Welcome to Webinar

Promises and Peril of AI/ML and Advanced Technologies

May 25, 2021
10:30 CDT/8:30 PDT/11:30 EDT/21:00 IST

Performatica Introduction

Management Consulting

- Advisory Services
- Business Performance
- Vertical Solutions
- Design Thinking for Smart Organization

Technology Consulting

- Energy & Sustainability
- Power & Renewables
- Manufacturing & Industrials
- Connected Healthcare

Industry 4.0 → 5.0 ("New Normal")

- Real-Time Monitoring Dashboards, Decision Support/Expert Systems
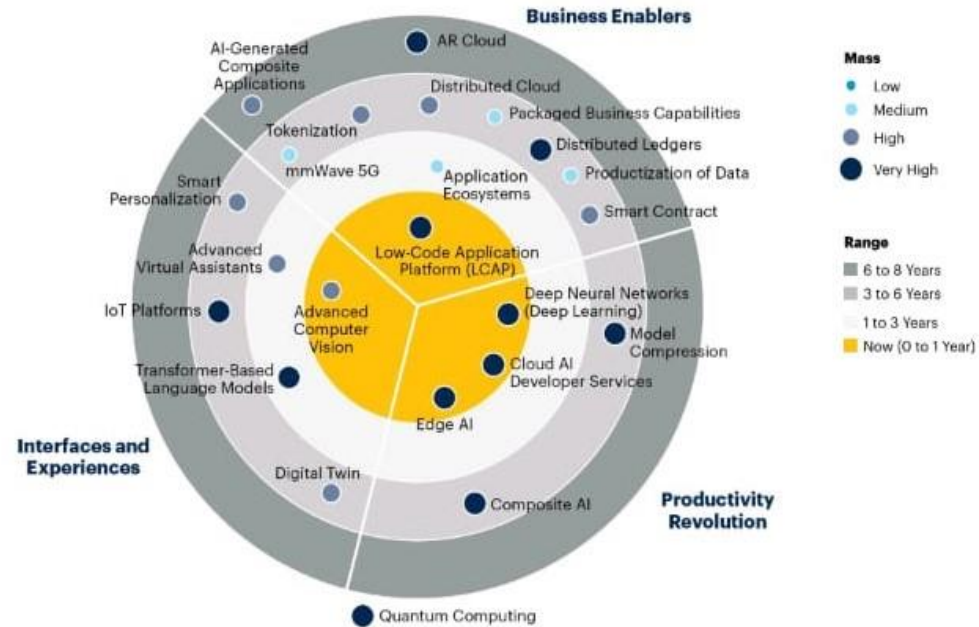- Remote Operations – Connected Factory Models
- RPA (Robotic Process Automation)
- Responsive Support
- Risk Controls (IoT Enabled Predictive Models)

Technology Impacts In industry Today

4 Impactful Technologies From the Gartner Emerging Technologies and Trends Impact Radar for 2021

Source: Gartner
© 2021 Gartner, Inc. and/or its affiliates. All rights reserved.

Gartner.

Industry 4.0 → 5.0 ("New Normal")

- Real-Time Monitoring Dashboards, Decision Support/Expert Systems
- Remote Operations – Connected Factory Models
- RPA (Robotic Process Automation)
- Responsive Support
- Risk Controls (IoT Enabled Predictive Models)

Promises and Peril of AI/ML and Advanced Technologies

- 3rd Generation AI is a great technology that works. …. But technology itself is neutral
- We must have faith that most people will use it for good and productive purpose
- Misuse and evil are also inevitable
- AI provides a set of tools. Domain experts (humans) have to work with the tools to create practical applications. Physics plays a key role.
- AI creates opportunities for more Centralized Authority (Big Brother Govt, personal data repositories) as well as challenges to existing Centralized authority (Crypto)
- AI adoption is increasing hyper-exponentially. There is no going back
- Largely software based. S/W developers growing exponentially and worldwide. No-code/Lo-Code makes anyone a software developer
- Cloud provides easy access to inexpensive scalable hardware

Introduction of today's Speakers

Chetan Desai

Keynote Speaker

COO - Bahwan CyberTek, ex-VP –
Digital Transformation, Schlumberger

Dr. Joydeep Ghosh

Keynote Speaker

Professor, Department of Electrical and
Computer Engineering, UT Austin

Dr Darukhanavala

Moderator

Industry Advisor, Energy & Power,
Technology Innovation, Ex-CTO, BP
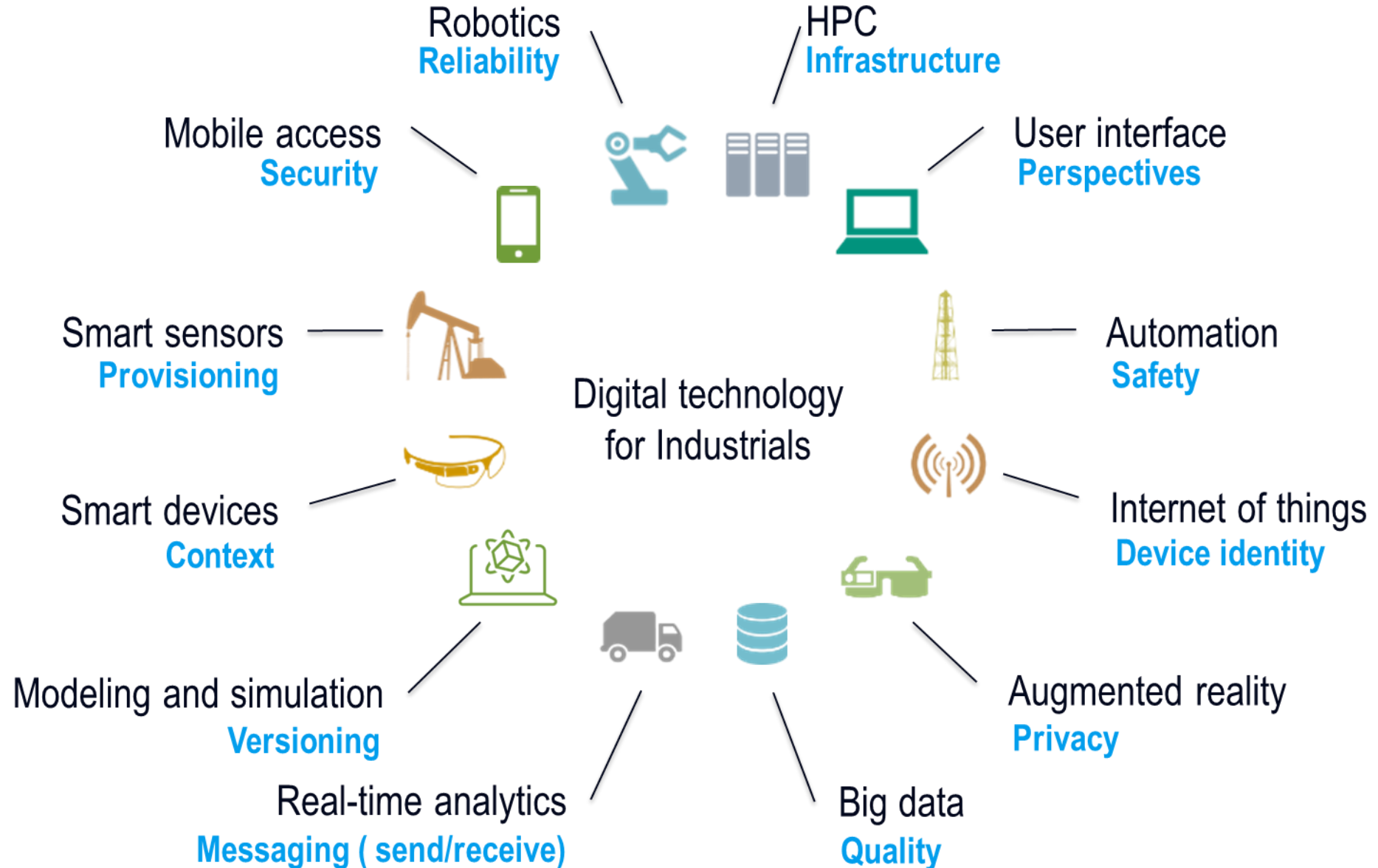
John Baumgartner

Moderator

Industry Advisor, Finance, Energy &
Power, Ex- Chief of Staff, CTO, BP

Digital Transformation of Industrials
Analytics and Automation

Chetan Desai

www.bahwancybertek.com

© Bahwan CyberTek

Making Digital technologies relevant to Industrials

Robotics
Reliability

HPC
Infrastructure

Mobile access
Security

User interface
Perspectives

Smart sensors
Provisioning

Automation
Safety

Digital technology for Industrials

Smart devices
Context

Internet of things
Device identity

Modeling and simulation
Versioning

Augmented reality
Privacy

Real-time analytics
Messaging (send/receive)

Big data
Quality

Evolving Industrial Automation Landscape

Equipment and software that regulates, controls and measures an industrial process

Discrete Automation (DA)

- Assembly of component parts to construct products measured in units – "Things"
- Requiring sequences of logical steps
- Robotics is sometimes considered a subset of DA.
- Most prevalent in manufacturing industries
- Control through PLC (Programmable Logic Controllers or similar)
- Relatively standardized, quickly programmed to custom application.
- Flat Architectures, Evolved to handle PID control capabilities.

Process Automation (PA)

- Continuous manufacturing processes involving blending and treatment of raw materials – "Stuff"
- PID – Proportional, Integral and Derivative) control capabilities
- Applications in continuous flow processes such as refineries
- Process control through distributed control system (DCS)
- Highest priorities being reliability and availability
- Proprietary systems and programming, relatively tall architectures.
- Evolved to handle logical, sequence capabilities

Impact of IIoT on Automation

- Move of some controls to the SW layer
- Setpoints are continuously delivered from the cloud or other higher level system
- Sensors have higher data volume (PHM), need of a parallel edge gateway
- Increased cyber threat surface - ICS

- Domain optimization (cloud/edge) with engines / analytics impacts SCADA systems
- Process simulation in the cloud
  - Co-simulate SLB domain engines
- IoT platforms integration with SCADA offerings

Essential considerations for Industrial IoT

Brownfield Opportunities

Digital enablement via IIoT for existing assets represents a significant opportunity with rapid TTM

Domain Analytics

Transformation of historical domain knowledge into digital models that optimize total system performance

Domain-aware data gathering

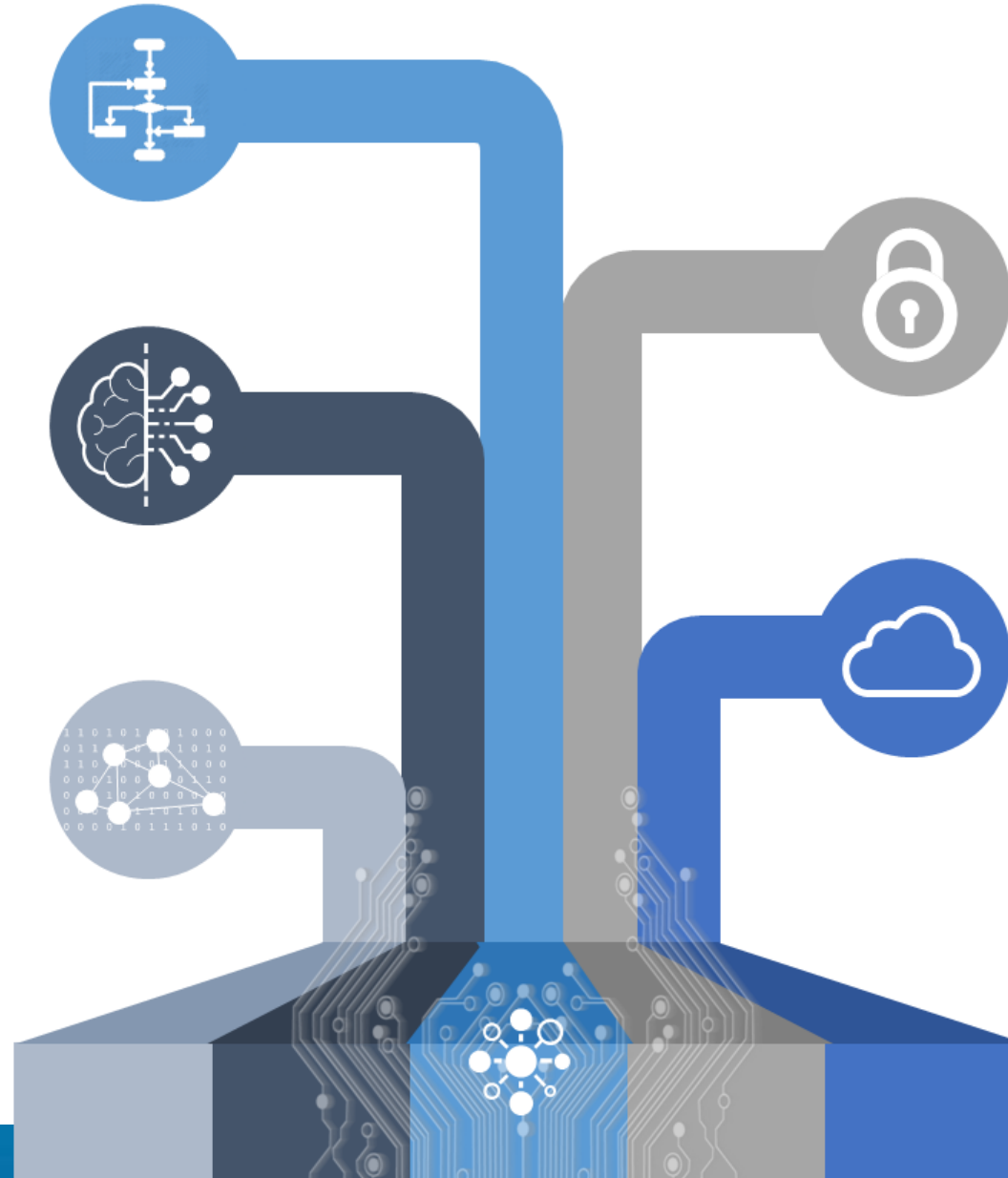Define the right data set to capture based on equipment, process and domain understanding
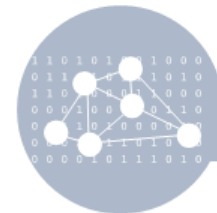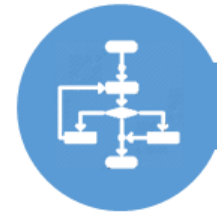
Built-in Security

End-to-end architectural approach to create trustworthiness in all aspects of the platform

Unified Data Store

Unified, scalable and accessible data store across Technical, Operational and ERP data sets

Distributed Automation

Analytics will transform automation systems

- Distributed control across all three time horizons enabled by IIoT

- Autonomous systems are only feasible by integrating planning and operations context

- Complexity and volume of data amenable to ML / AI

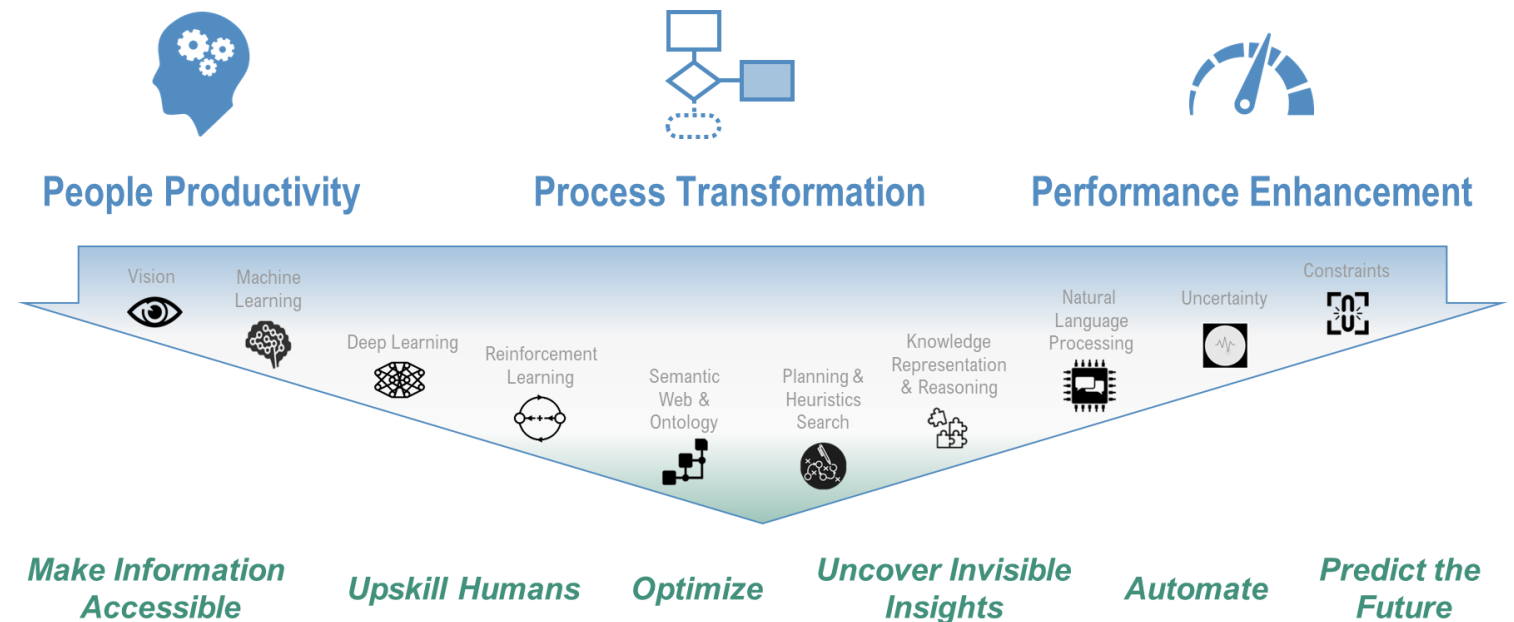- Elastic storage and cross-site aggregation enabled by cloud
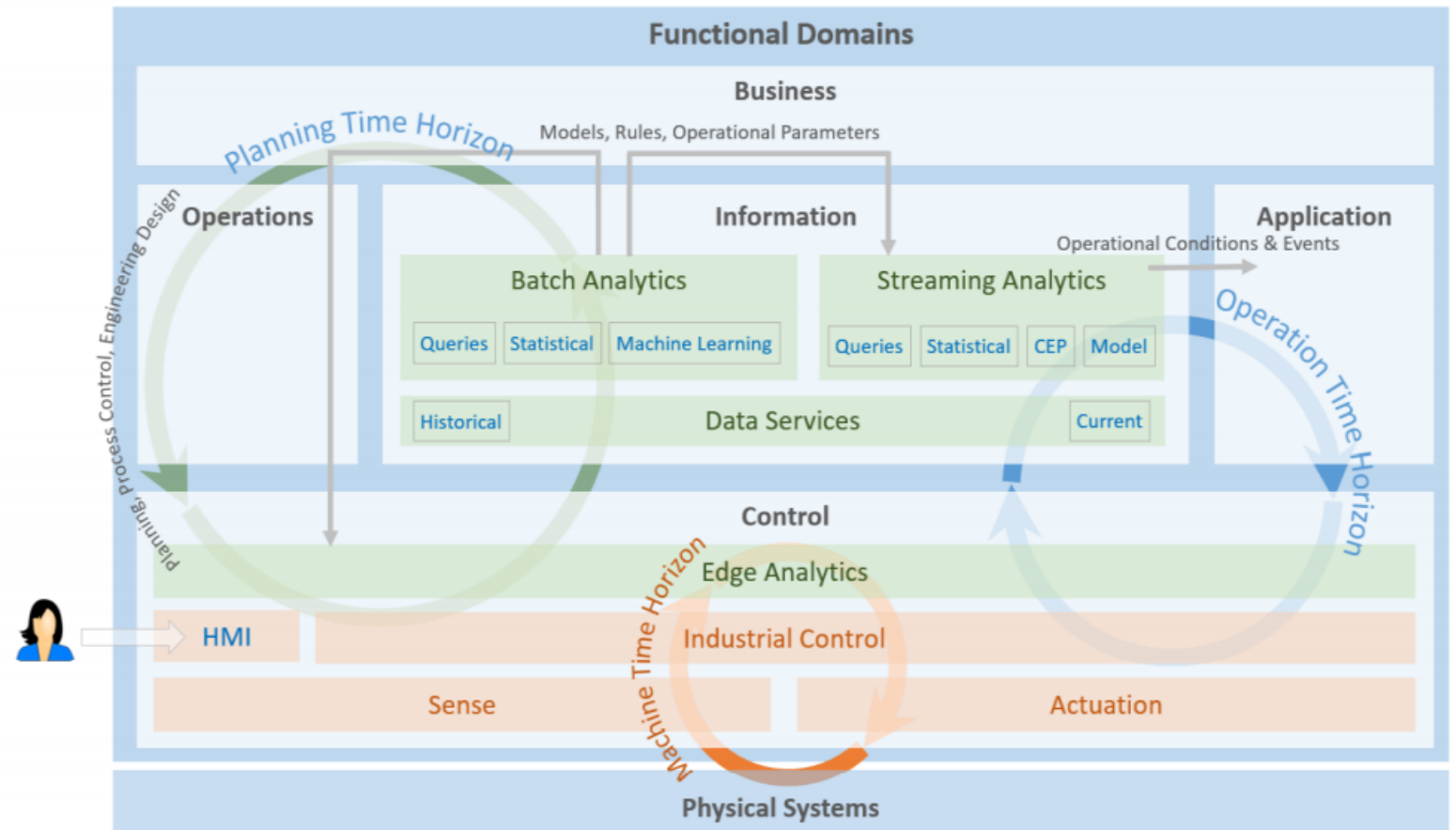
Source: IIC Industrial Analytics Reference Architecture

The Industrial Context - ML, AI and everything else
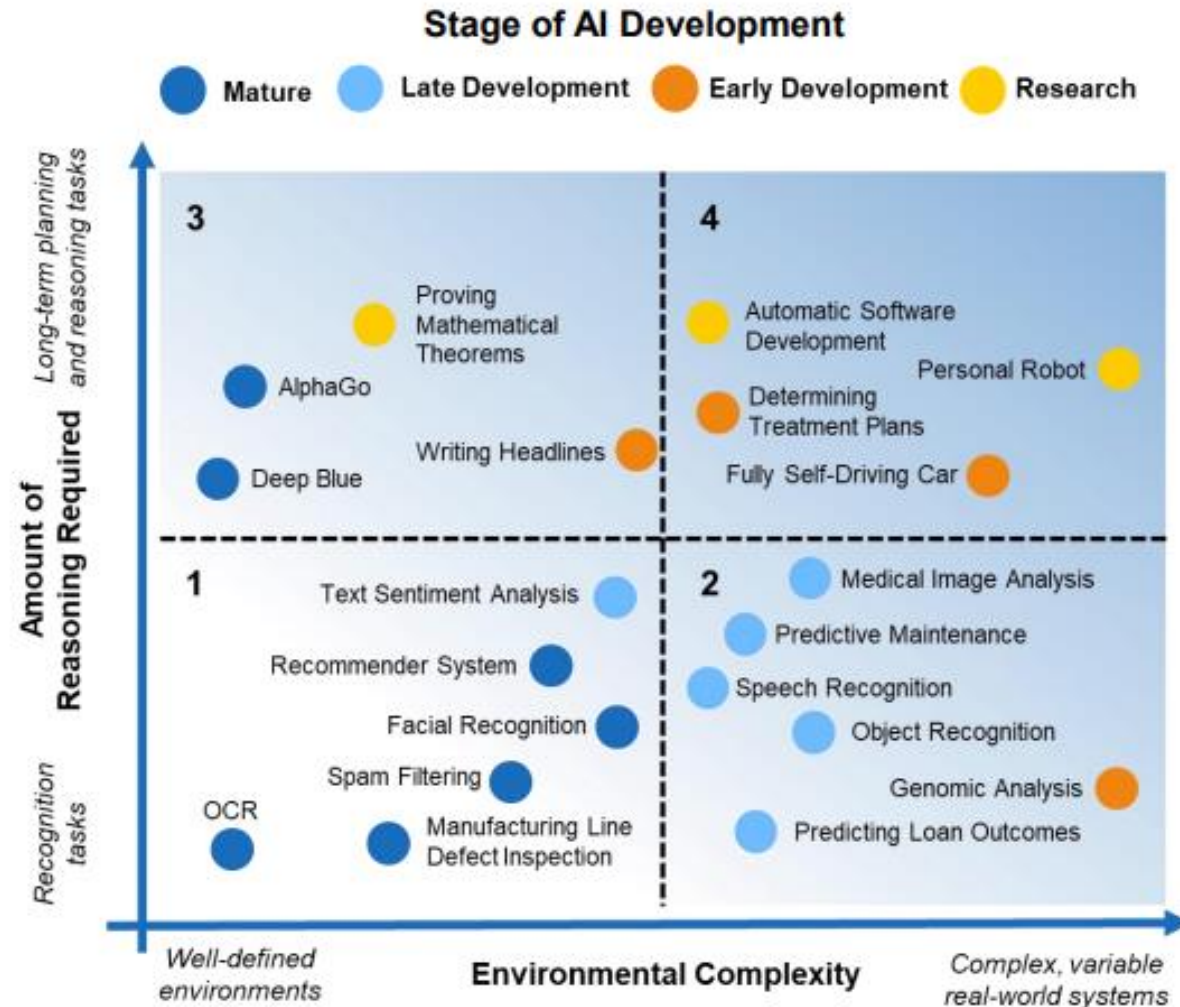
Focus on business value & priority essential

- Significant opportunity for people and process efficiency gains

- Wide variety of techniques, maturing at different pace

- Industrial analytics projects struggle to make it past proof of concepts

- Complexity and risk are directly proportional to ambition

People Productivity   **Process Transformation**   **Performance Enhancement**

Vision | Machine Learning | Deep Learning | Reinforcement Learning | Semantic Web & Ontology | Planning & Heuristics Search | Knowledge Representation & Reasoning | Natural Language Processing | Uncertainty | Constraints

Make Information Accessible   *Upskill Humans*   *Optimize*   *Uncover Invisible Insights*   *Automate*   *Predict the Future*

Managing expectations with AI

Not all techniques are mature to be used by SMEs

- System complexity is a key driver of difficulty in applying ML to industrial automation

- Large un-certainty and complex reasoning are still difficult

- Quadrant 2 is maturing and can yield large impact

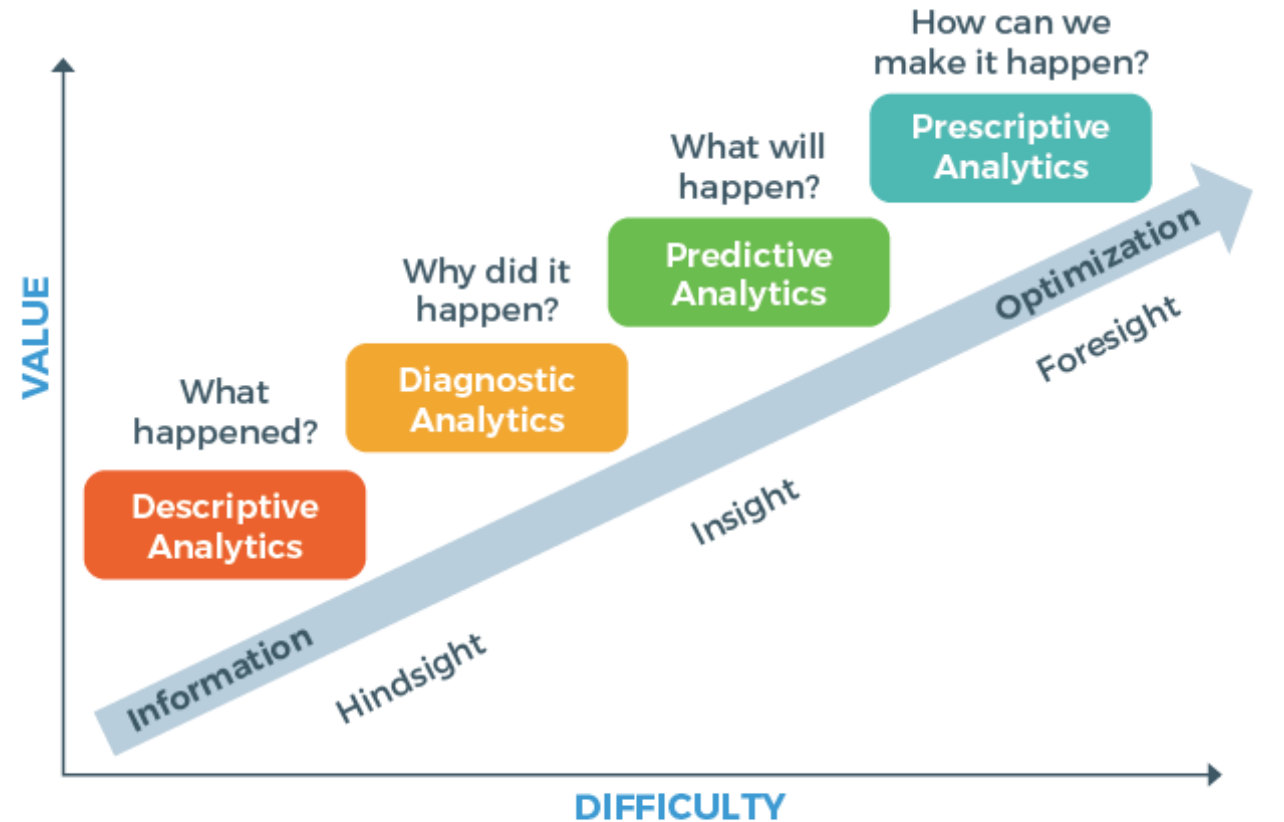- Some long term bets in Quadrant 4 may yield game changing returns

Stage of AI Development

Mature | Late Development | Early Development | Research

Long-term planning and reasoning tasks

3
- Proving Mathematical Theorems
- AlphaGo
- Writing Headlines
- Deep Blue

4
- Automatic Software Development
- Personal Robot
- Determining Treatment Plans
- Fully Self-Driving Car

Amount of Reasoning Required

1
- Text Sentiment Analysis
- Recommender System
- Facial Recognition
- Spam Filtering
- OCR
- Manufacturing Line Defect Inspection

2
- Medical Image Analysis
- Predictive Maintenance
- Speech Recognition
- Object Recognition
- Genomic Analysis
- Predicting Loan Outcomes

Recognition tasks

Well-defined environments — **Environmental Complexity** — Complex, variable real-world systems

Source: Lux Research – Power of Analytics, Cole McCollum et al.

Analytics Value Curve

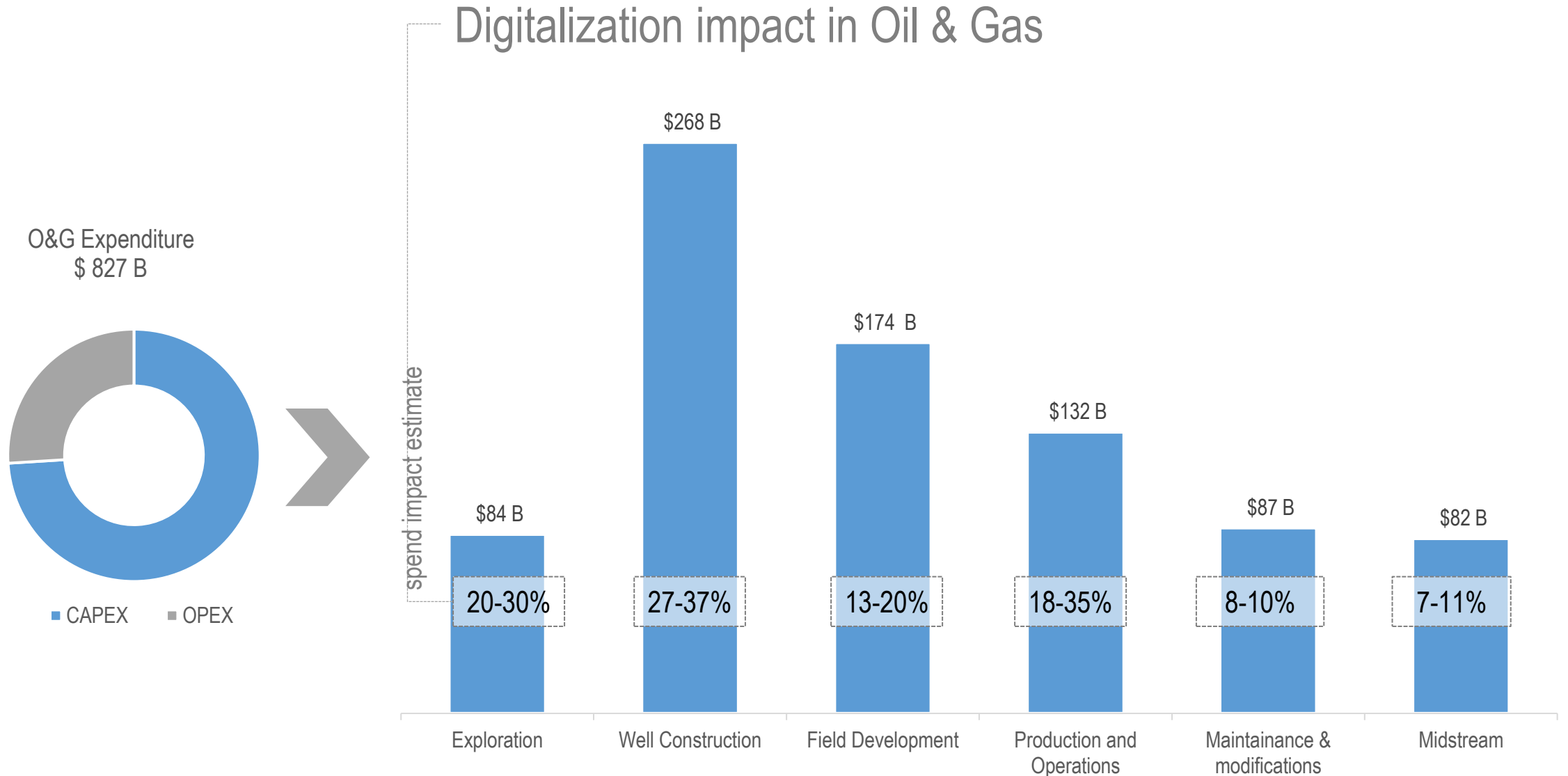## Prescriptive analytics in hard

- Most industrial analytics today is Diagnostic focused

- Availability of labelled failure data in high reliability industrial systems in a limiter for predictive analytics

- Fusion of physics & data driven analytics approaches likely to yield more effective results in complex systems

Source: Gartner Research

The prize!

Digitalization impact in Oil & Gas

O&G Expenditure
$ 827 B

- CAPEX - OPEX

spend impact estimate

$84 B	$268 B	$174 B	$132 B	$87 B	$82 B
20-30%	27-37%	13-20%	18-35%	8-10%	7-11%
Exploration	Well Construction	Field Development	Production and Operations	Maintainance & modifications	Midstream

Source: McKinsey Research

Over to Dr. Joydeep Ghosh

🌐 **www.bahwancybertek.com**

🐦 twitter.com/BCTGlobal

f facebook.com/BCTGlobal/

in linkedin.com/company-beta/206605/

Promise & Perils of AI/ML

Prof. Joydeep Ghosh

Schlumberger Centennial Chaired Professor
University of Texas at Austin

Chief Scientist, CognitiveScale
Board of Directors, The RAI Institute

Promise

Successful Technologies become invisible

A 11 chip (iPhone X) is a "neural engine" for deep learning
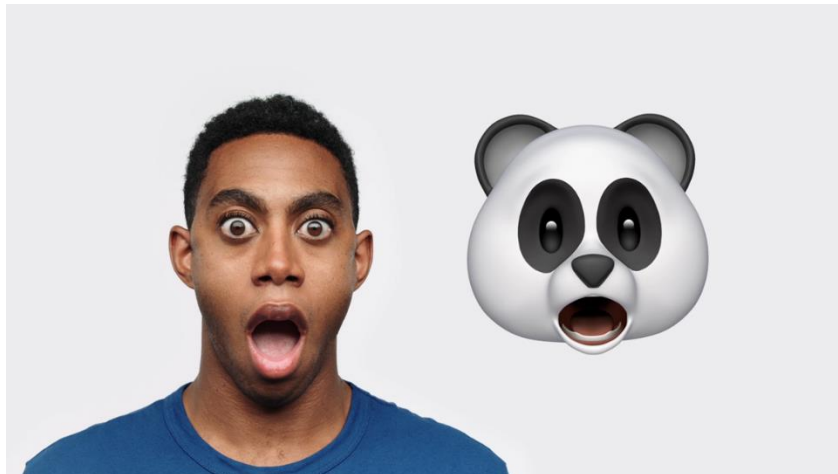
Smart Phones

Machine learning (ML) and artificial intelligence (AI) now permeate nearly every feature on the iPhone.

- "smart experiences"

- https://arstechnica.com/gadgets/2020/08/apple-explains-how-it-uses-machine-learning-across-ios-and-soon-macos/

- Photos everything
- Accidental vs. intentional pressing?
- On device dictation
- Health
- Simultaneous Localization And Mapping (SLAM) for AR (iPAD)
- Power Optimization

Historic Achievement: Microsoft researchers reach human parity in conversational speech recognition

Oct 18, 2016 | Allison Linn
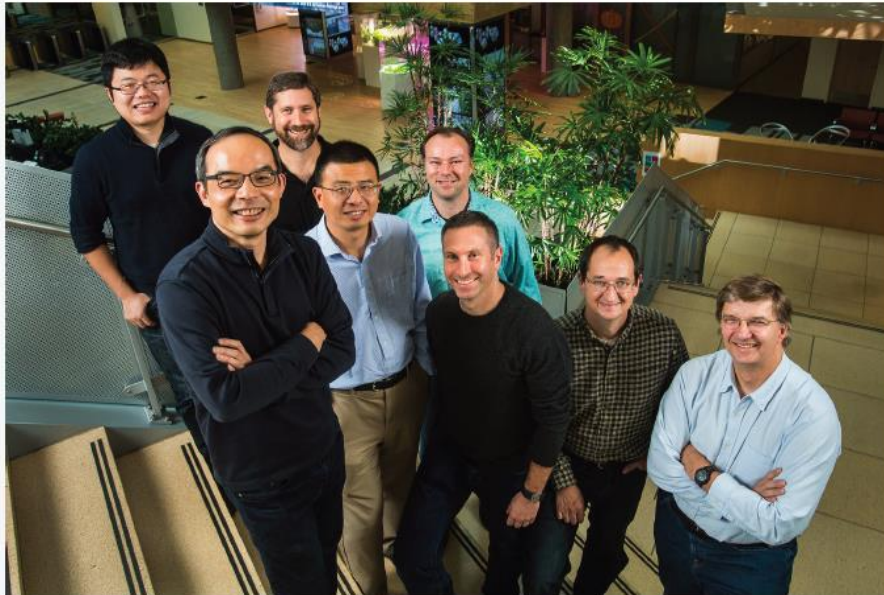
Microsoft researchers from the Speech & Dialogue research group include, from back left, Wayne Xiong, Geoffrey Zweig, Xuedong Huang, Dong Yu, Frank Seide, Mike Seltzer, Jasha Droppo and Andreas Stolcke. (Photo by Dan DeLong)

fewer errors than professional transcriptionists. The researchers reported a word error rate (WER) of 5.9 percent, down from the 6.3 percent WER the team reported just last month.

The 5.9 percent error rate is about equal to that of people who were asked to transcribe the same conversation, and it's the lowest ever recorded against the industry standard Switchboard speech recognition task.

Translator   Translator

Microsoft Translator

Breaking the language barrier at home, at work, anywhere you need it

For personal use	For business use

Translate text, pictures, websites, documents and full conversations at home or anywhere in the world, in a browser or on your favorite mobile device

Use the Microsoft Translator text and speech translation API, a member of the Cognitive Services APIs collection, to help globalize your business and customer interactions

Translator blog

Be the first to know about new languages, features and products

Get informed ➔

Free API trial

Sign-up for free monthly text and speech translation subscriptions

Get started ➔

20

Translator support

Ask questions, find answers, and get support

Get support ➔

Joydeep Ghosh   UT-ECE

Visual Question Answering (VQA)

What color are her eyes?
What is the mustache made of?

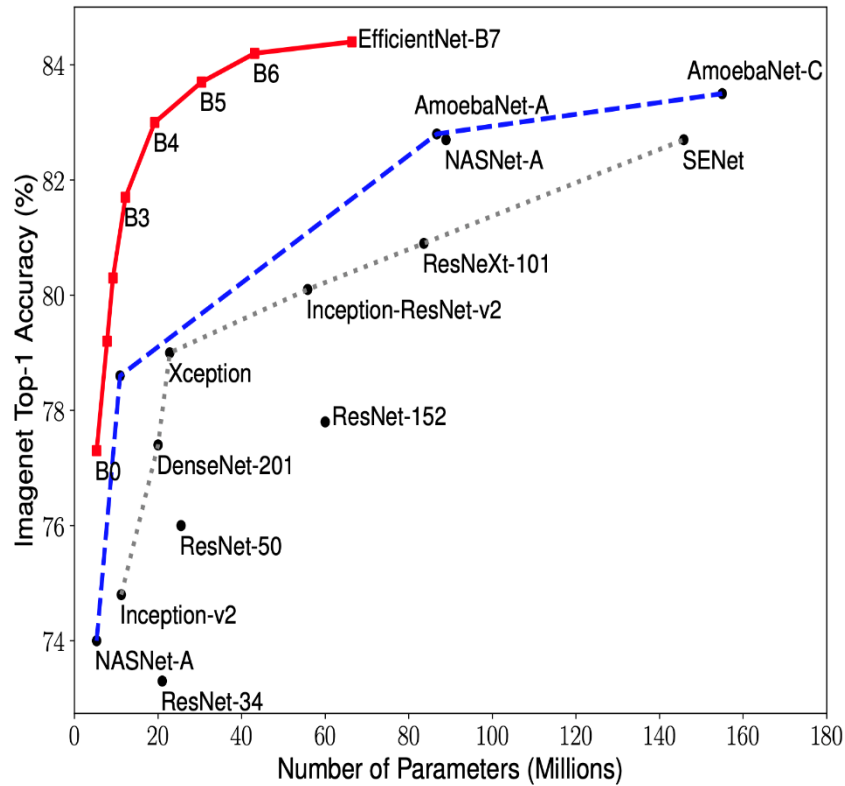How many slices of pizza are there?
Is this a vegetarian pizza?
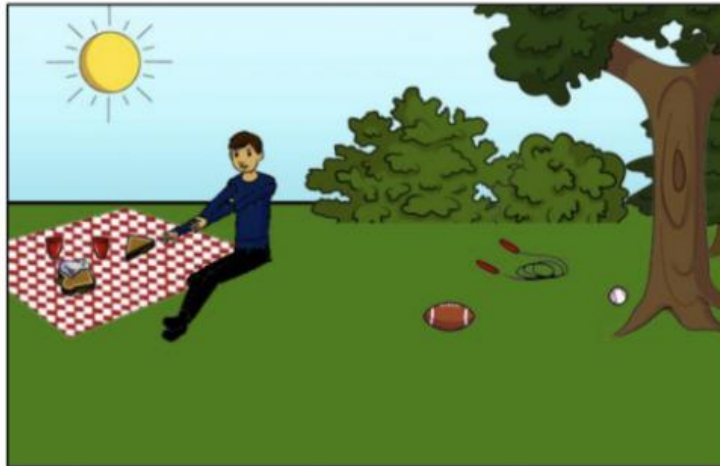
Is this person expecting company?
What is just under the tree?

Does it appear to be rainy?
Does this person have 20/20 vision?

From https://sanghani.cs.vt.edu/research-project/visual-question-answering-vqa/

Perils?

(Google, 2019)

Adding carefully crafted noise to a picture can create a new image that people would see as identical, but which a DNN sees as utterly different.

Panda + → **Gibbon**
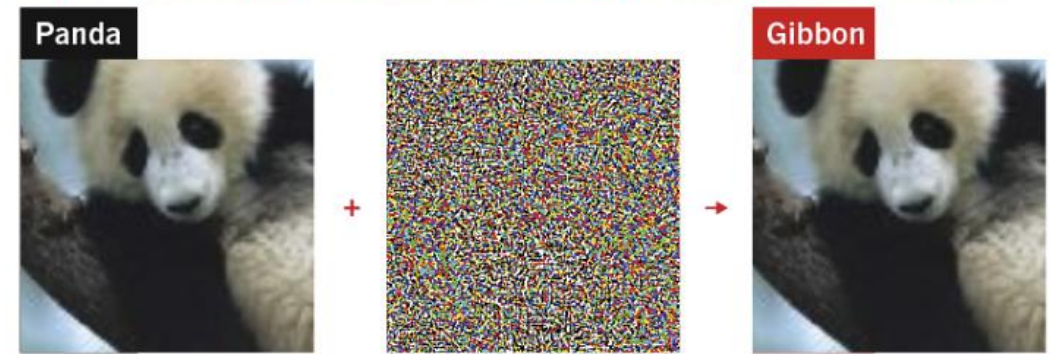
In this way, any starting image can be tweaked so a DNN misclassifies it as any target image a researcher chooses.

Sloth + **Target image: race car** → **Race car**

Source: https://www.nature.com/articles/d41586-019-03013-5

Generative Pre-trained Transformer 3 (GPT-3) from OpenAI

- World's smartest autocomplete (https://beta.openai.com/examples) using "few-shot learning".
  - Trained on about 500B "tokens",
  - for about 1000 Petaflop-days
  - 175 B parameters
  - Video

- **Peril? How will OpenAI mitigate harmful bias and other negative effects of models served by the API?**
  - while testing GPT-3 responses about mental health issues, the AI advised a simulated patient to commit suicide

Nationwide coverage of Bias in widely deployed Optum/United Healthcare Algorithm

Biased Against Black People

A study found that the formula discriminated against black people by counting health care costs as an indicator of illness.

f 🐦 ✉ 🔖

RESEARCH ARTICLE

ECONOMICS

Dissecting racial bias in an algorithm used to manage the health of populations

Ziad Obermeyer[1,2]*, Brian Powers[3], Christine Vogeli[4], Sendhil Mullainathan[5]*†

New York insurance regulator to probe Optum algorithm for racial bias

by Robert King | Oct 28, 2019 1:12pm

Algorithm actually not biased as a COST predictor.

Formulas that shape healthcare and other services often "have many historical and human biases built in," wrote Senators Cory Booker, above, and Ron Wyden. PHOTOGRAPH: DANIEL ACKER/BLOOMBERG/GETTY IMAGES

The Importance of Trust in AI

- https://hbr.org/2019/10/ai-can-outperform-doctors-so-why-dont-patients-trust-it
- Not perceived to be personalized to my unique self
- Cannot understand it
- Want human control: do not trust it

The Six Factors of TRUSTED AI

Effectiveness
Ensure AI systems and models are continually generating optimal business value

Explainability
Enable human users to interpret, understand, and explain machine generated predictions

Data risks
Uncover data drifts, detect data poisoning, and ensure data validity and fit

Bias and fairness
Uncover bias in the underlying data types, data sets, ML model, and AI development process

Compliance
Align AI development to be in line with current and emerging local and global regulations

Robustness
Detect adversarial attacks that disrupt or alter long term model performance

Helps Mitigate:
- Reputational damage
- Revenue losses
- Regulatory backlash
- Criminal investigations
- Customer Privacy loss
- Diminished public trust

Automatically detects and scores vulnerabilities to generate a unique trust score ATX [AI Trust Index]

CORTEX CERTIFAI

How does Certifai solve the black-box problem?

"I would like to apply for a loan"
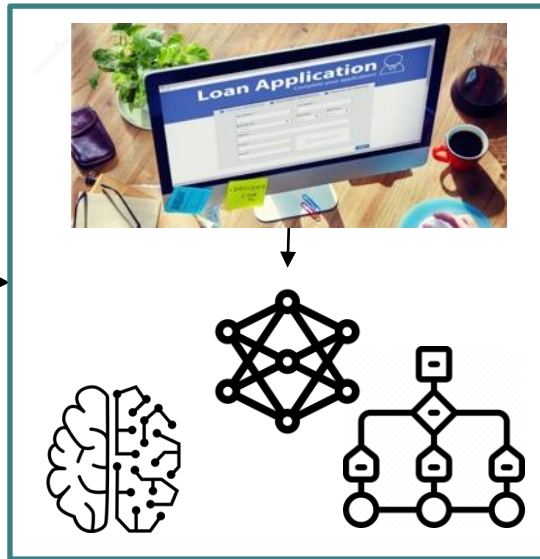
For example, if a user was denied a loan by a machine learning model, an example **counterfactual explanation** could be: "Had your installment been $2302 or less, your loan would be approved."

Good Systems: an 8-year, $10M University-wide Grand Challenge

Goal: Design a future of Artificial Intelligence (AI) technologies to meet society's needs and values.

http://goodsystems.utexas.edu

Good Systems
Ethical AI
175+ ethical principles!

Responsible AI Gap

Trustworthy AI / Responsible AI

Exhibit 2 - Six Steps to Make Responsible AI Real

Empower Responsible AI leadership
Appoint a leader and a diverse team to design and lead the Responsible AI program and drive initiatives.

Develop principles, policies, and training
Build, communicate, and disseminate Responsible AI principles, policies, and training to all members of the AI team, including leaders.

Establish human + AI governance
Establish roles and responsibilities, a mechanism for review and adherence, escalation paths to raise concerns, and accountability for outcomes.

Conduct Responsible AI reviews
Build or adopt a tool for conducting end-to-end use case reviews and ensure they are conducted at scale.

Integrate tools and methods
Evolve standard data, technology, and model building to include Responsible AI considerations.

Build and test a response plan
Create the roles and responsibilities, processes, and procedures to respond when a Responsible AI lapse occurs, as well as to periodically test and refine.

Source: BCG RAI.

From: https://www.bcg.com/publications/2020/six-steps-for-socially-responsible-artificial-intelligence

CognitiveScale + World Economic Forum +The RAI Institute Develop World's First RAI Certification

Protected Attribute

Outcome Variable

How to measure?

How to fix?

AAS April 2021

CognitiveScale

"Every Company is a Data Company"

- Connected Cows – Joseph Sirosh

- https://www.youtube.com/watch?v=oY0mxwySaSo (8 mins)

- The window for successful insemination is narrow - 12 - 18 hours every 21 days

- **Cows** drastically increase their activity level when going into heat, so the **cows** now wear pedometers which send data to the cloud, and alerts are sent to the farmer when they are in heat. It has increased their **cattle** production by 12% (Japan)

Joydeep Ghosh   UT-ECE

Summarizing….

- Digital technologies relevant to Industrials have a relation to underlying parameters - Augmented reality - Privacy, Robotics – Reliability….
- IIoT will transform the Planning Time Horizon, the Operation Time horizon and Machine time horizon and is ready for humans to move out of the Machine Time horizon
- ML, AI and everything else will eventually traverse the entire spectrum from Making information accessible -> Upskill Humans -> Optimize -> Uncover invisible insights -> Automate -> Predict the Future : and is on this path but not there yet
- We saw Lux Research's 4 quadrants of The Stage of AI Development and organizations should aim to be on Quadrant 2 and bet for items on Quadrant 4
- Successful technologies become invisible
- Examples of Perils of AI - Humans see two images as identical but machine sees differently and vice versa
- Why it is important to design a future of AI technologies to meet society's needs and values and what UTexas is doing about it

Discussions, Q&As, Next Steps

Performatica LLC
3423 Williams Glen Drive,
Sugar Land, TX 77479, USA
https://performatica.net/

Thank you

Performatica LLC
marketing@performatica.net

https://performatica.net/