

ZINNOV ZONES 2021

THE UNABATED RISE OF DIGITAL ENGINEERING

MAY 2022

Foreword

The ER&D spend has stayed resilient despite economic uncertainties, record inflation highs, and a looming recession, and showed the highest growth in a decade. Interestingly, Digital Engineering is growing faster than its traditional counterpart – ER&D, which has resulted in the recovery of the ER&D spend across geographies and industry verticals. The Digital Engineering spend is growing at a rate of 20% CAGR and stands at USD 653 Bn, driven by tech focus areas such as Metaverse, 5G, Digital Thread, Intelligent Automation, and Cloud/AI. And this focus will continue unabated, to touch a massive USD 1,278 Bn by 2025, especially in light of macro trends such as an increased spend on defense, pervasive semiconductor consumption, digital acceleration, and a heightened focus on sustainability. While North American enterprises are the biggest contributors to this phenomenal growth, accounting for more than 50% of the spend, APAC is set to overtake Western Europe in the next 12 months, owing to the presence of HiTech verticals that are spending on new-age technologies.

However, this exceptional growth and focus on Digital Engineering are marred by the ongoing talent wars, as the demand and supply gap for digitally skilled talent raises concerns. While immigration, offshoring, and nearshoring are helping bridge this gap significantly, key geographies like India, with its robust GCoE ecosystem and abundant next-gen Digital Engineering talent will be strategic for enterprises in the long run.

As more and more global enterprises focus on Digital Thread, Sustainability, 5G, Metaverse, Cloud/AI, etc., the Service Provider ecosystem will play a strategic role in enabling enterprise initiatives across verticals. While Digital Thread is making operations, manufacturing, and the supply chain ecosystem smarter than ever, Cloud adoption has been aggressive across Z1000* enterprises, with many focusing on strengthening their talent base, building dedicated Centers of Excellence (COEs), partnering with SPs and technology start-ups to accelerate their journeys. Similarly, the ongoing 5G rollout and adoption around the world will require the right talent to enable it seamlessly, which by our estimation, will account for 40% of all mobile connections by 2026.

Sustainability is another core theme that enterprises are increasingly investing in, in their quest to adhere to timelines of achieving carbon neutral operations. In fact, 80% of the Z1000 enterprises are working on net zero initiatives across the value chain, with heavy emphasis on energy-efficient product designs, green operations and resources, energy optimization, etc., across verticals. With Service Providers also jumping on the sustainability bandwagon and making noticeable partnerships, they are focusing on building portfolios to drive clean-green futuristic outcomes.

This comprehensive report, "The Unabated Rise of Digital Engineering," provides an in-depth view of the current global ER&D landscape, an analysis of the ER&D and Digital Engineering spending, enterprise priorities by key verticals, and the prominent role that Technology Service Providers are playing in accelerating enterprise technology adoption. The report also showcases the assessment of ~60 global Service Providers for their ER&D prowess, which will empower enterprises to make informed decisions for their strategic sourcing initiatives.

*Top 1000 global ER&D spenders across 20+ verticals

The report helps ER&D enterprises and Service Providers understand macro and tech trends that drive R&D priorities

Objective

- To analyse the current state of the ER&D market.
- To crystallize insights from dynamically evolving macro and tech trends in a post-pandemic world. The report contains:
  - An analysis of ER&D spending
    - Macro Trends (Increased defense spending, semiconductor consumption, sustainability focus. etc.) that are driving R&D priorities
    - Tech Trends (Meta, 5G, Cloud/AI, Digital thread, etc.) that will accelerate digital engineering spends
  - An analysis of digital engineering spending and priorities by key verticals
  - The market addressed by Service Providers and GCCs
  - An assessment of ~60 global service providers for their ER&D prowess, to help enterprises make informed purchasing decisions for strategic sourcing initiatives

IP and data assets

Z1000 database	GCC database	Service Provider database	ER&D deals database	Zinnov Zones
Zinnov's database of top 1,000 global ER&D Spenders across 20+ verticals	Database of 5,000+ ER&D Global Capability Centers (GCCs) analyzed across verticals	Database of 2000+ ER&D Service Providers tracked across the globe	Database of ~3,000+ ER&D deals signed across the globe across verticals	Database of ~60 global Service Providers rated as part of the Zones ER&D 2020 Ratings

Top 1,000 global ER&D Spenders

20+ verticals

5,000+ GCCs

2,000+ Service Providers

3,000+ ER&D Deals

Source: Zinnov Research and Analysis, Zinnov Z1000 database, ER&D deals database, GCC database, and DRAUP

The report helps understand changing R&D priorities on account of key macro and tech trends. It helps Service Providers recalibrate market positioning to enhance wallet share

Scope of the report

- This report provides an overview of the ER&D landscape along with an analysis of spending by Z1000 enterprises. It also helps understand the landscape by vertical and geography
- The report delves deeper into the unabated rise of digital engineering and analyses macro and tech trends that are fuelling this spend. Macro trends such as an increased spend on defense, pervasive semiconductor consumption, and a focus on sustainability are fuelling this shift in digital engineering spend
- The report also examines key tech trends that form the pillars of digital engineering viz. Metaverse, 5G, Digital Thread and Cloud/AI engineering
- It provides a deep-dive into the key contributing verticals of ER&D spending viz. Automotive, Software & Internet, Telecom, Industrial spending. It also provides a view on opportunities within services verticals such as BFSI and Healthcare
- This document examines the market addressed by Service Providers (SP) and GCCs and identifies opportunities for the SP community
- The report also provides a view on the talent wars for digital engineering in light of recent global events (i.e- Ukraine-Russia Conflict)
- As part of the Zinnov Zones 2021 Ratings for ER&D services, this report assesses and rates Service Providers for their:
  - Overall ER&D prowess
  - Horizontal specific capabilities (Digital engineering, AI Engineering)
  - Vertical specific capabilities (Automotive, Aerospace, Consumer Software, Enterprise Software, Industrial, Medical Devices, Semiconductor, Telecommunication)
  - Micro-vertical specific capabilities (ADAS, AI and ML for BFSI, Contactless Retail, Content Monetization, Cybersecurity, Digital Thread, SDN and NFV, Software Platform Engineering, Telematics, Telemedicine, and OTT)

Source: Zinnov Research and Analysis

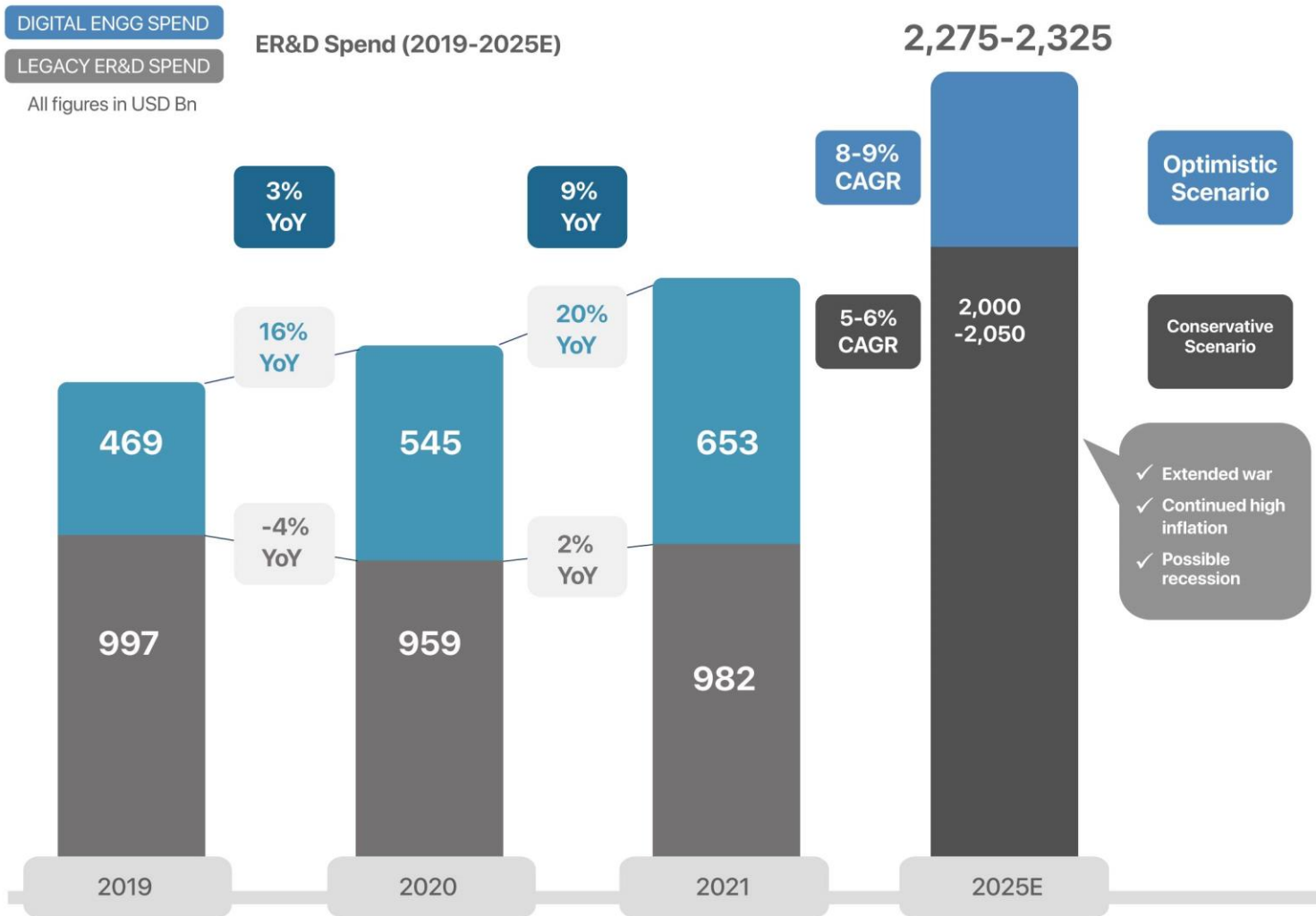
Topics

A	The unabated rise of digital engineering fueled by macro factors (Rise in defense, increased semiconductor usage, Focus on sustainability)
B	Technology pillars (5G, Digital Thread, Metaverse, and Cloud/AI) of digital engineering
C	Industry Deep-Dives and ER&D Spend trends and priorities
D	Addressed market and Service Provider opportunities
E	Talent wars for digital engineering talent
F	Growth levers for Service Providers
G	Zinnov Zones 2021 ER&D Ratings

Source: Zinnov Research and Analysis

ER&D spending has recovered quickly despite economic uncertainties and evolving geopolitical landscapes, and will continue to grow

A



ER&D spend growth has recovered and witnessed the highest growth rate in a decade

Most manufacturing-led verticals have witnessed faster than expected recovery cycles

A relentless focus on digital engineering initiatives by verticals has contributed to the recovery

Tech focus areas such a Meta, 5G, digital thread, and Cloud/AI are driving digital engineering spend

Increased spending on public defense, a razor sharp focus on sustainability, and pervasive consumption of semiconductors will further accelerate digital engineering spending

Source: Zinnov Research and Analysis, Zinnov Z1000 database

In a conservative scenario, the reduction in hi-tech and services led digital engineering spending will still be over USD 200 Bn

A

zinnov

MANUFACTURING LED VERTICALS

HITECH LED VERTICALS

SERVICES LED VERTICALS

KEY INSIGHTS →

OPTIMISTIC SCENARIO 2025

USD 2,275-2,325 Bn

ER&D SPEND	DE SPEND
957 Bn	195 Bn
990 Bn	725 Bn
357 Bn	357 Bn

An increased spending on public defense, a sharp focus on sustainability, and pervasive consumption of semiconductors will further accelerate digital engineering spending

CONSERVATIVE SCENARIO 2025

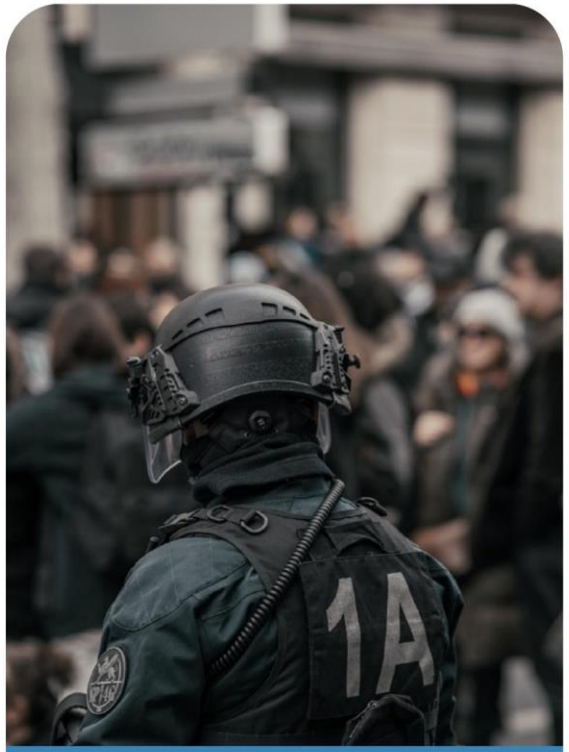
USD 2,000-2,050 Bn

ER&D SPEND	DE SPEND
877 Bn	140 Bn
859 Bn	601 Bn
297 Bn	297 Bn

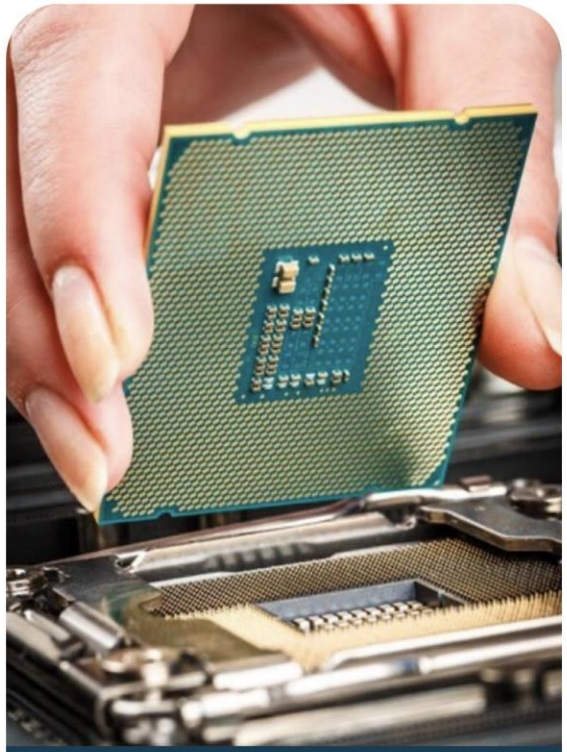
While manufacturing-led verticals will be impacted in a conservative scenario, the biggest delta in reduction will be from hi-tech and services led verticals

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Macroeconomic factors fueling engineering spend



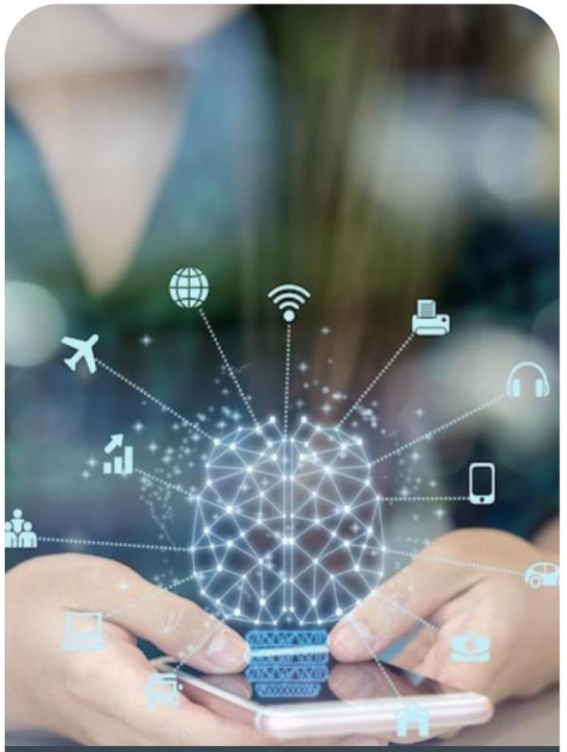
DEFENSE SPENDING



SEMICONDUCTORS SUPPLY CHAIN



SUSTAINABILITY



DIGITAL ACCELERATION

Source: Zinnov Research and Analysis

Rise in global defense spending

01

Tectonic shifts in geo-political landscapes have translated to an increased public defense spending

02

Suppliers of defense equipment are witnessing increased valuations and are beefing-up spending in anticipation of demand

03

Corporate defense enterprises are increasing their spend on digital engineering tech (AI/ML, autonomous, digital twin, 5G, etc.)

04

Such firms are increasingly leaning on the engineering Service Provider ecosystem to drive initiatives

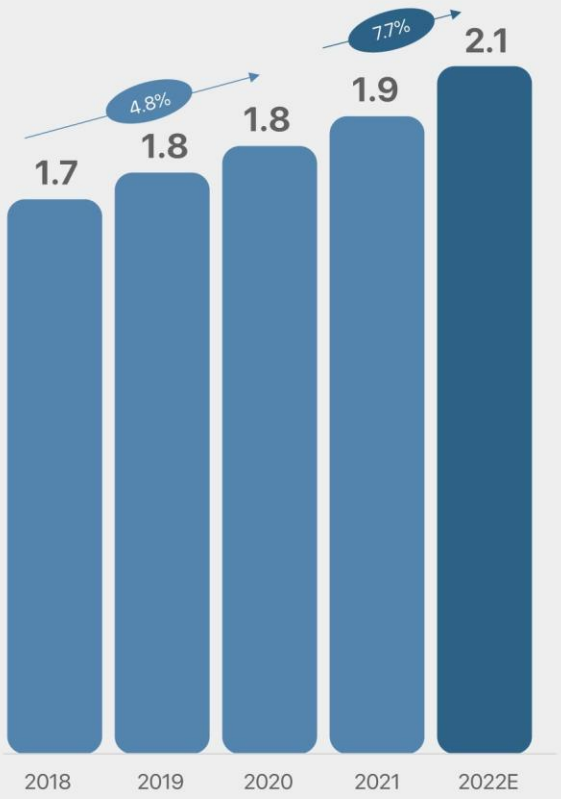
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Engineering Service Providers with robust design, embedded, and digital engineering capabilities are poised to garner greater wallet share

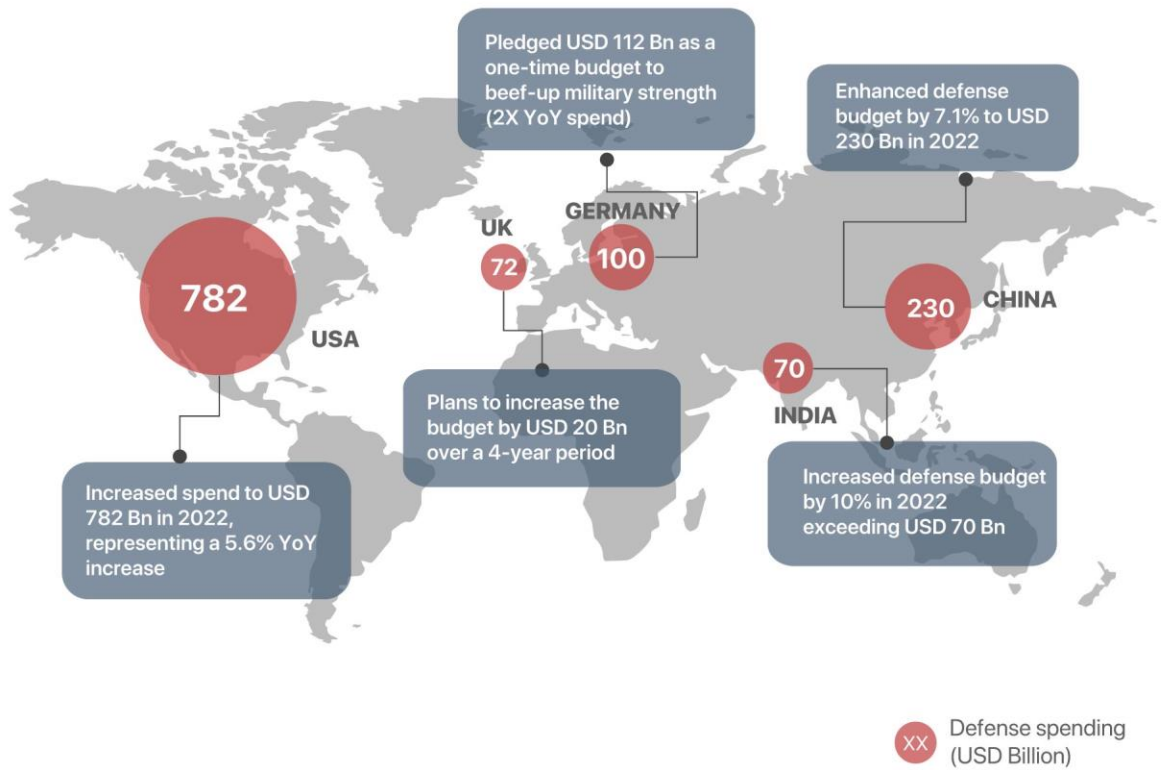
Source: Zinnov Research and Analysis

Tectonic shifts in geopolitical landscapes have contributed to the highest global defense spending growth in over a decade, despite an economic crunch

Global Government Defense Spending (USD Trillion)



Key Geographies increase spend in 2022



7.7%

- Highest YOY spend growth in more than a decade for global defense spending

Rising Geo-Political Tensions

- Ukraine-Russia Conflict
- China's continually increasing expenditure amid incidents of muscle-flexing in the Indo Pacific region

2X

- Germany's proposed increase in their budget. USD 113 Bn was set aside in 2022 as a one-time fund to beef-up military prowess

Source: Zinnov Research and Analysis, , Zinnov Z1000 database, International Institute for Strategic Studies (IISS)

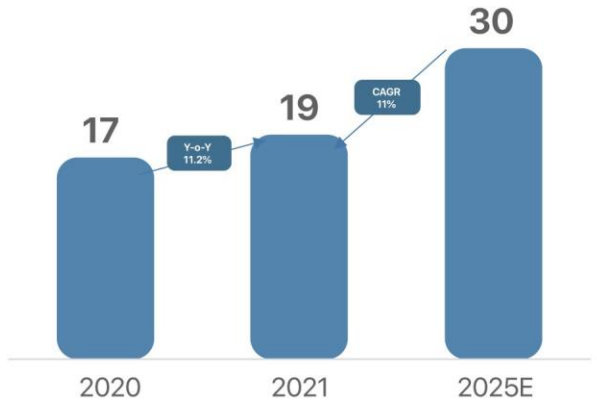
Similarly, suppliers of defense equipment are witnessing increased valuations and are beefing-up spend in anticipation of higher demand

TOP Z1000 Defense firms' stocks

Stock movement is for Q1 2022

Thales Group	▲ 50%
Dassault Aviation	▲ 49%
Leonardo	▲ 43%
BAE Systems	▲ 29%
Lockheed Martin	▲ 25%
General Dynamics	▲ 19%
Northrop Grumman	▲ 18%
Raytheon	▲ 14%
Elbit Systems	▲ 29%
SAAB	▲ 48%

Corporate Defense ER&D Spend (USD Bn)



Key R&D Focus Areas

- Artificial Intelligence & ML
- Autonomous Unmanned Systems
- Digital Twins
- Quantum Tech
- Space & 5G Communications

Z1000 Enterprise	2021 ER&D Spend* (USD Bn)	YoY
Raytheon	3.8	10%
BAE Systems	3.0	11%
Leonardo	2.9	19%
Lockheed Martin	2.1	20%
Thales	1.7	8%

Z1000 Enterprise	2021 ER&D Spend* (USD Bn)	YoY
Northrop Grumman	1.5	6%
Dassault Aviation	0.9	10%
General Dynamics	0.5	20%
Elbit Systems	0.5	14%
SAAB	0.3	38%

11.2%

YoY Corporate Defense ER&D spend grew at a higher than the global average ER&D growth rate in 2021

25+%

7 out of the top 10 Z1000 Defense spenders' stocks increased by 25%+ in Q1 2022

30 Bn

The cumulative spending on Corporate Defense ER&D by 2025

Source: Zinnov Research and Analysis, Zinnov Z1000 database

*Total ER&D spend of firm including commercial aero

Corporate defense organizations are increasing their spend on digital engineering technologies

Artificial Intelligence & ML	**AI and ML are being used in defense for** • Training • Surveillance • AI enabled advanced weaponry	Raytheon Technologies Raytheon leveraged artificial intelligence and machine learning to digitally test its Standard Missile-3 Block IIA missile in 2020	**8/10** Top Z1000 Defense companies have partnered with AI firms for developing capabilities in the last two years
Autonomous Unmanned Systems	Advancements in foundational tech (AI, ML, high performance embedded computing, etc.) are enabling defense firms to focus on unmanned aircrafts, ground vehicles, and submarines	LEONARDO Leonardo achieved the world's first military certification for a rotary uncrewed aerial system (for its AWHero RUAS) in 2021	**8/10** Top Z1000 defense companies have built in-house autonomous unmanned systems capabilities
Digital Twin	Digital Twin tech has the potential to enable the 'defense ecosystem' across entities to manage inter-dependencies over aspects such as design, engineering, sustenance, logistics, and operational performance	NORTHROP GRUMMAN Northrop Grumman announced plans to develop a "digital twin replica" of its Bombardier CRJ700 test-bed aircraft in 2022	**6/10** Top Z1000 Defense companies are developing in-house digital twin capabilities
Quantum Tech	**Quantum tech offers potential application across:** • Quantum sensing (Detecting submarines and stealth aircrafts) • Encryption of digital communication (Secure communication)	LOCKHEED MARTIN In 2021, Lockheed Martin Canada joined the IBM Quantum Hub to explore the potential of quantum computing	**6/10** Top Z1000 Defense companies have collaborated with startups and research institutes in the last two years
5G Communications	**5G can enable a host of applications in the military space such as:** • 5G networks for faster communication in the battle-field • 5G non-terrestrial networks for unmanned UAVs etc.	LOCKHEED MARTIN In 2021, the firm launched a new satellite dish which can be used for a 5G network to sync every weapon under Federal control	**5/10** Top Z1000 Defense companies are collaborating with telecom players for 5G capabilities

Source: Zinnov Research and Analysis

Defense organizations will increasingly lean on the engineering service provider and innovation ecosystem to cater to increased demand

Outsourcing Deals

2022 — expleo, Spirit AeroSystems

Expleo provides engineering services covering composites, stress and design, and an end-to-end fuselage experience

The firms will also collaborate on new-age areas such as rapid concept prototyping for testing, electrification for takeoff and landing tech, and automation in process and design

2020 — Alten, Airbus Defence & Space

Alten is providing design and development services across aircraft power systems

The firm is designing power systems for secondary power stages

2020 — Accenture, U.S. Air Force

A USD 90 Mn deal spread across 4 years is supporting the US Airforce develop solutions across MRO and ERP

The firm is developing solutions for MRO, Discrete Manufacturing, production, and scheduling, etc.

Ecosystem Partnerships

2022 — Northrop Grumman, Echodyne

Northrop Grumman expanded its partnership with Echodyne, a radar tech firm in the areas of defense and security applications

Northrop Grumman will integrate Echodyne's radar systems into its counter-UAS platform`

2021 — Atos, Thales

Atos entered a JV with big data and AI platform "Athea"

Athea will be helping enterprises in their defense, intelligence, and internal state security communities

2021 — Lockheed Martin, IBM

Lockheed Martin Canada joined the IBM Quantum Hub to explore the potential offered by quantum computing

- Top defense equipment suppliers are hiring aggressively to cater to the anticipated demand in: (**~2,000 openings** in the last 3 months)
  - Software
  - Embedded
  - Next-gen (AI/ML, IoT, Cybersecurity, etc.)
- **8/10** of the top Z1000 defense equipment suppliers have planned facility expansions
- Service Providers with design capabilities, embedded capabilities, and new-age capabilities stand to gain

Source: Zinnov Research and Analysis, Zinnov ER&D deals database

Semicon is the new software

01

Large enterprises across verticals have pervasively begun to design chips in-house to differentiate from the rest and accelerate time to market

02

Outside traditional semiconductor behemoths, GAMMA firms dominate the in-house silicon development spend

03

The increase in new markets for semicons has resulted in shortening NPD cycles; Disaggregated chip design is enabling faster and cheaper NPD

04

The surge in demand for chips has strained the semicon ecosystem and it now requires interventions to keep up with the demand

05

Engineering Service Providers are being leveraged for silicon design, embedded software, and integration of digital technologies

Source: Zinnov Research and Analysis

A demand surge for chips across Consumer electronics, Automotive and other high-tech led verticals are drawing investments to increase in-house chip development capabilities

CONSUMER ELECTRONICS

KEY GROWTH DRIVERS*

- Smart products
- Smart infrastructure
- Higher number of devices per person
- Gaming modules

MARKET UPDATES

SAMSUNG

Apple is working on several successors to the M1 custom chips for its use in the Mac main processor.

Samsung is planning to launch the new Exynos custom chip to use in the smartphones

AUTOMOTIVE

KEY GROWTH DRIVERS*

- ADAS systems
- Advanced navigation
- Smart assistance in vehicles
- Electric and Hybrid vehicles

MARKET UPDATES

Ford announced a collaboration with chipmaker GlobalFoundries

GM is set to co-develop new chips with semiconductor partners such as Qualcomm, TSMC etc

COMPUTER PERIPHERALS & STORAGE

KEY GROWTH DRIVERS*

- Digital Cards & Hard drives
- Webcams & Digital Cameras
- Microphones
- Image Scanners

MARKET UPDATES

WD and Seagate have designed a processor based on the open RISC-V Instruction set architecture for its hard disks to triple the performance and workloads.

NETWORK ENGINEERING PROVIDERS

KEY GROWTH DRIVERS*

- Network security
- Network traffic engineering
- Network Infrastructure

MARKET UPDATES

Cisco has developed a programmable chipset called 'silicon one' for high performance networking for future 5G applications

SOFTWARE & INTERNET

KEY GROWTH DRIVERS*

- Smart products
- Smart infrastructure
- Higher number of devices per person
- Custom chips for server computers
- Deep learning algorithms

MARKET UPDATES

IBM recently developed a first of its kind 2nm chip focused on improving performance and efficiency of next-generation products

Amazon is developing its own networking chip to power hardware switches that move data around networks.

Tencent designs custom chips for processing huge amounts of data to train AI systems

MEDICAL DEVICES

KEY GROWTH DRIVERS*

- Automated diagnostics
- Smart Inhalers & Pills
- Connected devices and wearables
- Electronic monitoring devices

MARKET UPDATES

Medical devices firms are leveraging partners to develop custom ASICs for low-power, high-performance medical grade equipment.

INDUSTRIAL

KEY GROWTH DRIVERS*

- Industry 4.0
- Smart meters & Smart grids

MARKET UPDATES

BOSCH

Robert Bosch opened a EUR 1 Bn chip plant in Germany in order to meet the demand for the latest electric and self-driving cars.

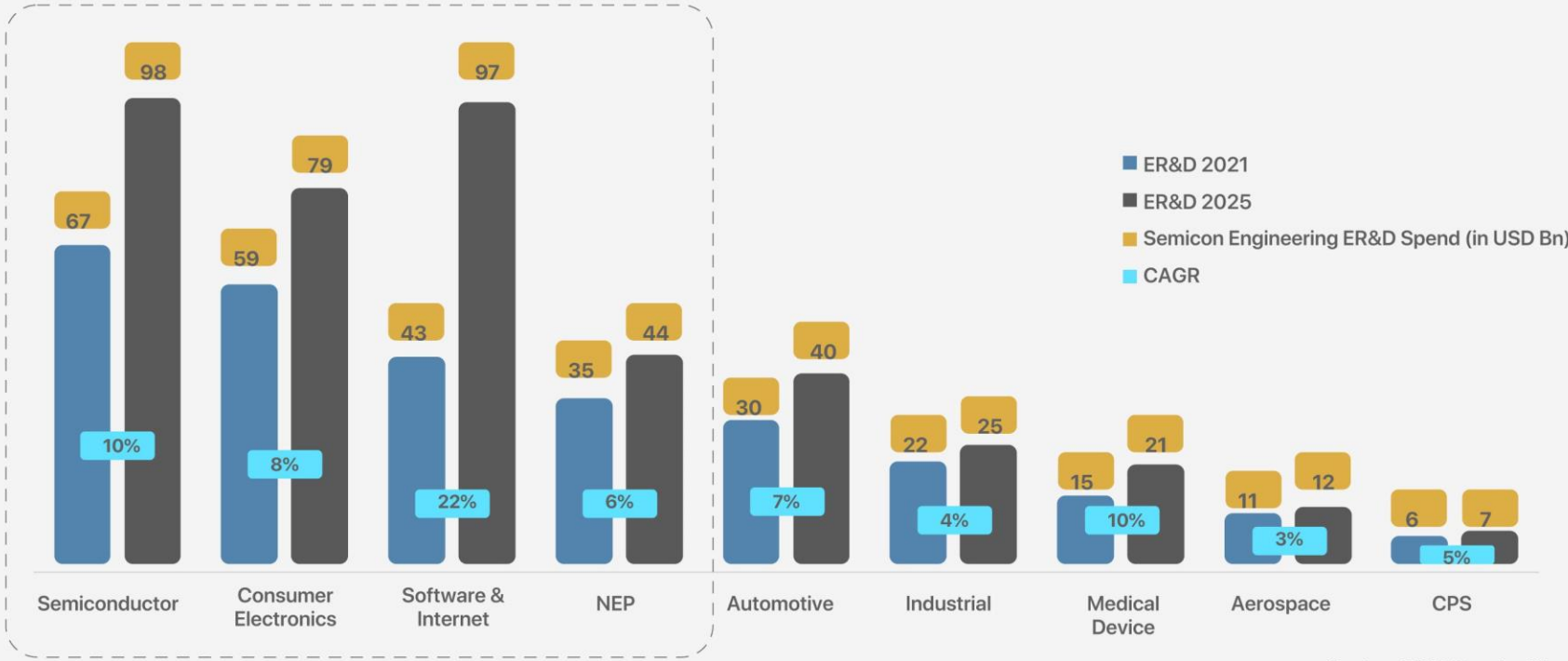
Source: Zinnov Research and Analysis

Almost a fifth of the overall ER&D spend can be attributed to silicon engineering

USD 1635 Bn
Total ER&D spend across verticals

USD 287 Bn
ER&D spend attributed to Semicon Engineering activities*

- **USD 61 Bn** Pre-Silicon
- **USD 67 Bn** Post Silicon
- **USD 159 Bn** Embedded Software



Semicon ER&D Spend split by focus verticals

~18%
Semicon engineering spend across the 9 focus verticals contribute to 18% of the overall ER&D spend

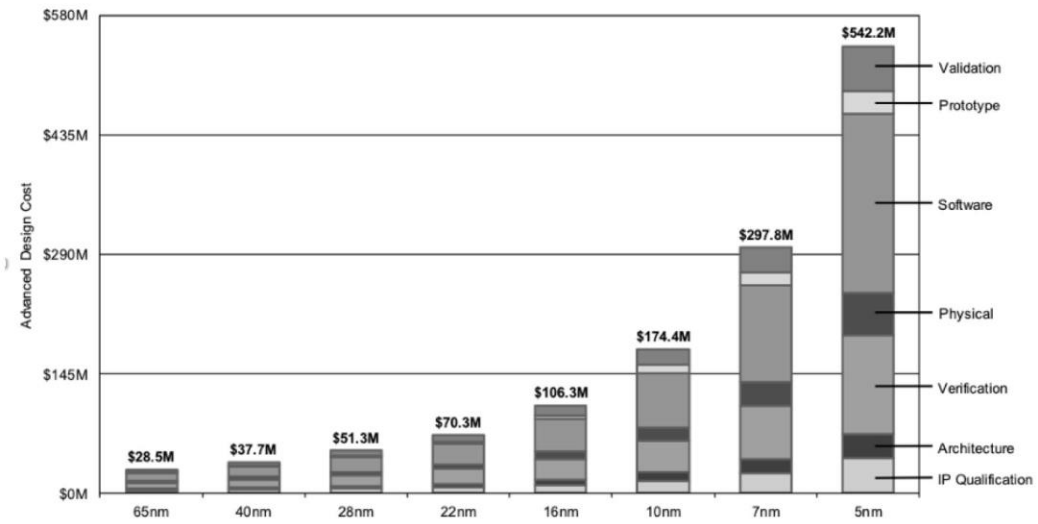
2.3X
Semiconductor engineering spend in the Software & Internet vertical will increase twofold with a CAGR of ~22% by 2025

71%
Semicon, CE, Software, and NEP account for nearly 3/4 of the overall Semicon engineering spend across the 9 focus verticals

Source: Zinnov Research and Analysis, Zinnov Z1000 database

To cater to increased demand and cut down on development time and costs, firms are adopting a disaggregated chip design strategy

Chip design cost is increasing with each node



- The chip design cost of a 5nm is expected to be double that of a 7nm
- In addition to V&V and Software, **reusable Silicon IP qualification** is one of the areas driving the change in the chip design process, to monitor costs

A disaggregation strategy using Individual IPs via the Tile or Lego approach helps in:

- Using **quality 3rd party IPs** that **are verified at the IP/chiplet level**
- **Reducing development time** to less than 1 year (from 2 - 4 years)
- Reducing bugs by over **10X**
- **Reusing the IPs** across multiple products

... has led the Semiconductor IP market to grow at a CAGR of 10% between 2020 and 2021 to USD 5.06 Bn

and is expected to reach USD 7.02 Bn by 2025 growing at a CAGR of 8.5%

This is driving the change in the Silicon IP sourcing trend. Chip designing firms are moving from fully insourced IP models to an outsourced IP model

For example; Intel has recently formed IP Group to focus on IP development and sourcing 3rd party IPs on their chipsets.

Demand for Silicon IPs is on the rise due to disaggregated chip design, fabless manufacturing, and various use cases across the industry. This is creating an additional opportunity for Service Providers to invest, develop and differentiate through proven IPs

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Engineering Service Providers are being leveraged for silicon design, embedded software, and integration of digital tech

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
NXP	QuEST Global	2022	Software Development	QuEST will provide software development and support for NXP's S32G Vehicle Network Processors. Through this partnership, QuEST will help NXP's customers deliver a secure vehicle network
Leading Semiconductor Manufacturer	LTTS	2022	Engineering Services / Digital Transformation	LTTS has entered a strategic partnership with a leading Semicon manufacturer for three years to provide engineering services for its product suite and aid their digital transformation journey
Renesas	AVL	2022	Automotive ECUs	AVL will help develop electronic-control units (ECUs) that comply with the ISO 26262 international standard for automotive functional safety. AVL will provide support for development of complex and specialized functional safety systems
NXP	TCS	2021	IT Innovation	NXP Semiconductors partners with TCS to drive its integrated IT services strategy across automotive, industrial & IoT, mobile, and communication infrastructure markets
CIMCON Lighting	UST	2021	Software/Firmware Development	UST has entered a strategic partnership with CIMCON Lighting to provide high-tech led services to CIMCON in the areas of software development, firmware development, manufacturing, and R&D to enhance smart-lighting controls and smart city platforms

Source: Zinnov Research and Analysis, Zinnov ER&D deals database

Building a carbon net zero future

01

Rising investor interest and a shift in consumer preferences is propelling enterprises to pursue sustainability goals aggressively

02

Z1000 enterprises across verticals have clearly defined timelines and targets to incorporate carbon net-zero/carbon neutrality

03

The digital engineering tech stack is enabling enterprises to drive green outcomes through product innovation and operations

04

Energy efficient product design and emissions control in the manufacturing process are table stakes for every industry

05

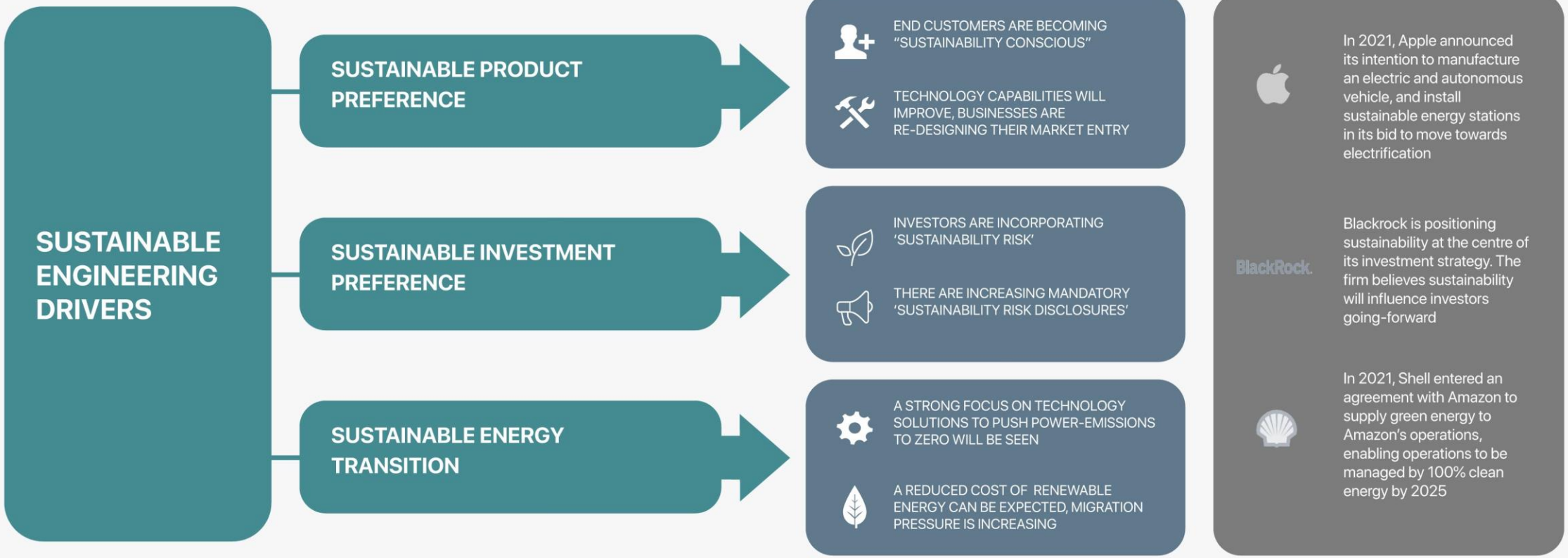
Based on green premium and level of adoption, enterprises can take a horizon view of technologies to achieve a carbon net-zero future

06

Enterprises need to re-assess and review detailed roadmaps using a horizon view of tech to achieve their sustainability goals

Source: Zinnov Research and Analysis

Sustainability initiatives are driven by both investor interest and a shifting consumer mindset



Source: Zinnov Research and Analysis

Z1000 enterprises are accelerating efforts to achieve a carbon net zero footprint as well

Microsoft invested **USD 1 Bn** towards its climate innovation fund in their bid to become carbon net zero by **2030**

Microsoft, Alphabet, Meta, Apple, IBM, Alibaba Group, Medtronic, vmware

Amazon has committed to an initial **USD 2 Bn** investment to meet their goal of carbon net zero emission by **2040**

amazon, PayPal, gm, Ford, PepsiCo, VISA, salesforce, verizon, P&G

Volkswagen seeks to have climate neutral mobility by **2050**

ORACLE, Volkswagen, Qantas, Barclays, bp, Nestlé

2030 — **2040** — **2050**

80%

Top 100 Z1000 enterprises have committed to a timeline to achieve carbon-net zero

USD 180 Bn

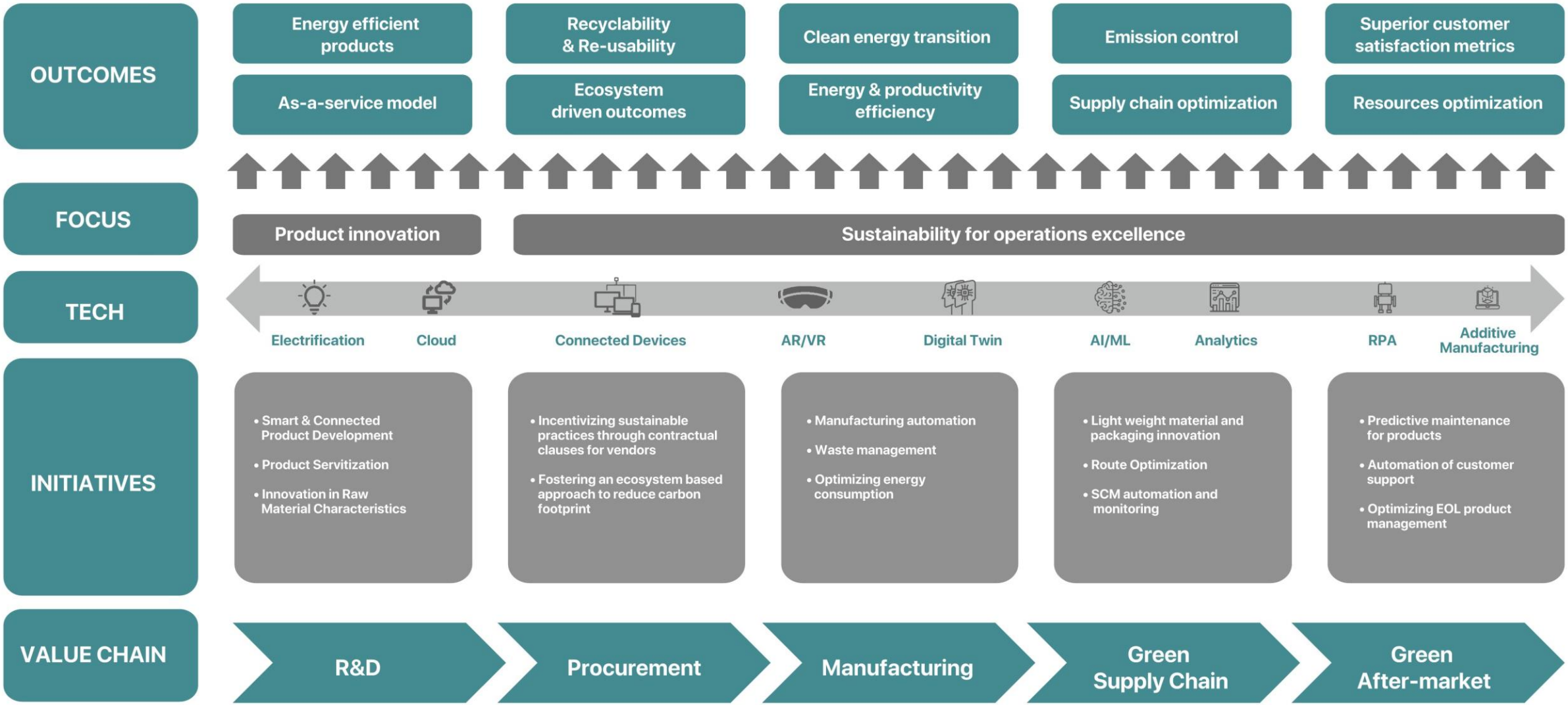
The amount of investments announced by the Top 100 Z1000 enterprises for carbon net zero initiatives

60%+

Investments from Top 100 Z1000 enterprises are from Manufacturing and Transportation enterprises

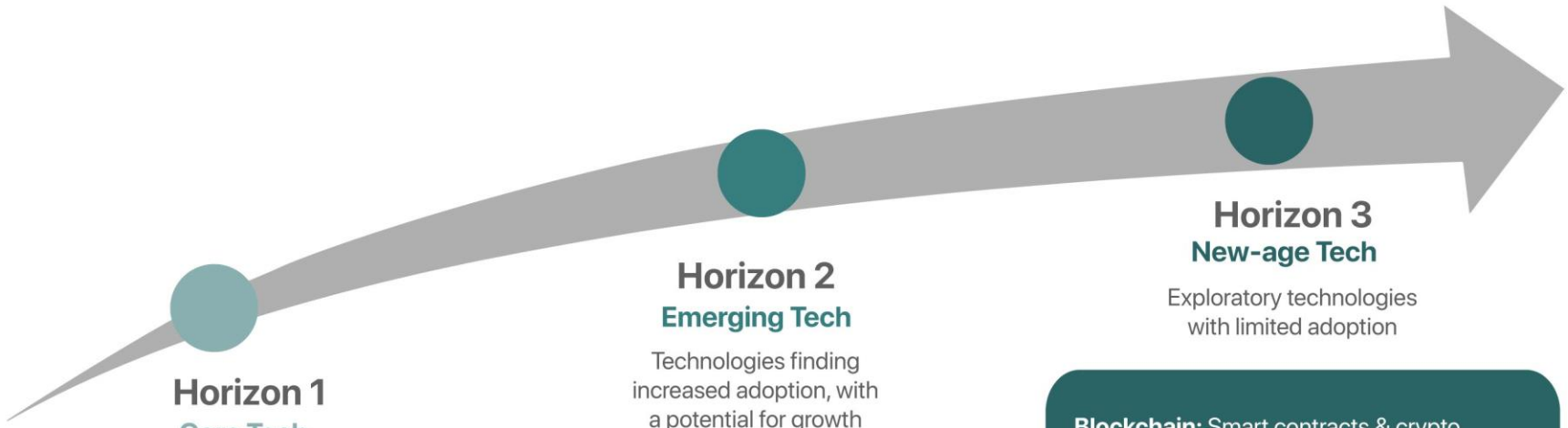
Source: Zinnov Research and Analysis, Zinnov Z1000 database

Sustainability engineering initiatives are focused on driving green outcomes in product innovation and operations – these are being underpinned by a digital engineering tech stack



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Based on green premium and level of adoption, enterprises can take a horizon view of technologies to achieve a carbon net-zero future



Horizon 1
Core Tech

Most widely used technologies to drive sustainability

AI/ML: Factory Automation, Predictive Monitoring

Cloud: Carbon Reduction, Energy Efficiency

Data & Analytics: Demand and Supply Forecasting, Resource Optimization

IoT/Connected: Emission Monitoring, Equipment Maintenance, Smart Alerting

Horizon 2
Emerging Tech

Technologies finding increased adoption, with a potential for growth

AR/VR: Remote inspections, Equipment Monitoring

Digital Twin: Process Monitoring Resource Optimization

Electrification: Powering Automobiles and Operations

Material Science: Water Efficient and Energy Efficient Product Development

Renewable Energy: Powering of Manufacturing and Supply Chain

Horizon 3
New-age Tech

Exploratory technologies with limited adoption

Blockchain: Smart contracts & crypto

Carbon Capture, Utilization and Storage (CCUS): Reduction of emissions from fossil power generation

Nuclear Energy: Low carbon-emission energy power

Photonics Network: Transmission loss reduction

Quantum Computing: Acceleration of R&D and processing

Horizon 1

- Involves a low Green Premium
- Has been significantly leveraged already by enterprises to achieve a carbon net-zero future
- Is seeing pervasive adoption by industries

Horizon 2

- Involves a moderate Green Premium
- Includes technologies that are increasingly gaining traction
- There is a significant interest by industries to explore use-cases

Horizon 3

- Has a High Green Premium
- Still is in exploratory stages by industries
- Holds a high future promise/potential for sustainability use cases

Source: Zinnov Research and Analysis

Enterprises need to develop and consistently review/re-assess detailed roadmaps to achieve sustainability goals

Clearly Define ESG Goals and Vision 01

Enterprises need to have a **clearly defined and well articulated vision** for sustainability with definite timelines and a roadmap for Carbon Net Zero Goals

Technology Assessment 02

Enterprises need to take a **horizon view for relevant technologies** and work towards solving green premium challenges and ensuring wider adoption

Prioritize/Re-Prioritize 03

Enterprises need to prioritize technologies that have **potential to create the highest impact** in their space and re-prioritize initiatives based on the horizon view

Governance 04

Enterprises need to **pre-define KPIs for performance assessment** and have steering-committees in place for governance and audits of ESG initiatives

Foster an Ecosystem-based Approach 05

Enterprises need to work with their **entire ecosystem** from vendors to customers to jointly solve sustainability related problems and work towards a **carbon net zero future**

Source: Zinnov Research and Analysis

Service Providers have been beefing-up capabilities in sustainability engineering to drive green outcomes

accenture

2025 Accenture to achieve net-zero emissions by 2025

- Partnered with Dassault Systemes to use digital twins. These will accelerate transformation to a circular economy
- (Minority) invested in Arabesque S-Ray which benchmarks & evaluates sustainability impacts and and Reactive Technologies which accelerates the transition to low-carbon energy

Key Focus Areas

Net Zero Transitions	Sustainable Cloud
Sustainable Value Chain	Analytics and Performance
Sustainable Customer Experience and Brand	Intelligent organization

Infosys

2020 Company achieved carbon neutrality in 2020

- Partnered with ASU Sustainable Urban Systems Lab, Ellen MacArthur Foundation, and MIT Blue Tech Barometer to drive sustainable outcomes for customers
- Built the platform ECOWatch to enable data capture, analysis of sustainability KPIs and ESG Metrics, water & waste management solutions, smart spaces, and circular commerce

Key Focus Areas

ESG Data and Analytics	Decarbonization
Smart Spaces	Sustainability Design Advisory
Automation	PLM Circularity

L&T Technology Services

2030 LTTS to achieve carbon and water neutrality by 2030

- Sustainability engineering is one its six "Big Bets" for growth
- There is a strong focus on a digital-engineering led approach to drive sustainability for clients
- The focus is on building and deploying IPs such as i-BEMs (Smart building optimization and experience design), ESMs (Utility monitoring) and Avertles (Predictive maintenance)

Key Focus Areas

Energy transition and management	Digital intervention
Water and waste management	Sustainability consulting
Circular product design	Climate action

Source: Zinnov Research and Analysis

The engineering Service Provider ecosystem is enabling enterprises to achieve their carbon net zero goals

ENTERPRISE	SERVICE PROVIDER	YEAR	TECH THEME	FOCUS AREA	ENGAGEMENT DESCRIPTION
Jaunt	LTTS	2022	SUSTAINABILITY	EV / CENTER SETUP	Has a multi-year USD 100 Mn+ deal with Jaunt Air Mobility. As part of the deal, LTTS will setup an R&D center in Quebec Province to provide engineering services for the eVTOL (electric Vertical Takeoff and Landing) air taxi
North America based pharmacy retailer	TCS	2022	SUSTAINABILITY	GREEN ENERGY	Deployed its Clever Energy AI-led platform at a client's 1,000+ retail stores that helped reduce emissions by 26%
GSE	Accenture	2022	SUSTAINABILITY	GREEN ENERGY	Deployed an EV Mobility Service Platform (EVSP) and a blockchain solution to incentivize end-users to use green energy powered EV charging stations
WIND my ROOF	Segula	2021	SUSTAINABILITY	GREEN ENERGY	Provided engineering support for design, conception and assembly of wind turbines
European car manufacturer	KPIT	2021	SUSTAINABILITY	EV	Made a USD 52 Mn deal spread across 5 years in the electric powertrain domain. KPIT is providing software development and integration support
Daimler	Infosys	2021	SUSTAINABILITY	GREEN DATA CENTER	Infosys helped transfer Daimler's High-Performance Computing (HPC) workloads that are used to design vehicles and automated driving technologies, to one of Europe's green data centers Lefdal Mine Datacenter in Norway
STILRIDE	Semcon	2020	SUSTAINABILITY	SUSTAINABLE MANUFACTURING	Provided product design and sustainable manufacturing techniques by leveraging robots
HyperloopTT	Capgemini	2020	SUSTAINABILITY	HYPERLOOP TRANSPORTATION	100+ engineers are supporting the development of a client's commercialized passenger hyperloop systems

Source: Zinnov Research and Analysis, Zinnov ER&D deals database

The unabated rise of Digital Engineering

01

Macro factors, advancements in tech, and a pervasive adoption of use-cases have led to accelerated Digital engineering spend

02

Digital Engineering spend will account for more than half of the ER&D spend in 2025. It will be as high as 2018's overall ER&D spend

03

The relentless rise of digital engineering is altering the pecking order of ER&D spend by verticals

04

Services-led and hi-tech led verticals will surpass overall ER&D spending by manufacturing verticals in the next year

05

The divide between North America's ER&D contribution and RotW is increasing as firms in the NA region have a higher DE intensity

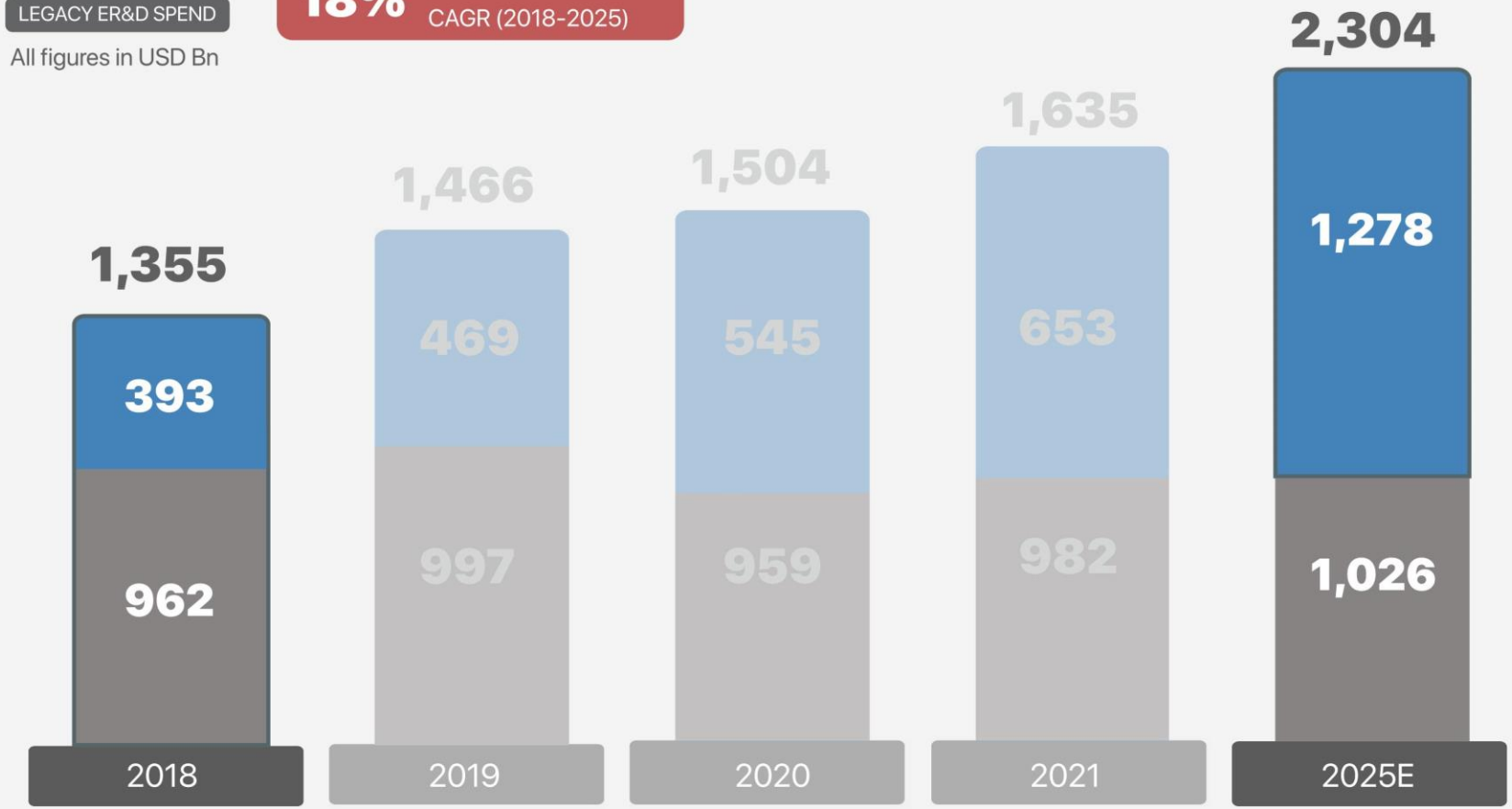
Source: Zinnov Research and Analysis

In an optimistic scenario, Digital Engineering spend in 2025E will be nearly as high as the overall ER&D spend of 2018

A

DIGITAL ENGG SPEND
LEGACY ER&D SPEND
All figures in USD Bn

18% DIGITAL ENGINEERING CAGR (2018-2025)



55%

Contribution of Digital engineering spend towards overall ER&D spend in 2025E

~2x

The amount the Digital Engineering spend is set to increase by, in the next 4 years

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Digital Engineering spend is accelerating across industries

A

2021
2025E
CAGR

USD 653 Bn
DIGITAL ENGINEERING SPEND (2021)

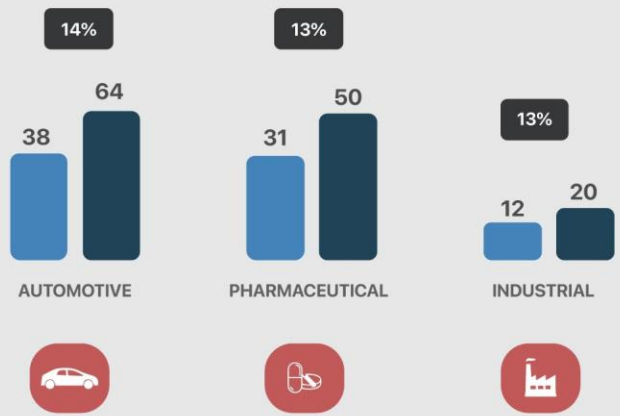
18% CAGR

USD 1,278 Bn
DIGITAL ENGINEERING SPEND (2025E)

~2x
Digital Engineering spending is set to increase by 2x in the next 4 years, crossing USD 1.2 Tn by 2025

MANUFACTURING

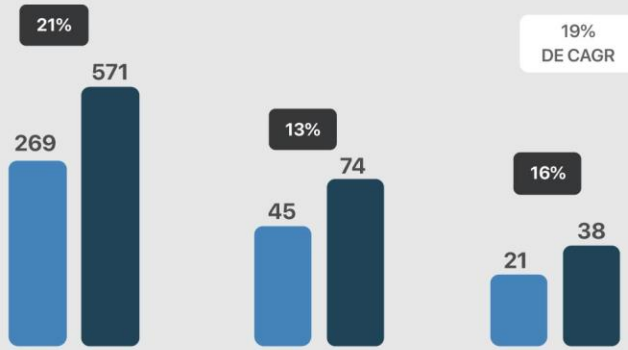
13% DE CAGR



Connected & autonomous vehicles	Wearables	Industry 4.0
Electrification	Remote Patient Monitoring	Smart Services

HI-TECH

19% DE CAGR



AI/ML	5G	IoT
Metaverse	SDN/NFV	AI/ML

SERVICES-LED

20% DE CAGR



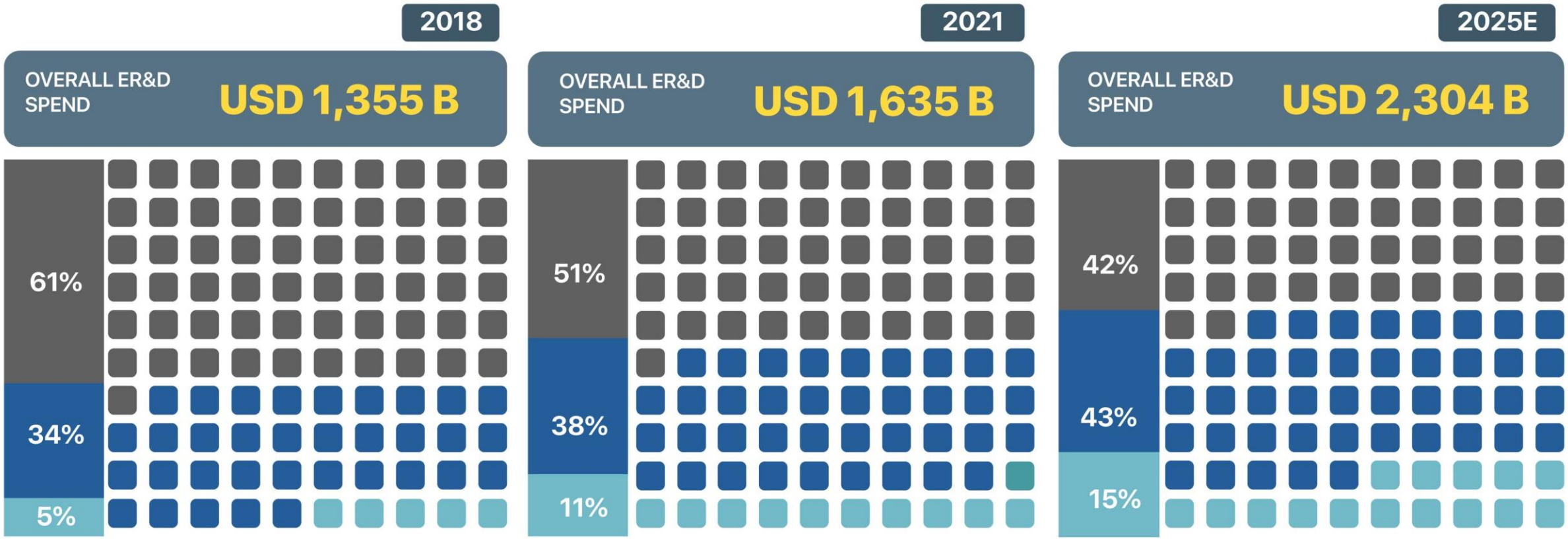
Robot advisory	Contactless Retail	Telemedicine
Fraud Detection	AR/VR	Remote Monitoring

Source: Zinnov Research and Analysis, Zinnov Z1000 database

*Healthcare Payers and Providers

The relentless focus on Digital Engineering is helping Hi-tech and Services-led verticals exceed the ER&D Spend of manufacturing-led verticals

OPTIMISTIC SCENARIO



- The increasing focus on digital initiatives by Hitech and Services led firms has resulted in a greater share of these verticals towards the overall ER&D spend
- Adoption of new-age themes such as 5G, Tele-X, Metaverse, AI/ML have further buoyed the digital engineering spending by Hitech and services led firms

Manufacturing-led verticals Hitech-led verticals Services-led verticals

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Topics

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A	The unabated rise of digital engineering fueled by macro factors (Rise in defense, increased semiconductor usage, Focus on sustainability)
B	Technology pillars (5G, Digital Thread, Metaverse, and Cloud/AI) of digital engineering
C	Industry Deep-Dives and ER&D Spend trends and priorities
D	Addressed market and Service Provider opportunities
E	Talent wars for digital engineering talent
F	Growth levers for Service Providers
G	Zinnov Zones 2021 ER&D Ratings

Source: Zinnov Research and Analysis

Going forward, 4 key themes will drive spending for the ER&D market



METAVERSE



5G



DIGITAL THREAD



CLOUD & AI

Source: Zinnov Research and Analysis

Summary of Tech themes (1/2)

OPTIMISTIC SCENARIO

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METAVERSE

- Rising investor interest and investments from large tech firms are spotlighting the Metaverse
- The Metaverse ecosystem is growing and expanding beyond gaming use-cases. Sales and customer engagement has emerged as a key theme/use-case in this space
- Currently, uncertain ROI and integration challenges plague adoption levels by enterprises
- While still at a nascent stage, leading Service Providers are building on existing capabilities to cater to Metaverse use cases



5G

- 5G is enabling a plethora of use-cases across industries that mandate diverse and dynamic network requirements
- Entities across the ecosystem are working on multiple 5G enabling features and solutions
- Network slicing, Edge Computing, and V2X will dominate Service Provider opportunities when it comes to 5G engineering services
- The last couple of years have witnessed multiple enterprises leaning on the Service Provider ecosystem for 5G requirements

Source: Zinnov Research and Analysis

Summary of Tech themes (2/2)

DIGITAL THREAD

- The digital thread is already transforming the way products are designed, manufactured, and serviced
- Smart manufacturing and smart tracking capabilities are already table stakes for enterprises across verticals
- The focus on factory automation in a post-pandemic era has witnessed multiple large manufacturing firms accelerate adoption by leveraging the engineering Service Provider ecosystem
- Enterprises have been leaning on the Service Provider ecosystem for digital thread-led initiatives

CLOUD & AI

- Enterprise demand for cloud serves as the nucleus for increased adoption
- Enterprises across verticals leverage the cloud for industry specific use-cases with varying adoption levels
- Z1000 enterprises have been aggressively enhancing their cloud capabilities
- Service Providers are significantly leveraging hyperscaler partnerships to tap into outsourcing opportunities and enable faster GTM for enterprises

Source: Zinnov Research and Analysis

Rising investor interest and investments from large tech firms is pushing Metaverse to the forefront

METAVERSE

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Web 2.0 versus Web 3.0 approach to the Metaverse

	Web 2.0	Web 3.0
Data Storage	• Centralized	• Decentralized
Content Interaction	• Read-Write	• Read-Write-Own
Portability	• Locked within Platform	• Transferable
Activities	• Socialization • MMORPG/eSports • Streaming	• Same as Web 2.0 • Experiences • Play-to-earn games
Infrastructure	• Cloud & Mobile	• Blockchain Cloud, Immersive Hardware
Payments Infrastructure	• Traditional payments (e.g., credit/debit card)	• Crypto wallets, Tokens

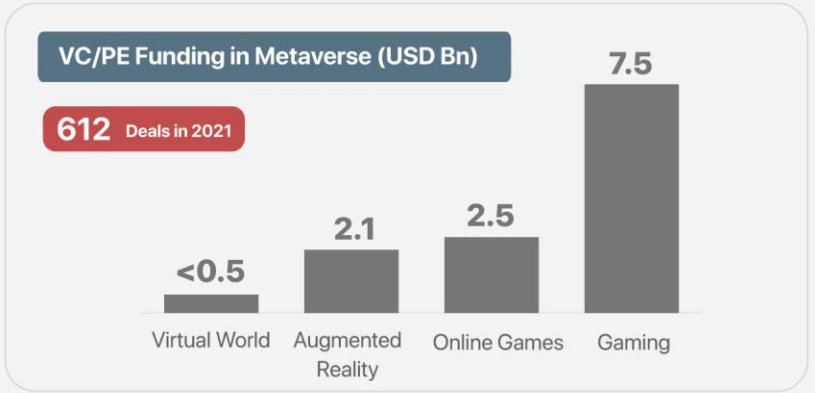
Evolution of Metaverse

The concept of a Metaverse is not a new one. The onset of COVID-19 powered digital third spaces and the inflection of new technologies - AR/VR, Digital Currencies, NFTs, 3D Avatars, which improve the user experience and drive the potential of Metaverse.

$2.4 Mn worth of virtual real estate sold on Decentraland

34 Mn VR headset installations worldwide by 2024

45+ Mn people attended Travis Scott's Astronomical tour in Fortnite



USD 10 Bn

Spend by Metaverse on AR/VR for developing Metaverse apps and services

USD 13 Bn

VC/PE funding on Metaverse focused projects driven by Virtual world, AR/VR, and Gaming

Source: Zinnov Research and Analysis

The lexicon of Metaverse is still evolving, it promises an immersive digital experience that aims to seamlessly blend both physical and virtual worlds

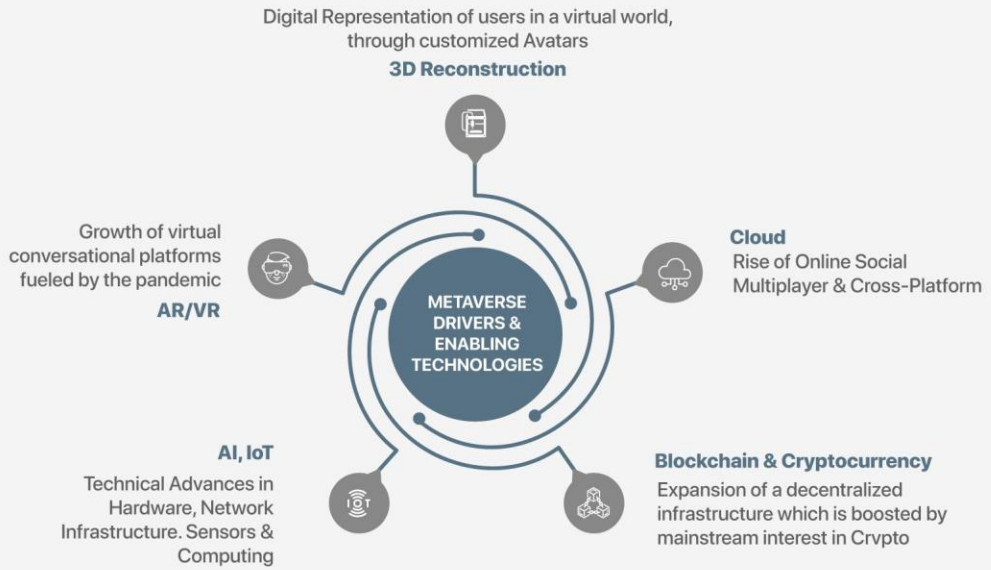
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Metaverse Definition

The Metaverse is a seamless convergence of physical and digital worlds that embodies a unified, virtual community where people can work, play, relax, transact and socialize. Digital items such as land, buildings, items and avatars can be created, bought and sold.

Metaverse Drivers & Enabling Technologies



Key Metaverse Characteristics

P — Persistent
The Metaverse is continuously active whether people are online or offline

U — User-Defined
It is owned and shaped by the people living, creating, connecting and participating in it

B — Bridge
It links both the physical and digital worlds

L — Limitless
No cap to number of users, experiences or worlds. Available in real-time for all

I — Immersive
Users can achieve a realistic sensory experience with extended reality (XR tools)

C — Creative
People actively engage with content rather than passively consuming it

Source: Zinnov Research and Analysis

The Metaverse Ecosystem is growing and expanding beyond gaming use-cases

METAVERSE

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What makes the Metaverse?

Experience Layer
(Use-Cases)*

- **Virtual Theme Parks** (Disney Metaverse Theme Park)
- **Virtual Concerts/Events** (Travis Scott's Fortnite Concert)
- **Virtual Fitness** (Supernatural, FitXR and Holofit)
- **Digital Wellness** (Apollo VR patient engagement)
- **Virtual Land** (Decentraland, Sandbox)
- **Virtual Store/Showroom** (H&M Virtual Reality Store)
- **Immersive Learning** (Ohio University Virtual Land)
- **Virtual Tourism** (Google's Great Wall of China Virtual Tour)
- **Immersive Games** (Fortnite, Axie Infinity)
- **Virtual Broadcast** (Australian Open Virtual Hub)
- **Virtual Workroom** (Meta Horizon Workrooms)
- **Virtual Training** (VR employee training)
- **Digital Twins** (BMW Hungary Factory)

Interaction Layer
(Platforms of Engagement)

- **Mobile Devices**
- **Web Browsers**
- **AR-VR Headsets / Smart Glasses**
- **Wearables**
- **Displays / Next-Gen TVs**

Interoperable data & standards

Technology Layer
(Enabling Technologies)

- **AR/VR:** Create virtual & immersive digital worlds
- **Artificial Intelligence:** To automate landscapes, buildings, avatars, non-player characters (NPCs)
- **IoT:** Seamlessly connect to a vast number of devices for real-time simulations
- **Blockchain & Crypto Currency:** Support decentralized data transmission & finance applications
- **3D Reconstruction:** Create realistic spaces, buildings, objects, avatars and physical locations

Infrastructure Layer

- **Distributed Cloud | Decentralized Cloud:** High degree of computing power combining cloud, edge, local and blockchain computing
- **Network & Hardware (Chips):** 5G/6G High bandwidth, low latency network capabilities, high performance & miniature hardware

Source: Zinnov Research and Analysis

Several factors are impeding large scale adoption across enterprises

METAVERSE

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Uncertain ROI

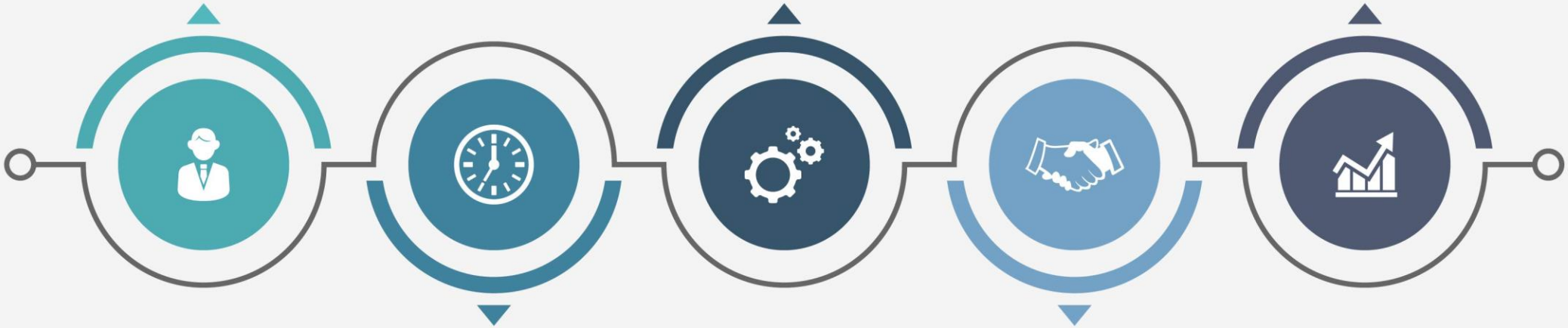
The Metaverse landscape is still evolving, making it difficult to develop compelling business cases for investment

Skill Gap

Skill gaps of existing staff in emerging technologies, such as AR/VR, Blockchain, etc. act as barriers to adoption

Cyber Security

There are Cybersecurity challenges, such as phishing, malware and hacking, potentially exposing vulnerabilities of VR headsets or avatars



Integration Challenges

There are integration challenges due to device interoperability and little standardization across multiple technology platforms

Regulatory Landscape

The regulatory landscape is still uncertain and there is volatility around crypto currencies and cross-border data flows

Source: Zinnov Research and Analysis

Leading Service Providers are investing in capabilities to cater to Metaverse requirements

METAVERSE

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Investment Areas

Solutioning / PoCs

- Invest in Co-innovation Labs & CoEs to build innovative solutions and Proofs of Concept (PoCs).
- Start creating PoCs around high potential applications such as:
  1. 3D Space / Avatar Development
  2. AR/VR Application Development
  3. Decentralized/DeFi Platform Development

Infosys

Infosys launched its Metaverse Foundry, a set of **100 ready-to-use** templates and use cases

Proprietary IPs

- Build 'Reusable' IPs such as products & frameworks to enhance competitive differentiation and support innovation use-cases.
- Invest in use-cases that always start off as a niche and then grow into the mainstream

accenture

Accenture has filed **600+ Patents** across the Metaverse Ecosystem

The Ecosystem

Leverage the ecosystem by partnering with new-age startups to build Metaverse use-cases.

DXC TECHNOLOGY

DXC partnered with **Microsoft Holo Lens** to support immersive experiences

Talent Skilling

The skill gap is a major challenge for enterprises in building AR/VR, Blockchain, 3D/Avatar technologies. Key skills Service Providers need to focus on how to upskill and hire new talent in:

- Blockchain & Crypto
- UI/UX
- AR/VR
- AI/ML

Tech Mahindra

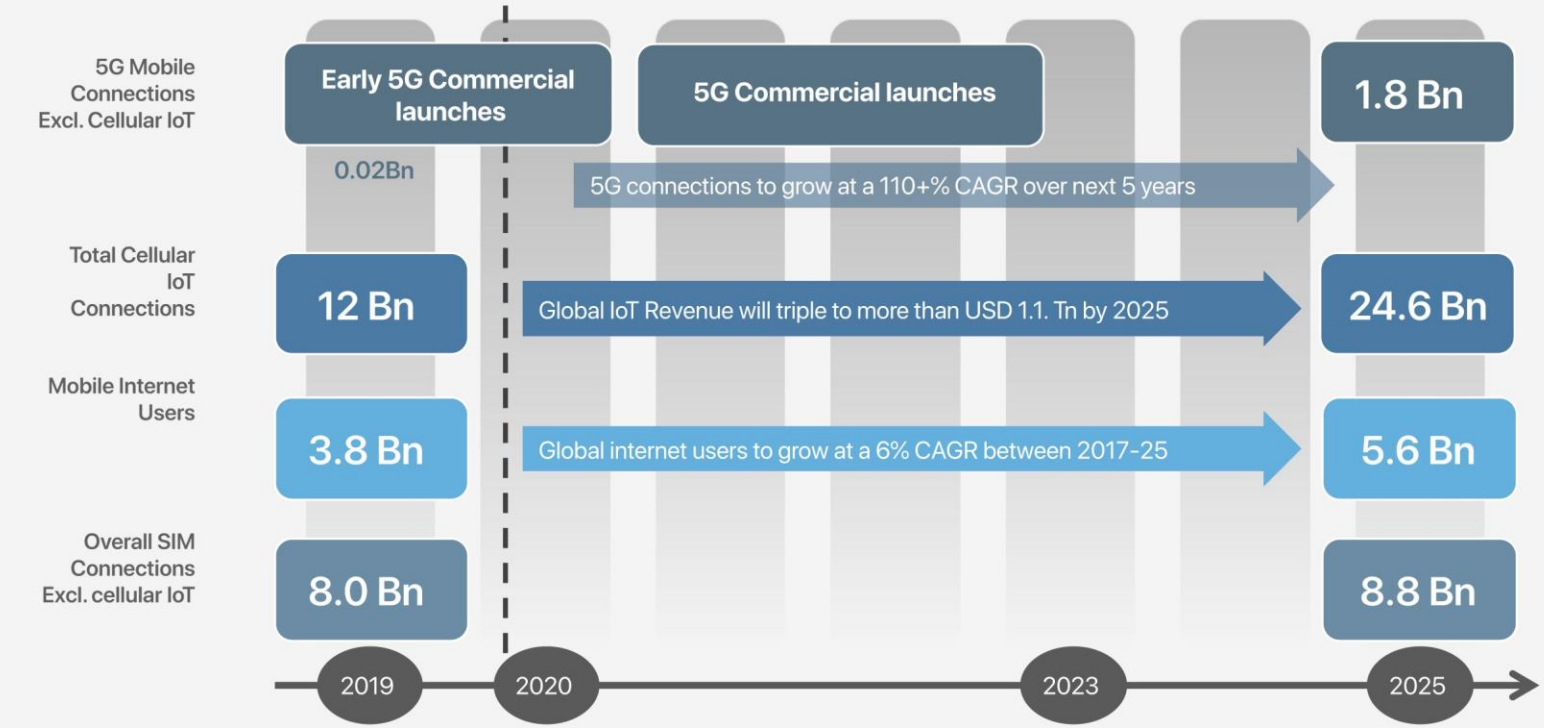
Has a **500+ team** of in-house talent who will be trained in NFT, AI, AR/VR, and Spatial Computing technologies

Source: Zinnov Research and Analysis

We are moving into the 5G era. Here are some observations:

5G

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MASSIVE FIRST STEPS

First telco in the world to offer 5G services in 2018

Start working with ~20 ODMs on 5G mobile devices

Qualcomm

SAMSUNG

Includes 5G capability in its Galaxy S10

Will pilot testing capabilities for the 5G standard in industrial conditions

NOKIA

HIGHLIGHTS

1. By 2026, 5G is estimated to account for 40% of all mobile connections i.e., 3.5 Bn subscriptions
2. 80% of CSPs' mobile capex investment [USD 1.1 Tn] from 2020-25 will be in 5G
3. Advanced device chipsets & Dynamic Spectrum sharing will accelerate market adoption

OUTLOOK

SHORT TERM 2020-22	US, China, Japan & South Korea lead the way and the coverage will evolve
MEDIUM TERM 2023-24	5G will accelerate in Europe, India & the Middle East. Use cases across industries will be enabled.
LONG TERM 2025 & Beyond	5G will gather steam in Latin America and Africa

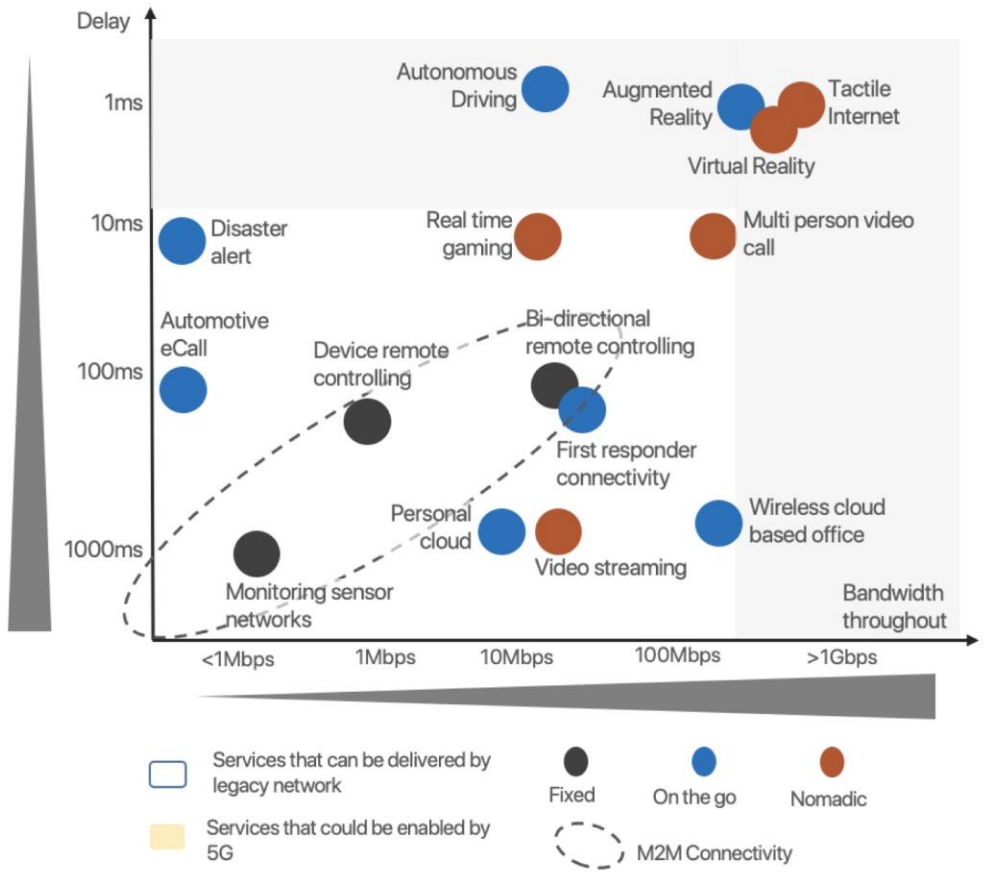
| GSMA Intelligence, Industry estimates

* Cellular IoT included within total connection | # Exabyte per month

Source: Zinnov Research and Analysis

The current use cases have demanding, diverse and dynamic network requirements

5G



GE Healthcare has partnered with SK Telecom to establish 5G enabled solutions

Sandvik has partnered with Nokia to deliver Industrial IoT to the mining industry over LTE and 5G Networks

BMW, along with Vodafone & Ericsson are working on 5G-based communication for future connected cars

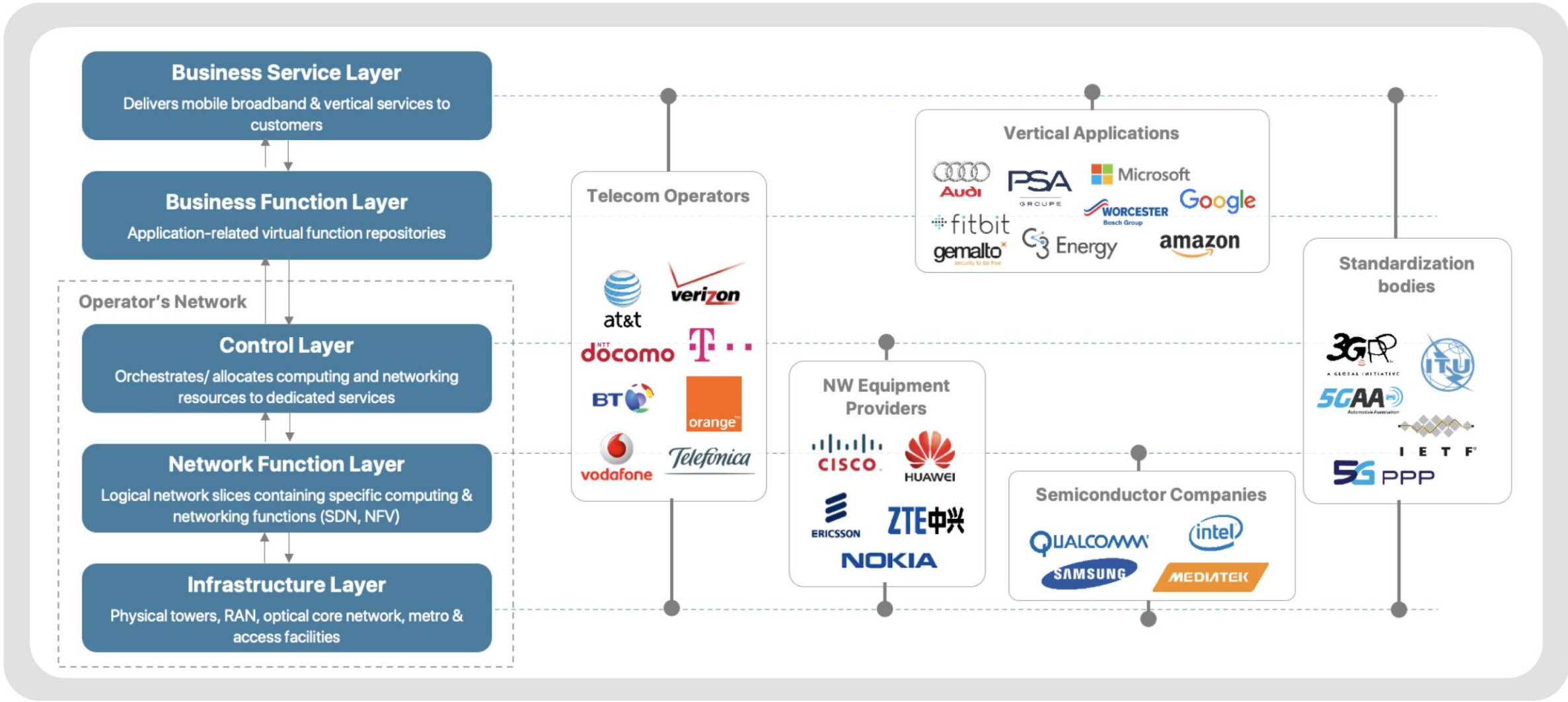
Amazon received FAA approval for Prime Air, an autonomous package delivery-via-drone service, in Aug'20

The 5G network facilitated online medical consultation. 5G has played a crucial role in treatment of severe cases of novel coronavirus and sharing experiences nationwide and worldwide.

Source: Zinnov Research and Analysis

Companies across the value chain have geared up to ride the 5G opportunity

5G



Source: Zinnov Research and Analysis

5G use cases provide major opportunities for ER&D Service Providers to gain more wallet share

5G

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SERVICE PROVIDER OPPORTUNITIES – 5G USE CASES

01 NETWORK SLICING

Network Slicing is expected to create value worth USD 16 Bn with Private Networks by 2025

HCL
Provides Zero touch VNF onboarding, Network Slices creation and service activation on a distributed NFV Telco Cloud

TCS
Hosts OpenStack integration and support capabilities with network slicing as a primary application

02 EDGE COMPUTING

Engineering spend on **Edge Computing** by telecom players is 7x more that the spend on any other use case

Capgemini
Capable of bringing applications to the edge platform with toolkits and API offerings

HCL
Provides edge computing capabilities, zero touch deployments and interoperability

03 5G C-V2X

~85% of all new cars will have telematics by 2025, **5G C-V2X** will play a crucial role in enabling several functionalities

Capgemini
Hosts end-to-end offering including software, hardware integration and telematics platform

TCS
Developed initial POCs to push traction in the C-V2X space

04 DISAGGREGATED NETWORKS

Disaggregated Networks will be the primary enabler of cost arbitrage driving 5G adoption

Infosys
Partnered with Comcast to introduce an open-source software that controls disaggregated white-box hardware

Tech Mahindra
Has experience in deployment of vRAN solutions

Source: Zinnov Research and Analysis

Across the value chain, the digital thread is incorporating intelligence at every step and enabling outcomes by combining next-gen technology into the process

DIGITAL THREAD

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Outcomes

Key Transformation Themes

Smart design

Product Design & Development

- Assisted Design
- Rapid Prototyping
- Accelerated Development

Smart manufacturing

Manufacturing

- Digital Analytics for process improvement
- Manufacturing robots
- AI/Analytics based quality control
- Predictive Maintenance
- Workplace Safety & Employee Training

Smart supply chain

Supply chain

- Life Cycle Management
- Inventory optimization
- Intelligent Procurement
- Fleet management

Smart insights

After sales

- Enhanced customer engagement & satisfaction
- Enabling product-as-a- service business models
- Usage based monitoring for insights

Smart services

Customer support

- Improved service technician effectiveness
- Reduced asset downtime
- Faster mean time to resolution

Enablers

IT/OT Integration through Digital Thread

The Digital Thread connects digital and physical worlds by creating a flow of information about a product's performance and use from design to production, sale, use and disposal

Industry 4.0 Technology Stack

- **Automation:** Autonomous Robots
- **AI/ML/Data:** Big Data, AI/ML Models
- **Additive Manufacturing**
- **Connectivity:** Internet of Things, 5G, Cyber- Physical systems
- **Augmented Reality, Simulation**
- **Cyber security**

Platforms/Applications

- Manufacturing Execution Systems
- IIOT Platforms
- Customer Facing systems
- Additive manufacturing platforms
- Data Analytics & Visualization platforms
- Surveillance and Security Systems

Source: Zinnov Research and Analysis

Enterprises have been leaning on the Service Provider ecosystem for digital thread-led initiatives

DIGITAL THREAD

ENTERPRISE	SERVICE PROVIDER	YEAR	TECH THEME	FOCUS AREA	ENGAGEMENT DESCRIPTION
Baker Hughes	Accenture	2022	DIGITAL THREAD	ASSET MONITORING	• Accenture provides product innovation, design, development, and strategic support and systems integration for Baker Hughes' industrial asset management (IAM) solutions. Accenture will collaborate with C3AI and Microsoft to develop and deploy IAM solutions
Automotive Tier 1	Tech Mahindra	2020	DIGITAL THREAD	SMART MANUFACTURING	• Tech Mahindra provides Industry 4.0 related services in 50+ manufacturing plants to implement IoT technologies and analytics
Terega	AKKA	2021	DIGITAL THREAD	DIGITAL TWIN	• AKKA is developing digital twin solutions for Terega's multiple facilities
Global food processing firm	LTTS	2021	DIGITAL THREAD	PLANT ENGINEERING	• LTTS signed a multi-year deal to provide plant engineering design services for the client's facilities in Europe and North America
CNH Industrial	Accenture	2020	DIGITAL THREAD	PREDICTIVE MAINTENANCE	• Accenture entered into a five-year agreement that will focus on new services such as computer-aided farming, predictive maintenance, enhanced fleet management, and green transportation
SNCG	Capgemini	2020	DIGITAL THREAD	REMOTE MONITORING	• Capgemini is deploying its solution to optimize supervision of rail networks • The solution will remotely monitor railway networks to detect any technical failures in the tracks
TEPCO	NTT Data	2020	DIGITAL THREAD	REMOTE MONITORING	• NTT Data developed a route platform for drones enabling advanced equipment monitoring

Source: Zinnov Research and Analysis, Zinnov ER&D deals database

Enterprise demand for cloud serves as the centerpiece for increased adoption

CLOUD & AI

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Key trends shaping the Cloud landscape

Serverless: The new normal

20%+ of global organizations have adopted serverless computing technologies which offer a faster time to market

DRaaS: On-demand disaster recovery

Demand for DRaaS has increased. Organizations are trying to avoid **downtime costs of USD 300K/hr** and instead expand their disaster recovery planning

Rising demand for containers

75%+ of organizations will be running containerized applications in their production by 2022, up from less than 30% in 2020

HPC workloads in public cloud

High Performance Computing (HPC) users in the cloud have increased, to ease bottlenecks in accessing resources

Hybrid cloud: Emerging opportunity

90% of organizations will have deployed a hybrid cloud model by 2024, fueled by factors such as cost efficiency, scalability and agility

Security first approach

To reduce the risk of data leaks and ransomware attacks, the demand for cloud security is increasing. It will exceed **USD 12 Bn by 2025**

Key drivers for enterprise cloud adoption

Low upfront cost
Subscription based model results in 15 – 20% lower initial costs

CapEX to OpEX
40-50% reduction in costs by shifting to the OpEX approach

Scalability and flexibility
Cloud platforms offer scalable and flexible usage based on demand

Efficiency
30-40% increase in employee productivity leading to increased engineering efficiency

Mobility
Cloud solutions with over 99% uptime can be accessed remotely on any device

Emerging tech
New technologies promise advanced capabilities like AI, IoT, etc. that companies can gain from

Source: Zinnov Research and Analysis

Z1000 enterprises have been aggressively enhancing their cloud capabilities

CLOUD & AI

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TALENT	Actively investing in building in-house Public Cloud talent for building internal capabilities to innovate on cloud scenarios	**13%** YoY growth in Cloud talent
CENTER OF EXCELLENCE	Establishing dedicated centers to push innovation through modern technologies (Cloud) across business functions	**47%** of enterprises have dedicated Cloud COEs
SOFTWARE TECH COMPANIES	Collaborating with software tech firms for different cloud related solutions	**800+** software tech firms are working with Z1000 US companies on Public cloud initiatives
SERVICE PROVIDERS	Engaging with Service Providers	Cloud solutions are being used in different business processes with the help of Service Providers
COLLABORATION STRUCTURE	Active collaborations with ecosystem enablers to excel and expand AI capabilities for the future	Enterprises are collaborating/investing with cloud Start-ups, more than ever

Source: Zinnov Research and Analysis

Service Providers are significantly leveraging hyperscaler partnerships to tap into outsourcing opportunities and enable faster GTM for enterprises

CLOUD & AI

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Key Hyperscale players

Microsoft Azure

Google Cloud

aws

Potential areas to jointly develop and take to market

360-degree platform partnership

Provide platform engineering support to developing solutions for and with hyperscaler platforms – these can then be taken to the marketplace

SaaS based industry-specific solutions

Industry-specific solutions built on hyper scale platforms create "client stickiness" due to proprietary architecture and custom APIs

Cloud-native digital product development

Example: EPAM developed a solution for Equifax to deliver real-time credit data to financial institutions, leveraging Google Cloud as the hyperscale platform

Product development on Hybrid & Private cloud

Leverage deep experience in deploying and managing on-premise and private cloud architecture, to co-develop hybrid and private cloud-based solutions

Source: Zinnov Research and Analysis

Enterprises have been prioritizing their FUTURE investments that will help build next-gen AI capabilities

CLOUD & AI

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SHIFTING FUNDING INTENSITY

- **APAC** will be the next AI innovation centre
- With a **173% YoY growth** in AI funding, it has surpassed North America in investments

BUDDING TALENT HUBS

- With **2X** growth in **AI talent** and **10k+** job openings, **China** will be the next **AI talent Hub** in the next 2-3 yrs.

REIMAGINING EXPERIENCES

- AI will integrate with other new age technologies such as Blockchain, metaverse, etc. to enable a **unified and cohesive user experience**
- Over **20%** of total enterprises are incorporating **AI** in **metaverse** to facilitate an engaging customer experience



PROLIFERATING UNICORNS

- **100+ Unicorns** expected in the next 2-3 years
- Start-ups providing AI solutions in **horizontal operations** are likely to achieve higher valuations

PRE-BUILT USECASE SPECIFIC APPLICATIONS

- Demand for use case specific **pre-built AI applications** will proliferate as **70%** of the enterprises plan to scale and deploy AI with faster time-to-market

ENABLING SUSTAINABILITY

- AI will take centre stage in achieving net-zero goals.
- **Over 60%** of the total enterprises have resorted to **AI tools** to track their **carbon footprint** & opt for sustainable operations

Source: Zinnov Research and Analysis

SPs with mature cloud and AI-led services have been winning significant large deals; Platform engineering services have remained the key outsourcing area

CLOUD & AI

ENTERPRISE	SERVICE PROVIDER	YEAR	TECH THEME	FOCUS AREA	ENGAGEMENT DESCRIPTION
Roku	GlobalLogic	2022	CLOUD & AI	CLOUD / OTT	• Developed 150+ applications for Roku's OTT platform • Cloud testing for performance and scalability, cross-platform app creation and QA are some of the outsourcing workloads
Australian Banking Org	HCL	2021	CLOUD & AI	CLOUD / PLATFORM ENGINEERING	• Multi-year contract where HCL is helping the client in platform engineering and support, automation, modernization of key platforms, and cloud transformation
ZF	TCS	2021	CLOUD & AI	ADAS	• Supporting ZF's ADAS program by leveraging its expertise in AI/ML to develop "Autonomous Vehicle Data Annotation and Analysis Framework"
Mavenir and NVIDIA	LTTS	2021	CLOUD & AI	AI/5G	• Supporting Mavenir with customization, integration and deployment of AI applications on NVIDIA's AI-on-5G unified platform
Global information services firm	HCL	2021	CLOUD & AI	CLOUD / PLATFORM ENGG.. / CENTER SETUP	• Setting up nearshore center in LATAM to help the client build capabilities across platform development and modernization, cloud migration and back-office support
Disney Studio	Accenture	2021	CLOUD & AI	CLOUD / IMMERSIVE	• Developing interactive movie posters that incorporate digital technologies, including cloud and OLED displays to provide an immersive content experience

Source: Zinnov Research and Analysis, Zinnov ER&D deals database

Topics

A The unabated rise of digital engineering fueled by macro factors (Rise in defense, increased semiconductor usage, Focus on sustainability)

B Technology pillars (5G, Digital Thread, Metaverse, and Cloud/AI) of digital engineering

C Industry Deep-Dives and ER&D Spend trends and priorities

D Addressed market and Service Provider opportunities

E Talent wars for digital engineering talent

F Growth levers for Service Providers

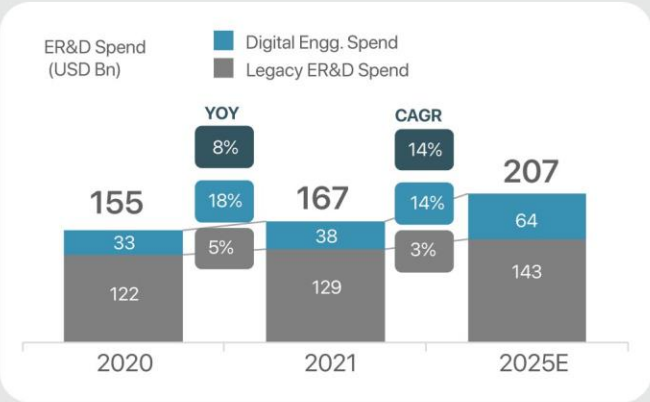
G Zinnov Zones 2021 ER&D Ratings

Source: Zinnov Research and Analysis

Manufacturing-led Verticals Summary – Automotive, Industrial, Aerospace & Defense

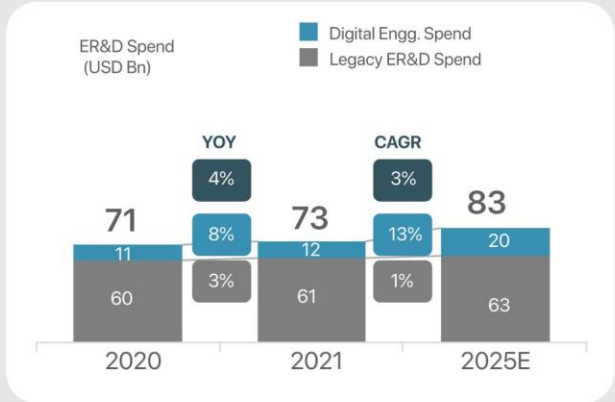
MANUFACTURING

AUTOMOTIVE



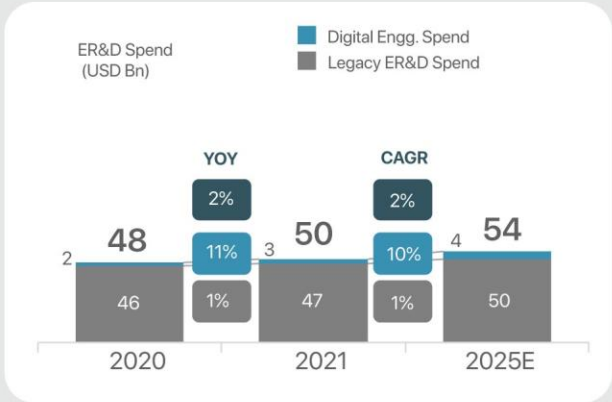
- The sector witnessed a faster than expected recovery cycle and carmakers continue to invest across CASE
- ER&D spend in the automotive space will exceed USD 200 Bn by 2025; Spending is consolidated with the top 10 firms and 50% of the geo-wise spend is from Europe
- Carmakers are struggling to hire software talent fast enough and are increasingly partnering with SPs for CASE initiatives
- More than 1/3rd of all automotive deals signed during the last 5 years had elements of CASE

INDUSTRIAL



- IT/OT convergence is enabling real-time manufacturing insights which in turn is helping enterprises incorporate digital thread as the back-bone
- VCs are increasing investments in digital thread-led startups as well in a bid to fortify the ecosystem
- Service Providers are playing a key role in helping enterprises build "Factories of the future"; Manufacturing Ops and field services have dominated Service Provider opportunities in the last 2 years

AEROSPACE & DEFENSE



- The sector was one of the most hit during the pandemic; The defense segment is leading recovery and no major changes are expected in R&D priorities for commercial aerospace
- Tectonic shifts in geo-political landscapes have contributed to increased public defense spending
- Suppliers of defense equipment are witnessing increased valuations and are beefing-up spend
- AI/ML, autonomous unmanned systems, digital twins, quantum tech, space & 5G comms have all emerged as key R&D focus areas

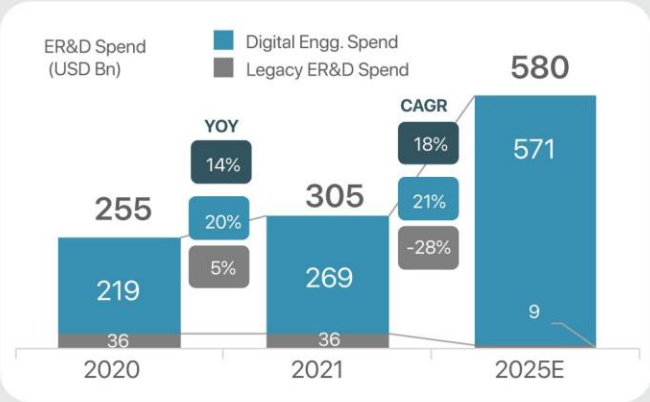
Source: Zinnov Research and Analysis, Zinnov Z1000 database

*CASE: Connected, Autonomous, Shared and Electrification

Hitech-led Verticals Summary – Software & Internet, Semiconductor, Telecom

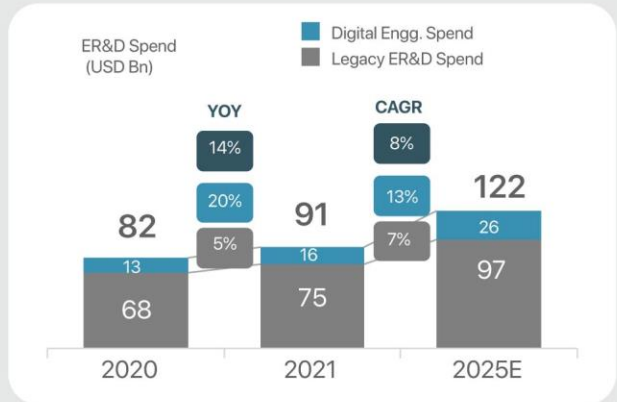
HITECH

SOFTWARE & INTERNET



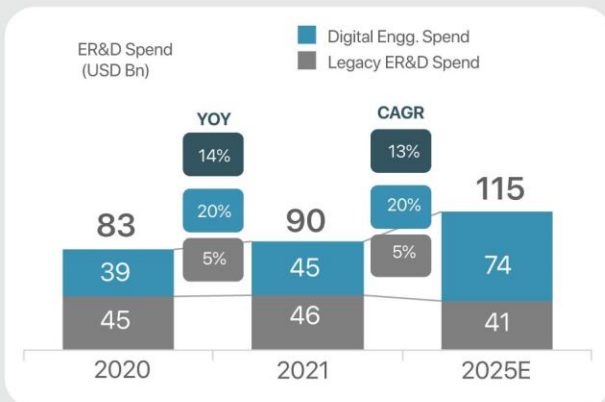
- Software & Internet is the largest vertical when it comes to ER&D spending. Spending is highly consolidated with large tech giants (GAMMA+BAT) and they cumulatively account for close to half of the vertical spending
- While cloud, big data, and AI/ML continue to remain focus areas for the large giants, Metaverse is increasingly gaining centerstage
- SPs need to take a two-pronged approach to garner greater wallet share. I.e- focus on large tech giants as well as leverage alternate channels such as PE to win deals

SEMICONDUCTOR



- Large enterprises across verticals have pervasively begun to design chips in-house to differentiate from competition and accelerate time to market
- Increase in new markets for Semicon has resulted in shortening NPD cycles; Disaggregated chip design is enabling faster and cheaper NPD
- The surge in demand for chips has strained the Semicon ecosystem and it now requires interventions to keep with the demand

TELECOM



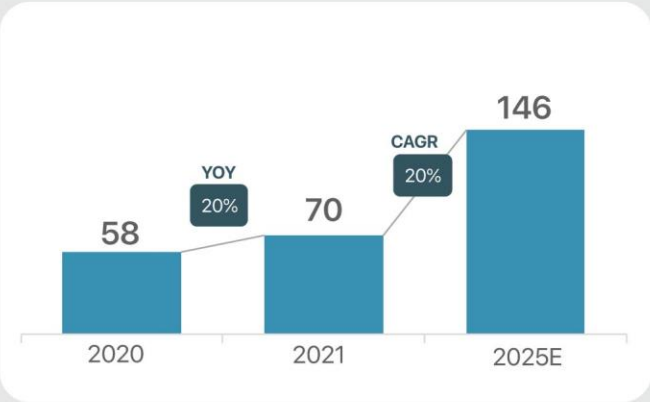
- Telecom ER&D spend will witness a healthy growth rising from an increased demand for faster networks, OTT, and connected ecosystems.
- The interplay between new-age technologies such as AI/ML and IoT is enabling a new era of use cases for telecom firms such as Distributed and decentralized intelligence
- 5G is a catalyst for enterprises that are looking to drive a wide range of existing & new use cases. This presents Service Providers a plethora of opportunities to partner for various products and services

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Services-led Verticals Summary – BFSI, Healthcare, Media & Entertainment

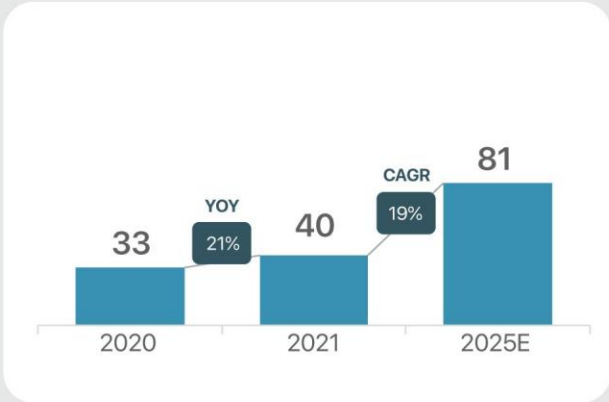
SERVICES-LED

BFSI



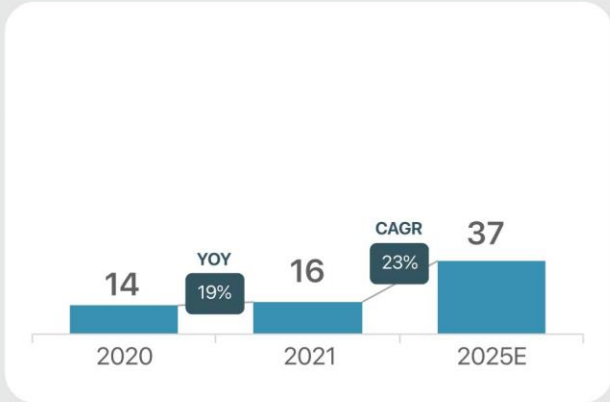
- The growth in the ER&D spend is expected to be driven by investments by BFSI companies towards customer centric applications, cybersecurity, compliance, risk management and AI driven investment and trading products
- Regulatory Compliance, Fraud Detection and Cybersecurity products form a sizeable volume of the BFSI ER&D spending
- Digitization continues to be priority for banks as they witnessed the adoption of digital products and channels

HEALTHCARE



- Patient experience is the key driver for the ER&D spending by providers, across the care lifecycle
- Patient monitoring devices will witness the fastest growth over the next 4 years and will grow 2X faster than other segments
- Medical device makers continue to maintain their focus on building connected devices
- Service Providers with strong IoT and embedded, software and cybersecurity capabilities stand to gain

MEDIA & ENTERTAINMENT



- Artificial Intelligence, Virtual and Augmented Reality, Blockchain – Digital technologies are set to unlock new revenue streams in the Media and Entertainment space
- 5G coupled with other tech advancements will give a major boost to content delivery
- OTT players are leveraging AI and ML to predict user behaviour and churn out content tailor-made for their active/prospective subscribers

Source: Zinnov Research and Analysis, Zinnov Z1000 database

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Source: Zinnov Research and Analysis

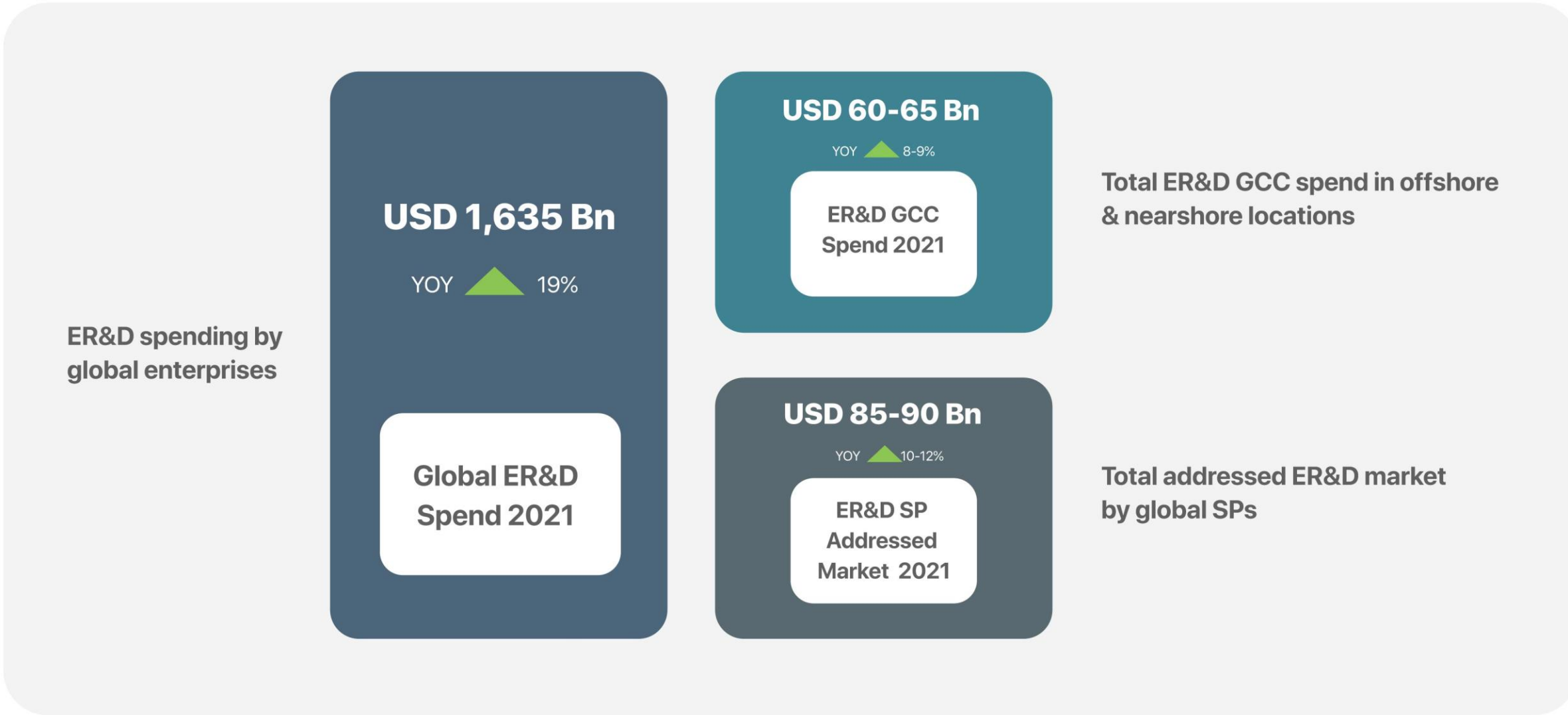
ER&D addressed market landscape

SUMMARY

- The total ER&D addressed market is valued at USD 145 Bn – 155 Bn in 2021 and accounts for ~10% of the overall ER&D spend
- India and China make ~55% of the globalization spending in 2021; Enterprises are relying on global talent chains to drive requirements around digital engineering
- Uncertainty of the ongoing geopolitical crisis may result in a talent exodus from the Eastern European region, despite its lucrative talent ecosystem
- The global SP addressed market is valued at USD 85-90 Bn and is growing at a faster pace than pre-COVID levels
- Accelerated digital engineering demand and outsourcing through PE-led channels is driving the large deal momentum

Source: Zinnov Research and Analysis

The market addressed by Service Providers for ER&D services is poised to exceed USD 100 Bn in 2022



Source: Zinnov Research and Analysis

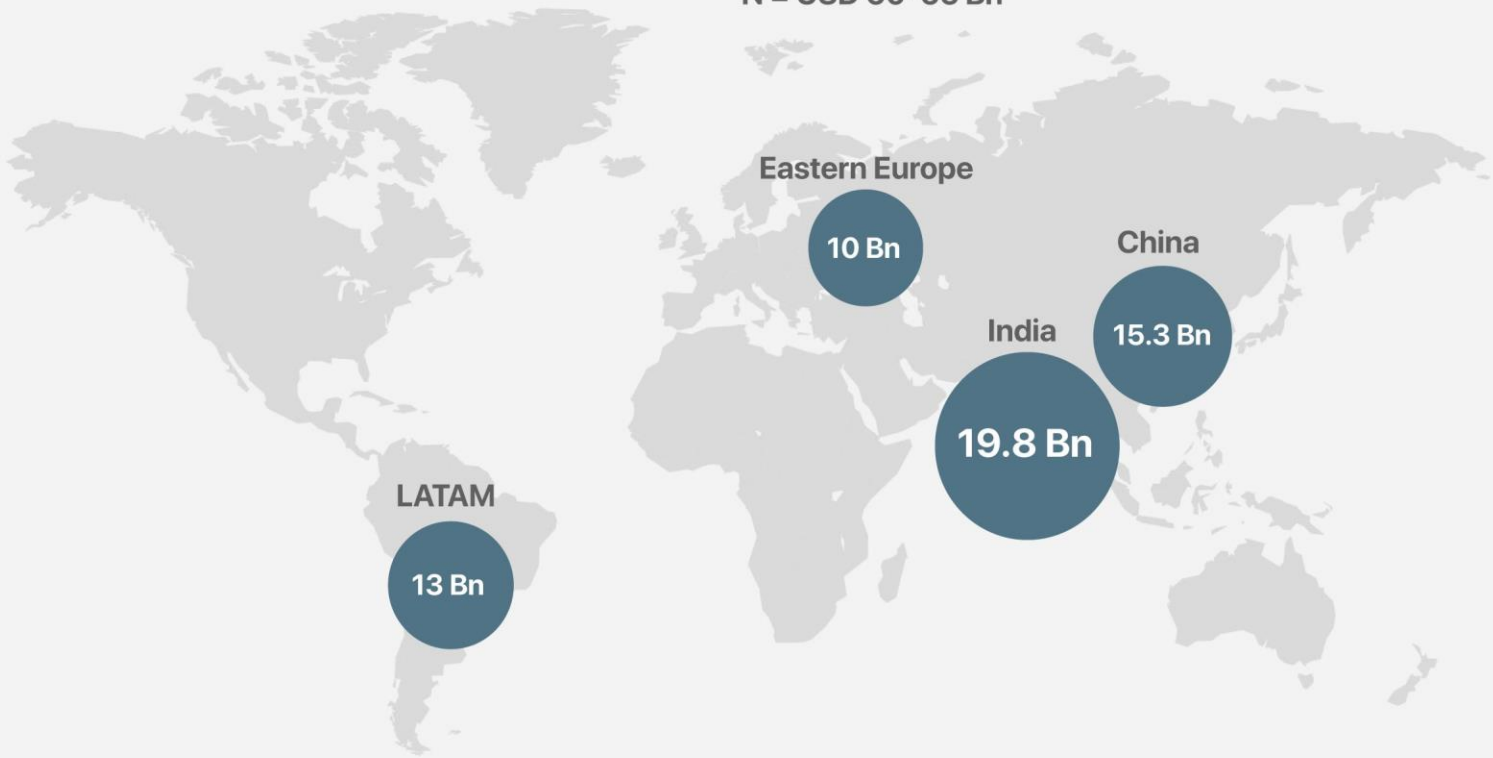
Enterprises are relying on global talent chains to drive requirements around digital engineering

GCC

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ER&D GCC spend 2021 by geography (USD Bn)

N = USD 60-65 Bn



N = Total ER&D GCC Spend in USD Bn

USD 60-65 Bn

YoY 7-9%

Total Spend on ER&D GCC - 2021

~55%

Cumulative GCC spend in India and China

Source: Zinnov Research and Analysis, Zinnov GCC database

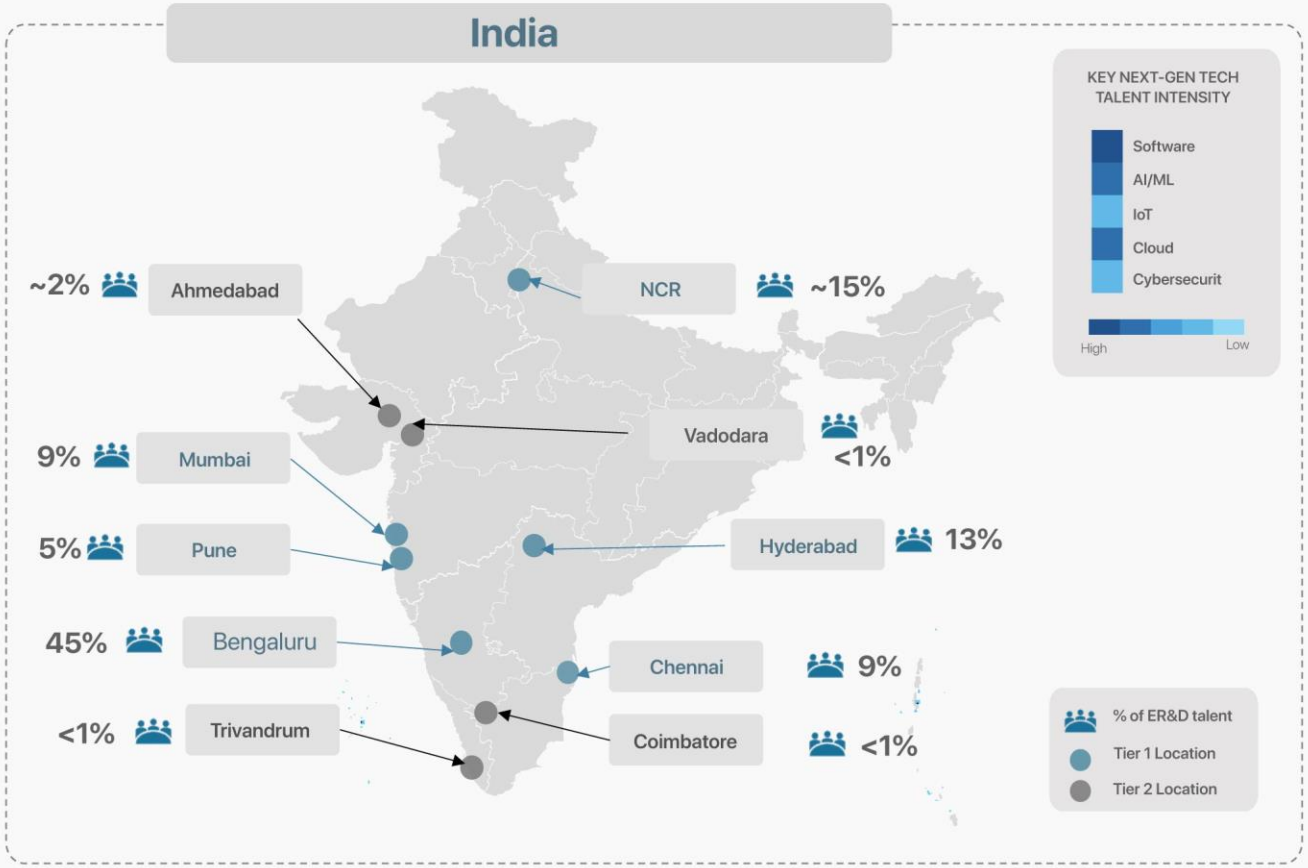
India's software engg. maturity and high-quality digital talent is drawing enterprises to offshore end-to-end product and platform development to the region

GCC

USD 19.8 Bn
ER&D GCC spend in India in 2021

~800K
Total ER&D installed talent in India - 2021

~90%
Of ER&D installed talent based out of Tier 1 locations



Top Enterprises with GCCs in India

amazon BOSCH ORACLE SAMSUNG NOKIA Microsoft CISCO DELL Qualcomm intel SAP Google ERICSSON Ford SIEMENS

~3/4th of the top 50 R&D spenders have GCCs in India. Enterprises are increasingly building end-to-end products and platforms in the country

India's robust GCC ecosystem and abundant next-gen digital engineering talent are helping Tier 2 locations emerge as a preferred R&D hub for enterprises

With lines between software and hardware blurring for product development, India's software engineering talent maturity drives impetus further, of setting up R&D centres

Source: Zinnov Research and Analysis, Zinnov GCC database, DRAUP

More than half of the ER&D talent is housed in Shanghai and Beijing; Tier-II cities are also fast catching up to become preferred GCC hubs, arising from the abundance of AI/ML talent

GCC

USD 15.3 Bn
ER&D GCC spend in China - 2021

~200K
Total ER&D installed talent in China - 2021

~90%
Of ER&D installed talent based out of Eastern locations



Top Enterprises with GCCs in China

General Motors, Ford, SIEMENS, amazon, Microsoft, NOKIA, SAP, Qualcomm, PHILIPS, ORACLE, CISCO, APTIV, DELL, intel, BOSCH

- ER&D talent is spread **~60%** in Beijing and Shanghai, with Tier-2 cities such as Nanjing, Chengdu fast catching up
- The Automotive, Semiconductor, and Software & Internet sectors account for ~50% of the region's ER&D spend
- Amid the US-China trade war, US-based firms are slowing down their R&D investments in China
- European firms continue to invest in the region (Volkswagen, Daimler opened R&D centers in China)

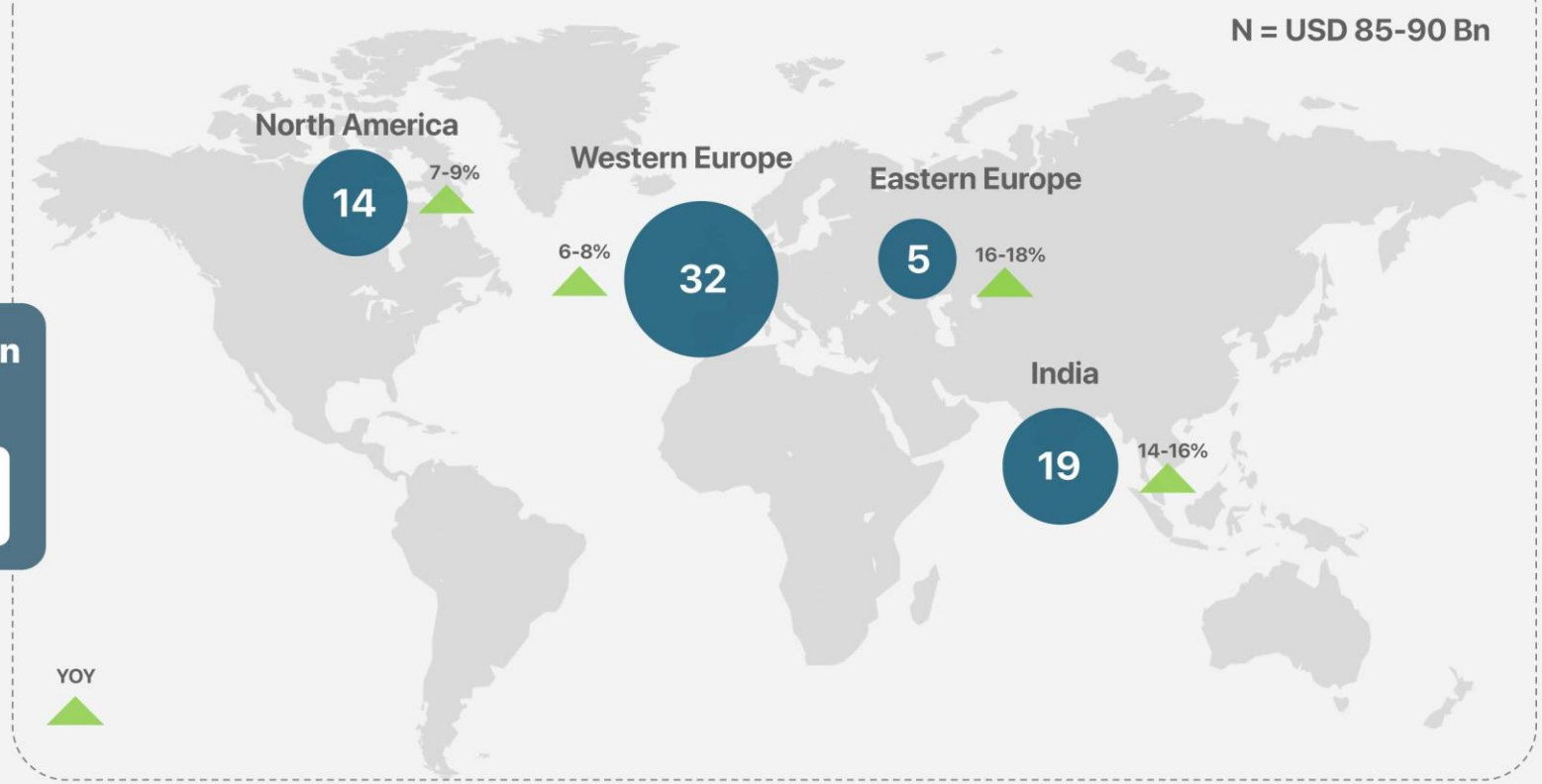
Source: Zinnov Research and Analysis, Zinnov GCC database, DRAUP

The global SP addressed market is growing at a faster pace than pre-COVID levels

SP ADDRESSED

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ER&D SP addressed market 2021 by geography (USD Bn)



N = Total ER&D SP Spend in USD Bn

- A significant outsourcing of digital engineering workloads is driving double digit growth for India
- Software focused SPs (Persistent Systems, GlobalLogic, Globant, etc.) have been growing at high double digits over the last 4 quarters
- SPs with a large presence in the conflict prone region will be significantly impacted in terms of delivery, this may result in slower growth

Source: Zinnov Research and Analysis, Zinnov ER&D deals database, DRAUP

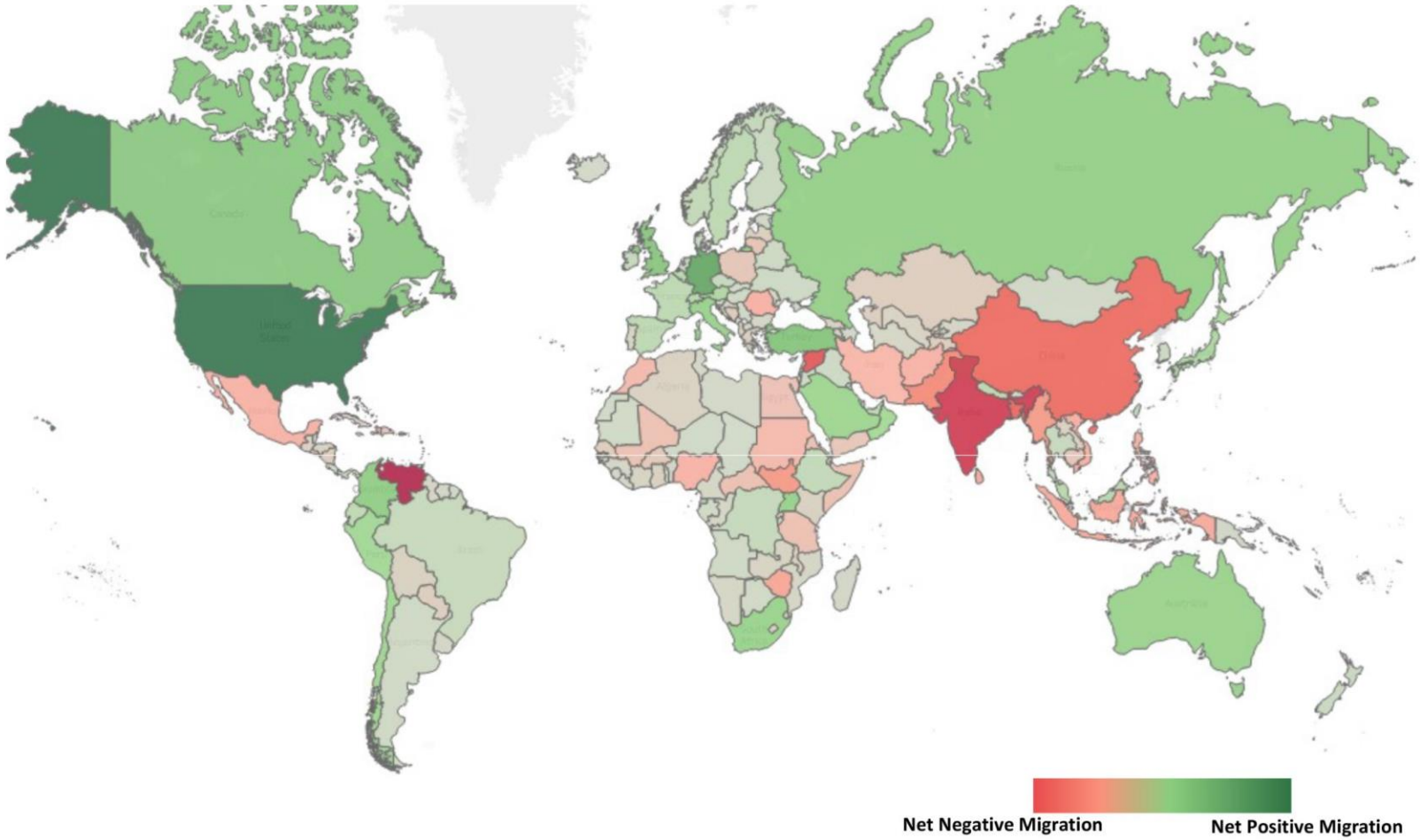
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Source: Zinnov Research and Analysis

The persistent demand-supply gap for digital engineering talent raises concerns for the future of work

NET ANNUAL MIGRATION (PRE-PANDEMIC)



TALENT SUPPLY-DEMAND GAP

TECH TALENT GAP

4.46 M (2021)

8.04 M (2026E)

Traditionally western countries used immigration, offshoring and nearshoring to close the demand-supply gap.

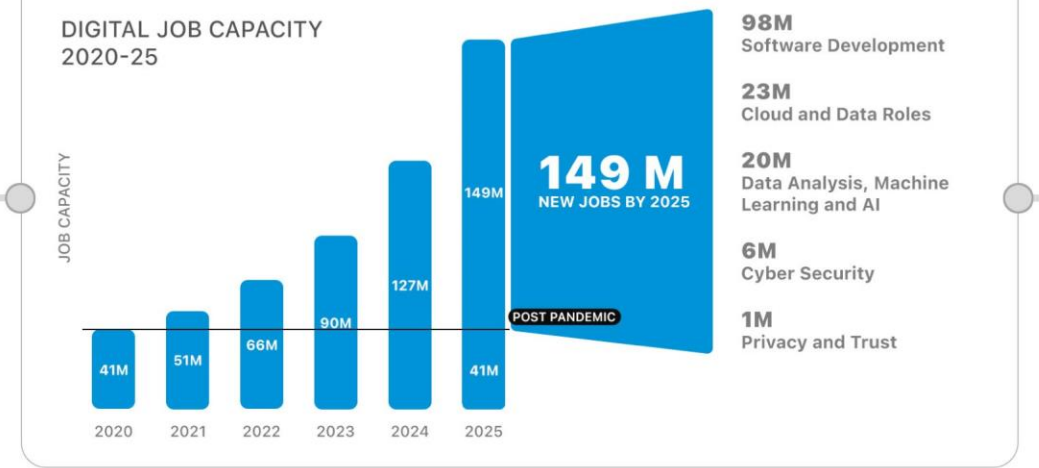
Source: Zinnov Research and Analysis

The Great Lockdown has accelerated digital transformation, translating to an increased demand for digital talent

ONSET OF COVID-19

COVID-19 pandemic has caused job losses that exceed the scale of the Great Recession

ACCELERATED DIGITIZATION



98M
Software Development

23M
Cloud and Data Roles

20M
Data Analysis, Machine Learning and AI

6M
Cyber Security

1M
Privacy and Trust

GREAT INFLATION

4.4%
increase in Compensation costs in 2021, much higher than the avg. range of 2-3 percent over the past two decades.

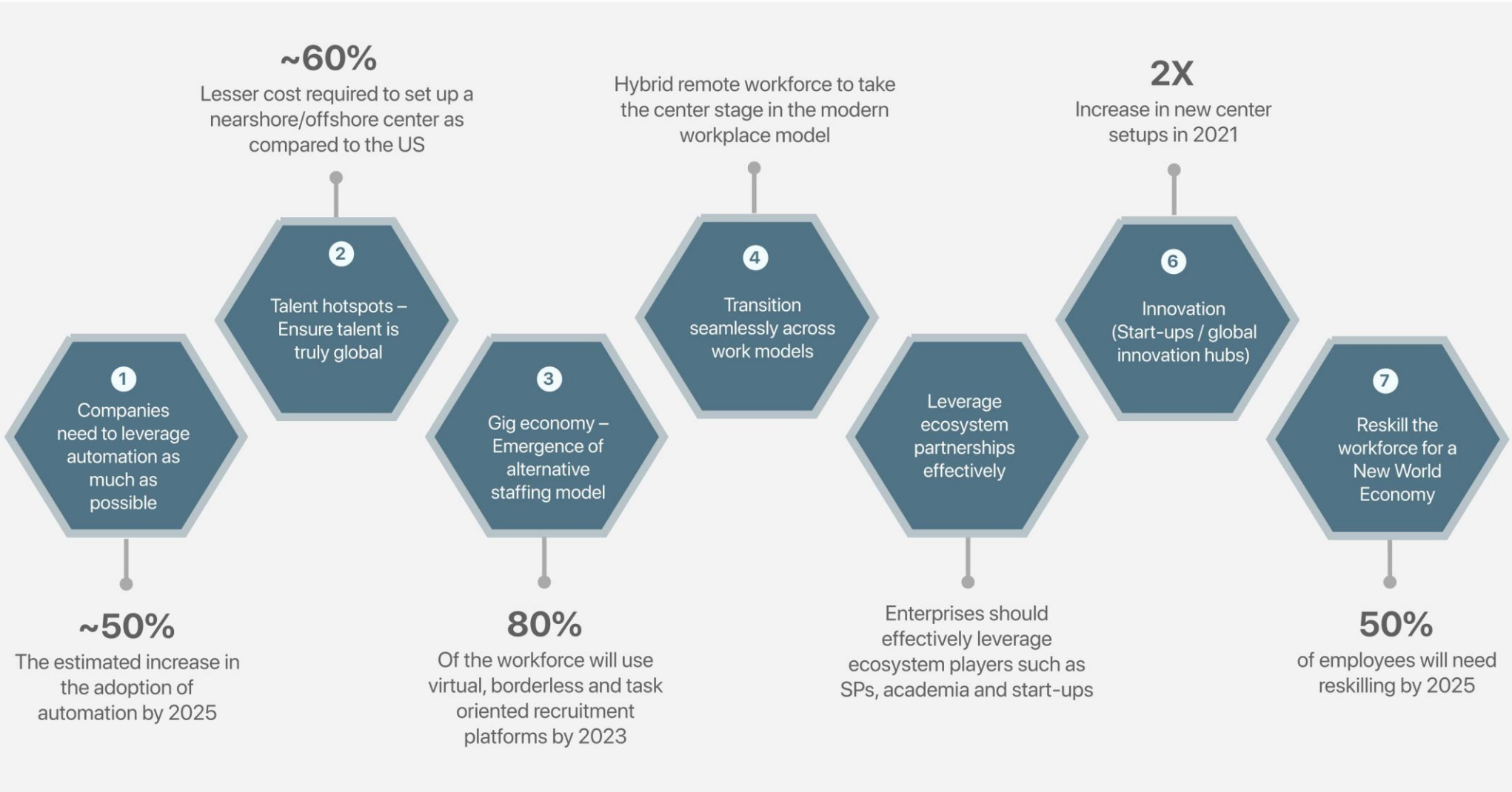
amazon
to boost its maximum base pay to $350K from $160K to help recruit top talent and retain existing employees

GREAT RESIGNATION

In 2021, a record 69 Million American workers quit their job for better pay and benefits

Source: Zinnov Research and Analysis

Enterprise Playbook for the future of work



Source: Zinnov Research and Analysis

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Source: Zinnov Research and Analysis

Several elements can be leveraged by SPs to create a unique growth story

ZINNOV'S ER&D UBIQUITOUS SUCCESS FRAMEWORK



VISION/STRATEGY	BUSINESS MODEL FLEXIBILITY	CONSULTING/ DESIGN LAYER	MANUFACTURING	OFFSHORE/ NEARSHORE	MERGERS & ACQUISITIONS
ACCOUNT STRATEGY	AGILE/ POD TEAMS	ACCELERATORS/IP	HI-TECH	MULTI LOCATION STRATEGY	HYPERSCALER PARTNERSHIPS
LARGE DEALS FOCUS	CUSTOMER EXCELLENCE TEAMS	LABS/COEs	SERVICE LED	LEADERSHIP	NEXT GEN PLATFORMS
DISTINCT VALUE PROPOSITIONS		MODERN TECH PRACTICE		L&D + RESKILLING INITIATIVES	
MULTI-CHANNEL SALES STRATEGY				EMPLOYER OF CHOICE	

WESTERN EUROPEAN

MARKET SIZE
USD 32 Bn
CAGR 2016-21 | 6-8%

SEGULA TECHNOLOGIES
bertrandt
ALTEN
Capgemini

INDIAN PLAYERS

MARKET SIZE
USD 19 Bn
CAGR 2016-21 | 14-16%

HCL
L&T Technology Services
wipro

EASTERN EUROPEAN

MARKET SIZE
USD ~5 Bn
CAGR 2016-21 | 16-18 %

epam
GlobalLogic
softserve

Source: Zinnov Research and Analysis

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Source: Zinnov Research and Analysis

ER&D Services Ratings 2021



*HARMAN Connected Services

*Robert Bosch Engineering and Business Solutions Private Limited (RBEI)

*Modis include Akka Tech.

Source: Zinnov Research and Analysis

Meet the Team



Sidhant Rastogi
Managing Partner
Zinnov



Sivaram S
Principal
Zinnov



Manali De Bhaumik
Engagement Manager
Zinnov



Rahul Ballem
Senior Lead Analyst
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Jibin John
Senior Lead Analyst
Zinnov



Pranjal Sethi
Project Lead I
Zinnov



Merlin Velloor
Analyst
Zinnov



Kunal Agarwal
Analyst
Zinnov



Debajyoti Endow
Engagement Manager
Zinnov



Saikrishna
Project Lead II
Zinnov



Ovya RK
Project Lead II
Zinnov



Rahul Krishna
Consultant II
Zinnov



Ayush Mohanty
Project Lead I
Zinnov

Source: Zinnov Research and Analysis

About Zinnov

Founded in 2002, Zinnov is a leading global management consulting and strategy advisory firm, with a presence in 8 global locations including New York, Santa Clara, Houston, Paris, Gurgaon, Bangalore, and Pune. In the last 20 years, Zinnov has partnered with Global Enterprises and Fortune 2000 companies across their value creation journeys to develop actionable insights – across revenue, talent, innovation, scale, and optimization.

Our nuanced understanding of the global Engineering R&D landscape enables us to work closely with our Technology Service Provider customers across Manufacturing-led, HiTech, and Services verticals, to identify whitespaces to unlock the best growth opportunities. We help our SP customers across –

- **Strategy and Go-to-Market:** We help our customers identify industry-specific whitespaces in various focus areas to optimize their ER&D-led digital spending. We support our customers to plan and execute comprehensive go-to-market strategies by recommending timebound business plans with actionable insights around solutions, offerings, account prioritization, and offerings, with a clearly defined roles and responsibilities matrix.
- **Value Proposition Identification:** We support our customers in distilling their value proposition by decoding industry and peer data and insights, to engender sustained competitive advantage and drive above-market growth.
- **Asset Identification and M&A:** We support and drive inorganic capability and competence upgrades, by discovering and acting on acquisition targets/assets, armed with data-backed, real-time insights. We support our customers' M&A journey with end-to-end transaction excellence, including strategic decision-making in Mergers & Acquisitions.
- **Market Visibility:** We work alongside our customers to anchor their positioning by leveraging thought leadership channels such as conferences, roundtables, whitepapers, blogs, posts, etc.
- **Zinnov Zones:** Zinnov Zones is an annual rating for Global Technology Service Providers that evaluates their prowess and scalability across ER&D, IOT, Media & Technology, Digital Services, and Automation. We ensure a high level of contextualization for our customers through this annual holistic 360-degree assessment of over 100 Service Providers across 70 sub-verticals, service lines, and use cases in 6 technologies and their sub-focus areas. Each assessment is further distilled to provide a vertical, horizontal, and technology lens-based view.

For more details, visit: www.zinnov.com



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