THE JOURNEY OF USING AUTONOMOUS MACHINES IN MINING

Michael Murphy
THE JOURNEY OF USING AUTONOMOUS MACHINE IN MINING

- HISTORY – CATERPILLAR PERSPECTIVE
  - RESEARCH PROJECT
  - DARPA
  - COMMERCIAL PRODUCT

- AUTONOMOUS ARCHITECTURE

- DEVELOPMENT TEAMS/VALIDATION

- CUSTOMER RESULTS
HISTORY OF CATERPILLAR AUTOMATION

- 1985  Autonomous Mining Truck (AMT) program commenced
- 1995  AMT operational at Texas quarrying operation
HISTORY OF CATERPILLAR AUTOMATION

- 1985  Autonomous Mining Truck (AMT) program commenced
- 1995  AMT operational at Texas quarrying operation
- 1996  Demonstrated at largest mining show - MINExpo 1996
- 1998  Placed program on hold – moved to building block strategy
HISTORY OF CATERPILLAR AUTOMATION

- 2004 – 2007
  DARPA Grand and Urban Challenges
DARPA CHALLENGE

1985    Autonomous Mining Truck (AMT) program commenced
1995    AMT operational at Texas Crushed Stone
1996    Demonstrated at MINExpo
2004    Caterpillar launched automated LHD – Command for UG
2007    DARPA challenge
2011    Pilot Autonomous Haulage System at BHPB Navajo
2013    Launch Western Australia: BHPB Billiton – Jimblebar mine
HISTORY OF CATERPILLAR AUTOMATION

- 2004 – 2007
  DARPA Grand and Urban Challenges

- 2008
  Caterpillar Autonomous Haulage New Product Introduction program commenced

- 2011
  Pilot Autonomous Haulage System at Coal Mine in United States

- 2013
  Launch Western Australia
  BHPB Billiton -Jimblebar mine – 6 trucks initially
  Fortescue Metals Group (FMG) – Solomon mine – 8 trucks initially
Autonomous Haulage Onboard & Systems

- Electro Hydraulic Controls
- High Precision GPS & IMU
- Autonomy Sensors – Radar and Lidar
- Mode Indicator Lights
- Autonomy Computers
- Site Aware Vehicles
- Autonomous Software - Onboard
- Radio Infrastructure
- Command for Hauling - Office
Layers of Protection

Multiple layers of system functionality to detect hazards

- Perimeter Security
- Site Procedures
- Office Emergency Stop
- Site Awareness Vehicles
- On-board Perception Systems
- On-Board Shut Down
- A-Stop

Potential Hazard
Worldwide Development, Testing & Field Follow

- Peoria, IL
- Pittsburgh, PA
- Tucson, AZ
- Chennai, India
- Brisbane, Queensland
- Pilbara, Western Australia

Caterpillar Confidential: Green WHEREVER THERE’S MINING

Field follow
Video – Fortescue Metals Group Solomon Mine
Results through People, Process and Technology

Fleet productivity

AHS are 20 per cent more productive than regular fleet of trucks of the same type

Haul truck performance

T.KmEFH, tonnes per kilometer effective flat haul
SUCCESS WITH CAT COMMAND FOR HAULING

TONNES SAFELY HAULED BY AUTONOMOUS TRUCKS

74 CAT 793F CMD TRUCKS ON CUSTOMER SITES
3.5 YEARS IN OPERATION
400 MILLION TONNES SAFELY HAULED
0 LOST-TIME INJURIES
100 AUTONOMOUS TRUCKS OPERATING BY END OF 2017
Automation

HAULING  LONGWALL  UNDERGROUND  DRILLING  DOZING
Thank You