



NOVEMBER 2022

## R&D@ABB

Industrial transformation's new imperative, digitalization and sustainability

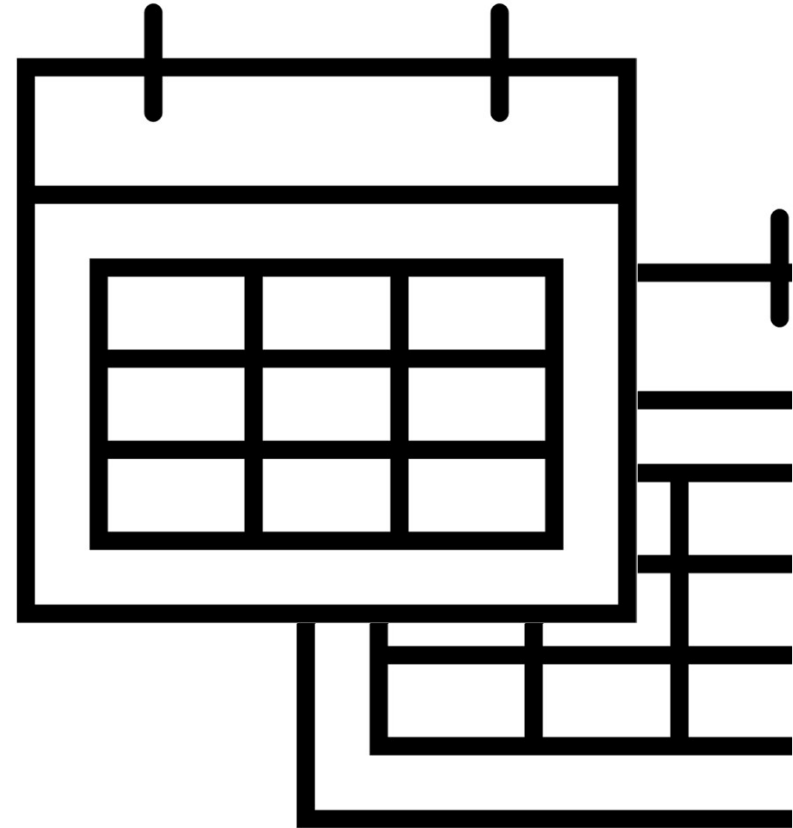
SHIVA SANDER TAVALLAEY, Senior Principal Scientist, Applied Analytics



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## Content

- Group presentation
- Industrial transformation's new imperative
  - “Billions of better decisions”
- R&D focus areas and innovation eco system



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**Group presentation**

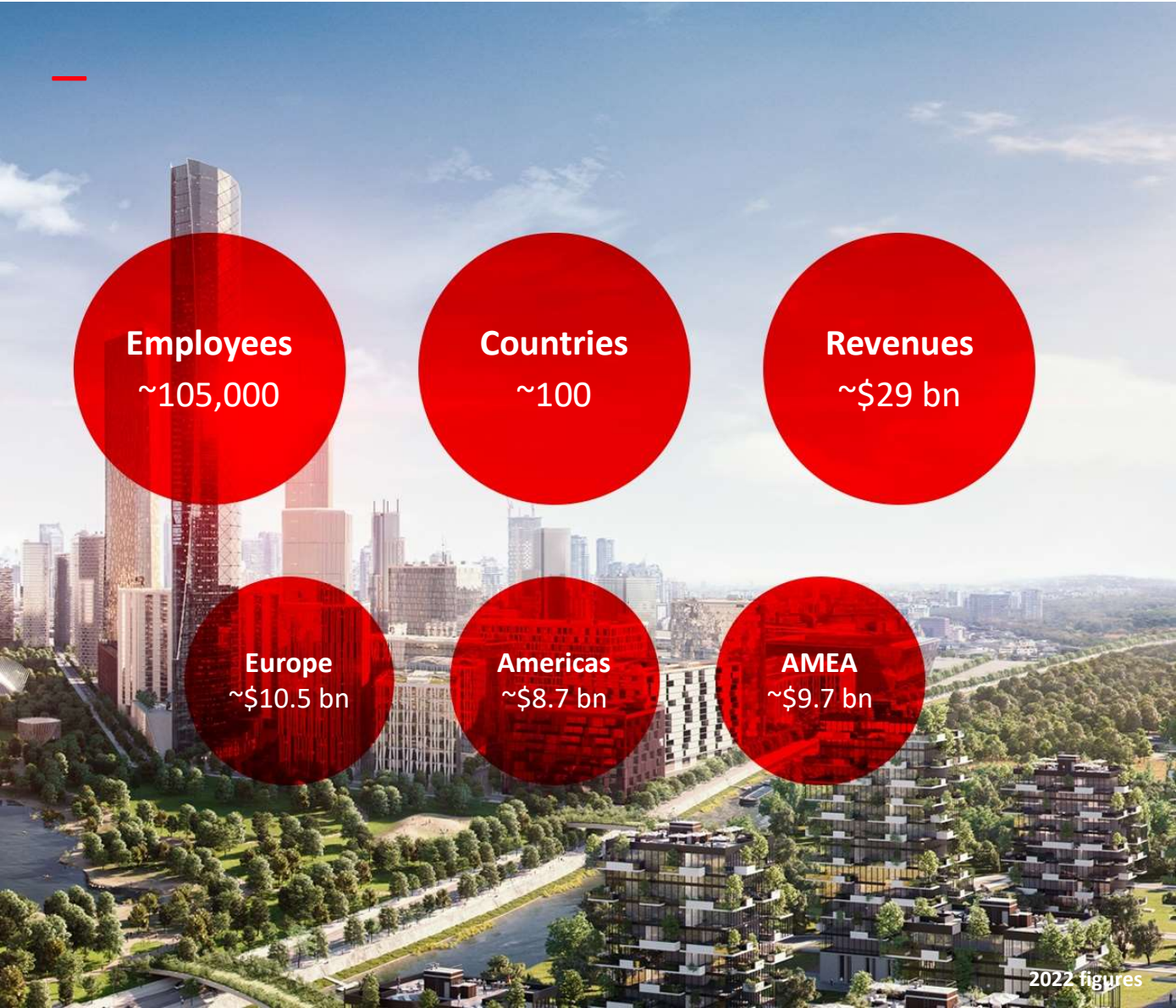


ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future.

By connecting software to its **electrification, motion, process automation and robotics & discrete automation** portfolio, ABB pushes the boundaries of technology to drive performance to new levels.

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## Our Business Areas

- Electrification
- Motion
- Process Automation
- Robotics & Discrete Automation



# Our business areas

## Electrification



Distribution Solutions

Smart Power

Smart Buildings

Installation Products

Power Conversion

E- mobility

Service

## Motion



IEC LV Motors

Large Motors & Generators

NEMA Motors

Drive Products

Systems Drives

Motion Service

Traction

## Process Automation



Energy Industries

Process Industries

Marine & Ports

Measurement & Analytics

## Robotics & Discrete Automation



Robotics

Machine Automation

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## R&D facts & figures



4.7% of revenues spent on R&D and digital



7000+ Scientists and Technologists which  
>60% focused on digitalization



11 countries with major R&D Centers



>100 University collaborations



>25,000 active patents to secure IP



Start-up engagement direct or via our  
own ATV & Synerleap

>15 strategic Partnership



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# Corporate Research

## Fueling tomorrow's innovation



~**300** highly qualified scientists and engineers

**7** corporate research and technology centers around the world

Business aligned research with **7** core technologies

>**200** technology projects and pre-studies

>**200** FFs and >**200** publications



# Technology Areas

of common interest within the ABB group



## Multiphysics

Merging physical properties with digital transformation



## Mechatronics

Intelligent and complex products: mechanic- electric-electronic- software-sensing- control



## Power Electronics

Conversion and control of electrical power in different applications.



## Connected Systems

Simple access and use of seamless and standardized information as well as systems.



## Sensing

Extract information, create solutions transform real-world parameters into valuable information



## Switching

Safe and controllable devices (switches and breakers) at system level.



## Software & Control

Efficiently engineered, user-friendly, optimal, intelligent and sustainable solutions.

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# ABB Research, Sweden

Research and Technology for the future

## Facts

- Located in Västerås
- Established 1916
- 90 Co-Workers (35 nationalities)
- 60% PhD researchers
- 10 Associate professors/affiliated faculty
- Intense Lab infrastructure
- Hosting SynerLeap
- University collaborations
  - KTH, Chalmers, LiU, MDU,, ...
  - Imperial College, Aalto, ETH....





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# Industrial transformation's new imperative

Digitalization and sustainability -> Autonomy

# Survey

How can industry transform to do better?

To explore the evolution of digital transformation and sustainability strategies, ABB commissioned a global research study that asked over **700 key decision-makers** across **12 industrial segments** how their businesses will address these issues.

This was supplemented by in-depth interviews with subject matter experts in these areas.



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## Billions of better decisions

As it confronts climate change, the world needs industry to be at its very best, balancing the needs of the economy and the environment to create a future that works for all. The Industrial Internet of Things (IIoT) will play a key role in striking this balance, delivering the infrastructure, innovation and intelligence to unlock new sources of productivity and efficiency and enable a low-carbon society.

# Billions of better decisions

## Survey methodology

**765**

respondents were comprised of executives, vice presidents, directors, and senior managers with operational knowledge of Industrial IoT

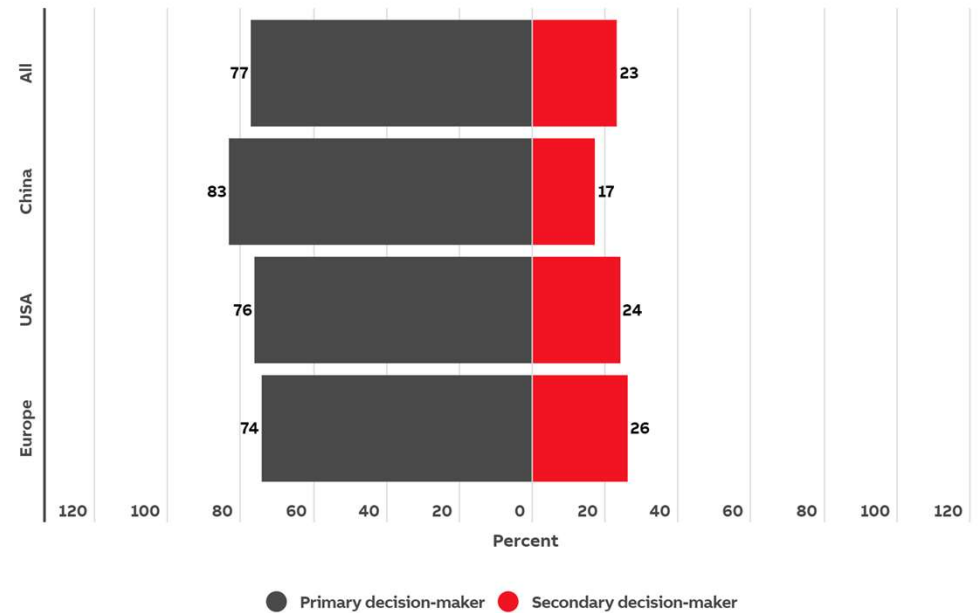
**77%**

primary decision-makers

**23%**

secondary decision-makers

The respondents came from a broad range of industries, with the largest share coming from discrete manufacturing, including automotive production.



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# Billions of better decisions

## The state of the Industrial IoT

**85%**

are now adopting Industrial IoT initiatives.

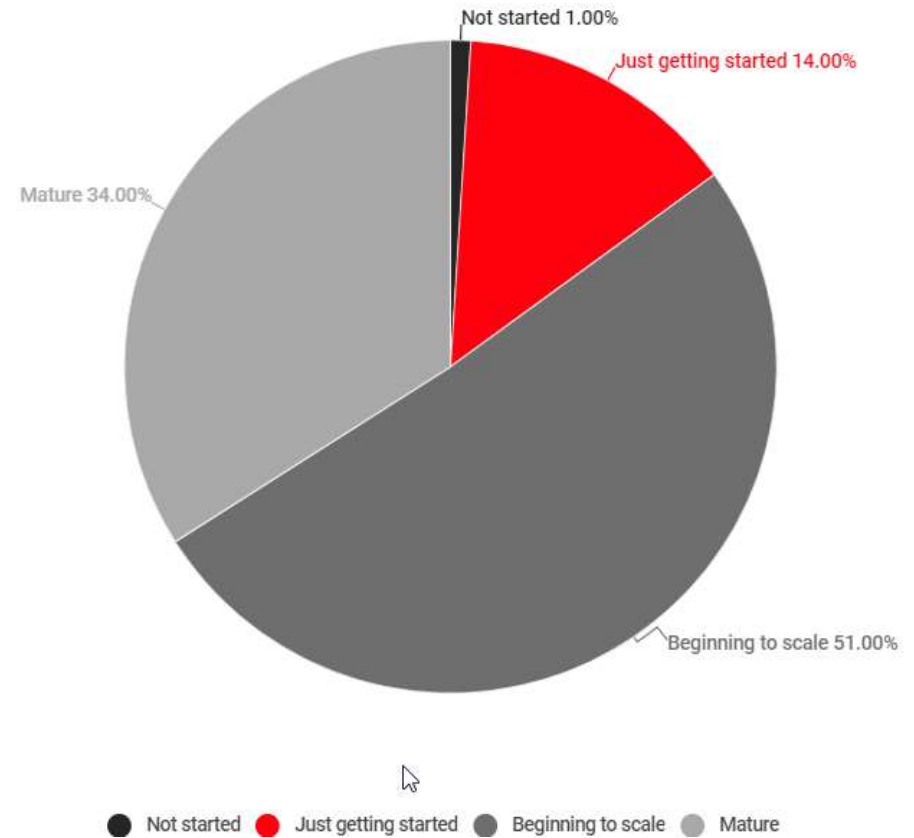
**14%**

Just getting started

**1%**

Not started yet

Self-declared Industrial IoT maturity



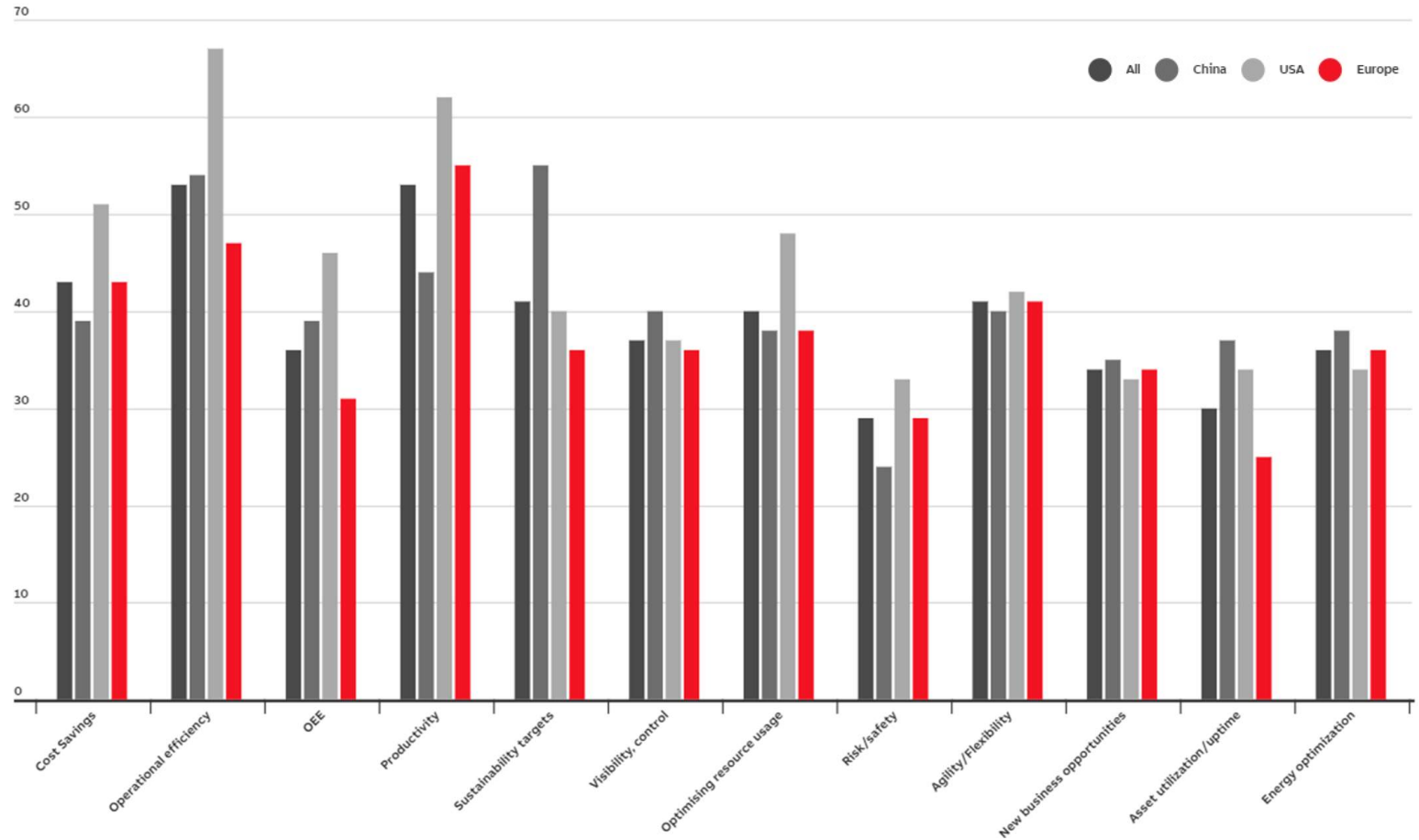
## Main drivers

**94%**

of respondents agree the Industrial IoT “enables better decisions, improving overall sustainability”

**72%**

said they are “somewhat” or “significantly increasing spending on Industrial IoT” due to sustainability





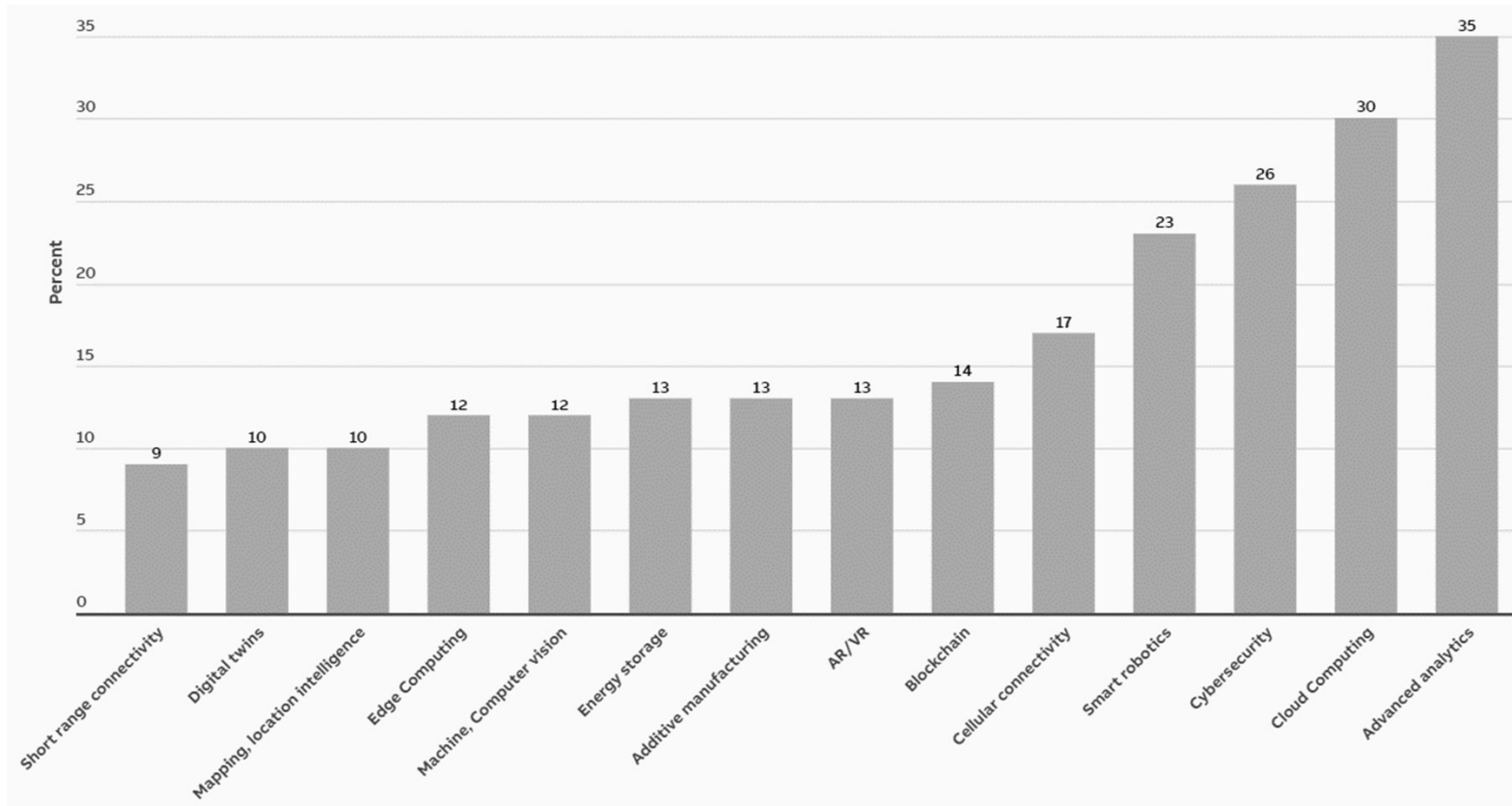
# Technologies for improving sustainability

## Top sustainability drivers

- Future competitiveness
- Efficiency
- Brand reputation

## Key Insight

The top 3 benefits of Industrial IoT for sustainability are... operational efficiency, safety, and optimizing energy and resource consumption.





**35%**

“digitally mature”



**33%**

“significantly increased”  
sustainability-oriented  
investment in Industrial IoT



**38%**

experienced top-line growth  
due to sustainability practices



**45%**

Improved Compliance



**42%**

reduced carbon footprint

# Knowing more, doing better

**96%**

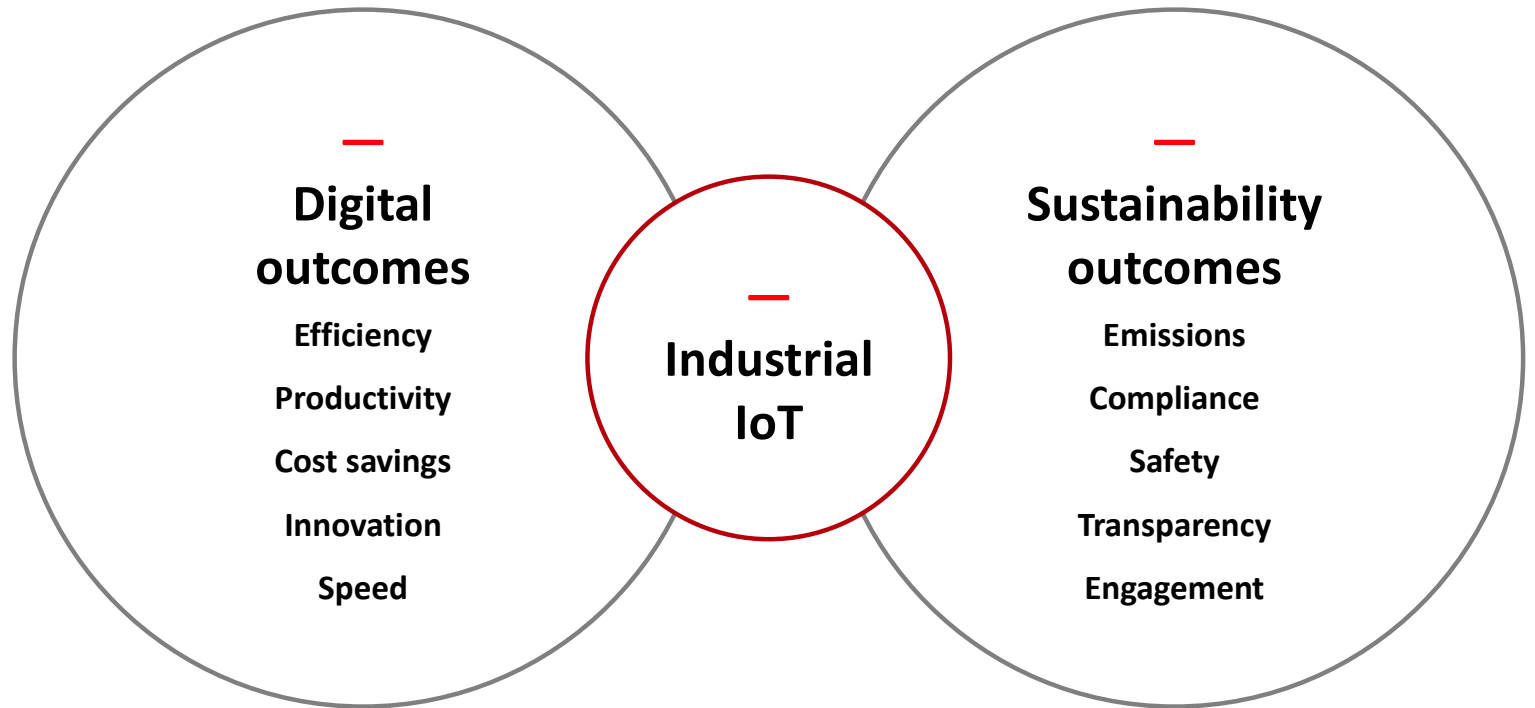
of decision-makers say digitalization is “essential to sustainability”

**\$7 trillion**

Projected global spending on digital transformation from 2020 to 2023

## Key Insight

Digitalization and sustainability are two of the biggest drivers of change across industries today.



# The transition to autonomous systems in industry

## Value proposition of autonomy



Handle increasing complexity of Industrie 4.0 systems



Lot size one production



Higher productivity / yield and increased quality



Lower cost and energy consumption



Improved worker health & amplify human potential



Bring out and accelerate new innovations

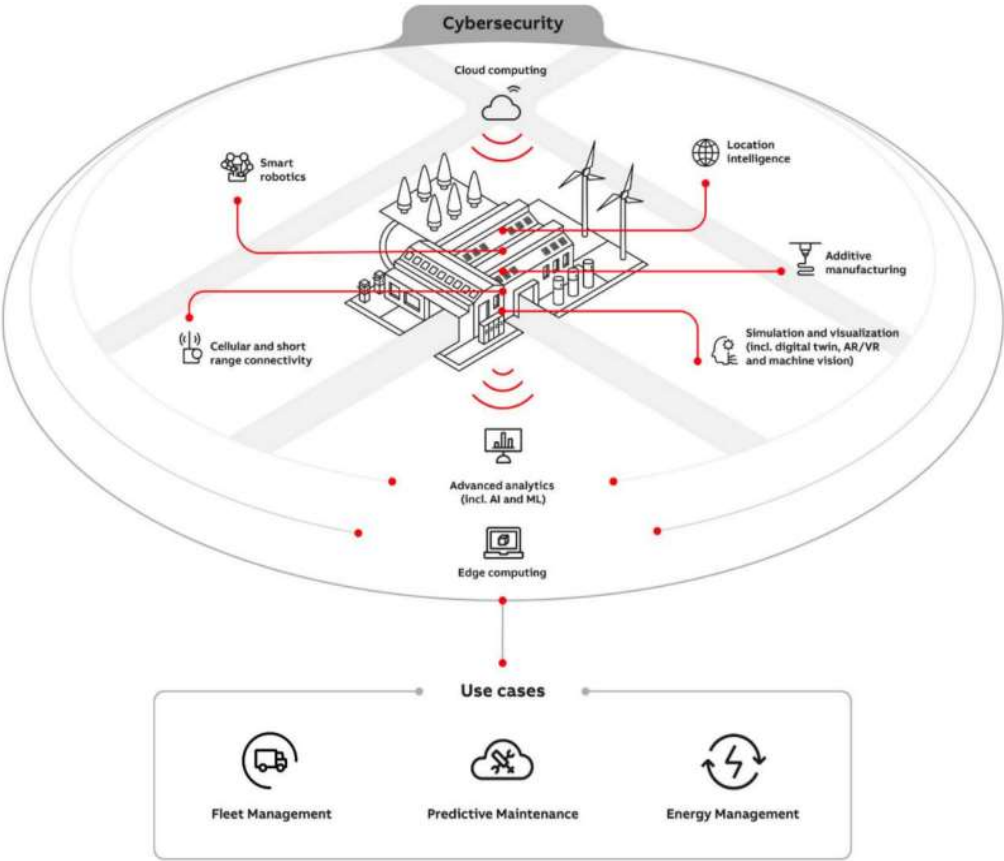


Enable new business models and value propositions

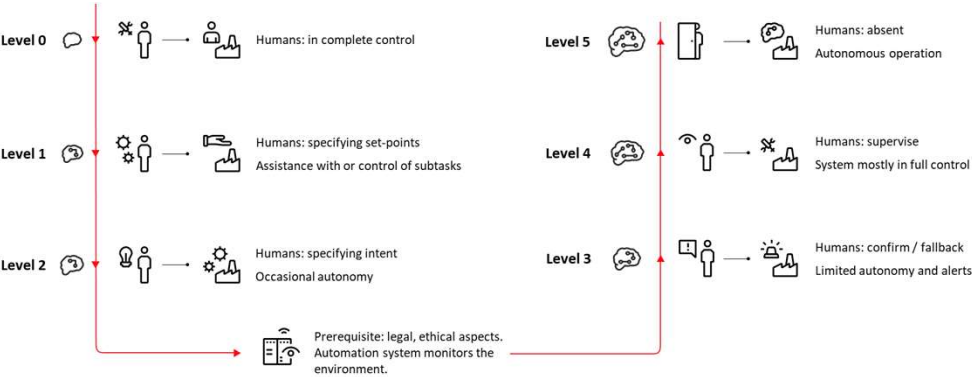


Opportunities currently not imagined at all

# Industrial IoT technologies



## Autonomous Industry



<https://new.abb.com/news/detail/11164/autonomous-systems>

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**R&D focus areas and innovation eco system**

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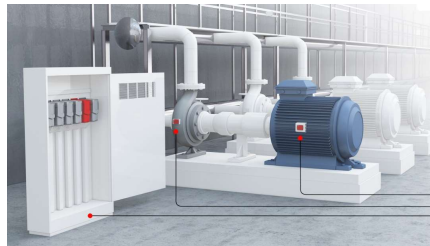
# ABB and R&D Demands

## Motion

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Market growth is driven by mega-trends such as growing population, urbanization and digitalization

This requires further automation of industrial processes, **energy efficiency** and electric mobility



## Electrifications

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Electricity demand grows 2x faster than other energy sources

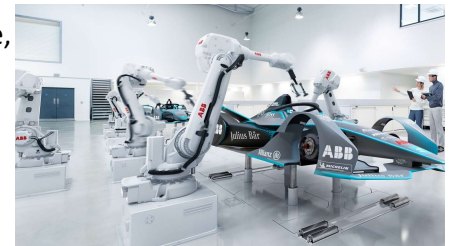
Digitalization accelerates demand for **intelligent solutions**



## Robotics & Discrete Manufacturing

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Market growth driven by mega-trends of individualized consumers, labor shortage, digitalization and uncertainty  
Resulting in need for automation solutions for increased **productivity**, highest **flexibility**, improved **quality** and maximum **simplicity**



## Process Automation

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Increasing demand for **end-to-end integrated, connected solutions** and **advanced services**

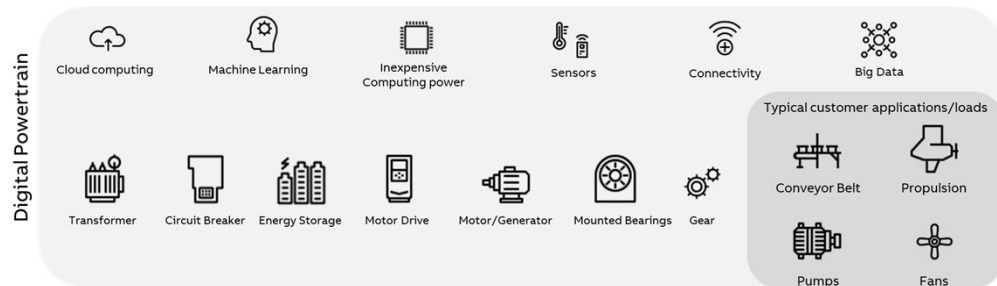
Increasing demand for applications to drive **autonomous** operations



# ABB Research Sweden

## Focus Areas

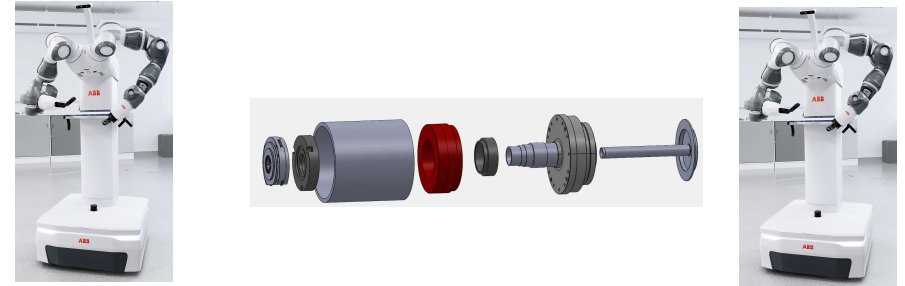
### Physical and Digital Powertrain



### Switching and Systems



### Robotics



### Automation





# Public R&D initiatives in Sweden

## Relevant to ABB, e.g.

### Swedish Electromobility Center

**Swedish Electromobility Centre (SEC)**  
A national COE for R&D of electric and hybrid vehicles & charging infrastructure

**Partners:** ABB, VOLVO, CHALMERS, EPRI, LUND UNIVERSITY, CEVT, POWERCELL, BergWarner, TITAN, SCANIA

**Five research themes:** Ability to charge, safety, reliability, efficiency, and performance; Vehicle-to-grid; Vehicle-to-vehicle; Vehicle-to-infrastructure; Vehicle-to-cloud

**Theme Electrical Machines & Drives:**

- High efficiency electric machines
- Electric drive systems
- Power electronics
- Energy storage
- Vehicle-to-grid
- Vehicle-to-vehicle
- Vehicle-to-infrastructure
- Vehicle-to-cloud

Moving forward with the fourth phase, perfect forum to interact and influence

### WISE

**WISE** Wallenberg Initiative Materials Science for Sustainability

WISE is a national research program, initiated and financed by the Knut and Alice Wallenberg Foundation.

**Vision:** Basic and need-driven material science for a sustainable world.

**Mission:** Perform materials science research at the international forefront to empower sustainable technologies with positive impact on society and to train future leaders in society, industry, and academia.

**Thematic areas:** Energy, Circularity, Climate and environment, Discoveries

**WISE includes:**

- €320,000,000 spanning 2022-2033
- Recruiting 26 assistant or associate professors
- Graduating 180 PhD students and 180 postdocs
- Science and technology platforms
- Research areas with industry
- Graduate school
- Guest professor programs

Partners: ABB, ERICSSON, SAAB, VINNOVA, and others.

### WASP

**WASP** Wallenberg AI, Autonomous Systems and Software Program

Largest individual research program in Sweden ever - Knut and Alice Wallenbergs stiftelse, Universities, Industry

**Vision:** Excellent research and competence in artificial intelligence, autonomous systems and software for the benefit of Swedish industry.

**Facts and Figures:**

- Launched in 2015
- Will continue at least until 2030
- Funding in total 5,5 billion SEK
- 38 successful international recruitments of senior faculty made by January 2021
- 40 companies engaged in the program
- Aiming to accept 600 PhD students, where of 150 in industry
- Aiming to establish at least 80 research groups

**Strategic Areas:**

- Perception and Learning
- Control and Decision Making
- Machine Learning and Knowledge Representation
- Interaction and Collaboration
- Software Technologies and Methods
- Mathematical Foundations and Theory

### Program for Advanced Digitalization

**Program for Advanced digitalization**

**WHY—WHAT—HOW**

**WHY:**

- The rest of the world is investing heavily in digital technology and innovation, and the pace of development is accelerating - which means that Sweden risks falling behind.
- Public investment in digitalization in Sweden is largely short-term, underfunded and reactive - resulting in sub-optimization and inefficiency.
- If Sweden is to maintain and strengthen its international competitiveness, a large and coherent effort is needed for digital transformation - this requires policy coordination and stakeholder collaboration.

**WHAT:**

- Accelerate transformation of Swedish industry enabling the achievement of Sweden's climate and sustainability goals.
- Capitalize on new opportunities created by advanced digitalization within all industry relevant areas.
- Support and build capabilities for development of the components, systems and system-of-systems solutions.
- Strengthen Sweden's attractiveness for research and innovation investment.

**HOW:**

- Long-term investment - 10 years or more.
- Dedicated and coordinated investment within:
  - Applied research and innovation
  - Advanced and open digital infrastructure for test and demo
  - Skill supply and long life learning
- Budget SEK 2 billion per year in full operation, half public and half private funds.

Partners: ABB, ERICSSON, SAAB, VINNOVA, and others.

### EU Graphene Flagship

**Graphene Flagship**  
European Commission's Future and Emerging Technology Flagships

**General Info:**

- Phase One: Enabling Science and Research
- Phase Two: Health, Medicine and Services
- Phase Three: Electronics and Photonics Integration
- Phase Four: Large Scale Technologies
- Phase Five: Large Scale Technologies, Growth

**ABB Engagement:**

- FP7 Consortium Agreement
- Horizon 2020 Consortium Agreement
- Timeline: Oct 2013, April 2014, April 2018, April 2020, March 2023
- ABB is part of HIF 14 (Composites)
- Projects: HIF 14 (Composites) - COMPLETED; HIF 14 (Composites) - COMPLETED; HIF 14 (Composites) - COMPLETED
- Project: HIF 14 (Composites) - COMPLETED

### Sustainable Underground Mining

**Sustainable Underground Mining (SUM)**  
Key transformation of Swedish mining industry

**Unique partnership in Swedish industry** Partners: ABB, LKAB, Epiroc, COMBITECH, VOLVO

**Partnership goals:**

- New, innovative & smarter solutions for future mining
- Efficient & autonomous production system:
  - Safety first
  - Sustainable
  - CO2 free production
  - 50% higher productivity
  - Robust production
- 2050 long-term partnership with LKAB
- Swedish ecosystem strengthening, industrial competitiveness & growth
- New world standard for sustainable mining

**Test Mine (SUM) - What, Why, How:**

- Establish safety and feasibility of breaking into deep & front one (or LKAB's)
- Minimize risks for investment decisions for LKAB by 2024
- Develop a real LKAB's underground mine and a virtual one - SUM(2018-2024)
- Estimated project cost - 2800 MSEK

Safe, carbon-dioxide-free, digitalized and autonomous Mine of the Future

# The Swedish R&D ecosystem

External and internal partnerships – increase the speed of innovation

## Industry partners

Partners in developing innovative solutions to real-time challenges



## Academia

Partners in developing long-term disruptive technologies



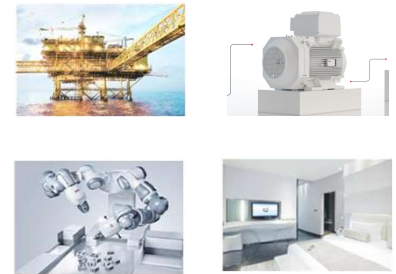
## Start-Ups

Partners in building breakthrough power and automation technologies



## Businesses

Close co-operation between core research and business ensuring constant customer value creation



Funding Agencies: EU, Energy Agency, Vinnova, KKS, SSF

**Industry** has a vision of **integrated digital operations** that create **better outcomes** - with self-managed, self-healing systems **powered by AI**



**ABB**