

MOOG

Shaping the way our world moves.

Moog Inc. Introduction

At Moog, We Are...

Three major business units



Aircraft Controls

FY22 sales \$1.2 billion



Industrial Systems

FY22 sales \$909 million



Space and Defense Controls

FY22 sales \$770 million

1951

Moog established

Over **14,000**

employees

Over **25**

countries with operations

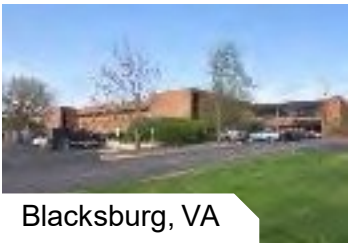
7,000

engineers with a pioneering and enabling culture

\$2.9 billion USD

2022 revenue

Major Design and Manufacturing Facilities



Blacksburg, VA



China



Australia



Italy



UK



India (E-City)



Corporate Offices, Elma, NY



Japan



Canada



Ireland



Baguio



Korea



Germany



Aircraft Controls



Space and Defense Controls



Industrial Systems

Typical Aircraft Flight Control System

“Stick to Tail” Control Systems

- Flight control computer & SW
- Actuation
- Control electronics

Moog Responsibilities

- Design
- Manufacturing
- Qualification and Testing
- Certification
- Aftermarket support



Typical Aircraft Flight Control System

100

Major programs

5

Years in development

50

Active programs

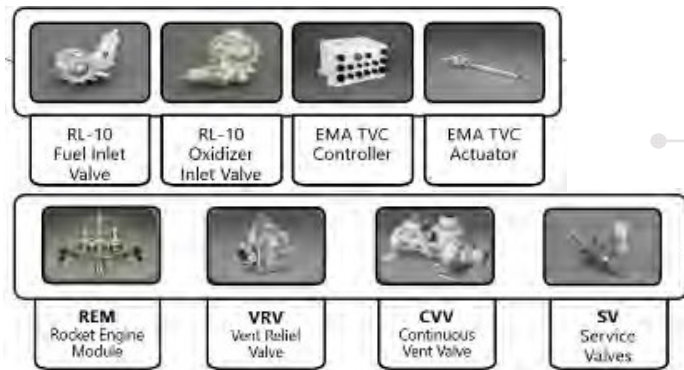
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Years in production and aftermarket support

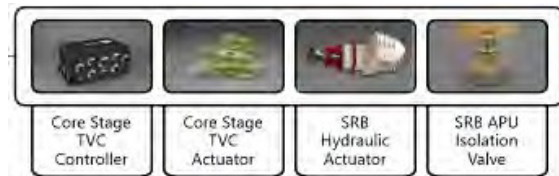


Typical Launch Vehicle Control System

Exploration stage actuation and electronics



Core stage and solid rocket booster Actuation and electronics



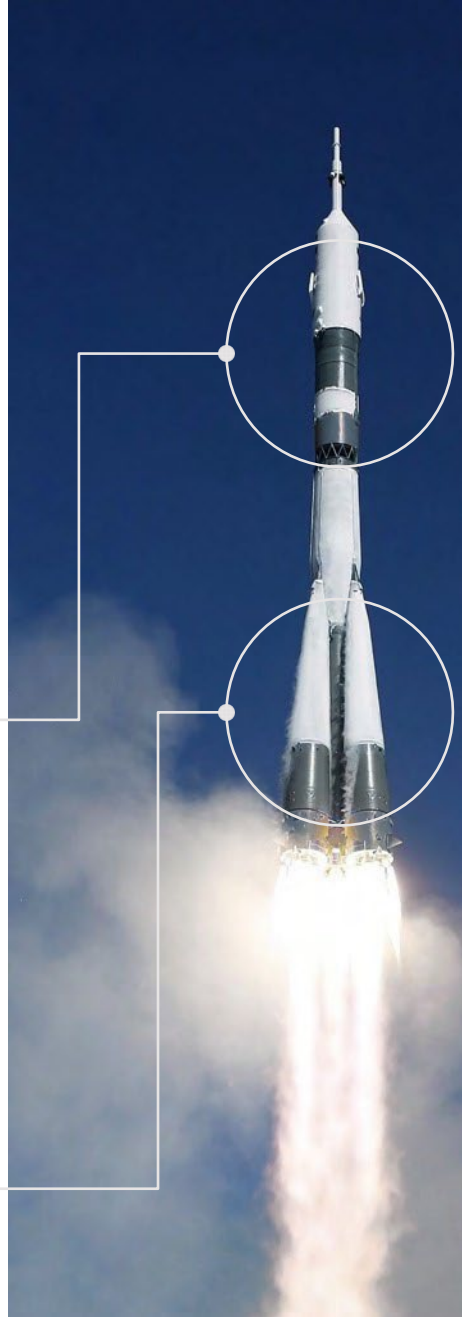
Every planet in our solar system.
Every civil, commercial, and national space mission.
Since the inception of spaceflight.

60 years

Spaceflight heritage

1X/week











Average number of Moog hardware launches into space



Industrial Electric And Hydraulic Products

Presenter Notes
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Moog electric products are brand labeled by some of the biggest electric distributors world-wide. Huge knowledge cross many industries. Bring that pedigree to bare at the component, system and solution level.

Electro-hydrostatic	Electro-mechanical	Electro-hydraulic	Motion control	Power and data
 <p>Electro-hydrostatic Pump Unit (EPU)</p>	 <p>Servo Motors</p>	 <p>Servo and Proportional Valves</p>	 <p>Servo Drives and Controllers</p>	 <p>Standard and Customized Slip Rings</p>
 <p>Electro-hydrostatic Activation Systems (EAS)</p>	 <p>Ball and Roller Screws</p>  <p>Electro-mechanical Actuators</p>	 <p>Radial Piston Pumps (RKP)</p>  <p>Cartridges and Servo-cartridges</p>		

Motion Control Products

Over 2,000,000
electric motors, drives,
actuators and controllers
per year.

Why Construction?

Make a big impact supporting OEMs
and construction companies

Where high tech meets heavy metal.
Bring aerospace technology to the
construction world but obviously for
affordable prices





Zero-emission And Productivity Gains

Presenter Notes
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These are global trends that are well recognized by most
Sustainability – Cost and impact of fossil fuels, regulatory, social responsibility

Since 1987, output per hour for workers in the manufacturing sector has increased by over 2.5 times.

250%

Safety

Changing Ecosystem

Automation

Retrofitting digital

Labor

Financial Performance

Zero Emission

TCO

OpEx

Productivity

New Technology

CapEx

**Strategic
Decisions!**

Regulations

New Products

Connectivity

Autonomous

Sustainability

New Suppliers

Strategic Decisions

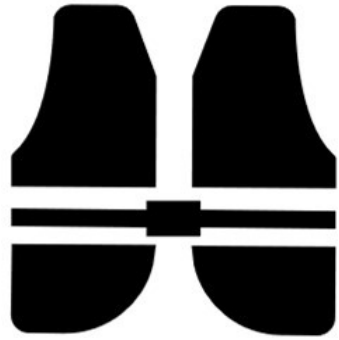




Macro Trends

Presenter Notes
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These are global trends that are well recognized by most
 Sustainability – Cost and impact of fossil fuels, regulatory, social responsibility
 Since 1987, output per hour for workers in the manufacturing sector has increased by over 2.5 times.
 250%



Safety



Shortage of qualified labor



Increasing Productivity



Sustainability

Global trends of Construction and Mobile Machinery

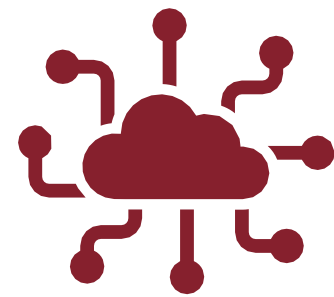




Future of Construction Technology

Presenter Notes
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Advisors have driven us to have our own point of view on the future, and then determine what we will do to enable this future or address gaps
Robots – working in and around humans (like manufacturing). Robots only is far away. Humans could work in (augmentation), teleoperate, or manage fleet
Digital – Data becomes very powerful and valuable (lots of industry examples)
Existing value chain is calling upon Moog as they lack capability and experience bringing these solutions forward



Zero-Emission

Connected

Digital

Automated

Equipment & Infrastructure

People, Machines, Material

Data Driven Decision Making & AI Insights

Robots Interacting with Humans

Enabling “NEXT” Generation Machines and Construction Productivity

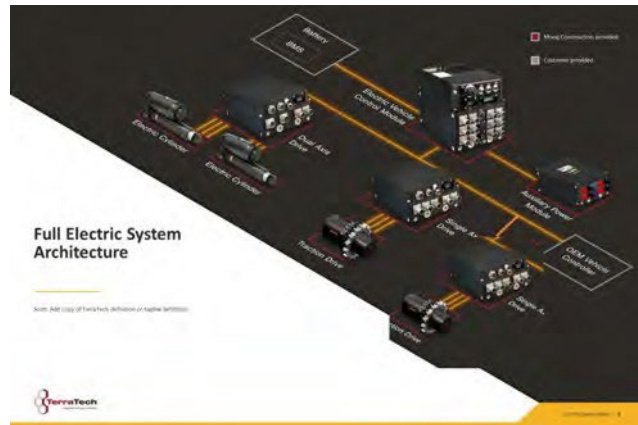


Future of Construction Technology



Next gen. full electric vehicles

- Increasing energy efficiency
- Increasing controllability
- Data



Automation and autonomous vehicle

- Autonomous navigation
- Tele-operation
- Automated trenching, digging



Converting existing diesel fleet to electric:

- Stricter regulations
- Vehicle Lifespan: 10-15 years



Zero Emissions Machines Are A Reality Today



Track Loader

All-Electric System

- ✓ First all-electric track loader
- ✓ Performance meets or exceeds diesel hydraulic version
- ✓ Software features and digital insights



Wheel Loader

All-Electric System

- ✓ Prototype delivered in 6 months
- ✓ Performance meets or exceeds diesel hydraulic version
- ✓ Software features and digital insights



Backhoe loader

Zero emission
Electrohydraulic system

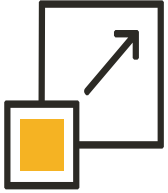
- ✓ First zero emission electric backhoe made
- ✓ In low volume production in US

Electrification



**Integrated
Intelligence
in Motion**

Value of TerraTech



Scalable

One solution that fits across all your machine sizes and types.



Standardization

- Economies of scale
- Lower lead times
- Less Inventory



Modular

Designed to be standardized for all machines.



Reusability

Interconnected and reusable hardware and software.



Configurable

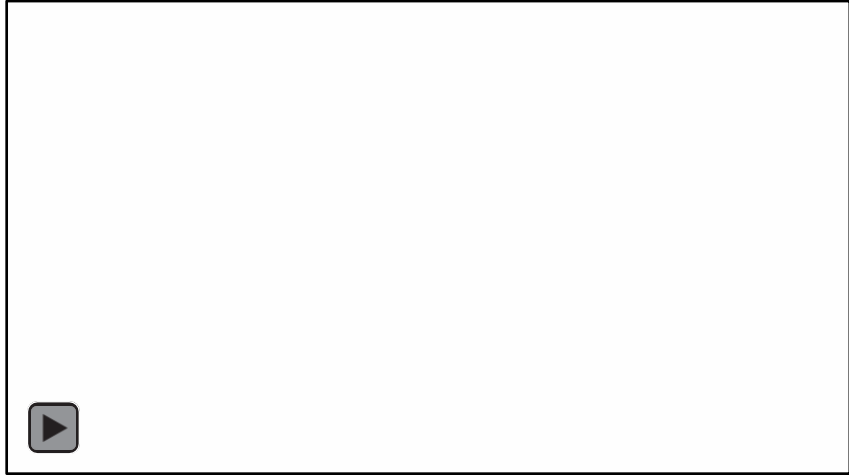
Common Software and hardware that across all machines



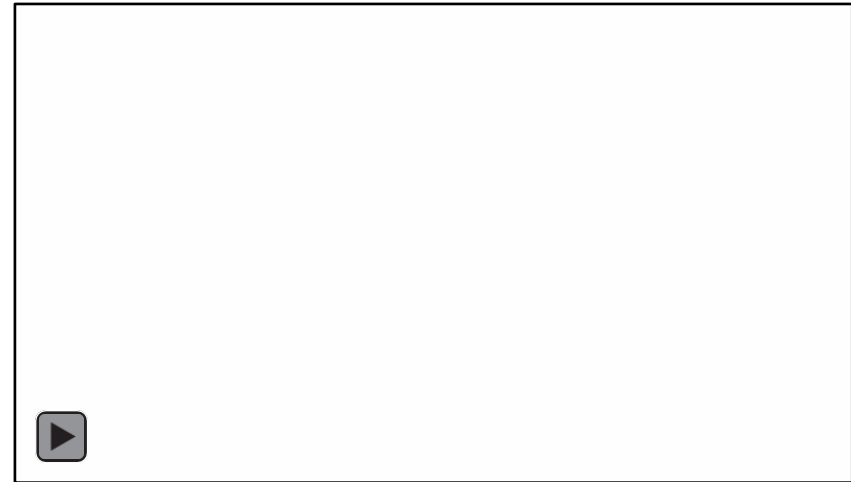
Improved Financial

Lower development cost, faster to market, better ROI.

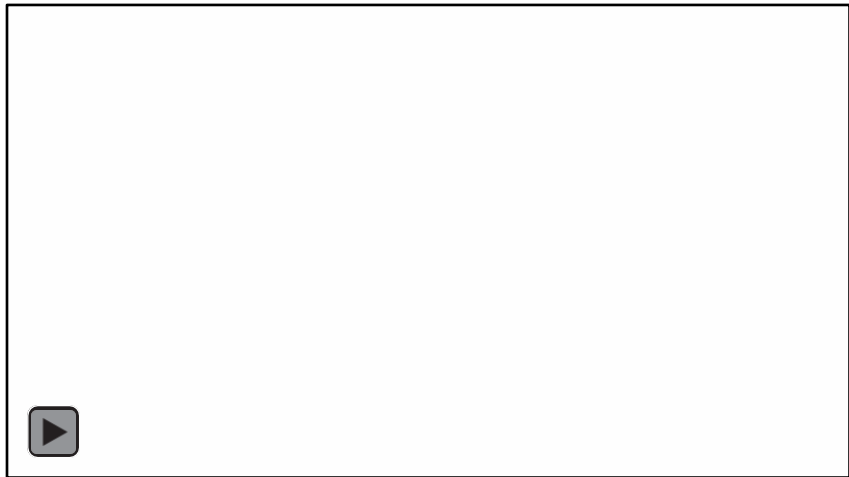
Automation & Autonomy



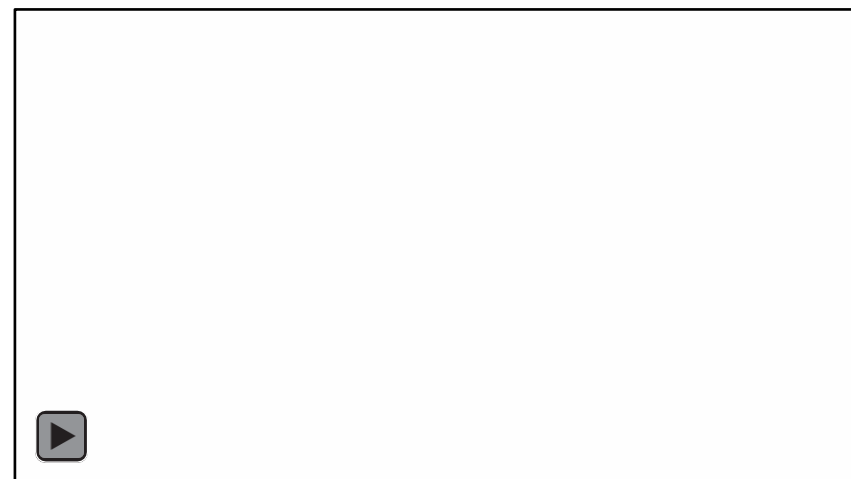
Object detection / avoidance



Intuitive remote control



Intuitive machine control



Automated tasks



CrewMate Solar Automation

Presenter Notes
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Add zero safety at the end and emphasize it.
None of the above matters if safety is a major concern

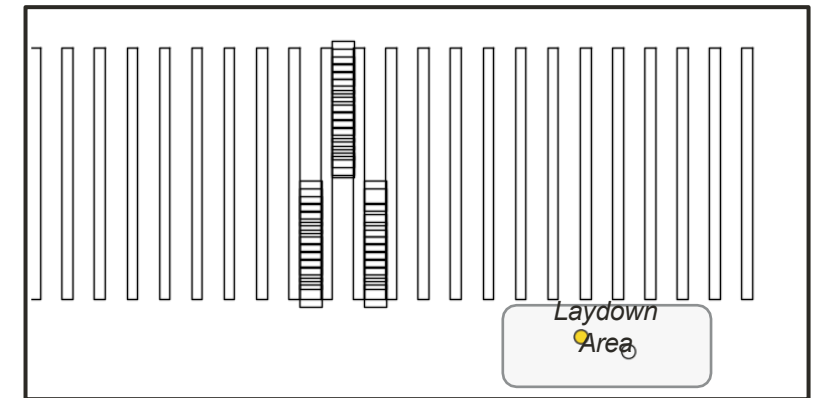
Autonomous just-in-time delivery

Site Automation Solution

- Transitioned a 3 stage process to a 1 stage process with automation of dull part of the job

Value created through

- Reduced labor hours to install panels
- Shortened schedule
- Less module breakage





Retrofit Zero Emission Vehicles

Goal

Convert diesel machines to zero-emissions:

- Fast and easy conversion
- High performance system
- Run-time and serviceability

ZQUIP solution

- Modular
- High voltage system
- Integrated batteries, motors, and electronics
- Swappable system, can be replaced on field

ZQUIP upgrades can be completed in just a few days, at a customer's site, and require minimal changes to the rest of the machine.



Total Cost Of Ownership And The Economics Of Alternative Energy Equipment



Six Variables Used To Calculate ROI



Return



Reduced labor cost



Increased throughput



Total Cost of Ownership



Increase in Quality



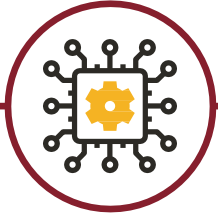
Reduced worker injuries



Increased uptime

Financial Influencers

Advancing Technology



- Energy source
- Machine controllability
- Data Analysis
- Autonomy
- Tele-operation
- Automation
-

Targeted Applications



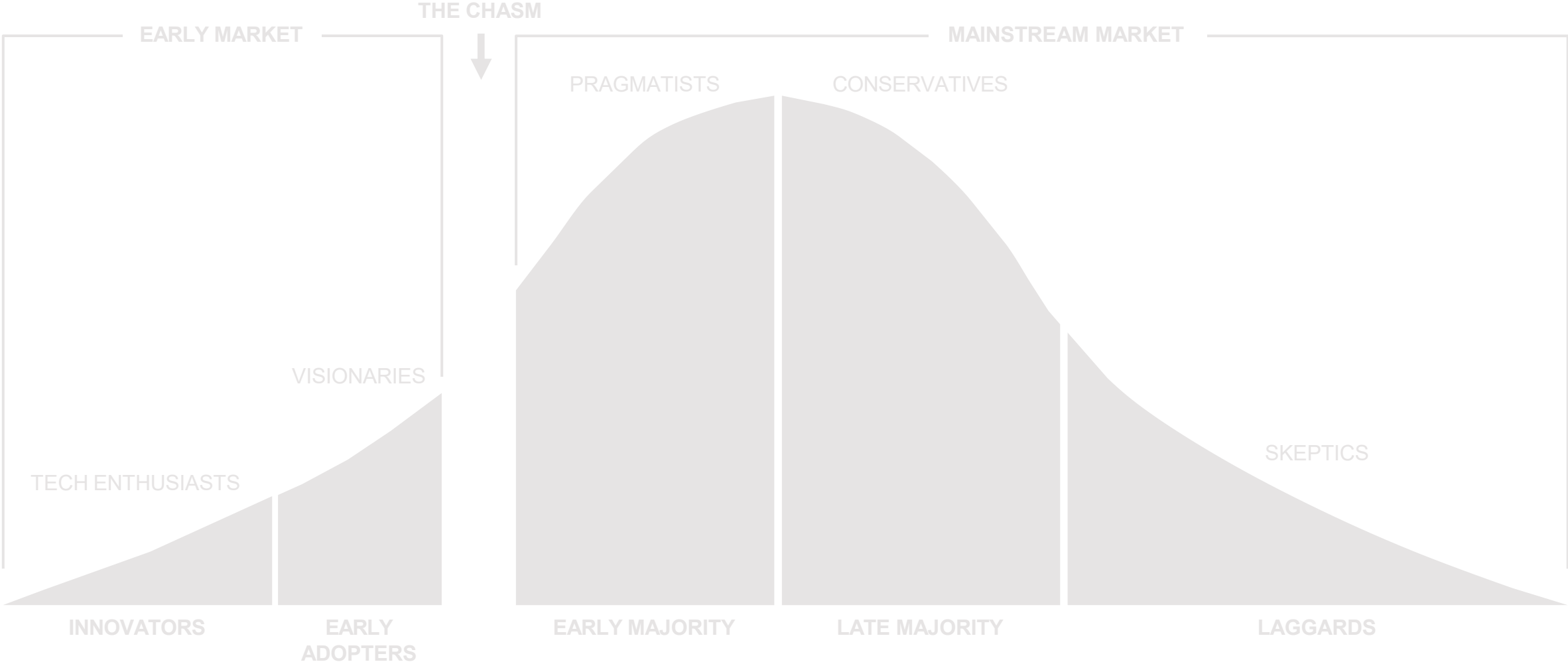
- Precision trenching
- Customized pick and place
- Stacking and sorting
- Autonomous grading
- Material movement
- Hauling
- Dirt removal
-

Return on Investment

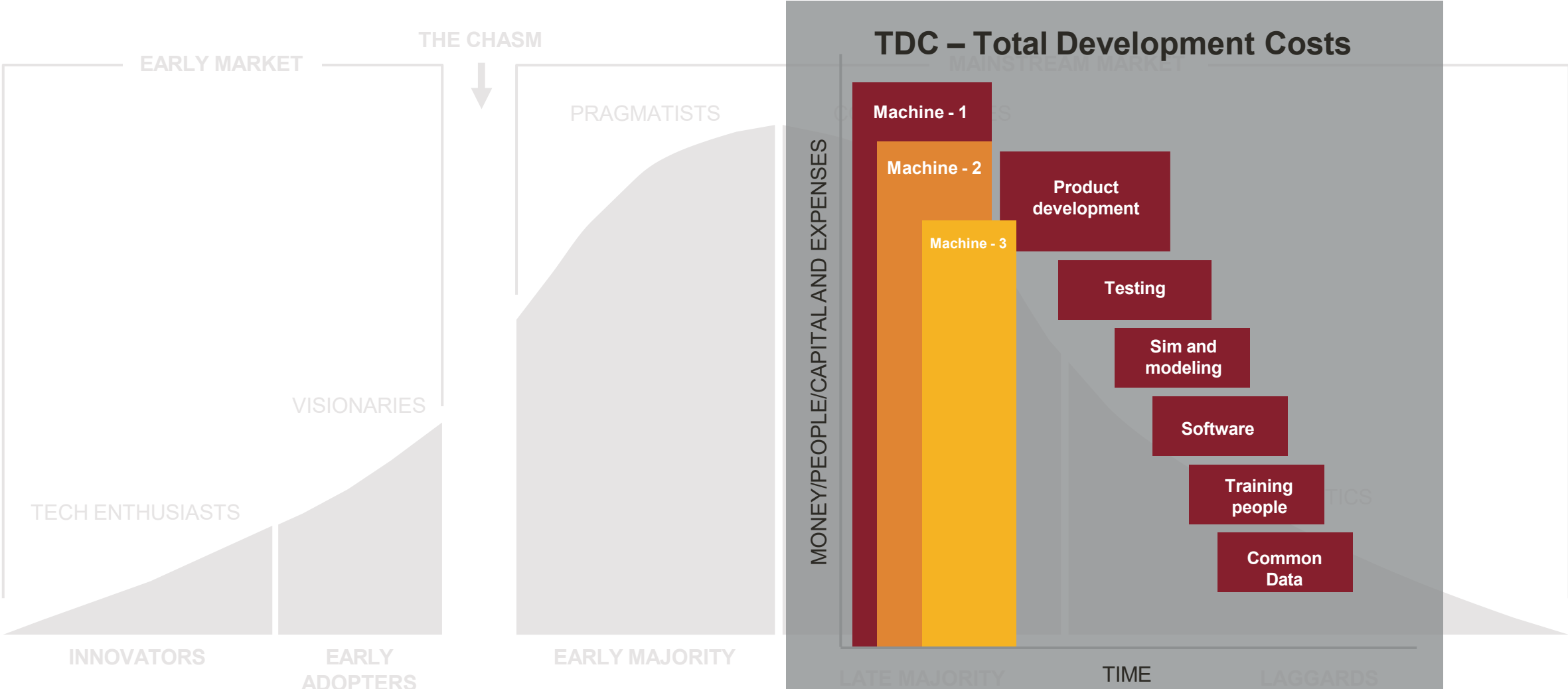


- Increased throughput
- Shorter production runs
- Automated changeover
- Increased Work Safety
- Retraining and upskilling workforce
- Measurable cost savings
- Consistent quality
- Less product damage
- Improve up-time

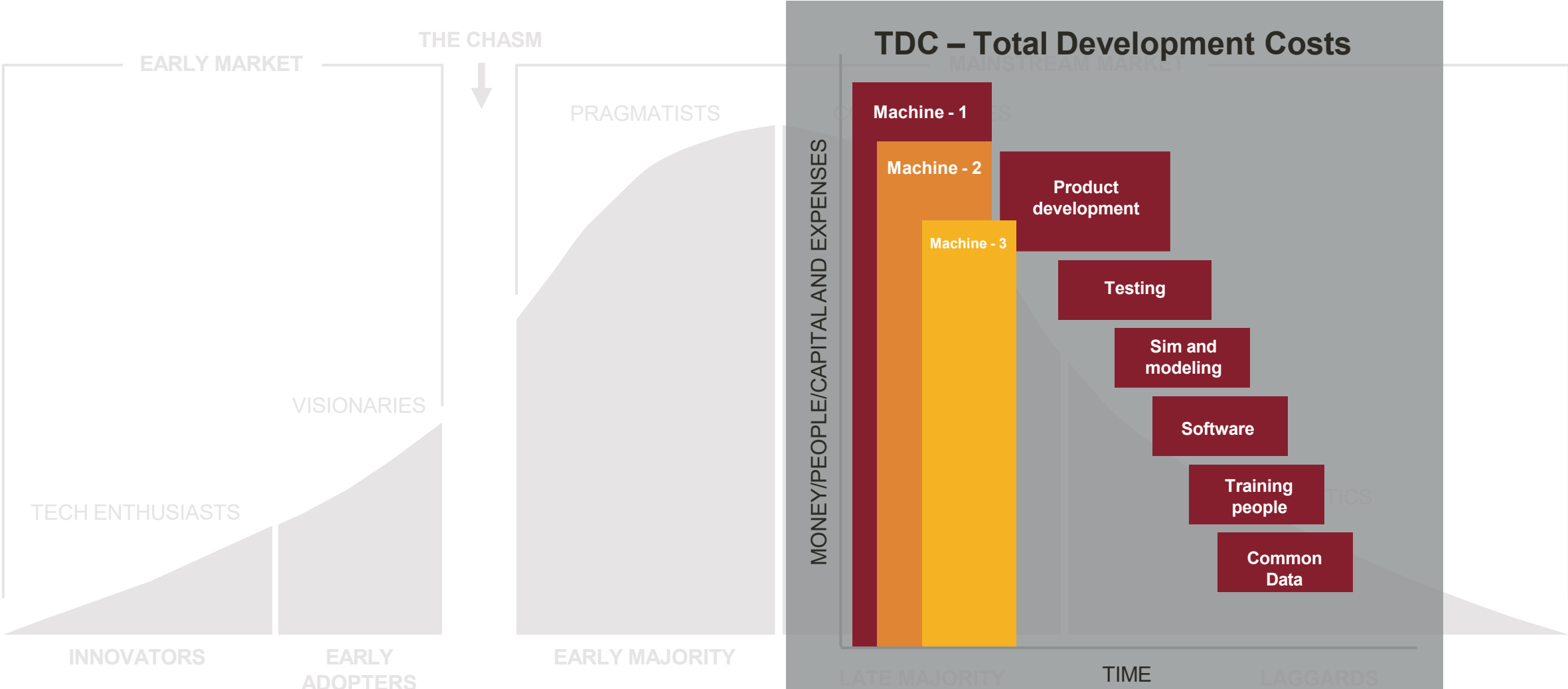
Total Development Costs



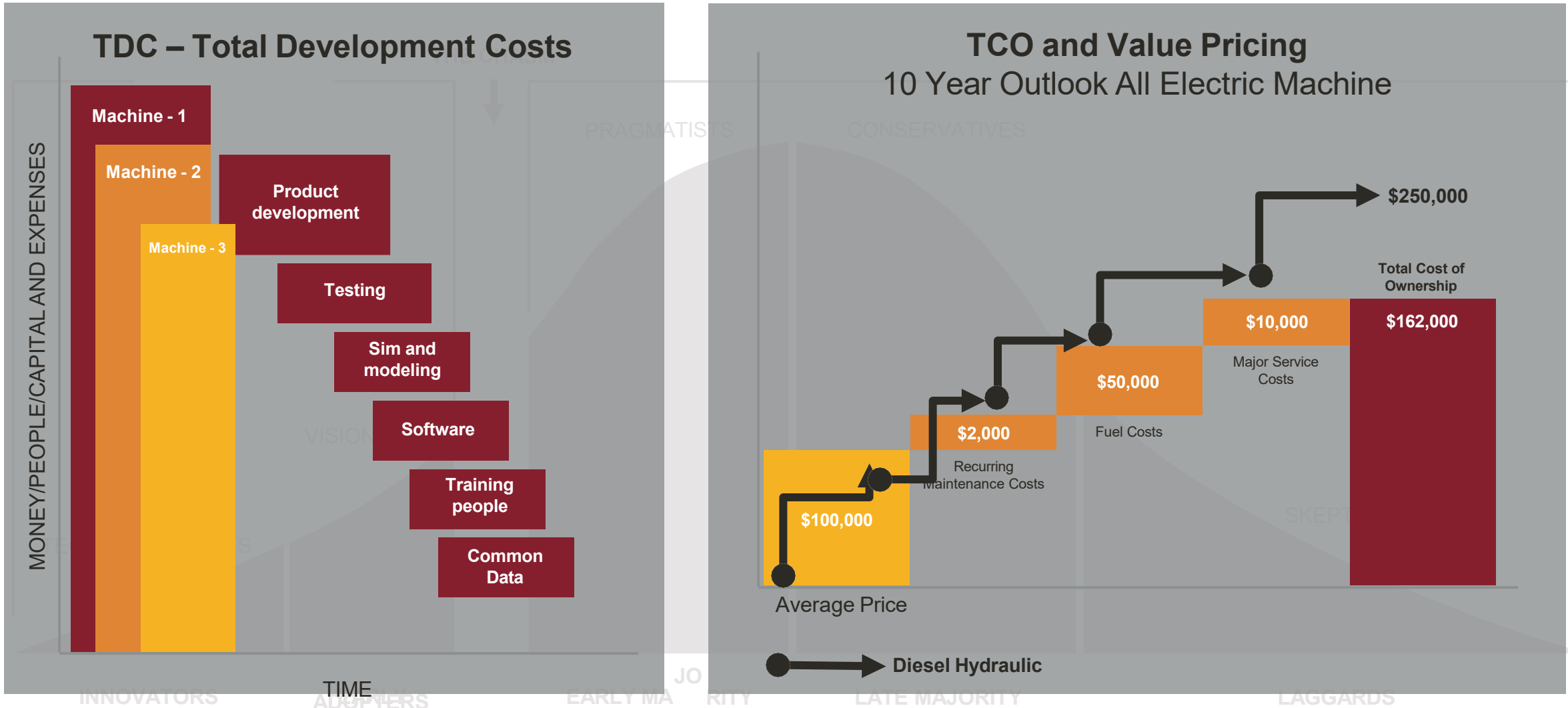
Total Development Costs



Total Development Costs



Total Cost of Ownership



Thank You

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