Zinnov Zones Digital Engineering Report 2022

The Inevitable Rise and Impact of Digital Engineering

June 2023

Foreword

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The year 2022 was rife with geopolitical tensions, recessionary pressures, government protectionism, and supply chain constraints – across geographies. Despite these headwinds, the global Digital Engineering spend, which is a subset of the global overall Engineering R&D spend, grew. The pandemic-induced digitalization initiatives continued unabated, with technologies such as Cloud, Artificial Intelligence, Metaverse, 5G, Digital Thread, etc., leading the charge. These technologies not only garnered significant investments, but also became sandboxes for exploring newer use cases and business models.

With the Digital Engineering spend estimated to double and touch a massive USD 1.6 Tn by 2026, these technologies will be instrumental in shaping enterprise digital priorities and spends. This dynamic landscape offers unprecedented opportunities for Service Providers to collaborate and innovate alongside enterprises. Service Providers are not only building in-house capabilities in Generative AI, Metaverse, Digital Thread, etc., but are also focusing on winning large deals as a growth strategy. Across verticals, SPs are tapping into significant opportunities to enable and further enterprises' Digital Engineering needs.

Additionally, sustainability remains a key enterprise priority area, which Service Providers can actively capitalize on. Carbon Reduction, Clean Energy, Circular Economy, and Energy Management are the four key sustainability themes that enterprises are doubling down on. From asset-heavy industries investing in electrification to driving operational excellence to meet carbon neutral targets, Service Providers are partnering with enterprises across the sustainability value chain.

In this Zinnov marquee report, **"The Inevitable Rise and Impact of Digital Engineering,"** we explore the key trends driving Digital Engineering spend and investments in enterprises, the technologies shaping the landscape, and opportunities that Service Providers can capitalize on. It also delves into what is driving growth and spend in key verticals such as Software & Internet, Automotive, Telecom, Aerospace & Defense, BFSI, Healthcare, and Industrial. From the rise of agile methodologies to the increasing importance of sustainability and environmental considerations, we highlight the trends shaping the global technology landscape.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Executive Summary

1 The global Digital Engineering spend is pegged at USD 810 Bn and is expected to grow at a CAGR of 18% to touch a massive USD 1.6 Bn by 2026.

2 Hi-tech-led verticals are the largest contributors to the Digital Engineering spend and are growing at a faster rate of 20% CAGR than Services and Manufacturing-led verticals.

3 Services-led verticals (especially consumer-facing ones) are experiencing a softened Digital Engineering spend owing to macro factors; however, they are still expected to grow at 18+% CAGR and account for 27% of the overall DE spend by 2026.

4 Manufacturing-led verticals contribute to 15% of the global DE spend and are expected to grow at 15% CAGR through 2026.

5 Recessionary pressures, geopolitical tensions, government protectionism, supply chain constraints, rising cost of debt and others are some of the macro-economic factors that have affected Digital Engineering spend across verticals, besides investments, large deals, and talent sourcing.

6 Four key themes are driving the global Digital Engineering spend – Generative AI, Metaverse, Digital Thread, and Hyperscalers.

7 Sustainability remains a priority for enterprises across industry verticals. Across both products & services, clean and green alternatives remain the primary initiative.

8 ER&D market addressed by engineering service providers is pegged at USD 105-110 Bn in 2022, growing at 12-14% YoY. S&I and Automotive are the most addressed verticals, contributing ~38%.

9 India's higher density of Digital Engineering talent has helped it grow faster than Western Europe. Big Data, Cloud Computing, and AI/ML continue to be the major areas of investment for Service Providers.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The report caters to ER&D Enterprises and Service Providers, and helps understand macro and tech trends that drive enterprise R&D priorities

ER&D SERVICES

Objectives

- To analyze the current state of the Digital Engineering market
- To gain insights from dynamically evolving macro and tech trends in a post-pandemic world. The report contains:
  - An analysis of Digital Engineering spending
    - Despite Challenging Macro Trends (Evolving business fundamentals, Complex geopolitical landscape, Supply chain constraints etc.) R&D priorities continues its upward trajectory
    - Tech Trends such as Digital Thread, Generative AI, Industrial Metaverse, and Hyperscalers are accelerating Digital Engineering spend
  - An analysis of Digital Engineering spending and priorities across key verticals
  - The market addressed by Service Providers
  - An assessment of 75+ global Service Providers for their Digital Engineering prowess, to help enterprises make informed purchasing decisions for strategic sourcing initiatives

IP and Data Assets

Z1000 Database

Zinnov's database of top 1,000 global ER&D Spenders across 20+ verticals

GCC Database

Database of 5,000+ ER&D Global Capability Centers (GCCs) analyzed across verticals

Zinnov Zones

Database of 75+ global Service Providers rated as part of the Zones ER&D 2022 Ratings

Service Provider Database

Database of 2000+ ER&D Service Providers tracked across the globe

ER&D deals Database

Database of ~3,000+ ER&D deals signed across the globe across verticals

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

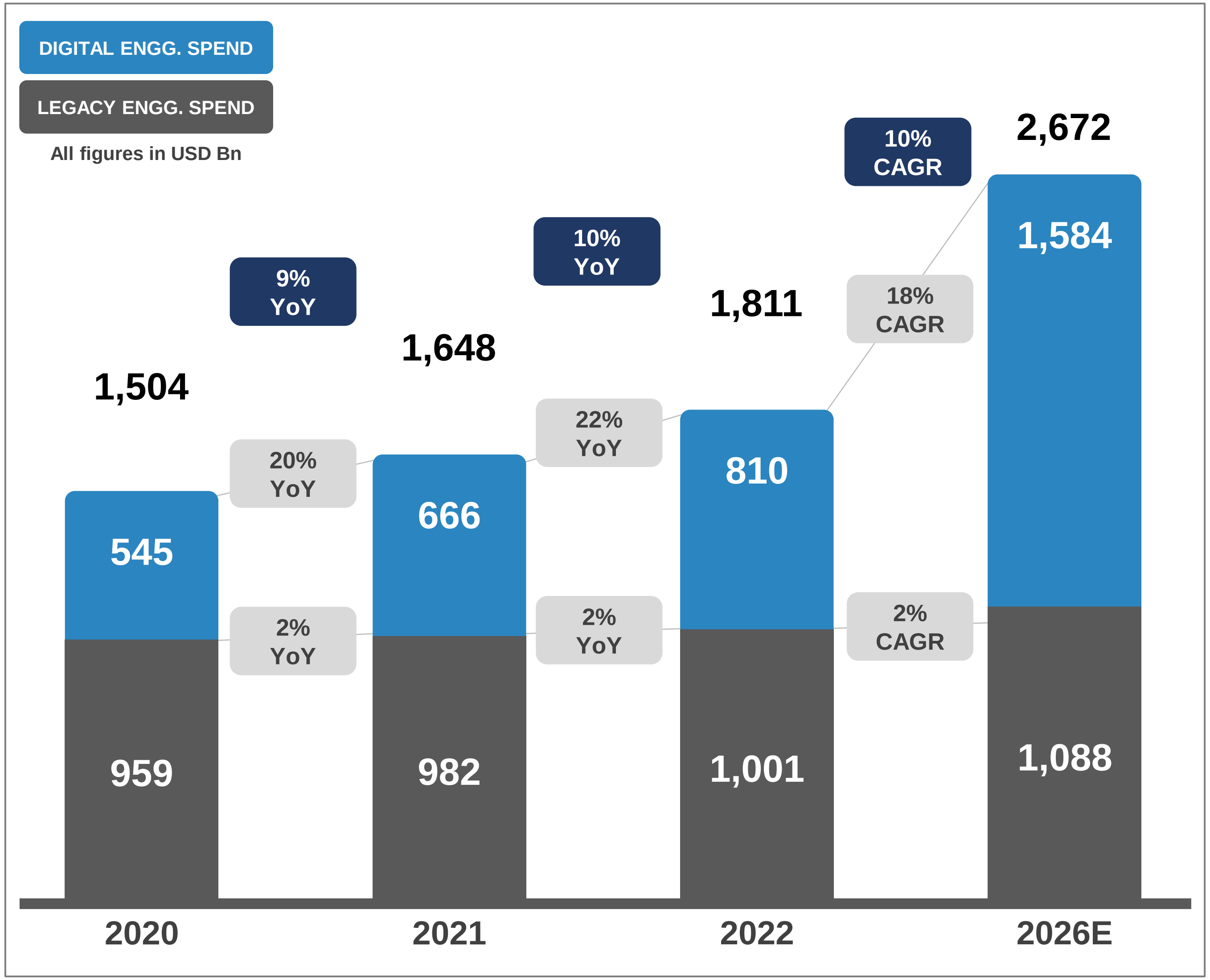
AGENDA

A	The Rise of Digital Engineering
B	Technology Pillars of Digital Engineering
C	Sustainability – A Priority
D	Industry Deep Dives - ER&D Spend Trends & Priorities
E	Addressed Market and Service Providers’ Opportunities
F	Growth Levers for Service Providers
G	Zinnov Zones for ER&D Ratings 2022

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Digital Engineering will continue to grow and is expected to reach USD 1.6 Tn by 2026, even with adjusted macro-economic headwinds

ER&D Spend (2020 – 2026E)



CXOs are committed to innovation despite volatile macroeconomic environment, funding it with cost optimization and productivity gains

Relentless focus on digital tech and engineering initiatives by enterprises on technologies such as 5G, Cloud, and Generative AI, continues

Digital transformation and pervasive consumption of Cloud, chips, and data will further accelerate Digital Engineering spending

Data Engineering and Analytics, Cybersecurity, and IOT are among the most sought-after capabilities

SPs have witnessed substantial growth in the last 12 months, driven by strong demand from the US and Europe. However, there was deceleration in the last quarter of 2022

Source: Zinnov Research and Analysis, Zinnov Z1000 database

By 2026, Hi-tech-led verticals will account for 58% of the overall Digital Engineering spend, followed by services-led verticals

■ DE Spend 2022
■ DE Spend 2026E
■ DE CAGR%

USD **810** Bn
DIGITAL ENGINEERING SPEND (2022)

18% CAGR

USD **1,584** Bn
DIGITAL ENGINEERING SPEND (2026E)

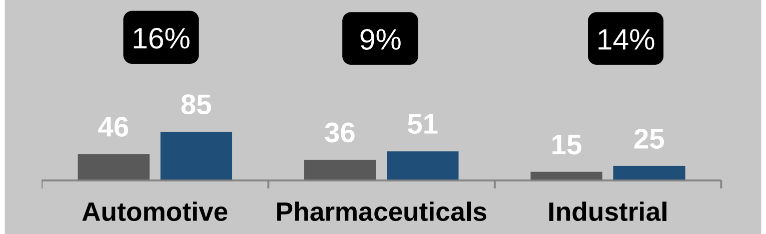
~2x

The Digital Engineering spend is set to increase by 2X in the next 4 years, crossing USD ~1.6 Tn by 2026

MANUFACTURING

15% CAGR

Manufacturing-led verticals will account for **15%** of the overall Digital Engineering Spend by 2026

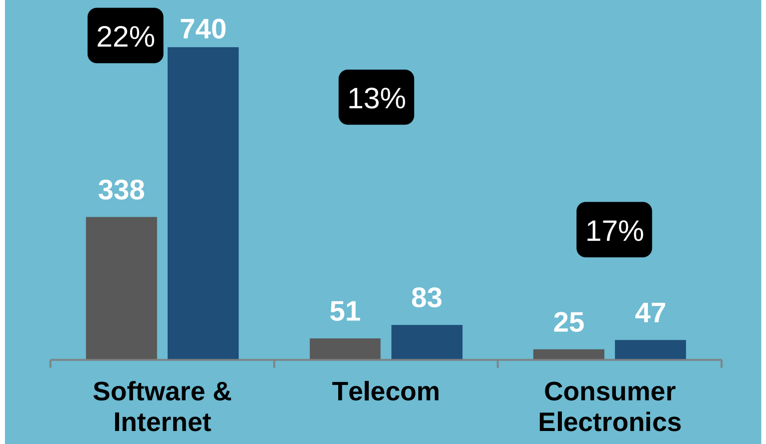


Connected Vehicles	Wearables	Industry 4.0
Autonomous	Remote Patient Monitoring	Smart Service

HI-TECH

20% CAGR

Hi-tech-led verticals will account for **58%** of the overall Digital Engineering Spend by 2026

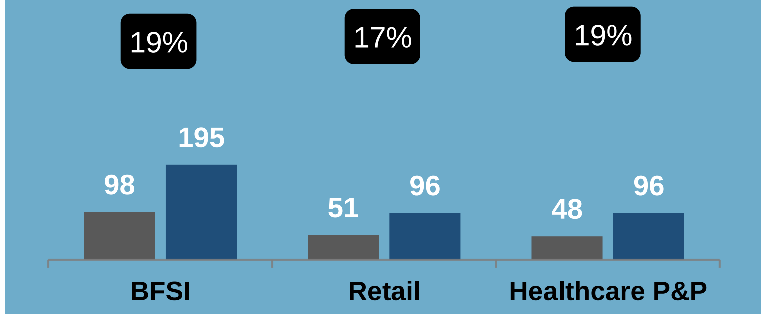


AI/ML	5G	IOT
Cybersecurity	SDN/NFV	Metaverse

SERVICES-LED

18% CAGR

Services-led verticals will account for **27%** of the overall Digital Engineering Spend by 2026

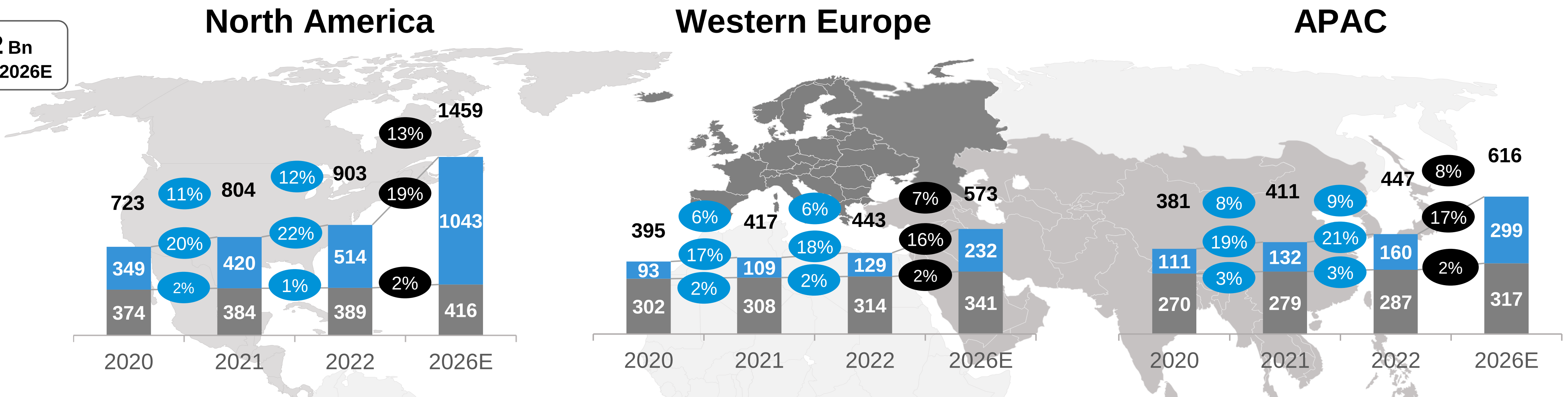


Robo Advisory	Contactless	Telemedicine
Fraud Detection	AR/VR	Remote Monitoring

Source: Zinnov Research and Analysis, Zinnov Z1000 database

APAC surpassed Western Europe in ER&D spending, driven by a heightened focus on Digital Engineering by Hi-tech-led verticals in the region

USD **2,672** Bn
ER&D Spend, 2026E



Top Verticals

~55%

North American enterprises contribute to the largest share of the Digital Engineering spend. The region also has the highest growth rate and will account for ~55% of the global ER&D spending by 2026

Rise of APAC

APAC surpassed Western Europe marginally in terms of spend, owing to the heightened focus on Digital Engineering by Hi-tech firms in the region

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The current macro-economic environment is impacting different verticals to varying degrees; certain consumer-facing industries will be more impacted than others

Industries	Shifting Demand Patterns	Business Fundamentals			Geopolitical Landscape		Supply Chain Constraints		Zinnov Overall Impact Index
	Consumer Sentiment	Rising Inflation and Interest Rate	Access to Capital	Commodity Price Pressure	Russia-Ukraine War	Government Protectionism	Raw Material Shortage	Regulatory Environment	
Defense	▒	░	░	▒	░	░	▒	▒	░
Automotive	░	▒	▒	▒	▒	▒	▓	░	▒
Healthcare	▒	▒	▒	▒	▒	░	▒	▒	▒
Enterprise Software	▒	▒	▒	▒	▒	▒	▒	░	▒
Aerospace	░	▒	▒	▒	▓	░	▒	▒	▒
Energy & Utilities	▒	▒	▒	▓	▒	▒	▒	▒	▒
BFSI	▒	▓	▓	▒	▒	▒	▒	▒	▒
Semiconductors	▒	▒	▒	▓	▒	▒	▓	░	▒
Mining	▒	▒	▒	▓	▓	▓	▒	▒	▓
Consumer Software	▓	▒	▓	▒	▒	▓	▒	▒	▓
Retail	▓	▓	▒	▓	▒	▒	▓	▒	▓

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Impact ░ Positive ▒ Moderate ▓ Negative

Inflation, increasing interest rates, limited access to capital, and commodity price pressures had various effects on all industry sectors in 2022

Business Fundamentals

Inflation and the Rising Interest Rate

8.8%

- *According to the International Monetary Fund (IMF), global inflation rose from 4.7% in 2021 to 8.8% in 2022*
- *The US Federal Reserve increased interest rates to 4.75-5% by March 2023, followed by other global central banks*

Access to Capital

35%

- *The investment pace by venture and growth investors in private companies decelerated in late 2022, indicating a slower funding environment in early 2023*
- *Global venture funding dropped by 35% in 2022 to USD 445 Bn, compared to USD 681 Bn in 2021*

Commodity Price Pressures

- *In addition to the issues arising from the surge in price levels, businesses also face the challenges posed by increased commodity price volatility.*
- *Prior to Russia's invasion of Ukraine, world food commodity prices experienced an almost 40% increase, which further surged due to the war*
- *Very high fluctuations in commodity prices can disrupt government finances in export-driven countries, causing intermittent public investment.*

Other key macro trends in 2022

Climate Change and Sustainability

- Increased focus on sustainability and climate-related initiatives led to greater efforts in transitioning to renewable energy and reducing carbon emissions

Increase in Energy Prices

- Following a substantial price surge that commenced prior to the Russian invasion of Ukraine, prices continued to skyrocket until the second half of 2022

Trade and Globalization

- Despite an anticipated record USD 32 Tn in global trade for 2022, a slowdown that began in the latter part of the year is projected to intensify in 2023

Technological Advancements

- Rapid advancements in areas such as Artificial Intelligence (AI), Blockchain, and Automation continue to drive innovation and shape various sectors

Source: Zinnov Research and Analysis, Zinnov Z1000 database

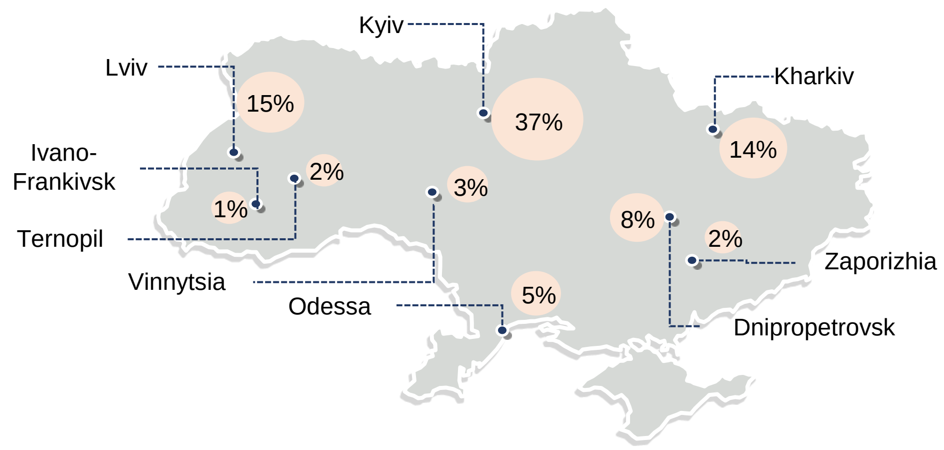
Business fundamentals had significant implications on the ER&D sector, particularly in Mergers & Acquisitions, valuations, and talent scarcity

1	**Impact on Valuations**	Large tech firms are experiencing decreased revenue growth projections due to rising interest rates, causing investors to be more cautious
2	**Mergers & Acquisitions**	The interest rate warning had varying impacts on financial investors and strategic buyers. Private Equity (PE) investors relying on debt faced immediate capital constraints and costs, affecting large M&A deals
3	**Emphasis on Customer Experience**	Service-focused industries are placing emphasis on creating customer experience strategies that rely on data and provide personalized guidance during challenging economic circumstances
4	**Shift in Demand**	Digital-first companies are experiencing a decline in demand due to the opening-up of the economy after COVID-19 and a decrease in purchasing power
5	**Tech Layoffs**	The tech sector has experienced significant job losses, with over 150,000 employees laid off, including an additional 40,000 job cuts announced in recent months, primarily attributed to major US tech companies like Alphabet, Amazon, Microsoft, and Meta

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Geopolitical tumult, talent challenges, tough economic conditions, and increasing labor costs will continue to affect businesses in the near-term

Software Installed Talent Pool in Ukraine (185,000+)



The flow of immigrants has been towards Turkey, Poland, Uzbekistan, Armenia, Georgia, etc.

UKRAINE TECH SECTOR ANALYSIS

Ukrainian tech / developer wages are about **2-3X** lower than in Denmark, the UK, Canada, and ~**4X** lower than in the US	**2-4X**
~50-55K or 15-20% of Ukraine's total number of tech specialists had moved abroad as of May 2022	**15-20%**
Kyiv has the highest number of R&D centers - 69, followed by Lviv - 15, Kharkiv – 10, and Odessa - 10	**69**

EMPLOYEE MIGRATION AND BUSINESS CONTINUITY PLAN

- In early 2023, around 70,000 Russian IT specialists left their homes, heading to Georgia, Turkey, and Armenia due to visa-free regimes
- Service providers enacted business continuity plans and increased hiring in Central and Eastern Europe, Latin America, and India
- Tech companies relocated operations to Poland, Turkey, and Romania due to low language barriers and cultural proximity
- Cybersecurity threats prompted investments in network infrastructure and encryption algorithms for enhanced protection against cyber attacks

Large Enterprises	# Tech Talent
SAMSUNG	~750
ORACLE	~380
amadeus	~150
IBM	~120
PEPSICO	~120

Large Enterprises	# Tech Talent
<epam>	~12,000
softserve	~8,000
GlobalLogic	~7,200
CIKLUM	~3,000

Service Providers to absorb Ukrainian talent at centers in Poland, Hungary, and Romania

HCLTech
L&T Technology Services
DXC TECHNOLOGY
<epam>
tcs TATA CONSULTANCY SERVICES
Mindtree

Presence of other major Service Providers in Ukraine*

CIKLUM
N-iX
infopulse
DataArt
X-TENSIVE
GlobalLogic

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Though other locations have emerged, India remains an attractive delivery location

Country	Political Stability	Government Support	DE Market Size	Demand / Growth	Talent Availability	Talent Cost Benefit	Digital Talent	Language Proficiency	Overall Attractiveness
Turkey	◑	◕	◑	◕	◑	◔	◑	◔	3 / 5
Poland	◕	◑	◑	◕	◕	◔	◕	●	3.5 / 5
Georgia	◕	◑	◔	◑	◑	◑	◔	◕	3 / 5
Argentina	◕	◑	◑	◑	◕	◑	◑	◑	3.5 / 5
India	◕	◕	●	◕	●	◕	◑	●	4 / 5

India and Poland rank high on Digital Talent, with Argentina leading in LATAM

Country	Top 3 Digital Skills	Top 3 Industry Verticals	Remarks
Turkey	**Java / Big Data / Mobile**	**Automotive / Electronics / Industrial**	**Evolving skillset and competitive talent pool**
Poland	**Java / Big Data / Cloud**	**Telecom / BFSI / Software & Internet**	**Experienced/skilled talent pool; Telecom expertise**
Georgia	**Java / JavaScript**	**Software & Internet / Telecom / Industrial**	**Emerging Hi-tech engineering talent pool; limited tech support skillsets**
Argentina	**JavaScript / Python / Cloud**	**Fintech / Software & Internet / Manufacturing**	**Evolving technical skills and increasing tech talent pool**
India	**Software / Big Data / Cloud**	**BFSI / Software & Internet / Telecom**	**Largest skilled talent pool of all delivery locations**

Source: Zinnov Research and Analysis, Zinnov Z1000 database

As supply chain disruptions continue to pose risks, organizations are building resilient supply chain networks with the latest digital capabilities and data-driven networks

Supply Chain Resilience

AI & Machine Learning

- Interoperability across business landscapes
- Technology-driven evolution to Industry 5.0

Data & Cybersecurity

- Reduced redundancy
- Resilient firewalls
- Advanced anti-hacking technologies

Robotics

- Robot assisted warehousing and transportation
- Automated last-mile delivery

Digital Supply Chain

- Adoption of digital supply chain
- Digital infrastructure and process automation

Sustainable Supply Chain

- Circular supply chain
- Emphasis on renewables

Big Data & Analytics

- Automation enablement
- Predictive and Prescriptive Analytics

Smart Logistics & IOT

- Real-time logistics information
- Predictive maintenance

> *"Supply chains are evolving from low cost and optimized to be more risk-resilient and sustainable."*
>
> - **Richard Howells**
> Vice President, Solution Management for Digital Supply Chain at SAP

18%

Expected Supply Chain Analytics market growth rate till 2026

8/10

Companies are using Electronic Data Interchange (EDI) for digital supply chain operations

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Enterprises are collaborating with SPs for Innovation, tapping into their ER&D ecosystem, remote work, and diversifying supply sources to face challenges in their medium-term plans

SECTORAL HEAT MAP FOR TOP CHALLENGES

TOP CHALLENGES	Automotive	Semiconductors	Industrial	Energy, oil, & gas	Software & Internet	Medical Devices	Aerospace & Defense	Telecom
Supply chain disruptions and the resultant impact on increasing product costs	Moderate	Moderate	Moderate	Low	Low	High	Low	Moderate
Pace of innovation	Low	Moderate	Low	Low	High	Low	Low	Moderate
Product development and time to market	Moderate	Low	Low	Low	Moderate	Low	Low	Moderate
Key skills availability	Low	Moderate	Low	Moderate	Low	Moderate	Moderate	Low
R&D globalization	Moderate	High	Low	Low	Low	Moderate	Moderate	Low
Tech ecosystem enablement	Moderate	Moderate	Low	Low	Low	Low	Moderate	Low
Sustainable products and adoption rate	Moderate	Moderate	Low	Low	High	Moderate	Moderate	Low
Evolving service delivery models	Low	Moderate	Moderate	Moderate	Low	Moderate	Low	Low

Key Insights

ER&D Footprint

Companies are expanding their ER&D footprint beyond cost arbitrage and entrusting their COEs to oversee end-to-end PLM, thereby advancing their position in the value chain

Software & Internet

The evolving landscape of new technologies poses challenges for software companies in setting their focus and priorities

EMEA

With increased focus on product sustainability and technologies in Automotive and Industrial verticals, faster product development is a major challenge in EMEA

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Impact ▨ Low ▨ Moderate ■ High

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A	The Rise of Digital Engineering
B	**Technology Pillars of Digital Engineering**
C	Sustainability – A Priority
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Source: Zinnov Research and Analysis, Zinnov Z1000 database

Technology Pillars of Digital Engineering

Generative AI

Industrial Metaverse

Digital Thread

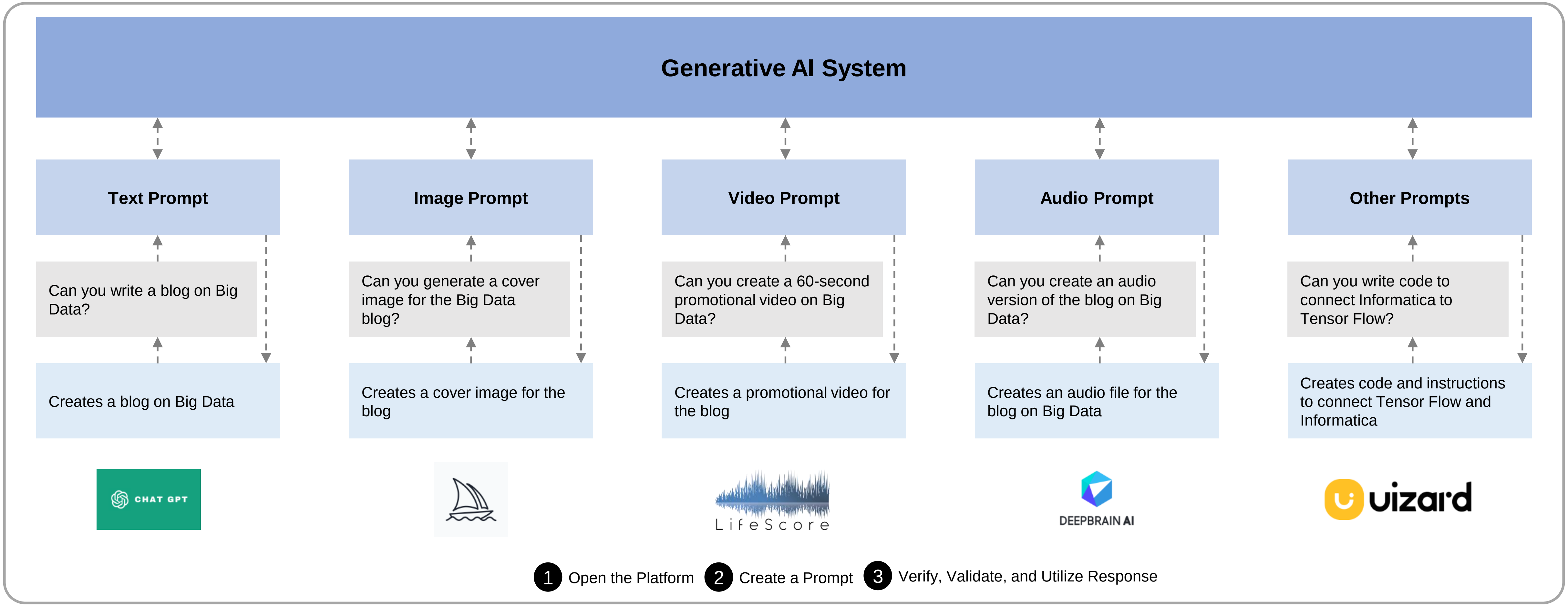
Hyperscalers

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Although Generative AI is in its nascent stages, its transformative power can greatly shape the future of how businesses are run

Generative AI

Generative AI is an advanced type of an Intelligent System that runs on Deep Neural Networks, that have the potential to understand user queries and generate new content in the form of text, images, audio, video, among many others, based on large sets of training data.



Generative AI System

Text Prompt

Can you write a blog on Big Data?

Creates a blog on Big Data

Image Prompt

Can you generate a cover image for the Big Data blog?

Creates a cover image for the blog

Video Prompt

Can you create a 60-second promotional video on Big Data?

Creates a promotional video for the blog

Audio Prompt

Can you create an audio version of the blog on Big Data?

Creates an audio file for the blog on Big Data

Other Prompts

Can you write code to connect Informatica to Tensor Flow?

Creates code and instructions to connect Tensor Flow and Informatica

1 Open the Platform 2 Create a Prompt 3 Verify, Validate, and Utilize Response

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Prompt Type	Prompt	Response

Increased VC funding for Generative AI is fueling an array of innovative use cases that can revolutionize how businesses operate in the near future

Generative AI Landscape

Text Platforms

- ParagraphAI
- SellScale
- CopyMonkey
- seek
- Outerbase
- Parabolic
- Locofy
- DISTYL
- Second
- Buildt
- Witchpot
- deeploop
- reKnow reUse rePurpose reNew
- aiFlow
- consensus
- Correcto.
- type
- mutable.ai
- SYNATIV
- edgi
- {lyne}
- yurts ai
- Illusion
- HoneyHive
- SEO.ai
- WriterZen
- Meru

Image Platforms

- Poly
- MODELME
- YODAYO
- TERRA
- starryai
- HEXO
- mirage
- Galileo AI
- Autoenhance.ai
- Diagram

Video Platforms

- Bosch.IO
- METAPHYSIC
- REMBRAND
- elai.
- LINUM

Audio Platforms

- Lychee Formerly AudioLabs
- ElevenLabs
- beatoven.ai
- OpenDialog
- AUDIOGEN
- Attention
- coqui

Others Platforms

- Friday
- PR Guy
- needl
- OfOne
- timelyAI
- Galileo
- turntable
- VECTOR
- Keytrends
- betterdata
- cogram
- Alias
- jiGSO
- COXWAVE
- UNSTRUCTURED
- Monterey
- pathway

Generative AI Maturity

885
Investments deals made in Generative AI by VC firms between 2018 and 2022

USD 13-14 Bn
Capital raised by Generative AI companies from VC firms between 2018 and 2022

USD 5-6 Bn
Capital raised by companies on text-based platforms

USD 7-8 Bn
Capital raised by companies on image, audio, video, and other platforms

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Data-rich companies will lead Generative AI adoption; they may prioritize horizontal use cases over vertical use cases to test its potential and reap financial returns

Zinnov Classification	Industry	Theme	Company Name	Industry Case Study
Manufacturing	FMCG	*Text + Image*	Coca-Cola	The Coca-Cola Company is set to harness OpenAI's Generative AI technology to enhance their marketing and consumer experiences.
	Automotive	*Audio*	gm	General Motors is developing an AI assistant for their vehicles, powered by Microsoft's Azure Cloud service and OpenAI, providing drivers with conversational language-based information about their vehicles.
	Biotechnology	*Image*	AMGEN	Amgen and Nvidia's BioNeMo™ Cloud services have joined forces to enhance drug discovery efforts. Amgen will utilize its proprietary data to pre-train large language models for molecular biology using the Cloud service, paving the way for developing next-generation therapeutic proteins.
	Chemicals & Materials	*Text*	3M	3M Health Information Systems (HIS) partnered with Amazon Web Services (AWS) on Generative AI to ease documentation for Healthcare providers.
Hi-Tech	Energy & Utilities	*Text*	SIEMENS	Siemens will launch an app called Teamcenter for Microsoft Teams, utilizing Generative AI to enhance productivity and innovation in industrial businesses. The app will combine Azure OpenAI Service's language models and other Azure AI capabilities with Teams' platform and Siemens' PLM software.
	Telecommunications	*Text + Image*	CISCO	Cisco's Webex video conferencing platform integrates ML and Generative AI capabilities to enhance collaboration, focusing on remote work and customer relationship management, offering improved video experiences and ChatGPT-like natural language interfaces.
Services	BFSI	*Text*	Morgan Stanley	Morgan Stanley's wealth management division leverages GPT-4 technology to optimize knowledge management, benefiting stakeholders through efficient utilization of intellectual capital.
	BFSI	*Text*	stripe	Stripe partners with OpenAI to enhance support services with tailored solutions, including fraud detection and customer query assistance.
	BFSI	*Text*	Bloomberg	BloombergGPT, a finance-specific language model, utilizes Generative AI with a decoder-only architecture and 50 Bn parameters to generate text on finance and economics..

Source: Zinnov Research and Analysis, Zinnov Z1000 database

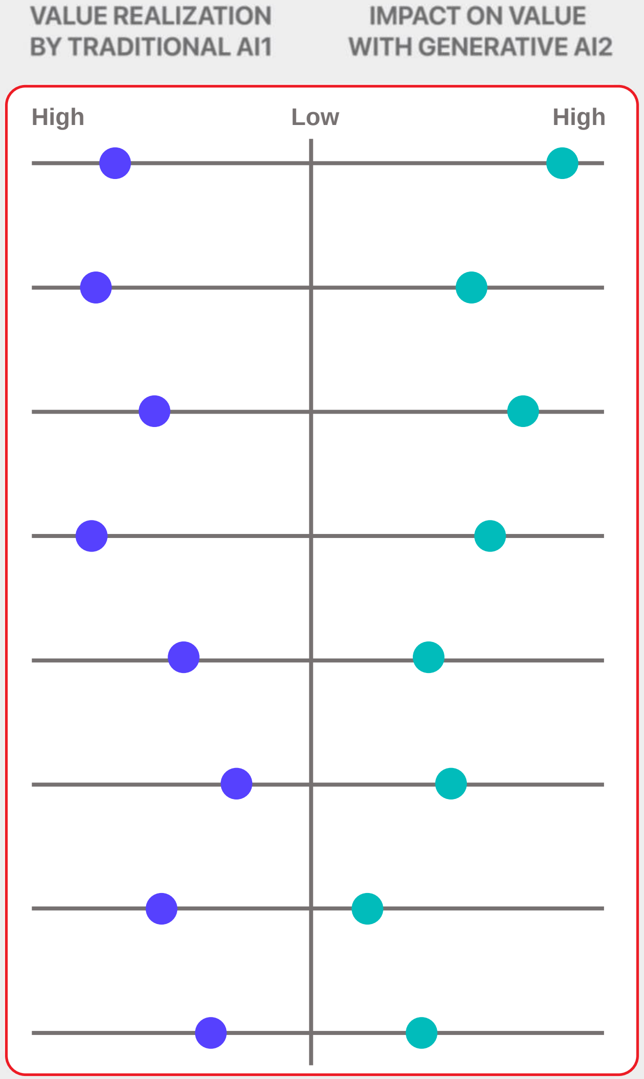
For significant financial returns, Service Providers should focus on commercializing their Generative AI offerings in text, image, audio, and video platforms

Themes		Text	Image	Audio	Video	Others
Manufacturing	Automotive	Content Generation Personalized Chat Bots Knowledge Management Knowledge Transfer	Concept Designs	In-car Voice Assistant	Spare Parts Installation	Virtual Test Drives
	Aerospace		Generative Simulation and Safety Testing	Acoustic Simulation MRO Training		
	Energy & Utilities		3D Rendering: Well Sites, Pipelines, etc.		Automated Tech. Equipment Training	Geological Assessment for Oil Exploration
Hi-tech	Software & Internet		UX Design Generation		Instructional Video Generation	Code Snippet Generation
	Consumer Electronics				Promotional Video Generation	Virtual Showrooms
	Telecommunications	Manual Generation and Device Configuration	Network Design	Multi Language Voice Dubbing	News Video Generation	
Services-Led	Retail	Product Catalog Generation Personalized Product Images		Intelligent Voice Assistant		
	BFSI	Intelligent Reports and Charts Generator Personalized Virtual Financial Advisor		Conversational Banking	Consumer Banking Operations Training	Fraud Simulation and Pattern Detection
	Healthcare	Mental Health & Wellness Plans	Clinical Trial Designs	Therapeutic Voice Assistants		Drug Discovery Through Molecule Simulation

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Mature Use Cases

Service Providers can develop proprietary IPs to address the most impacted business functions - Sales, Marketing, and Customer Service



BUSINESS FUNCTION	BUSINESS FUNCTION	BUSINESS FUNCTION	
		JOB LOSS INTENSITY	HUMAN ENGAGEMENT WITH GENERATIVE AI
CUSTOMER SERVICE	Generative AI enhances customer service by integrating with chatbots and virtual assistants to generate descriptions, marketing campaigns, etc.	▲	**Replace Humans:** Customer Support Agents, Transcribers
SALES & MARKETING	Generative AI **automates** the process of **creating and optimizing marketing materials and processes**, saving time and resources for enterprises	▲	**Replace Humans:** Content designing, Email Outreach
IT & ADMIN	Generative AI helps in **automating multiple routine tasks** like data entry, document processing, and workforce scheduling	▲	**Replace Humans:** Code testers, Data Q/A analysts
FINANCE, LEGAL & ACCOUNTING	Generative AI enhances **analysis and decision-making by automating complex calculations**, identifying anomalies, and **ensuring regulatory compliance**	▲	**Replace Humans:** Paralegals, Legal assistants, Financial advisors
PRODUCT DEVELOPMENT	Integration of Generative AI in **generating design ideas** can enhance product development	▼	**Co-work with Humans:** Product Planning and Manufacturing
HUMAN RESOURCES	Talent Acquisition specialists can use conversational Generative AI to enhance the **candidate screening process**	▼	**Co-work with Humans:** Learning & Development, Query Management
SUPPLY CHAIN & LOGISTICS	Generative AI enables **real-time optimization of processes**, enhances **demand forecasting**, and improves **inventory management**.	▼	**Co-work with Humans:** Demand Forecasting, Route Optimization, etc.
RESEARCH & DEVELOPMENT	Generative AI accelerates experimentation, enhances **simulation accuracy**, and fosters innovative solutions	▼	**Co-work with Humans:** Drug Design, Product Designing

1 Zinnov's Enterprise AI survey 2022

2 Based on enterprise CXO sentiments, market signals, Press releases, Industry reports

Jobs at high-risk of being replaced by Generative AI

Source: Zinnov Research and Analysis, Zinnov Z1000 database

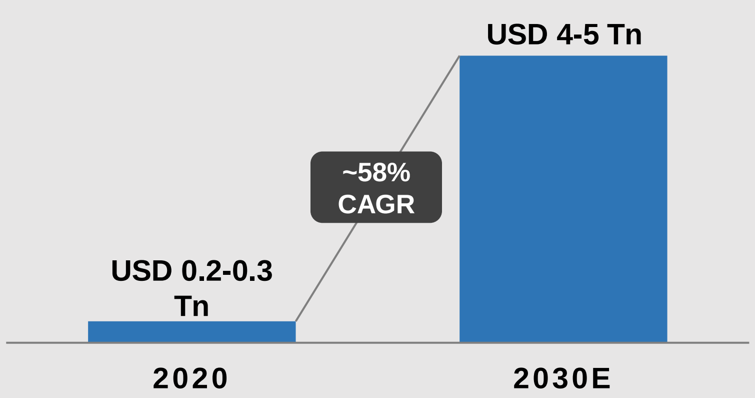
Industrial Metaverse is at the forefront of Industry 5.0, and attracting an influx of investments across technology firms

Industrial Metaverse

Metaverse / Immersive Experience

Metaverse / Immersive Experience is a form of digital experience that combines cutting-edge technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), to create a highly interactive and engaging experience for users. Immersive Experiences can transport users to entirely new environments and provide them with a sense of presence that is difficult to replicate.

Global Metaverse Market Size



Extended Reality (XR)
Umbrella Term - Any technology that alters the reality by adding digital assets

Mixed Reality (MR)
Technology that blends virtual objects with the real world

Real Environment

Augmented Reality (MR)
Technology that adds digital objects to the real world
Ex: Using a phone app to see what furniture would look like in your room

Virtual Reality (VR)
Technology that immerses you in a completely virtual world
Ex: Wearing a headset to play a game that takes place in a different world

Virtual Environment

No/Low Immersion ↔ **Full/High Immersion**

USD 115 Bn
Investment committed by companies on Metaverse since 2010

3200+
Companies competing in the Metaverse Market Landscape

9600+
Early and late-stage VC investment deals since 2010 in the Metaverse Market

~80%
Metaverse companies are in North America and Europe

Industrial Metaverse Tech Stack

Storage, Compute & Security Layer	**Data Centres, Edge Centres, Cloud Computing Platforms**
Connectivity Layer	**Network Infra including 4G/5G Connectivity**
Device Layer	Existing Devices New Devices
Application Layer	Gaming App Tourism Apps Manufacturing Operations Apps Real Time Collaboration Apps

Enabling Technologies

1	**Edge & Cloud Computing:** *Edge Computing involves processing data closer to the source, while Cloud Computing involves delivering computing services over the Internet*
2	**Digital Twins:** *Digital Twins are virtual replicas of physical systems that can be used to simulate and optimize performance*
3	**5G Networks:** *5G networks are the next generation of cellular networks, offering faster data transfer speeds, lower latency, and increased network capacity*
4	**IOT & IIOT:** *IOT and IIOT involve connecting physical devices to the Internet, allowing them to collect and share data*
5	**Blockchain:** *Blockchain is a secure, decentralized digital ledger that can be used to record transactions*
6	**AI ML:** *AI and ML involve developing intelligent systems that can learn and make decisions based on data*
7	**XR:** *XR is an umbrella term that encompasses VR, AR, and MR technologies that create immersive, interactive experiences*

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Companies in Hi-Tech and Services industry are driving innovation, creating new avenues for customer engagement, and unlocking untapped value across the value chain

Industry Category	Industry	Focus Area	Company Name	Industry Case Study
Manufacturing	Automotive	Virtual Reality	MG MORRIS GARAGES Since 1924	MG Motor has introduced their innovative Metaverse platform, MGverse, to bring the company's customers, partners, and employees together for immersive experiences.
	FMCG	Virtual Reality	Nestlé PURINA.	Nestle has adeptly executed the integration of Blue Yonder's category management solution with 3DVR Solutions' (3DVRS) cutting-edge 3D virtual reality technology, empowering retail partners to optimize store shelf merchandising.
	Medical Devices	Virtual Reality	Johnson & Johnson	Johnson & Johnson starts an Innovation Room in Mexico, featuring Oculus Quest 2 for VR simulations. Doctors can tailor difficulty and procedures in a virtual operating room to enhance skills.
Hi-Tech	Computer Peripherals & Storage	Extended Reality	LG Electronics	LG Electronics has partnered with Oorbit, a Metaverse platform provider, to enable interoperable virtual worlds on LG TVs, bringing immersive games and experiences to users.
	Software & Internet	Virtuality Reality	Walmart Save money. Live better.	Walmart has introduced a virtual try-on technology that employs AI, enabling customers to envision clothing on models who resemble them in appearance and body shape when shopping online.
	Software & Internet	Extended Reality	Adobe	Adobe's Substance 3D tools are an end-to-end solution for creating standalone 3D content and metaverse-ready immersive experiences. It empowers creators and brands to craft engaging and immersive experiences that captivate audiences.
Services	BFSI	Extended Reality	JPMORGAN CHASE & CO.	JP Morgan, a top US bank, has established a lounge in Decentraland, a popular metaverse built on blockchain technology. Decentraland is one of the most popular virtual worlds where users explore different experiences in a fully decentralized environment.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Industrial Metaverse use cases have gained momentum across four key areas

Industrial Metaverse

	Industry	Connectivity	Customer Experience	Digital Training	Workplace Safety & Assistance
Manufacturing	**Aerospace**	Virtual Flight Tour		Astronaut / Pilot Training	Remote Assistance
	Automotive	Holographic AR Navigation	Virtual Showroom	MR based Vehicle Assembly Training	Operator Assistance
	Biotechnology			Multisensory-Stimulation Training	Equipment Issue Detection
	Energy & Utilities	Asset Management & Maintenance		Employee Training	Virtual Drill / Oil Rig Exploration
Hi-tech	**Semiconductor**	Guided Manufacturing		Design & Testing Simulation on	Remote Collaboration
	Software & Internet			AR-Enhanced Software Training	Software Debugging & Testing
	Telecommunication	Network Planning	Customer Support		
Services-Led	**BFSI**	Virtual Branch	Immersive Banking	Employee Onboarding	
	Media & Entertainment	Virtual Theme Parks	Fan Engagement		
	Travel & Hospitality	Virtual Events	Immersive Travel	Cabin Crew / Housekeeping Training	

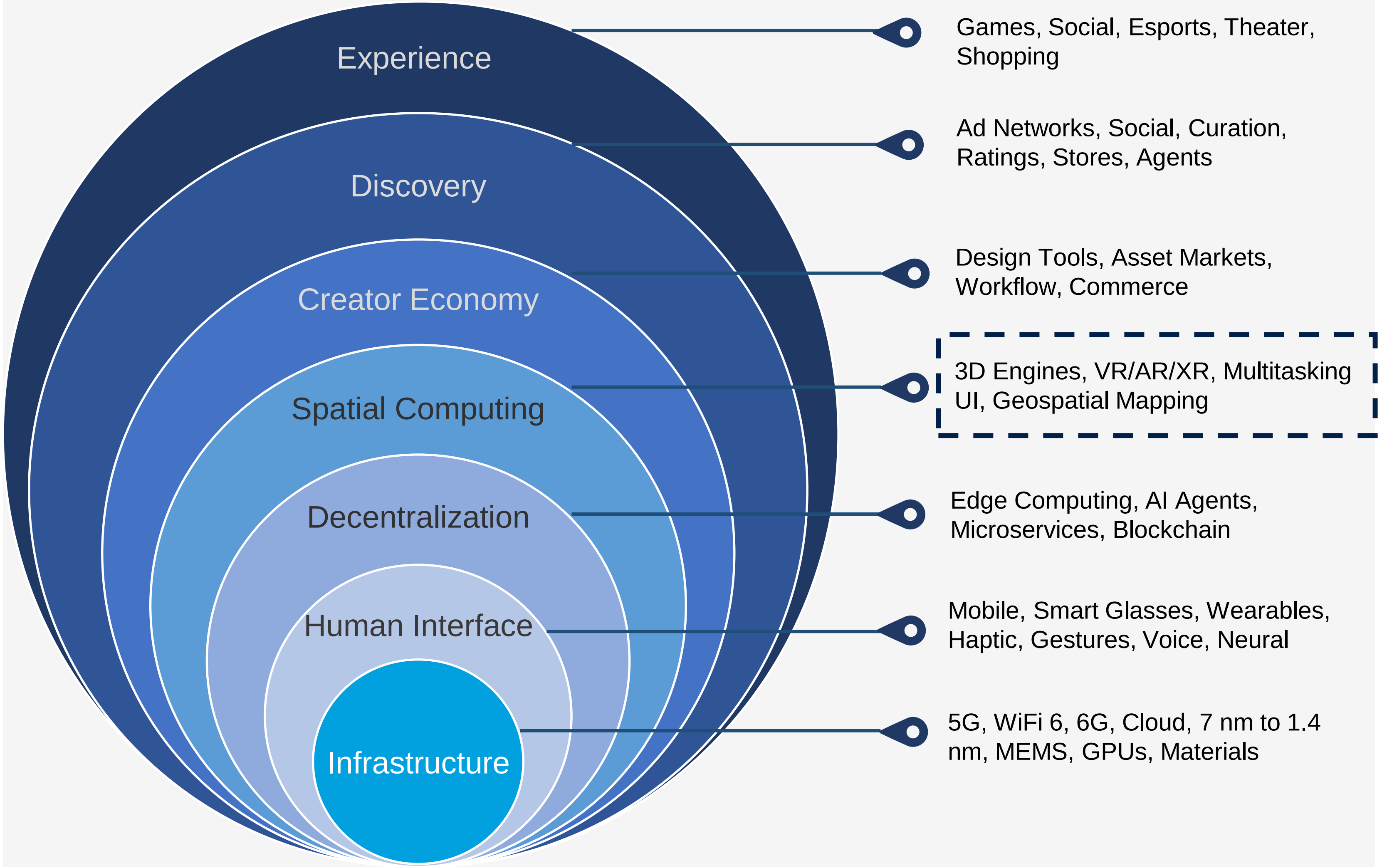
Source: Zinnov Research and Analysis, Zinnov Z1000 database

AR VR MR

Spatial computing in the industrial Metaverse offers benefits across visualization, remote collaboration, digital twins, training, and analytics

Industrial Metaverse

The Seven Layers of the Metaverse



Games, Social, Esports, Theater, Shopping

Ad Networks, Social, Curation, Ratings, Stores, Agents

Design Tools, Asset Markets, Workflow, Commerce

3D Engines, VR/AR/XR, Multitasking UI, Geospatial Mapping

Edge Computing, AI Agents, Microservices, Blockchain

Mobile, Smart Glasses, Wearables, Haptic, Gestures, Voice, Neural

5G, WiFi 6, 6G, Cloud, 7 nm to 1.4 nm, MEMS, GPUs, Materials

USE CASES

***GE** implements spatial computing using AR devices for maintenance and repair, enabling technicians to access real-time data and instructions, improving efficiency and equipment reliability*

***Siemens** utilizes spatial computing, including VR simulations for training and AR for maintenance, to enhance proficiency, safety awareness, and provide real-time instructions to technicians.*

***Honeywell** is utilizing AR and VR for training, maintenance, and warehouse optimization to enhance worker training, reduce maintenance errors, and optimize warehouse operations*

***Boeing** utilizes spatial computing with AR headsets to enhance assembly processes, providing guided instructions and component highlighting for improved accuracy and efficiency*

***Ford** employs spatial computing with VR simulations for design, prototyping, and vehicle development, enabling faster iterations, ergonomic evaluation, assembly testing, and improved manufacturing feasibility*

***BMW** uses VR simulations for production planning and layout optimization to streamline operations, enhance efficiency, and optimize workflows through testing various layouts*

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service Providers are at the forefront of the industry and proactively investing in Metaverse capabilities to cater to the evolving needs of their clients

1.

Solutioning / PoCs

Invest in Co-innovation Labs & COEs to build innovative solutions and Proof of Concepts (PoCs). Start creating PoCs around high potential applications such as:

- *3D Space / Avatar Development*
- *AR/VR Application Development*
- *Decentralized/DeFi Platform Development*

2.

Proprietary / IPs

Build "Re-usable" IP such as products & frameworks to enhance competitive differentiation and support innovation use-cases. Invest in use-cases that initially emerge as niche but eventually transition into the mainstream.

3.

Ecosystem leverage

Increase ecosystem leverage by partnering with new-age Start-ups to build metaverse use-cases.

4.

Talent Skilling

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

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

Source: Zinnov Research and Analysis, Zinnov Z1000 database

A Connected Supply Chain (CSC) is an end-to-end connected loop across 5 stages of a supply chain operation, enabled by seamless flow of information of physical goods and services

Connected Supply Chain

1. Synchronized Planning

- Enterprise Plan Reconciliation
- Intelligent Demand Management
- Inventory Optimization

2. Intelligent Supply

- E-sourcing and Procurement
- Contact Management
- Assisted System and Processes

3. Smart Operation

- Smart Factory
- Asset Management
- Connected Worker
- Command Center

4. Digital Logistics

- Chain of Custody and Integrity
- Autonomous Delivery
- Fleet Management
- Smart Packaging
- Warehouse Automation and Robotics

5. Connected Customer

- Self-service and Fulfilment
- Customer Experience Management

Supply Chain Wide Capabilities

- *Supply Chain Analytics*
- *Supply Chain Automation*
- *Supply Chain Integration*

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Several mega trends are at work, giving rise to new business priorities and corresponding investment in Connected Supply Chain use cases

Mega Trend		Challenges & Opportunities	Investment Areas
Growing Customer Expectation	Increased demand for product customization, personalized packaging, delivery agility, etc.	Rising cost of operation and longer lead times due to smaller production lot sizes	• **Additive manufacturing** and **digital twin**-based simulation for rapid product design and prototyping • **Predictive maintenance** for anticipating machinery breakdown to prevent production downtime
Change in Buying Preferences	Rise of omni-channel buying with customers seamlessly navigating between online and off-line channels	Complexity in demand and inventory planning across multiple channels	• **Multichannel** ordering, **inventory tracking** and management for omni-channel user experience • **Recommendation engine**, anticipatory shipping, etc. to predict and respond to buying behavior
Increased Globalization	Rise in global trade, with ~ 25% of global production is being exported	Complex cross-country trade with multiple touch points, complex pricing rules, and regulations	• **Cross-border logistics** services, such as freight brokerage, cargo insurance, invoice automation, etc. • Use of **blockchain** by banking and financial institutions for efficient **cross-border payments**
Rapid Urbanization	Rise of global urban population, with staggering 90% of the growth in emerging economies	Increased network complexity and challenges in last mile distribution	• Increased trial of **autonomous delivery** solutions for last-mile delivery • Proliferation of new business models, such as dropshipping, on-demand warehousing
Sustainability Requirement	Regulatory constraints around carbon emissions, electronic logging device (ELD) compliance, and ethical sourcing	Opportunity to improve resource utilization while promoting “green” products for new revenue steams	• **Fleet management** solution for fuel management, fleet utilization, truck loading and driver safety • Blockchain based **product provenance** for a transparent supply-chain across diverse ecosystem
Shortage of Talent & Resources	Limited availability of skilled workers and warehousing space	Limited availability of skilled workers has resulted in fierce competition for talent	• **Warehouse robotics** and automation (Autonomous Mobile Robot, Automated Guided Vehicle) for automated material handling • AR/VR assisted training, remote guidance and voice picking for **augmented workforce**

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Zinnov identified an initial list of ~55 high-level use cases across 5 Connected Supply Chain stages and 17 associated capability areas

ER&D SERVICES

CSC

Connected Supply Chain Use Cases

Dynamic Planning	Intelligent Supply	Smart Operation	Connected Customer	Digital Logistics
Enterprise Planning Reconciliation	**e-Sourcing and Procurement**	**Operations Command Center**	**Customer Experience Mgmt.**	**Chain of Custody and Integrity**
Response and Supply Planning	e-Procurement	SCM control tower	Clickstream Analytics	Shipment Tracking
Sales & Operations Planning	Smart Vendor Screening	Logistics control tower	Customer Analytics	Product Provenance
Integrated Business Planning	Supplier Risk Mgmt.	**Smart Factory**	Customer Feedback Mgmt.	Cold Chain Monitoring
Network Design and Optimization	Spend Analytics	Industrial Robotics	Customer Relationship Mgmt.	**Autonomous Delivery**
Intelligent Demand Management	Invoice Processing Automation	Vision Inspection	Product Recommendation Engine	Autonomous Trucks
Demand Sensing	Partner Onboarding	Smart Meter	**Self-service and Issue Resolution**	Autonomous Cargo
Demand Forecasting	Intelligent Document Processing	**Asset Management**	Customer Support	Delivery Drones
Inventory Optimization	**Contract Management**	Asset Performance Management	Real-time Customer Tracking	Delivery Robots
AI-powered Inventory Management	Contract Management	Predictive Maintenance		**Fleet Management**
Inventory Monitoring	Smart Contract	**Connected Worker**		Fleet Monitoring
Inventory Replenishment and Management	**Assisted System and Processes**	Augmented Workforce		Vehicle Telematics
Multi-channel Order Management	Contactless Payment	Workplace Safety and Assistance		Driver Monitoring
	Credit Investigation			Truck Loading
	Digital Wallets			Warehouse Management
	AML/CFT Automation			Automated Parcel Processing
				Order Picking and Storage
				Smart Packaging
				Advanced Product Packaging
				Automated Packaging
				Smart Product Label

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Low □ ▨ ■ High

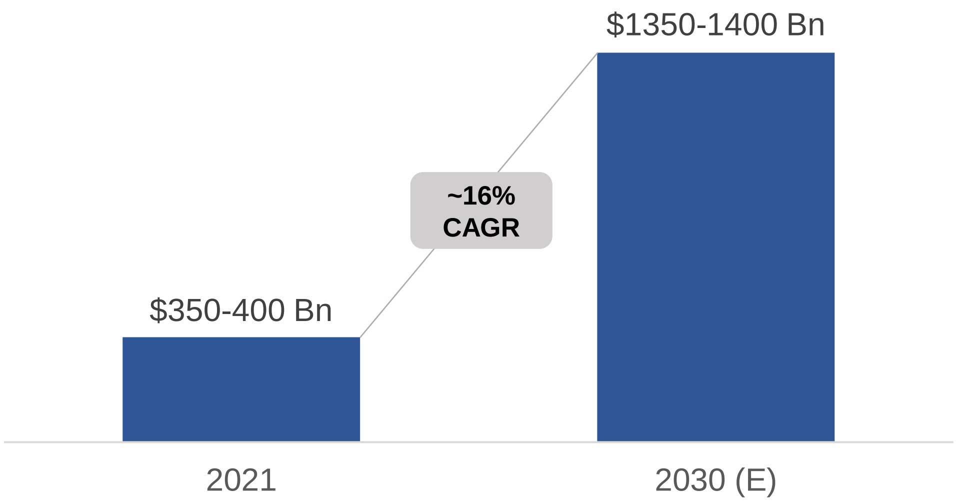
Leading Service Providers are developing comprehensive portfolios of in-house IPs and accelerators in the prioritized areas

tcs TATA CONSULTANCY SERVICES	Infosys	Capgemini
More than 40 proprietary assets and vertical specific solutions focused on planning, procurement, manufacturing and logistics operation	*More than 25 proprietary assets as part of "Live" supply chain offering with additional IPs (NIA, Epoch, etc.) infused from subsidiaries and COEs*	*Over 25 proprietary solutions, frameworks, and platforms with coverage across sourcing, warehouse automation and asset management*
✓ TwinX and Equiptix – ML-based health score computation and predictive maintenance solution ✓ IKRISTM, neural manufacturing framework with industrial vision system to automate inspection ✓ DigiFleet, a suite of solutions for route optimization, shipment tracking and ETA prediction	✓ Smart fleet solutions, including vehicle monitoring, driver ✓ Digital WMS solution with image analytics for inventory counting, AR directed storage and robotic picking capabilities ✓ Multiple solutions (Asset Genome, Smart Asset Management, etc.) for asset management and monitoring	✓ Columbia Capgemini and Idemia jointly developing a connected and autonomous transport solution ✓ Perform-AI Platform for Quality Inspection (and Asset Monitoring, Energy savings, etc.) with Deep learning and Computer Vision ✓ SpendSMART with 300 industry standard KPIs and 100 dashboards for procurement, invoice, etc.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The Cloud market is projected to witness a CAGR of ~16% from 2021 to 2030, surging to a market size of USD 1.3 Tn

GLOBAL CLOUD MARKET (USD Bn.)



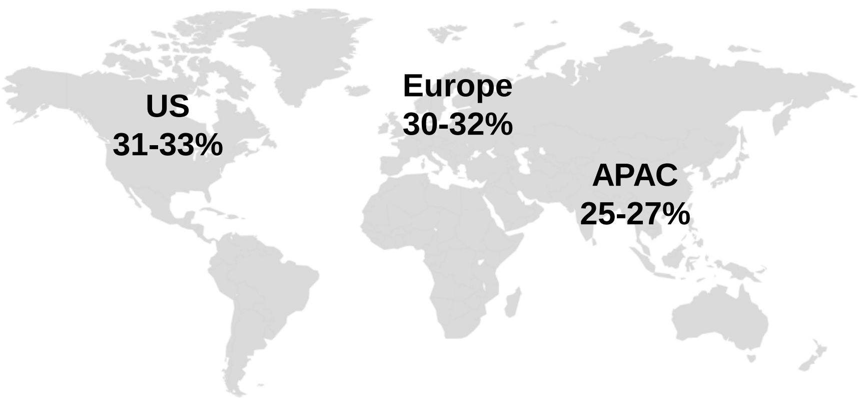
AWS and Azure lead the market while GCP is showcasing highest growth rate among top players in Cloud

	REVENUE	GROWTH RATE
amazon web services	80.09 Bn	29%
Microsoft Azure	75.25 Bn	25%
Google Cloud	26.28 Bn	37%

Other Key Players

Alibaba Cloud, Adobe, IBM, salesforce, ORACLE, Microsoft, workday, SAP, Hewlett Packard Enterprise, cisco

GEO DISTRIBUTION



TOP GLOBAL VERTICALS

BFSI 25%	**Telecom** 16%	**Media** 11%
Retail 11%	**Healthcare** 8%	**Manufacturing** 9%

SEGMENT-WISE TRENDS

By 2024, **enterprise** cloud spending will make up 14% of IT revenue globally

43% of **SMBs** preferred to use a public-hosted cloud service in 2020

KEY GROWTH DRIVERS

Adoption of Digital-led Services with increasing penetration of internet and mobile devices, and rise in consumption of big data

Rising digitalization among enterprises in APAC region due to increased focus on cost optimization

The economic, organizational and societal impact of the pandemic will continue to serve as a catalyst for digital innovation and adoption of cloud services

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Enterprises across services industries are strategically investing across multiple use cases

zinnov ZONES ER&D SERVICES

HYPERSCALERS

Manufacturing	**Chemicals & Materials**	Cloud-based Production Monitoring	Cloud-based Enterprise Energy Management System	App-based Plant Repair and Maintenance Log	Cloud-based Virtual Print Management	Cloud-based Customer Relationship Manag. (CRM) System					JSW	JSW with Salesforce launched Aikyam to enhance distribution, & supply chain
	Energy & Utilities	App-based Field Repair and Maintenance Log	Mobile Device Plant Enablement	Utilities Apps for Consumers	Smart Meters	Customized Energy Packages	Mobile-based Turbine Control	Cloud-based Solar Design		Virtual Power Plant		BPLC partnered with Microsoft to address challenges of the oil & gas sector
	FMCG	Digital Signage	Virtual Queue Management System	Self Service Retail Kiosks	On-demand Scheduled Customer Delivery	Interactive Digital Walls in Retail Stores	AI-based Inventory Tracking	Real-time Customer Order Tracking		Digital Wallet	Kellogg's	The Kellogg Company runs SAP HANA on AWS
	Industrial	Building/Home Intrusion Detection System	Smart Energy Meters	Cloud-based Energy Information Systems	Factory Robot Training using Extended Reality	Cloud-based Industrial Noise Monitoring	App-based Plant Repair & Maintenance Log					Volkswagen used AWS IOT to build Industrial Cloud
	Transportation	Vehicle SOTA/FOTA Updates	Connected Vehicle Platform	Cloud-based Automotive Manufacturing Noise Monitoring	Cloud-based Infotainment	Cloud-enabled Data Recording	Robot Training using Extended Reality	Cloud-based Logistics	Management		ups	UPS uses Google cloud to save $400M every year with smart analytics
Hi-Tech	**Consumer Electronics**	Digital Signage	Electronic Shelf Label	AI-based Inventory Tracking	Cloud-based Energy Information Systems	Cloud-based Object Storage System	App-based Plant Repair & Maintenance Log	Digital Wallet			LG	LG Electronics uses AWS's NICE DCV to accelerate product design
	Telecommunications	Digital Wallet	Mobile Device Plant Enablement	Over-The-Top (OTT) Voice Calling	Video Over-The-Top (OTT)	Over-The-Top (OTT) Quality of Service Monitoring using AI	Cloud-based Data Management	Over-The-Top (OTT) Messaging		Telecom Mobile Apps	verizon	Verizon Media leverages AWS to handle high-quality broadcasts demands
Services	**BFSI**	Digital Wallet	Personalized Banking Dashboard	Self Service Banking Kiosks	Interactive Teller Machines with Remote Tellers	Unified Payment Platforms	Cloud-based Loan Processing	Workday Implementation		Cloud Banking	HSBC	HSBC built its PayMe for Business app on Microsoft Azure
	Media & Entertainment	Cloud-based Content Management System	Cloud Gaming	Smart Game Traffic Monitoring	Cloud Security Automation	Game Crash Reporting using Cloud/IOT	Digital Coupons				NETFLIX	Netflix uses AWS for its computing, storage, analytics, and recommendations
	Retail	Digital Wallet	Digital Signage	Virtual Queue Management System	Self Service Retail Kiosks	On-demand Scheduled Customer Delivery	AI-based Inventory Tracking	Interactive Digital Walls in	Retail Stores	Real-time Customer Order Tracking	Pizza Hut	Pizza Hut increased customer coverage & on time deliveries with Google Cloud & Maps
	Healthcare	e-Appointments	Virtual Hospital	Telemedicine	Remote Patient Monitoring	mHealth	AI-based Inventory Tracking	Electronic Health Records	(EHR)	AI for Coordinated Care	moderna	Moderna pioneered mRNA medicines using AWS to reduce time to market

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Low | Medium | High

AWS, Azure, and GCP have established themselves as market leaders with a wide range of products and services, collectively capturing a significant 58% market share

		amazon web services™	Microsoft Azure	Google Cloud
Overview	Founded	2006	2010	2011
	Headquarters	Washington, United States	Washington, United States	California, United States
	Revenue’22 (Bn, USD)	80.09	75.25	26.28
	Growth Rate YOY	28.76%	25%	36.8%
	Market Share	32%	19%	7%
	No. of Locations	66 regions	54 regions	20 regions
Cloud Platform Profile	Services	200+	100+	60+
	Verticals	15	7	9
	Data centers	38	200	23
	Pricing	AWS offers you a pay-as-you-go approach for pricing for over 200 cloud services	Azure offers heavy discounts for general purpose and compute optimized instances	Google offers customer-friendly pricing structure with big discounts and flexible billing options
Key Observations	Strength	• Dominant market position with extensive and mature offerings • Customer service • Extensive training with Global reach	• Integration with Microsoft tools and software • Broad feature set • Hybrid cloud and support for open source • Long standing customer relationships	• Designed for cloud-native businesses • Commitment to open source and portability • Deep discounts and flexible contracts • AI/ML solutions and BigQuery
	Weakness	• Less cost effective in long-run • Overwhelming options of list of products • Comparatively limited options for hybrid cloud	• Lack of services, outside of Americas • Issues with technical support, documentation, training, and breadth of the ISV partner ecosystem	• Customer support yet to be ramped up • Fewer features and services • Historically not enterprise focused

Source: Zinnov Research and Analysis, Zinnov Z1000 database

AWS's Amazon Partner Network (APN) offers four partnership options to Service Providers, helping them build capabilities

	Registered	Standard	Advanced	Premier
Requirements	Online Profile Completion	• APN Program Fee 2500 USD Per Year • AWS Billing >50,000 USD **AWS Accreditations** • 8 Technical Professionals • 8 Business Professionals • 4 TCO and Cloud Economics **AWS Certifications** • 2 Associate Level • Customer References: 2 • AWS Support Level: Developer+	• APN Program Fee 2500 USD Per Year • AWS Billing >50,000 USD **AWS Accreditations** • 8 Technical Professionals • 8 Business Professionals • 4 TCO and Cloud Economics **AWS Certifications** • 4 Associate Level • 2 Professional Level • Customer References: 6 • AWS Support Level: Business+	• APN Program Fee 2500 USD Per Year • AWS Billing By Regions **AWS Accreditations** • 20 Technical Professionals • 20 Business Professionals • 8 TCO and Cloud Economics **AWS Certifications** • 20 Associate Level • 8 Professional Level • Audited MSP Program or DevOps Consulting Competency • 1 AWS Competency • Customer References: 10 within past 12 months • AWS
Benefits	-	All Registered Benefits +	All Standard Benefits +	All Advanced Benefits +

	• APN Portal Access
	• APN Webcasts
	• Online Trainings and AWS Accreditations
	• Discounts on Instruction Led Trainings
	• AWS Solution Trainings for Partners
	• Access to APN Learning Path
		• Use of APN Logo
		• Company Profile on Partner Solutions Finder
		• Access to training funding
		• Access to APN Marketing Central
		• Eligible for PoC funding
		• Unlock Programs
		  • AWS Channel Reseller Program
		  • AWS Service Delivery Program
		  • Public Sector Partner Program
			• Eligible for Market development Funding
			• Unlock Managed Service Provider Partner Program
			• Unlock AWS Competency Program
				• APN Premier Partner Page Listing
				• Eligible for AWS written case studies
				• Eligible for AWS Professional Services Bootstrap training
				• 2 weeks of professional services for qualified enterprise opportunities
				• Eligible for Additional Market Development Funding
				• Named AWS Partner Account Manager
				• Named AWS Solution Architect

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Microsoft offers Service Providers three distinct channels; Sell-To, Sell-With, and Sell-Through, providing a range of collaborative opportunities

Channels	**Sell-to Microsoft**			**Sell-With Microsoft**	**Sell-through Microsoft**
	(Engineering)	**(IT and Business Functions)**	**(Enterprise Services)**		
Definition	• Service Partner delivers engineering and support services to internal Microsoft teams • Invoice is generated by Microsoft		• Service Partner is subcontracted by Microsoft Enterprise Services team for enterprise customers • Invoice is generated by Microsoft	• Partner led or Microsoft led GTM motion to co-sell/reselling services directly to enterprise customers • Invoice is generated by Service Provider	• Service Partner builds custom packages and sells via Azure marketplace / Microsoft store
Microsoft Teams	• Cloud and AI • Experiences and Devices • Technology and Research • LinkedIn • Nuance	• Microsoft Digital (Internal IT) • Business Functions (CMO, CFO)	• Industry Solution Delivery (formerly known as Microsoft Consulting Services) • Customer Experience and Success	• Global Partner Solutions • Industry Solutions	• Global Partner Solutions • Industry Solutions
Revenue Streams	• Staff Augmentation • Managed Services / Project-based Services		• Staff Augmentation • Managed Services - Volume of tickets	• Managed Services • ACR Revenue	• Marketplace Revenue
Partner Programs	Microsoft Cloud Partner Program (Not Mandatory)		Microsoft Cloud Partner Program Azure Expert MSP Program	• Cloud Solution Provider • Azure Expert MSP / AMMP	• Cloud Solution Provider • New Commerce Experience

Source: Zinnov Research and Analysis, Zinnov Z1000 database

GCP's Partner Program offers a wide range of partnerships to help accelerate the development of Cloud programs in a rapidly changing environment

Certified Partner

Requirements
- ✓ Resource pool trained and certified in GCP

Benefits
- ✓ Partner directory listing

Expertise Partner

Requirements
- ✓ Annual Business plan
- ✓ Sell– 2 Technical and sales credentials
- ✓ Service – 2 professional level certifications
- ✓ Build – 1 Product integration

Benefits
- ✓ Differentiation on partner directory listing
- ✓ Training support

nagarro
BRIO

Specialisation Partner

Requirements
- ✓ Annual Business plan
- ✓ Minimum Qualifying billings
- ✓ 3 Case studies
- ✓ Sell– 20 Total credentials
- ✓ Service – 12 professional level certifications
- ✓ Build – 2+ Product integration

Benefits
- ✓ Differentiation on partner directory listing
- ✓ Training support/Partner discounts
- ✓ Dedicated partner manager and program support

SpringML

Premier Partner

Requirements
- ✓ Top 3-5% of the participating companies are awarded premier partner status after assessment of Performance, case studies and certifications

Benefits
- ✓ Invitation to Partner advisory council to shape GCP's strategy
- ✓ Co-branding marketing funds
- ✓ Dedicated partner manager

Atos
accenture
Cognizant
Deloitte.
Capgemini
tcs TATA CONSULTANCY SERVICES
IBM

Source: Zinnov Research and Analysis, Zinnov Z1000 database

AGENDA

- **A** The Rise of Digital Engineering
- **B** Technology Pillars of Digital Engineering
- **C** Sustainability – A Priority
- **D** Industry Deep Dives - ER&D Spend Trends & Priorities
- **E** Addressed Market and Service Providers' Opportunities
- **F** Growth Levers for Service Providers
- **G** Zinnov Zones for ER&D Ratings 2022

Source: Zinnov Research and Analysis, Zinnov Z1000 database

SUSTAINABILITY

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Increasing political, social, and regulatory pressures along with major investments by PE/VC firms are directing enterprises' missions towards sustainability

SUSTAINABILITY

DRIVERS

Political

- **Paris Climate Agreement and European Green Deal** focussed on reduction of GHG emission

Social

- **Increased consumer awareness** about adoption of **recyclability and circular model**
- **Competitive advantage** for companies adopting sustainable practices in terms of cost savings and customer loyalty

Environmental and Legal

- **Stricter regulatory pressure** like emission caps, and waste management
- **UN's Sustainable Development Goals** addressing various global challenges

ENABLERS

Economical

- Major **investment attraction** due to low future risks and high transformation potential

KKR *Leading PE firms like KKR, BlackRock, TPG, Apollo etc., have released dedicated **ESG funds***

- **Market incentives** to reduce Co2 emission like carbon pricing, carbon tax credits, and cap-and-trade system

Technology

- **Technological advancements** in clean energy, energy efficiency, and circular economy solutions driving sustainability across the value chain
- **Demand of skilled workforce** for green roles like sustainability managers, ESG analysts, environmental consultant, etc.

Schneider Electric *Schneider Electric is planning to hire for **~2000** green roles for building green management solutions*

$ 250 Bn

Sustainability is expected to influence **150 - 250 Bn USD** of technology and operations spend by 2030

$ 6 Bn

~$6 Bn invested by PE/VC firms for Hydrogen based stratups in 2022, **3X** times increased investment than in **2019**

13 Mn

~13 Mn new jobs to be created globally by 2030 based on **8% YoY growth** in job postings with green skills in last **5 years**

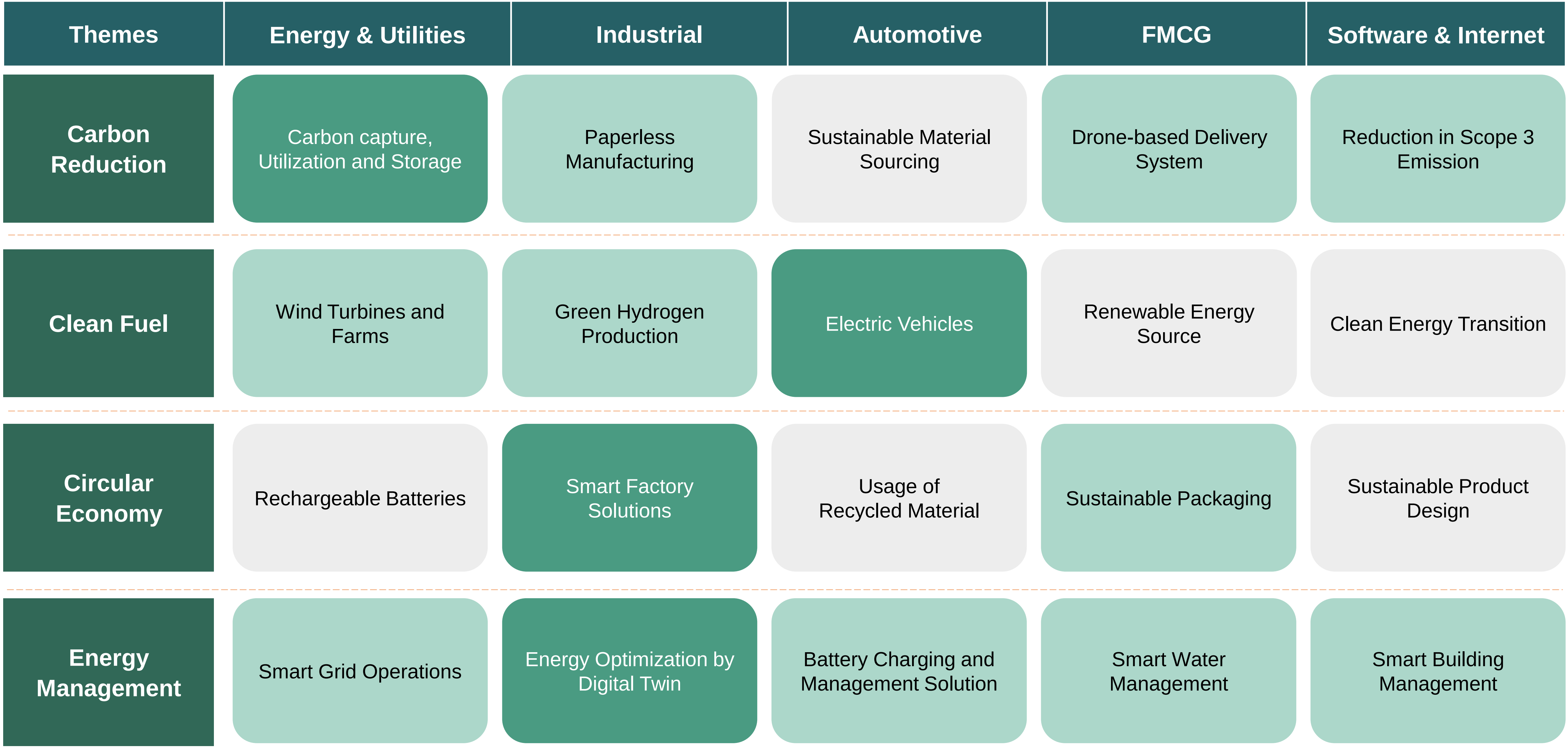
Source: Zinnov Research and Analysis, Zinnov Z1000 database, NASSCOM, Pitchbook and Economic Times Reports

Global players across the value chain are increasingly promoting decarbonization efforts based on four major themes

Carbon Reduction	***Reduction of carbon footprints*** *across complete process* ranging from manufacturing to operations - Carbon capture, utilize and storage (CCUS) - Reduction in scope 2 and 3 emission	bp BP to build a **cluster of CCUS** based low-carbon projects in southern China with PetroChina, which will have a combined output of upto 860 MW electricity	**10/10** Top Z1000 Energy & Utilities companies are investing in creating CCUS storage hub
Clean Energy	***Energy derived from naturally replenished sources*** used for transportation, lightning, etc. - Renewable Energy - Product Electrification	Volkswagen has planned to **invest ~$125 Bn for electrification and digitalization** in next 5 years targeting electric vehicles to contribute 80% of total sales by 2030	**10/10** Top Z1000 Automotive companies have targeted sale of EVs as percentage of total sales by 2030
Circular Economy	***Reuse and regeneration of materials*** as a continuous process of production - IIOT for Waste Management - Sustainable Packaging	Honeywell Honeywell has developed an Upcycle process for **advanced plastic recycling** to increase the amount of plastic recycled by 3X times and reduce the GHG emissions	**10/10** Top Z1000 Industrial companies are building in-house capabilities to operate in a circular model
Energy Management	***Systematic monitoring, control and optimization*** of production, transmission, and usage of energy - Digital Twin - Sustainable Design	Microsoft Azure Digital Twin is an IOT platform used to gain insights and **optimize operations and costs** by creating digital representation of connected environments	**9/10** Top Z1000 Software & Internet companies are levering digital twin capabilities for energy optimization

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Adoption of sustainability-related use cases is accelerating in the Energy & Utilities, Industrial, and Automotive verticals



Themes	Energy & Utilities	Industrial	Automotive	FMCG	Software & Internet
Carbon Reduction	Carbon capture, Utilization and Storage	Paperless Manufacturing	Sustainable Material Sourcing	Drone-based Delivery System	Reduction in Scope 3 Emission
Clean Fuel	Wind Turbines and Farms	Green Hydrogen Production	Electric Vehicles	Renewable Energy Source	Clean Energy Transition
Circular Economy	Rechargeable Batteries	Smart Factory Solutions	Usage of Recycled Material	Sustainable Packaging	Sustainable Product Design
Energy Management	Smart Grid Operations	Energy Optimization by Digital Twin	Battery Charging and Management Solution	Smart Water Management	Smart Building Management

Source: Zinnov Research and Analysis, Zinnov Z1000 database

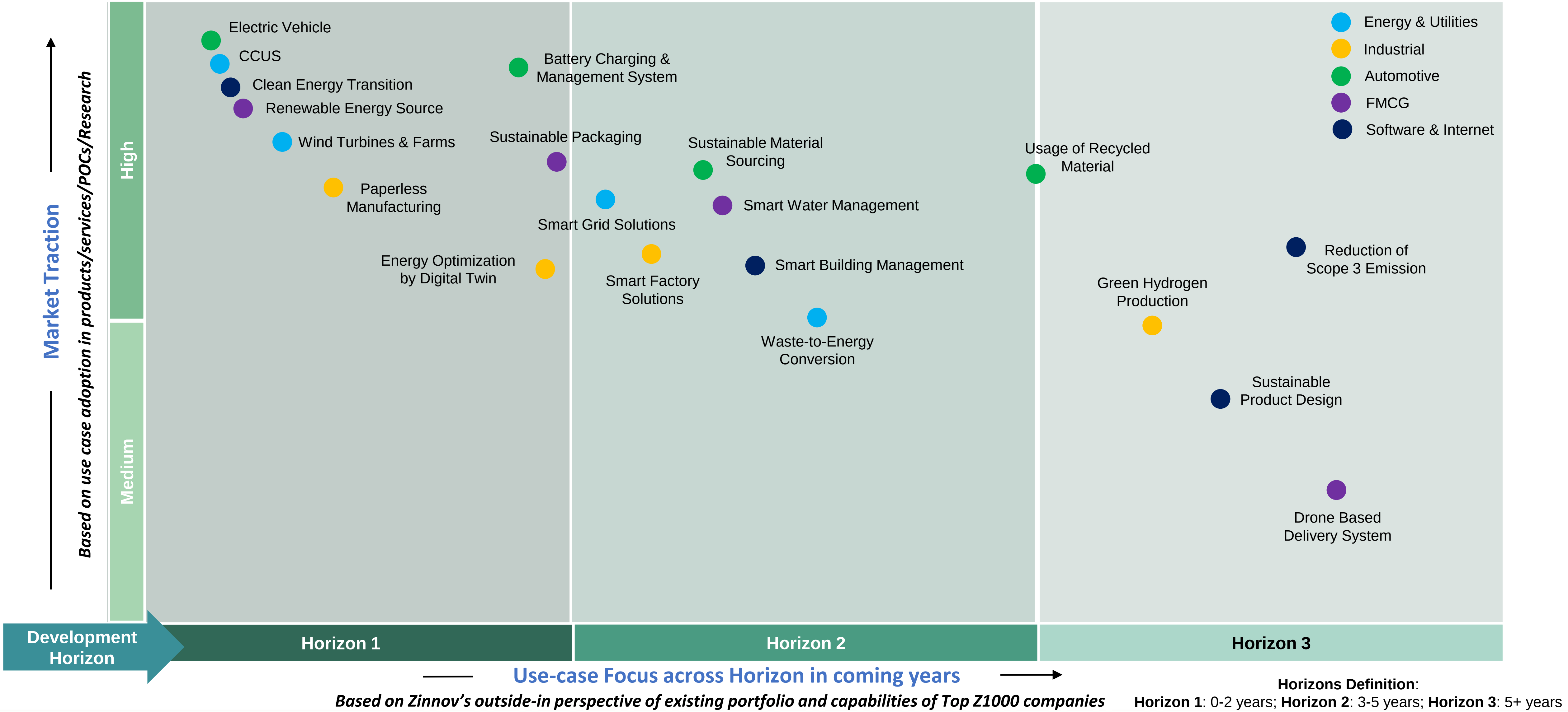
Scale of Adoption

Low	Medium	High

Electric Vehicles, CCUS*, and Clean/Renewal Energy use cases are growing

SUSTAINABILITY

Sustainability Use-Case Landscape



Based on Zinnov's outside-in perspective of existing portfolio and capabilities of Top Z1000 companies

Horizons Definition:
Horizon 1: 0-2 years; **Horizon 2**: 3-5 years; **Horizon 3**: 5+ years

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Companies are introducing Sustainability in products and services driven by both operational excellence and product innovation

SUSTAINABLE ENGINEERING

SUSTAINABILITY BY OPERATIONS EXCELLENCE

THEME

- ✓ Carbon Reduction
- ✓ Energy Management

- ❖ Automation-led manufacturing
- ❖ Reduced emissions in supply chain
- ❖ Carbon capture and utilization
- ❖ Clean energy adoption
- ❖ Cloud migration for energy savings

SUSTAINABILITY BY PRODUCT INNOVATION

- ❖ Smart and Connected Devices
- ❖ Designing Energy Efficient Product
- ❖ Light-weight Material, Packaging Innovation
- ❖ Product Electrification

THEME

- ✓ Clean Energy
- ✓ Circular Economy

SIEMENS AGC Pharma transformed into ***paperless manufacturing*** by Opcenter Execution system with electronic batch record solution developed by Siemens

Honeywell Honeywell's Thermal IQ platform provides helps its end users to ***harness hydrogen as an alternative fuel*** for the industrial thermal processes

DUKE ENERGY Duke Energy is using ***cloud-based software to manage its energy grid and reduce carbon footprint***, avoiding emitting over 4,000 metric tons of carbon dioxide each year.

TOYOTA Toyota Motors to develop a ***vehicle-to-grid technology*** in collaboration with Oncor Electric, providing customer and grid benefits in the BEVs

ExxonMobil Unilever used ***recycled plastic for 21% of total product packaging in 2022***, collaborating with suppliers to develop new technologies for recycled plastic

Collins Aerospace Collins Aerospace is working on developing ***hybrid-electric and water-enhanced turbofan technology*** for future aircraft propulsion systems

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service Providers have built an array of sustainable engineering capabilities to help enterprises achieve their net zero targets

SUSTAINABLITY ENGINEERING OFFERINGS

Product Design

Design integrated, sustainable products and services by synchronizing all dimensions of sustainability and promoting sustainable development across the entire product lifecycle

- Energy efficient product design
- Lightweighting or material substitution
- Tools and automation design
- PLM circularity

L&T Technology Services

L&T TS's client was able to experience 30% overall reduction in waste, 90% reduction in packaging cost and 66% reduction of the Co2 footprint in freight

Sustainable Operations

Develop and execute the sustainable roadmaps for the companies by building safe, intelligent and efficient systems, using IOT, edge, and AI as go-to technologies

- Product electrification
- EV Charging Infrastructure deign
- Building digital twins
- Green data centre

TATA
TATA TECHNOLOGIES

Tata Technologies supported a Swedish automaker in the design and development of a luxury, plug-in hybrid sports car based on Aluminum fiber

Energy Transition

Ensure carbon neutrality by helping enterprises pivot from conventional to renewal energy sources and drive climate saving actions across processes

- Digital manufacturing
- Decarbonization
- Distributed energy generation
- Predictive planning and route optimization
- Closed-loop supply chain

Capgemini

Capgemini spearheaded the transition of a French delivery services company to sustainable supply chain and reduce its network Co2 emission by 10%

Reporting and Analytics

Provides the tools and technologies to help businesses gather and analyze data and report to enable energy management and achieve efficiency

- Audits, reporting and target definition
- Water and waste management
- Risk management
- Smart Building
- System Integration

accenture

Volkswagen accelerated its sustainability strategy, post the ESG performance analysis by Accenture leading to a rise in market cap

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The growing emphasis on product electrification is creating significant opportunities for Service Providers

100-120

 # Outsourced Deals

2020-2023

- **110+** sustainable engineering deals are outsourced by enterprises from 2020 onwards
- **>70%** of total outsourcing engagements are focused on the **design and development of EV**
- **Hybrid & Electric Mobility and Software Testing** are two mostly outsourced workloads
- **Automotive** manufacturers comprise the largest client base for outsourcing services
- **Capgemini, Cognizant, and KPIT** are the top service providers in sustainable engineering

GLOBAL ENTERPRISES

Microsoft
BMW
usbank
GSK
British American Tobacco
NOVARTIS
Bloomberg
Ford
ABB
GROUPE RENAULT
TotalEnergies
NXP
EATON

SERVICE PROVIDERS

HCLTech
cognizant
L&T Technology Services
accenture
tcs TATA CONSULTANCY SERVICES
KPIT
wipro
ALTEN
TATA TECHNOLOGIES
Capgemini
bertrandt

OUTSOURCED WORKLOADS

- Hybrid & Electric Powertrain Engineering
- Development and Management of Battery Pack
- System Integration
- Body and Chassis Engineering
- Power Electronics
- Vehicle Electronics and Control System
- Data Engineering
- Business Intelligence and Analytics
- Software Testing

Source: Zinnov Research and Analysis, Zinnov Z1000 database, Draup Deals Database

Recent outsourcing deals are majorly focused on clean energy and carbon reduction themes

SUSTAINABILITY

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
Honda	**KPIT**	2023	**Clean Energy**	Development of Honda’s software capabilities for next-gen E&E architecture, electrified powertrain, advanced safety, automated driving, infotainment, and connected technologies
Orica	**Cognizant**	2023	**Carbon Reduction**	Implement an ESG data strategy and digital platform for real-time reporting and forecasting of scope 1 and 2 emissions, as a part of decarbonization project in Australia which is worth 27 Mn USD
Sprint AeroSystems	**Infosys**	2022	**Circular Economy**	Started a 5-years collaboration offering end-to-end product development services, to develop highly efficient structural designs for manufacturing lightweight and sustainable aircraft structures and components
Jaunt Air Mobility	**L&T TS**	2022	**Clean Energy**	L&T TS multi-year $100+ Mn deal with Jaunt Air Mobility, will help the firm setup an R&D center in Quebec Province to provide engineering services for the eVTOL air taxi
North America based pharmacy retailer	**TCS**	2022	**Clean Energy**	Deployed its Clever Energy AI-led platform at client’s 1,000+ retail stores that helped reduce emissions by 26%
GSE	**Accenture**	2022	**Clean Energy**	Deployed EV Mobility Service Platform (EVSP) and blockchain solution to incentivize end-users for the usage of EV charging stations powered by green energy

Source: Zinnov Research and Analysis, Zinnov Z1000 database

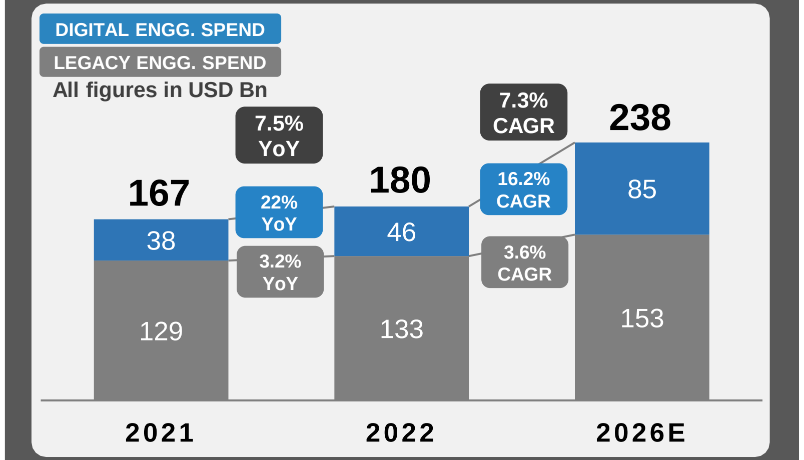
AGENDA

A	The Rise of Digital Engineering
B	Technology Pillars of Digital Engineering
C	Sustainability – A Priority
D	**Industry Deep Dives - ER&D Spend Trends & Priorities**
E	Addressed Market and Service Providers’ Opportunities
F	Growth Levers for Service Providers
G	Zinnov Zones for ER&D Ratings 2022

Source: Zinnov Research and Analysis, Zinnov Z1000 database

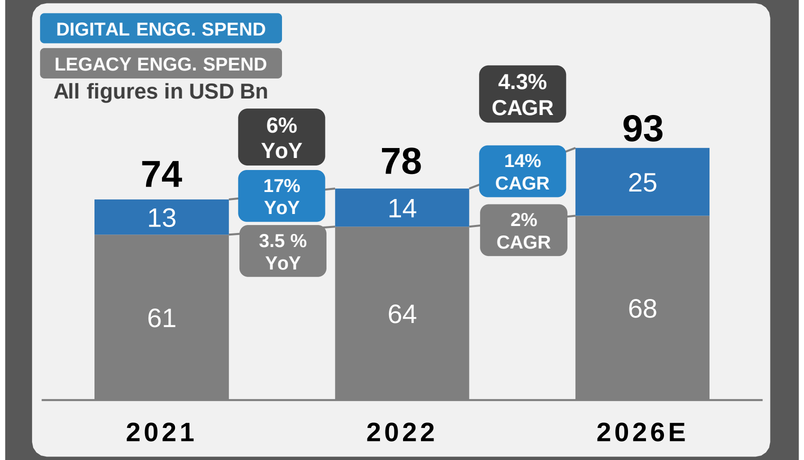
Manufacturing-led Verticals Summary – Automotive, Industrial, Aerospace & Defense

AUTOMOTIVE



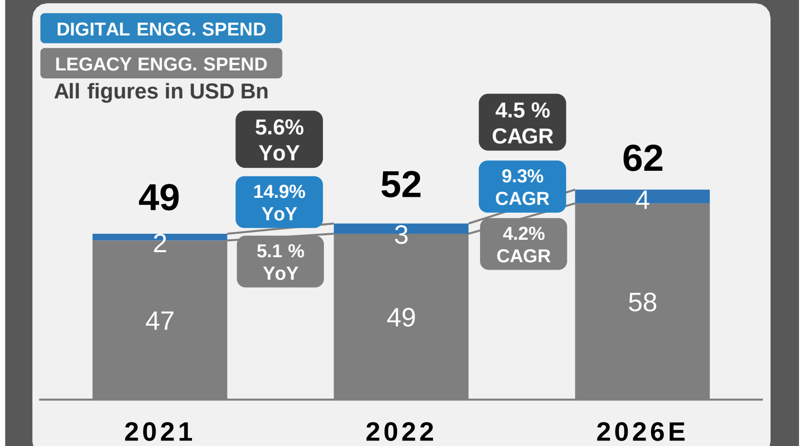
- The ER&D spend in the Automotive space will exceed USD 238 Bn by 2026 growing at 7.3% CAGR between 2022 and 2026
- Top car makers prioritize Connected and Electrification as they strive to enhance their CASE capabilities
- Europe dominates the EV R&D market with 40% of total spending due to favorable regulations and major auto manufacturers
- Leading OEMs are in a race to develop centralized in-house software for modular operating systems and cloud platforms

INDUSTRIAL



- The ER&D spend in industrial sector is anticipated to reach USD 93 Bn, growing at a CAGR of 4.3% between 2022 to 2026
- Enterprises are increasing their adoption of advanced AI technologies to drive process innovation and enhance operational efficiency
- Industry 5.0 is the next phase of industrial transformation that focuses on human-robot co-working dynamics
- The industrial sector encounters significant challenges as it contends with rising inflation, supply chain limitations, and labor shortages

AEROSPACE & DEFENSE



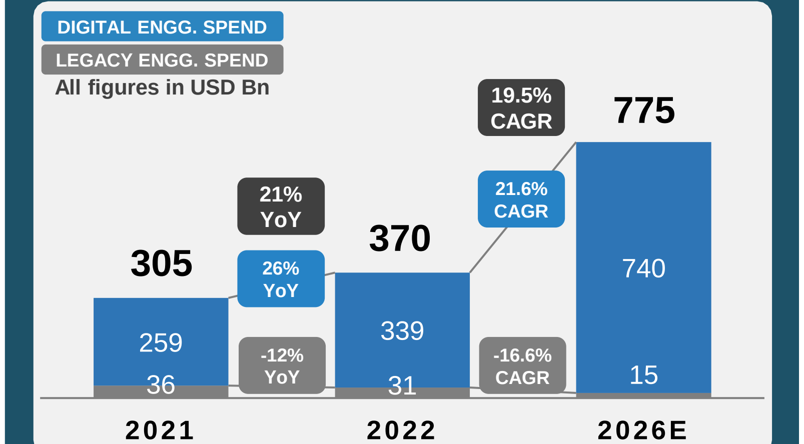
- The ER&D spend in the Aerospace & Defense (A&D) sector will exceed USD 62 Bn by 2026 growing at 4.5% CAGR between 2022 and 2026
- The global A&D sector has been primarily focused on post-COVID recovery throughout the year 2022
- Advanced Air Mobility (AAM), Metaverse, and Space Tech are at the core of the A&D sector’s transformation
- Despite an overall decline in M&A activity within the A&D sector in 2022, defense and space subsectors remained resilient with steady levels of activity

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Hi-tech-led Verticals Summary – Software & Internet, Semiconductor, Telecommunications

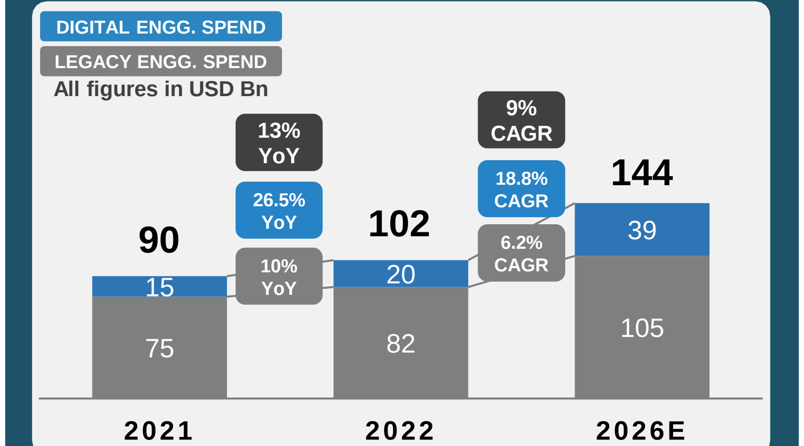
Hi-Tech

SOFTWARE & INTERNET



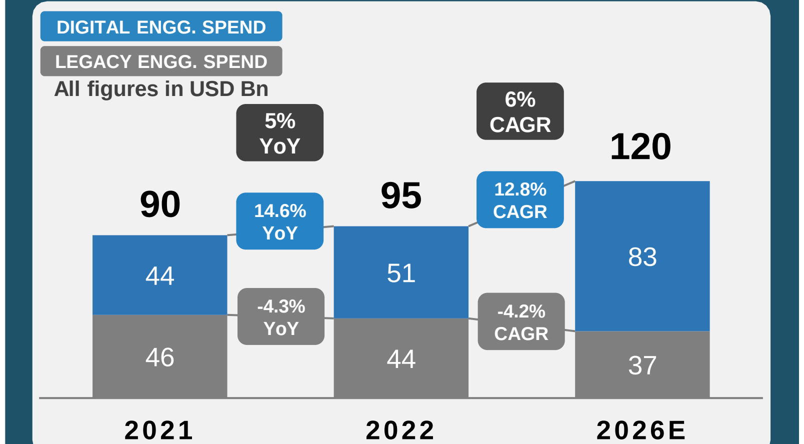
- The ER&D spend in the Software & Internet space will exceed USD 775 Bn by 2026 growing at 19.5% CAGR between 2022 and 2026
- S&I companies continued to invest heavily in technologies despite facing challenges such as stumbling valuations and shifting demand patterns
- Tech giants maintained substantial investments in next-generation technologies while scaling back on other capital expenditures
- Applied AI use-cases witness rapid adoption, while Generative AI and Software 2.0 also see growing implementation

SEMICONDUCTOR



- The ER&D spend in the semiconductor space will exceed USD 144 Bn by 2026 growing at 9% CAGR between 2022 and 2026
- Increased use of digital ICs in the electronics, automotive, and telecommunications industries are among the major factors driving the ER&D spend
- Wireless Transmission, Autonomous Vehicles, 5G, AI, IOT, and AR/VR are some major trends in the Semiconductor Industry
- Enterprises are investing in fabrication plants to expand their manufacturing capacity, global footprint, and technology portfolio

Telecommunications



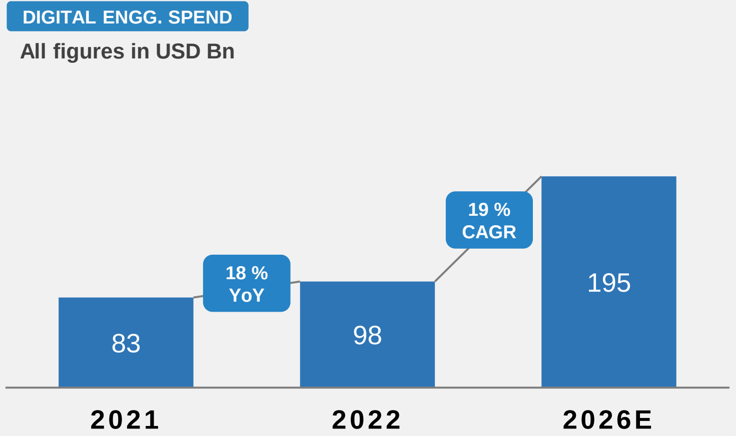
- The ER&D spend in the telecommunications space will exceed USD 120 Bn by 2026 growing at 6% CAGR between 2022 and 2026
- 5G deployment, AI/ML integration, IOT, and computer/machine vision present key opportunity areas for Service Providers
- Enhanced Mobile Broadband (eMBB) use cases will lead the way, followed by Ultra Reliable Low Latency Communications (URLLC), while Massive Machine Type Communications (mMTC) will take longer to become widespread
- Telcos aim to make substantial investments in cloud-native deployments, targeting CAPEX and OPEX savings

Source: Zinnov Research and Analysis, Zinnov Z1000 database

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

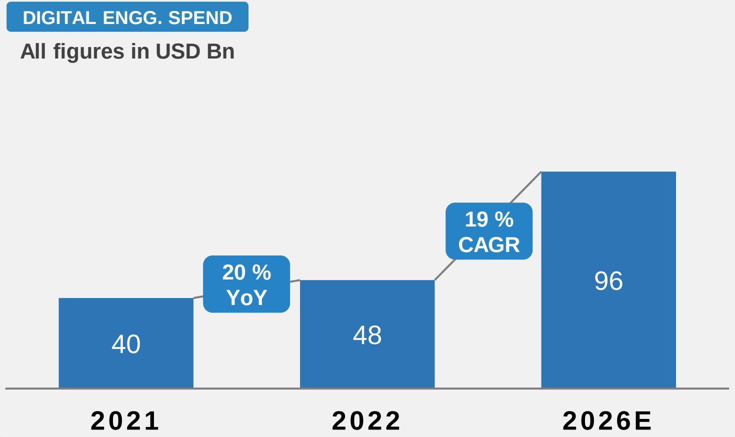
Services-led

BFSI



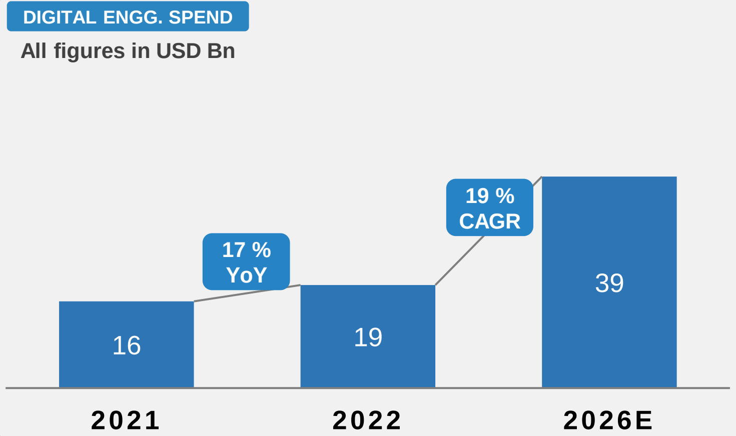
- BFSI sector's ER&D spending is set to surpass USD 195 Bn by 2026, with a 19% CAGR between 2022 and 2026
- Banks will optimize operational spending and channel it for innovation resulting in high growth of DE spend
- Big Data, Digital Banking, Customer Experience, and Digital Infra initiatives will drive the future of outsourcing spend
- Service Providers are leveraging their inhouse platforms to win large deals

HEALTHCARE PAYERS & PROVIDERS



- The ER&D spend in the Healthcare space will exceed USD 96 Bn by 2026 growing at 19% CAGR between 2022 and 2026
- Digital adoption, Start-up investments, and M&A are key strategies for Healthcare companies to foster innovation and expand market share
- Healthcare providers are accelerating digitalization to optimize cost & drive enhanced clinical outcomes
- Rising chronic disease rates have spurred global demand for innovative drugs, propelling the growth of the drug discovery market

MEDIA & ENTERTAINMENT



- The ER&D spend in the Media & Entertainment space will exceed USD 39 Bn by 2026 growing at 19% CAGR between 2022 and 2026
- 5G, AR/VR, IOT, AI, Cloud, and Blockchain are key technology trends fostering the market
- The next-generation gaming market will focus on cloud gaming to reduce hardware cost
- Enterprises are engaging in M&A deals, particularly acquiring gaming companies to expand their offerings with a focus on AI and virtual reality (VR)

Source: Zinnov Research and Analysis, Zinnov Z1000 database

AUTOMOTIVE SUMMARY

ER&D spending in this sector experienced a rapid recovery cycle, reaching USD 179 Bn in 2022, and constituting approximately 10% of global ER&D spending

Europe holds a dominant position in the Automotive industry, representing over 40% of the global Automotive ER&D spending

Automakers are prioritizing SDV (Software Defined Vehicle) and Electrification by partnering with engineering service providers and innovation ecosystems to enhance their in-house capabilities

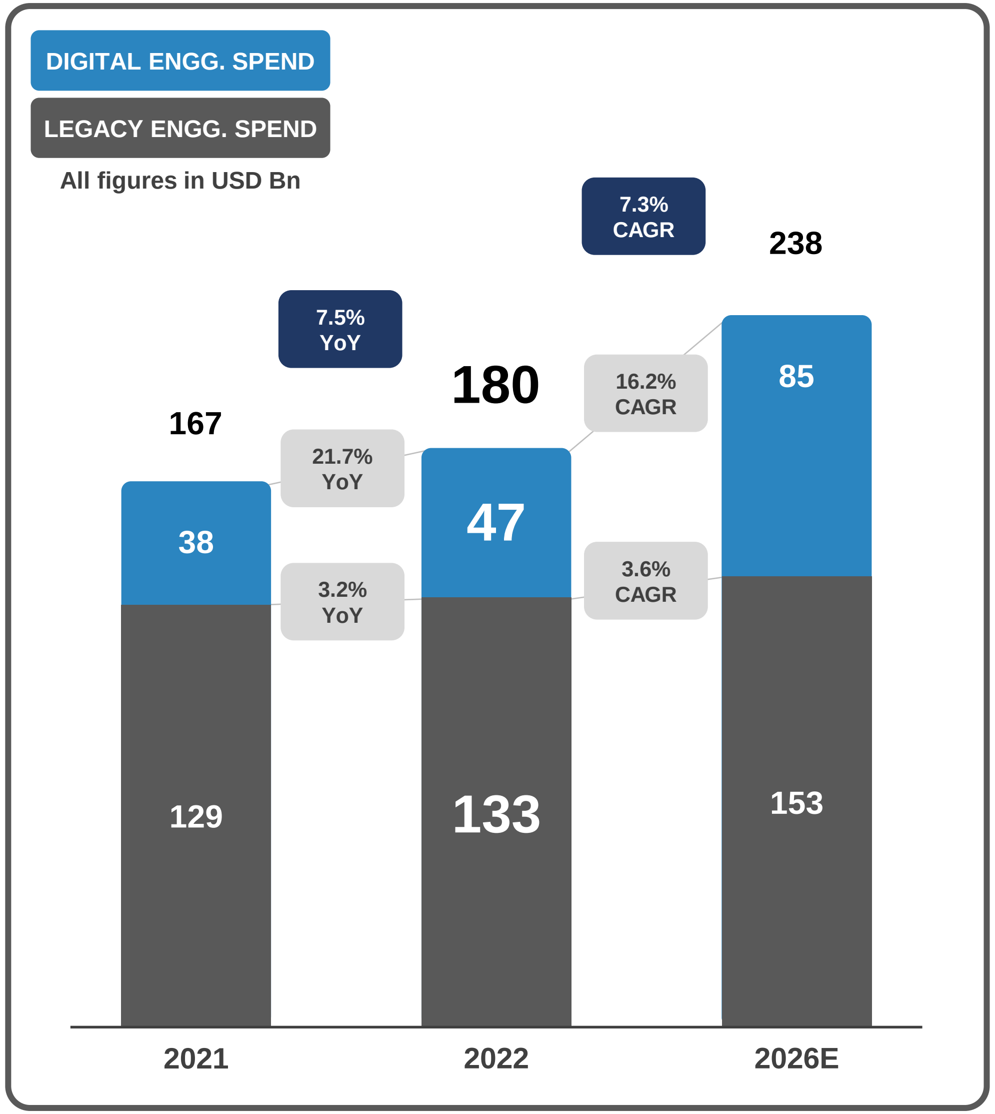
In recent years, carmakers and service providers have forged substantial collaborations focused on electrification and connected car initiatives

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Software-defined vehicles and electrification are transforming the Automotive industry, necessitating increased investment in Digital Engineering

zinnov ZONES ER&D SERVICES

Automotive ER&D Spend (2021 – 2026E)



TOP 10 AUTOMOTIVE ER&D SPENDERS (USD Bn)

22.3	Volkswagen Group	7.5	Robert Bosch GmbH
10.8	General Motors	7.2	Honda Motor
10	Toyota Motor	6.6	Mercedes-Benz Group
8.6	Ford Motor Company	6.1	Stellantis NV
7.8	BMW	4.5	Denso

Investment in R&D and innovation for next-gen platforms and software capabilities is experiencing continuous growth

Rise in EV adoption and stringent CO2 emission regulations by govt. is driving OEMs, Tier-1s, and New-Age players to invest in this ecosystem

Carmakers are taking a collaborative approach to augment in-house CASE capabilities and accelerate time-to-market

~50%

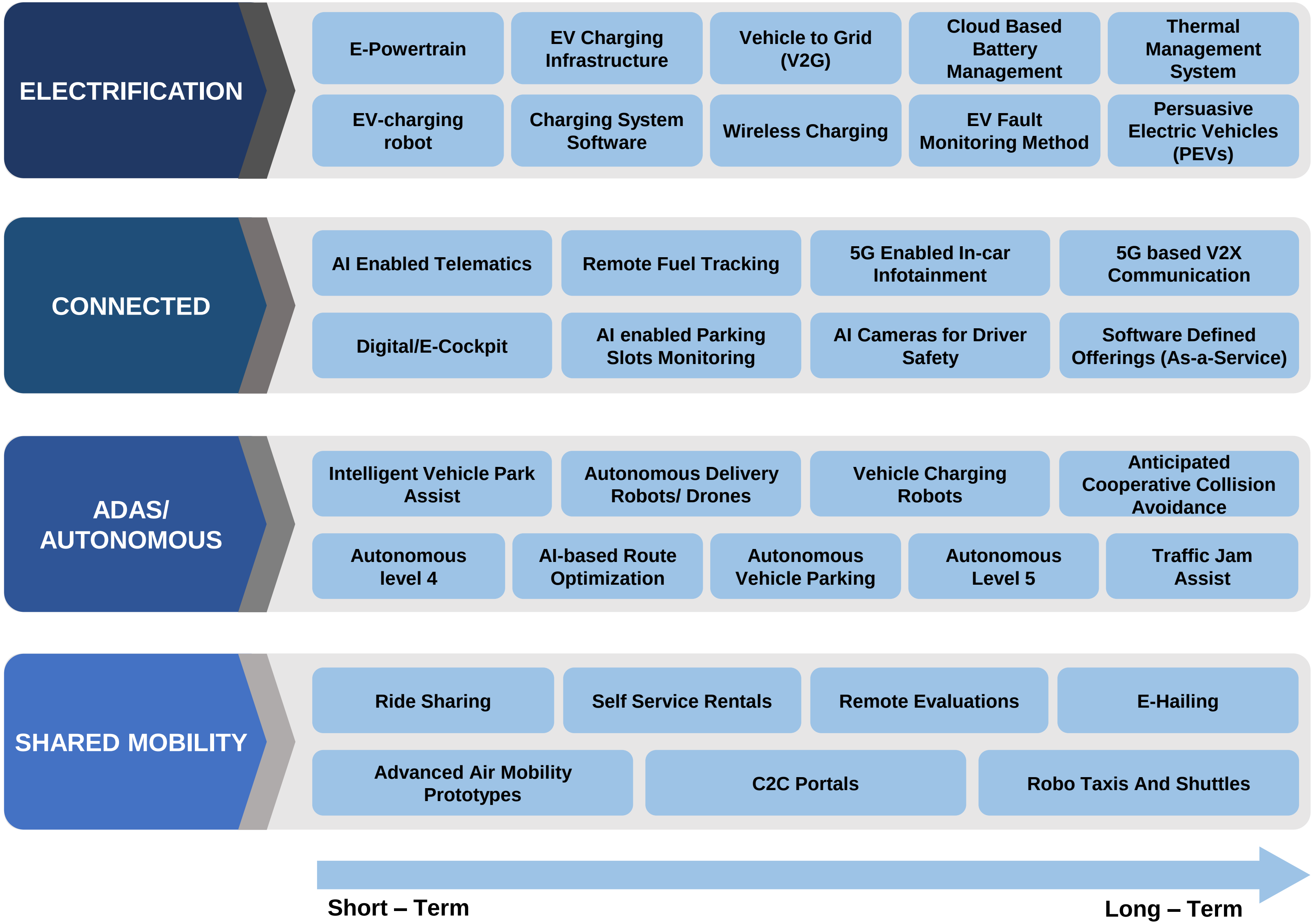
Contribution by Top 10 firms towards the global Automotive ER&D spend

3rd largest industry, accounting for ~10% of global ER&D spend

EV dominates R&D spending in Automotive industry, contributing **~40%** of the overall R&D spend

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Automakers continue to focus on building CASE capabilities; Connected and Electrification are the most pressing capabilities for top car makers



ELECTRIFICATION

- E-Powertrain
- EV Charging Infrastructure
- Vehicle to Grid (V2G)
- Cloud Based Battery Management
- Thermal Management System
- EV-charging robot
- Charging System Software
- Wireless Charging
- EV Fault Monitoring Method
- Persuasive Electric Vehicles (PEVs)

Mercedes-Benz collaborated with Nvidia, Luminar, and Google to develop in-house OS MB.OS for its next-gen EV, while Honda partnered with General Motors for Ultium batteries

28%
Share of EV for passenger vehicle sales by 2030

CONNECTED

- AI Enabled Telematics
- Remote Fuel Tracking
- 5G Enabled In-car Infotainment
- 5G based V2X Communication
- Digital/E-Cockpit
- AI enabled Parking Slots Monitoring
- AI Cameras for Driver Safety
- Software Defined Offerings (As-a-Service)

General Motors joins forces with Red Hat to create 'Ultifi,' a software platform, while Toyota teams up with Google Cloud for audio multimedia systems and Google Cloud's AI services

373 Bn
Size of Global Connected Car Market by 2030

ADAS/ AUTONOMOUS

- Intelligent Vehicle Park Assist
- Autonomous Delivery Robots/ Drones
- Vehicle Charging Robots
- Anticipated Cooperative Collision Avoidance
- Autonomous level 4
- AI-based Route Optimization
- Autonomous Vehicle Parking
- Autonomous Level 5
- Traffic Jam Assist

BMW and Valeo join forces to develop the next-gen Level 4 parking experience, while Automotive OEMs aim to achieve SAE Level 2 and Level 3 driving automation by 2025

10X
Projected growth of Autonomous Market by 2030

SHARED MOBILITY

- Ride Sharing
- Self Service Rentals
- Remote Evaluations
- E-Hailing
- Advanced Air Mobility Prototypes
- C2C Portals
- Robo Taxis And Shuttles

Volkswagen has partnered with MILES Mobility to expand its car-sharing portfolio

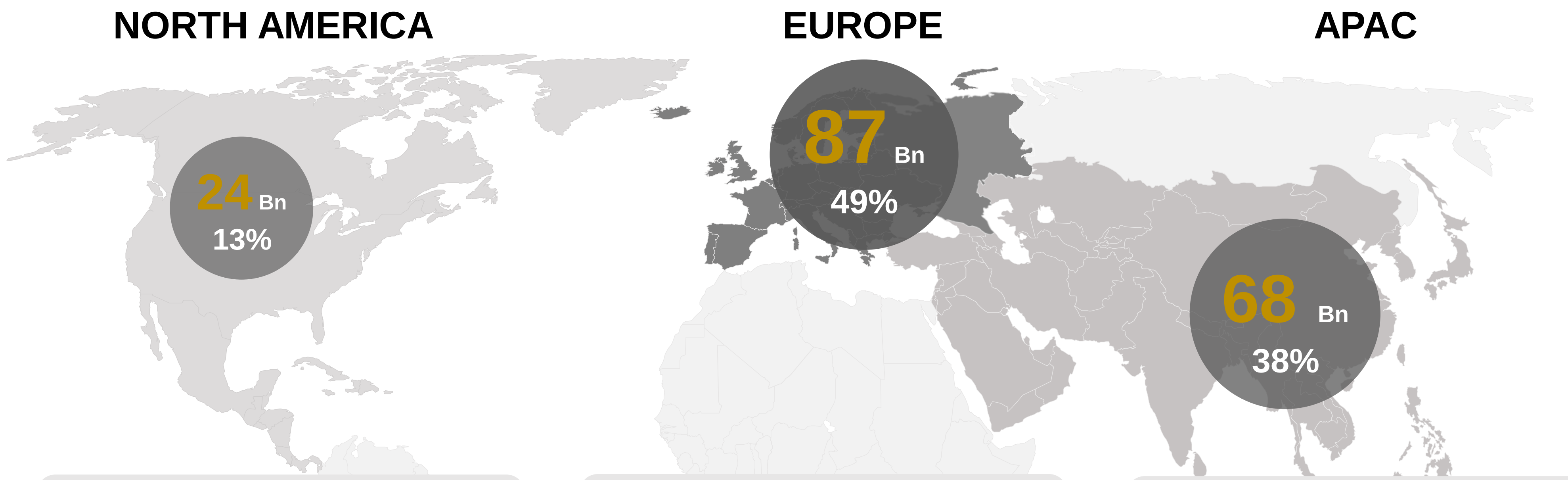
3X
Projected growth of Ride Sharing Market by 2028

Short – Term → **Long – Term**

Source: Zinnov Research and Analysis, Zinnov Z1000 database

■ ■ ■ ■ Investment Intensity

Europe leads the R&D market in the Automotive industry due to favorable regulations and the presence of major auto manufacturers



NORTH AMERICA

Top Spenders

gm Ford TESLA

- GM and Ford are making significant investments in the EV ecosystem to establish their leadership in the market
- GM is focusing on transforming its conventional manufacturing facilities for EV production, while battery cells and Circular EV Battery serve as additional growth drivers

EUROPE

Top Spenders

BMW Mercedes-Benz

- Europe stands as the global Automotive hub, driven by R&D investments from major players like Volkswagen, BMW, and Mercedes.
- Volkswagen is focusing on accelerating autonomous driving and battery system projects, along with substantial investments in EV charging infrastructure.
- BMW and Mercedes are actively funding the development of solid-state batteries and in-house production of fuel cells

APAC

Top Spenders

TOYOTA HONDA DENSO NISSAN

- Japanese OEMs is becoming a major contributor, bringing them closer to Europe in terms of Automotive advancements
- China is establishing itself as an R&D hub for electrification, with new-age OEMs like BYD leading the way
- Honda is actively engaging in multiple JVs, including the recently launched Honda-GS Yuasa EV Battery R&D Co., Ltd., focusing on EV battery R&D

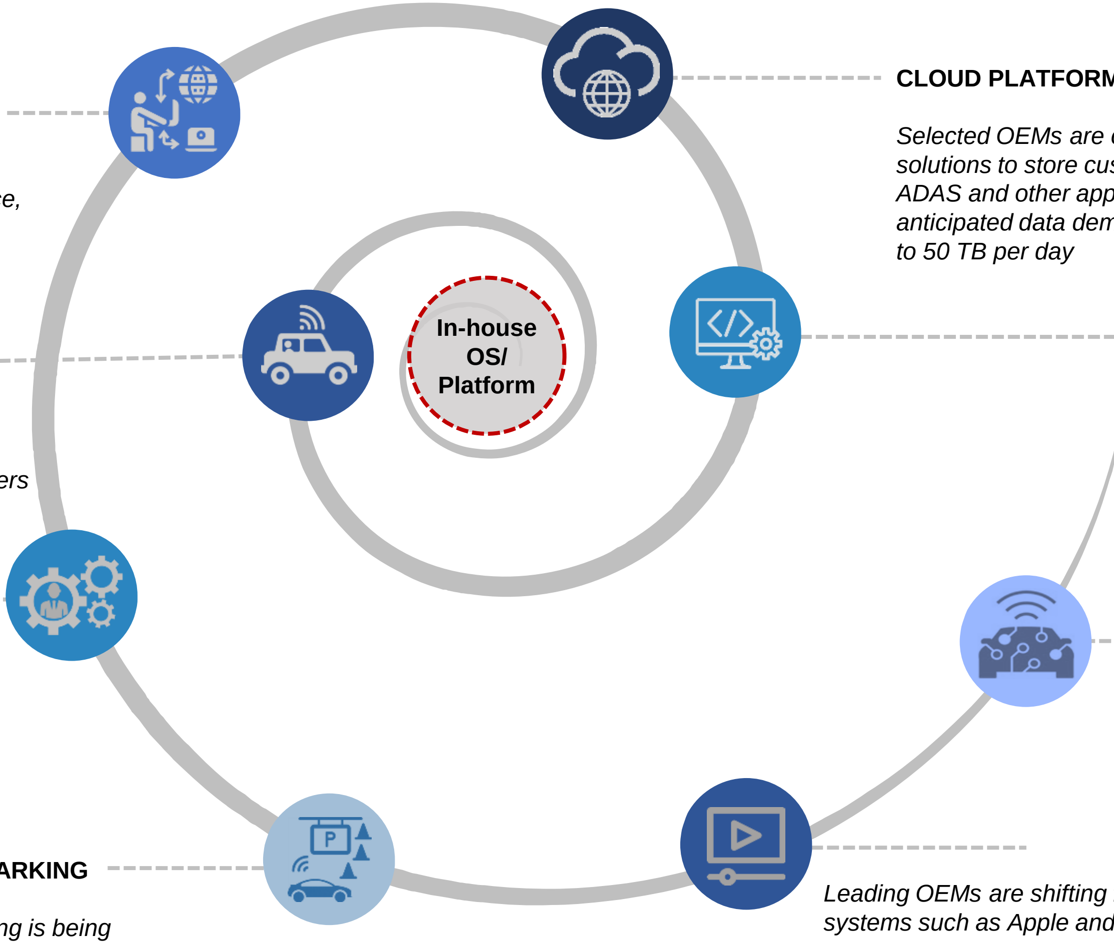
Approximately 40% of the total EV spend is allocated to EV R&D in Europe, propelled by strict CO2 emission regulations and government policies

Japanese OEMs such as Toyota and Honda contribute significantly to the overall APAC spend

With a developing EV infrastructure in the region, North America presently accounts for approximately 20% of the total EV spend

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Leading OEMs are in a race to develop centralized in-house software for modular operating systems and Cloud platforms



REMOTE DIGITAL SERVICES

Remote vehicle control, Remote diagnostics, Roadside assistance, Maintenance are focus areas

AUTONOMOUS DRIVING

OEMs are developing ADAS applications in partnership with various Semicon and security players

PERSONAL ASSISTANT

Personal assistant is a standard app/ feature as part of most of the OS that is being released

AUTOMATED PARKING

Automated Parking is being provided as an add-on subscription/ feature by OEMs

CLOUD PLATFORM

Selected OEMs are creating their own cloud solutions to store customer data, utilized for ADAS and other applications, with the anticipated data demand per car reaching up to 50 TB per day

OTA/ SOFTWARE UPDATES

OS platforms enable Over-The-Air (OTA) updates, allowing customers to access and benefit from the latest software upgrades supported by their vehicles

SMART MOBILITY

Mobility as a service, Ride sharing, and fleet management services are being developed/ offered by OEMs

INFOTAINMENT SYSTEMS

Leading OEMs are shifting from third-party infotainment systems such as Apple and Android to their proprietary infotainment operating systems. Significant emphasis is on subscription-based revenue streams, including navigation, entertainment, heads-up display (HUD), and more

6/10

Top OEMs have started investing in their own in-house **Operating System**

4/10

Top OEMs have started investing in their own **Cloud Platform**

>20%

of OEMs revenue to be driven by Software-based features & services by 2030 vs 7% in 2021

Source: Zinnov Research and Analysis, Zinnov Z1000 database

e-Powertrain contributes ~40% of the EV R&D spend; horizontal segments such as Infotainment and ADAS are applicable to both ICEs* and EVs

EV R&D Spend

E–Powertrain
40 - 45%

Infotainment
30 - 35%

ADAS
15 - 20%

Body Engineering
15 - 20%

Energy Storage
55 – 60%

Battery Management	Battery Pack Installation	Battery Design & Development
MEB Battery Systems	Solid-state Battery systems	Battery Recycling
Electrical routing / Circuit design	Validation / Testing	

Drive Train
10 - 15%

Powertrain Controller Software	Modular e-Drive Platform	Design of transmission System
E-Engine design	Inverter Gearbox	ECU development

Power Distribution & Charging
10 - 15%

Powertrain Inverter design	Pulse Inverters	Thermal Management System
On-board Charger design	CCU design and development	OCPP Application
Battery Swapping	Charging Infrastructure	Vehicle to Grid Comm

Integration
8 - 10%

E-Powertrain Integration	Powertrain Master Control	Packaging & Homologation
E-Powertrain Testing	Virtual Testing and Integration	System Testing and Simulation

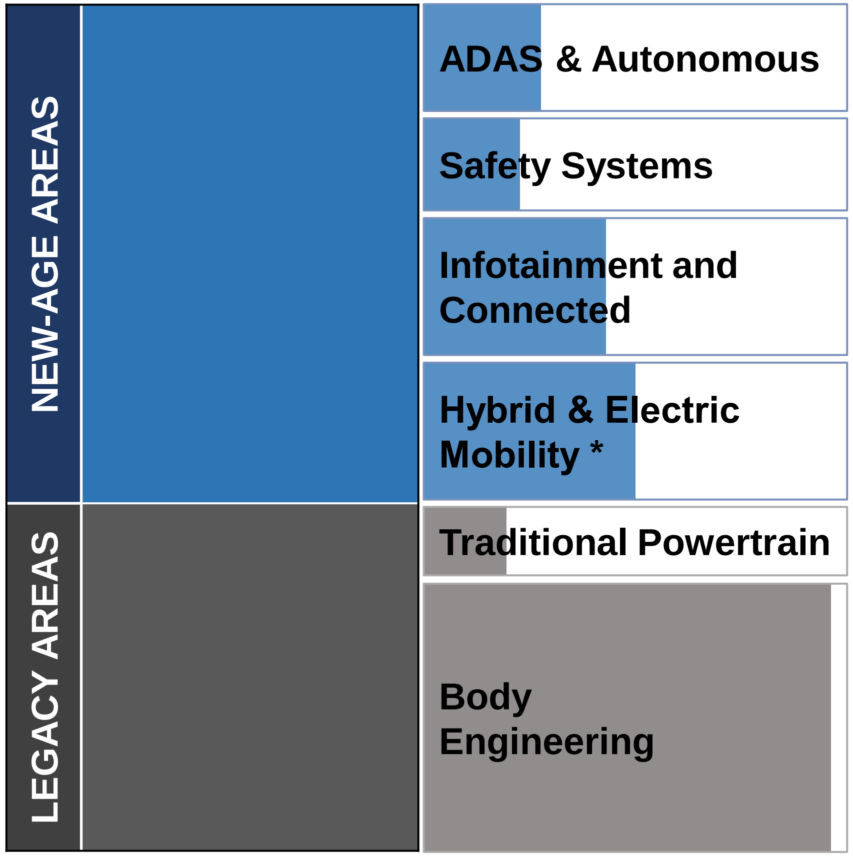
- Ford plans to invest CAD1.8 Bn to transform the Oakville assembly complex into an EV manufacturing facility, encompassing vehicle and battery pack assembly
- General Motors collaborates with Microvast to develop specialized EV battery separators, prioritizing safety, charging, and battery life
- ŠKODA is making investments in Mladá Boleslav to produce MEB battery systems
- VW introduces new powertrain components for its e-cars, enhancing efficiency compared to previous models
- Elli and Elia Group join forces to integrate EVs into the electricity system, utilizing EV batteries as mobile power banks
- VW and Siemens are establishing the largest public ultra-fast charging network for EVs in America
- Daimler Truck and the Volvo Group form the TRATON GROUP, a JV focused on charging infrastructure in Europe

Source: Zinnov Research and Analysis, Zinnov Z1000 database

BMS comprises of four main functions - Battery Monitoring, Battery Analytics, Thermal Management and Battery Diagnostics
**ICE - Internal Combustion Engine*

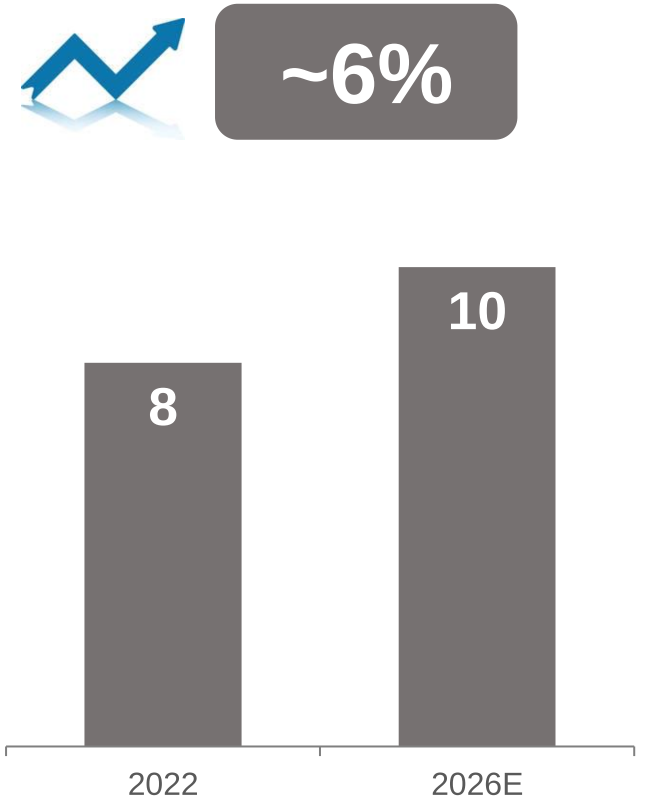
While body engineering represents the largest outsourced segment, opportunities in new-age areas will grow at a much faster rate

AUTOMOTIVE ADDRESSED SPEND 2022 (USD Bn)

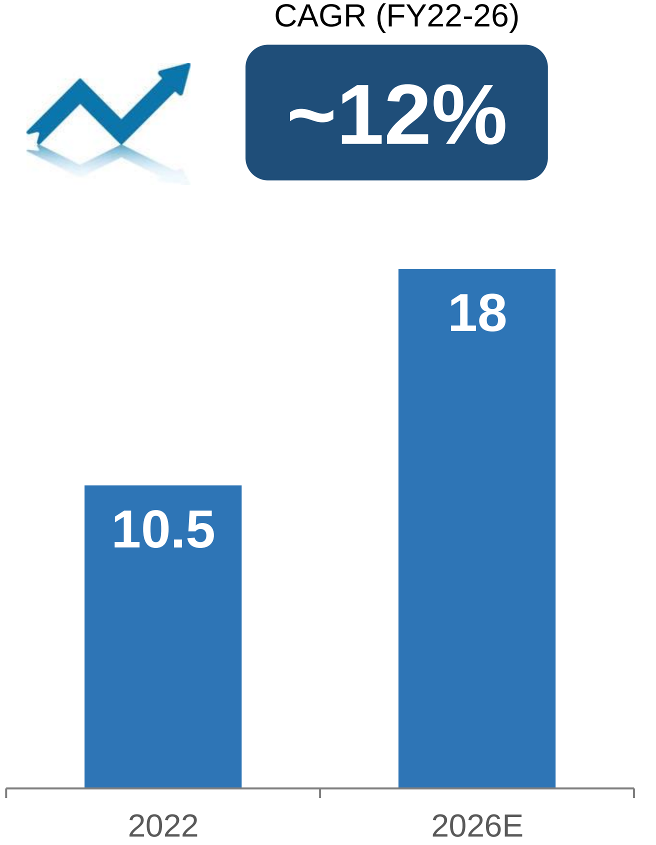


ADDRESSED MARKET 2022

19-20 Bn



LEGACY ENGINEERING SPEND



NEW-AGE AREAS SPEND

*** Across all segments, Hybrid and Electric Mobility is expected to be fastest growing segment in the Automotive Addressed Spend**

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The EV segment has dominated large deals for Automotive SPs in the recent years

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
Honda	**KPIT**	2023	**Operating System, EV powertrain & IVI**	Honda and KPIT have joined forces to prioritize software development for next-generation E&E architecture, electrified powertrains, IVI, and connected technologies
Mercedes-Benz	**Capgemini**	2023	**Autonomous Driving**	The focus at Honda and KPIT includes developing and managing a Big Data platform dedicated to optimizing AI technology for autonomous driving by processing scalable big data
Jaguar Land Rover	**Tata Technologies**	2023	**Digital Transformation**	JLR aims to accelerate its digital transformation strategy, commencing with solution implementation in its core production facilities in the UK, followed by global deployment
Volkswagen Group Ireland	**Cognizant**	2023	**Consumer Platform**	Cognizant has been assigned the task of transforming VWG Ireland's siloed contact center platform into a comprehensive omnichannel customer experience (CX) platform
Japanese Tier-1	**Tata Elxsi**	2022	**EV Software**	The establishment of a high-voltage EV system software development innovation center in Bangalore is underway
Automotive Cell Company	**SEGULA Technologies**	2022	**EV Batteries**	SEGULA is actively involved in supporting the capacity development of EV battery gigafactories for clients in France, Italy, and Germany
American Automotive supplier	**L&T TS**	2022	**EV and Power Electronics**	L&T TS has been selected as a strategic partner by an American Automotive supplier to provide engineering services for their EV and Power Electronics product portfolio
American Tier I	**KPIT**	2022	**Autonomous Drive**	KPIT has been chosen by a leading American Tier I company for multiple engagements in the Autonomous Driving domain

Source: Zinnov Research and Analysis, Zinnov Z1000 database

INDUSTRIAL SUMMARY

The Digital Engineering spend is anticipated to reach USD 21 Bn, growing at a CAGR of 9.5% between 2022 to 2026

Enterprises are increasing their advanced AI technology adoption for process innovation and improving operational efficiency

Industry 5.0 will emphasize human-robot collaboration, maximize automation while reducing human involvement to enhance efficiency in smart factories

Enterprises have been intensifying their investments in digital transformation to prioritize sustainable manufacturing

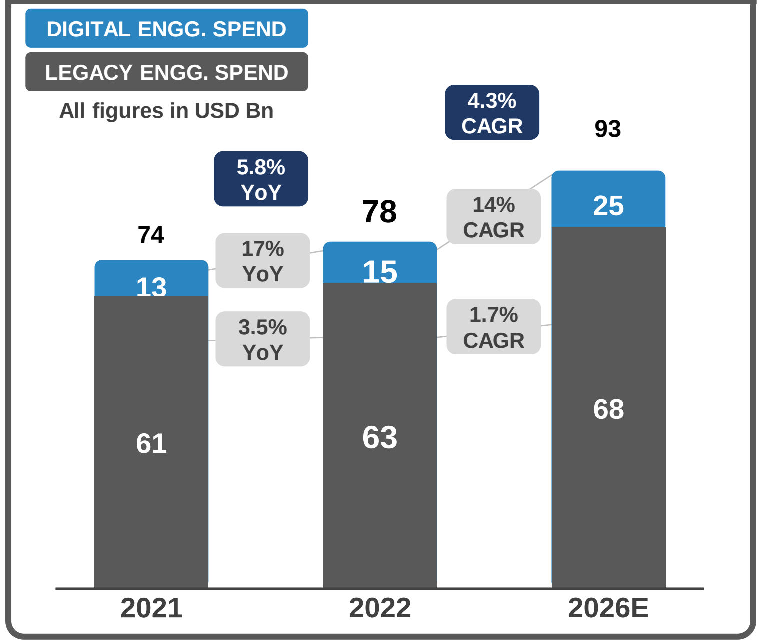
The Industrial sector is grappling with challenges such as inflationary pressures, constraints in the supply chain, and labor shortages

Industrial enterprises are increasingly depending on service provider ecosystems for collaborations

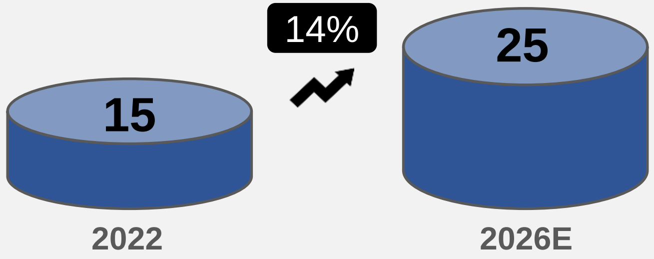
Source: Zinnov Research and Analysis, Zinnov Z1000 database

Technological advancements, Industry 4.0 adoption, and Sustainability are driving Digital Engineering spend in the Industrial sector

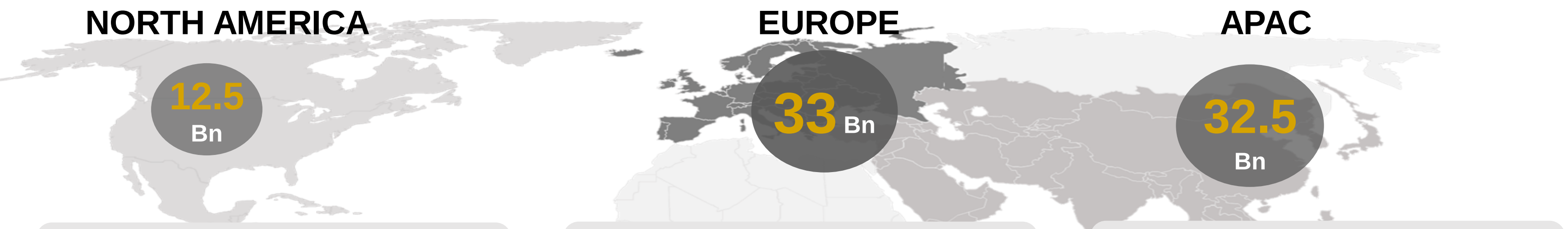
INDUSTRIAL ER&D SPEND (2021-2026E)



Industrial Digital ER&D spend 2022



Industrial Digital Engineering spend is projected to account for ~14% of overall manufacturing-led verticals' Digital Engineering spend by 2026E



Top Spenders

TDK, SUMITOMO ELECTRIC, FANUC, EATON, Cummins, SKF

- Eaton USD3 Bn R&D investment to accelerate the development of its digital capabilities and sustainable solutions by 2030

Top Spenders

Nidec, Atlas Copco, ASSA ABLOY, SANDVIK, ABB, Schneider Electric

- ABB is making a ~USD170 Mn investment in its automation business and clean energy transition in the US to address growing customer demand

Top Spenders

muRata, Kawasaki, brother, TOSHIBA, MITSUBISHI, YOKOGAWA

- Toshiba invested USD7.2 Bn in ER&D to transition into a CPS technology company, bridging the physical and digital realms to generate value

Top 15 firms account for ~40% of the overall Industrial ER&D Spend — 40%

Western Europe and APAC lead in ER&D spending for the industrial sector, making up ~84% of the overall Industrial ER&D spend — 84%

Industrial firms are increasing adoption of AI-led technologies to enable smart factories, optimize production, enhance quality, and promote sustainability goals
AI market in the manufacturing-led sector is projected to grow at a ~40% CAGR and reach USD30 Bn by 2030 — USD ~30 Bn

Top Use Cases

- Equipment / Device Automation
- Predictive & Preventive Maintenance
- Digital Twins
- Smart Factories
- Product Design

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Enterprises are strategically ramping up adoption of advanced AI technologies in three core processes for innovation and improved operational efficiency

AI-driven Industrial Manufacturing

Key Areas

Robotics & Automation

- **Industrial Automation**
    - Factory Floor Instrumentation
    - Plant Management / Asset Management
- **Building / Warehouse Automation**
    - Smart Buildings / Shop Floor Automation
    - Remote Monitoring
    - Predictive / Preventive Maintenance
    - Safety Systems

Manufacturing & Machinery

- **Production Equipment**
    - Control Systems and Process Controls
    - Communication Systems
- **Lights-out Manufacturing**
    - MOM Software
    - Digital Twin
    - Less Human Intervention

Supply Chain

- **Digital Supply Chains**
    - Raw Material Handling / Demand-Supply Management
    - Real-time Market Intelligence
    - Logistics Management
    - Tracking and Traceability
    - Risk Management
    - Quality Control

Key Enablers

Hyperscalers, Software and Platforms

- ➢ **AI-based Solutions**
- ➢ **Cloud Services**
- ➢ **MES Platforms**
- ➢ **Big Data**
- ➢ **IOT Platforms**
- ➢ **Edge Computing**

Embedded | **Connectivity** | **Analytics** | **IOT** | **Digital Twin** | **AR/VR** | **Automation**

Key Players

- Leading companies such as Kuka, ABB, and Fanuc Corp are increasing their use of warehouse automation systems, driven by the adoption of AI and robotics.
- ABB is investing USD20 Mn to expand its US robot factory, targeting the packaging and machinery industries.

- KUKA has invested in lights-out factories, offering advanced robotic solutions and automation technologies.
- Siemens has invested in lights-out factories, leveraging technologies such as robotics, IOT, and AI to enable fully automated production lines.

- Cummins joins hands with Infosys to reinvent its approach to digital transformation in the aspects of supply chain predictability and visibility.
- Hexagon created Intergraph Smart Materials, a software solution for managing materials, facilitating collaboration, and streamlining work for supply chain partners.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Further integration of AI, Analytics, and other digital technologies is revolutionizing the Industrial vertical, enabling streamlined operations and enhancing efficiency

Digital Technologies

AI/ML/NLP

↕

ADVANCED ANALYTICS

Big Data,
Predictive Analytics,
Manufacturing Analytics,
Data Modeling,
Data Visualization

+

Digital Technologies	Key Use Cases	Key Developments
Automation	Collaborative Robots Predictive & Preventive Maintenance Lights-out Manufacturing Warehouse Automation	▪ Siemens uses collaborative robots from Universal Robots (UR) to prevent planning errors and ensure high process and product quality. ▪ Kawasaki aims to build a new digital environment “Kawasaki Digital Platform” for robotics business, which can be used by customers and partners in a collaborative effort.
IIOT	M2M Automation Monitoring Assistance Smart Assets	▪ Mitsubishi Electric Automation utilizes Industrial IOT and MTConnect adapter for cross-manufacturer communication in shop floor monitoring. ▪ Schneider Electric increased its valuation of Aveva to $11.6 Bn and acquired the remaining ~40% stake to enhance its Industrial IOT capabilities.
Digital Thread	Smart Manufacturing Digital Twin Remote Monitoring	▪ ABB enables the customers to remotely monitor the health and performance of general machinery with the ABB Ability Smart Sensor, a key element of the ABB Ability Digital Powertrain. ▪ Hexagon and Fujitsu partnered to deliver a digital twin platform to support the city’s (Stuttgart, Germany) urban digital twin project.
AR/VR	3D Designs Field Maintenance Employee Safety	▪ Siemens and TeamViewer collaborated to integrate enterprise AR into product lifecycle management with interactive, 3D content connected to the digital twin of a product. ▪ Toyota and Invisible AI allied to integrate computer vision in its North American manufacturing operations to improve safety, quality, and efficiency.

Market Update

~10%

Industrial automation market is growing at a CAGR of ~10%, market to reach ~300 Bn USD by 2029

~7%

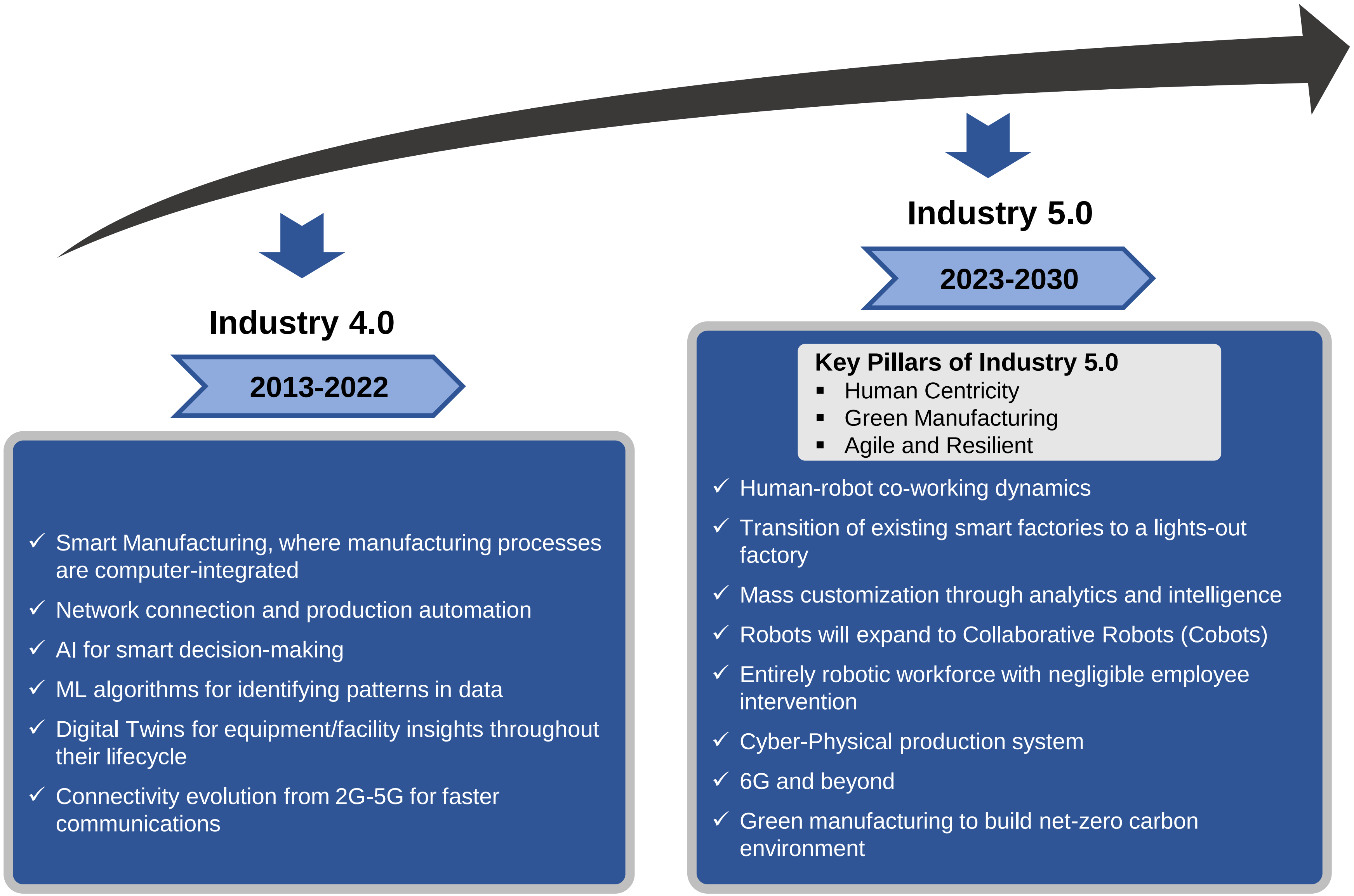
Global Industrial IOT market is expected to reach USD ~124 Bn by 2028, growing at a ~7% CAGR

USD 70 Bn.

By 2030, global AR/VR in manufacturing-led vertical to reach ~70 Bn USD growing at ~28% CAGR

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Industry 5.0 aims to achieve efficiency in smart factories by emphasizing human-robot co-working dynamics in the next phase of industrial transformation



Industry 4.0

2013-2022

- ✓ Smart Manufacturing, where manufacturing processes are computer-integrated
- ✓ Network connection and production automation
- ✓ AI for smart decision-making
- ✓ ML algorithms for identifying patterns in data
- ✓ Digital Twins for equipment/facility insights throughout their lifecycle
- ✓ Connectivity evolution from 2G-5G for faster communications

Industry 5.0

2023-2030

Key Pillars of Industry 5.0

- Human Centricity
- Green Manufacturing
- Agile and Resilient

- ✓ Human-robot co-working dynamics
- ✓ Transition of existing smart factories to a lights-out factory
- ✓ Mass customization through analytics and intelligence
- ✓ Robots will expand to Collaborative Robots (Cobots)
- ✓ Entirely robotic workforce with negligible employee intervention
- ✓ Cyber-Physical production system
- ✓ 6G and beyond
- ✓ Green manufacturing to build net-zero carbon environment

Enterprises moving towards Industry 5.0

1. Momenta, a leading Digital Industry VC firm, launches the $100Mn Industry 5.0 Fund.
2. TDK Ventures supports Start-ups in decarbonization, industry 5.0, and related fields through funding and access to resources.
3. Honeywell, 3M, Intel, and Samsung experiment with intelligent connected solutions in manufacturing.
4. Intel and Siemens collaborate on AI-driven air interface, frequency, resolution localization, and sensing for connected intelligence.
5. European countries collaboratively launch the Hexa-X Project to envision the future of wireless tech.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Enterprises have been intensifying their investments in digital transformation to prioritize sustainable manufacturing

SIEMENS

$700Mn **Siemens to invest USD 700 Mn for decarbonization by 2030**

- Siemens reduced approximately 46% Co2 in its own operations since 2019
- Approximately 150 Mn tons customer emissions avoided with Siemens' products and solutions in FY 2022
- USD 300 Mn investment for training and continuing education of own workforce in 2022

Key Focus Areas

Decarbonization	Long term Employability
Sustainable Value Chain	Environmental Protection
360-degree approach for ESG	Climate Protection

Schneider Electric

2500 **Schneider Electric to create 2500 jobs to aid the acceleration of climate action**

- ABB achieved a reduction of 13,400 tons in annual CO2-equivalent emissions at its manufacturing hub in Xiamen, China
- With a focus on electrifying its vehicle fleet and utilizing renewable energy sources, ABB aims to decrease scope 1 and 2 greenhouse gas emissions by at least 80% by 2030

Key Focus Areas

Resource Efficiency	Green & Reliable Electricity
Energy Management	Value Chain Engineering
Clean Water Sanitization	Affordable and Clean Energy

Cummins

$1.5Bn **Cummins to invest USD 1.5 Bn in U.S manufacturing unit to support clean energy economy**

- Cummins aims at net-zero carbon emissions by 2050 through its sustainability strategy called PLANET 2050
- Cummins is advancing diesel and natural gas engine technology while developing electrified solutions. They are investing in alternative technologies such as natural gas and hydrogen fuel cells to achieve zero emissions

Key Focus Areas

Clean Energy Generation	Net Zero Carbon Emission
Water and waste management	Energy Diversity
Health & Safety	Climate Action

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The Industrial sector is grappling with challenges such as inflationary pressures, constraints in the supply chain, and labor shortages

Inflation

- Midway through 2021, there was a global rise in inflation, with many nations experiencing their highest rates in decades
- Commodities including steel, aluminum, and oil have seen rising prices, and this trend is anticipated to continue

~31.8%

Increase in prices of energy and petroleum products in Dec 2022 compared to Dec 2021

Supply chain constraints

- Supply chain issues have impacted the industrial sector more than any other vertical
- Major supply chain disruptions were caused by offshoring of electronic components, the pandemic's effects, geopolitical tensions and shipment delays

USD 122.65 Bn

As per Oxford Economics, Economic losses due to supply chain disruptions in the Europe region were estimated at USD 122.65 Bn

Labor shortage

- The industrial sector is facing a severe causes of labor shortage because of aging workforce, low unemployment rate, low wages, lack of skilled workers, and more restrictive immigration policies

750,000

Jobs are unfilled in the manufacturing sector, as per U.S. Bureau of Labor and Statistics in 2022

Impact on Industrial Vertical

- ***Pricing pressure***
- ***Reduced investment***
- ***Demand volatility***
- ***Shifts in competitive landscape***

- ***Imbalances in supply and demand***
- ***Shifts in global trade***
- ***Market instability***

- ***Productivity decline***
- ***Shift towards automation***
- ***Workforce Skill gaps***

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Lack of skilled in-house talent and cost-saving initiatives are resulting in outsourcing for Automation, Cloud enablement, and equipment management

SEGMENTS	KEY OUTSOURCED WORKLOAD			
Robotics & Automation	**Industrial & Robotics Automation**			**Building Automation**
	PLC/HMI/SCADA programming	Technology Migration and Upgrade	Development of Robot Solution Architecture	Integrated Device / Facility Mgmt. Platform
	Data Modelling and Analytics for Predictive Maintenance	Intelligent Algorithm / Predictive Analysis Modules	Vision based Quality inspection systems	Building Monitoring and Security Platform
	System configuration / Software Design	AR/VR for training / Maintenance Support	Robotics as a Service (RaaS) Models	Efficient Lighting / Fire Safety Management
Mfg. and Machinery	**Industrial Equipment Machinery**	**Construction / Agricultural Machinery**		
	Data Eng./ Analytics for Equipment Maintenance	Telematics / Remote Asset Monitoring	HMI Design & Dev (Mobile / Web)	Autonomous System/ Architecture Development
	Mobile & Web Application Development	Vehicle Data Management	Cloud enablement and support	Autonomous System V&V/ Retrofit
	Equipment Management / tracking	Embedded SW Architecture development	Farm/Construction Management software	Equipment Cybersecurity
Digital Thread	**Manufacturing Ops**	**Field Services**	**Design Services**	**Platform Development**
	Overall Equipment Efficiency (OEE)	Predictive maintenance	Digital Twin	IOT Platform dev. (Plant performance, Asset monitoring)
	Integration of PLM, SCADA, MES, ERP in to IIOT platform	Asset health monitoring	Sensor design, IIOT gateway design	Remote service platform dev.

Industrial Sector SP Addressed Spend, 2022

USD **5-6** Bn

Contribution of Industrial enterprises to the overall ER&D addressed market

5-7%

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Outsourcing Propensity **Low** ░ ▒ ▓ **High**

Enterprises are increasingly relying on Service Provider ecosystems to foster collaborations in emerging focus areas

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
Global Industrial leader	**Tata Elxsi**	2023	**AR/VR, Smart Manufacturing**	Design, integrate, and set up smart manufacturing leveraging AR/VR-based safety training and worker productivity training centers across multiple manufacturing plants
Johnson Controls	**Accenture**	2022	**AI, Digital Twin, 5G, IOT, Cloud**	Accenture will deliver two new Johnson Controls OpenBlue Innovation Centers seeding development of AI-enabled building control system products and services
Middle East based manufacturing firm	**L&T TS**	2022	**Predictive Maintenance**	Developing AI-based decision support system to forecast asset performance using ML models
Swiss building materials provider	**TCS**	2022	**Predictive Maintenance**	Providing neural manufacturing framework to develop IOT-based digital solutions, enabling predictive operations and maintenance
Schneider Electric	**NTT**	2022	**Smart Factory, 5G**	NTT will deploy a private 5G network at Schneider's Lexington Smart Factory, enabling the use of digital technologies for equipment availability, machine performance, and product quality
Global Steel Producer	**WIPRO**	2022	**Cloud Engineering**	Wipro supports the cloud transformation process by modernizing OT applications, and implementing Azure-based data analytics, Agile, and DevOps practices

Source: Zinnov Research and Analysis, Zinnov Z1000 database

AEROSPACE & DEFENSE SUMMARY

2022 saw a surge in defense sector spending across the globe due to escalating geopolitical tensions

Europe and North America together accounted for 90% the global Aerospace & Defense (A&D) ER&D spending in 2022

The A&D sector underwent a transformative shift by leveraging innovative concepts and technologies for enhanced capabilities and efficiency

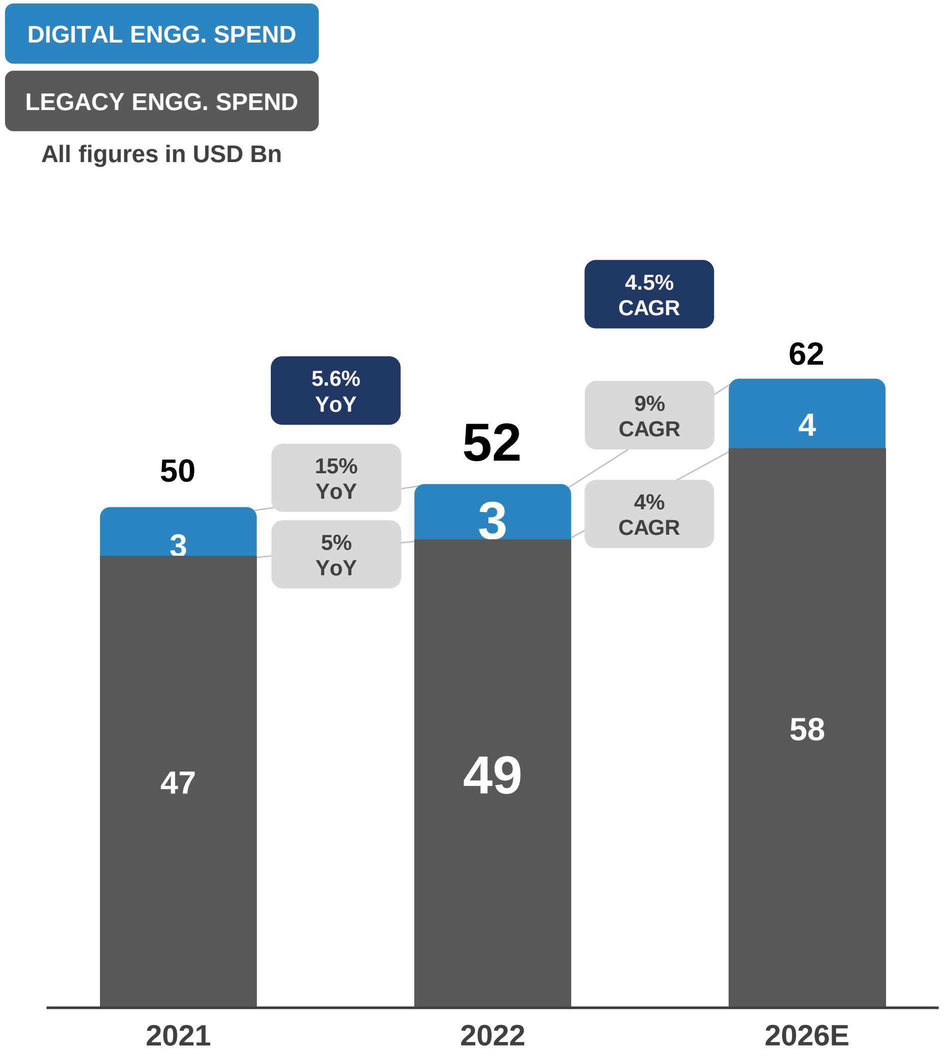
While geopolitical conditions boosted defense spending in A&D sector, it encountered macro-economic challenges related to supply chain and talent scarcity

While overall M&A activities in the A&D sector dropped to a three-year low in H2 2022, specific defense and space subsectors maintained steady activity

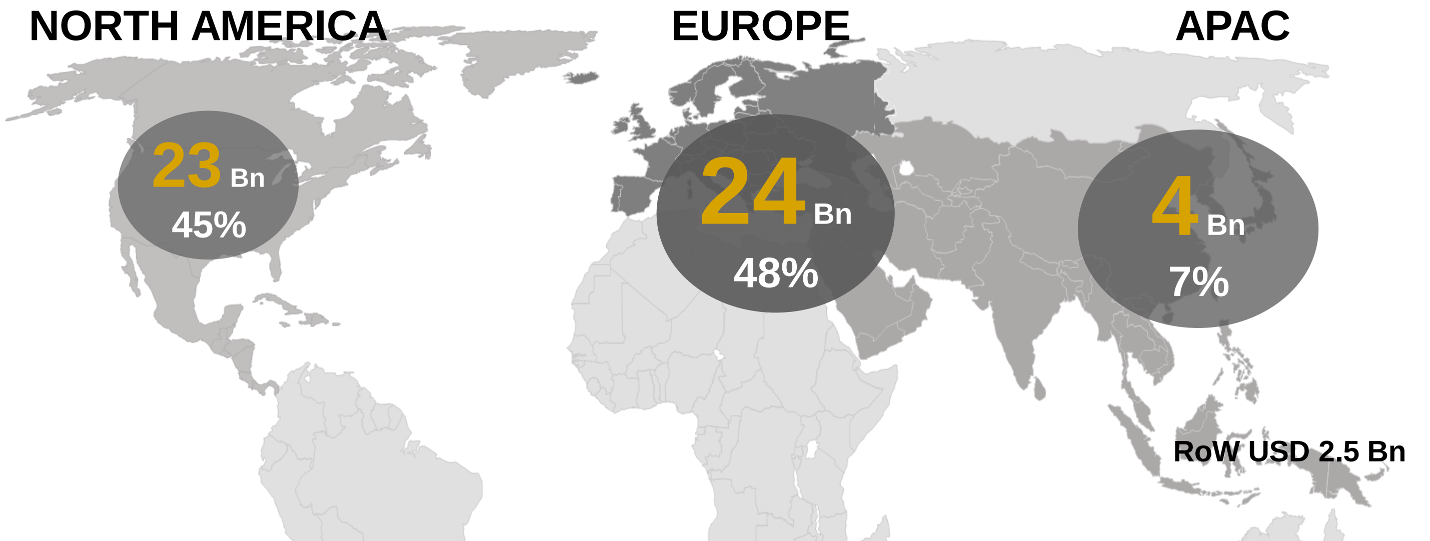
Source: Zinnov Research and Analysis, Zinnov Z1000 database

Europe and North America together accounted for 90% the global Aerospace and Defense ER&D spending in 2022

Aerospace & Defense ER&D Spend (2021-2026E)



A&D ER&D Spend by GEO



Top Spenders

BOEING
Raytheon Technologies
LOCKHEED MARTIN

- Around 85% of the ER&D expenditures in North America are contributed by the A&D companies based in the United States
- Boeing is strengthening its ER&D capabilities with a USD 200 Mn, 43 acre wholly-owned engineering and technology campus in Bengaluru, India

Top Spenders

AIRBUS
BAE SYSTEMS
LEONARDO

- Europe is the largest geography in terms of the Global Aerospace and Defense ER&D spend
- Airbus Group, being the top ER&D spender in A&D market globally, keeps its investment in ER&D high enough to sustain a competitive position in the international aircraft manufacturing market

Top Spenders

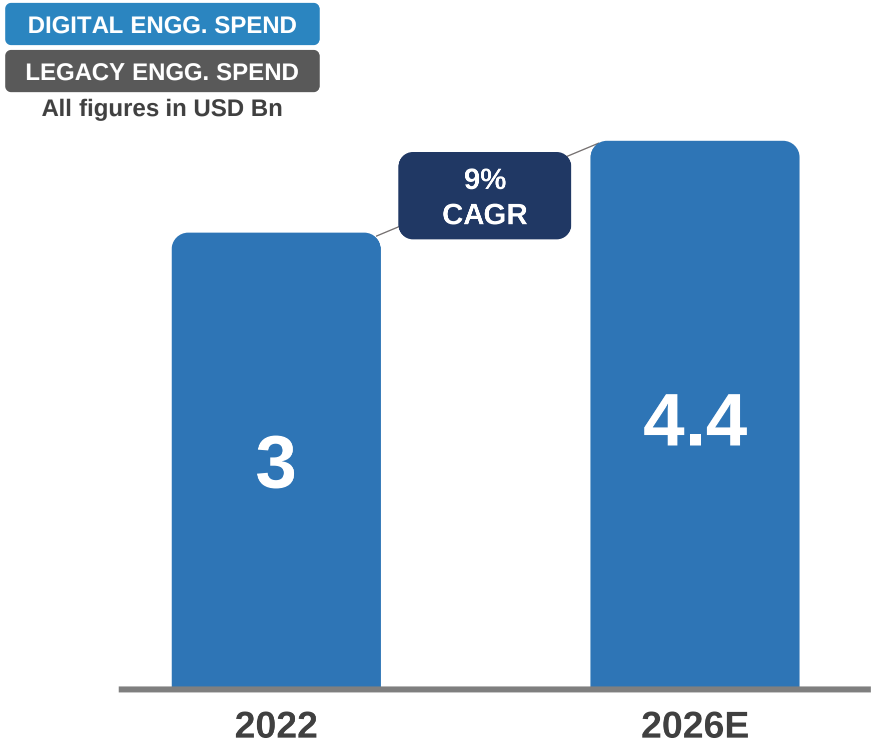
AVIC
CASC
MITSUBISHI

- Japan and China are the major contributors of the ER&D spending in the APAC region
- The top three enterprises alone contributes to approximately 38% of the ER&D spending in the APAC region

Source: Zinnov Research and Analysis, Zinnov Z1000 database

A&D experienced a surge in AI, autonomous systems, advanced materials, and additive manufacturing investments aimed at enhancing capabilities

A&D DIGITAL ENGINEERING SPEND



TOP 10 TOP AEROSPACE & DEFENSE ER&D SPENDERS (USD Bn)

4.6	Airbus Group AG	2.4	Lockheed Martin
4	Boeing	1.7	Northrop Grumman
3.8	Raytheon	1.6	Thales Group
3.4	BAE Systems	1.5	Safran S.A.
3	Leonardo-Finmeccanica	1.5	Rolls-Royce Holdings

~53%

TOTAL SHARE OF TOP 10 SPENDERS

1.5x

Increase in DE Spend by 2026

~42%

Contribution of defense firms towards the A&D ER&D spend

Boeing's R&D spending rose by $603 Mn in 2022, primarily for 777X, 737 MAX, and product development

Bae Systems invests in diverse areas like autonomy, manufacturing, advanced electronics, sustainable technology, cyber, and space

Leonardo focuses on significant R&D investments in digital technologies particularly on AI and their application to its products and solutions

Lockheed Martin launched an AI related R&D project in Romania

Rolls-Royce Holdings’ R&D spending increased due to its investment in Electrical and Small Modular Reactors (SMR)

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The A&D sector experienced a revolutionary transformation with the development of innovative technologies that enhanced capabilities and efficiency

ARTIFICIAL INTELLIGENCE	• Air traffic management • Pilot training • Fuel consumption optimization	• Autonomous unmanned systems • Mission planning and optimization • Cognitive systems	AIRBUS *Airbus bets on AI to fix pilot shortage by developing autonomous flight and ML solutions for next generation aircraft*
DIGITAL THREAD	• Factory Automation • Asset Monitoring • Predictive maintenance	• Product Lifecycle Management • Maintenance, Repair, and Overhaul (MRO)	BOEING *Digital thread assists Boeing technicians in constructing the MQ-25 Stingray unmanned aerial refueler for the U.S. Navy*
ADVANCED AIR MOBILITY (AAM)	• Reconnaissance and Surveillance • Airborne Communication and Connectivity	• Aerial ambulances for medical evacuation purposes • Special operations support	NASA *NASA initiated the AAM National Campaign and is testing eVTOL aircraft for potential air taxi use*
METAVERSE	• Virtual flight tour • Generative simulation and Safety training	• Remote assistance • Acoustic simulation • MRO training	LOCKHEED MARTIN *Lockheed Martin employs HoloLens 2 mixed reality headsets in Orion Spacecraft assembly operations*
ADDITIVE MANUFACTURING	• Creating rocket bodies • Accelerating production of commercial aircrafts	• Rapid prototyping • Advanced materials development	Collins Aerospace *Collins Aerospace opens nearby facility for additive manufacturing in North Carolina*
SPACE TECHNOLOGIES	• Satellite constellations for global communication and imaging • Space tourism • Space data management	• Space-based intelligence • Intelligence, Surveillance and Reconnaissance (ISR) capabilités	SPACEX *SpaceX has raised multiple deals in space tech for a total of more than $3.6 Bn in 2022*
QUANTUM TECHNOLOGIES	• Quantum computing • Quantum sensing and navigation • Quantum metrology	• Quantum communications • Quantum cryptography	Raytheon Technologies *IBM and Raytheon Technologies collaborate on AI, cryptography, and quantum solutions for Aerospace and Defense*

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Although the overall deal-making in the A&D sector reached a three-year low in H2 2022, the Defense and Space subsectors maintained a consistent level of activity

AERO SECTOR

21% Aero sector's MRO market rebounds, growing 21% from 2022, reaching pre-pandemic levels and driving majority of deals in 2023.

The Aero industry experienced growth in new technologies like ***eVTOL aircraft, drone delivery****, and true* ***zero-emission aviation*** *powered by batteries or hydrogen gained traction*

ACITURRI *Aciturri Aeronáutica to acquire Malichaud Atlantique to expand its current technological and industrial capabilities*

SPACE SECTOR

$ 272 Bn PE investments in the global space sector reached approximately US$272 Bn by the end of 2022

2022 witnessed a groundbreaking shift in the space sector, achieving a record-breaking ***186 (increase of 28%)*** *successful rocket launches.*

SPACEX *SpaceX's 2022 funding round of approximately $2 B fuels their ambitious 2023 agenda, including 87 launches and moon exploration.*

DEFENSE SECTOR

39% Defense-focused M&A deals surged, from 19% of total A&D deal volume in Q2 2021, to 39% in 2022

The ***war in Ukraine*** *and China's growing military power are causing European countries to increase their defense spending, which is shifting global spending priorities*

L3HARRIS™ *L3Harris Technologies to acquire Aerojet Rocketdyne, the US-based manufacturer of propulsion systems for Defense and space applications*

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Aerospace and Defense organizations are increasingly relying on Engineering Service Providers to meet the growing demand

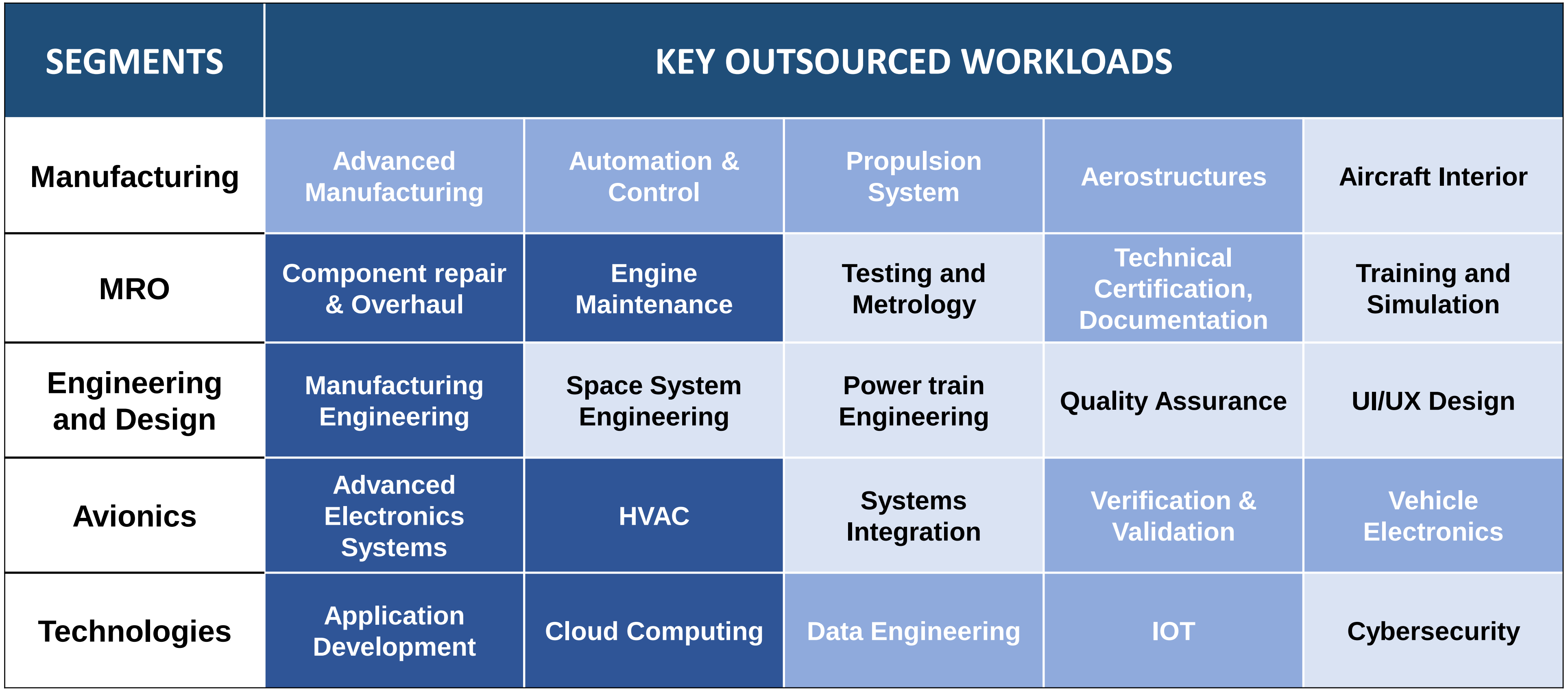
Aerospace & Defense SP Addressed Spend, 2022

USD Bn

9-10

Contribution of A&D enterprises to the overall ER&D addressed market

8-10%



SEGMENTS	KEY OUTSOURCED WORKLOADS				
Manufacturing	Advanced Manufacturing	Automation & Control	Propulsion System	Aerostructures	Aircraft Interior
MRO	Component repair & Overhaul	Engine Maintenance	Testing and Metrology	Technical Certification, Documentation	Training and Simulation
Engineering and Design	Manufacturing Engineering	Space System Engineering	Power train Engineering	Quality Assurance	UI/UX Design
Avionics	Advanced Electronics Systems	HVAC	Systems Integration	Verification & Validation	Vehicle Electronics
Technologies	Application Development	Cloud Computing	Data Engineering	IOT	Cybersecurity

TOP A&D COMPANIES IN THE SP OUTSOURCING MARKET

AIRBUS ROLLS ROYCE BOEING THALES SAFRAN AEROSPACE·DEFENCE·SECURITY Collins Aerospace

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Low ▢ ▨ ■ **High**

To meet the rising demand, Aerospace and Defense organizations are increasingly relying on collaborative partnership ecosystems

Aero Sector	Space Sector	Defense Sector
2022 L&T TS will establish an ER&D center in Québec, Canada, to deliver engineering services for Jaunt Air Mobility's electric Vertical Takeoff and Landing (eVTOL) air taxi	**2022** AT&T and Northrop Grumman collaborated to develop a 5G-powered digital battle network for the U.S. DoD	**2023** DSTA and Lockheed Martin have partnered to enable data analytics and workflow automation for mission readiness
2022 ArianeGroup will develop and provide support for the liquid hydrogen fueling system of Airbus' ZEROe demonstrator during testing	**2022** Collaboration between SpaceX and T-Mobile brings direct-to-cell connectivity via Starlink satellites, addressing cellular network gaps in rural and remote areas	**2023** Boeing and Shield AI collaborate on integrating AI and autonomous capabilities for defense programs and military needs
2022 Cyient partners with Honeywell in a multi-year deal to manufacture the industry's first cloud-connected cockpit system, the Honeywell Anthem	**2022** SpeQtral and Thales Alenia Space collaborate to explore, develop, and showcase space-to-Earth quantum communications	**2022** L3Harris Technologies and Shield Capital partner to develop and deploy innovative defense and commercial technologies

Source: Zinnov Research and Analysis, Zinnov Z1000 database

SOFTWARE & INTERNET SUMMARY

The Software & Internet (S&I) vertical accounted for ~20% of the total global ER&D spending in 2022

However, tech giants are strategically investing in next-generation technologies with controlled capital expenditures

Firms are putting larger stakes on AI, Cloud Computing, Metaverse, and Blockchain technologies to build-the-new and renew-the-old

Strategic partnerships with broader ecosystem players to enable and expand to the new horizons; leading to new business models, innovative products and platforms

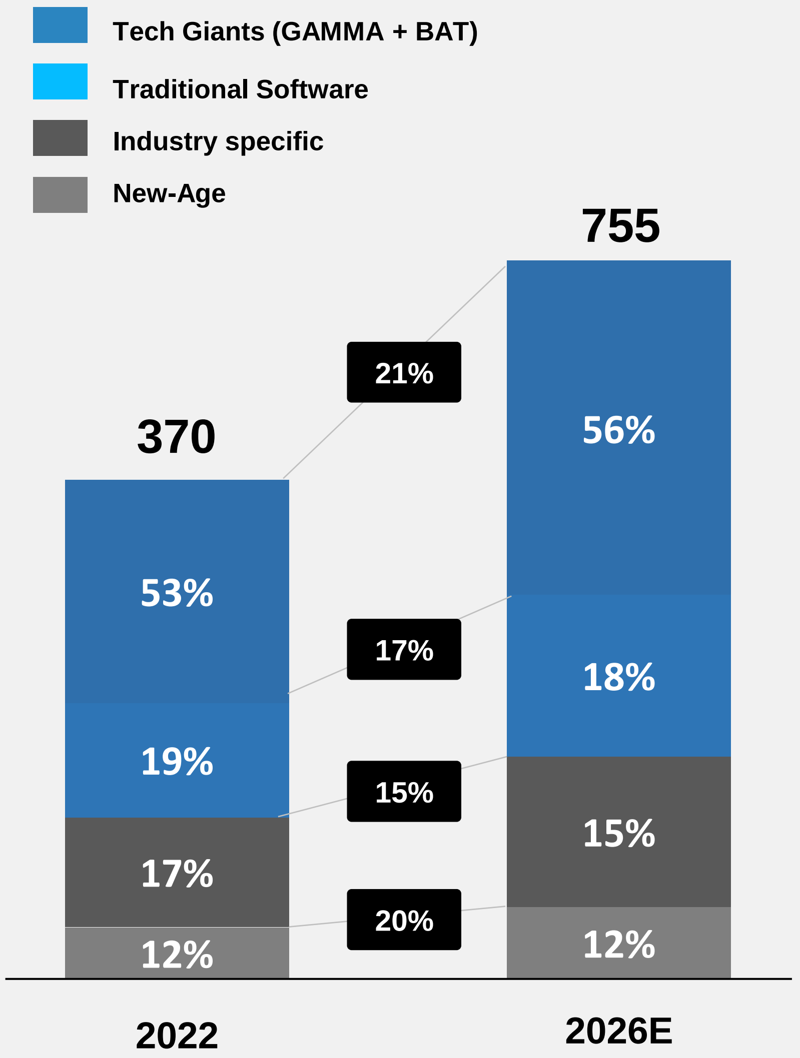
Hyperscalers will play a crucial role in enabling and scaling existing businesses, helping them leapfrog into new markets and offer innovative products and services

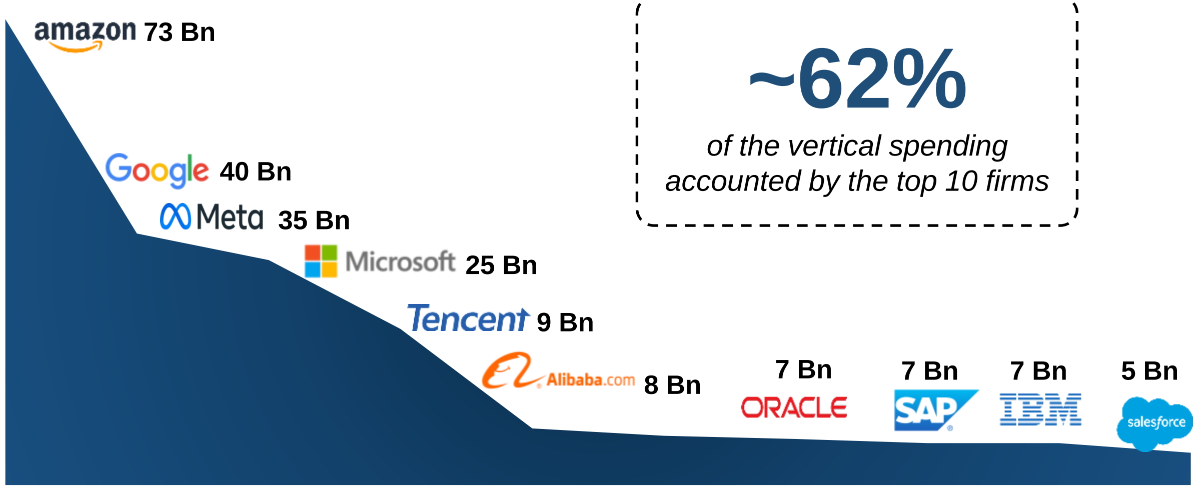
Service providers are focusing on targeted account strategies and partnering with hyperscalers to build reusable IP frameworks, solutions and horizontal capabilities

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The Software & Internet ER&D spend will grow by 2X in 2026, with tech giants accelerating their digital technology spends

S&I - Digital ER&D Spend 2022 (USD Bn)





~62%
of the vertical spending accounted by the top 10 firms

Microsoft Microsoft to invest USD 10 Bn in open AI, to integrate Open AI capabilities into potential Microsoft products in 2023

Meta Meta plans to invest USD 19.2 Bn in 2023 in its metaverse division Reality Labs

Alibaba.com Alibaba pledges USD 1 Bn investment to support its cloud computing customers over the next 3 fiscal years

SAP SAP to invest USD 200 Mn over the next five years to build an innovation lab in Singapore to strengthen its capabilities in AI/ML and digital supply chain

~20%
S&I ER&D spend contribution towards global ER&D spend

USD 250 Bn
Approximately invested on Cloud, Metaverse, and AI by the top 10 S&I firms in the last 2 years

7/10
Software firms acquired large corporations and several innovative Start-ups in 2022

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Technology firms are addressing the impact of various market influences on their operations to sustain their businesses

Market Influence on S&I Industry

Impact areas

Impact of Inflation across industry verticals

- ✓ Increasing prices of physical assets such as Data centers, Servers, Network equipment, Software, etc.
- ✓ Rise in capital expenditure to handle increased demand for products & services

- Greater impact on revenues and profitability
- Unanticipated layoffs across regions to reduce bottom-line growth impact

High inflation rates drove enterprises such SAP and Oracle increase their support prices on existing agreements and few other support services fee by 3.3% and 8% in key locations

War for skilled talent

- ✓ Increased adoption of digital technologies leading to abnormal spike in salaries and benefits to attract skilled talent
- ✓ Additional financial burden to upskill the existing talent through learning and development activities
- ✓ High demand for AI/ML, Data Science, DevSecOps, etc.

- Talent costs to shoot up for acquiring digitally skilled talent for business expansion and innovation

Amazon invested approx. **USD 1Bn** in increased wages. In addition, it started career advancement and development program designed to place operational employees in Engg. roles within AWS

Changing scope of tech regulations

- ✓ Governments are strengthening regulations on platform activities, privacy, and antitrust issues
- ✓ Enforcement of Digital Markets Act (DMA) may force tech giants to open walled gardens in 2023

- Increased competition
- Compliance with changing regulations can be major setback for tech giants

Enforcement of DMA may force tech giants to open walled gardens in 2023

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Tech giants are investing heavily in AI, Metaverse, & Cloud to capitalize on the opportunities presented by these moonshot technologies

Key Trends	**AI/ML Technologies**	**Metaverse**	**Cloud Computing**	**Blockchain**	**Cybersecurity**
Focus Areas	▪ AI Solutions & Platforms ▪ Data & Analytics ▪ Generative AI ▪ Cloud Infrastructures ▪ Process Automation ▪ UI/UX	▪ Metaverse Platforms ▪ Gaming and Entertainment ▪ Customer Experience ▪ Education and Training	▪ Cloud-native platforms ▪ Hybrid Infrastructure ▪ XaaS ▪ Big Data Analytics	▪ Supply Chain Management ▪ Asset Management ▪ Non-Fungible Tokens (NFTs) / Crypto ▪ Smart Contracts	▪ Identity and Access Management ▪ Network Security ▪ Platform Security ▪ Risk Management
Enterprise Spend Insights	Microsoft Announced third phase investment of USD 10 Bn on OpenAI in view to integrate OpenAI technology into Microsoft products	Meta Meta plans to invest USD 19.2 Bn in 2023 in its metaverse division Reality Labs	amazon Amazon is planning to invest nearly USD13 Bn in India by 2030 focusing on cloud infrastructure	Google Alphabet, Google's parent company invested USD 1.5 Bn in the blockchain sector between September 2021 and June 2022	IBM IBM launched a global cybersecurity hub in India to provide Managed Security Services
Market Forecasts	**3X** Growth in the global spending on Artificial Intelligence by 2026	**USD 100 Bn+** Over USD 100 Bn invested in Metaverse in 2022	**95%** Of new digital workloads will be deployed on cloud-native platforms by 2025	**USD 20 Bn+** Investment in blockchain technology by businesses by 2025	**12%** Growth in spent on cybersecurity annually by organizations

Source: Zinnov Research and Analysis, Zinnov Z1000 database

While most Applied AI use cases are being adopted the fastest, some use cases in Generative and Software 2.0 are also increasing rapidly

Strategic Priorities	Use-cases	Key Investments
Generative AI	Personalized Marketing Product Design & Modelling Neural Network Design	**servicenow** ServiceNow launched two generative AI offerings, including a natural language search tool and a connection to Microsoft's Azure OpenAI **Microsoft** Microsoft is introducing Dynamics 365 Copilot for applications that handle tasks such as sales, marketing and customer service
Applied AI	Edge AI AI Cybersecurity Facial Recognition AI Assistants Demand prediction using AI AI-aided Design and Prototyping Deep Reinforcement Learning	**IBM** IBM launched New QRadar Security Suite, built on an open foundation and embedded with advanced AI and automation designed specifically for the demands of hybrid cloud
Generative AI	Low Code/ No code AI-based testing Automated Code Review	**SAP** SAP SE acquired AppGyver Oy, a pioneer in no-code development platforms to broaden its offering in the area of business process intelligence **databricks** Databricks acquires 8080 Labs marking the company's expansion into the low-code/no-code space to broadens the accessibility of its lakehouse platform to a wider audience of citizen data scientists
Generative AI	AI for supply chain AI Recruiting Tool Ethical Supply Chain Sourcing	**Inspectorio** Inspectorio launched the Corrective and Preventive Action (CAPA) recommender, a ChatGPT-driven AI tool that assists brands, factories and other organizations with supply chain management. **seekout** SeekOut, a recruitment intelligence platform, launched a new generative AI technology based on OpenAI's GPT, called SeekOut Assist.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Low ▨ ▨ ▨ ■ High

Enterprise-led Metaverse use cases will see higher adoption compared to consumer-led use cases

Strategic Priorities	Use-cases	Key Investments
Sales & Customer Engagement	Immersive Games NFTs/ Collectibles Virtual Events Virtual Worlds / 3D Social Network VR-enabled Apps Virtual Theme Park Virtual Showroom Virtual Lounge	ByteDance acquired VR gaming headset developer Pico Interactive for USD 1.5 Bn
Design and Discovery	Digital Twin for Prototyping VR-based product design	Dassault Systèmes has introduced Creative Design Experience In Virtual Reality (R2023xGA) to discover a 3DSketching and 3Dsculpting complete toolset for Creative Design and Ideation Process
Remote Collaboration and Operation	Virtual Facility Tour and Orientation Virtual Workroom AR Navigation	Google acquired Phiar Technologies, a Taiwanese-founded AI Start-up that develops AI-powered Augmented Reality navigation driving software solution
Immersive Learning & Training	Immersive Learning Employee Training and Onboarding	Meta is investing USD 150 Mn into its Immersive Learning project in partnership with extended reality education software company VictoryXR

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Low ▨ ▨ ▨ ▨ High

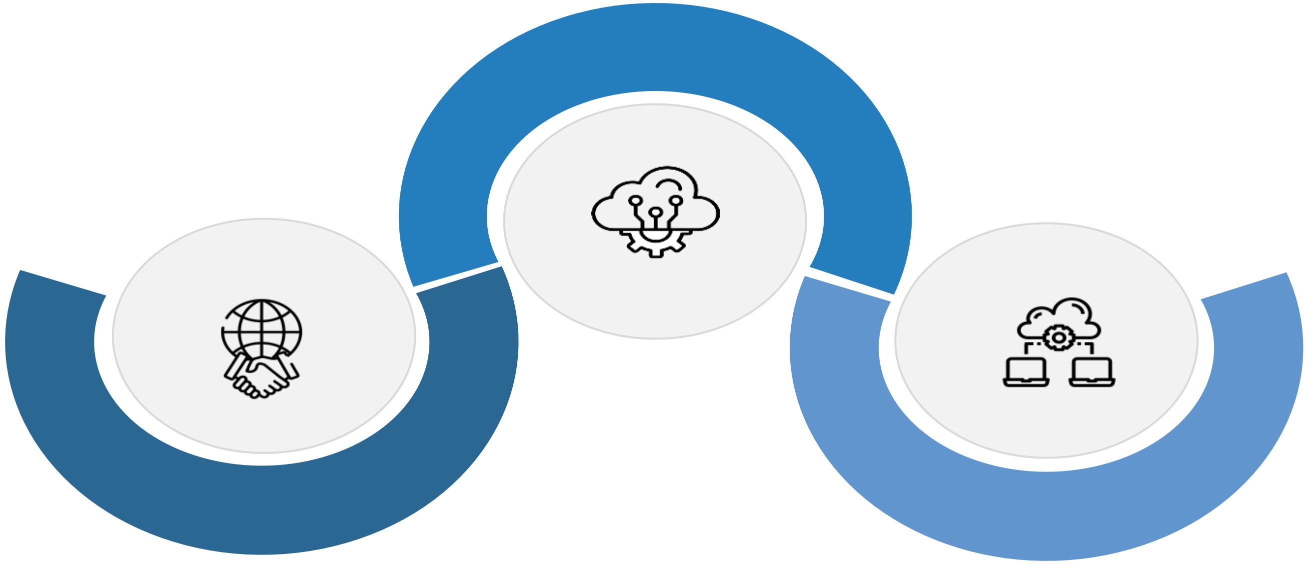
Cloud providers are shaping the Cloud marketplace with investments in strategic areas while tracking the evolving needs of their customers and partners

Strategic Priorities	Use-cases	Key Investments
Application Modernization	Cloud-native applications Industry-specific platforms Cloud Observability and Management Platforms	Chronosphere and Google Cloud partner for cloud-native observability solution Microsoft is launching its next-generation hybrid cloud platform “Azure Operator Nexus” for communication service providers
Multi Cloud	Data Center Modernization Telecommunication Cloud Hybrid Cloud Edge Cloud	Google Cloud launched Google Distributed Cloud powered by Anthos to extend the power of Google Cloud infrastructure and services to the edge
Security	Network Security Solutions Cloud Security Solutions	Alibaba Cloud entered into a global partnership with cybersecurity consulting company LGMS to help companies enhance their cyber security capabilities in a multi-cloud environment
Virtual Cloud Network	Data Center Networking Edge Networking 5G Cloud Networking	IBM launched IBM Hybrid Cloud Mesh, a multicloud networking solution designed to allow organizations to establish simple and secured application-centric connectivity
Sustainability	Emissions Impact Dashboard Carbon Footprint Tool Green Cloud	AWS launched Customer Carbon Footprint Tool that allows customers to see the estimated carbon impacts of their AWS workloads down to the service level for its EC2 compute service and S3 storage service

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Low ▨ ▨ ▨ ▨ High

SPs are leveraging end-to-end partnerships with Hyperscalers to grab the vast opportunity offered by the growing Cloud market



Enterprise-led Partnership

- Domain expertise and industry-specific solutions
- Access to a diverse customer base
- Seamless integration and interoperability
- Regulatory compliance and industry standards
- Co-innovation and market differentiation

IBM SIEMENS

Collaborated to accelerate sustainable product development and operations

Hyperscaler Partnership

- Cloud-native development
- Enhanced performance and reliability
- Market reach and customer acquisition
- Competitive advantage
- Focus on core competencies

PEGA

Partnered to combine the capabilities of Google Cloud's Healthcare Data Engine and Pega's suite of intelligent Healthcare solutions

Service Provider-Hyperscaler Partnership

- Access to cutting-edge infrastructure
- Wide range of cloud services
- Global reach and scalability
- Security and compliance
- Cost-effectiveness and flexibility
- Integration with other services

aws accenture

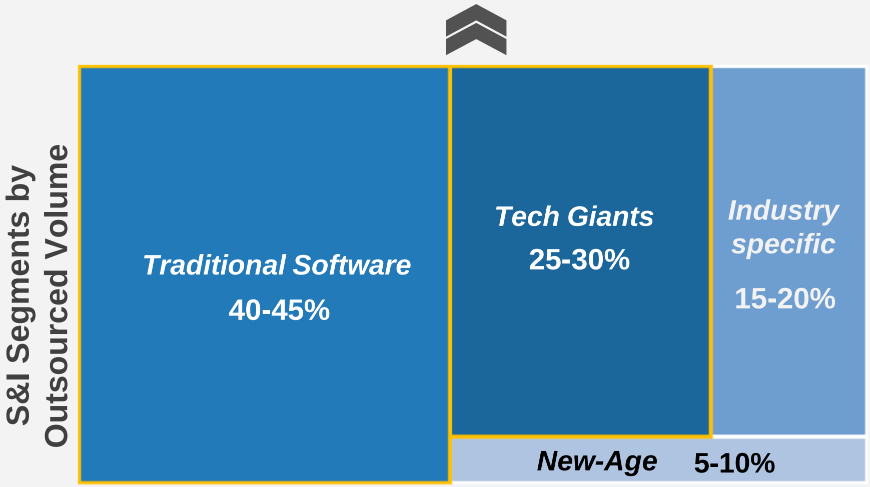
Launched Velocity – a platform to help clients drive up to 50% faster business transformation

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Platform Engineering and Software Testing are the major outsourced workloads; traditional software firms account for the largest portion of the outsourced spend

S&I SP Addressed Market (2022)

USD **22-24** Bn



~75% Traditional software firms and Tech giants together account for approx. 75% of the outsourced volume

KEY OUTSOURCERS

TECH GIANTS	Google Microsoft
TRADITIONAL SOFTWARE	IBM vmware salesforce Adobe
INDUSTRY SPECIFIC	GoDaddy ptc amdocs
NEW-AGE FIRMS	Uber zendesk workday.

Tech Giants

- Google and Microsoft are the largest outsourcer in GAMMA.
- Google predominantly outsources large low-end portions of its Ads and Search business. While Microsoft outsources product sustenance services

Traditional Software

- IBM has the largest outsourcing spend from traditional companies
- There is a long tail of traditional Software firms with sizable ER&D spends that engage actively with global outsourcing partners and local staffing companies in the USA

Industry Specific Software

- Industry specific outsourcing is very fragmented with top 5 players PayPal, Expedia, eBay, Amadeus & Fiserv accounting for less than 25% of the segment outsourcing share

New-Age Firms

- New-Age firms are leveraging SPs for support and development activities. Uber, Pinterest, Survey Monkey are top outsourcers.

DEALS INSIGHT

45-50%

of the deals have Data, Analytics, BI and AI related workloads

20-25%

of the deals have workloads around Cloud Engineering

3-5%

of the deals have Cybersecurity and AR/ VR related workloads

Engineering Workstreams

Platform Engineering	▓
Software Testing	▓
UI/UX Design	▒
Data Engineering	▒
Cloud Computing	▒
Sustenance & Support	░
Legacy Modernization	░

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Outsourcing Intensity Low ░ ▒ ▓ High

Service Providers are building capabilities in AI, Metaverse, and the Cloud as a strategic move to reach target customers

	ARTIFICIAL INTELLIGENCE	METAVERSE	CLOUD	
SOLUTIONS & OFFERINGS	**Atos** ThinkAI enables organizations to design, develop and deliver high-performance AI applications	**Tech Mahindra** TechMverse to deliver interactive and immersive experiences in the Metaverse for its enterprise customers	**Persistent** See Beyond, Rise Above Developed an intelligent cyber recovery solution, PiCR, together with Google Cloud	**8/10** *SPs launched Artificial Intelligence platforms to improve their businesses*
COE/INNOVATION LABS	**accenture** Partnered with Johnson Controls on AI-enabled OpenBlue innovation centers in Bangalore and Hyderabad which will drive the rollout of building control system products and services using technologies such as AI, digital twins, IOT, 5G, and the cloud.	**Coforge** Sets up a Metaverse COE, planning to deepen its mixed reality offerings by identifying the right use cases	**VVDN TECHNOLOGIES** VVDN setup COE through Global Strategic Partnership with Google Cloud. VVDN will also develop the next gen innovative solutions, such as IOT and Video Cloud Platform, and a next gen enterprise private 5G Cloud, etc.	**5/10** *Top 10 SPs have setup innovation labs for Metaverse*
INVESTMENTS	**Capgemini** Acquired AI start-up Quantmetry to strengthen it's AI offerings in Industrial and tech sectors	**accenture** Invested in XR based learning and training application Talespin.	**cognizant** Acquired Bright Wolf, a Microsoft Azure and AWS cloud partner specializing in custom Industrial Internet of Things (IIOT) solutions	**7/10** *SPs invested in independent cloud consulting firms to strengthen their cloud capabilities*
PARTNERSHIPS	**wipro** Partnered with EROS investments to co-develop AI-based content localization solutions	**Capgemini** Partnered with Unity to co-develop sector-specific metaverse and immersive experience solutions	**Tech Mahindra** Partnered with Indosat Ooredoo Hutchison to launch Google Cloud Smart Analytics and Center of Excellence (COE) lab	**7/10** *SPs partnered with enterprises to build capabilities in AI, Cloud and metaverse*

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service Providers are signing deals in AI, Metaverse, and Cloud Computing as enterprises accelerate their digital transformation initiatives

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
Fintech Unicorn	Persistent See Beyond, Rise Above	2022	**AI led Automation**	Persistent will be working as an extended engineering team to develop an AI led automated risk and pricing platform
cybereason	GlobalLogic	2022	**AI-driven Cybersecurity**	GlobalLogic to offer next-generation security platform & services to Cyberreason, AI-driven XDR platform provider
Microsoft	ttec	2022	**AI-powered Contact Center Platform**	TTEC is partnering with Microsoft in launching the Digital Contact Center platform which combines Nuance, Microsoft Dynamics 365, Microsoft Teams and Azure
unity	Capgemini	2022	**Metaverse, Web3**	Capgemini to collaborate with Unity to conduct joint R&D projects of metaverse/Web3, support solution development, and scale-up talent bench
Union Bank of India	Tech Mahindra	2022	**Metaverse**	Tech Mahindra is enabling Union Bank of India to launch its Metaverse Lounge “Uni-Verse”
Lenovo	TATA TATA ELXSI	2022	**Metaverse, XR**	Tata Elxsi will help Lenovo develop smartXR solutions for enterprise applications
vmware	kyndryl + aws	2022	**VMware Cloud Accelerator**	Kyndryl and AWS are developing an accelerator for VMware Cloud on AWS
Backcountry	Infosys + Google Cloud	2022	**Digital Transformation**	Backcountry is leveraging Infosys Cobalt and Google Cloud Platform to enhance the customer experience and improve its cybersecurity landscape
PIRAEUS BANK	accenture + Microsoft Azure	2022	**Digital Transformation**	Accenture is aiding Piraeus Bank to devise and execute its strategic cloud migration and help the company develop and introduce new cloud-based services

Source: Zinnov Research and Analysis, Zinnov Z1000 database

TELECOMMUNICATIONS SUMMARY

Wireless deployments, multi-access edge computing, and private cellular networks are driving the Telecom ER&D spend

5G's widespread adoption is reshaping the global connectivity landscape

The open RAN ecosystem and private 5G network infrastructures are enabling the development of new products and services

Telecommunications companies and technology partners are developing comprehensive 5G solutions within the CSP* and NEP ecosystem**

Service Providers employ a three-pronged strategy of build, buy, and partner to bolster 5G capabilities

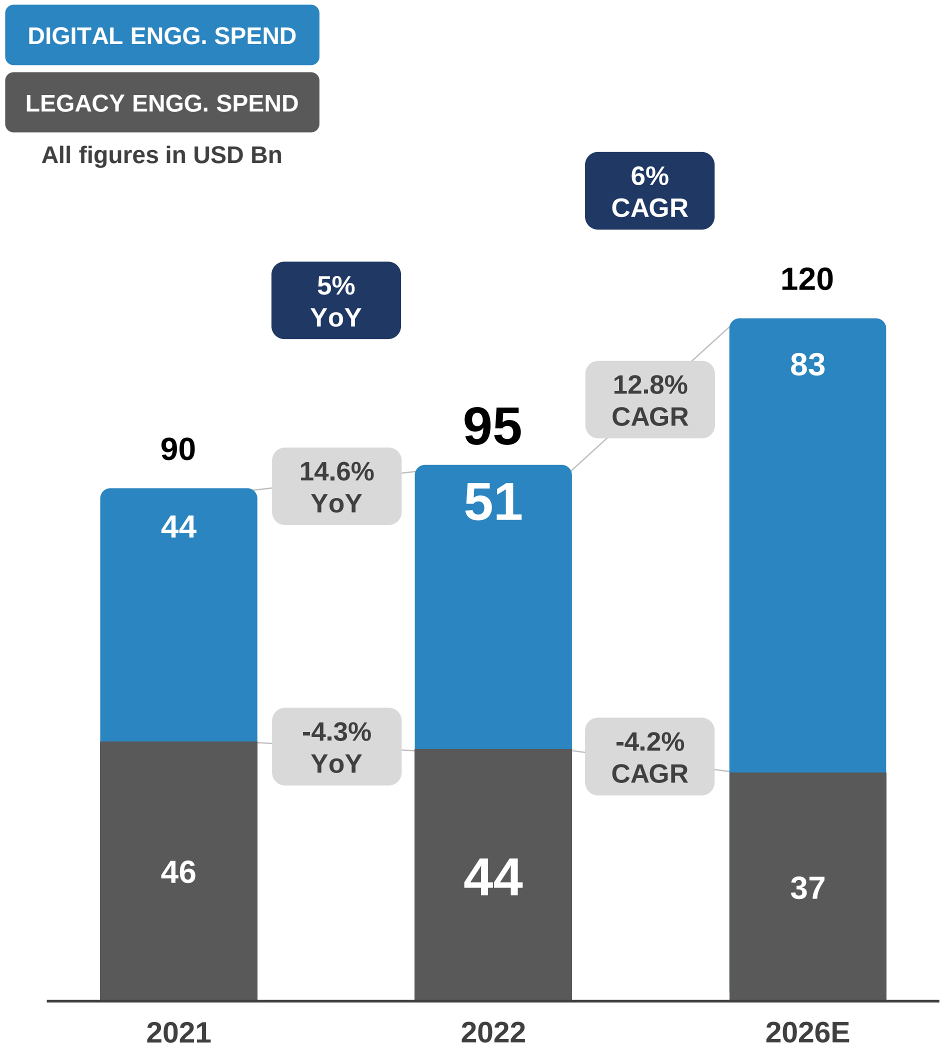
Source: Zinnov Research and Analysis, Zinnov Z1000 database

* CSP - Communications Service Providers

** NEP – Network Equipment Providers

Telecommunications ER&D spending will witness a healthy growth owing to wireless deployments, multi-access Edge Computing, and private cellular networks

Telecommunications ER&D Spend (2021-2026E)



ER&D Growth

ER&D spend in the telecommunications industry to reach $120 Bn by 2026 with technologies such as 5G, AI, and IOT revolutionizing the telecommunications industry

Fixed Wireless Access

By 2028, 5G will account for almost 80% of Fixed Wireless Access (FWA) connections. FWA connections to reach 300 Mn in 2028 from 107 Mn in 2022 with a CAGR of 19%

Infrastructure Investments

Investment in R&D infrastructure and digital centres to create a skilled talent pool and provide solutions across 5G, 6G, AI, cloud RAN, and core network technologies globally

Investing to lead in 5G-Advanced and 6G networks

NEPs are investing in 5G-Advanced and preparing for the upcoming 6G era with the first networks expected in 2025, aided by collaborations with consortiums and initiatives such as Hexa-X II and 6G-ANNA

Network-as-a-Service (NaaS)

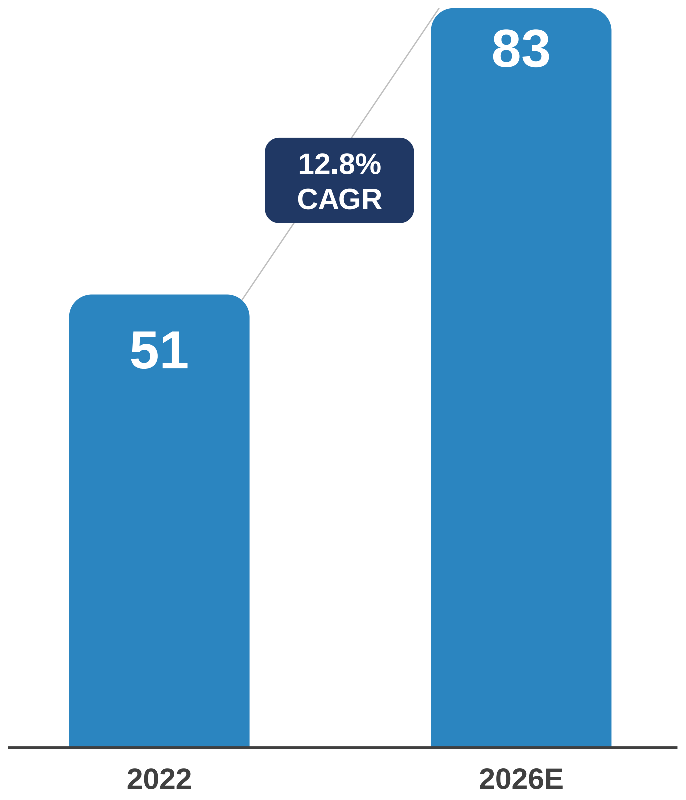
NaaS adoption, with pay-as-you-consume spending, enables flexible and predictable IT expenditure. It is utilized for use cases like securing remote workplaces, multi-cloud access, and multi-branch networking

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Metaverse, Cloud, IOT, Cybersecurity, and AI/ML are the key digital themes driving the Telecommunications Digital Engineering spend

Telecommunications Digital Engineering Spend (2022-2026E)

All figures in USD Bn



- Increased 5G deployment has led to a higher demand for cloud-native solutions based on SDN and NFV, improving CSPs' performance and revenue, and enabling collaboration with cloud providers
- Telcos are embracing recurring revenue-based models driven by software and subscriptions, and integrating AI/ML into cloud management platforms to offer intelligent solutions for efficient network management
- The metaverse is rapidly evolving and expected to push data consumption by 20x across the globe by 2032
- Enterprise network infrastructure spending will reach USD 45 Bn by 2028, with Network as a Service (NaaS) accounting for USD 15 Bn. CSPs tapping into NaaS are more likely to outperform peers

Short-Term ← **INVESTMENT FOCUS** → **Long-Term**

Digital Themes

- AI/ML
- Cloud/Edge Computing
- Metaverse
- IOT
- Computer Vision
- Blockchain
- Digital Twin

Technology Adoption

- Network Slicing
- Multi-access Edge Computing (MEC)
- O-RAN & Virtualization
- NSA to SA Deployment
- 5G Modems and Chipsets
- Enhanced Mobile Broadband (eMBB)
- 5G C-V2X
- Private 5G - Low Latency Use Cases

2022

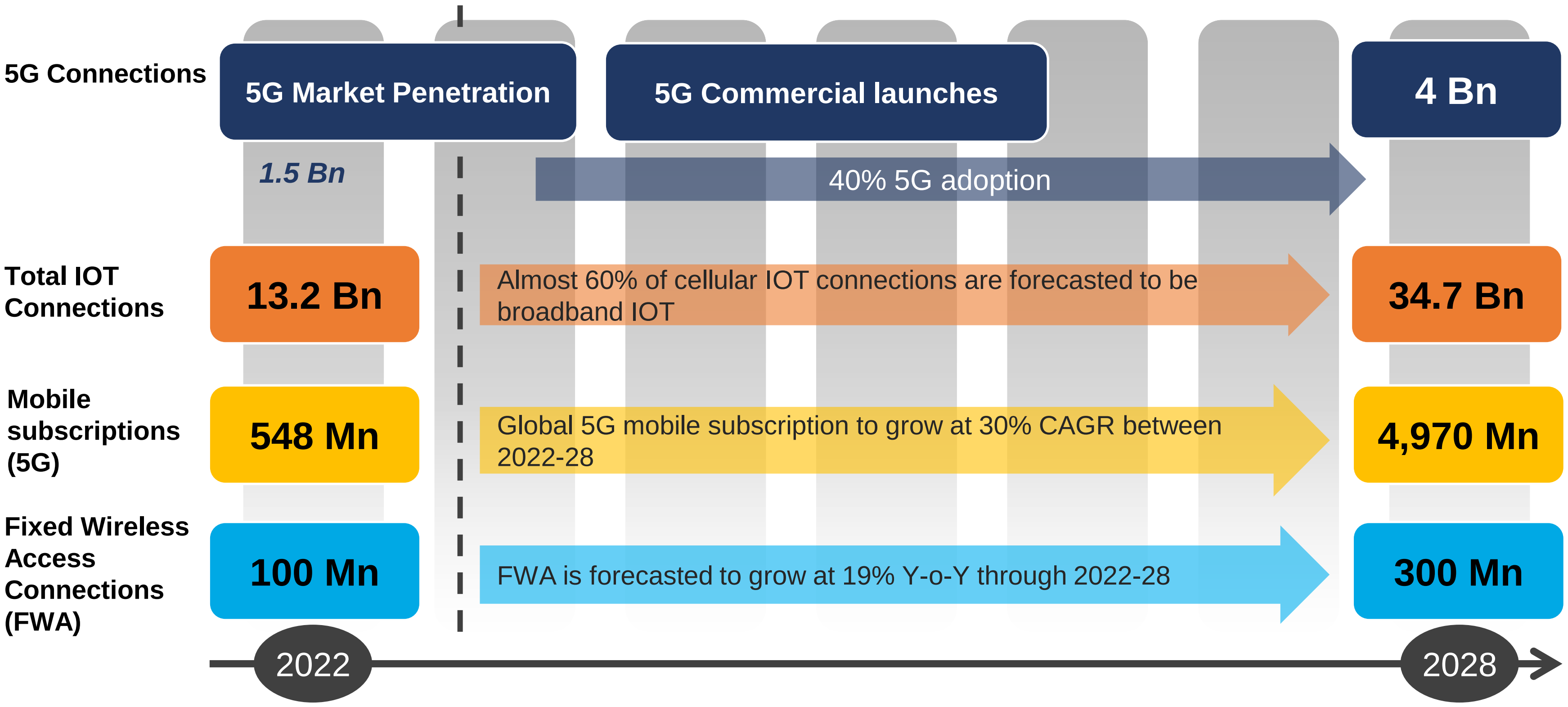
~6% of USD 810 Bn is spent on Digital Engineering by telecommunications vertical

2026E

~5% of USD 1,088 Bn is spent on Digital Engineering by telecommunications vertical

Source: Zinnov Research and Analysis, Zinnov Z1000 database

5G is changing the connectivity landscape globally through high penetration and subscription rates



	2022		2028
5G Connections	1.5 Bn	5G Market Penetration; 5G Commercial launches; 40% 5G adoption	4 Bn
Total IOT Connections	13.2 Bn	Almost 60% of cellular IOT connections are forecasted to be broadband IOT	34.7 Bn
Mobile subscriptions (5G)	548 Mn	Global 5G mobile subscription to grow at 30% CAGR between 2022-28	4,970 Mn
Fixed Wireless Access Connections (FWA)	100 Mn	FWA is forecasted to grow at 19% Y-o-Y through 2022-28	300 Mn

HIGHLIGHTS

1. **By 2026, 5G is estimated to account for 40% Mobile connections i.e., 3.5 Bn subscriptions**
2. **In 2022, smartphone penetration reached 81% and IOT connections hit 2.5 Tn**
3. **The value of the network automation and orchestration market will reach USD 16 Bn by 2027, growing at a CAGR of 9.3% 2022 to 2027**

OUTLOOK

SHORT TERM 2022-24	**229 operators in 87 markets launched 5G services. 30 new markets will launch 5G mobile services including developing markets, Africa and Asia**
MEDIUM TERM 2024-26	**5G will accelerate in Europe, India and Middle East. Also, use case across industries will be enabled**
LONG TERM 2026 and Beyond	**By 2028, North America is projected to have the highest 5G penetration**

Regional Views

North America

- In 2022, the second wave of build-outs and user adoption of 5G resulted in a global addition of over 140 Mn subscriptions. It is anticipated that by 2028, 5G subscriptions will exceed 420 Mn, accounting for over 90% of mobile subscriptions

India

- 5G subscriptions in India, driven by aggressive deployments and increasing affordability and availability of 5G smartphones, reached 31 Mn by end of 2022 and expected to reach 690 Mn by end of 2028

Western Europe

- 5G subscriptions to reach almost 150 Mn by 2023-end, with 88% penetration by 2028. 5G subscriptions rose from 32 Mn in 2021 to 63 Mn by 2022-end and are expected to grow strongly

Northeast Asia

- Telecom operators are experiencing growth in service revenues and ARPU due to the availability of 5G device models and the rapid increase in 5G subscriptions, which added approximately 320 Mn subscriptions in 2022

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Telcos are setting up 5G labs to make 5G services future ready

COMPANY	COE/LABS/INVESTMENTS	LOCATION	FOCUS AREA	DETAILS
Telefónica	Innovation Center	Madrid, Spain	**5G, AI, Smart Fibre, Edge Computing, Deep Learning Algorithms, IOT, Cloud, Cybersecurity, and Blockchain**	▪ Technological developments based on holography, gaming, robots, connected cars, drones, security, and the development of hybrid classrooms ▪ The hub functions as a network of interconnected smart buildings, utilizing 5G technology and holographic communication ▪ Investment of £100 Mn until 2024
AT&T	5G Innovation Lab	Mexico, North America	**Private 5G industrial wireless network, FSM 5G RAN technology and IOT device solutions**	▪ Nokia is partnering with AT&T lab as a strategic collaborator to develop tailored 5G use cases for the Mexico 5G ecosystem ▪ Develop use cases to accelerate the adoption of private networks in Mexico ▪ Leverage technologies developed by Qualcomm, Celona, Axity and Veea
NOKIA	Centre of Excellence	India	**Networked Robotics, 5G and AI**	▪ Support Nokia Bell Labs in robot orchestration, robot network control and human-robot interaction ▪ Early use-cases will focus on 5G drones for remote management in agriculture and industrial automation
BT	Investment	London, U.K	**5G, IOT, Edge Compute, Cloud and AI**	▪ Investment of £100 million in its Division X business unit to develop solutions integrating emerging technologies over the next three years ▪ Launch of cyber defense and assessment tools- Safe Security cyber health check tool ▪ Use-cases for manufacturing, health, port operations, transport, and logistics sectors
orange™	Orange Digital Center (ODC)	Kinshasa, Democratic Republic of the Congo	**Digital skills and innovation**	▪ 500 sq. m facility with a coding school, FabLab- digital manufacturing workshops and a Fab Start-up accelerator ▪ The center will provide ecosystem dedicated to the development of digital skills and innovation ▪ Orange plans to establish a network of 25 ODCs deployed in Africa, the Middle East, and Europe by 2023

Source: Zinnov Research and Analysis, Zinnov Z1000 database

With plans to deploy Open RAN, Telecom operators are calling for collaborative efforts to further fuel the Open RAN ecosystem

		ENTERPRISES	COMMUNICATION SERVICE PROVIDERS	NETWORK EQUIPMENT PROVIDERS
	SEGMENT FOCUS	▪ **SD-Edge Solutions**, helps enterprises manage their network with industry-standard SDN hardware ▪ **Overhead Reduction** for multi-vendor and hybrid environments	▪ **SDN controller** applications to facilitate monitoring, troubleshooting and VNF onboarding ▪ **New Revenue stream** – Operators with SDN expertise leverage own locations for Edge Service	▪ **SDN Orchestration** to simplify network designing, scaling and planning ▪ **End-to-end SDN solutions** combined with AI capabilities
COMPETITION FOCUS	**SUPPLIERS**	CSPs, NEPs, ER&D SPs	NEPs, ER&D SPs	ER&D SPs
	KEY SUPPLIER OFFERINGS	▪ NFV service orchestration ▪ NFV and SDN interoperability testing ▪ Performance Benchmarking ▪ SDN Migration for Legacy infrastructure	▪ VNF Testing and Certification ▪ VNF Onboarding and Testing Automation ▪ Network Design and Planning	▪ NFVI and VIM Support and Maintenance ▪ VNF Operations & Maintenance ▪ E2E Network Service Operations
	DIFFERENTIATION	▪ Customized Open-source tools ▪ Seamless Migration and Integration with existing technologies	▪ Automated VNF onboarding ▪ Leveraging Open-Source components for SDN/NFV ▪ Unified Platform for Network management	▪ Multi-vendor Hardware Compatibility Platforms ▪ Market Ready Solutions/IPs for market acceleration
	ILLUSTRATIVE DEALS/ PROJECTS	▪ **TCS & RedHat** - OpenStack NFV Orchestration and Test Solution	▪ **STC Solutions** – Altran- COE for carrier-grade SDN/NFV **Telefonica**-Altran- SDN/NFV and network capacity service	▪ **Ericsson**-HCLTech: NFV DevOps, Lab Trials-as-a-Service **AEWIN**-Altran: uCPE Solutions for SD-WAN

MARKET TRENDS

FOCUS AREAS	END-TO-END DEPLOYMENT	USE-CASE POCs	VALUE CHAIN INTEGRATION
Growth spearheaded by Large Enterprises and hyper-scalers since SDN-NFV is in mainstream adoption over the last 2 years	Ready to use O-RAN architecture and 5G life labs for life cycle management, end-to-end network deployment, and automation	Provide in-house open-source labs to develop customized POC for trials Highlight various cloud computing service models (IaaS, PaaS) through 5G COEs	Industry and Open standard partnerships for E2E network management and delivery from factory to EOL

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Enterprises are building in-house 5G network infrastructures to unlock new products and services based on high bandwidth, IOT and ultra-low latency capabilities

		ENTERPRISES	COMMUNICATION SERVICE PROVIDERS	NETWORK EQUIPMENT PROVIDERS
	SEGMENT FOCUS	▪ **5G Use Case Discovery**: Accelerated by Edge-computing, focus is on ROI justification and market potential assessment of 5G use cases	▪ **5G Edge offerings** combined with private 5G network solutions ▪ **Improved cellular spectrum** performance enabling reliable coverage over the breadth of your footprint	▪ **End-to-end industrial-grade** capabilities under Industry 4.0 use case applications ▪ **5G-capable MEC offerings** for private cellular solutions to use CBRS LTE
COMPETITION FOCUS	**SUPPLIERS**	CSPs, NEPs, ER&D SPs	NEPs, ER&D SPs	ER&D SPs
	KEY SUPPLIER OFFERINGS	▪ End-to-end user service model design ▪ Reference architecture (blueprints) for virtualization, network, ▪ End-to-end cloud-native vision for cloud processing	▪ Intelligent network automation – Network AI ▪ Inter-domain Operation Support System ▪ Virtual prototyping and network planning ▪ Trials and POCs	▪ Open Source and community collaboration ▪ Rapid prototyping of use cases ▪ Edge-to-cloud services across industrial workloads
	DIFFERENTIATION	▪ Custom-tailored business models and services ▪ Enable cloud to network data management	▪ Automate Management and Operations for CSPs ▪ Lower Time of Completion and lean operations ▪ Build cloud native network	▪ Accelerated deployment by frameworks, platforms and tools ▪ Cloud computing services on edge
	ILLUSTRATIVE DEALS/ PROJECTS	▪ **Phillips66** – Accenture/AT&T – Private 5G network setup for US refineries ▪ **AtlasCopco**- Ericsson-Orange- 5G deployment for I4.0	▪ **AT&T**- Tech Mahindra- Modernize internal network app ▪ **SK Telecom** -Deutsche Telekom- Trial for 5G indoor	▪ **Qualcomm** - Altran- Software for private 5G solutions **AWS** has partnered with 4 major operators to launch its new 5G edge computing service

MARKET TRENDS

FOCUS AREAS	END-TO-END DEPLOYMENT	USE CASE POCs	VALUE CHAIN INTEGRATION
Transformation of legacy infrastructure to modern applications; move towards software-defined design and cloudification	Access to private wireless platform and the flexibility to create an open architecture for MEC, enabling low-cost trials for POCs	Enable integration of software and cloud defined use-cases and eliminate multi-vendor complexities	Transition to software defined networking with on-demand slicing capabilities

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Telecom companies are modernizing 5G networks using Cloud and AI to provide machine-to-machine services, autonomous vehicle technology, remote healthcare, and innovative video delivery services

zinnov ZONES ER&D SERVICES

	Auto & Transport	Manufacturing	Healthcare	Construction & Mining	Energy & Utilities	Retail	Agriculture	RECENT USE CASES
Replenishment System	▮▮▯▯	▮▮▯▯	▮▮▮▯	▮▮▯▯	▮▯▯▯	▮▮▮▮	▮▮▯▯	*Orange demonstrated use of a camera which leverages 5G and edge computing capabilities to alert when stock at a store needs to be refilled* orange™
Quality Control and Monitoring	▮▮▮▯	▮▮▮▮	▮▮▮▯	▮▮▯▯	▮▮▮▯	▮▮▯▯	▮▮▯▯	*A 'digital twin' that works using technologies such as 5G, Edge Computing, data analytics, and ML to optimize industrial part production and make real-time decisions* Telefónica
Connected Transportation	▮▮▮▮	▮▮▮▯	▮▮▯▯	▮▮▯▯	▮▮▯▯	▮▮▯▯	▮▮▯▯	*Porsche Engineering's Italian tech center implemented a 5G hybrid private mobile network, enabling the deployment of business-critical applications such as V2V connectivity and self-driving vehicles* vodafone
AI-Based Video Surveillance	▮▮▮▮	▮▮▮▮	▮▮▯▯	▮▮▮▯	▮▮▮▯	▮▮▮▯	▮▮▯▯	*T-Mobile, Pano AI, and Portland General Electric have deployed 5G-connected cameras to detect wildfires in their early stages using ultra-HD cameras and AI platform* T Mobile
Private 5G Network Deployment	▮▮▮▮	▮▮▮▮	▮▮▮▯	▮▮▮▯	▮▮▮▯	▮▮▯▯	▮▯▯▯	*Private 5G network deployed in Mexican underground mines with 20MHz bandwidth in 700MHz band for real-time monitoring of machines, sensors, and energy systems in tunnels* ERICSSON
Infrastructure inspection using drones	▮▮▯▯	▮▮▮▯	▮▯▯▯	▮▮▮▯	▮▮▮▮	▮▮▯▯	▮▮▯▯	*A dual-gimbal stabilized camera drone solution that connects to public or private 5G/LTE networks via Nokia's MX Industrial Edge* NOKIA

Source: Zinnov Research and Analysis, Zinnov Z1000 database

LOW ▮▮▯▯ **HIGH** **Use-case adoption intensity across verticals**

Within the telecom ecosystem, CSPs’ & NEPs’ expansion of cutting-edge capabilities and commitment to build and manage solutions will increase business agility and efficiency

CSP & NEP MUTUAL SOLUTIONS

CISCO NTT

Deployment of Private 5G network

- Private 5G networks to enable critical Industry 4.0 capabilities like push-to-talk communications, automated guided vehicles, and machine vision.
- These networks will drive use cases in the Automotive, Logistics, Healthcare, Retail, and Public sectors

CISCO telenor

Accelerate As-a-service business models and Internet for the Future

- Joint Purpose Agreement (JPA) will focus on Environmental, Social, and Governance (ESG); as-a-service and automation innovations; and cybersecurity & multi-cloud as-a-service

stc HUAWEI

Cloud and Core Infrastructure Collaboration

- MOU to establish a Cloud and Core Infrastructure Collaboration (CIC) at MWC23 in Barcelona
- The partnership will accelerate the traffic migration towards Telcom Cloud, build an Autonomous Driving Network (ADN), and develop innovative technologies solutions in Saudi Arabia

orange™ ERICSSON

Ericsson 5G Charging monetization platform

- Orange selected Ericsson Charging solution as strategic monetization platform for its 5G network
- The solution will be integrated with legacy B2C and B2B billing platforms and handle nearly 28 Mn Orange Customers and 20 Mn IOT devices

NOKIA BT

AI network monitoring platform

- BT plans to improve operational efficiency and net promoter scores by utilizing Nokia's AI network monitoring software, built on an AI/ML platform.
- BT is investing significantly in advanced AI systems, including their new AI Accelerator platform, which speeds up the production of AI models from 6 months to 6 days.

NOKIA AT&T

Industrial private wireless network solution

- Deployment of Private 5G Network at APM Terminals Yucatán using Nokia Digital Automation Cloud (DAC) platform to securely connect workers, sensors, equipment, and vehicles

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Telecom companies are focusing on the innovation ecosystem of technology partners to build new end-to-end 5G solutions

SERVICE PROVIDER

Telia · TCS

TCS assisted Telia create a centralized cloud-based API management platform using Apigee Edge to enhance service reusability and innovation by enabling different units to effortlessly develop and host APIs

- Google Cloud App Dev
- Building solutions

T Mobile · Atos

Atos built a multi-channel chatbot for T-Mobile Netherlands using AI/ML technologies from Google Cloud to streamline customer queries, increase satisfaction, and reduce costs

- Product Engineering
- AI Chatbot

HFCL · wipro

Wipro and HFCL collaborated to develop 5G products, leveraging Wipro's expertise in 5G/LTE, VLSI design, design services, and embedded software through Tarang Labs in Bangalore

- Product Engineering
- Compliance and Certification

HYPERSCALER

dish · aws

Dish network deployed a cloud-native 5G network using Amazon Virtual Private Cloud architecture, with plans to spend USD 10 Bn on its deployment

- 5G Architecture in AWS Cloud
- Building solutions

BT · Google Cloud

BT leveraged Google Cloud's suite of products and services, including cloud infrastructure, AI/ML, data analytics, security, and API management, for digital transformation within its dedicated BT Digital unit

- Digital transformation
- Cloud-first and AI-first strategy

SK telecom · aws

SK Telecom and AWS to jointly develop edge computer vision services that leverage AI models, anonymized video data, and AWS's edge services, IOT, database, and storage capabilities

- Computer Vision AI Services
- AWS edge services

ENTERPRISE

Telefónica · 3M

Introduced an AI/ML-based Hospital Emergency Analytics solution with predictive capabilities to enhance Hospital Emergency Department (HED) operations and improve patient satisfaction

- Predictive analytics & AI/ML model
- Building solutions

BT · ABB

BT deployed a Wi-Fi 6 software platform to enable digital manufacturing with robotics, IOT, and Big Data technologies, connecting ABB's 600 production sites securely and efficiently with multi-layered cyber securit

- Connected Factory
- Digital network infrastructure

T · VINFAST

VinFast's electric vehicles will offer personalized in-car experiences with connected services in North America and Europe, utilizing T-Mobile's IOT platform for real-time data connectivity, monitoring, maintenance management, and remote notifications

- Vehicle as a service (VaaS)
- Connected Vehicle

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service Providers use a three-pronged approach to augment their 5G capabilities -Build, Buy, Partner

Build

LABS / COEs

CYIENT

Under a MoU, **Cyient** and IIT Hyderabad launched COE to develop Private 5G network solutions

Capgemini

5G solutions facility in San Francisco, US, to boost adoption of 5G and edge technologies

TECH mahindra

5G Lab innovation centre that will leverage telecom and cloud partner ecosystem to build end-to-end 5G solutions

TECHNOLOGY SOLUTIONS/PLATFORM

wipro	**5G Def-i platform**
HCLTech	**CloudSMART Modernization Experience and Site Reliability Engineering (SRE)**
Infosys	**Private 5G-as-a- Service**
AMANTYA	**5G Lab solution**

Buy

wipro / **CAS Group** CONVERGENCE ACCELERATION SOLUTIONS

With a deal value of **USD 80 Mn**, Wipro acquired Convergence Acceleration Solutions (CAS Group) to strengthen Wipro's mobile/wireless, business and fiber-optic services, cable, data, and telecom retail offerings

CYIENT / **CELFINET** A CYIENT COMPANY

Cyient acquired Portugal-based Celfinet for **EURO 41 Mn** to strengthen its Wireless Engineering practice. The acquisition will further bolster Cyient's presence in Europe

tcs

Carveout

- A **Network solutions and services**
- B **Cognitive enterprise network**

The units will focus on 5G rollout and engineering and intelligent network management solutions

Partner

verizon / **wipro**

The partnership establishes an on-demand Network-as-a-Service (NaaS) solution, offering pre-configured service chains on a subscription-based model for network consumption

airtel / **TECH mahindra**

Mahindra's Chakan manufacturing facility deployed '5G for Business' solution to enable 5G connectivity and improve network connectivity, resulting in better multiple software flashing sessions

MAVENIR / **HCLTech**

The partnership aims to develop a scalable private 5G network solution for CSPs, integrating Intel Xeon processors, Mavenir RAN, Intel SmartEdge, and HCLTech's orchestration and automation services, with a cloud-native end-to-end architecture

BSNL Connecting India faster / **AMANTYA**

Amantya Technologies plans to deploy and maintain captive private 5G networks in India using its Astra 5G solution, catering to emerging IOT use cases and enabling businesses to have private 5G networks

Source: Zinnov Research and Analysis, Zinnov Z1000 database

zinnov

Service Providers are grabbing opportunities in areas like 5G deployment, AI & ML integration, and Cloud platforms

zinnov ZONES ER&D SERVICES

ENTERPRISE	SERVICE PROVIDER	YEAR	ENGAGEMENT DESCRIPTION	OUTSOURCED ACTIVITIES
THALES	L&T Technology Services	2023	• Deployment of 5G private networks solutions for urban railways leveraging L&T TS' chip-to-cloud expertise, IOT and 5G small cells based on Qualcomm Technologies	• Application Development and Maintenance • Data Center and NOC Infrastructure • UI/UX Design • Data Engineering
Schneider Electric	Capgemini	2023	• Deliver end-to-end 5G private network hoisting solutions for industrial automation. • The industrial 5G use cases will encompass discrete manufacturing, hybrid, and process automation applications, and seamless integration of 5G for equipment automation	• Application Development and Maintenance • Cloud Computing • Infrastructure Management System • Network Equipment Testing and Automation • Software Testing
eir	(expleo) Think bold, act reliable	2023	• Leveraging RPA, process optimisation techniques, AI & robotics, Expleo helped eir improve their customer operations resulting in higher customer satisfaction	• Network Equipment Testing and Automation • Software Testing
BSNL Connecting India Faster	tcs	2022	• TCS will provide network equipment and 4G & 5G core radio solutions	• Application Development & Maintenance • Software Testing • Data Engineering
NOKIA	wipro	2022	• The partnership is focused on process optimization, touchless processing and enhanced user and customer experience across Nokia's business operations	• Software Testing • Application Development & Maintenance • Network Equipment Testing & Automation
indosat OOREDOO HUTCHISON	TECH mahindra	2022	• TechM partnered with Indosat to create a Joint GTM strategy in areas such as Industry 4.0, Cloud, and 5G • COE focusing on 5G, Edge Computing, Data Analytics, IOT, AR, and VR	• Software Testing • Data Engineering • Data Center and NOC Infrastructure

Source: Zinnov Research and Analysis, Zinnov Z1000 database

BFSI SUMMARY

Digital Banking, Customer Experience, and Process Digitization initiatives will drive ER&D spend

AI/ML, Data Analytics, Cloud Computing, and Cybersecurity will account for the largest spend

Emerging technologies and changing business models are contributing to increased BFSI spending

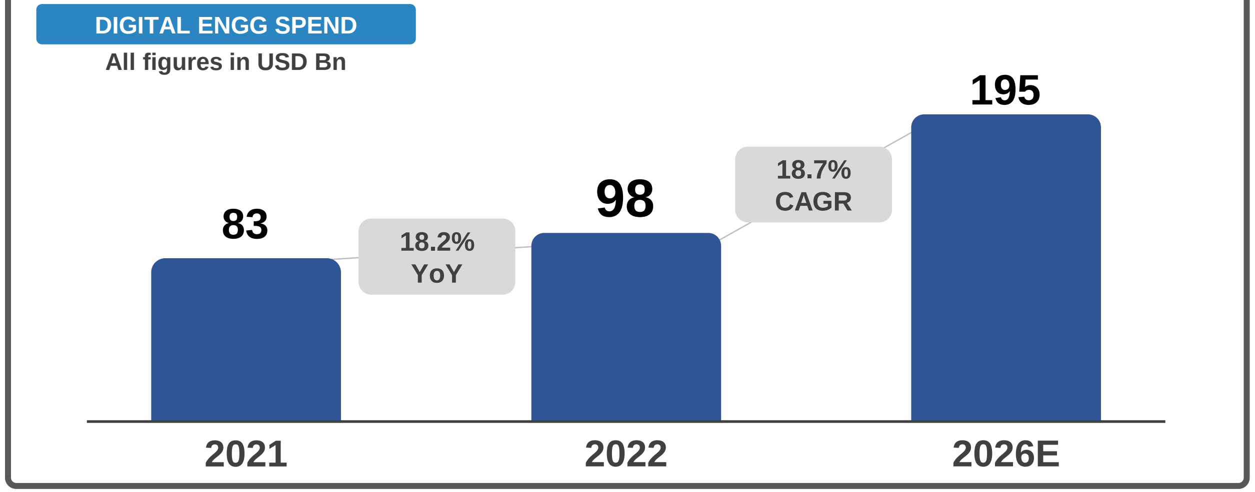
Acquisitions, tech partnerships and key deal wins across platforms and solution development are enabling Service Providers to cater to product engineering requirements

India and Central & Eastern Europe emerge as delivery destination of choice owing to low cost and skilled talent pool

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Digital Banking, hyper-personalized customer experiences, and process digitization will influence global BFSI ER&D spend

BFSI ER&D Spend (2021-2026E)



New Digital Initiatives in BFSI have accelerated Digital Engineering spend in BFSI

- The overall global BFSI Digital Engineering spend is expected to grow at a CAGR of 18.7% in the next 5 years
- Enterprises across the BFSI segment have seen increased levels of digital engagement pushing them to accelerate their Digital transformation journey
- BFSI Firms will strive to provide hyper-personalized experiences matching digital natives
- Technology skill sets and capabilities will be important to deliver newer products, services, and experiences

Key Trends & Driving Factors

- Leveraging advanced technologies, such as biometrics, and virtual cards, to transform the payment system for secure and cashless transactions
- Open Banking combines fintech and banking, allowing data networking across various institutions and allowing banks to understand one‘s data in a systemized and secure way, enabling data to be shared digitally
- With the reduction of real-life interactions, people opt for online transactions and digital payment methods, and banks analyze digital transactions and get an overview of clients’ expenditure patterns

The growth is expected to be driven by investments across key technological areas

AI-driven investment and trading products

Mobile and Digital Banking

Fraud Detection

Chatbots, Robot Advisors

Mobile Payments

Customer Facing Applications

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Digital applications and regulatory/compliance products will drive growth in Retail Banks, while the demand for digital advisory will fuel growth in Wealth and Asset Management

Retail Banking

- Enhanced consumer experience has become table stakes for retail banking
- Large banks are embracing the Digital First philosophy by investing in cloud-native applications for contactless client management
- Structured open banking approach has resulted in the creation of new value propositions for third parties
- End to end automation; building regulation compliance products for Know-your-customer(KYC) and AML
- Core/legacy application modernization will see a continued focus across the banking sector

BANK OF AMERICA
JPMorgan Chase & Co.
BARCLAYS
BNP PARIBAS
citi
LLOYDS BANKING GROUP
HSBC
RBC
CRÉDIT AGRICOLE

Commercial and Wholesale Banking

- Focus on creating lending platforms that digitize the E2E loan management process for corporates
- Using Blockchain to create smart contract-powered supply chain finance solutions for SMBs
- Commercial Banks are spending significantly on AI/ML-based trade management and risk management platforms
- Investing in providing Corporate Cash management solutions to their customers for tracking payables, receivables, and liquidity

citi
BANK OF AMERICA
BNP PARIBAS
WELLS FARGO
ICBC
中国农业银行 AGRICULTURAL BANK OF CHINA
HSBC
CRÉDIT AGRICOLE
Santander

Insurance

- Cloud based claims processing platforms and products form significant portion of spending
- Investing in AI based fraud detection / risk management platform
- Other areas: Operational excellence / Process digitization, Digital front end

PING AN Finance · Technology
MetLife
Prudential
LIC
Liberty Mutual INSURANCE
ZURICH
NISSAY
GENERALI
Allianz
AXA

Wealth and Asset Management

- Markets are volatile, and investors require holistic advice; the need for digital advisory has increased
- ML-driven security analysis/trading, and portfolio management platforms form a common investment area

UBS
BlackRock
Goldman Sachs
Brookfield
TEMASEK
Blackstone
Bank of America Merrill Lynch
FALABELLA
charles SCHWAB
Morgan Stanley
CREDIT SUISSE

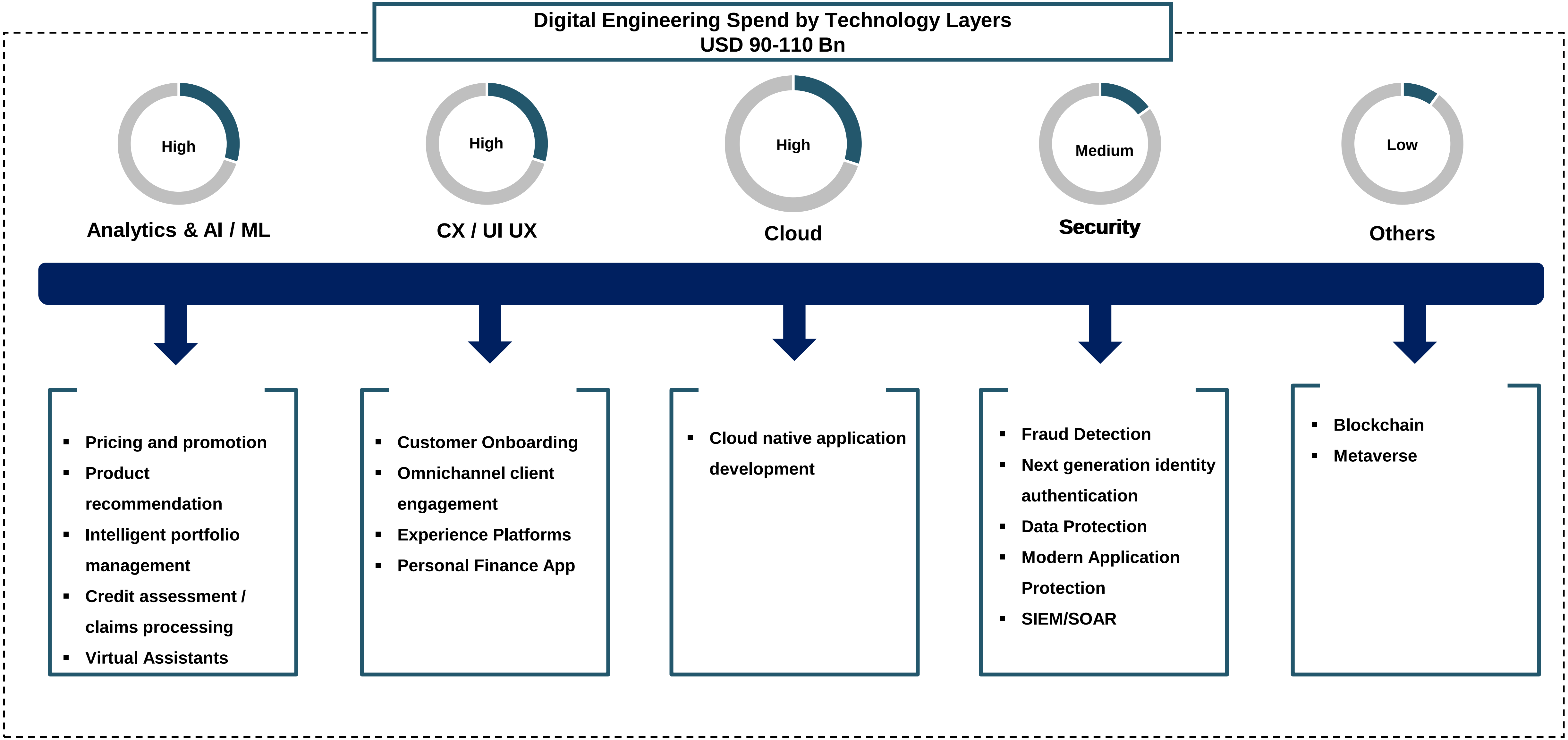
Investment Banking

- Investment banking revenues to decline with fewer M&A
- Derivative trading and risk platforms form a significant investment by Investment banks
- Electronic trading and brokerage platforms are being built to execute trades in real-time

citi
charles SCHWAB
CREDIT SUISSE
MUFG
NOMURA
Jefferies
Deutsche Bank
Goldman Sachs
UBS
BERKSHIRE HATHAWAY INC.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Analytics, Cloud and, enhancing Customer Experience account for the largest spend in the BFSI sector



Digital Engineering Spend by Technology Layers
USD 90-110 Bn

Analytics & AI / ML: High

- Pricing and promotion
- Product recommendation
- Intelligent portfolio management
- Credit assessment / claims processing
- Virtual Assistants

CX / UI UX: High

- Customer Onboarding
- Omnichannel client engagement
- Experience Platforms
- Personal Finance App

Cloud: High

- Cloud native application development

Security: Medium

- Fraud Detection
- Next generation identity authentication
- Data Protection
- Modern Application Protection
- SIEM/SOAR

Others: Low

- Blockchain
- Metaverse

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Emerging technologies, changing business models, newer consumption preferences, and market forces are contributing to increased spending

TECHNOLOGY

Data Analytics & AI/ML

AI/ML and data analytics assist banks in developing AI-based algorithms for automating back-end and customer-facing processes

Cloud

Increase in data, need for storage and agility are pushing banks to invest in Cloud

UI/UX

There is a shift towards improved CX and omnichannel digital platforms

Security

With increase in digital channels, cyber security remains as the top focus area for banks

Blockchain

Decentralized Finance, Cryptocurrency, Central Bank Digital Currency (CBDC) and other trends are powered by Blockchain

BUSINESS MODEL

API Driven Banking

With potential to benefit end users as well as to foster innovations, Open Finance is emerging as a key trend

Direct to Consumer

Millennials' demand for digital services is leading to an increase in the popularity of digital-only banks

Design led Product Eng.

Large service providers are acquiring design firms to enhance CX, and deliver on product engineering requirements

Platforms for Banks / Insurers

>80% of insurers rely on 3rd party platforms; Banks are leveraging various digital engagement platforms to deliver omnichannel/ digital banking experience

CONSUMPTION

Digital Consumption of Services

The consumption pattern among users is changing with increasing preference for Digital payment and Digital

Increase In Insurance Purchase

COVID19 helped to showcase relevance of insurance industry, increase in purchase and premium of health/life insurance

Financial Advisory

Increasing need for personalized financial advisory services due to high market uncertainties

MARKETS

Competition from Tech Giants/ Fintech

Increased funding towards Fintech start-ups, easing regulatory environment is causing threat to traditional financial services

Partnerships and Collaboration

Partnerships between traditional financial services providers and digital natives are growing to improve both parties' capabilities

Changing Regulatory Environment

Evolving regulatory framework and increased emphasis on data protection and privacy have led to a rise in reg-tech companies throughout the BFSI value chain

Risk & Fraud Management

BFSI institutes are increasingly focused on mitigating risks through risk management platforms owing to the rapidly changing environment

Source: Zinnov Research and Analysis, Zinnov Z1000 database

BFSI companies are investing in digitization to enhance customer engagement and increase business efficiency

Key Trends

Retail Banking	Retail banks' traditional revenue streams such as interest spreads, Foreign exchange fees, and interbank transfer fees have been affected by the arrival of FinTech
Commercial Banking	FinTech companies are consuming a significant chunk of the SME lending pie as they expand towards enabling easy access to finance
Wealth & Asset Management	Equities trading and brokerage stand as one of the primary categories that have been disrupted by FinTech companies
Insurance	Insurance is at the higher end of the digitization curve as technology has transformed the complete value chain from purchase to claims
Investment Banking	Banking tech firms are looking at platformization of investment trading solutions. Risk management is becoming highly critical in volatile markets

Tech Giants are relying on their well-established reputation to create disruption in the BFSI industry

Advantages for tech giants and fin-techs

- **New standard of consumer experience**
- **Leaner operations free of legacy systems**
- **Focus on activities/business segments with higher return on investments**
- **Giant Tech platforms have strong reputation and an established, loyal customer base**

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Macro-economic factors have varying levels of impact on each of the BFSI segments

01

Prioritize on Customer experience

Due to higher rates, inflation, and lower growth, retail banks will prioritize developing customer experience strategies that are data-driven and offer consumers personalized advice to navigate difficult economic conditions

02

Reinvention in Insurance

Rising inflation, interest rates, loss costs, impending threats of a recession, climate change, and geopolitical turmoil will test the resiliency of insurers, long term reinvention is the key focus area

03

Inflationary Concerns

Higher inflation will bring uncertainty and unpredictably, causing consumers to rely heavily on wealth managers to manage their finances. This would increase the need of personalized wealth management applications and robo-advisors

04

Rising importance of risk management

With predictions of an upcoming recession, there will be an increase in default rates in both retail and consumer banking segments. This will cause banks to focus heavily on liquidity and risk management

05

Higher Interest Rates

Higher Interest rates will reduce consumer spending. Banks will have to rely on loans and facilitate them through loan management platforms and digital banking apps to manage their working capitals

	Retail Banking	Commercial Banking	Wealth Management	Investment Banking	Insurance
Interest Rates	■	■	■	■	■
Inflation	□	□	■	□	□

Impact ■ Positive □ Negative

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Digital-native portfolios, tech partnerships, and open banking platforms are shaping the future of the BFSI industry

GROWTH LEVERS

OPEN BANKING

- Collaboration with Fin Techs and Third-Party Organizations
- Improved Customer Experience
- Reduced Partner Costs
- Foster innovations through partnerships
- New Revenue Streams – API Monetization
- Backed by regulations, European Banks are leading from the front

Wells Fargo to integrate its products and services into the Finicity environment, allowing sharing of customer information between the two entities

Barclays launched new services using Open Banking. These applications help one to manage their finances

DIRECT-TO-CONSUMER

- Speed to market
- Reinvent Customer Experience
- Increased Customer Satisfaction
- Low-cost Infrastructure
- Reduced Geographic limitations
- Traditional banks are starting their own direct banking wing

Bandhan bank uses a fully integrated banking and payments platform through a totally outsourced delivery model to connect customers in India's rural and urban areas

BNP Paribas Wealth Management accelerated the digital transformation journey by expanding its suite of digital banking solutions

EMERGING BETS

- Fraud Detection Solutions
- Cloud-based Payments
- Financial Robo Advisor
- AI- Based Claim Approval and Settlement System
- ML based Investing and Trading Platform
- Cross Border Bank Payments using Blockchain

Morgan Stanley launched Robo-Advisors Financial product that employs algorithms to build and maintain a detailed investment plan

Launch of Mastercard’s Brighterion AI technology providing transaction fraud screening and merchant monitoring

TECHNOLOGY-SPECIFIC PARTNERSHIPS

- Experience Engineering
- Cloud Native Engineering
- Data analytics, AI/ML
- Banking Platforms
- Testing / Application Modernization
- Digital Transformation

TCS will deliver hyper-personalized customer experiences using its AI-powered Customer Intelligence and Insights analytics platform

Brillio acquired CloudStratex to enable cloud infrastructure expertise, establish presence in the UK and Europe and expand its offerings for BFSI clients

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service Providers have strategically pursued a series of “tuck-in” acquisitions to enhance their capabilities, increase geographical reach, and improve nearshore business models

Acquisitions 2022-2023

ACQUISITION KEY HIGHLIGHTS

Service providers made acquisitions around Digital Customer Exp and Consulting / Advisory capabilities to move further up value chain

Large service providers are acquiring design firms to enhance customer experiences, and deliver on product engineering requirements

Focus on expanding cloud-based banking platform-as-a-service offerings, ranging from core banking services to online banking and regulatory services

Strategic Rationale

accenture	ARZ	Expand Accenture’s cloud-based banking platform-as-a-service offerings, ranging from core banking services to online banking and regulatory services
accenture	BLACKCOMB Part of Accenture	Enhances Accenture’s ability to deliver Guidewire solutions to insurers globally to help them become “cloud-first” businesses
Capgemini	CH & Co. Part of Capgemini Invent	Strengthen capabilities to advise Banking, Wealth Management and Insurance clients in NA, Europe, SE Asia, and expand consulting expertise
Capgemini	knowledge expert	Enhance Capgemini’s capabilities in its digital customer experience offerings across Insurance and financial services industry in Europe
TECH mahindra	:ctco COM TEC CO IT LTD	Tech Mahindra acquired Com tec Co IT (CTC) for 310 Mn Euros to strengthen its digital engineering and insurance technology businesses
endava	LEXICON an Endava company	The acquisition increased presence in Australia and added clients from the insurance and wealth management sectors

Source: Zinnov Research and Analysis, Zinnov Z1000 database

SPs can expand their BFSI presence in Poland and Romania for nearshore delivery, while India remains a cost-competitive location in the mid to long-term

Poland

● Hotspots

BFSI Tech Talent Pool

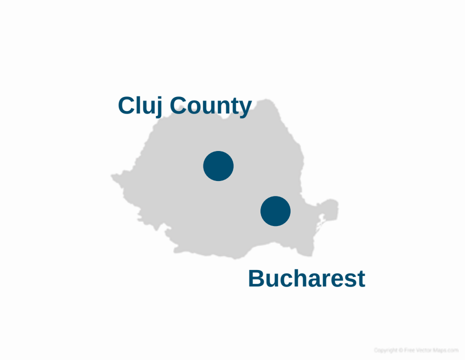
~52000

40 Ease of Business Ranking	>USD 54000 Average FTE Annual Salary
19% Attrition Rate	6 weeks Time to Hire

Talent Split by Location

22K	8K	7K
Warsaw	Krakow	Wroclaw

Romania



BFSI Tech Talent Pool

~12000

55 Ease of Business Ranking	>USD 47000 Average FTE Annual Salary
17% Attrition Rate	8 weeks Time to Hire

Talent Split by Location

9K	0.7K
Bucharest	Cluj County

● Hotspots

Mexico

● Hotspots

BFSI Tech Talent Pool

~29000

60 Ease of Business Ranking	>USD 43000 Average FTE Annual Salary
22% Attrition Rate	7 weeks Time to hire

Talent Split by Location

20K	2K	2K
Mexico City	Queretaro	Monterrey

India

● Hotspots

BFSI Tech Talent Pool

~400000

62 Ease of Business Ranking	>USD 37000 Average FTE Annual Salary
18% Attrition Rate	4 weeks Time to Hire

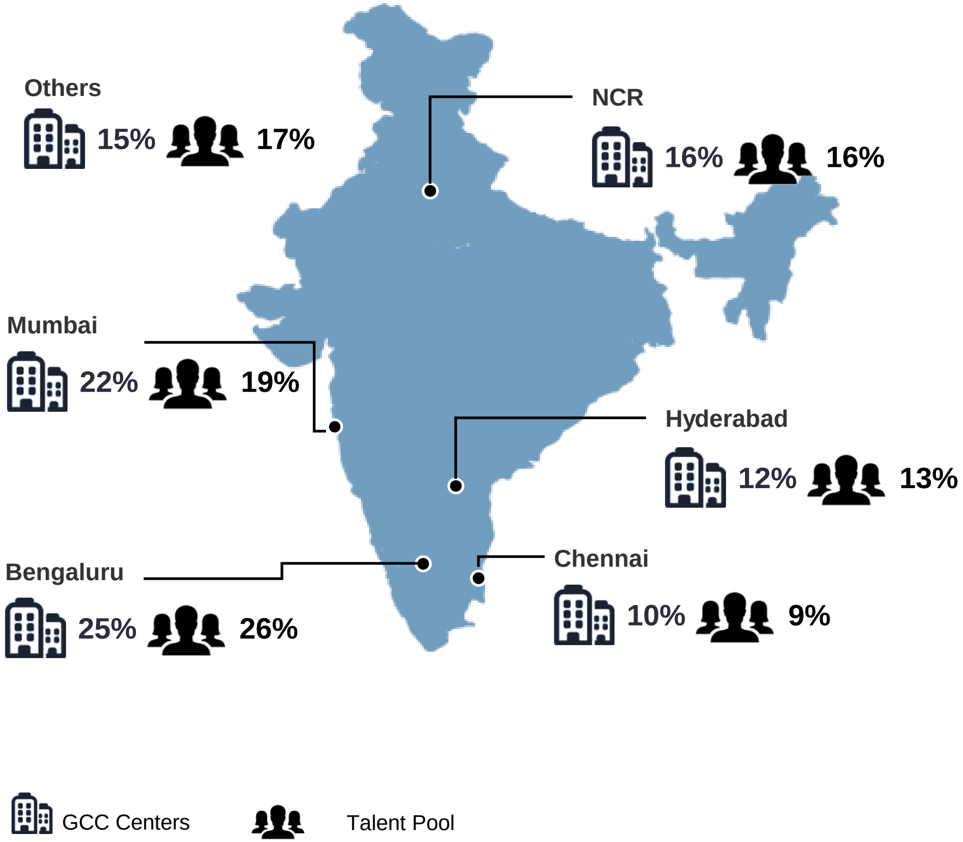
Talent Split by Location

84K	67K	59K	55K
Bengaluru	Mumbai	NCR	Hyderabad

Source: Zinnov Research and Analysis, Zinnov Z1000 database

BFSI continues to be the second-largest vertical in India’s GCC ecosystem, in terms of installed talent base

BFSI GCC and Talent Distribution

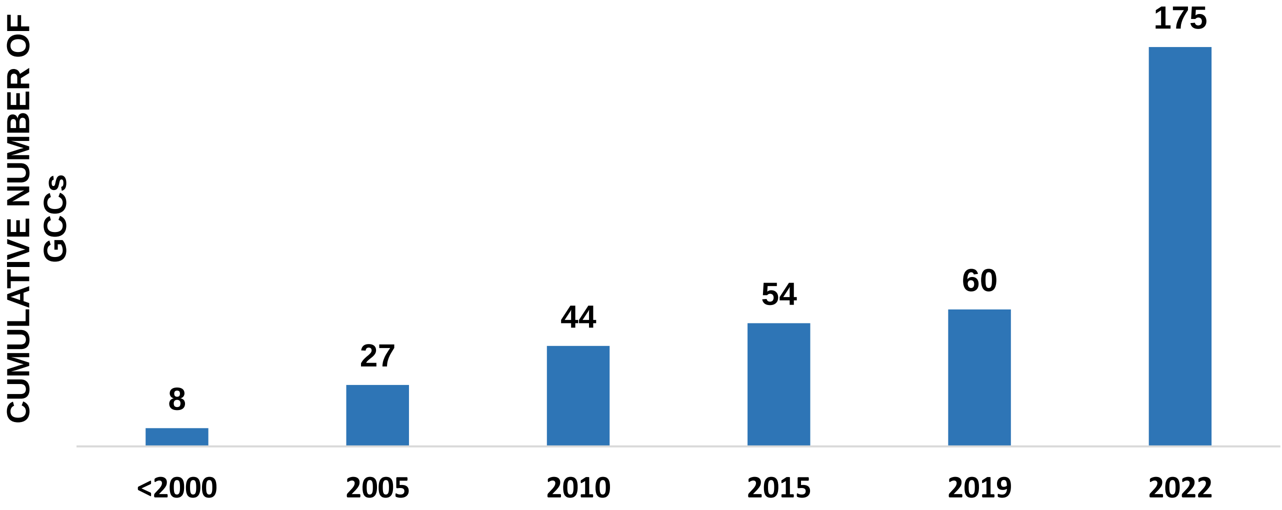


India remains a top offshore location due to high quantum of talent and low cost

85+
BFSI MNCs

175+
BFSI GCC Centers

295K+
BFSI GCC Talent



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Banks are tapping into SPs expertise for technological advancements, optimizing operations, and enhancing customer-centricity

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
HDFC WITH YOU, RIGHT THROUGH	accenture	2022	**Lending Platform**	Development of a cloud-native lending platform using cloud-native applications, AI/ML, and advanced analytics to provide AI-driven insights throughout the customer lending lifecycle
FINASTRA	wipro	2022	**Trade Finance Solutions**	Multi-year engagement to deploy Finastra's trade finance solutions for corporate banks in the Middle East to digitally transform the trade finance process, offering automation, optimization, faster time-to-market, and improve customer response times for banks
PREMIUM CREDIT	TECH mahindra	2022	**Premium Finance**	Premium Credit Limited partnered with Newgen and Tech Mahindra to implement Newgen's iBPS low-code platform, aiming to enhance the premium finance process for insurance customers
Largest third-party Claim Administrators	Persistent See Beyond, Rise Above	2022	**Data Center Modernization**	Implementing data center modernization and infrastructure transformation to enhance customer experience and business outcomes for one of the largest third-party claim administrators
Phoenix	tcs	2023	**Customer Experience**	TCS secured a USD 720 Mn deal to digitally transform Phoenix Group's ReAssure business, leveraging the TCS BaNCS platform

Source: Zinnov Research and Analysis, Zinnov Z1000 database

HEALTHCARE SUMMARY

Increasing competition within the Healthcare industry will rise investments in R&D spending for developing innovative drugs, devices, and Healthcare services

Healthcare ecosystem players have ramped up adoption of digital health technologies to deliver enhanced and personalized patient care

Investments in Start-ups and M&A remain a key strategy for Healthcare companies to accelerate innovation, expand market share, and remain competitive

Increasing utilization of Robotics, Artificial Intelligence, Gene Editing, and Decentralized Clinical Data will revolutionize the Healthcare industry

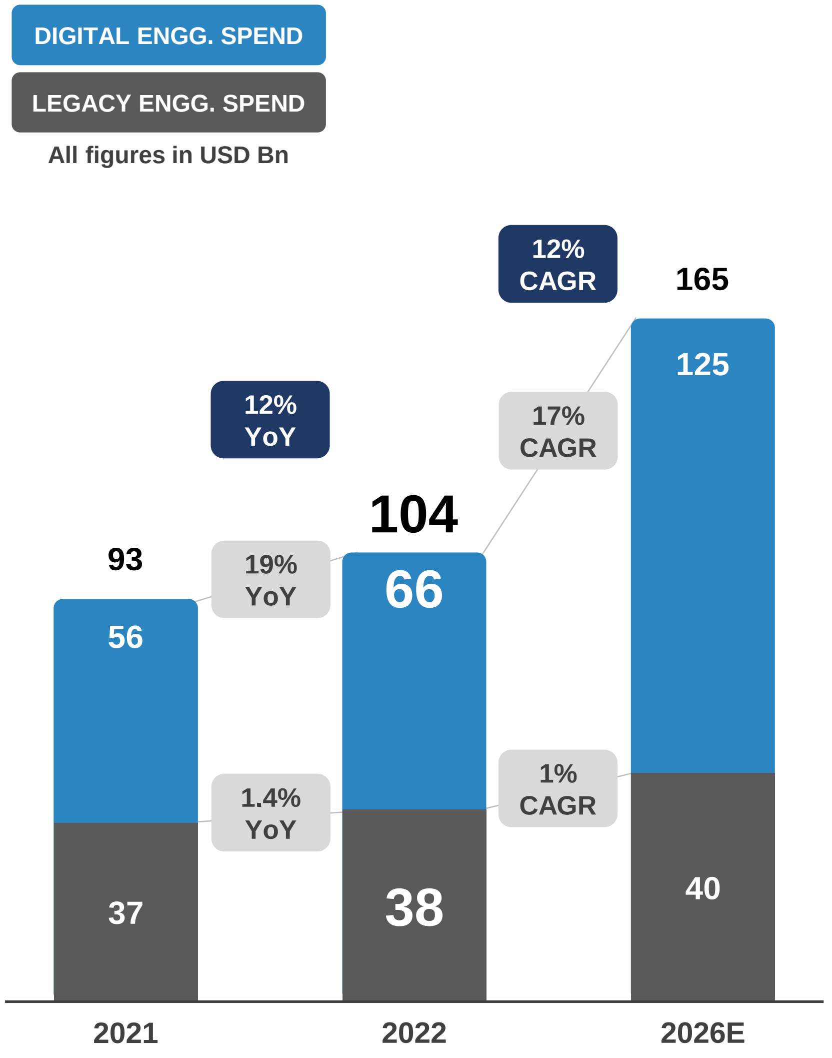
The role of HealthTech start-ups and tech giants is becoming crucial in introducing innovative business models, empowering patients, and making healthcare more affordable

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The Digital Engineering spend of the Healthcare industry to grow at a ~17% CAGR reaching USD 125 Bn by 2026 - nearly 2X spend from 2022

ER&D SERVICES

Healthcare* ER&D Spend (2021-2026E)



Key Digital-led Priorities

Telehealth

- Accelerated adoption of Telehealth by Healthcare companies for broader coverage options, wider patient reach and improved patient care
- Chronic diseases management and Speciality care to further accelerate the adoption of Telehealth

Remote Patient Monitoring

- Connected systems, Wearable tech, Patient data & Analytics to make RPM more effective by helping doctors with patient data for informed decisions
- Opens up new revenue streams, aids product innovation, and lowers overall Healthcare costs

AI-led Innovation

- AI-led technologies are widely implemented across Healthcare segments for drug discovery, new product designs, claims management, and diagnosis and therapy planning, etc.
- Significant rise in investments by Healthcare companies on AI-based Healthcare Start-ups, platforms and solutions, etc

Robotics Assisted Surgery

- Increasing use of robotics adoption is driven by rise in minimally invasive surgical procedures for reduced incisions, high precision and improved visualization during surgeries

Market Insights

53%

North America holds ~53% of Telehealth market share in 2022

7X

Approx. 7X growth with CAGR of ~45% estimated for AI in Healthcare market by 2030

~7K

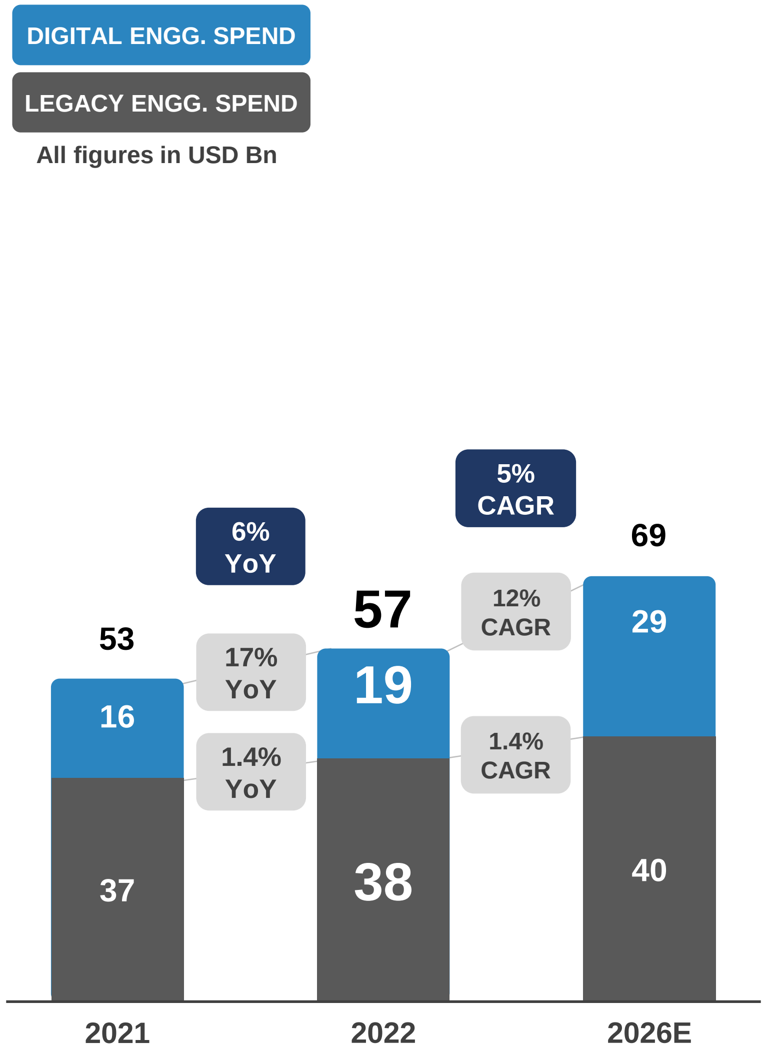
Nearly 7000 Da Vinci Surgical Systems installed worldwide for minimally invasive procedures

Source: Zinnov Research and Analysis, Zinnov Z1000 database

*Healthcare includes Medical devices and Healthcare payers & providers

The Medical Devices ER&D spend accounts for USD 57 Bn in 2022; ~55% of the spend is by the top 10 firms

Medical Devices ER&D Spend (2021-2026E)



USD 57 Bn

Medical Devices ER&D Spend 2022

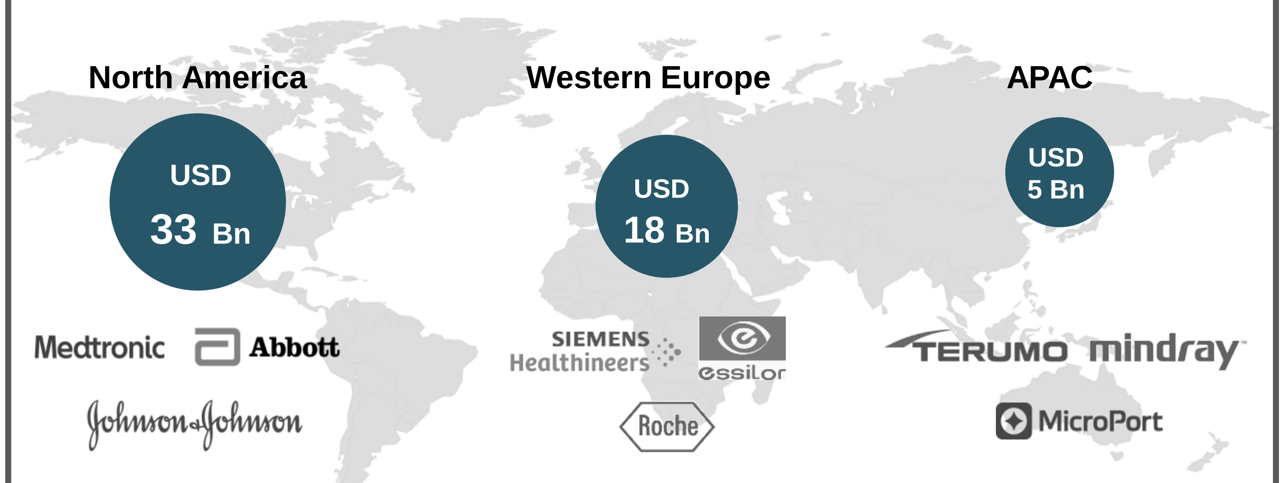
➔

USD 69 Bn

Medical Devices ER&D Spend 2026E

Medical Devices accounts for ~56% of the overall Healthcare* ER&D spend

Medical devices ER&D spend by Geo



Medtronic launched “AI Access” platform to accelerate medical AI innovation and improve patient care through real-time AI applications

Siemens introduced its mobile X-ray system “Mobilett Impact” enabling end-to-end digital integration of Radiology workflow

Terumo developed Quantum Flex Bioreactor, a scalable Good Manufacturing Practice (GMP) compliant platform to streamline cell manufacturing and data management

55%

Top 10 medical device R&D spenders account for approx. 55% of the ER&D spend

~60%

North America accounts for approx. 60% of the overall ER&D spend

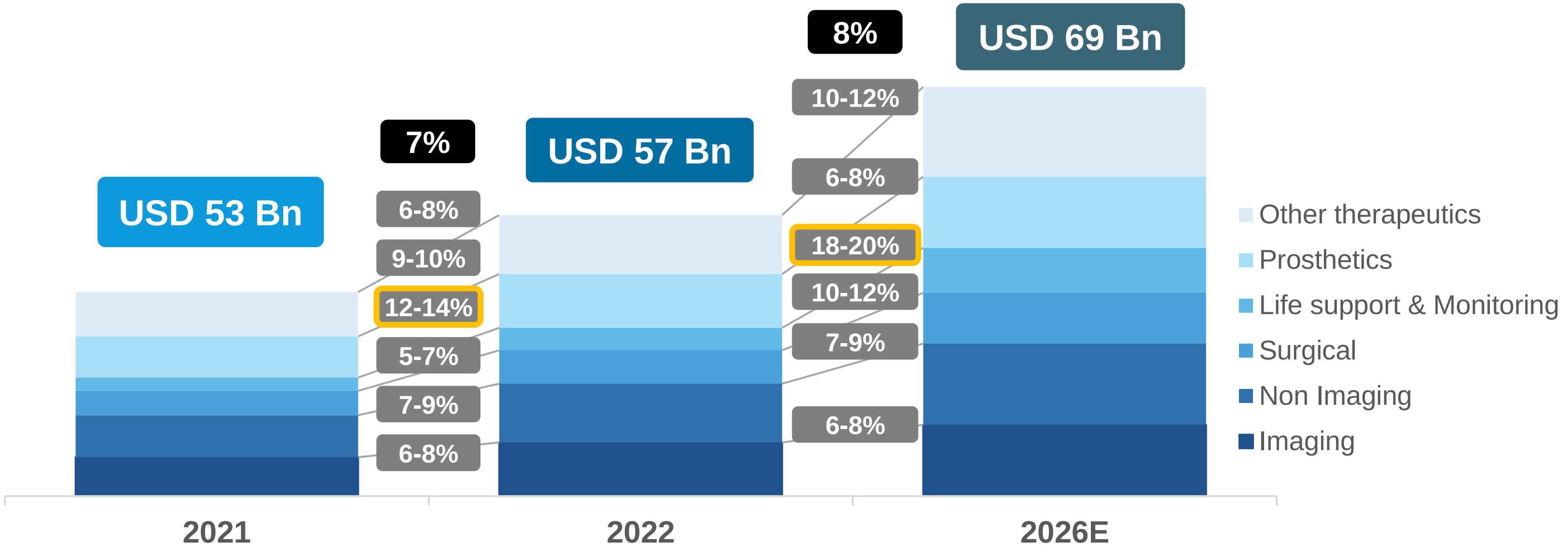
~40%

of the ER&D spend by Medical device companies will be digital engineering-led by 2025

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The rise of connected devices enabling remote monitoring use cases will lead to life support and patient monitoring devices witnessing the fastest growth by 2026

Medical Devices ER&D Spend by Segment (2022)



ENTERPRISE INVESTMENTS

Company	Key Focus	Outcome
Medtronic	USD 350 Mn investment on R&D center in Hyderabad, India	▪ R&D center to support Healthcare technologies such as robotics, imaging & navigation, surgical technologies and implantable technologies
Boston Scientific Advancing science for life™	Launch of second R&D center in Pune, India	▪ R&D center houses **170 engineers** supporting **mechanical design, software engineering, sustaining engineering, and quality & compliance** across interventional cardiology, peripheral interventions, cardiac rhythm management, endoscopy, and more.
GE HealthCare	Digital focused acquisitions Caption Health IMACTIS	▪ **Caption Health** to enhance ultrasound examinations and treatment decision-making with **AI-Powered Image Guidance** ▪ **IMACTIS** strengthens GE Healthcare's **Interventional CT capabilities**

Key Insights

INVESTMENT IN DIGITAL HEALTH

- With **USD 23.3 Bn**, 2022 remains the second-highest annual investment year in digital health industry worldwide
- Digital Fitness and Wellbeing Devices are expected to reach **USD 99.1 Bn** by 2027 growing at a CAGR of **9.9%**
- In Q3 2022, the Apple Appstore had **41,517** Healthcare apps, the Android Appstore had **54,546** Healthcare apps, and the Amazon Appstore had **2,380** Healthcare apps

INCREASE IN GREENFIELD INVESTMENTS

- ~ **116** greenfield FDI projects in the United States in the Medical Devices sector by 2021 with an estimated capital expenditure of USD 2 Bn and over 8,000 jobs created

FDA APPROVED AI/ML ENABLED MEDICAL DEVICES

- In 2022, FDA authorized **91 AI- or machine-learning-**enabled medical devices
- Out of 521 submissions, FDA has authorized over **390 AI devices** in radiology and approx. **11%** in cardiology
- **GE Healthcare and Siemens** have the highest number of authorized AI/ML medical devices, with GE having 42 FDA-approved AI/ML-enabled medical devices for radiology

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The future trends in Healthcare will center on advances in telemedicine, value-based healthcare, and home healthcare; enhanced Cybersecurity will be a major focus area

Key trends shaping the Healthcare Payers & Providers

1

Rise of Telemedicine

- ✓ EHRs and Internet of Medical Things (IoMT) are the two prominent trends in telemedicine, which are enabled by AI & Bigdata
- ✓ Telehealth's growth demands cybersecurity to prevent data breaches, as 29 Mn records have been compromised on an annual basis

2

Wearables & Remote Monitoring Devices

- ✓ Cardiac wearables grows rapidly due to ECG monitoring demand, while expanding blood pressure monitoring adoption
- ✓ North America leads the wearable device market, while Asia-Pacific shows the highest growth potential

3

Home Healthcare

- ✓ Health insurers maintain focus on home health, a key segment in 2023
- ✓ UnitedHealth Group signed a USD 5.4 Bn deal to acquire home health provider LHC Group

4

Value-based Healthcare

- ✓ Value-based care shifts payment to Healthcare providers based on patient outcomes, not service volume
- ✓ This model has potential to tackle high Healthcare spending in countries like the U.S

5

Retail Healthcare

- ✓ A twofold increase in Healthcare services offered by retail outlets in 2023
- ✓ Retail giants like Walmart, Amazon, and CVS are expanding their Healthcare offerings, disrupting traditional providers

6

Medical Inflation

- ✓ Since 2000, medical care costs, encompassing services, insurance, drugs, and equipment, surged by 115.1%
- ✓ In 2022, Medical care prices rose at a slower pace than other consumer goods

Key Insights

38X

Telehealth services have reached a stabilized state, maintaining 38x higher than pre-pandemic level

Stryker acquired Vocera Communications to strengthen its Advanced Digital Healthcare offerings

CVS signed an USD 8 Bn deal to acquire home health provider Signify, outbid other potential acquirers, including Amazon

30%

Private capital inflow in value-based care assets rose from 6% of the capital investment in hospitals to nearly 30% within two years

Amazon has invested multiple billions in 2022 to enter the home Healthcare market

2.3%

In Feb 2023, medical care prices grew by 2.3% from the previous year

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Amidst market uncertainty in the Healthcare sector, both deal value and deal volume experienced a decline in 2022 as companies paused their M&A activity

M&A

28% ⬇

Average transaction value in Healthcare providers rose 5% in 2022, with a 28% decrease in overall volume

*With Amazon's acquisition of **One Medical,** it enters primary care, disrupting Healthcare, while CVS's acquisition of **Signify Health** blurs retail-healthcare boundaries*

VALIDIC
Trapollo

Validic Inc., acquired Trapollo LLC's assets to strengthen its core capabilities in delivering personalized healthcare for patients and clinicians

PE-LED INVESTMENTS

30% ⬇

Healthcare PE deals dropped by 30% from 2021's record high of 515 deals to around 350 deals in 2022.

*From a geo perspective, activity slowed overall, but the **Asia-Pacific region** saw a strong interest in large deals, with six deals valued over **USD 1 Bn***

GENERAL ATLANTIC
CVS

General Atlantic and CVS led a USD 300 Mn Series D investment in Biofourmis, a virtual care and digital medicine-focused HCIT company

VC FUNDING

USD 22 Bn

VCs poured in nearly USD 22 Bn in 2022, second only to the record USD 28 Bn allocated in 2021

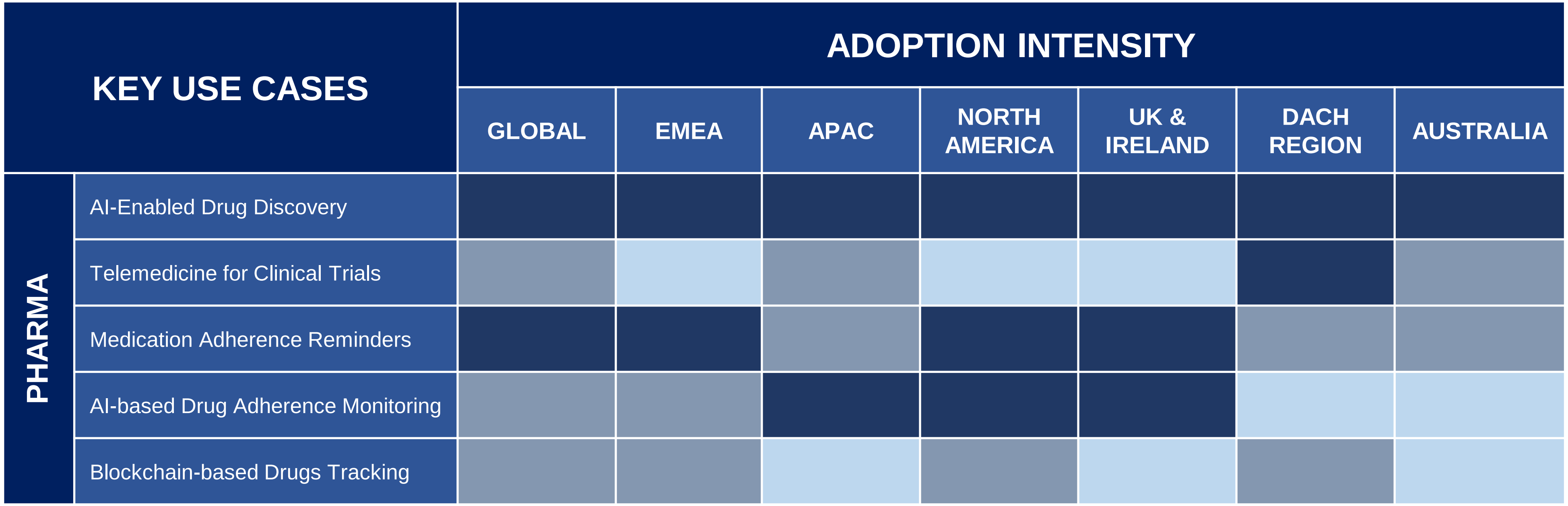
*Despite market challenges, investors anticipate digital health investments to remain steady, generating **USD 15-25 Bn** in 2023, to be on par with 2020*

UCDAVIS HEALTH
GENERAL CATALYST

UC Davis Health system forms a partnership with General Catalyst, aiming to revamp their digital health strategy

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Pharmaceutical companies are investing in AI and Big Data Analytics for AI-based Drug Discovery Clinical Trials and Gene Therapy



	KEY USE CASES	ADOPTION INTENSITY						
		GLOBAL	EMEA	APAC	NORTH AMERICA	UK & IRELAND	DACH REGION	AUSTRALIA
PHARMA	AI-Enabled Drug Discovery	■	■	■	■	■	■	■
	Telemedicine for Clinical Trials	▨	□	▨	□	□	■	▨
	Medication Adherence Reminders	■	■	▨	■	■	▨	▨
	AI-based Drug Adherence Monitoring	▨	▨	■	■	■	□	□
	Blockchain-based Drugs Tracking	▨	▨	□	▨	□	▨	□

Key Investment Areas

- Clinical Trials
- AI-based Drug Discovery
- Gene Therapy
- Medication Adherence
- Pharmacovigilance
- Drug Development
- Medical Imaging
- Mobile Health Service
- VR-based Surgery
- Drug Adherence Monitoring
- VR-based Drug Discovery
- Digital Therapeutics

CVSHealth

Investments (2022-2023)

SpectrumAi	Monogram Health	Array Behavioural Care	Biofourmis Inc.	Oui Therapeutics
USD 20 Mn Series A	**USD 375 Mn** Series C	**USD 25 Mn** Series C	**USD 300 Mn** Series D	**USD 26 Mn** Series A

M&A ➜ **Oak Street Health** **USD 10 Bn** **Signify Health** **USD 8 Bn**

FOSUN PHARMA Insilico Medicine

AI-driven Drug Discovery

Collaboration agreement of **USD 13 Mn for AI-powered discovery and development**

Boehringer Ingelheim

Cutting-edge Innovation

Boehringer Ingelheim investment of **€11 Mn to boost its global digital center in Catalonia**, focusing on innovative projects in automation and measurement

hikma. tact.ai

AI-powered Patients Engagement

Hikma **invested in Tact.ai,** a life-sciences customer engagement company, collaborating with healthcare professionals and pharma companies for faster delivery of medicines

AstraZeneca

Research Hub

AstraZeneca invests another **USD 100 Mn in an R&D center in Cambridge**. The addition brings the total costs of the over-budget and overdue research hub to USD 1.3 Bn

Source: Zinnov Research and Analysis, Zinnov Z1000 database

□ Low ▨ Medium ■ High

Using Cloud Computing capabilities and software development expertise, tech giants are venturing into Healthcare-related investments, partnerships, and product offerings

- Acquired **One Medical** for USD **3.9 Bn** in 2022 to expand its telehealth services and gain access to access to over 200 brick-and-mortar physicians' offices with about 815,000 members
- **GE Healthcare** and AWS have teamed up to offer hospitals and Healthcare providers AI-powered imaging solutions and cloud-based services
- **Baxter** and AWS collaboration to develop personalized digital health solutions that enhance patient care and create seamless experiences for Healthcare customers
- Acquired **PillPack for USD 753 Mn in 2018** and has since begun selling prescription drugs online under the brand Amazon Pharmacy
- Amazon, Berkshire Hathaway, and JPMorgan Chase launched Haven, a joint venture to reduce Healthcare costs and improve care access. The venture was limited to an insurance pilot administered by Cigna and Aetna before its closure in January 2021

- **Drug discovery and personalized medicine:** Microsoft collaborates with pharmaceutical companies to develop AI-powered tools for efficient drug discovery and personalized medicine, enabling customized treatments based on individual patient's genetic and environmental factors for improved effectiveness and reduced risk of adverse reactions.
- **Medical imaging:** Microsoft is investing in AI-powered tools for medical imaging analysis to improve disease detection and diagnosis accuracy and speed, potentially reducing the need for repeat scans and biopsies and aiding informed treatment decisions by Healthcare providers
- **Patient engagement and monitoring:** Microsoft is creating AI-powered tools like chatbots and virtual assistants for patient engagement and monitoring. These tools help patients manage their health conditions effectively and provide real-time health data to healthcare providers, potentially reducing hospital readmissions and emergency room visits while improving patient outcomes

Source: Zinnov Research and Analysis, Zinnov Z1000 database

AGENDA

Source: Zinnov Research and Analysis, Zinnov Z1000 database

ER&D ADDRESSED MARKET LANDSCAPE

The total SP ER&D addressed market is pegged at USD 105 Bn – 110 Bn in 2022 and is growing 12-14% year-on-year

Western Europe is dominating the service provider market, followed by India owing to an increase in the demand for digital technologies.

Large deals by Digital Engineering service providers have increased significantly from previous year

AI/ML and Big Data to become one of the key Digital Engineering outsourced workloads in the upcoming years

Source: Zinnov Research and Analysis, Zinnov Z1000 database

The total ER&D addressed market was pegged at USD 105-110 Bn in 2022

ZINNOV ZONES
ER&D SERVICES

SP Addressed

USD 1,811 Bn

YOY ▲ 10%

Global ER&D Spend 2022

ER&D spending by global enterprises

USD 65-70 Bn

YOY ▲ 10-12%

ER&D GCC Spend 2022

Total addressed ER&D GCC spend

USD 105-110 Bn

YOY ▲ 12-14%

ER&D SP Addressed Market 2022

Total addressed ER&D market by global SPs

Outsourced ER&D spend by Verticals USD 105-110 Bn

S&I	$22-24 Bn	Telecom	$10-12 Bn	Healthcare	$8-9 Bn	Industrial	$4-6 Bn
Automotive	$18-20 Bn	Aerospace	$9-11 Bn	Semiconductor	$5-7 Bn	Others*	$20-22 Bn

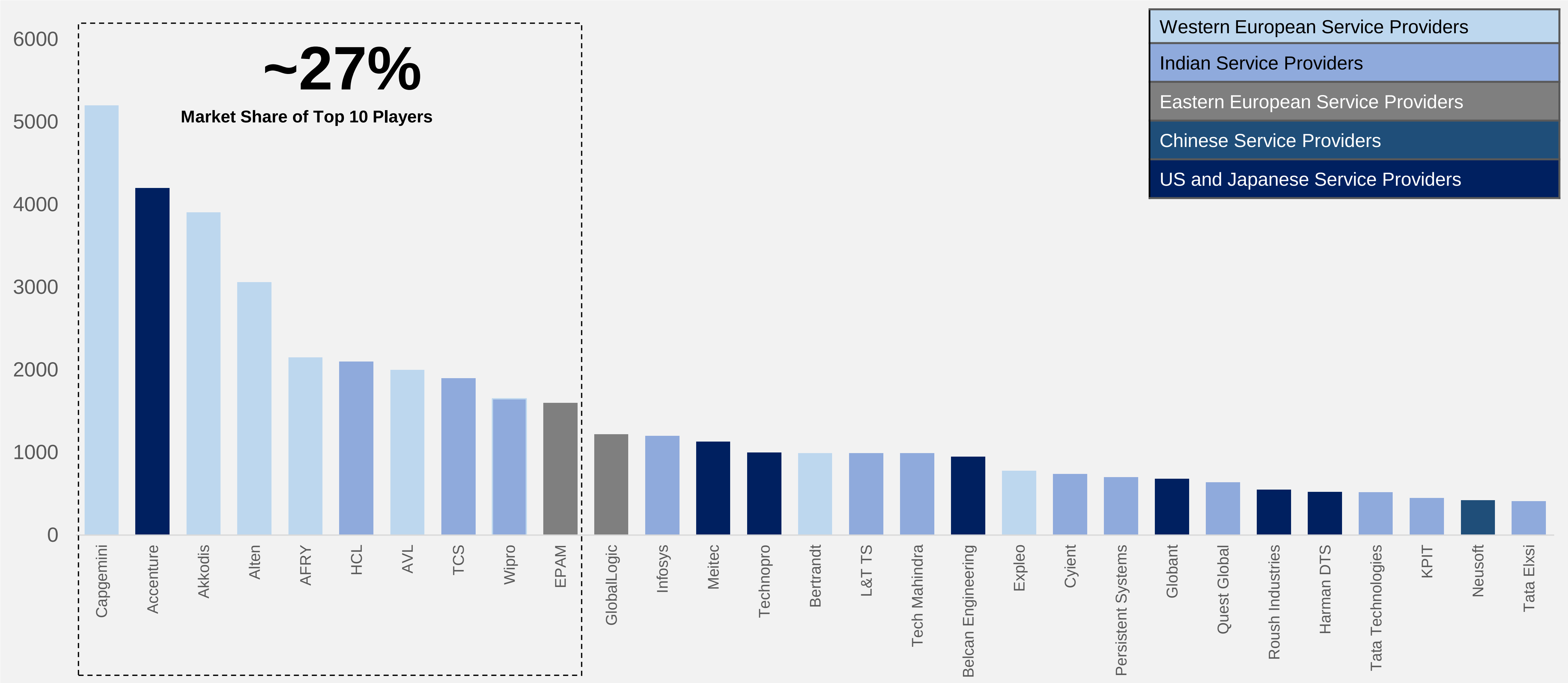
*Others include verticals such as BFSI, Retail, hospitality, consumer electronics, etc.

Source: Zinnov Research and Analysis, Zinnov Z1000 database, Zinnov GCC database

The addressed market is still fragmented with multiple specialists across geographies and verticals; the top 10 SPs capture 27% of the overall market

SP Addressed

Digital and ER&D Revenues – Top Service Providers (USD Mn)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

The global Service Providers' market is growing rapidly due to the rising demand for Digital Engineering services

zinnov ZONES ER&D SERVICES

SP Addressed

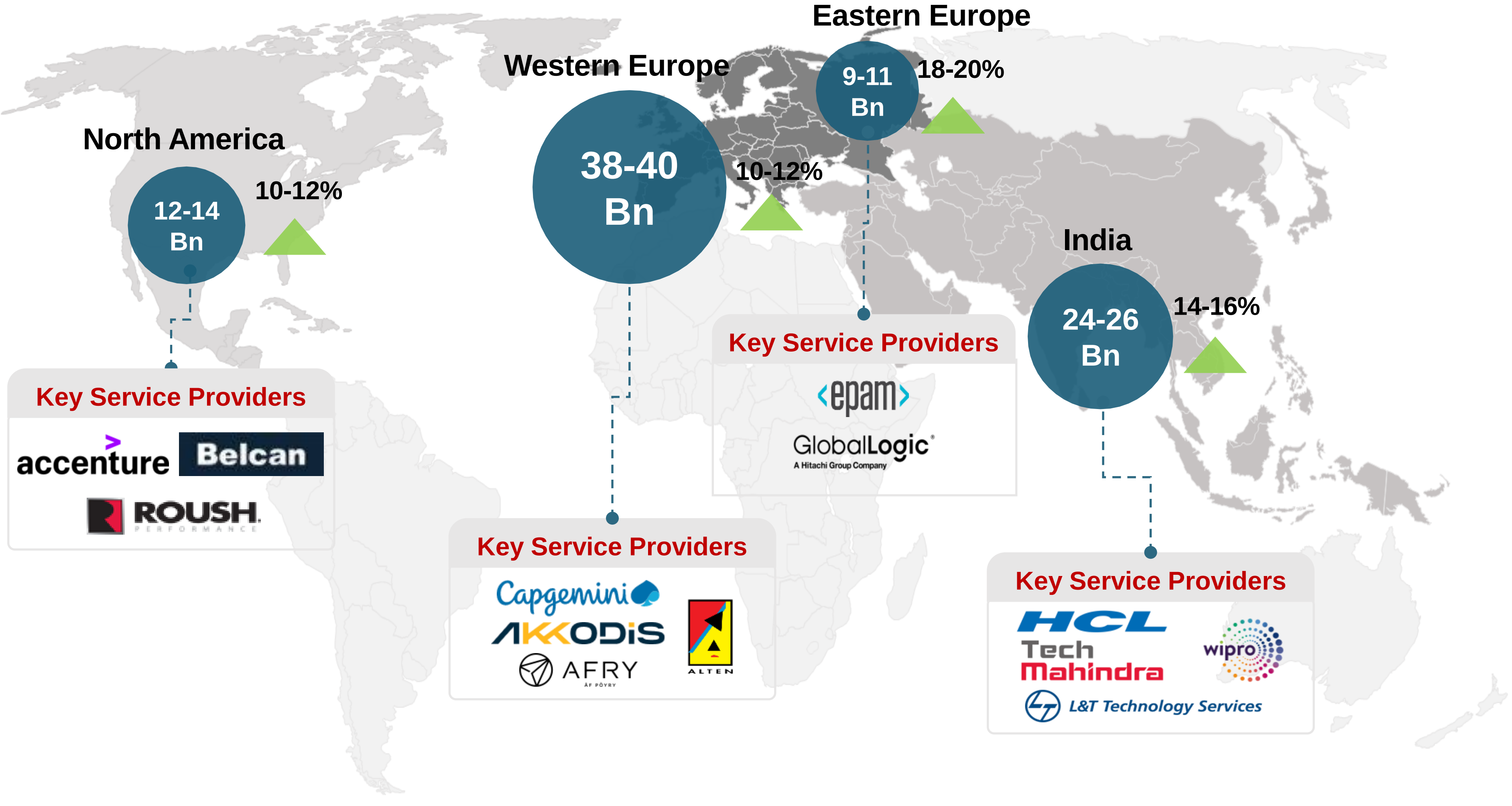
Addressed Global ER&D Services Market (USD Bn)

105-110 Bn

YoY 10-12%

8/10 Western European pure-play ER&D service providers are growing with double-digit growth, boosted by the post-COVID recovery in the Aerospace and Automotive sectors

India is growing faster than Western Europe owing to the significant growth in the digital engineering workloads



North America

12-14 Bn

10-12%

Key Service Providers

accenture
Belcan
ROUSH PERFORMANCE

Western Europe

38-40 Bn

10-12%

Key Service Providers

Capgemini
AKKODiS
AFRY
ALTEN

Eastern Europe

9-11 Bn

18-20%

Key Service Providers

epam
GlobalLogic A Hitachi Group Company

India

24-26 Bn

14-16%

Key Service Providers

HCL
Tech Mahindra
wipro
L&T Technology Services

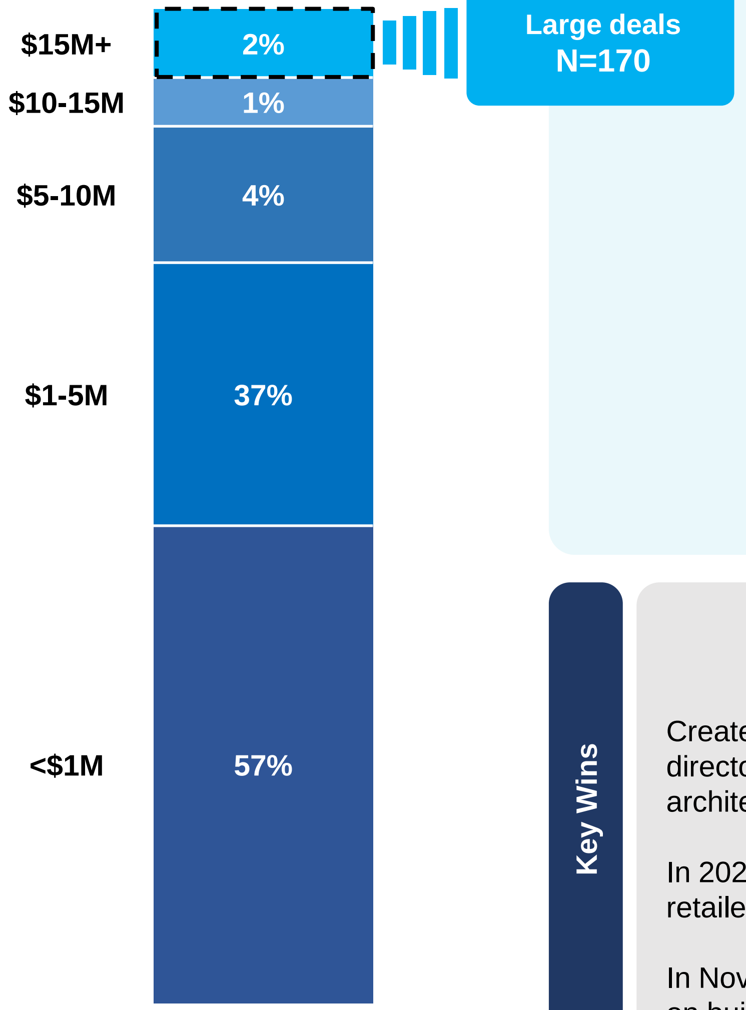
Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service Providers have been focusing more on large deals

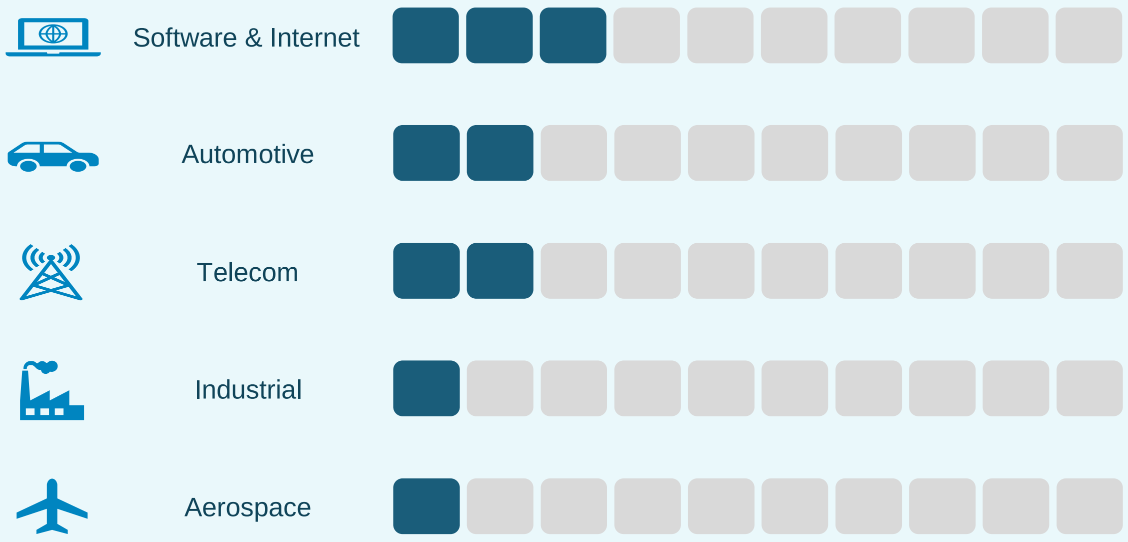
SP Addressed

ER&D DEALS (2021-22)

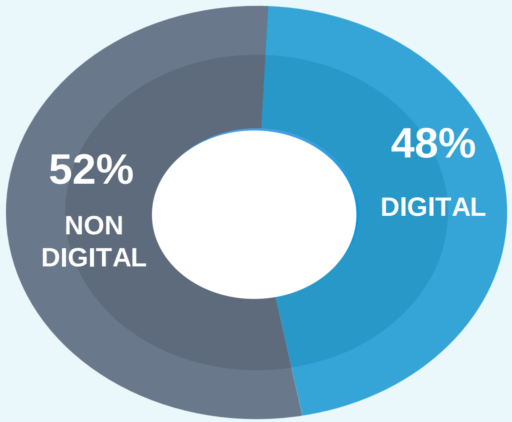
N= ~11,000



LARGE DEALS BY VERTICAL



DEALS BY TECHNOLOGY



Key Wins

Persistent
See Beyond, Rise Above

Created an integrated ecosystem of large deals specialists (deal directors, influencer team, industry experts, global solution architect model, etc.)

In 2023, Persistent won USD 70 Mn contract with an US online retailer

In Nov 2022, Persistent and Software AG announced partnership on building a professional services centre of excellence

cognizant

Dedicated large deal teams to drive Digital Engineering GTM efforts

In Jan 2023, Cognizant won 10-year services agreement valued at about USD 1 Bn with CoreLogic. As part of the deal, cognizant to deliver solutions and CX through digital transformation and operational excellence

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Strategic Initiatives of Service Providers

SP Addressed

SOLUTIONS & OFFERINGS

Wipro's Smart i-Connect (WSiC) is an enterprise IOT platform that enables solutions for six critical objectives of IOT applications

EPAM launched "AosEdge", a vehicle-to-cloud platform, which would help automakers and third-party OEMs in the next phase of the evolution of connected cars

COE/INNOVATION LABS

HCLTech's NEXT.ai lab facilitates research and co-create AI enabled solutions for platform engineering and problem solving

Tech Mahindra and Anritsu, established an IOT Experience Lab at Fremont to provide efficient testing of IOT and 5G devices

PARTNERSHIPS & COLLABORATIONS

Cognizant collaborated with Qualcomm to launch 5G experience center for digital transformation across industry verticals

HCLTech and Google Cloud expanded their strategic partnership to accelerate digital transformation for enterprises

Google Cloud Partner

R&D

Capgemini collaborated with Georgia Tech to develop cutting-edge technologies leveraging AI/ML capabilities

L&T TS unveiled an ER&D centre in Poland, to serve Mobility and Hi-Tech customers and customers from Europe and North America. It plans to increase the strength over 300 engineers in three years.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Leading Service Providers are enhancing their Digital Capabilities through Acquisitions

SP Addressed

1.

Globallogic acquired Hexacta In January 2023.

Focus Area: Digital Engineering

This acquisition is part of GlobalLogic's continued strategy to expand its offerings, and its roster of exceptional engineering talent to meet the strong market demand for digital engineering services.

2.

Wipro Acquired Linecraft in December 2022.

Focus Area: AI/ML

This acquisition will further help Wipro expand its digital capabilities and offer turnkey automation solutions with a bolt-on digital layer which provides deep insights and analytics to customers.

3.

Accenture Acquired Albert in November 2022.

Focus Area: Big Data and AI

The acquisition will add a large team of data scientists to Accenture to further strengthen its data and AI capabilities for clients.

4.

Capgemini Acquired Braincourt in October 2022

Focus Area: Data Analytics

This acquisition strengthens the Capgemini's advanced business intelligence, AI, data and analytics capabilities in Germany and Northern Europe.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Enterprises across verticals are leaning on the Service Provider ecosystem for end-to-end management

ER&D SERVICES

SP Addressed

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
MBDL ((Matra, BAe Dynamics and Alenia)	**Persistent Systems**	2022	**PLM**	Support engineering lifecycle management systems
Siemens	**Softdel**	2022	**IOT Services**	Softdel to help Siemens IOT ecosystem partners to connect with Siemen's Desigo BMS
DataBricks	**Mphasis**	2022	**Engineering / Center Setup**	This partnership is for using their Delta Lakehouse platform which provides a low latency integrated data lake+warehouse solution compared to using multiple components from Hyperscalers
Ambarella	**eInfochips**	2022	**Vision AI Services**	Vision AI based product design and development using Ambarella CV2X, CV5 and SL series system on chip (SoCs)
Ultragenic	**Apexon**	2022	**AI/ML**	Advanced AI, machine learning and RPA solutions to help life sciences organizations of all sizes optimize their Medical Affairs, Regulatory and Safety (MARS) functions
ThyssenKrupp	**Capgemini**	2022	**Digital Thread**	Capgemini is providing real-time end to end demand visibility
European material handling and logistics automation company	**L&T TS**	2022	**Carve-Out**	A multi-year product sustenance program, where L&T TS take over lifecycle maintenance of few of the legacy products while helping innovate and introduce new products using digital technologies

Source: Zinnov Research and Analysis, Zinnov Z1000 database

SPs have tapped into significant opportunities across verticals

SP Addressed

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
Australia based CSP	**Cyient**	2022	**Network Slicing**	Cyient to help the CSP to accelerate their broadband network performance as well as network transformation
US based Enterprise Software Firm	**Persistent Systems**	2022	**Platform Engineering**	Persistent to build a COE and offer development support and professional services for connected applications
Norway based Fabless Firm	**N-iX**	2022	**Design and Development**	N-iX to help the fabless firm with design and development services of wireless connectivity for IOT systems
Large Semiconductor Firm	**L&T TS**	2022	**End to end Engineering Services**	L&T TS signed a three-year deal with large semiconductor firm to offer engineering services to its entire product suite
US based Provider	**HCLTech**	2022	**Automated Testing**	Providing software testing services for client’s entire suite of applications and products by leveraging its automation solutions to enable continuous testing for faster GTM
Leading Medical device firm	**L&T TS**	2022	**Device Engineering**	A multi-year engineering program for client’s line of medical devices

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service Providers have been supporting engineering requirements of enterprises

zinnov ZONES ER&D SERVICES

SP Addressed

ENTERPRISE	SERVICE PROVIDER	YEAR	FOCUS AREA	ENGAGEMENT DESCRIPTION
Highmark Health	**Accenture**	2022	**Data/Cloud**	Helped the firm improve personalized customer experience by leveraging cloud and consolidating enterprise data to provide faster insights
Global Healthcare Provider	**L&T TS**	2022	**Data Engineering**	Provided data engineering support which tracks execution of triage and vigilance preparation to help accelerate productivity and reduce training costs
NHG	**NTT Data**	2022	**Platform Engineering**	Developing a Digital HealthApps Platform that supports NHG’s initiative for population health in Singapore
Health-tech firm	**Persistent Systems**	2022	**Modernization**	Leveraging its industry and technology expertise to modernize key platforms and enable scalability
US based CSP	**HCLTech**	2022	**5G**	HCLTech to provide VoIP, mobility and collaboration related services on 5G. The deal also includes network lab certification, and network verification services

Source: Zinnov Research and Analysis, Zinnov Z1000 database

AGENDA

Source: Zinnov Research and Analysis, Zinnov Z1000 database

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 39 Bn

YoY 2021-22 10-12% ↑

Capgemini
AKKODiS
ALTEN

INDIAN

MARKET SIZE
USD 25 Bn

YoY 2021-22 14-16% ↑

HCL
tcs
wipro

EASTERN EUROPEAN

MARKET SIZE
USD 10 Bn

YoY 2021-22 18-20% ↑

<epam>
endava
GlobalLogic

Source: Zinnov Research and Analysis, Zinnov Z1000 database

AGENDA

A The Rise of Digital Engineering

B Technology Pillars of Digital Engineering

C Sustainability – A Priority

D Industry Deep Dives - ER&D Spend Trends & Priorities

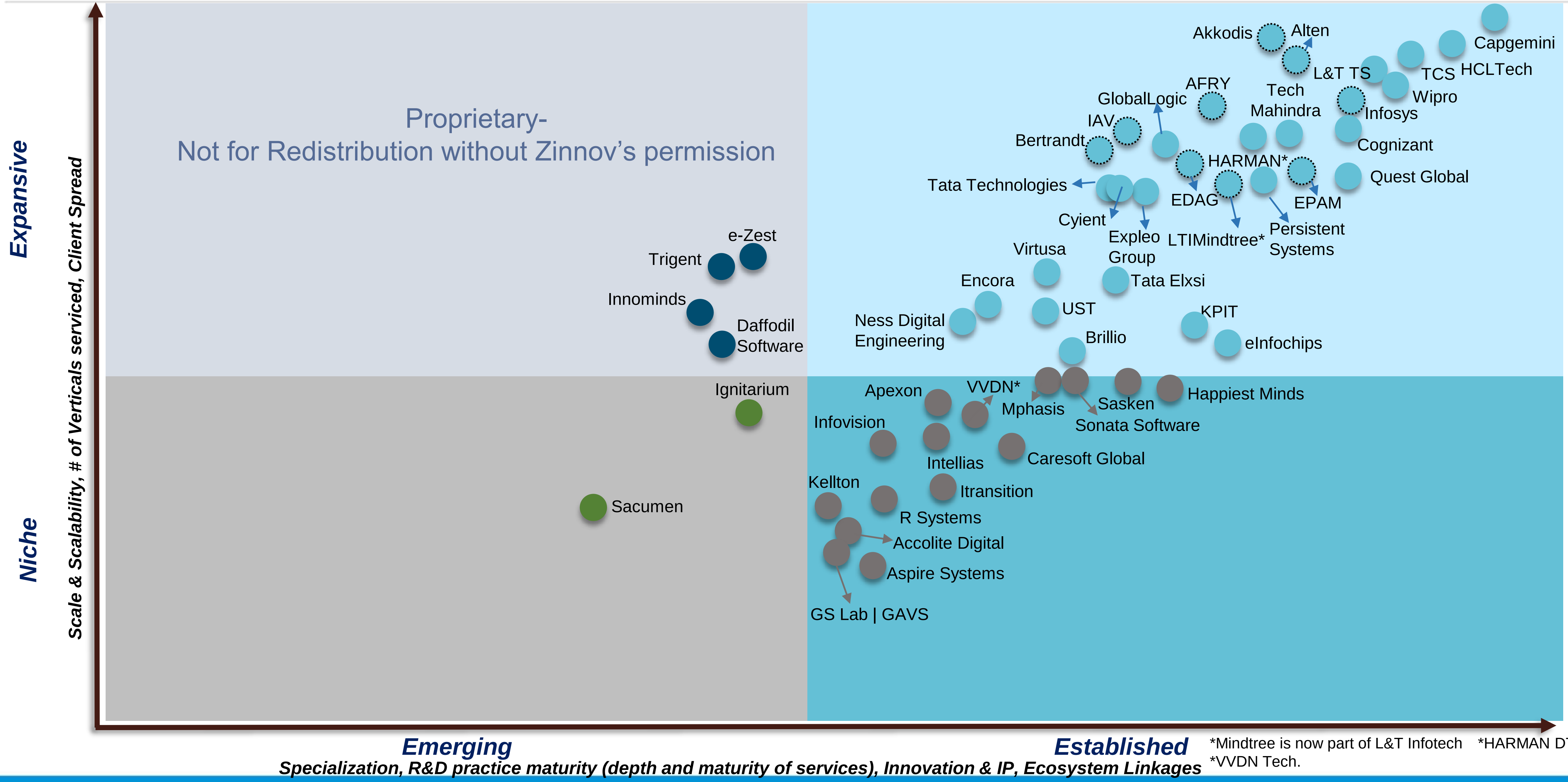
E Addressed Market and Service Providers’ Opportunities

F Growth Levers for Service Providers

G Zinnov Zones for ER&D Ratings 2022

Source: Zinnov Research and Analysis, Zinnov Z1000 database

ER&D Services – Overall Ratings 2022

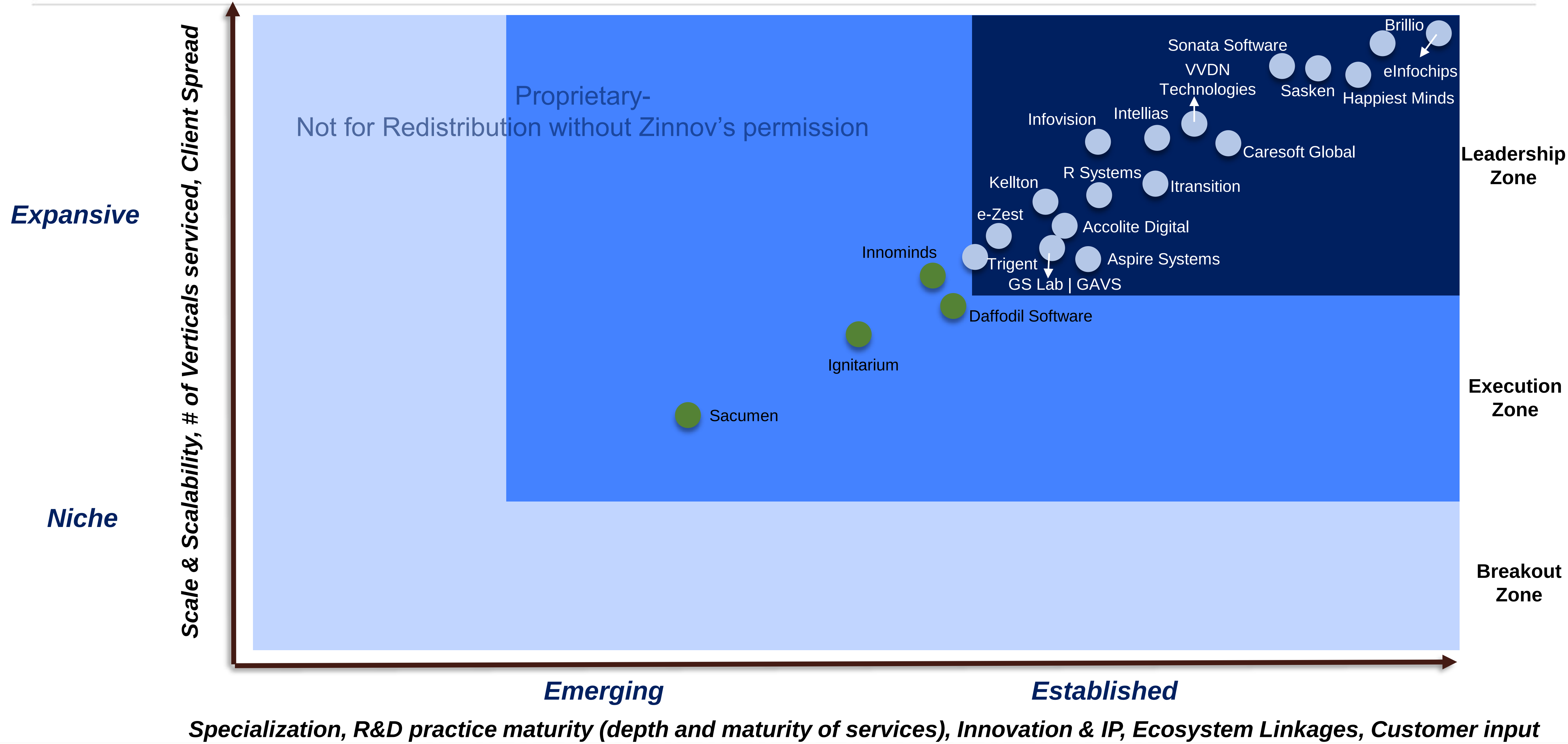


*Mindtree is now part of L&T Infotech *HARMAN DTS
*VVDN Tech.

Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service providers with dotted lines have been evaluated based on Zinnov's analysis and understanding

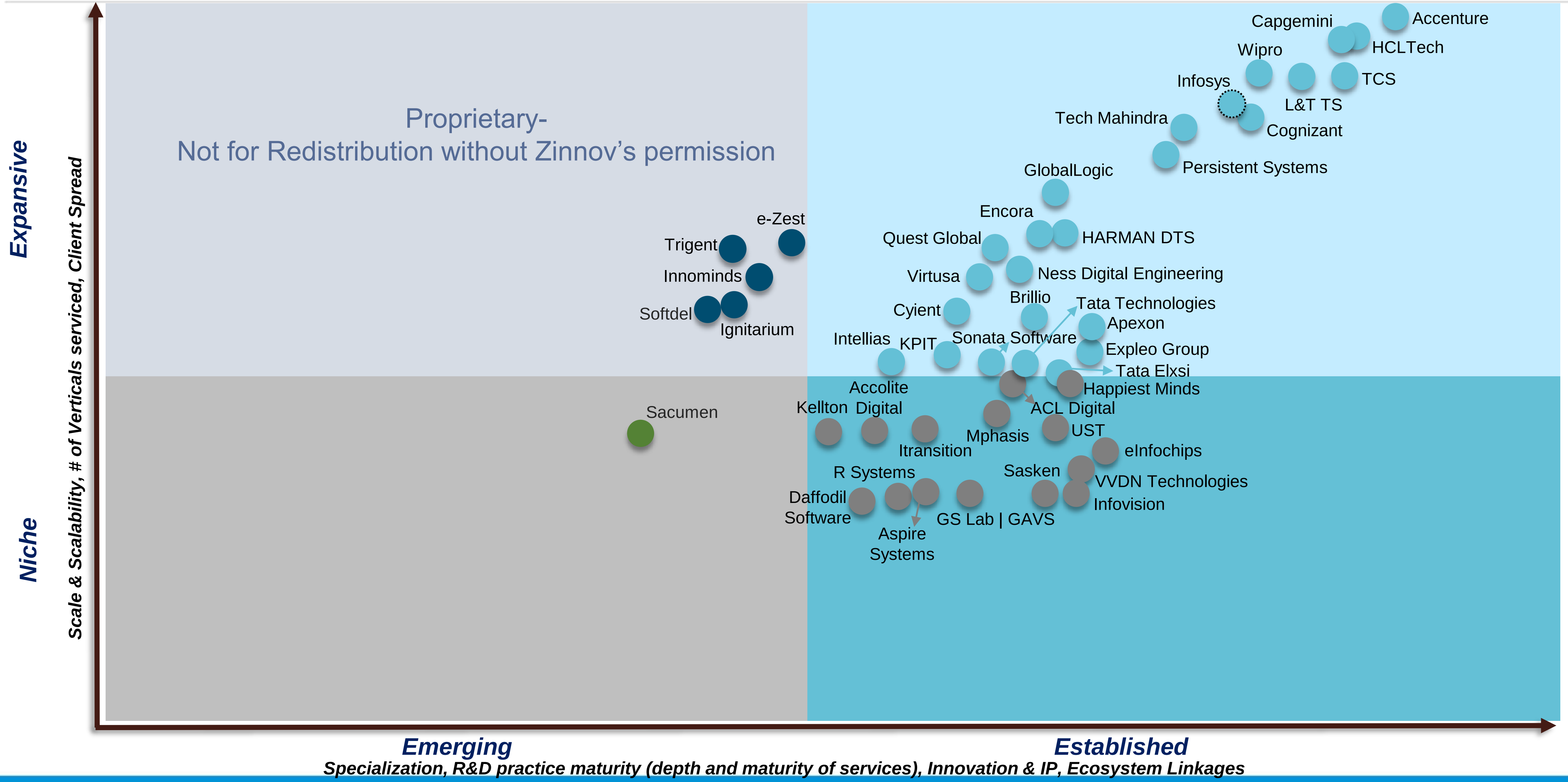
ER&D Services – Overall Ratings 2022 (Small & Medium Service Providers*)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

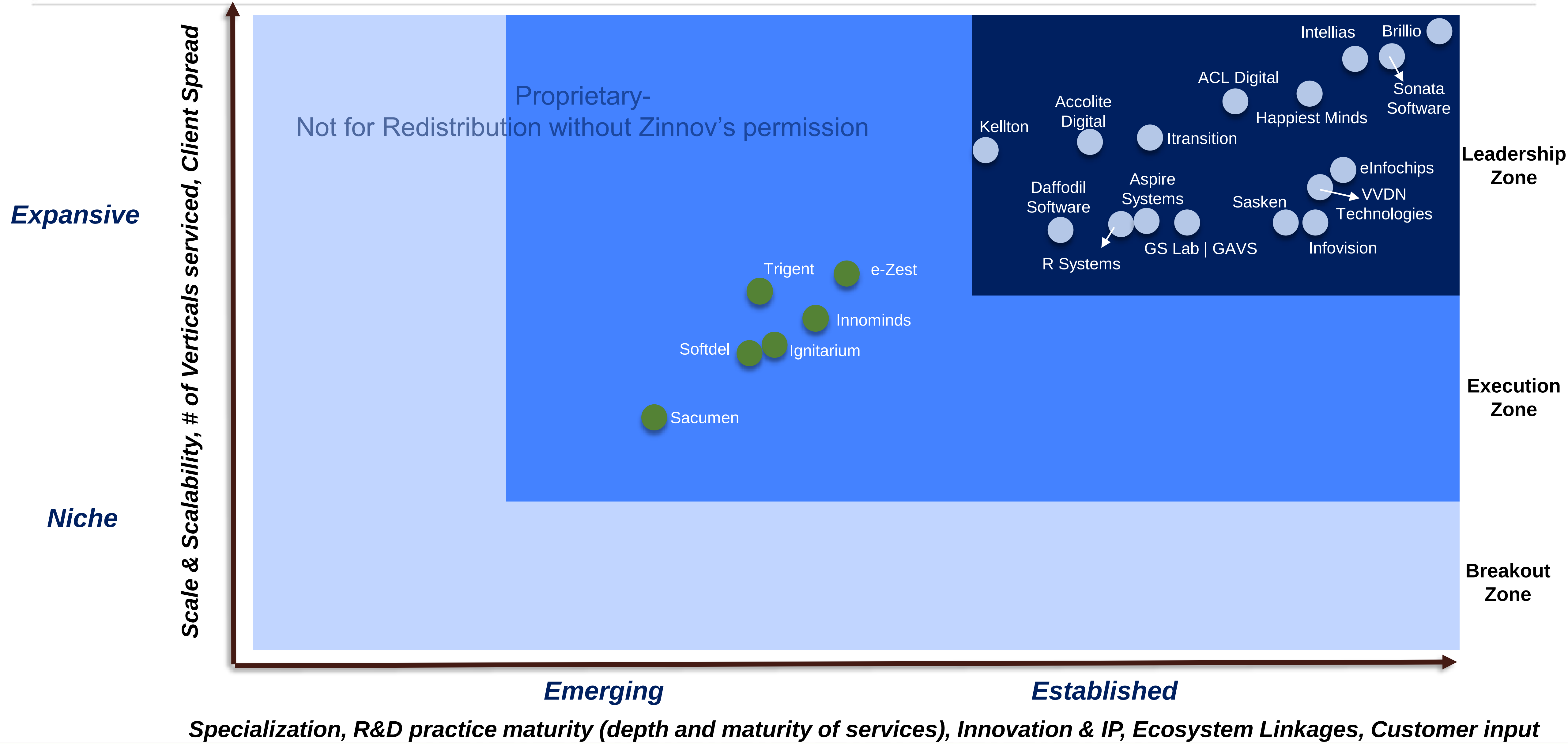
*Overall ER&D services revenue <USD 250 Mn

ER&D Services – Digital Engineering Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

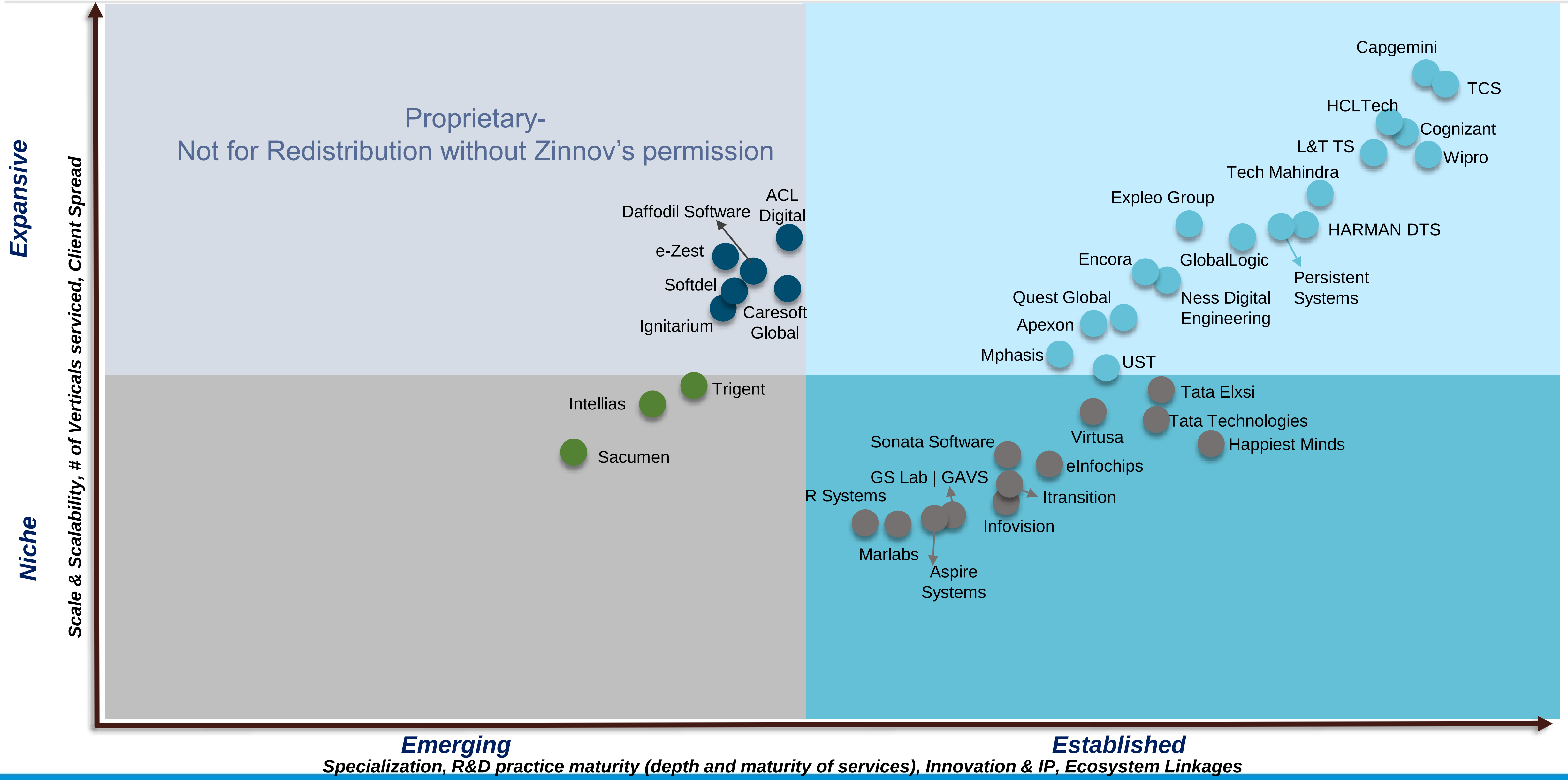
ER&D Services – Digital Engineering Ratings 2022 (Small & Medium Service Providers*)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

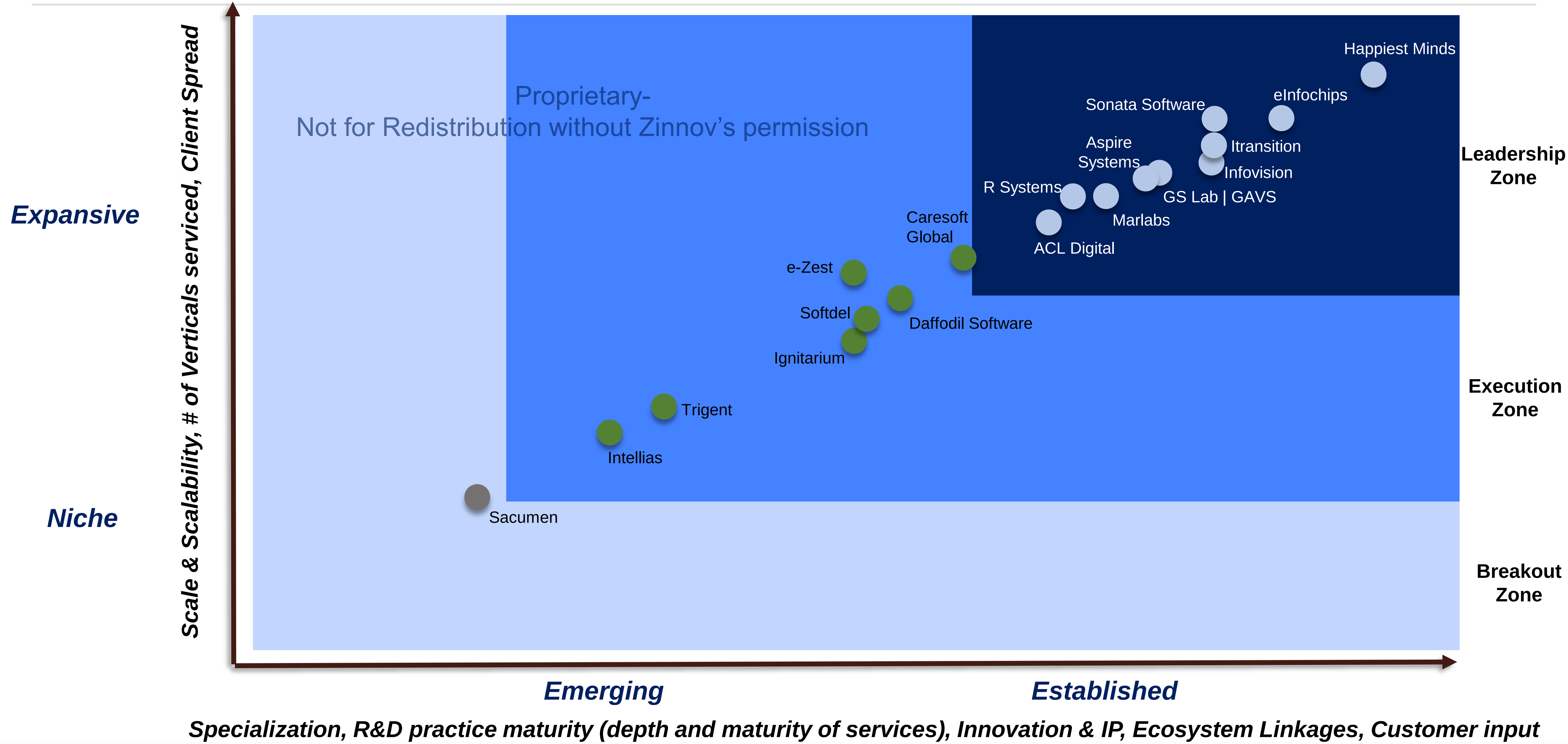
*Overall ER&D services revenue <USD 250 Mn

ER&D Services – Data & AI Engineering Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

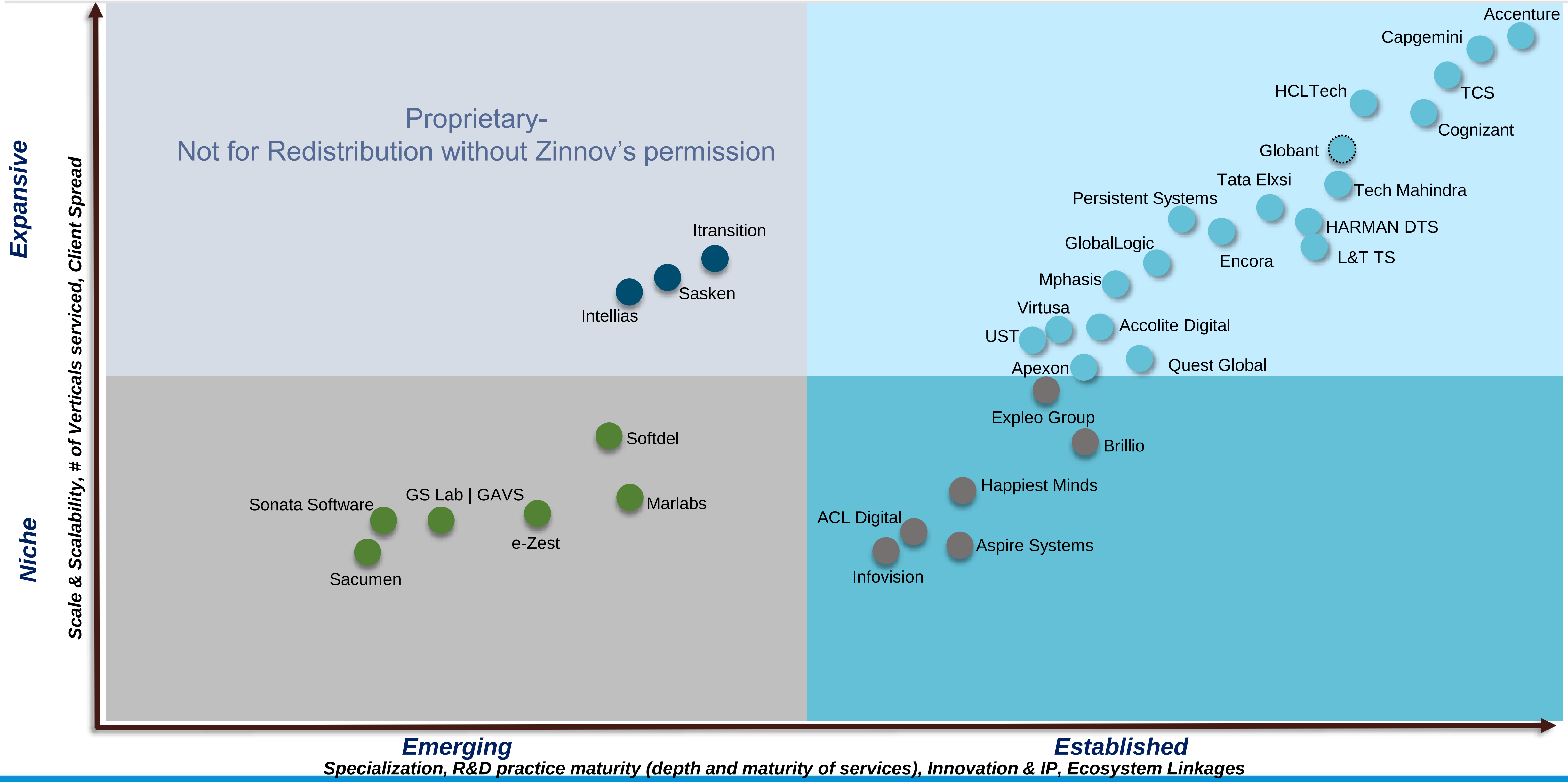
ER&D Services – Data & AI Engineering Rating 2022 (Small & Medium Service Providers*)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

*Overall ER&D services revenue <USD 250 Mn

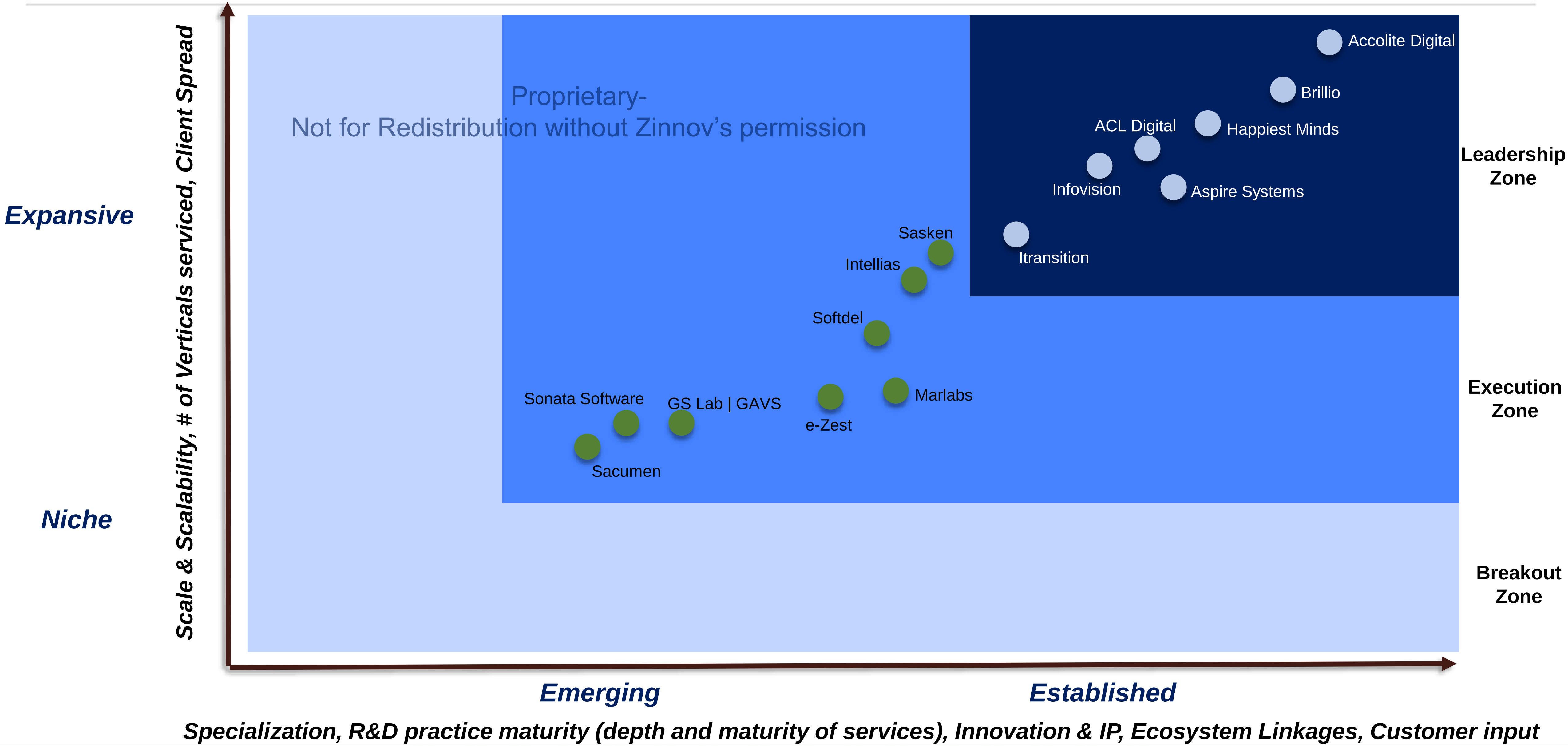
ER&D Services – Experience Engineering Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service providers with dotted lines have been evaluated based on Zinnov's analysis and understanding

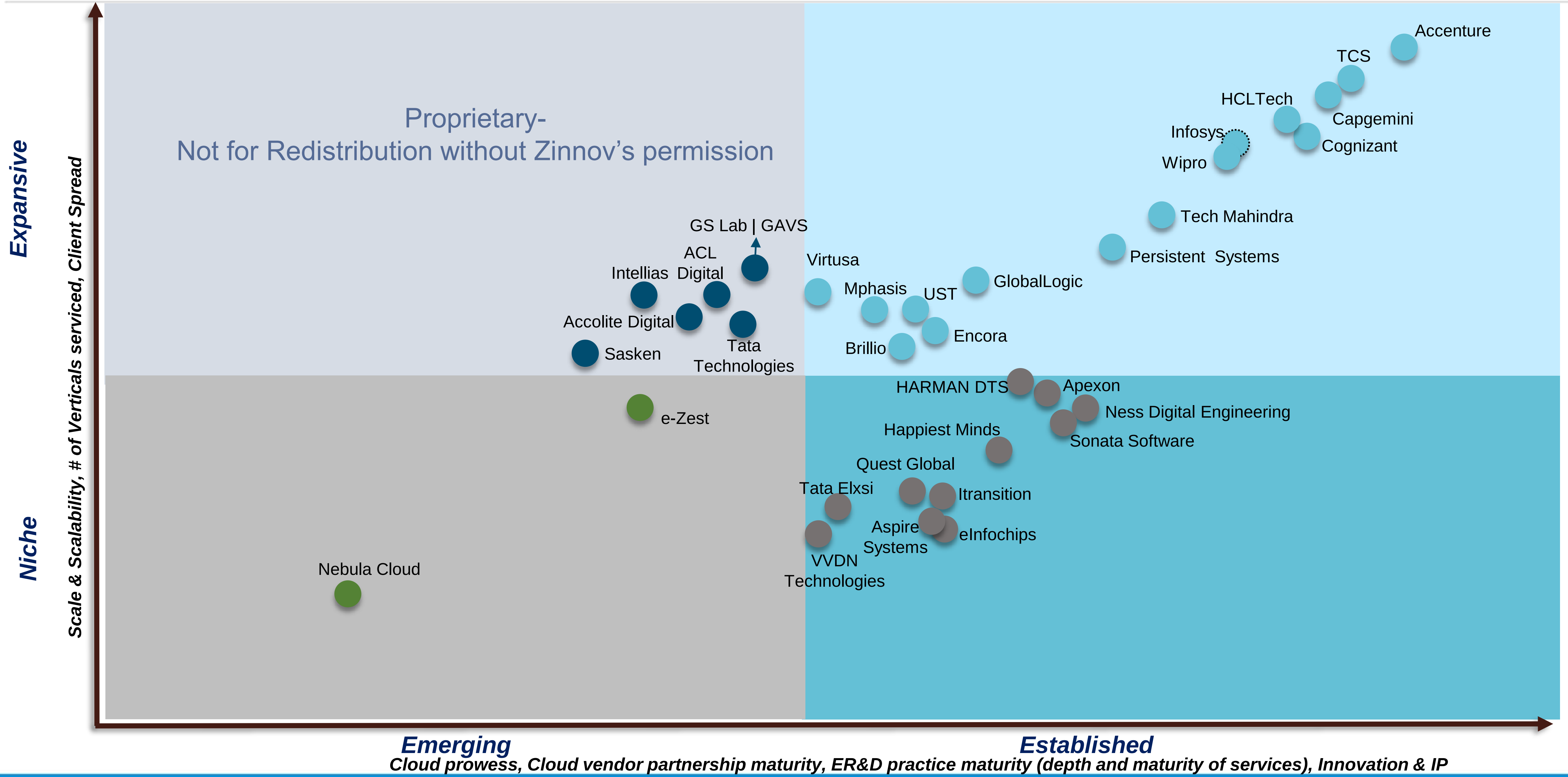
ER&D Services – Experience Engineering Ratings 2022 (Small & Medium Service Providers*)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

*Overall ER&D services revenue < USD 250 Mn

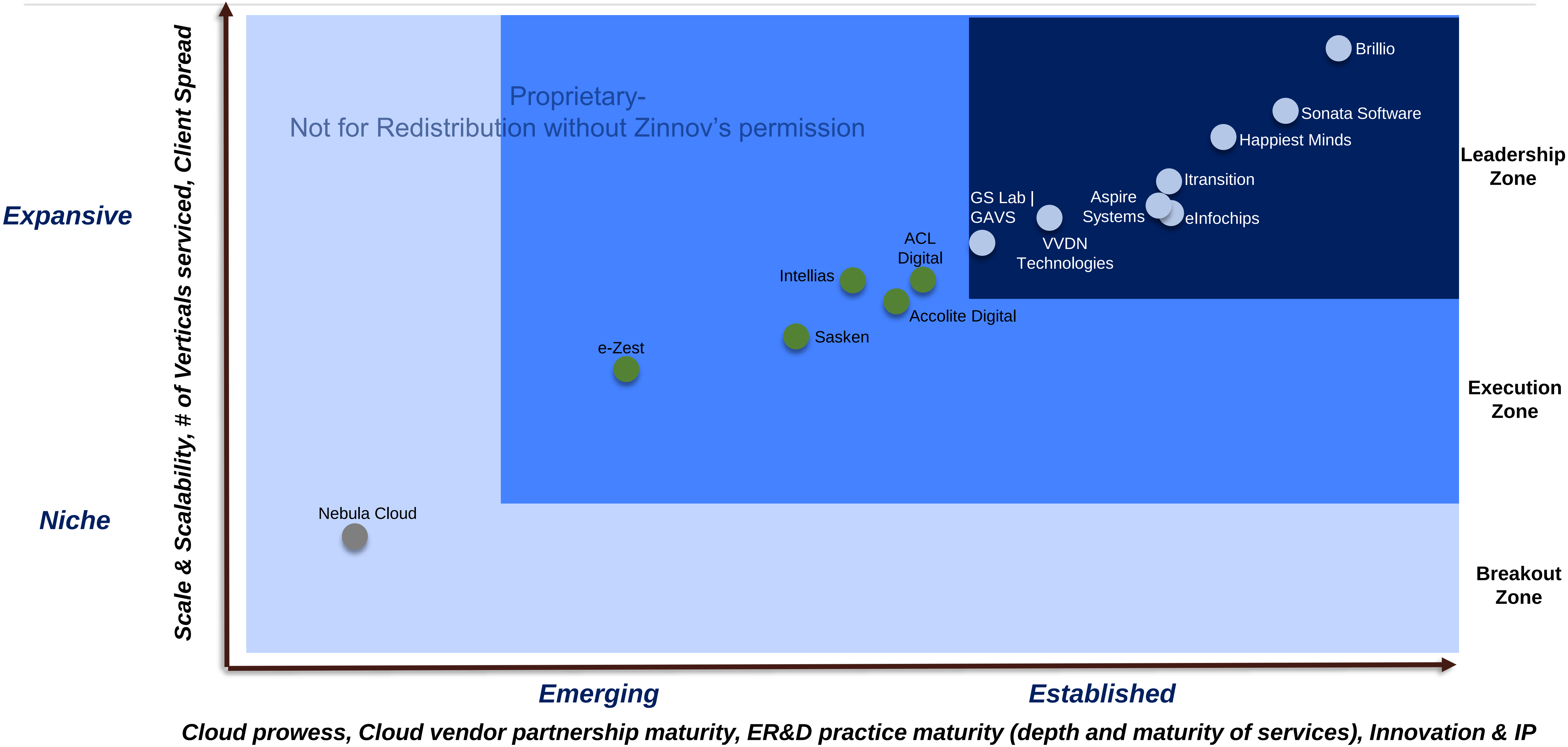
ER&D Services – Hyperscalers Services Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Note: Service providers are assessed basis their partnership depth with hyperscaler vendors. Benchmarking is based on SP's talent expertise, specializations, and breadth of offerings aligned to ER&D services

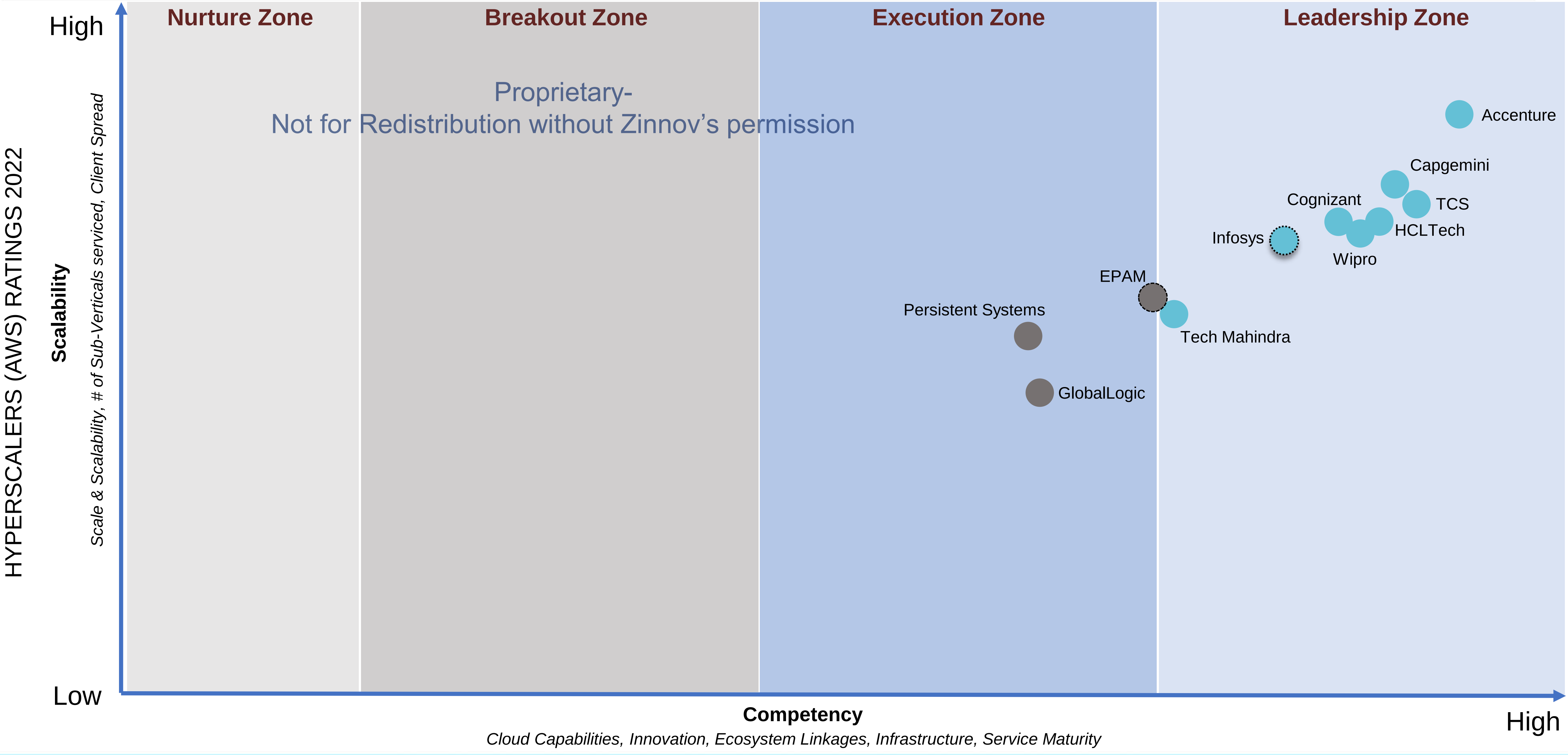
ER&D Services – Hyperscalers Services Ratings 2022 (Small & Medium Service Providers*)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

*Overall ER&D services revenue < USD 250 Mn

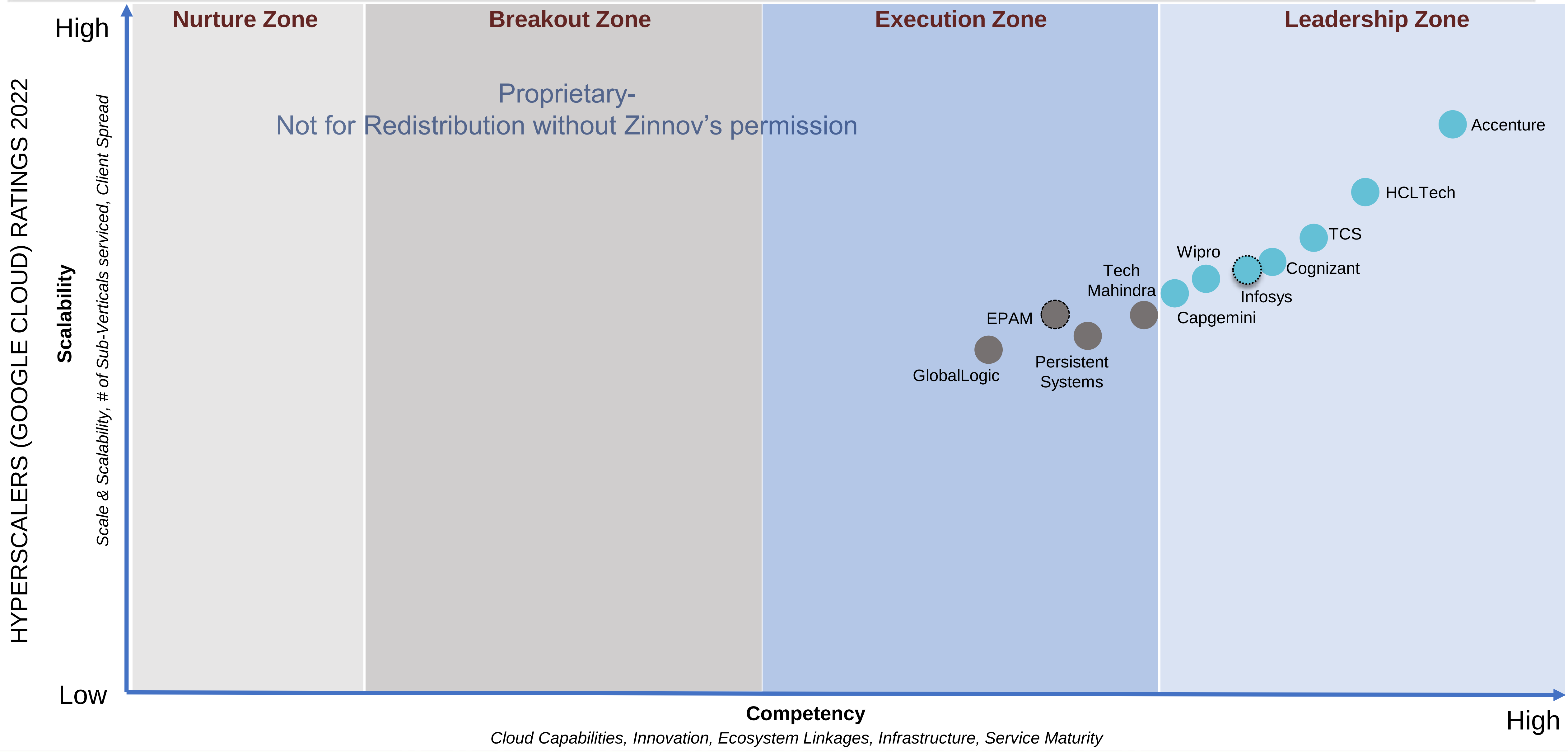
ER&D Services – Hyperscalers (AWS) Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Note: Service providers are assessed basis their partnership depth with hyperscaler vendors. Benchmarking is based on SP's talent expertise, specializations, and breadth of offerings aligned to ER&D services

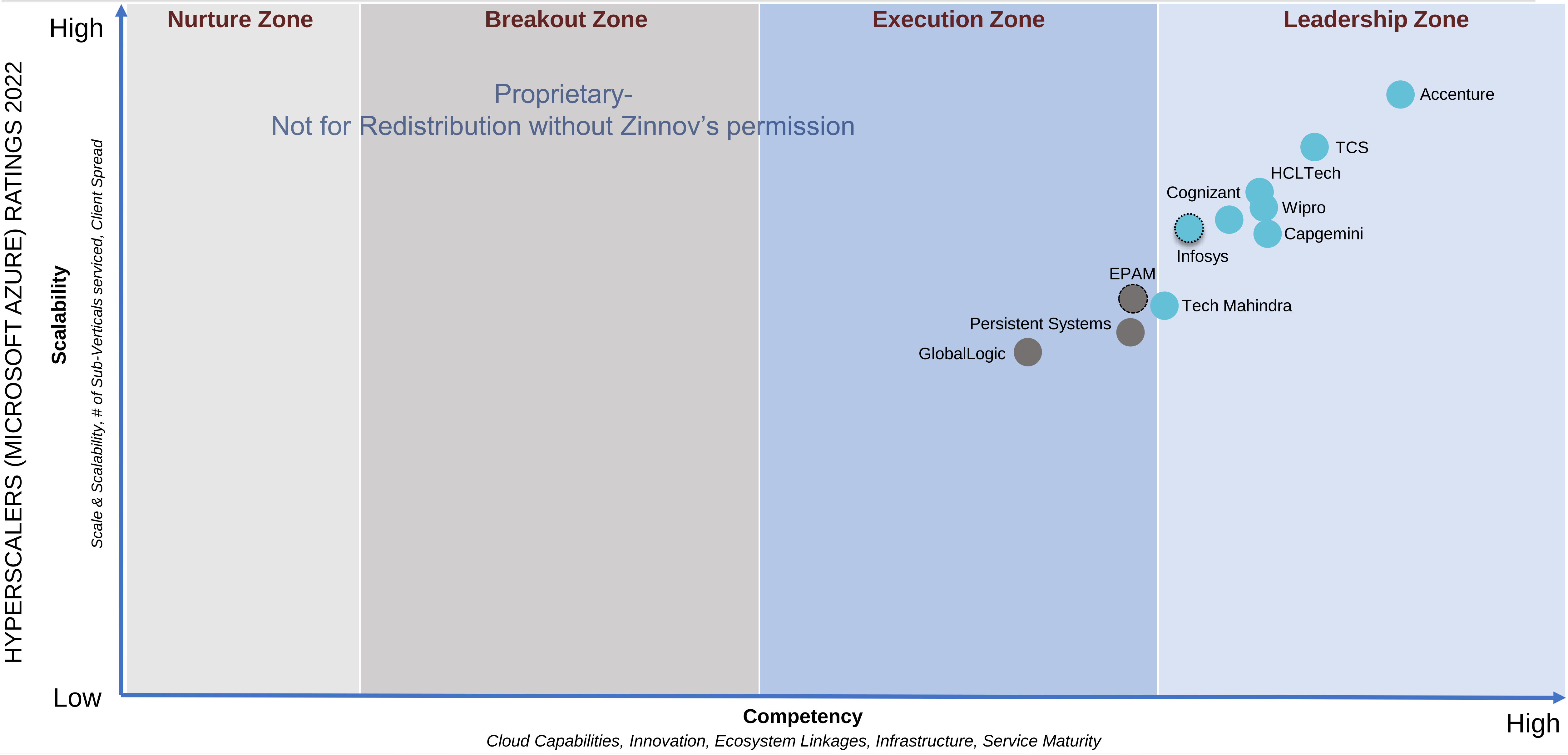
ER&D Services – Hyperscalers (Google Cloud) Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Note: Service providers are assessed basis their partnership depth with hyperscaler vendors. Benchmarking is based on SP's talent expertise, specializations, and breadth of offerings aligned to ER&D services

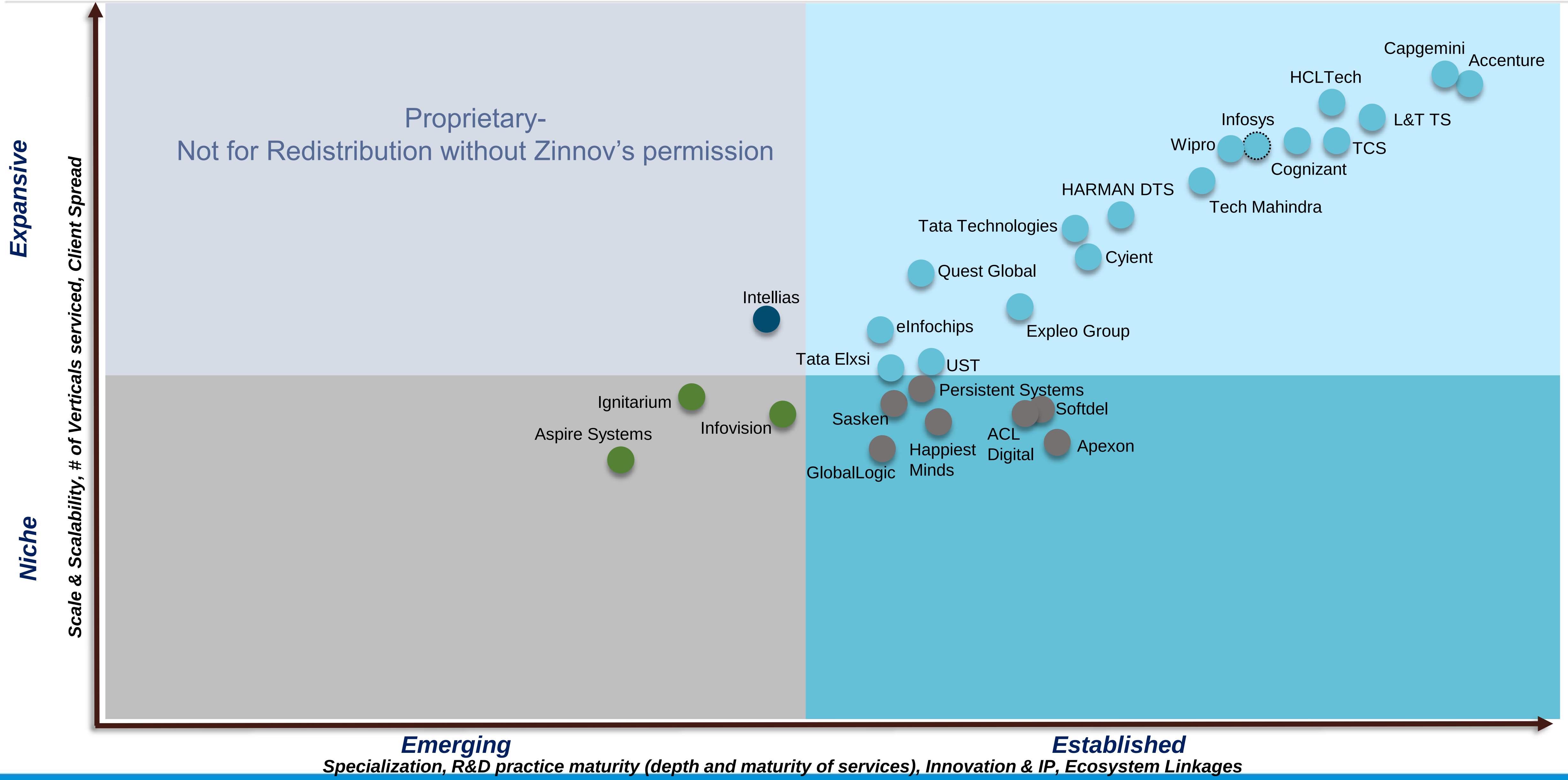
ER&D Services – Hyperscalers (Microsoft Azure) Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

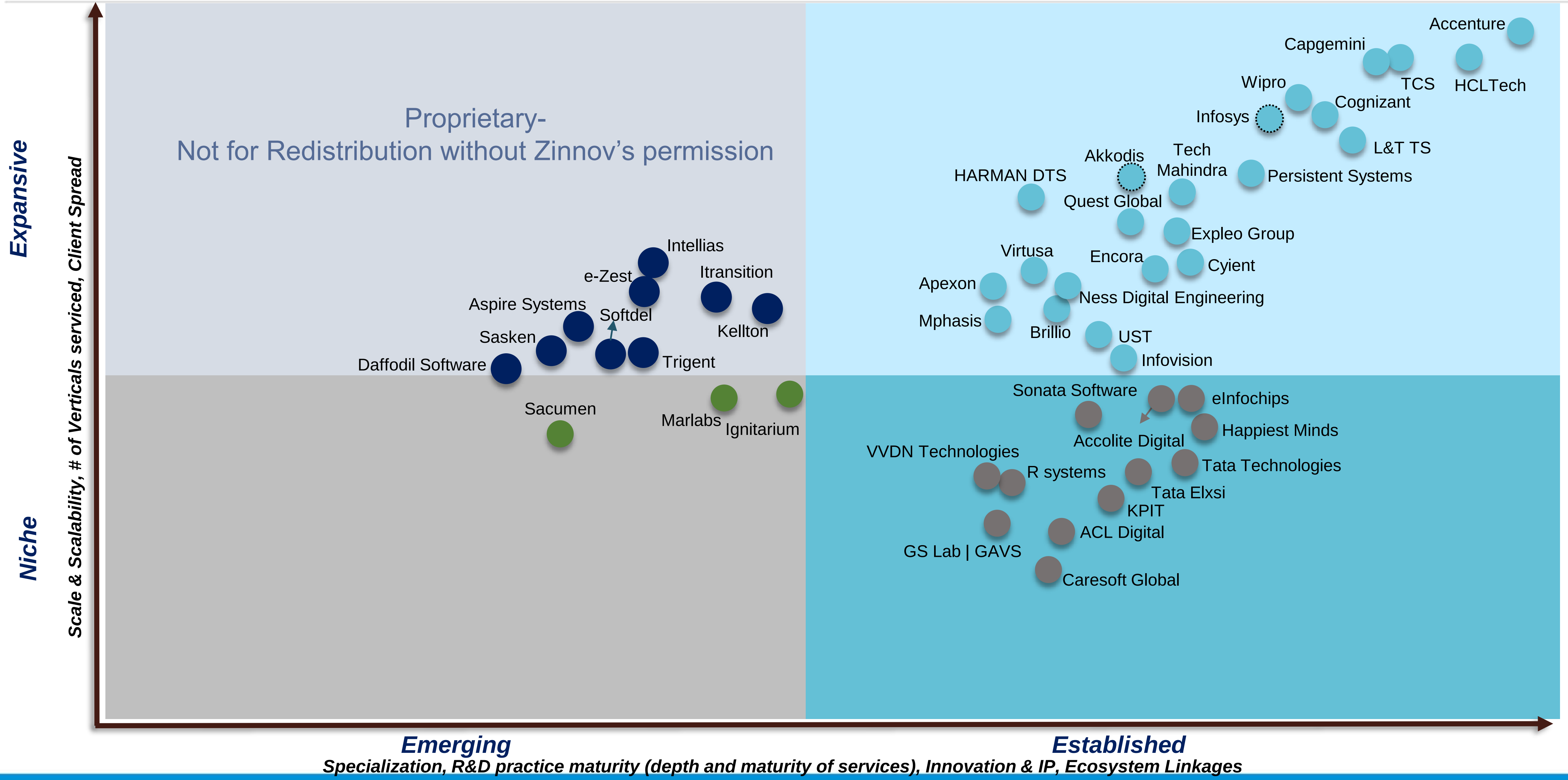
Note: Service providers are assessed basis their partnership depth with hyperscaler vendors. Benchmarking is based on SP’s talent expertise, specializations, and breadth of offerings aligned to ER&D services

ER&D Services – Industry 4.0 Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

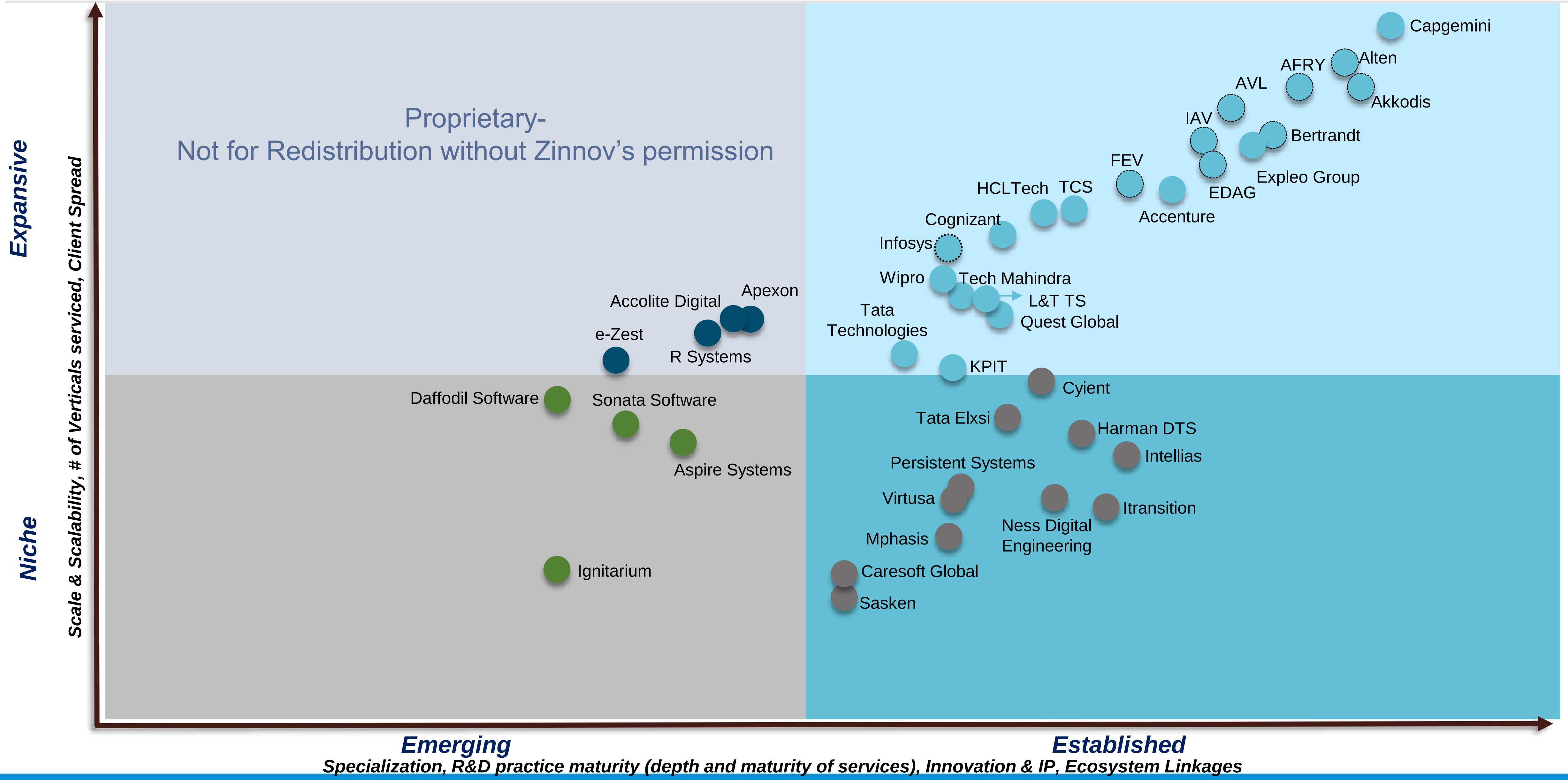
ER&D Services – US Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service providers with dotted lines have been evaluated based on Zinnov's analysis and understanding

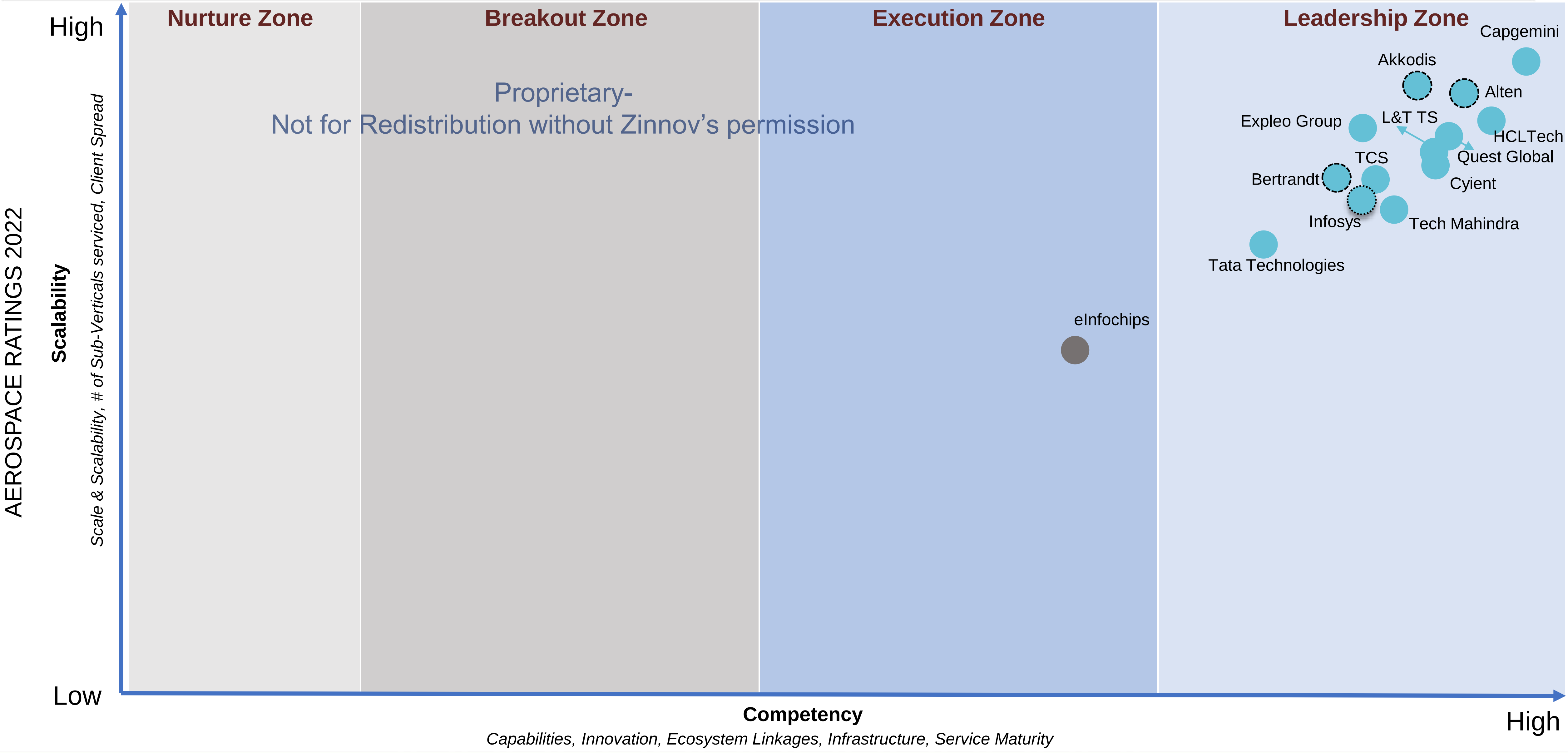
ER&D Services – Europe Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service providers with dotted lines have been evaluated based on Zinnov's analysis and understanding

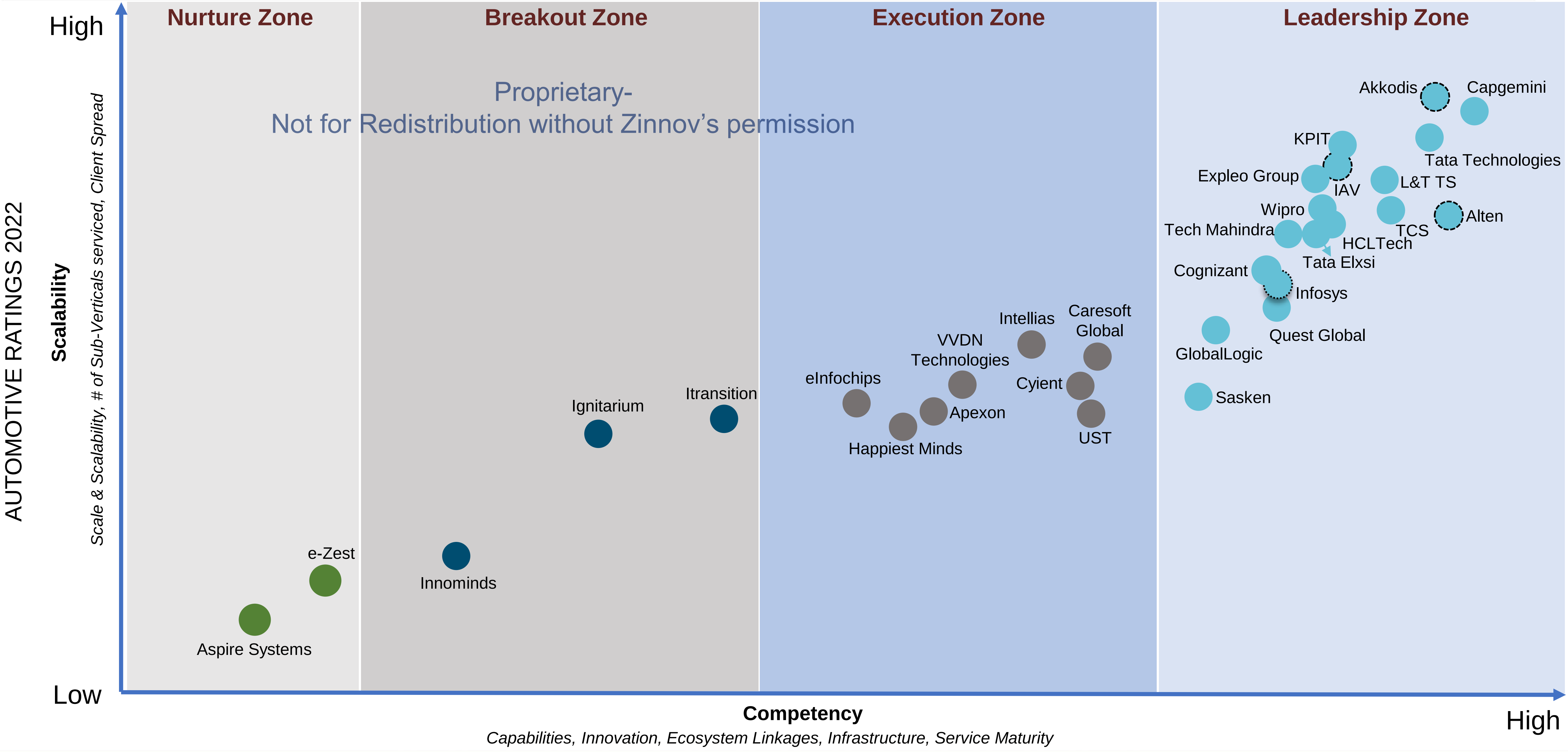
ER&D Services – Aerospace Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service providers with dotted lines have been evaluated based on Zinnov’s analysis and understanding

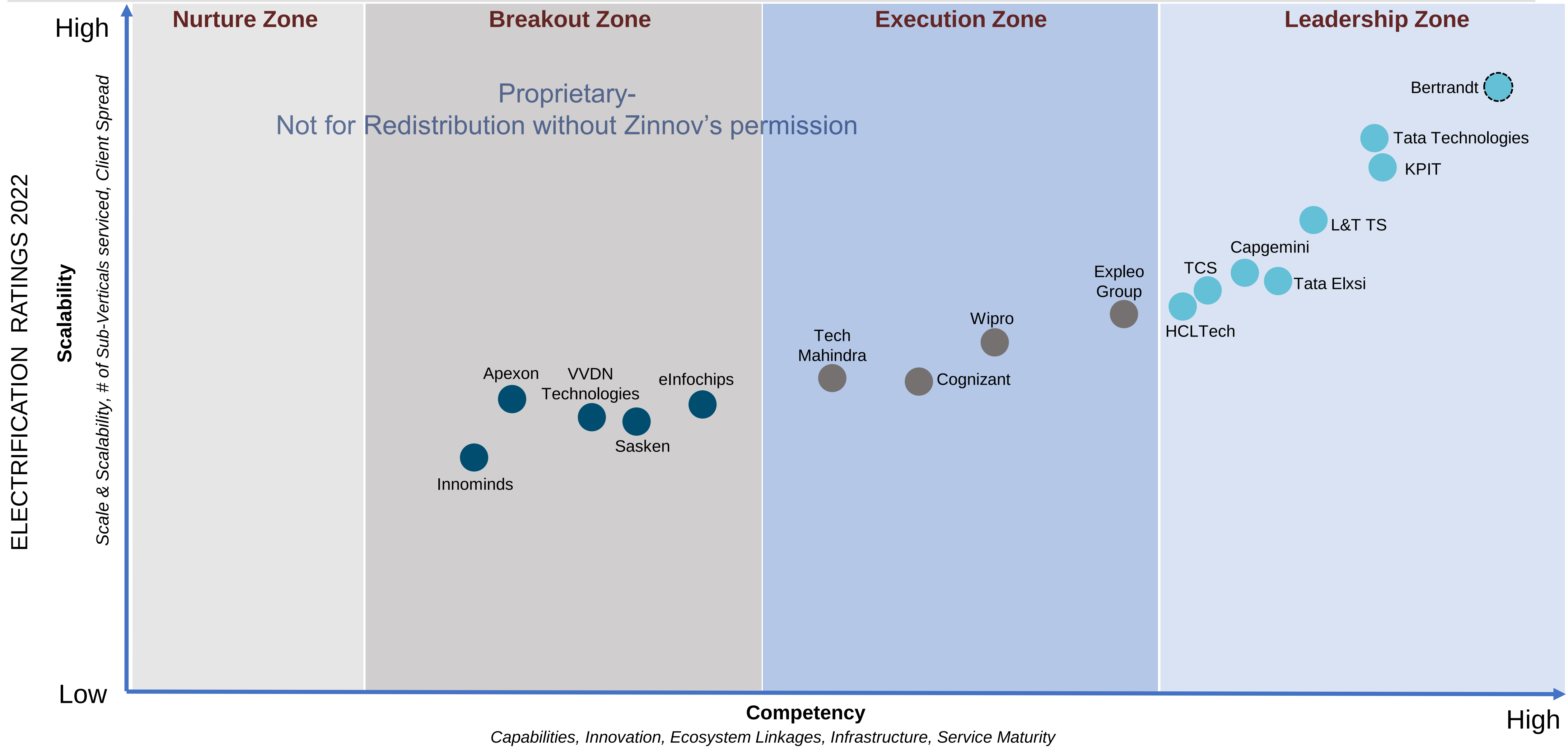
ER&D Services – Automotive Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service providers with dotted lines have been evaluated based on Zinnov’s analysis and understanding

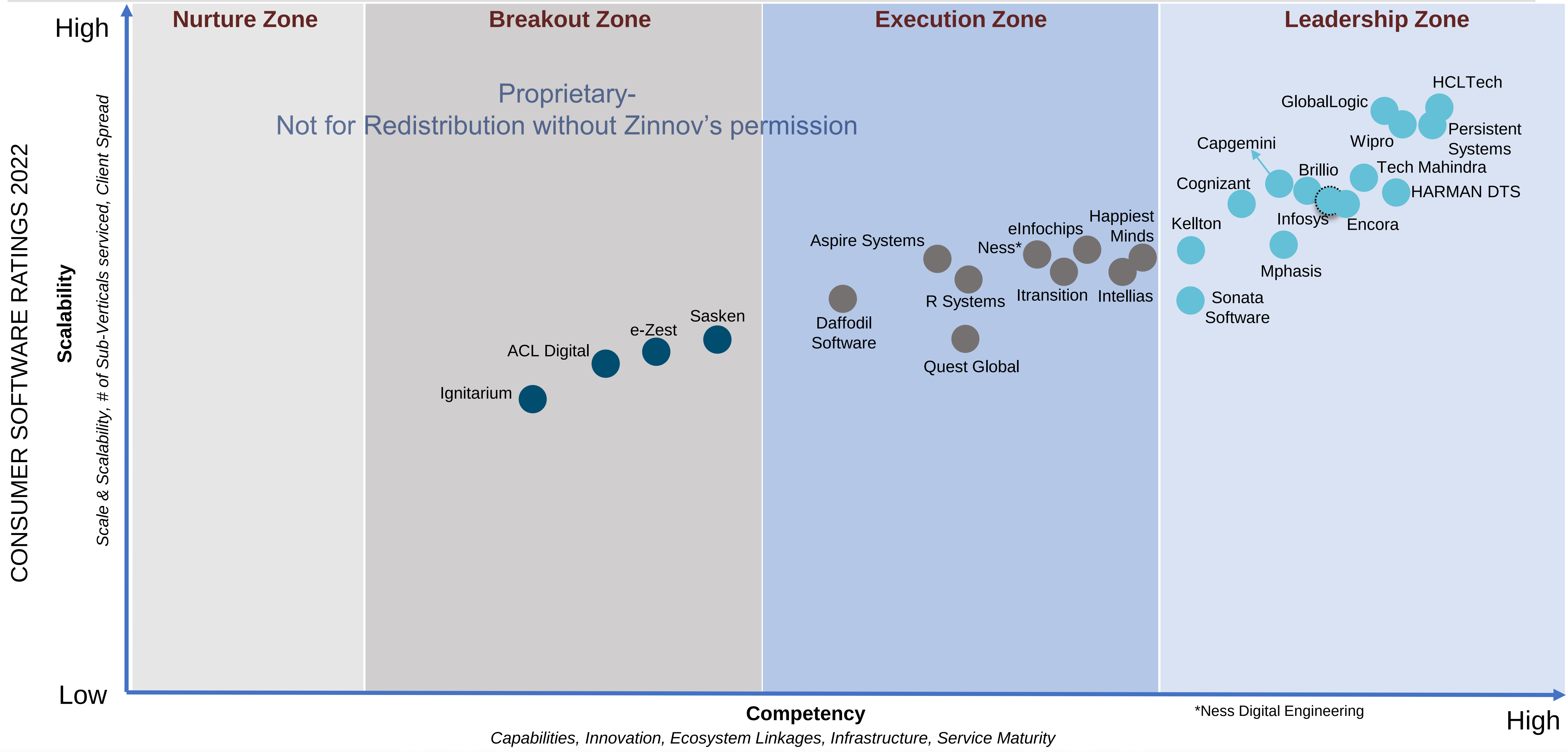
ER&D Services – Electrification Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

Service providers with dotted lines have been evaluated based on Zinnov's analysis and understanding

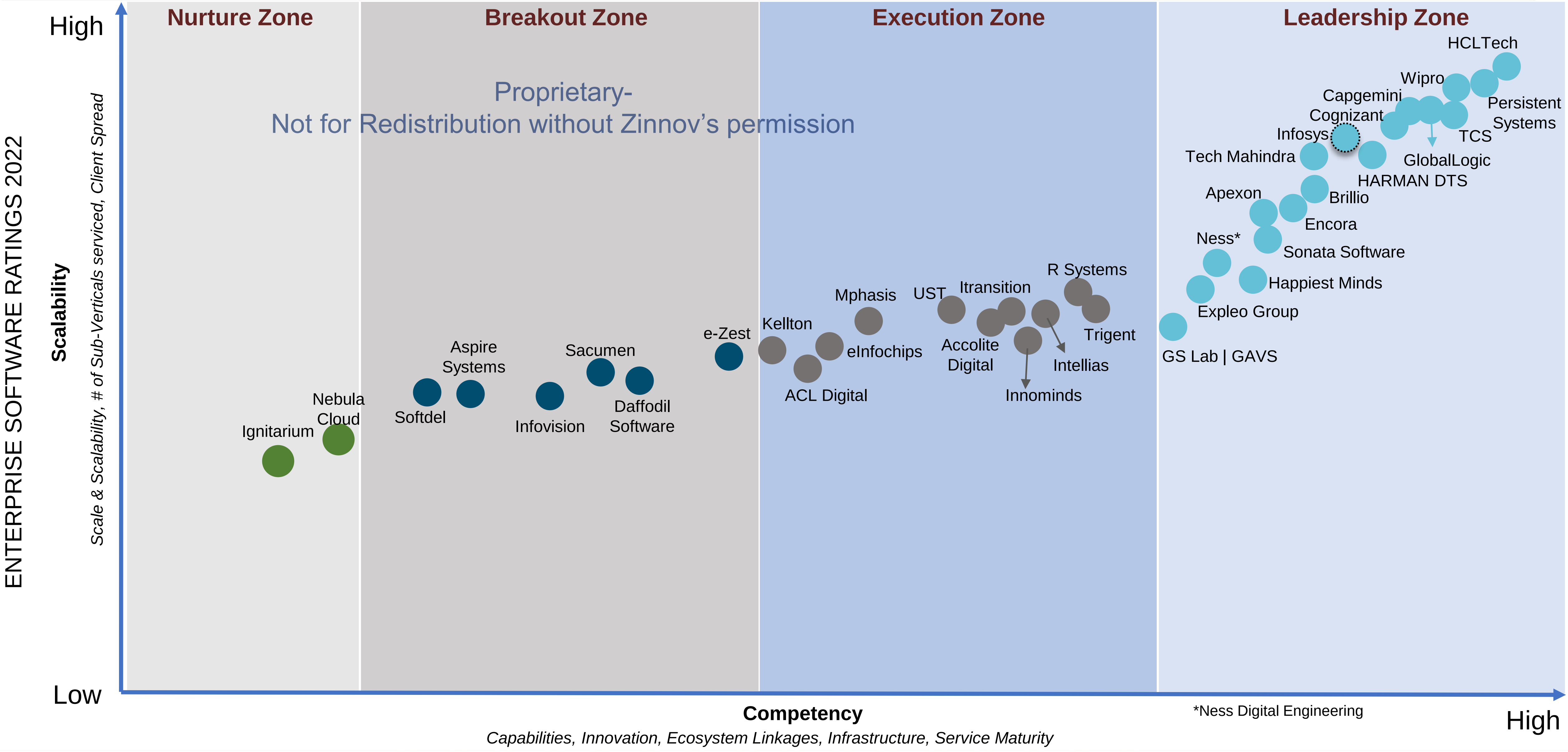
ER&D Services – Consumer Software Ratings 2022



*Ness Digital Engineering

Source: Zinnov Research and Analysis, Zinnov Z1000 database

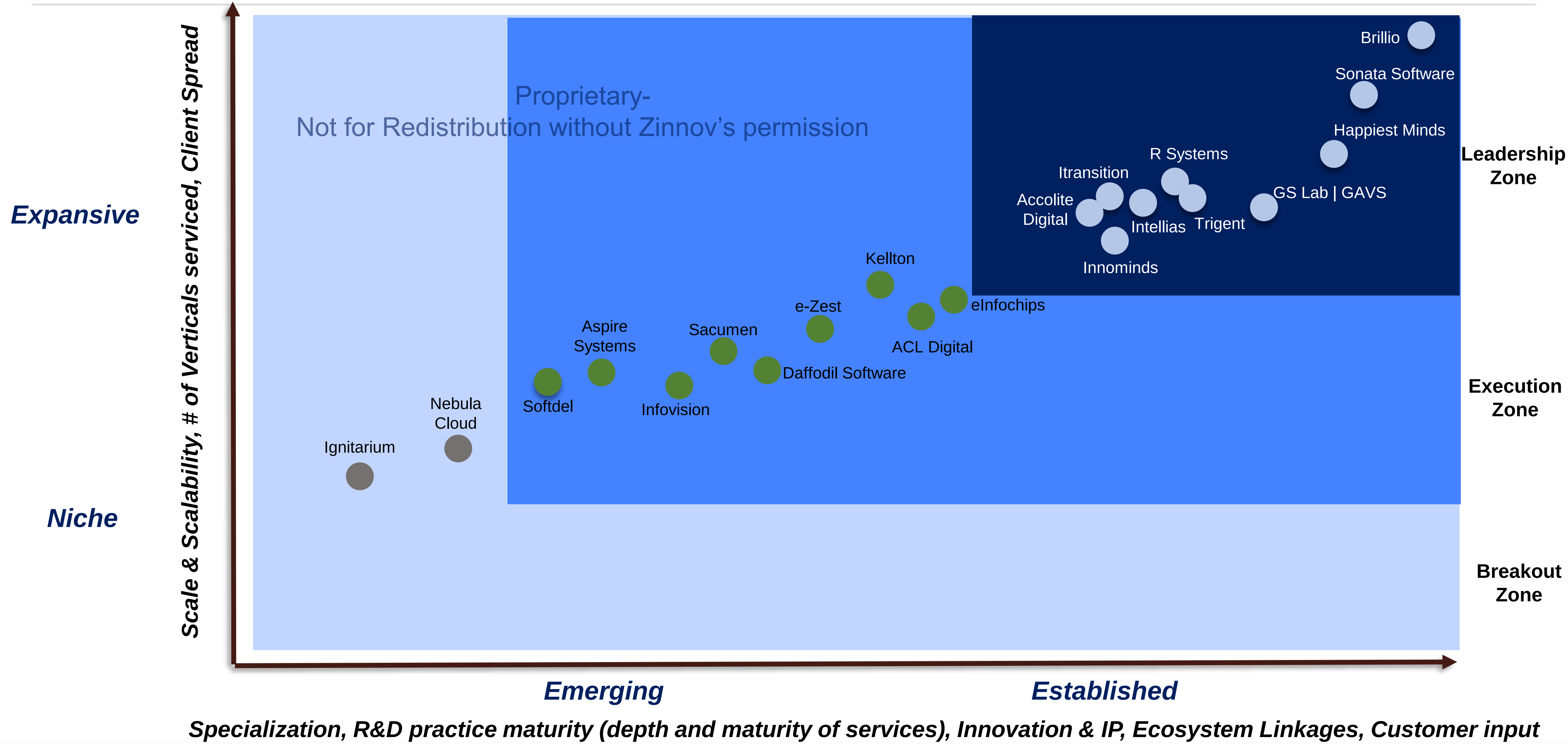
ER&D Services – Enterprise Software Ratings 2022



*Ness Digital Engineering

Source: Zinnov Research and Analysis, Zinnov Z1000 database

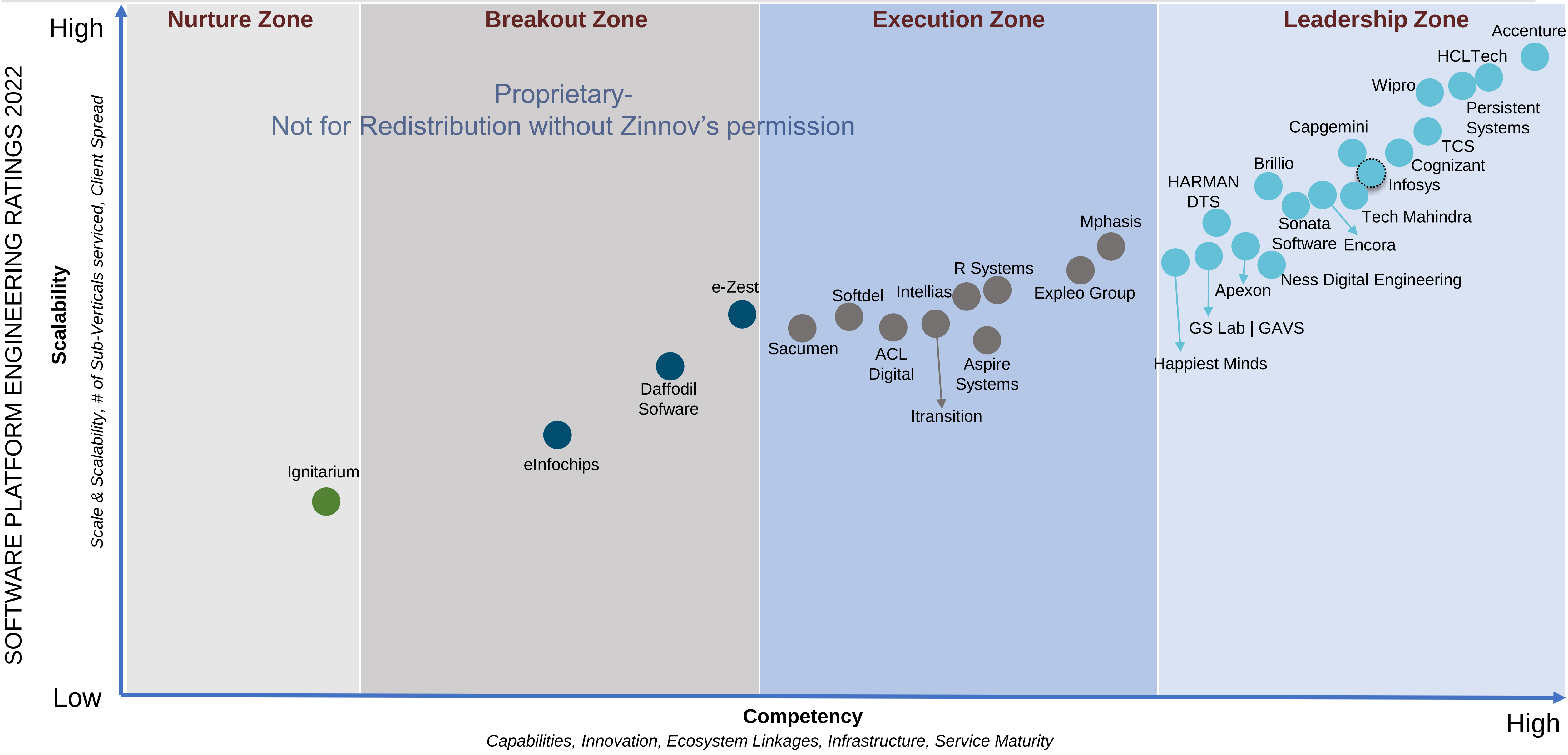
ER&D Services – Enterprise Software Ratings 2022 (Small & Medium Service Providers*)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

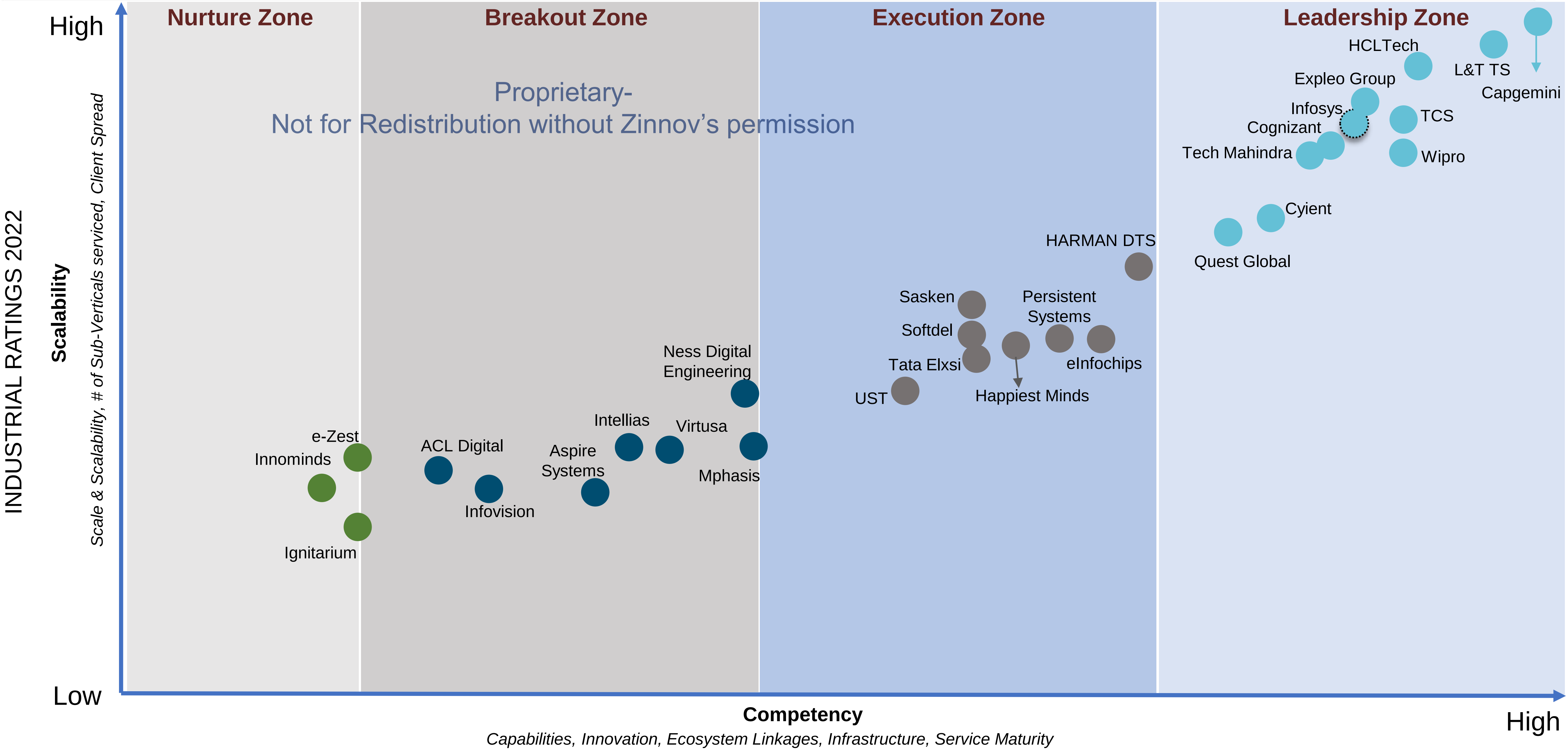
*Overall ER&D services revenue < USD 250 Mn

ER&D Services – Software Platform Engineering Ratings 2022



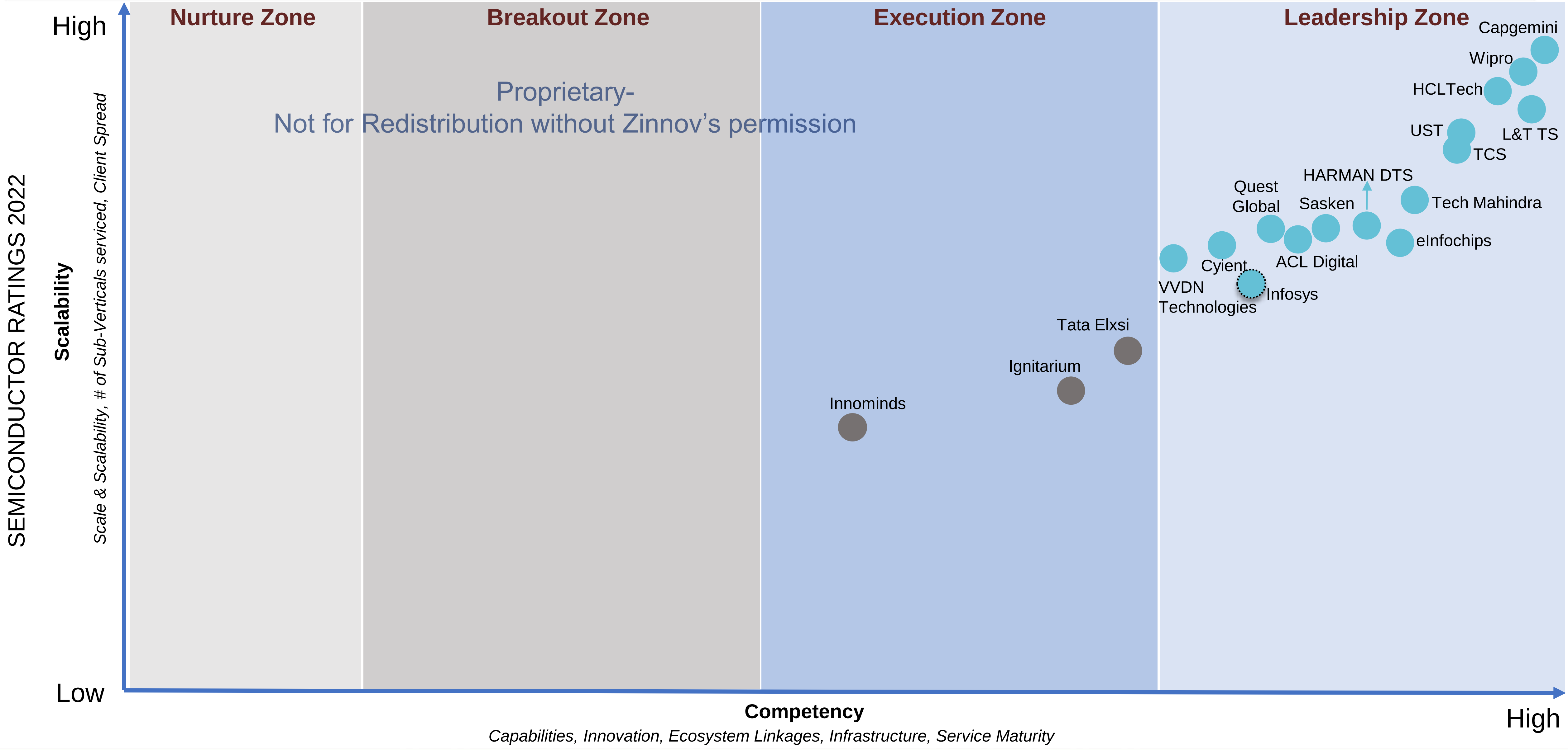
Source: Zinnov Research and Analysis, Zinnov Z1000 database

ER&D Services – Industrial Ratings 2022



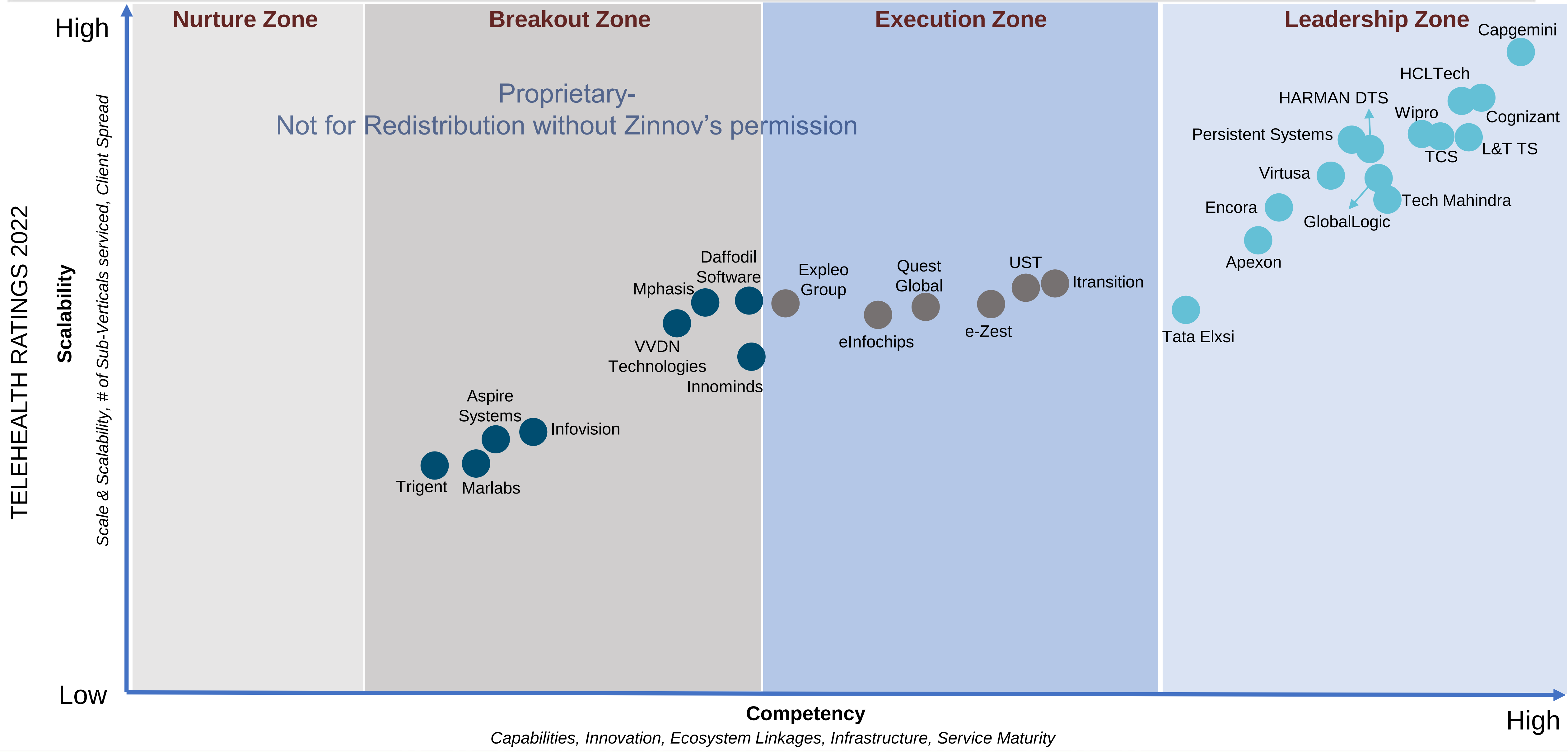
Source: Zinnov Research and Analysis, Zinnov Z1000 database

ER&D Services – Semiconductors Ratings 2022



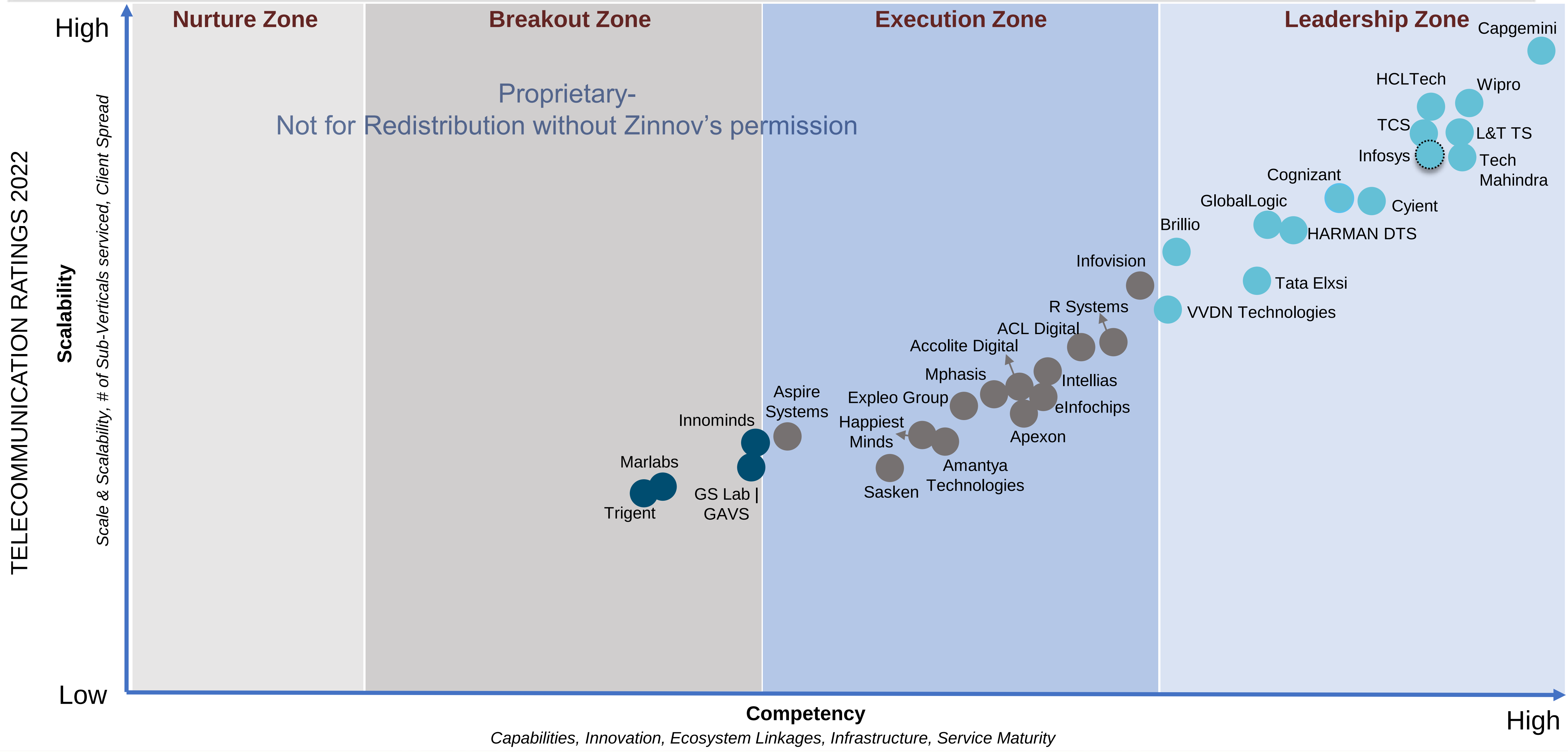
Source: Zinnov Research and Analysis, Zinnov Z1000 database

ER&D Services – Telehealth Ratings 2022



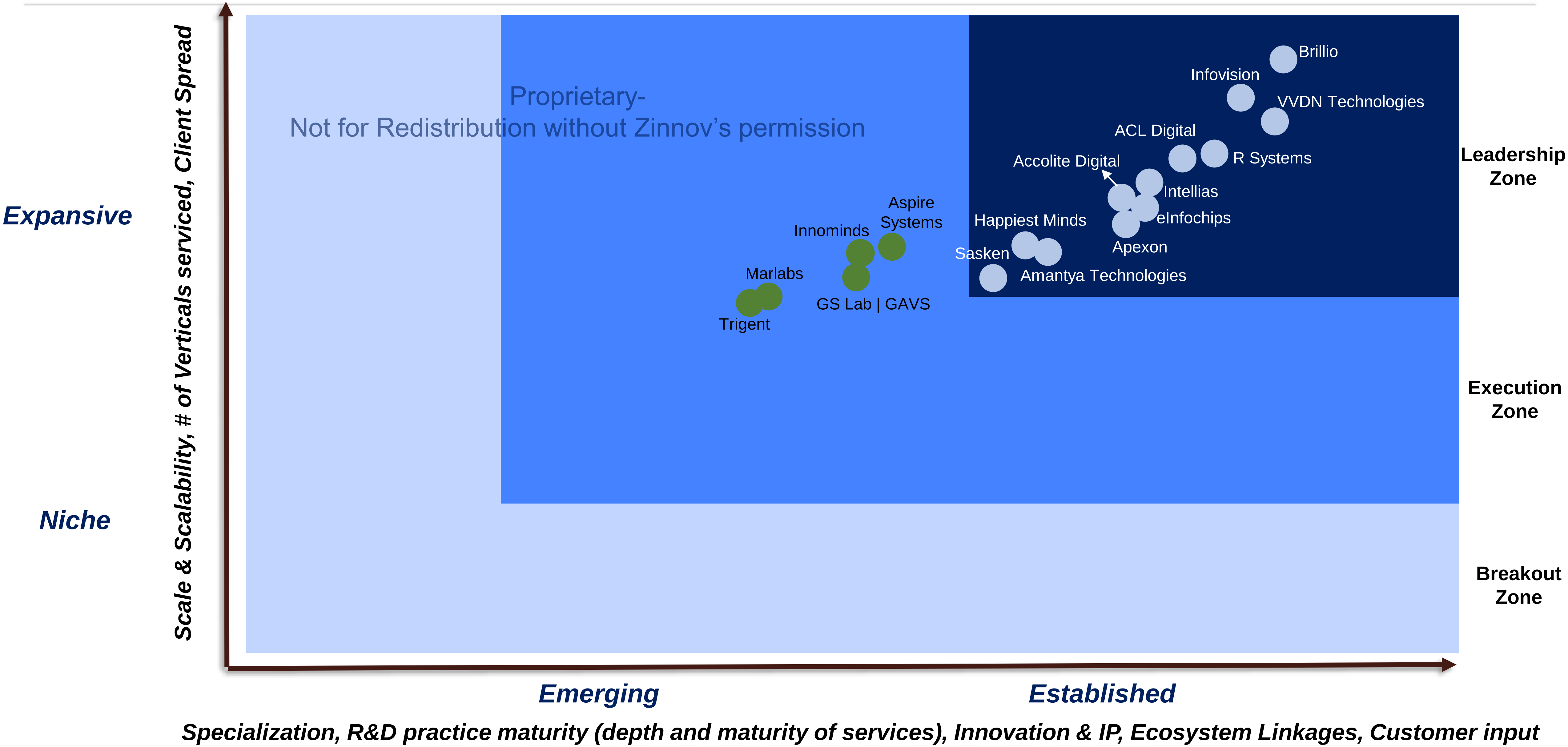
Source: Zinnov Research and Analysis, Zinnov Z1000 database

ER&D Services – Telecommunications Ratings 2022



Source: Zinnov Research and Analysis, Zinnov Z1000 database

ER&D Services – Telecommunication Ratings 2022 (Small & Medium Service Providers*)



Source: Zinnov Research and Analysis, Zinnov Z1000 database

*Overall ER&D services revenue < USD 250 Mn

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Source: Zinnov Research and Analysis, Zinnov Z1000 database

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