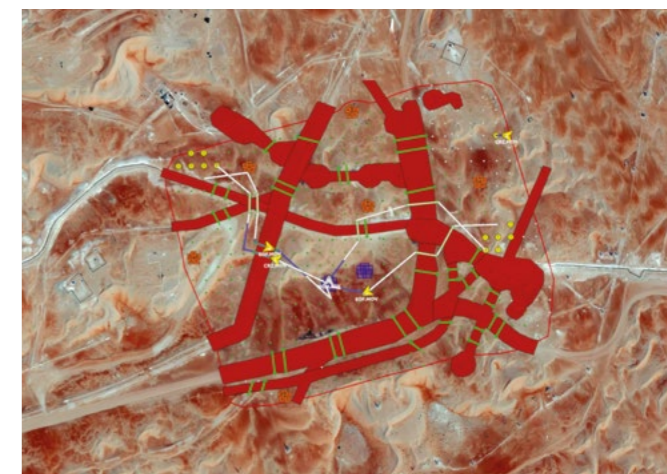
CUTTING EDGE ROBOTICS

Optimizing the combined drone/DARTs® system and deploying ground robotics contribute to the operating efficiency of the METIS® system, allowing faster (and therefore less costly) operations and sharply limiting human intervention and the associated HSE risks.
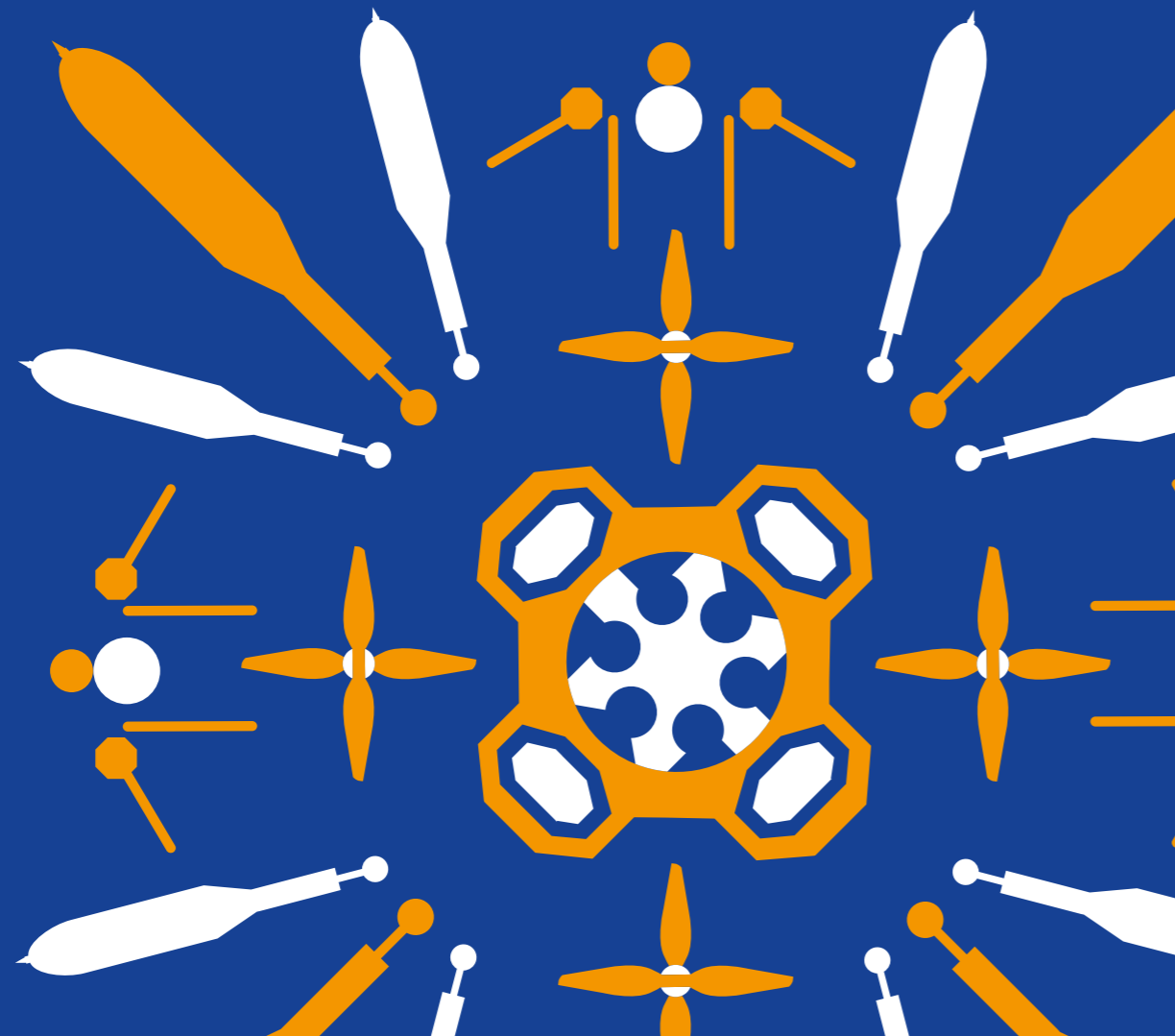
DRONE & DARTs®: MORE INTERACTION

The smart drone design developed for the METIS® 2020 field pilot combines efficiency and modularity. The most noteworthy new features include a carousel (the central part of the device) holding six DARTs®, and the drone batteries, which are easy to remove for quick and simple replacement. The shape of the DART® has also been tailored to the drone carousel to ensure a perfect fit with the DART® launcher tubes for fully reliable interaction with the DART® dual locking mechanism.

Thanks to a communications system between the drone and the DARTs®, the quality of each drop can be monitored in real time: each DART® is equipped with an accelerometer and a tiltmeter. The readings are transmitted to the drone to validate the positioning of each DART® on the ground before the next DART® is released.

THE SALAMANDER, AN AUTONOMOUS UGV TO COLLECT THE DARTs® ON THE GROUND

To complete the automation of the acquisition process and minimize human presence on the ground, a prototype Unmanned Ground Vehicle (UGV) automatically recovers the dropped DARTs® and transports them back to the base of operations. Ultimately, the management of this modular electric ground robot will be integrated with the drone fleet control system.

INNOVATIVE ACQUISITION DESIGN

One of the major benefits of the METIS® acquisition system is the flexibility offered by its package of disruptive innovations. Because it can be tailored to the specific features of the acquisition area, every survey layout is designed to yield the best possible image of the subsurface.
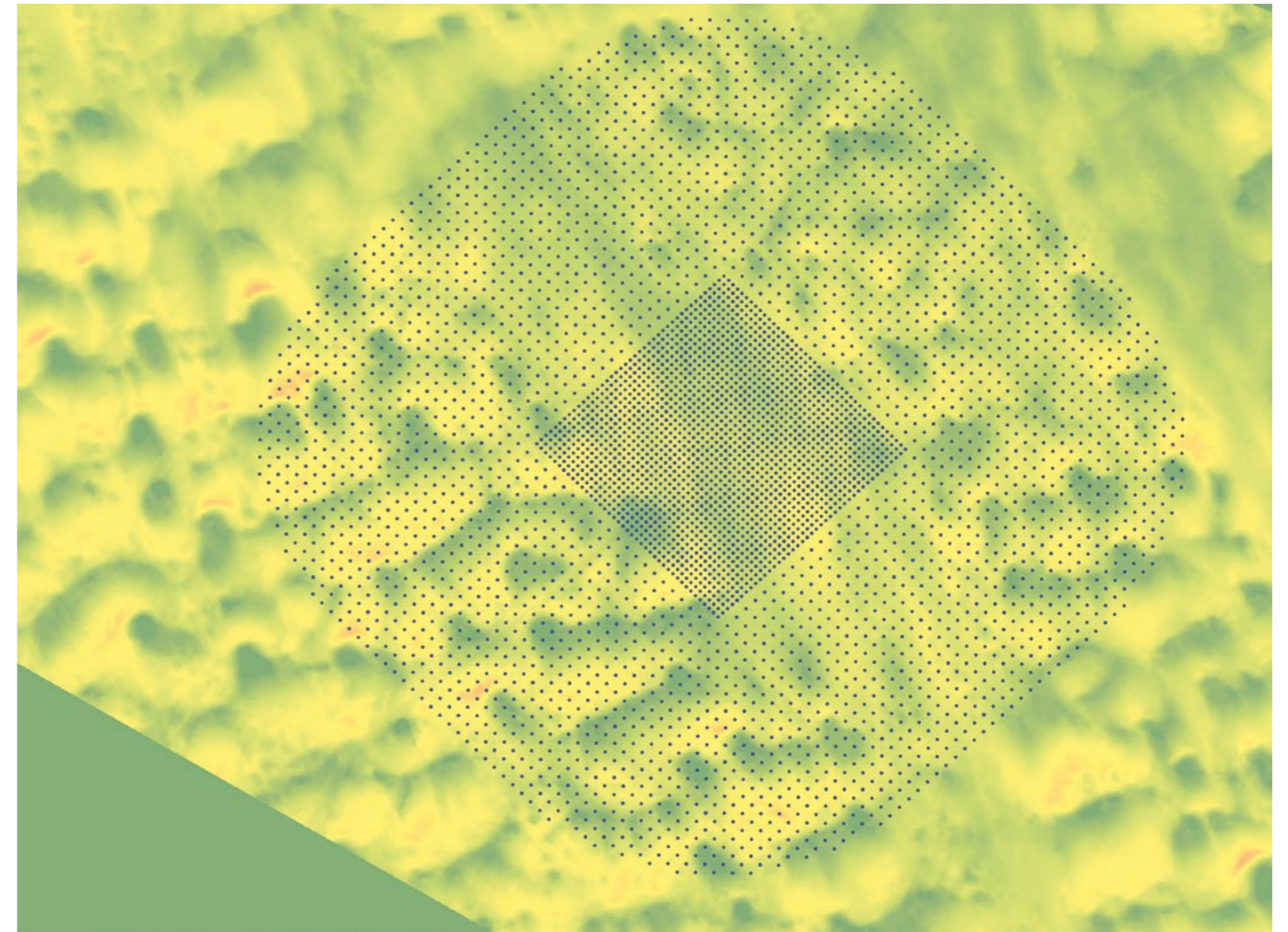
A NUMERICAL MODEL OF THE TERRAIN FOR SURVEY PREPARATION

Before the actual survey, LIDAR data are used to develop a high-resolution numerical model of the terrain.

Having this detailed knowledge of the topography serves especially to define the ideal positioning of seismic sources and receivers and determine the best routes for the seismic vibrator trucks and ground robot circulating in the dunes.

CARPET RECORDING

The automated deployment of the seismic receivers paves the way for innovative and "customized" survey designs. The innovation introduced for the METIS® 2020 field pilot is the variable density of receiver placement and shot points, in non-uniform arrangements that will allow for better sampling of the seismic wavefield. This innovative positioning of the DARTs®, combined with a large number of sources, gives excellent seismic coverage (up to ten times denser than a conventional acquisition layout).
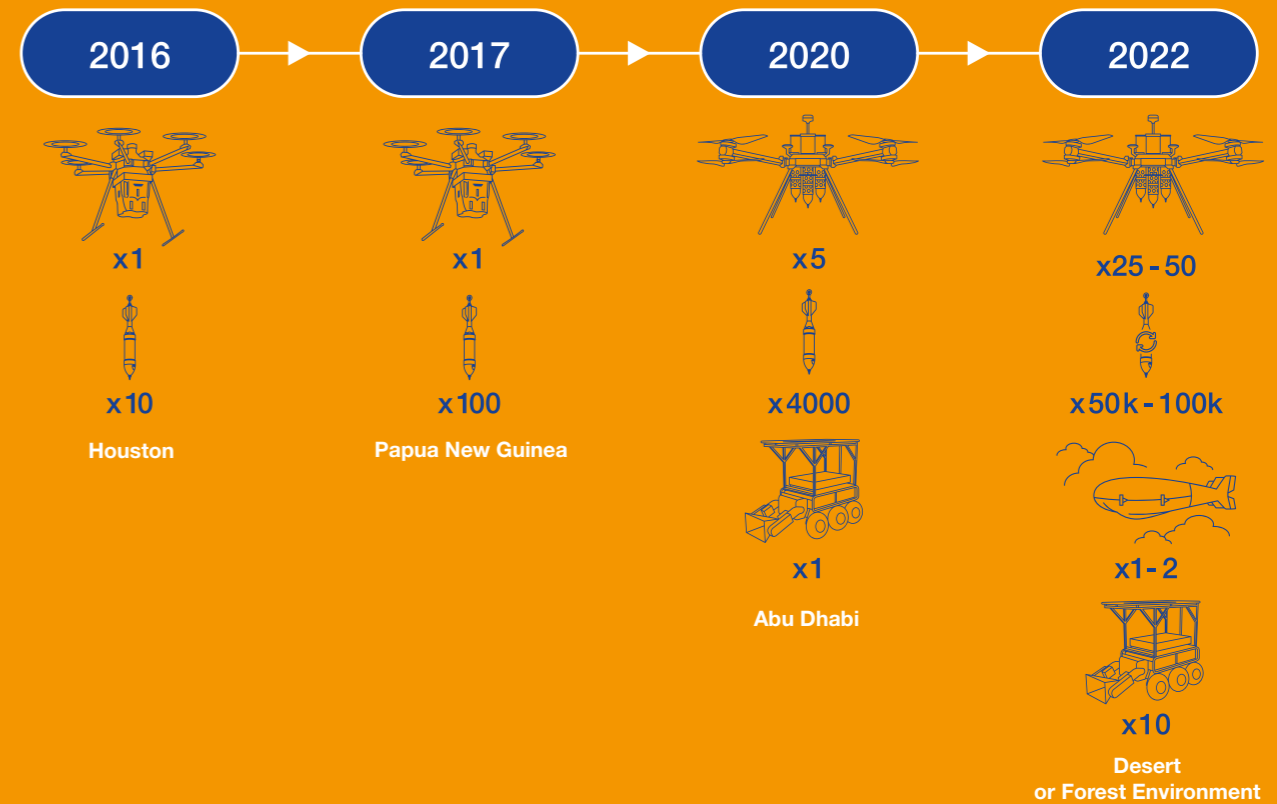
HIGH-DENSITY 3D IMAGING OF THE SUBSURFACE

The DARTs® of the METIS® 2020 field pilot are the first to incorporate a wireless communication system for real-time data transmission to the laboratory. The laboratory performs quality assurance/quality control of the data as it is acquired and decides whether there is a need to drop additional DARTs®.

Thanks to this innovative acquisition system, the METIS® technology will deliver its very first high-density 3D seismic image of the subsurface.

TOWARDS AN INDUSTRIAL-SCALE PILOT

2016
x1
x10
Houston

2017
x1
x100
Papua New Guinea

2020
x5
x4000
x1
Abu Dhabi

2022
x25 - 50
x50k - 100k
x1 - 2
x10
Desert
or Forest Environment

The industrial-scale pilot of METIS® planned for 2022 in the desert or in the forest environment, will deliver a real-time 3D image of a subsurface area covering roughly a hundred square kilometers. At this time, the most advanced option is the Papua-New-Guinea project, for which a high-density 3D image will enable the optimization of Antelope field development Phase II.

This extensive pilot will mobilize a fleet of several dozen drones deploying tens of thousands of EcoDARTs. The latter are a biodegradable version (design and battery) of the original DART® with printed electronics, designed specifically for hard-to-reach areas. This is a disruptive innovation that will preserve the environment and reduce the need to send hundreds of personnel into the field for DART® recovery.

This large-scale field pilot will mark the debut of the Manta hybrid Airship designed by the METIS® project team. Less costly than a helicopter and having a smaller environmental footprint, this innovative Hybrid Airship with a 2-ton payload will carry equipment, manage communications as well as acquiring non-seismic data.

Innovation is also on the agenda concerning data processing: for the first time, the acquisition parameters can be fine-tuned if some zones are not adequately illuminated. Above all, this innovative system has the potential to deliver subsurface imagery just a few hours after the shots are done!

PARTNERS IN THE METIS® PROJECT

ADNOC
The METIS® 2020 field pilot

Altran and Scalian
Smart system enabling autonomous fleet flight of drones // design and manufacture of the METIS® drones // development of the Safety Clearance algorithm

RPS & ISS Aerospace
Drone design and construction

SAExploration
METIS Project integrator
Command & Control systems (real-time tracking of personnel, 3D geofencing for Safety Clearance on the ground, local 4G communications network) // Real-time data processing and QC

Wireless Seismic
Wireless communication system of the DART® for data transmission in real-time

Flying Whales
Manta Hybrid Airship

VTT
Printed electronics for the EcoDART

Fuelium
Biodegradable battery for the EcoDART

Shark Robotics
Unmanned Ground Vehicle

Total is a major energy operator that produces and markets fuel, natural gas and low-carbon electricity. Our 100,000 employees are committed to better energy that is safer, cleaner, more affordable and accessible to as many people as possible. Active in more than 130 countries, our ambition is to become the responsible energy major.