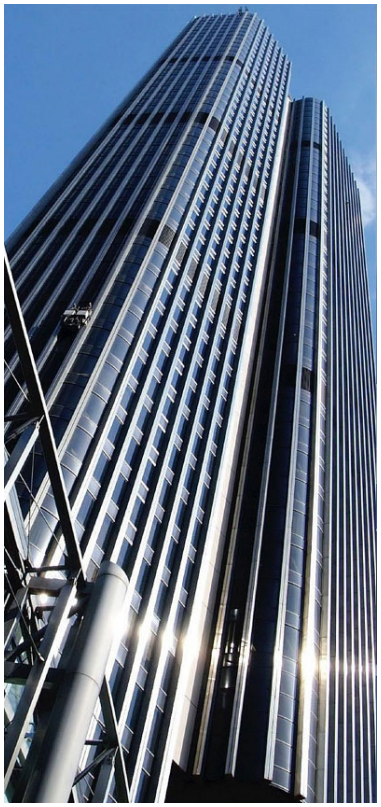
United Technologies
Research Center
IWES 2018
Presented by
Giacomo Gentile
Group Lead, Embedded Technologies
September 13, 2018
Be Curious SM

Providing high technology systems and services
to the aerospace and building industries.

United Technologies

Our business units

"UTRC is where you bring your toughest problems."



UTC Aerospace Systems

United Technologies
Climate | Controls | Security

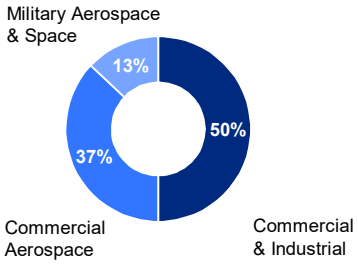
Pratt & Whitney
A United Technologies Company

Otis
A United Technologies Company

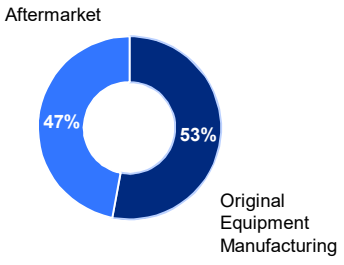
$60B
2017 UTC Sales

$3.9B
invested in R&D

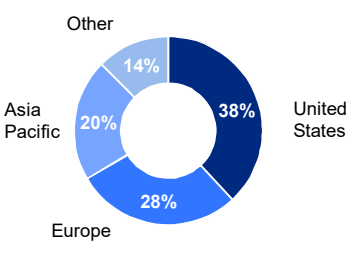
END MARKETS



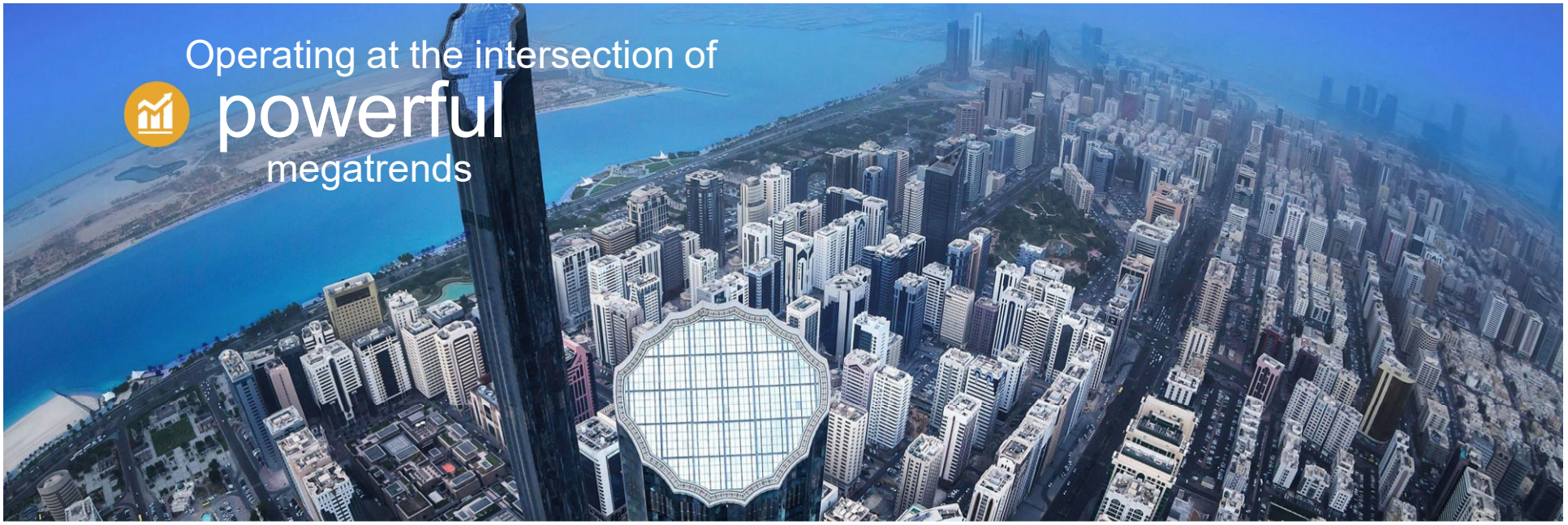
SALES BY TYPE



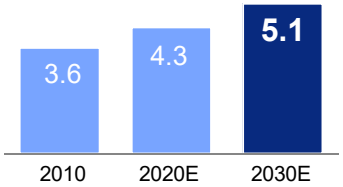
SALES BY GEOGRAPHY



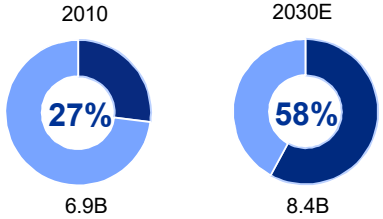
United Technologies



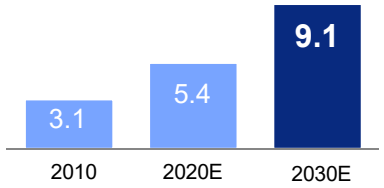
Growing urban population
(billions)



Expanding global middle class
(share of population)



Increasing demand for air travel
(revenue passenger miles in trillions)



United Technologies

Academic
advancement

UTC EMPLOYEE SCHOLAR PROGRAM

"...employees across 50 countries have earned more than 38,000 college degrees. In total, UTC has invested more than $1.2 billion. We consider it one of our most important investments."

– Greg Hayes,
UTC Chairman and CEO

United Technologies

UTRC's

vision & values

We ensure UTC's technological advantage in the market and solve the toughest scientific challenges for our business unit customers.

UTRC is UTC's

innovation engine

Defining what's next:

Define new frontiers

Co-develop new technologies

Solve tough problems

Serve as hub for technical interchange

Leverage global network of innovation

United Technologies Research Center

A global presence

Cork, Ireland

Established in 2010, focuses on energy, security and aerospace systems

Shanghai, China

Established in 1997, focuses on integrated buildings, fluid and mechanical systems

Berkeley, CA

Established in 2009, focuses on cyber physical systems and embedded intelligence

East Hartford, CT

Founded in 1929, focuses on a broad range of system engineering, thermal, fluid, material, and informational sciences

Rome, Italy

Joined UTC in 2012, focuses on model-based design and embedded systems engineering

People with

knowledge & perspective

89%

Advanced Degrees

68%

Doctorate

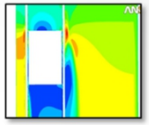
16%

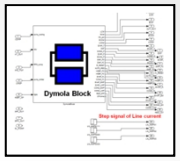
Masters

United Technologies Research Center

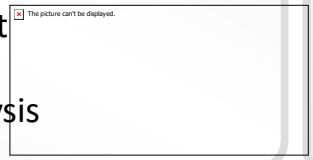
UTRC Italy (ALES) Capabilities and

System, Controls & Optimization

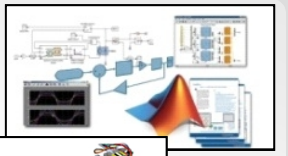


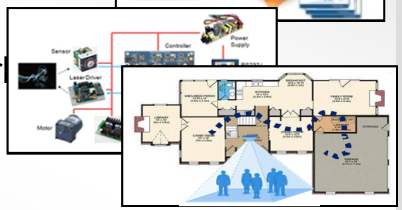


- System modeling
- Safety
- Model-based control design
- System performance assessment
- Optimization-based control
- Hybrid system reachability analysis
- ARP4754A, ISO26262, IEC 6158



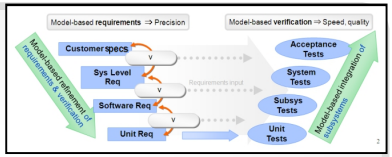
Embedded Intelligence

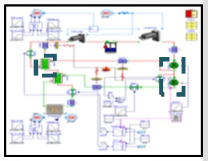




- Cyber-Physical Systems
- AI & Robot technology
- Embedded systems & Networ
- Security
- Mixed-Criticality Sys.
- Internet-of-Things tech.
- Simulation Technology (FMI)
- Model-based design: SysML, Modelica, Simulink

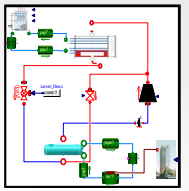
Formal Methods





- Requirements Analysis
- Automatic Test Generation
- Model Checking
- Safety & Security Formal Methods
- SAT & SMT Technologies
- Contract based methodology
- DO333, DO331, DO178C

Software Technologies



- Ontology technology
- Software engineering: UML
- Agile development
- Eclipse, EMF, MDA technologies
- Cloud computing
- Advanced scientific computing tool development

This page contains no technical data subject to the EAR or the ITAR.

Our leadership

David Parekh
Corporate Vice President, Research, and Director, UTRC

Isaac Cohen
Executive Director, Research Operations

John Milton-Benoit
Manufacturing & Service Technologies Program

Jodi Vecchiarelli
Physical Sciences Department

Gary Linsey
Business Development

Orlando Ferrante (interim)
ALES (Italy)

Mark Thompson
Otis Program

Paul Van Slooten
Thermal & Fluid Sciences Department

Stephanie Duvall
Communications

Ellen Sun
UTRC China

Catalin Fotache
Pratt & Whitney Program

Andrzej Banaszuk
Systems Department

Russell Chaput
Human Resources

Raymond Foley (interim)
UTRC Ireland

Steve Tongue
UTC Aerospace Systems Program

Phil Podgorski
Finance

Craig Walker
UTC Climate, Controls & Security Program

Greg Stephenson
Law

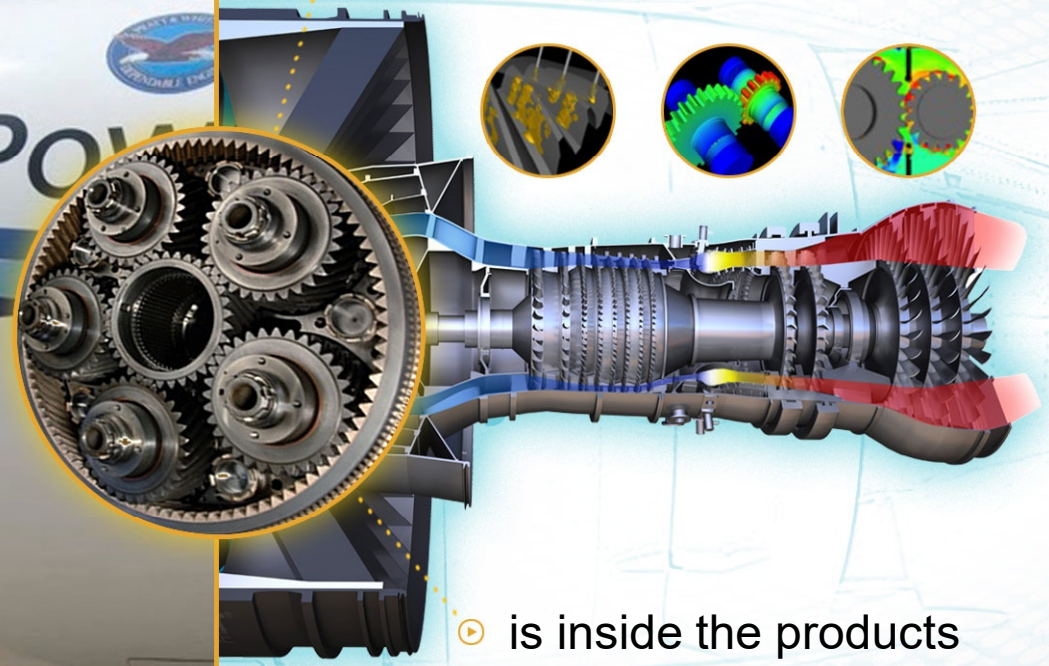
Senior Fellows

Vlado Blasko

Sergei Burlatsky

Om Sharma

Our technology

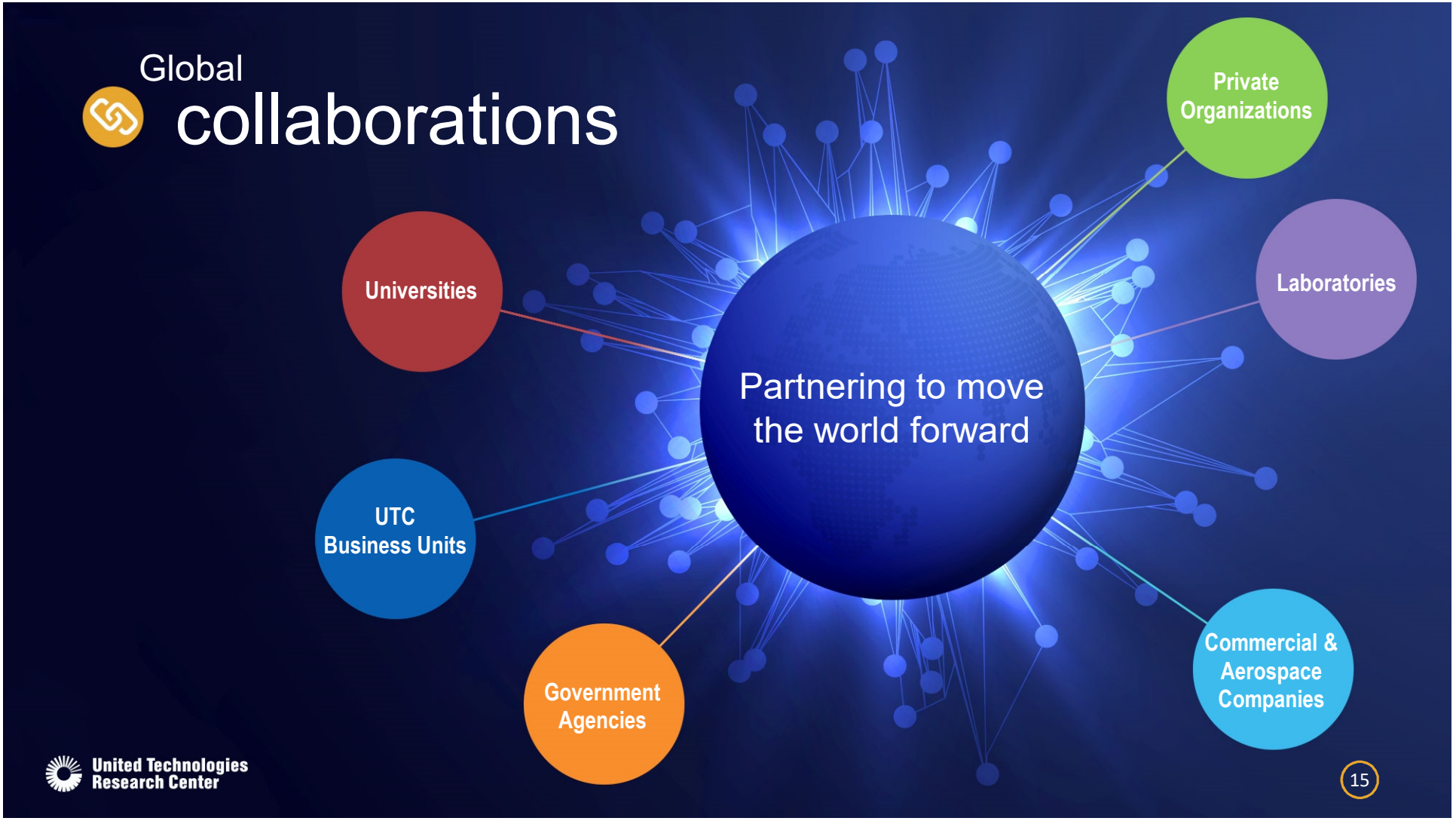


- is inside the products that move you

Defining the cutting edge

- Advanced Manufacturing
- Aerodynamics & Acoustics
- Applied Mechanics
- Autonomy & Controls
- Combustion
- Cyber Physical Security
- Data Science
- Embedded Intelligence
- Materials
- Networks & Communications
- Power Electronics
- Thermal Management

Global collaborations



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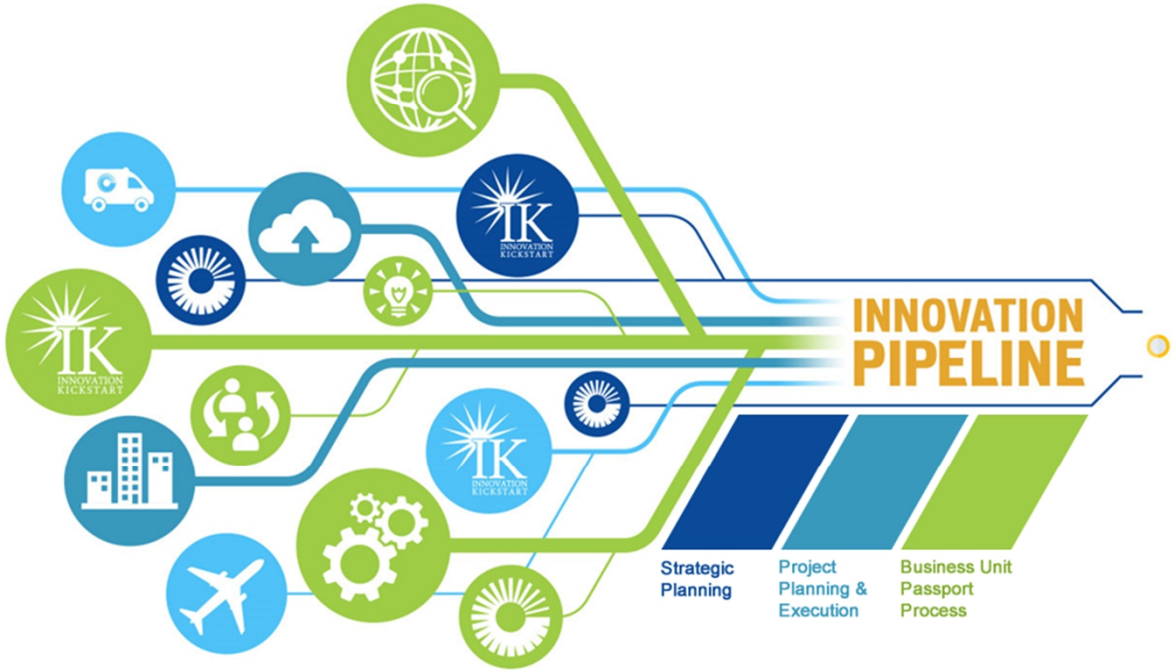
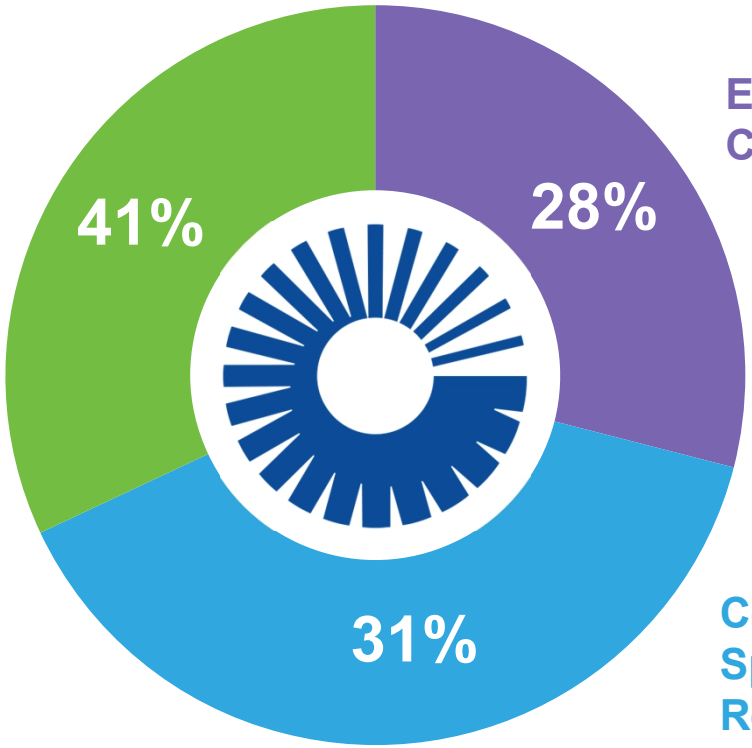
Continuous innovation



United Technologies Research Center

How we're funded



Physical Sciences

– Advanced Materials
– Applied Physics
– Environmental Science
– Materials Chemistry
– Measurement Science
– Solid Mechanics
– Surface Mechanics

Systems

– Advanced Laboratory for Embedded Systems
– Control Systems
– Cyber-Physical Systems
– Decision Support & Machine Intelligence
– Electromagnetics & Networks
– Power Electronics
– Software Systems
– System Dynamics & Optimization

Thermal & Fluid Sciences

– Acoustics
– Aerodynamics
– Aero-Thermal Testing
– Combustion Science
– Propulsion Technology
– Thermo-Fluid Dynamics
– Thermal Management

Focused on

performance

Physical Sciences

Applied Physics
- Optical/chemical sensing
- Printed electronics
- Microfabrication

Solid Mechanics
- Structural analysis
- Material damage modeling

Surface Mechanics
- Process modeling
- Tribology
- Advanced manufacturing

Environmental Science
- Process development and scale-up
- Green and sustainable manufacturing
- Membranes and sensing

Measurement Science
- Material characterization
- Mechanical property testing
- Component forensic analysis
- Inspection technique development

Advanced Materials
- Materials for structures
- Coatings
- Additive manufacturing

Materials Chemistry
- Green surface protection technologies
- Electromechanical systems and sensors
- Material design and synthesis

Focused on performance

Systems

Advanced Laboratory for Embedded Systems

- Simulation of embedded systems and networks
- Synthesis and verification
- Formal methods
- Software technologies
- Analysis, control, and optimization

Control Systems

- Multi-variable controls
- Robust controls
- Optimization-based controls
- Adaptive controls
- State estimation and navigation

Cyber-Physical Systems

- Intelligent systems and robotics
- Model-based development
- Validation and verification of complex systems

Decision Support & Machine Intelligence

- Machine learning, data mining
- Diagnostics, prognostics, PHM
- Sensor fusion
- Video analytics
- Human machine interaction

Electromagnetics & Networks

- Electromagnetics
- Communications, wireless
- Sensor networks
- Embedded processors

Power Electronics

- High density converters
- High temperature-high frequency devices
- Converter topologies
- High speed machines

Software Systems

- Software engineering and architectures
- Formal methods
- Cyber-physical systems security

System Dynamics & Optimization

- Uncertainty quantification
- Multi-scale system modeling
- Mathematics on graphs, computational mathematics
- Optimization

Focused on performance

Thermal & Fluid Sciences

Acoustics

- Aeroacoustics
- Structural Acoustics/Dynamics
- Noise and vibration diagnostics, modeling, and control

Aerodynamics

- Flow physics
- CFD Modeling
- Experimental aerodynamics
- Turbomachinery

Aero-Thermal Testing

- Component performance and operability
- Experimental model validation

Combustion Science

- Multi-phase reacting flows
- Material flammability
- Laser diagnostics

Propulsion Technology

- Experimental Combustion
- Combustor systems
- High speed propulsion systems

Thermo-Fluid Dynamics

- Thermodynamics
- Multi-phase Flow Heat Transfer
- Experimental Heat Transfer
- Thermal Dynamic Modeling

Thermal Management

- Heat transfer
- Multi-scale modeling
- Thermal system optimization

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Research Center
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