Video Analytics for Smarter, More Efficient Subsea Inspection

Hani Elshahawi, Ilkay Darilmaz, Georgios Papadopoulos Shell
Nader Salman, Schlumberger
Jack Vincent, OneSubsea

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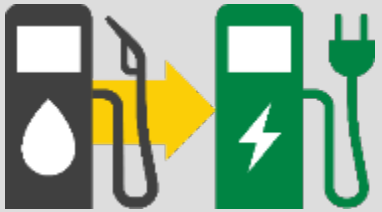
Digital has disrupted several deeply rooted industries - Now Re-shaping the Energy System

Changing landscape

Energy Transition & Mobility Shifts



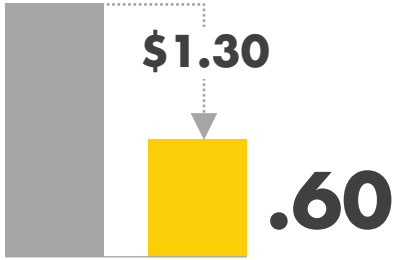
Digitalization & other

Shifts in Demographics & Consumer behaviours

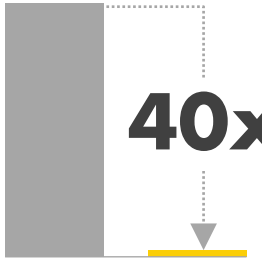
Key trends potentially re-shape several industries

Technology: **faster** and **cheaper** over the past ten years

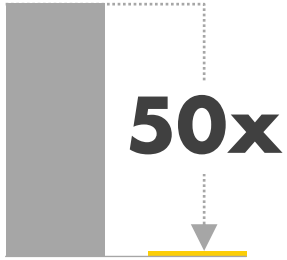
COST OF SENSORS



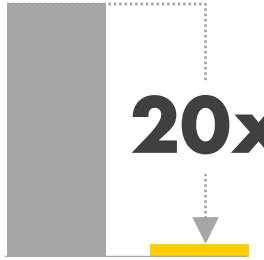
COST OF BANDWIDTH



COST OF PROCESSING POWER



COST PER MB OF CLOUD INFRASTRUCTURE



Shell Digital Strategy

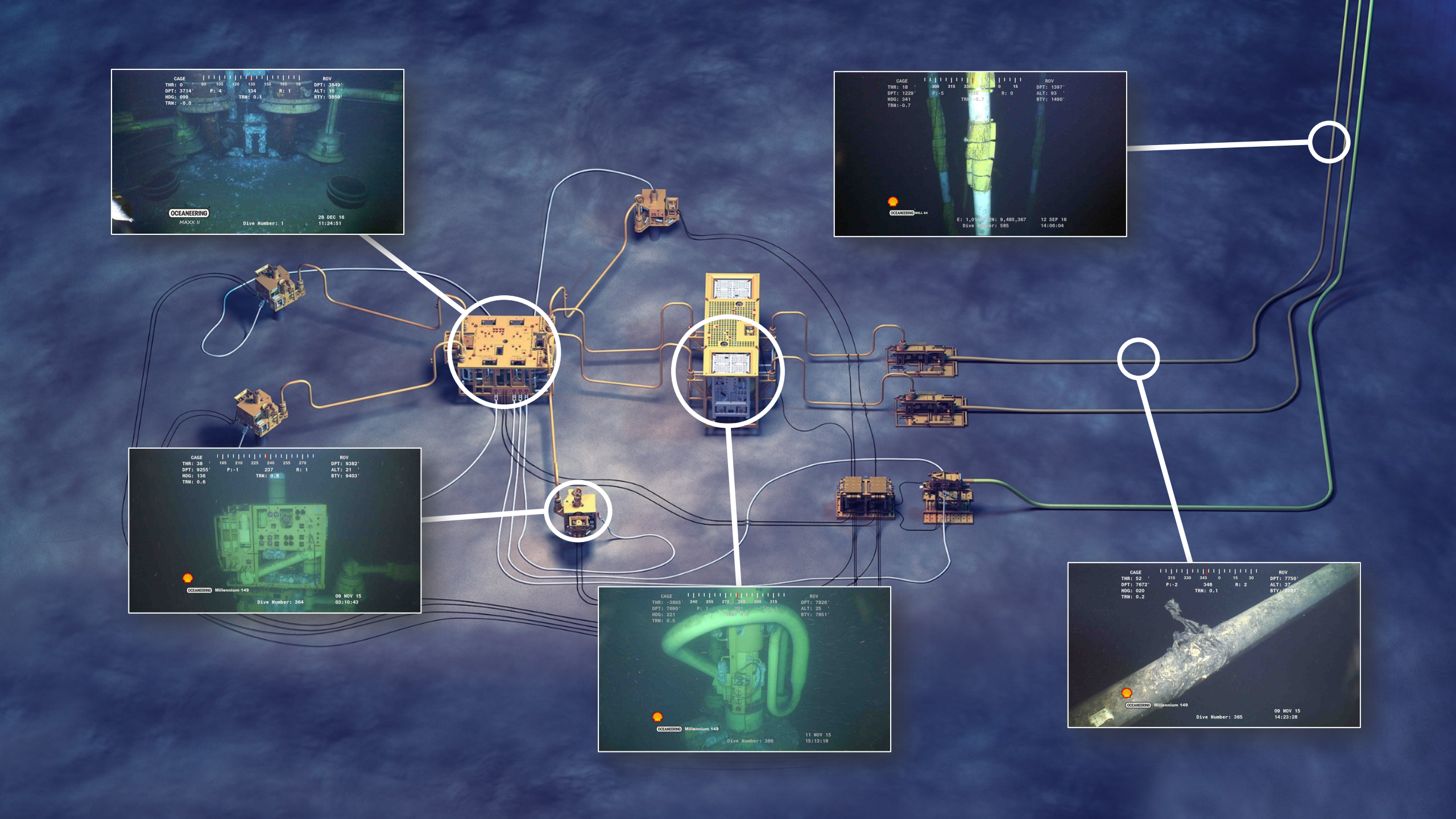
A coherent approach across Shell to realize and accelerate value through digital
led by business – supported by Digital COE

FIVE DIGITAL DESIGN PRINCIPLES

- CUSTOMER/USER IS CENTRAL
- 010101 110011 100100 DATA IS AN ASSET
- BUSINESSES OWN DIGITAL
- BUILD IN-HOUSE CAPABILITY
- ACT OUR WAY INTO THE FUTURE

UNDERPINNING CRITICAL SUCCESS FACTORS

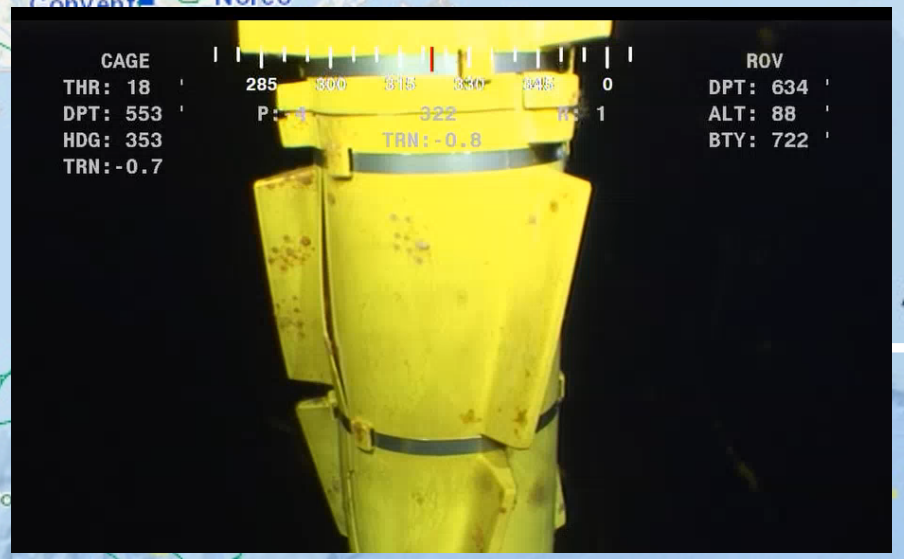
- CAPABILITIES
- OPERATING MODEL AND WAYS OF WORKING
- LEADERSHIP, MIND-SETS AND BEHAVIOUR


CAGE
THR: 0
DPT: 3714'
HDG: 099
TRN: -0.0
P: 4
134
TRN: 0.1
R: 1
ROV
DPT: 3849'
ALT: 10 '
BTY: 3859'
OCEANEERING
MAXX II
Dive Number: 1
28 DEC 16
11:24:51
CAGE
THR: 18 '
DPT: 1229'
HDG: 341
TRN:-0.7
P:-5
TRN: -0.7
R: 0
ROV
DPT: 1397'
ALT: 93 '
BTY: 1490'
OCEANEERING
MILL 64
E: 1,01
N: 9,485,367
Dive Number: 585
12 SEP 16
14:06:04
CAGE
THR: 38 '
DPT: 9255'
HDG: 136
TRN: 0.6
P:-1
237
TRN: 0.8
R: 1
ROV
DPT: 9382'
ALT: 21 '
BTY: 9403'
OCEANEERING
Millennium 149
Dive Number: 364
09 NOV 15
03:10:43
CAGE
THR: -3895'
DPT: 7690'
HDG: 221
TRN: 0.5
P: 1
281
R: 1
ROV
DPT: 7826'
ALT: 25 '
BTY: 7851'
OCEANEERING
Millennium 149
Dive Number: 366
11 NOV 15
15:13:18
CAGE
THR: 52 '
DPT: 7672'
HDG: 020
TRN: 0.2
P:-2
348
TRN: 0.1
R: 2
ROV
DPT: 7750'
ALT: 37
BTY: 7787'
OCEANEERING
Millennium 149
Dive Number: 365
09 NOV 15
14:23:28

Video Logs		Ocean Alliance		Mil 64	
Client	SHELL	Dive Number	585	Recording #	1
Location	AC 857	Video Format	NTSC	Total Pages	1
Job #	172616	Equipment	Panasonic DMR-EH69	Date	12-Sep-16
Subject	Perdido ISIP: DCR Riser DVA				

Date	Time	Description
12-Sep-16	11:51	Begin Recording #1, Snail trail on U4.
	12:04	Starting Snail trail on U4
	12:25	Snail trail complete at -1000 FSW, Paused Recording #1.
	12:34	DCR riser DVA Start REC #1 Inspection
	13:35	Clearing tether path.
	12:36	Down DCR Riser DVA at -531 FSW
	12:38	Photo of missing strake at -537 FSW
	12:42	Photo of Bullseye at -650 FSW
	12:43	Photo of Bullseye clamp at -600 FSW
	12:44	Missing strakes -640 FSW to -650 FSW
	13:47	Missing strakes at -705 FSW to -725 FSW
	12:49	Missing strakes at -790 FSW to -800 FSW
	12:51	Photo taken of damaged strake at -862 FSW
	12:52	Photo taken of missing strakes at -865 FSW to -875 FSW
	12:54	Missing strakes at -940 FSW to -950 FSW
	12:56	Photo taken of missing strake at -1015 FSW to -1025 FSW
	12:57	Photo taken of damage strake at -1042 FSW

"Event"



Map Source: Shell Investors Handbook 2017

Schlumberger

OneSubsea
A Schlumberger Company

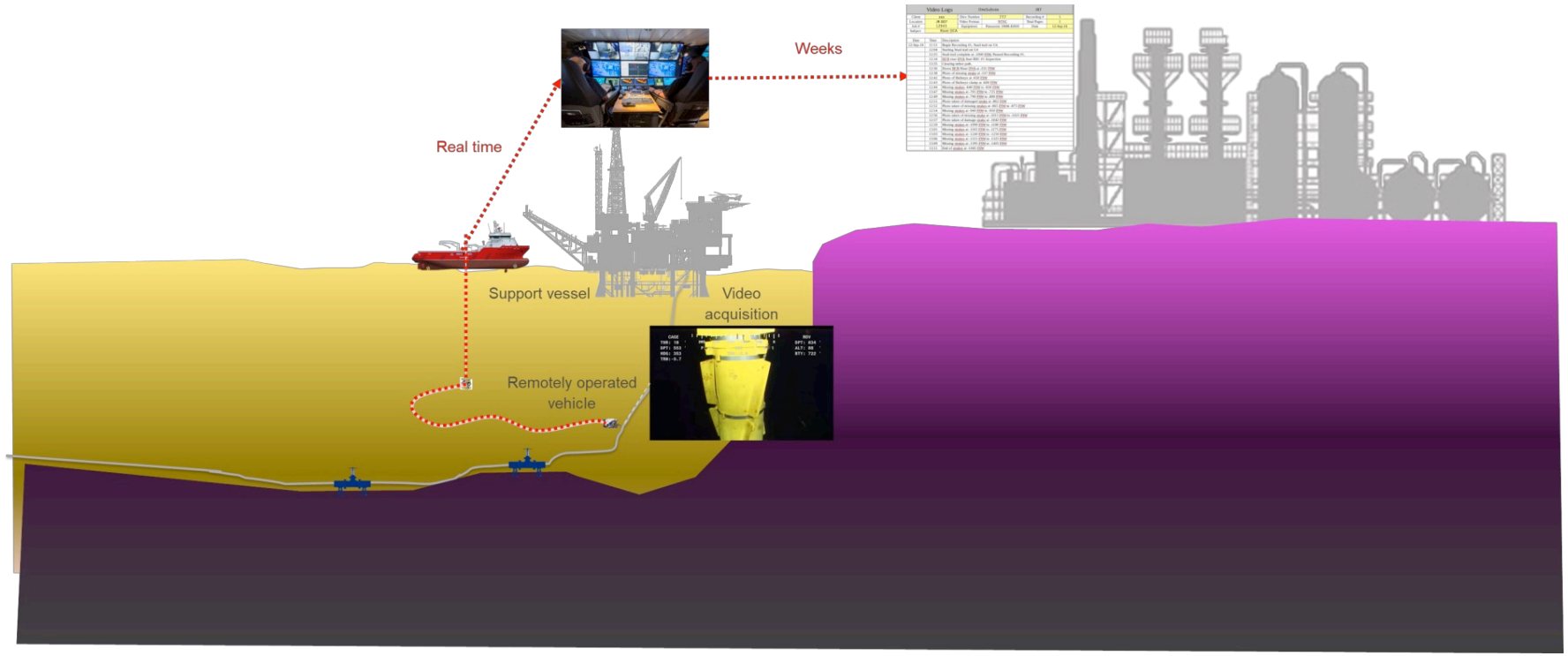
AUTOMATE

DIGITIZE

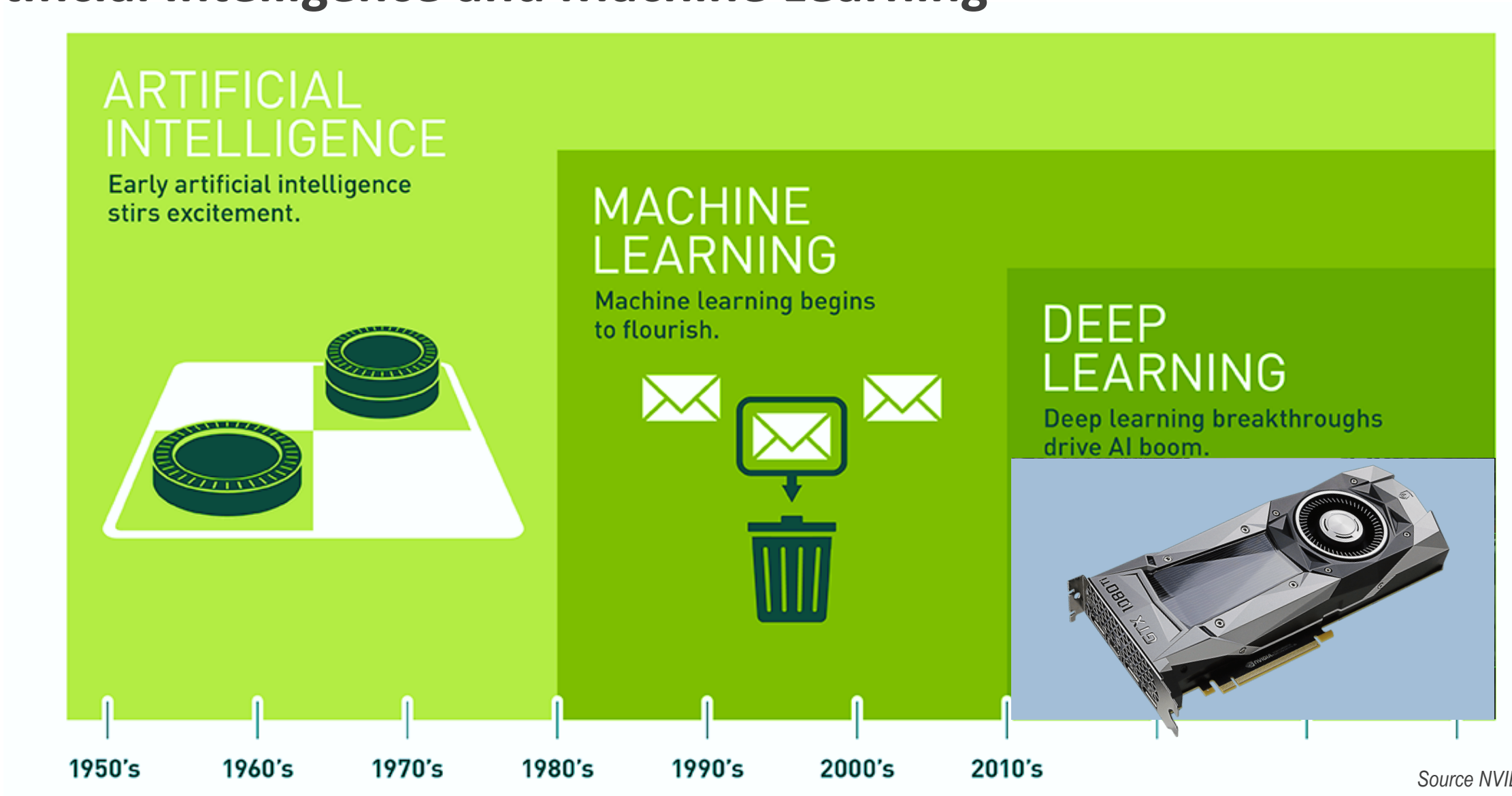
MANTIS

Asset Integrity Inspection Today

- Asset integrity inspection data is getting greater by the year
- Need cost-effective solutions that can enable to detect elements of interest within the data
- Need scalable and computationally efficient prediction models



Artificial Intelligence and Machine Learning

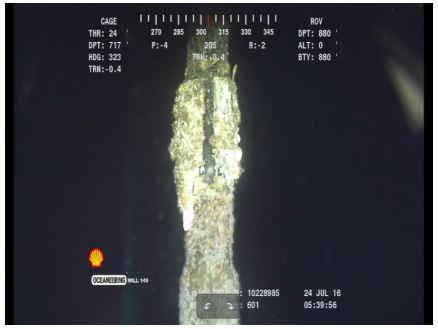


Source NVIDIA

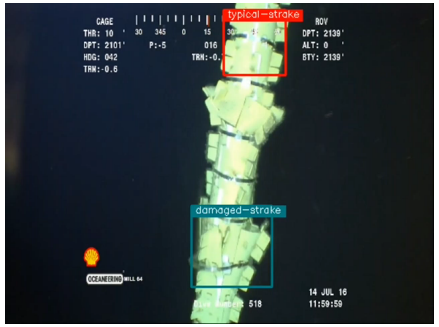
Application of Machine Learning to Subsea Integrity Monitoring

3.3 TB of Data
1300h+ of video
605 logs

x 75

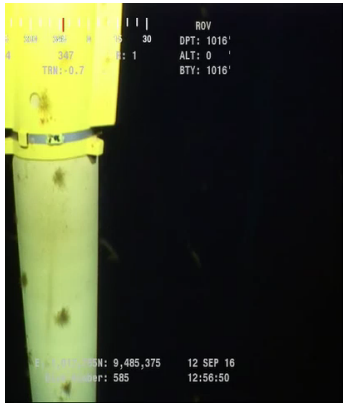


Offline



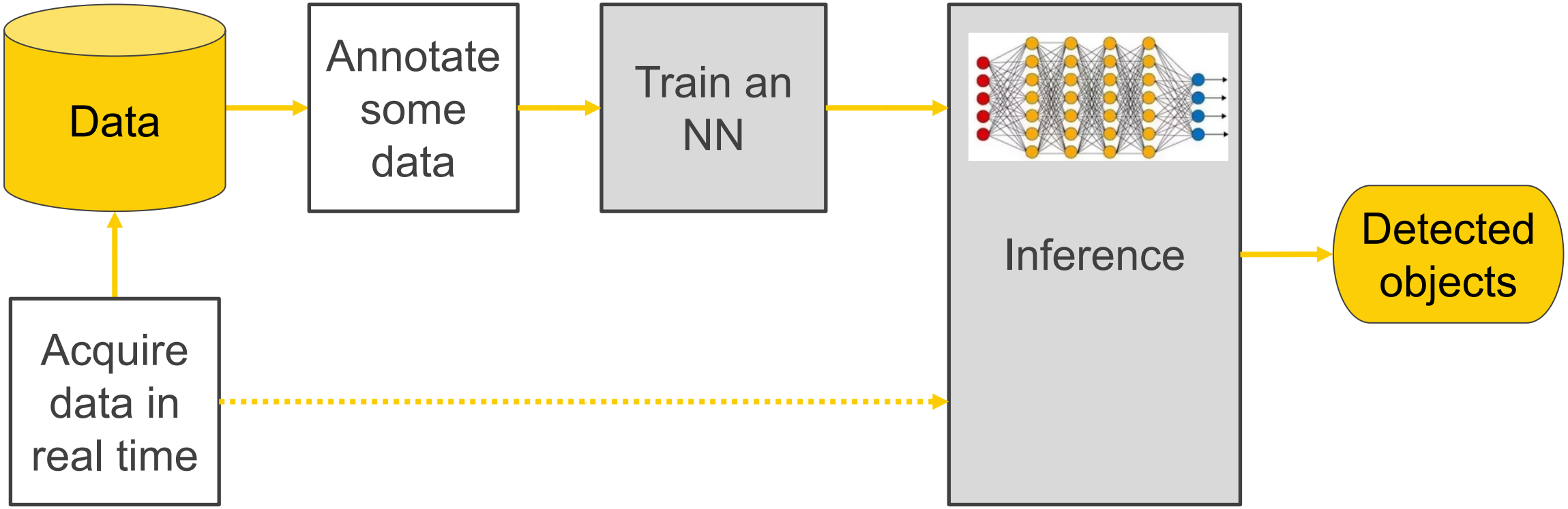
Real-time

Mantis

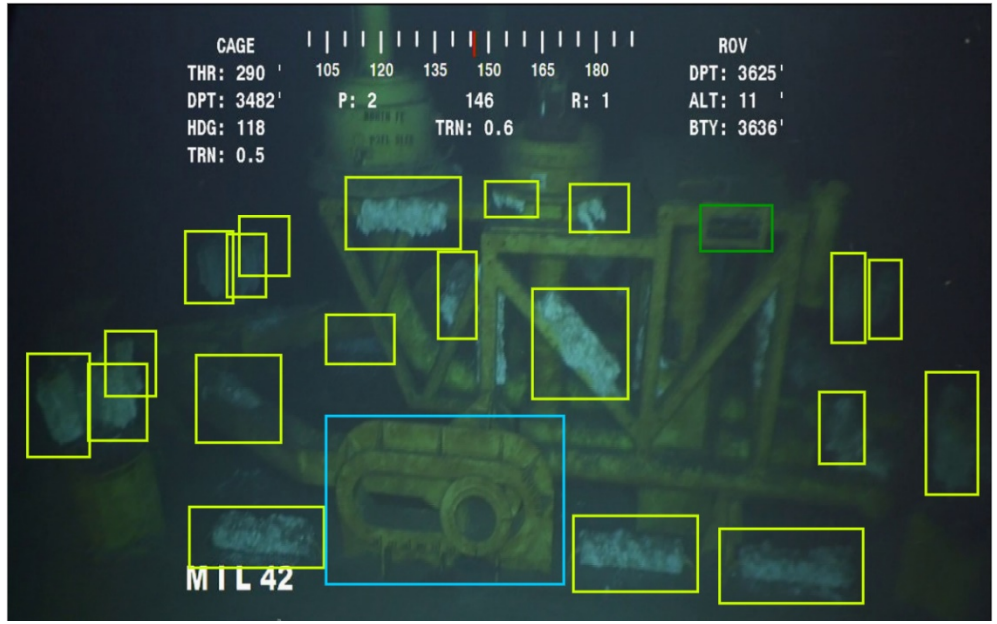


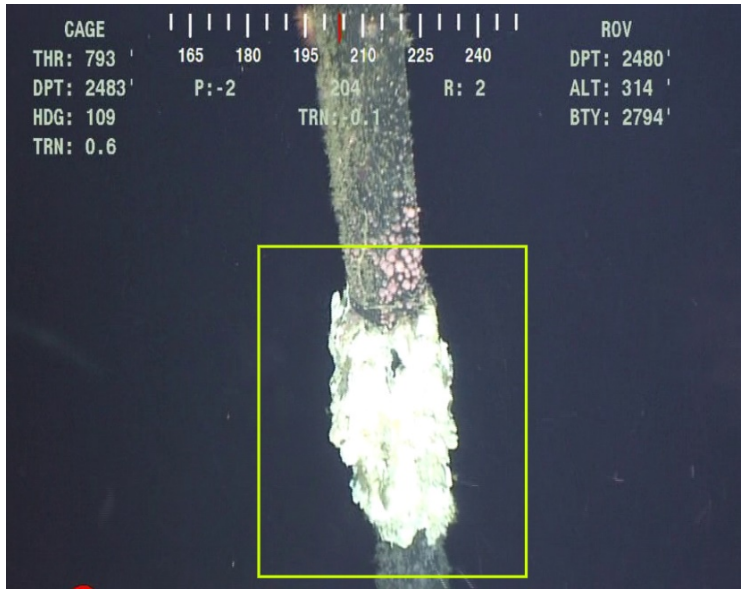
Auto Eventing Log

Application of Machine Learning to Subsea Integrity Monitoring



Deep Supervised Learning - Challenges





Database: 25,000 images

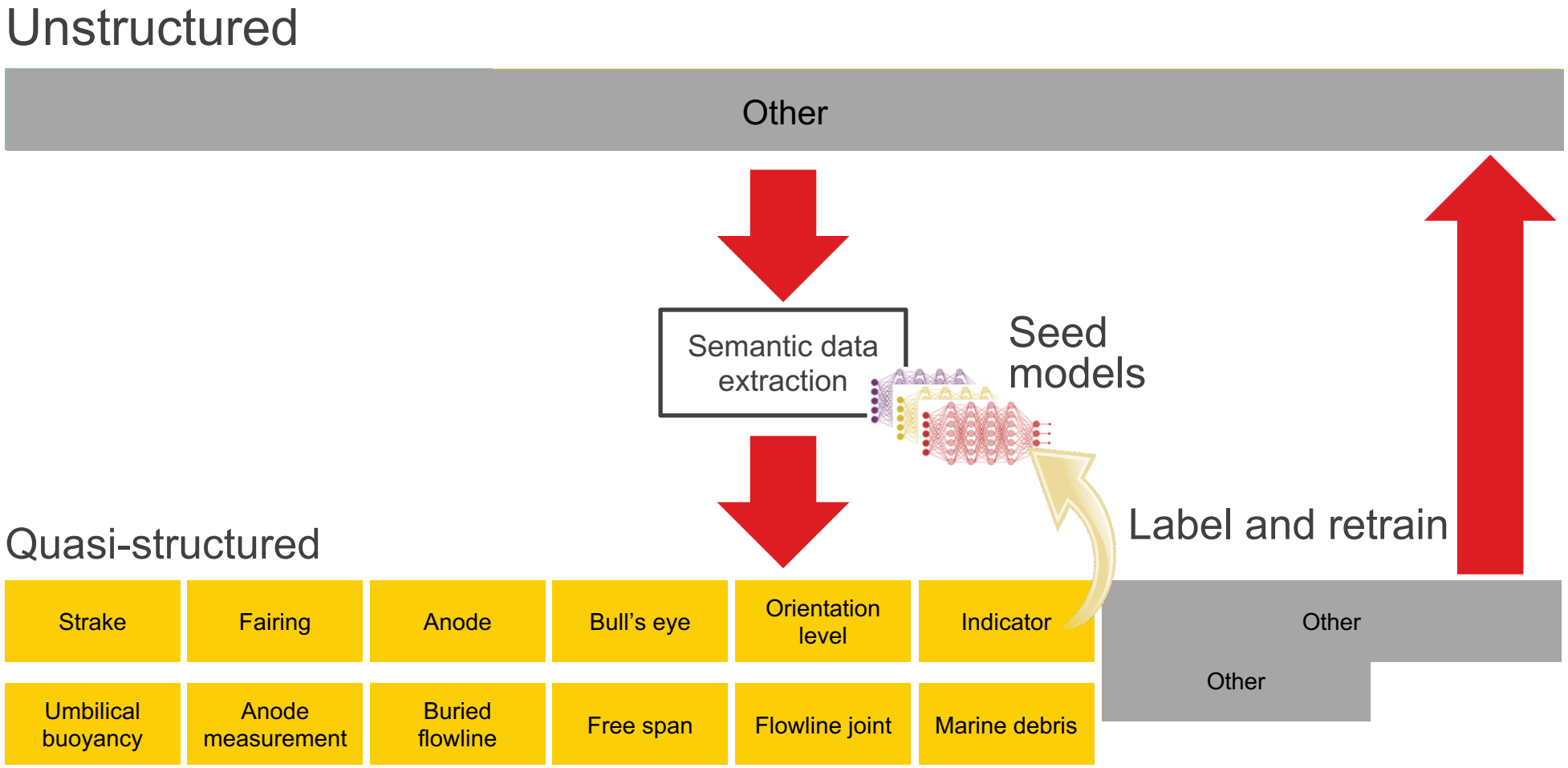
Labeling rate: 80 images/hr

312 hrs/database

Manual box annotation:

- Needs expert annotator
- ~80 to 150 images/hr

Data Mining - Semantic Data Extraction

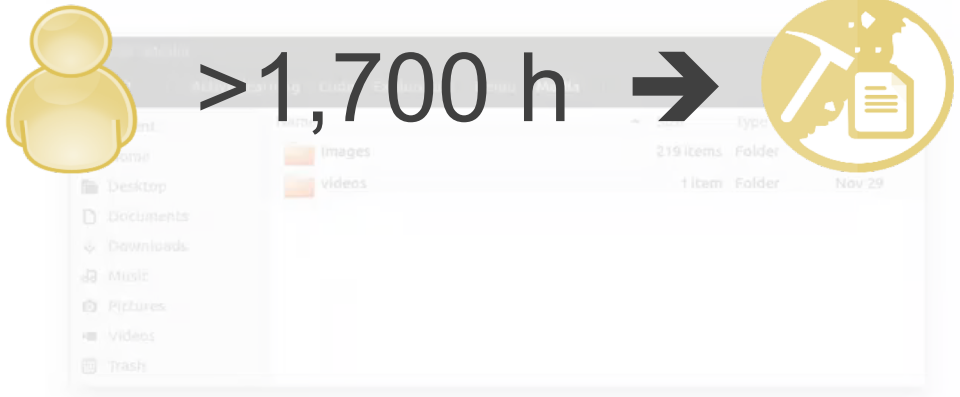


Data Mining - Semantic Data Extraction

3.2 TB
unstructured data
(videos and images)

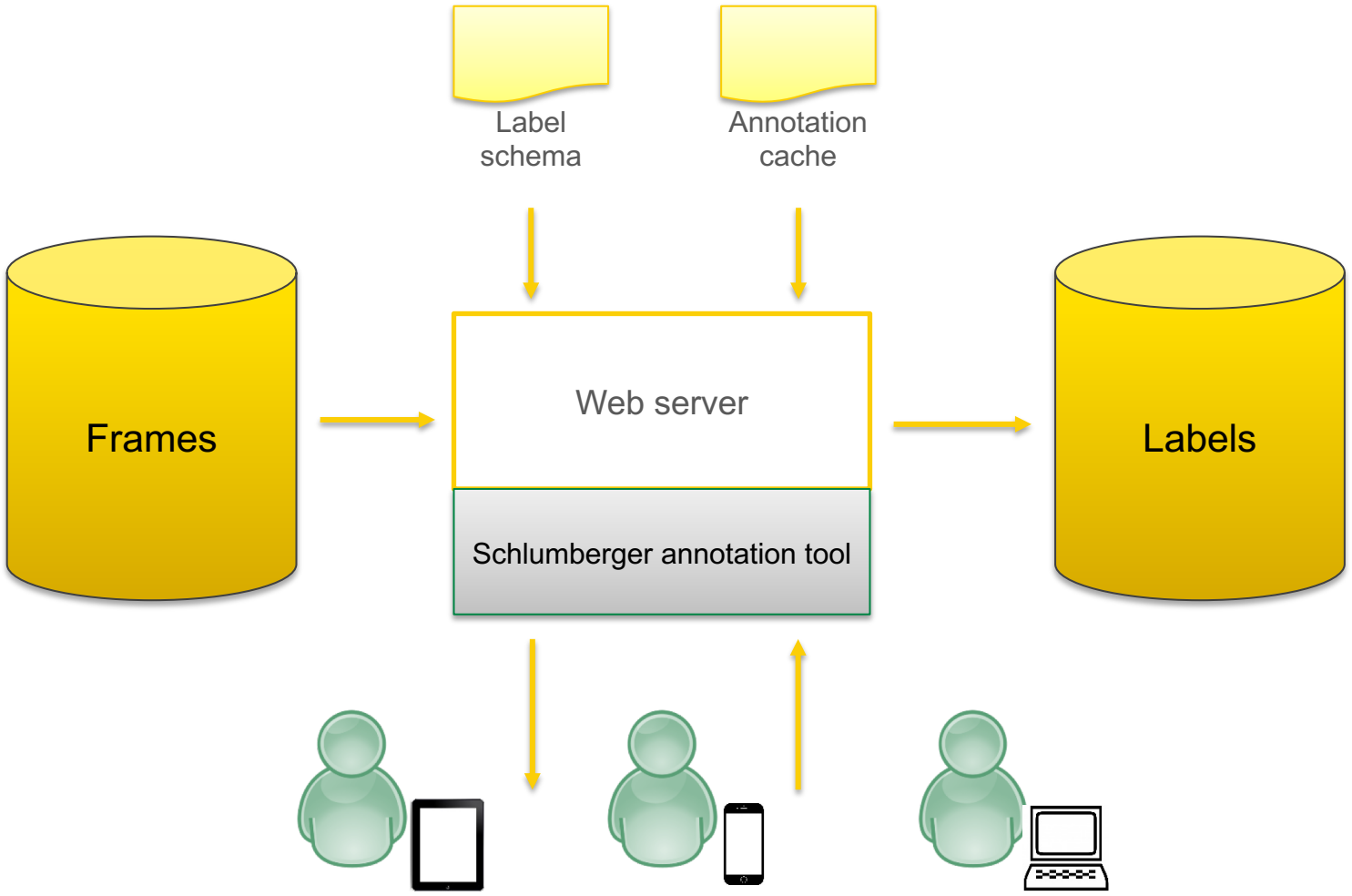
1,319 h of video

Locate videos + Cross correlation + Frame extraction + Classification



>1,700 h ➔ 26 h

Data Labeling - Multiuser Labeling



10 users

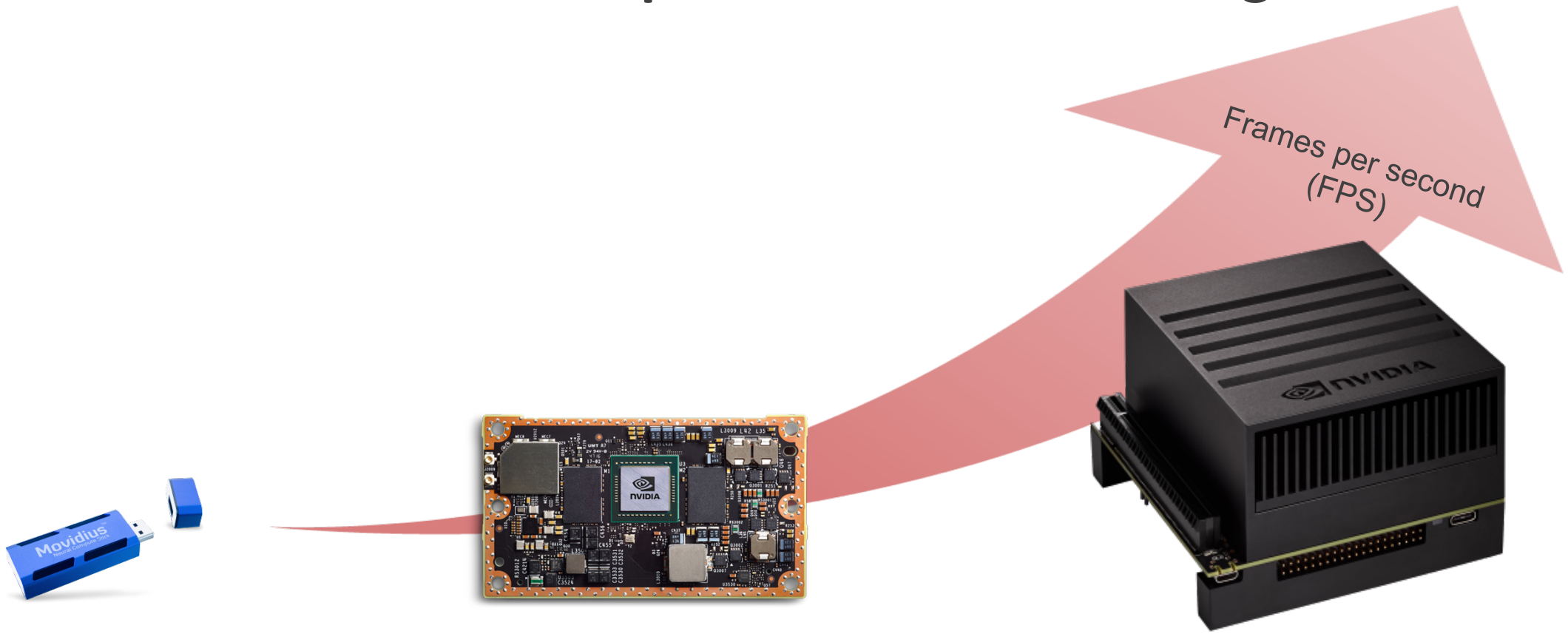
3 locations

15 classes

70,000+ labeled images

110,000+ labels

Real-Time and Embedded Implementation at the Edge

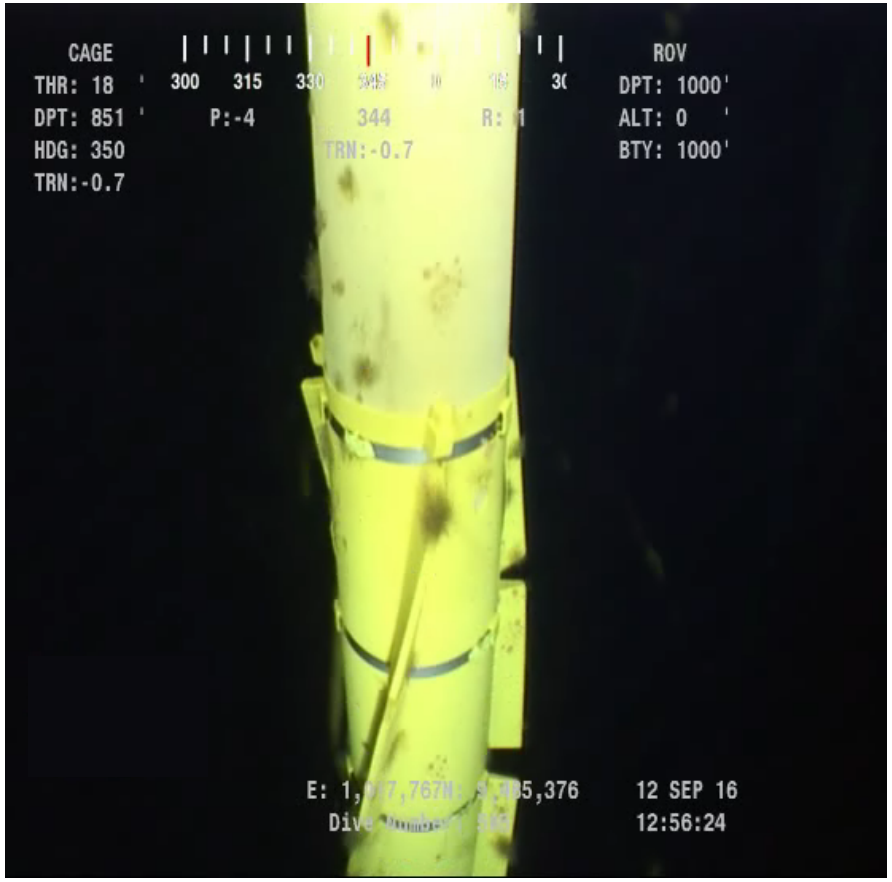


Intel Movidius

Nvidia TX2

Nvidia Xavier

Real-Time Anomaly Logging



Client: Shell	Dive number: 585
Location: AC 857	Video Format: NTSC
Equipment: Panasonic DMR-EH69	Date: 12-Sep-16
Subject: Perdido ISIP DCR Riser DVA	

Depth	Description

4-20 x Faster Acquisition

Conclusions

- Machine learning is a powerful tool for automating and digitizing subsea asset integrity video analytics.
- Automation of the machine learning workflow is crucial to efficient ingestion, processing, and actioning of the results.
- This type of workflow orchestration (DATA → INFORMATION → KNOWLEDGE → ACTION) is key to unlocking digital opportunities in asset integrity in subsea and across a wide variety of oil and gas use cases.