



SARCOS®

EXTENDING SUSTAINMENT OPERATIONS AND WORKER SAFETY USING ROBOTICS

JTEG TECHNOLOGY FORUM – FEBRUARY 2021

THE SARCOS MISSION: TO DELIVER FORCE-MULTIPLYING TECHNOLOGIES THAT YIELD DECISIVE CAPABILITIES



COMBINING HUMAN INTELLIGENCE WITH ROBOTIC STRENGTH,
ENDURANCE, AND PRECISION FOR COMPLEX AND
UNSTRUCTURED TASKS IN DYNAMIC ENVIRONMENTS

OPPORTUNITIES FOR DOD

SPECIAL OPERATIONS COMMAND

Logistics
Sustainment

AIR FORCE

Logistics
Sustainment /
Aircraft
Maintenance

MARINE CORPS

Expeditionary
Logistics /
FARP Operations

ARMY

Long Range Fires /
FARP Operations /
Sustainment Ops

NAVY

Shipyard
Logistics /
Expeditionary
Ops

DEFENSE LOGISTICS AGENCY

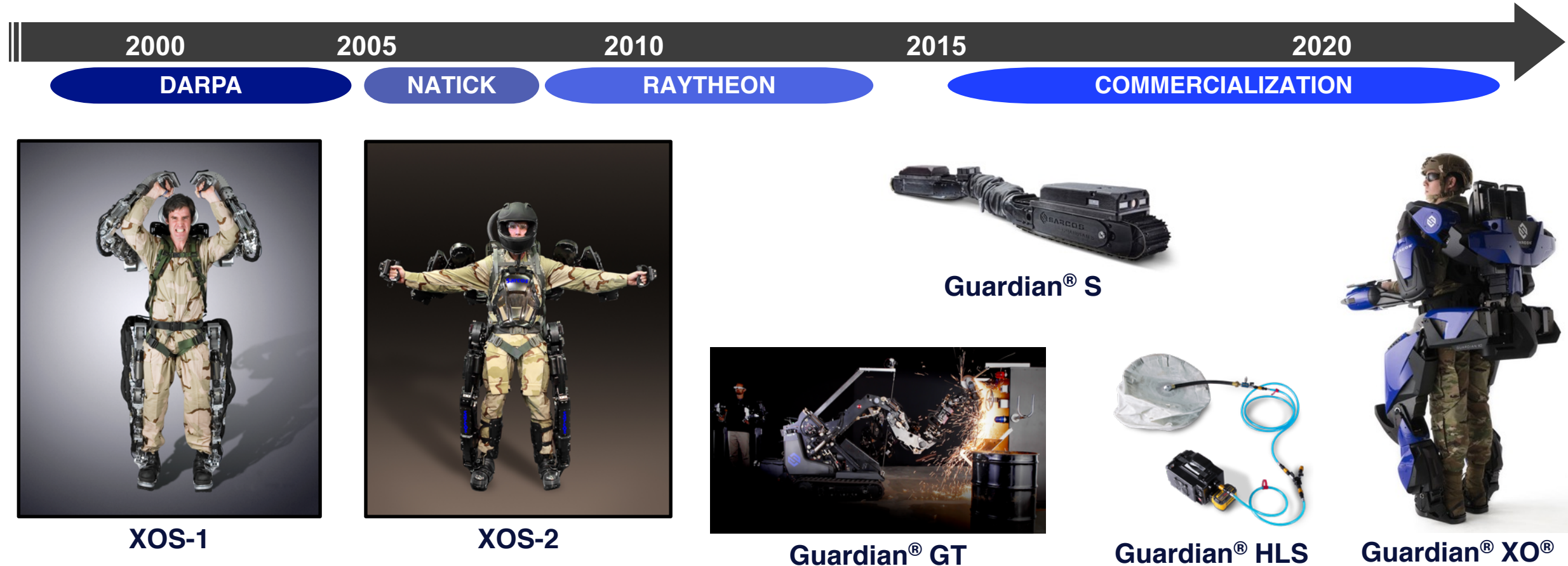
Warehouse
Operations

The Sarcos suite of dexterous robotic solutions can support DoD sustainment operations while underway, forward deployed, and in the yard by:

- Conducting maintenance in forward and unsupported locations
- Expediting battle damage repair
- Speeding up yard turnaround time
- Improving recruitment and retention by making maintenance jobs cool instead of boring and back-breaking
- Enhancing the high-tech competencies and skill sets of the DoD workforce

RETURN ON GOVERNMENT INVESTMENT

- More than 80 government and commercial customers have contributed to our **prolific research and design experience**.
- **Unmatched technical knowledge**, achieved through diverse investments, enable singular product development.
- Since its inception, **>\$300 million has been invested** to develop Sarcos technology.
- **More than 140 patents** have been granted that are relevant to core products.



THE COST OF MUSCULOSKELETAL INJURIES (MSKIs)

2,996

LOST WORKDAYS DUE TO INJURIES TO THE HEAD, BACK, AND ANKLES OF THE MILITARY'S AIRCRAFT MAINTENANCE CORPS

MILITARY TIMES, 2018

> 2 MILLION

ANNUAL NUMBER OF NONCOMBAT INJURIES AMONG ACTIVE COMPONENT SOLDIERS.

MILITARY MEDICINE, SEP-OCT 2020

4%

OF ACTIVE COMBAT SOLDIERS CANNOT DEPLOY AT ANY GIVEN TIME DUE TO MSKIs

MILITARY MEDICINE, SEP-OCT 2020

63%

of upper extremity injuries reported were in the shoulder, caused by overexertion while lifting or lowering¹

20 DAYS

median number of limited duty days taken by the mechanics due to injury²

90%

chance that a disability discharge within an enlisted soldiers' first year of service is caused by musculoskeletal injury³

EXISTING SOLUTIONS

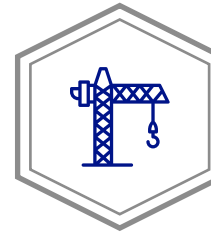
DON'T GET THE JOB DONE

Not suitable for tight spaces

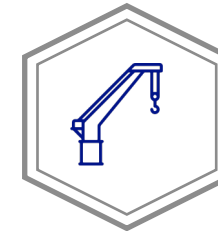
Require structured environments

Require specialized training or licensing

Are perceived as boring and back-breaking instead of the cool tech of the future



Overhead Crane



Fixed Lift Assist



Portable Crane



Forklift

GUARDIAN® XO®

Full-Body, Powered Exoskeleton

Augment Strength &
Endurance

Reduce Injuries

Optimize Productivity



BENEFITS

- Multiples of productivity:
1 person + 1 XO = 3+ workers
- Extend useful life of workers
- Opens aperture of worker pool

FEATURES

- Lift and dexterously manipulate up to 200 lb (90 kg)
- Near-continuous operation with hot-swappable batteries
- Capable of 100% load relief
- < 30 seconds to don and doff



Transport and
Active Rigging



Manufacturing



Logistics



Energy and
Utilities



Automotive



Aerospace



Construction

APPROACH

INTUITIVE CONTROLS

- Easy to Use
- Integrated Feedback



Modelled after human movement



Designed with human body ratio

HUMAN-LIKE DEXTERITY

- Versatile
- Adaptable



Requires human ability to operate in complex, unstructured terrain



Augments with robotic strength, stamina, precision and speed

AUTONOMOUS POWER

- All-Day Use
- Weightless



Reduced power consumption from 6,800 to 500 watts



Capable of supporting 100% of load



BACK SHOP SUPPORT

Maintenance, cleaning,
and inventory of
equipment and parts

HANGAR AND FLIGHT LINE MAINTENANCE

- Material handling (parts, pylons, pods, tool kits, and weapons)
- Pushing/pulling support carts
- Torquing tasks (all platforms)





SUPPLY & MUNITIONS SUPPORT

- Material handling
- Pre-assembly parts sequencing
- Munitions transport

ANY BASE, ANY PLACE

GUARDIAN® DX – TELEOPERATED ROBOTIC SYSTEM

Challenges



More support required



Cost of equipment



Worker fatigue & injury



Hazardous conditions

Features

- Lift and manipulate up to 200 lb (typical laborer can lift 40 lb)
- HD immersive experience
- Force feedback to control precision and use off-the-shelf tools
- Can mount to a variety of mobile and telescoping bases
- Indoor and outdoor use

Benefits

- Optimize productivity for precise tasks in dangerous environments
- Reduce at-height and overhead fatigue, injury & exposure to hazardous conditions
- Mitigate risks and associated costs





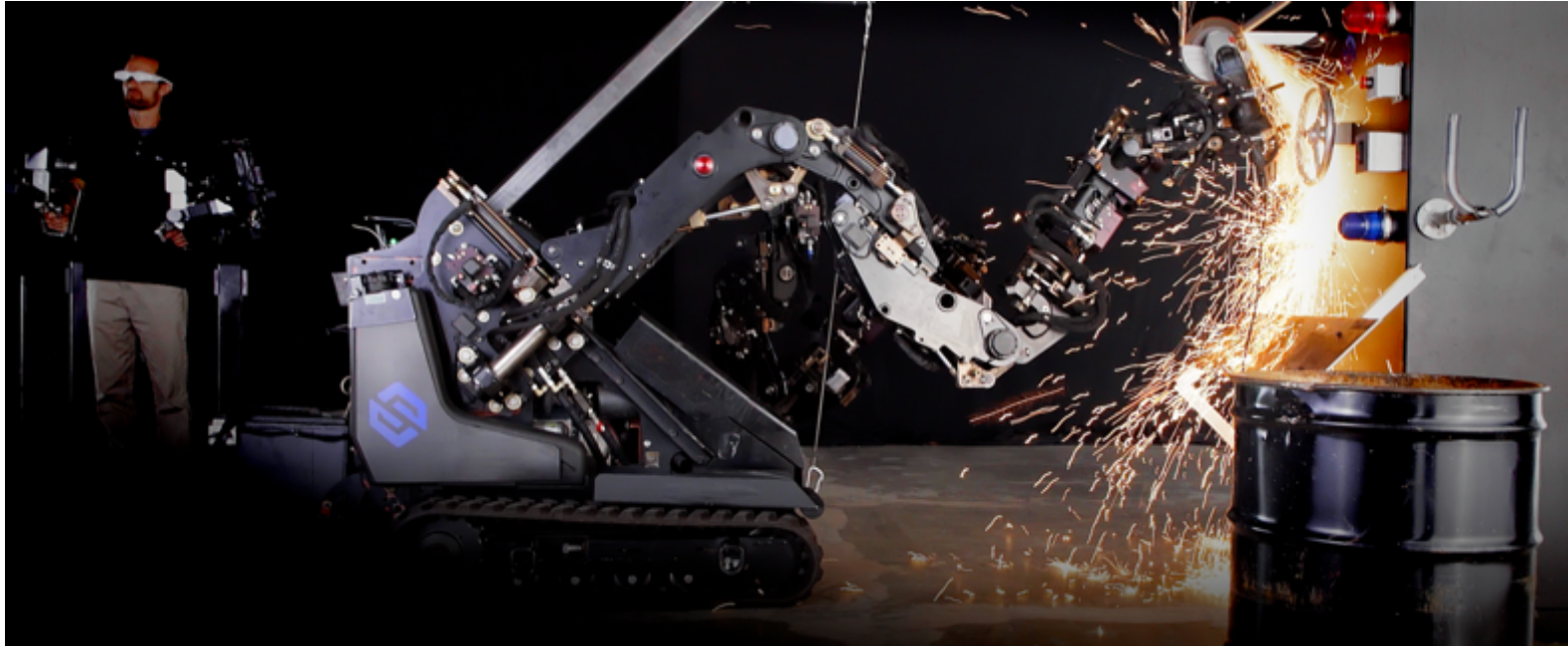
GUARDIAN® XT

APPLICATIONS

- Non-destructive test & asset inspections
- Overhead and at-height tasks
- Use of high impact power tools welding, riveting, chainsaw
- Live wire repair
- Steam pipe repair

GUARDIAN® GT

Unparalleled Combination of Dexterity & Strength



USES

- Fabricate, weld, grind
- Safe structure demolition
- Assemble and join
- Palletize and depalletize

FEATURES

- 7 ft arms lift 1,000 lb
- High-fidelity force feedback
- Can use off-the-shelf tools
- Remote or local operation

SEE IT IN ACTION

<https://www.sarcos.com/products/guardian-gt/>



Construction



Manufacturing



Nuclear/Hydro



Disaster Recovery



Maritime



Heavy Equipment

OCONUS BATTLE DAMAGE REPAIR / MAINTENANCE IN FORWARD LOCATIONS

EOD

- Render hazardous, explosive devices safe
- Evacuate and relocate hazardous materials and munitions
- Disable or safely detonate, with operator out of harm's way
- Manage vehicle-borne IEDs or larger ordinance

DISASTER RECOVERY

- Build and repair structure and equipment
- Erect temporary storage structures
- Aid in safe structure demolition and removal
- Repair machinery and exchange parts

LOGISTICS

- Transport and redeploy materials
- Palletize and de-palletize; loads and unloads supplies
- Handle unmanageable materials in challenging terrain
- Move heavy rocks and debris in a controlled manner



GUARDIAN® S

Modular Sensor-based Inspection Platform



USES

Industrial inspections
Confined spaces
Infrastructure
Non-destructive testing
Surveillance

FEATURES

- IP65
- ~3 miles travel or 12 h surveillance
- ~17 lb + accessories
- Cloud-based services



Construction



Oil & Gas



Power
Generation



Aviation



DHS
Border Patrol



Public Safety



Hazmat

ROBOTIC INSPECTION: A PART OF YOUR O&M TOOLKIT

Remote Visual Inspection
Robots provide a
complement to other
inspection tools

WHEN-YOU-NEED-IT INSPECTIONS

- Quick deployment
- Urgent and emergent situations; incurring downtime, potential hazards

ADVANCED MANEUVERABILITY & EXTENDED RUN TIMES

- ~3 miles travel or 12 hours surveillance
- Traverses stairs, pipes, tanks, culverts, and vertical ferromagnetic surfaces
- Able to access confined spaces with 7" diameter openings

BEYOND VISUAL LINE-OF-SIGHT

- Camera feeds, pitch & roll indicators, and robot avatar on OCU increases situational awareness
- Camera capabilities / stability



GUARDIAN[®] HLS FIELD APPLICATIONS

POWERFUL LIFTS WHEN TIMING IS CRITICAL



USES

- Emergency response and rescue
- Vehicle recovery and repairs
- Routine maintenance in uncertain or unstructured terrain
- Structure collapse and extrication
- Combat search and rescue

FEATURES

- Single-piston, pneumatic 60 psi compressor lifts up to 22,500 lb per bag
- Made of durable Dyneema[®] fiber for superior strength and an 18 inch lift
- Lightweight, portable, and reusable
- Common battery; interchangeable with fielded tools



Logistics and
Warehousing



Military



Towing



Disaster Recovery



Public Safety

AWARD WINNING PRODUCTS

Guardian® XO®

Time Magazine 2020

Best Inventions of 2020, Productivity

Fast Company 2020

Finalist: Innovation by Design

Nat'l Center for Mfg. Sciences 2020

Winner: Commercial Technologies for Maintenance Activities Technology Competition

Digital Trends 2020

Top Emerging Technology

PCmag.com 2020

Best Robot of CES

Wired 2020

Smartest Technology on Show Floor

Venture Beat 2020

Best Idea & Product of CES

Time Magazine 2010

50 Best Inventions, Military

Material Handling 24/7 2020

Readers Choice: Product of the Year



Guardian® GT

Frost & Sullivan 2018

Best Practices in Tech: Dexterous Mobile Robotics

IEEE Robotics 2018

Robot of the Week

Popular Science 2018

Best of What's New: 100 Most Incredible and Innovative Technologies



Guardian® S

IEEE Robotics 2019

Product Innovation & Robot of the Week

TechConnect Defense 2018

Innovation: Warfighter & National Security

Fast Company 2017

Honorable Mention: Innovation by Design

Best in Business Awards 2017

Gold: Most Innovative Product of the Year



Sarcos

Frost & Sullivan 2020

Dexterous Robots & Exoskeletons Company of the Year

Robotics Business Review 2019

Top 50 Robotics Companies



THANK YOU



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