TECHNOLOGY PREDICTIONS 2026

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Surprises in 2026 Predictions

- The speed, depth, and breadth of AI adoption over the course of last year biased the prediction team to being more near-term focused
  - Literally all predictions were AI-related, -influenced, or -driven; six were directly related (slide 7)
  - Many more predictions have higher impact on humanity than likelihood of success, requiring more funding (slide 16)
  - This forced the team to introduce risk–reward categories from remaining honorable mentions (slide 11)
- Aggressive AI adoption enables or fosters:
  - new megatrends (health, energy, space, and robotics, slide 19)
  - new verticals (future of coding/work), and
  - new types of computing (in-memory, rack-scale, slide 7)

- It seems like AI-driven technologies are advancing at a much higher rate than any other previous revolutions (digital transformation, industrial revolution)
- Being a group of acknowledged technology experts, we have a bias toward believing in the “success” of technology. Therefore, a dedicated perspective on risks and rewards is introduced.
- The optimism about relatively immature technologies (e.g., Social AI, AI Personalities) is also reflected in the anticipated adoption in 2026

2026

TECHNOLOGY PREDICTIONS

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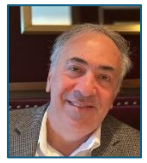

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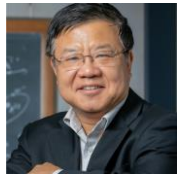

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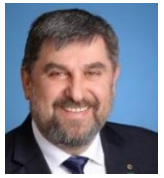
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Executive Summary

Technology Predictions: Broadening AI application across all verticals

IEEE Computer Society technology experts have unveiled 26 breakthrough technologies set to redefine industries and shape the future of our world for decades to come

The 114-member 2026 Technology Predictions team foresees:

- Accelerated growth in many AI facets, requiring reskilling of workforce
- Increased focus on new sources of power and energy to feed demanding application of AI
- Ever-increasing automation in many dimensions, setting the stage for additional AI opportunities
- Emergence of health/bio-tech/agro-tech and personal assistants by wearables and physical AI

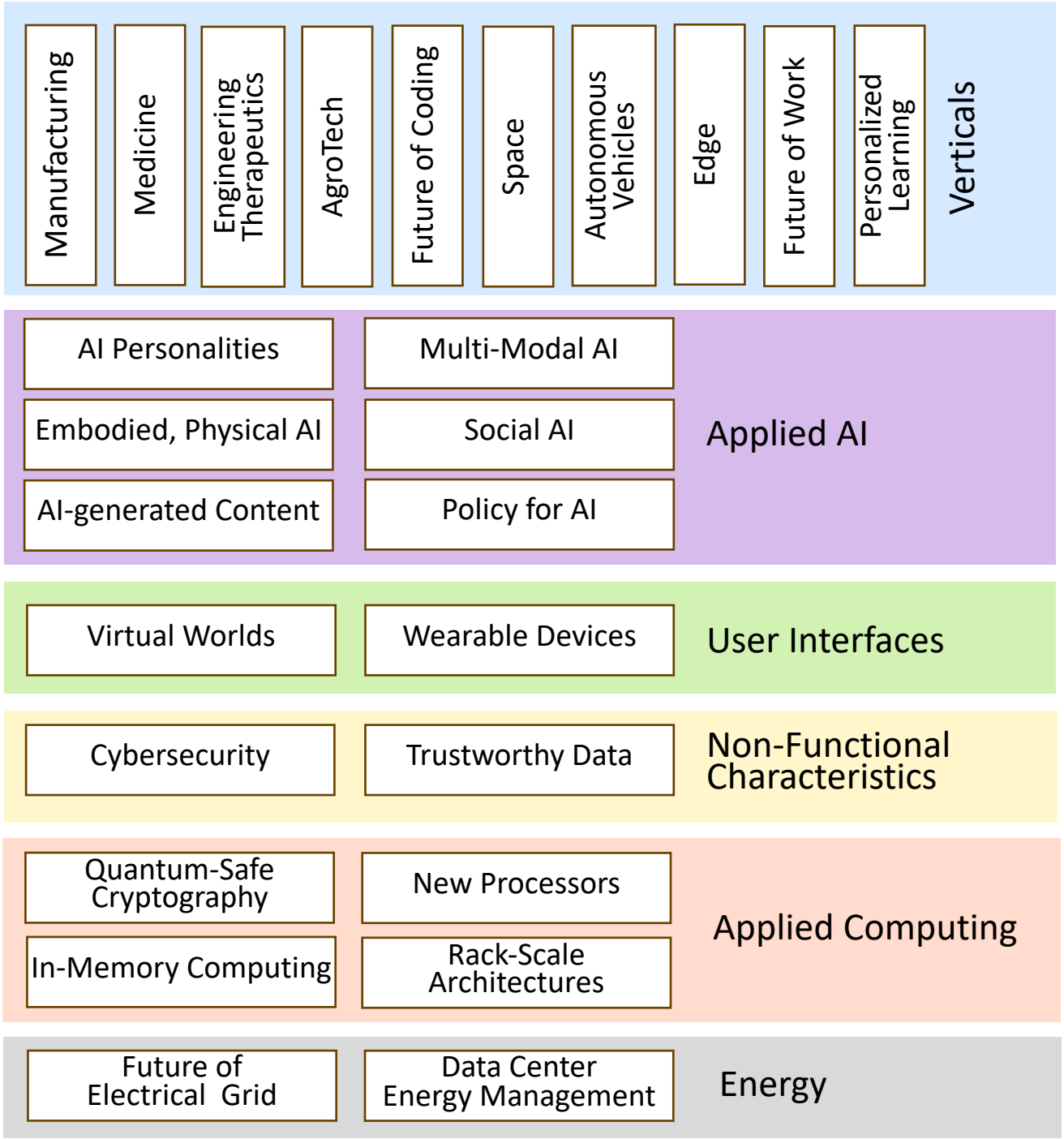
The 26 technology predictions (see next slide) were

- Made in 6 categories: verticals (10); applied AI (6); user interfaces (2); non-functional characteristics (2); applied computing (4); and energy-related (2)
- Evaluated for likelihood of success in 2026, impact to humanity, maturity, market adoption, adoption horizon (the most likely to succeed & adopted is AI-generated content; the most impact to humanity is in the future of medicine)
- Correlated and confidence interpreted as a standard deviation
- Mapped to the IEEE Future Directions Committee's (FDC) megatrends as a guiding principles for technology trends

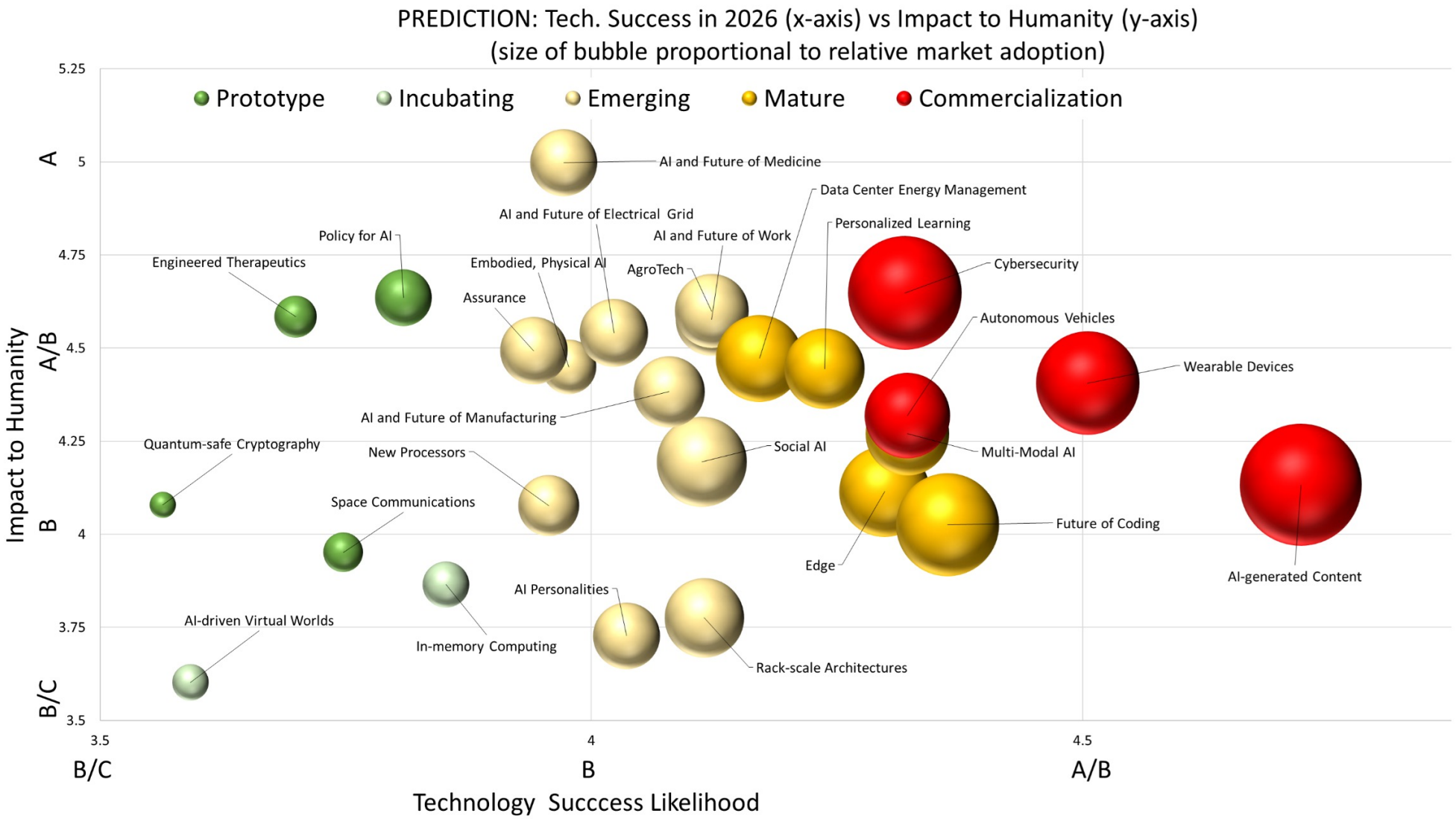
Among the predictions, the technologies most likely to scale are not only those with strong AI capabilities but also those supported by three recurring enablers:

- Trust/security
- Governance/policy, and
- Safe human–ai interaction (social AI)

Landscape of Predicted Technologies



2026 Technology Predictions



2026 Technology Predictions (votes, grade for tech development)*

1. **AI and Future of Work (150**, B):** AI agents will become standard “team members” for most knowledge workers. Competitive advantage shifts from headcount scale to intelligence leverage.
2. **Embodied, Physical AI (118, B):** Physical AI (Robots, Drones, Smart Devices): Physical AI will push intelligence into the real world, automating manufacturing, logistics, and urban infrastructure with autonomous, adaptive machines that sense, decide, and act dynamically—driving efficiency and safety.
3. **Wearable Devices (106, A/B):** New form factors for wearable devices will continue to integrate AI into everyday life in small, practical ways. These always-on, unobtrusive devices will push privacy concerns further to the fore.
4. **Data Center Energy Management (80, B+):** Scaling of datacenters to meet AI needs will force further innovation in energy production, management, and dissipation in datacenters.
5. **Social AI (80, B):** Artificial Emotional Intelligence - AI assistants will be tuned to detect mood, tone, and sentiment to master "soft skills" such as resolving misunderstandings, negotiations, etc.
6. **Edge (77, B+):** Edge AI will enable privacy-preserving, low-latency, energy-efficient, generative intelligence via small language models on resource-constrained devices, extending AI access to remote settings and extreme environments where continuous connectivity is not guaranteed.
7. **Space Communications (62, B-):** Satellite direct to cell/device communications will be accomplished using existing radio protocols without extra hardware on the device. Both cellular & Zero-Trust approach in Space-based 6G networks will be very effective to overcome perimeter-based protection.
8. **AI and Future of Electrical Grid (56, B):** The future power grid will be AI-driven, predictive, and increasingly autonomous.
9. **AI and Future of Medicine: Adaptive Bio-AI Interfaces Listen to Your Body (55, B):** Adaptive bio-AI interfaces that continuously sense and interpret human biological signals to adjust therapies, environments, or digital tools in real time will emerge as a breakthrough technology in 2026, marking the first true fusion of personalized health and intelligent computing.
10. **Assurance Layers in AI Pipelines (52, B):** Mandatory assurance layers (sandboxed tools, provenance tracking, misuse detection) become standard in foundation-model deployments.
11. **Autonomous Driving: Commercialization and Adoption (44, B+):** Autonomous mobility shifts toward compute-heavy, capital-intensive robotaxi services in dense cities, driven by digital twin-based training, increased safety, and a novel AI stack.
12. **Cybersecurity (43, B+):** In 2026, identity-first, AI-assisted security becomes baseline as ransomware and supply-chain pressure will force CTOs to consolidate platforms, prove MTTD/MTTR, and harden data/software supply chains under tighter regulation.
13. **Future of Coding (42, B):** Vibe coding, facilitated by AI-native development platforms, will increasingly be used by non-developers to produce functional code using "prompts" and natural language descriptions, giving new meaning to low-code/no-code.

**Please see backup slides for more detailed description (1 slide summary of Problems/Demand, Opportunities, Impact, and Sustainable Solution/Business Opportunity (including Enablers/Inhibitors) for each prediction.*

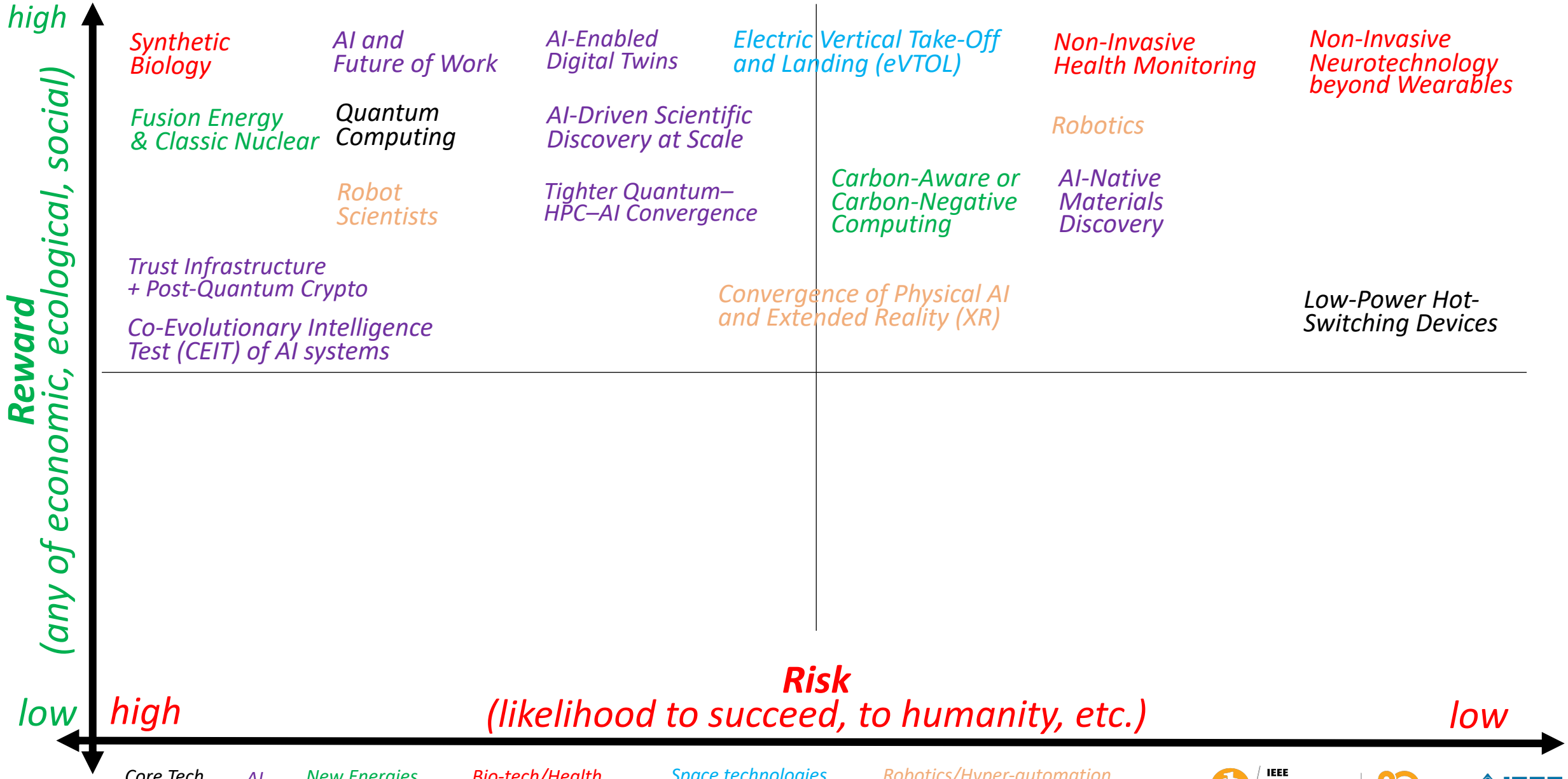
***Some technologies have more votes than there are authors, this is because we rolled up multiple technologies into one after voting.*

2026 Technology Predictions (votes, grade for tech develop)*

14. **AgroTech (37, B):** Artificial Intelligence as a support tool to enhance and predict agricultural productivity, improving the quality of consumer products while reducing costs.
15. **Rack-Scale Architectures (34, B):** Rack-scale architectures optimized for the IT-Power on-off Grid domains cross-management will improve power and energy efficiency of next-generation data centers, by shaving power peaks, balancing sources of power, individually and across multiple data centers.
16. **Multi-Modal AI (34, B+):** Intelligent systems transcend single-modality constraints, unifying language, vision, audio, 3D, and sensor data for comprehensive understanding.
17. **In-memory Computing for AI (33, B-):** Analog in-memory computing will bring computation directly into memory arrays, dramatically reducing data movement, the dominant source of power and latency in today's AI systems, delivering order-of-magnitude improvements in performance-per-watt from edge devices to data centers.
18. **Policy for AI (32, B-):** Governments and organizations will impose ethical and responsible AI and will drive its use to unleash human potential and serve humanity in areas such as improving health while emphasizing fairness, transparency, privacy and human oversight to mitigate risks like bias.
19. **AI-Generated Content (31, A-):** AI transforms how videos, music, presentations, documents, and multimedia content are made and consumed. But it raises questions about authenticity, creativity, and economic disruption.
20. **Engineered Therapeutics (31, B-):** In 2026, we will see the use of genetic/synthetic biology for the treatment of medical aliments in humans. This will include Living Therapeutics (ETLs) and non-living molecules and materials.
21. **AI Personalities (30, B):** 2016 will see the rise of a range of AI generated actors, presenters, influencers, newsreaders, etc., which by late 2016 will not be easily distinguishable from humans fulfilling these roles.
22. **New Processors (28, B):** New processors should offer 1000 times performance improvement and 1000-fold power consumption reduction – This can be achieved by exploring and integrating new technologies and full free 3D architectures with support of AI-based design strategies.
23. **Quantum-Safe Cryptography (27, B/C):** Quantum-safe cryptography will be a key area of development and standardization to de-risk the increasing threat of quantum computing breaking current encryption algorithms.
24. **AI-Driven Virtual Worlds (25, B/C):** Autonomously generated, adaptive, and personalized Virtual Worlds created by AI models that synthesize 3D content, narrative, and social interactions, driving system decisions and behaviors in real time.
25. **Future of manufacturing (25, B):** Enabling least lifetime-energy products.
26. **Personalized Learning (22, B+):** Long desired in pedagogical theory and practice, teaching that can be adapted to the path and pace of an individual student can be a better experience and result in better outcomes for the learner. AI tools and capabilities are making this possible in valuable and cost-effective ways.

**Please see backup slides for more detailed description (1 slide summary of Problems/Demand, Opportunities, Impact, and Sustainable Solution/Business Opportunity (including Enablers/Inhibitors) for each prediction.*

Risk-Reward Analysis for Select Honorable Mention Technologies

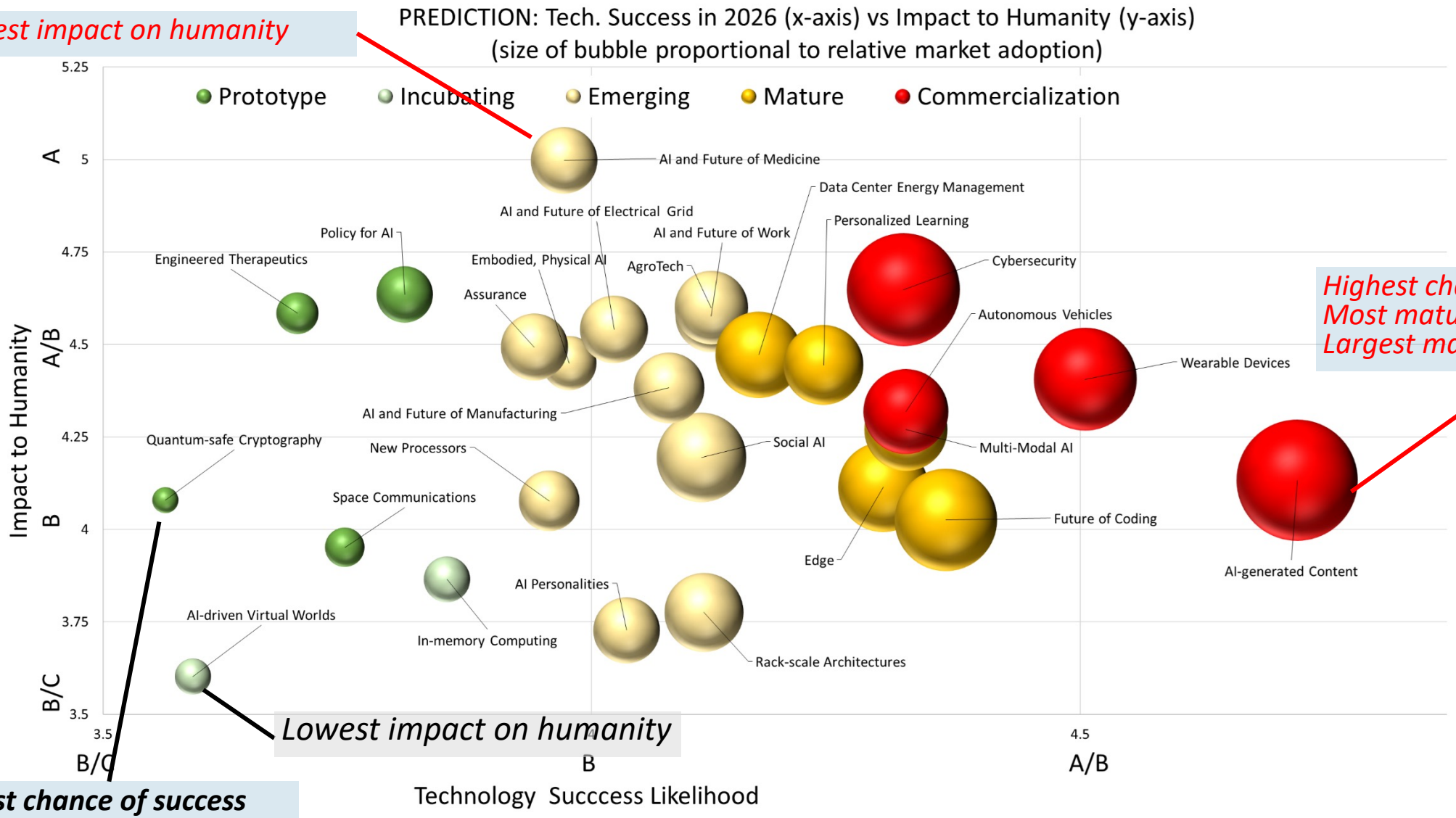


Technologies with High Risk-Reward Beyond 2026

Technology	Comparison	
	Risk	Reward
Electric Vertical Take-Off and Landing (eVTOL)	Major pending hurdles to maturity and adoption are related to regulatory oversight concerning safety and air traffic control.	It could bring improvements to urban mobility, although scaling it for massive adoption is uncertain.
Fusion Energy and Classic Nuclear	Consequence of broad adoption of nuclear processes and lack of equipped workforce to oversee and react to catastrophic events.	Cheaper and cleaner energy delivered off Grid without the need for transportation and easier to manage
Convergence of Physical AI & eXtended Reality (XR)	Larger attack surface for humans as well as giving away more control to AI (and AGI eventually)	More credible XR, with closer loops and enabling new applications and development of high fidelity immersive interactive experiences
Quantum Computing	Inability to achieve stable and reliable computing at large scale resulting in the wasted investments	Enabling new scientific experiments impossible to conduct with classical computing
Robot Scientists	Some experiments can get away or lead to incorrect conclusions	Accelerating science
Low-Power Hot-Switching Devices	Unproven technology with limited testing, risk of large-scale deployment	Communication systems require hot-switching at high frequency, with negligible losses and with high reliability.
Robotics	Lack of control can lead to catastrophes	Assist humankind especially in risk environments
Co-Evolutionary Intelligence Test (CEIT) of AI systems	Attack surface for testing AI and enabler towards uncontrolled AGI	If done right, a safer AI and control points for guardrails
Trust Infrastructure including Post-Quantum Crypto	Continued misinformation at largest scale	Trust is in essence of everything
Synthetic Biology	Huge risk in generating new viruses	Huge opportunity in medical and other bio-tech
AI and the Future of Work	Trust shifts from institutions and humans to opaque systems	Knowledge management and productivity
AI-Driven Scientific Discovery at-Scale	Confidence in optimal findings	Substantial advancement in scientific discovery
AI-Native Materials Discovery	Reliability and durability of these materials will take some time to prove	New features enabling additional deployment of AI, in space, etc.
Carbon-Aware or Carbon-Negative Computing	Timing of these discoveries is critical	Assist against global warming and shortages of water
Non-Invasive Neurotechnology beyond Wearables	Long term impact on bodies despite non-invasiveness and effectiveness thereof	Substantial cost reduction and increase in adoption
Tighter Quantum–HPC–AI convergence	Relatively low, given the speed of quantum in its own right tighter integration is the safest bet. Risk is if quantum if never pans out.	HPC and AI-ready Quantum technology if/once it gets developed
AI-Enabled Digital Twins	Data security vulnerabilities, biases in decision making and accountability for autonomous decisions	Lowering of costs through emulation (vs. replication), predictive maintenance, optimized operations
Non-Invasive Health Monitoring (through Quantum Sensing and AI)	Deployment with inadequate testing can be disastrous	Can revolutionize access to and efficiency of health monitoring, affording more focus on care administration

Comparing 2026 Technology Predictions, Lowest/Highest

Largest impact on humanity



Highest chances of success
Most mature
Largest market adoption

Lowest impact on humanity

Lowest chance of success
Lowest market adoption
Lowest maturity

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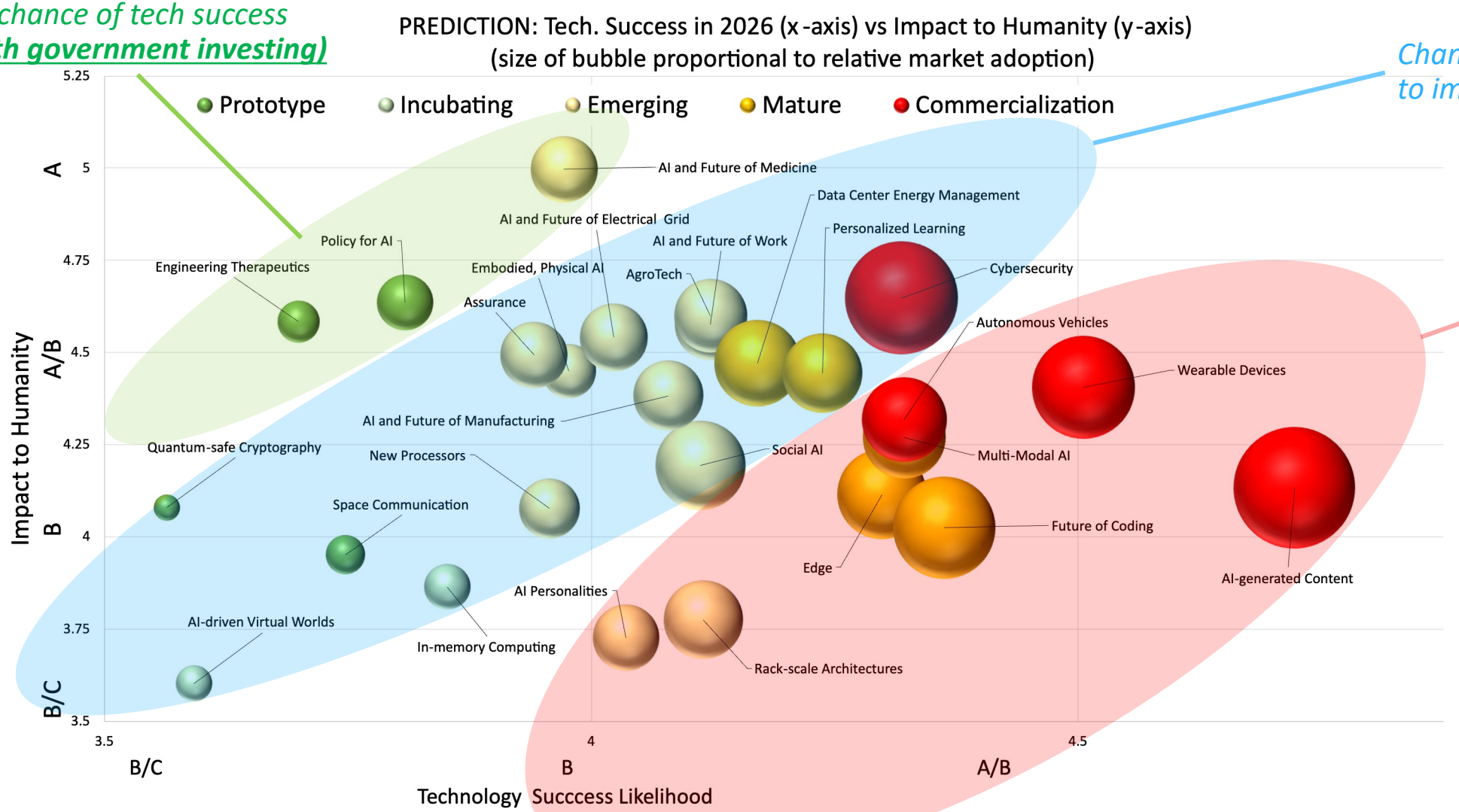
Comparing 2026 Technology Predictions, Outliers

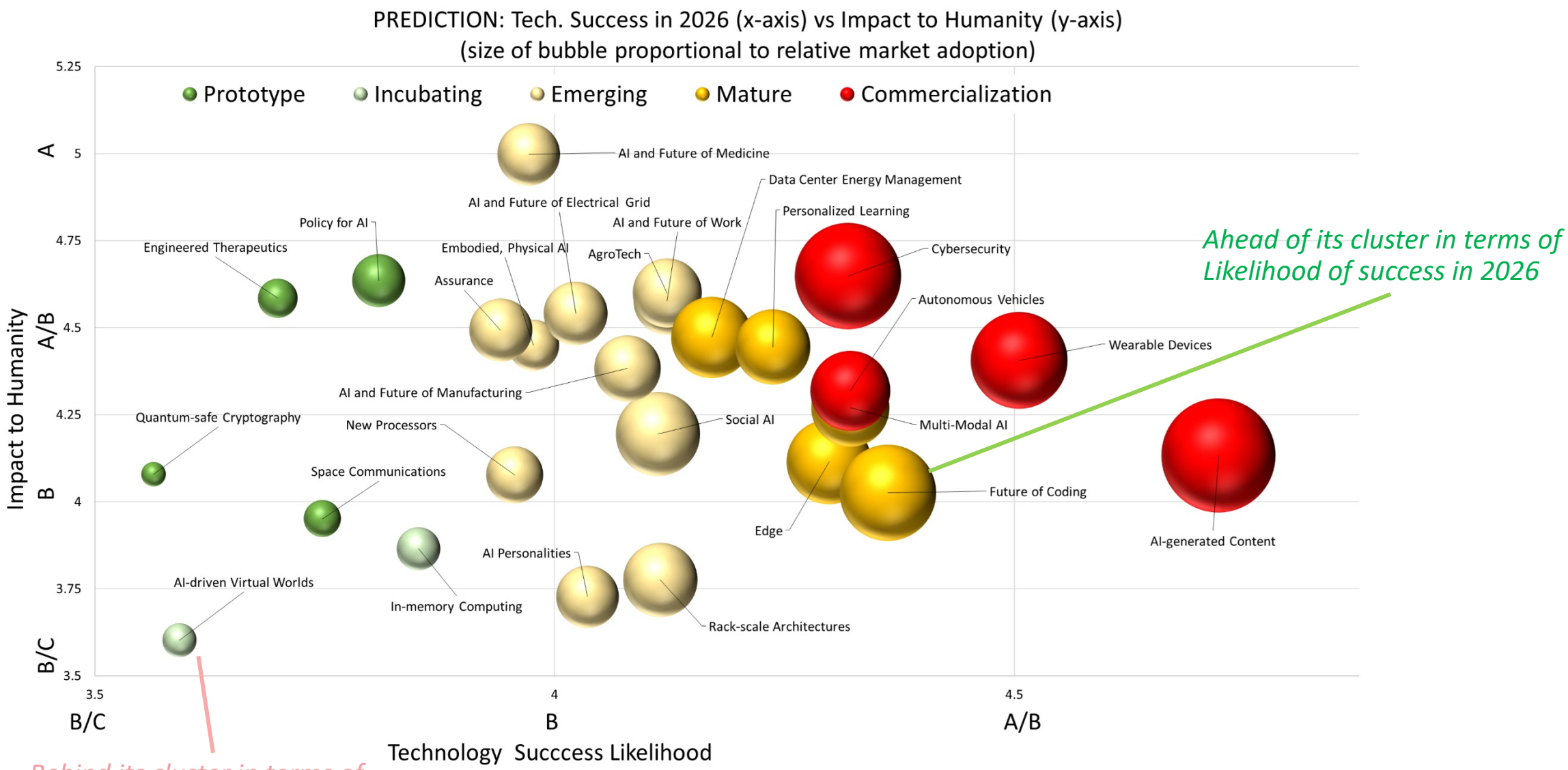
Impact on humanity higher than chance of tech success ***(worth government investing)***



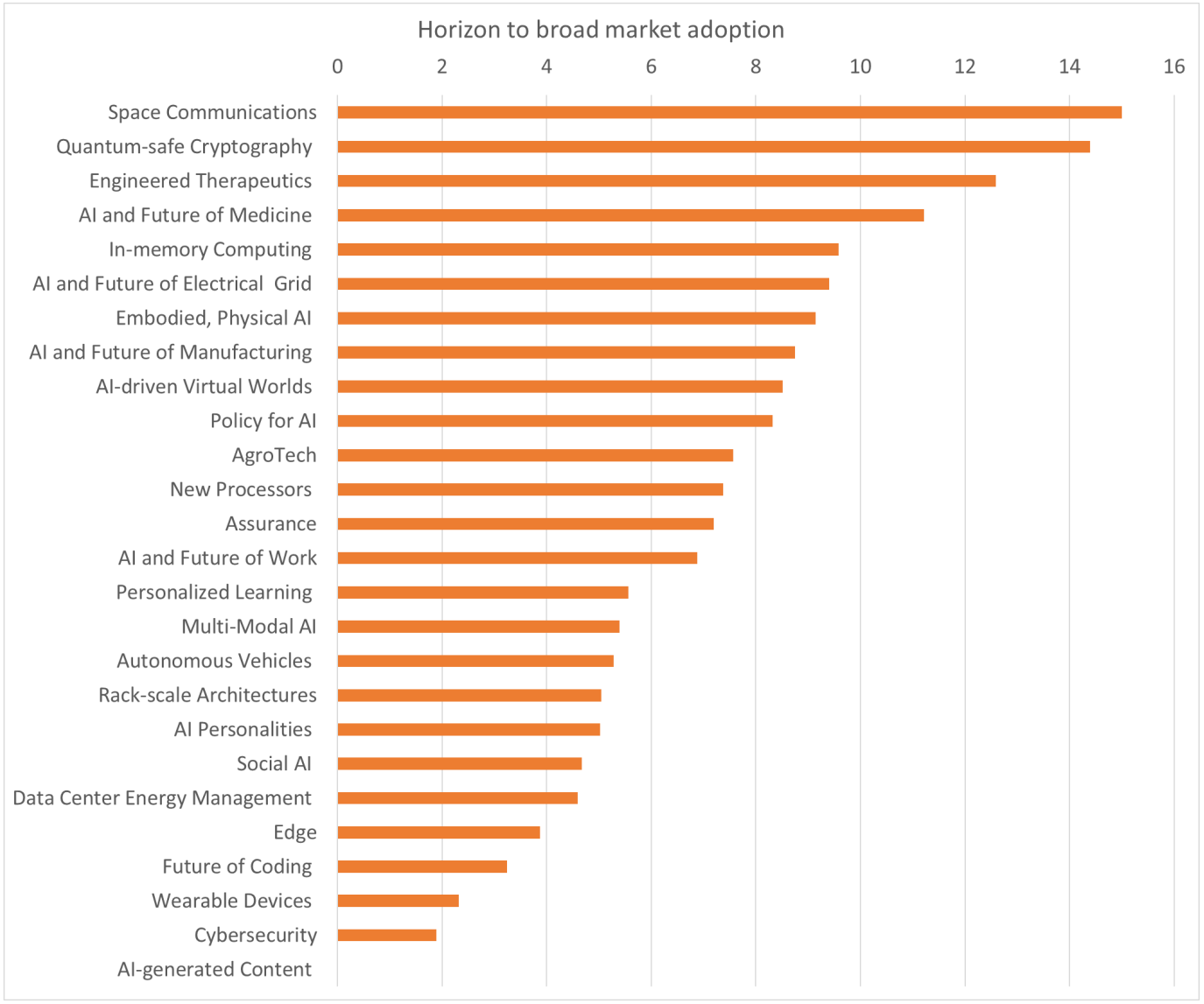
Chance of success correlates to impact on humanity

Chance of tech success higher than impact on humanity ***(worth industrial investment)***

Comparing 2026 Technology Predictions, Outliers, cont.



Horizons to Commercial Adoption*



Requires research;
Opportunity for academia**
(out-of-box thinking, inventions)

Requires increasing readiness level;
Opportunity for governments**
(funding, regulations)

Requires industrialization and standardization;
Opportunity for professional organizations** (standards, future directions, roadmaps)

Requires commercialization;
Opportunity for industry**
(inventions, productization, new markets)

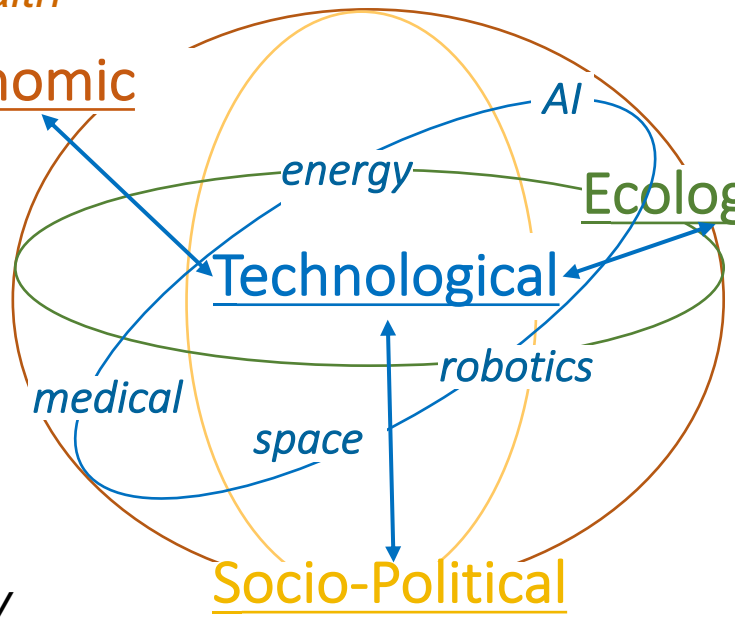
* *Horizon to commercial adoption was linearly normalized from inputs to [0,15] years.*

** *See also slide 22 for detailed recommendations to each of four stakeholders*

Insights and Opportunities

- **Insights for 2026**
  - Technology with most advancement, largest market adoption, and market maturity is AI-generated content (A-)
  - Technology with highest potential for impact on humanity is Future of Medicine (A)
  - Adoption bottlenecks are Trust + Power: identity/provenance, assurance, and software supply-chain controls + data-center/grid energy constraints
  - Long-term opportunity is in Space Technologies (intelligent non-terrestrial networks; satellite to cell communications; nano satellites as a service; zero-trust approach in space-based 6G networks)
- **Insights across Years**
  - AI strengthened its absolute dominance compared to previous years
  - We see continued need for trustworthiness and cybersecurity
  - The competitive shift is from capability to assurance: outcome metrics, audit-ready evidence, and evaluation frameworks increasingly determine deployment at-scale
  - Compared to last year, we see substantial decline in sustainability- and ethics-related technologies and concerns
- **Longer-Term Broader Opportunities with Optimal Risk-Reward Ratio**
  - Electric Vertical Take-Off and Landing (eVTOL)
  - Fusion Energy
  - Robotics and Robot Scientists
  - Quantum Computing
  - Convergence of Physical AI and Extended Reality (XR)
  - Low-Power Hot-Switching Devices

Technology- vs General-Megatrends



emerging markets

cost of climate change

increasing environmental pollution

emerging global wealth

climate change and resource scarcity

shifting economic power

biotech/synthetic biology

liability due to automation

globalization

changing disease burdens, risk of pandemics

Increasingly Multi-Polar World

mobility

demographics and social change

rapid urbanization

labor impact due to AI

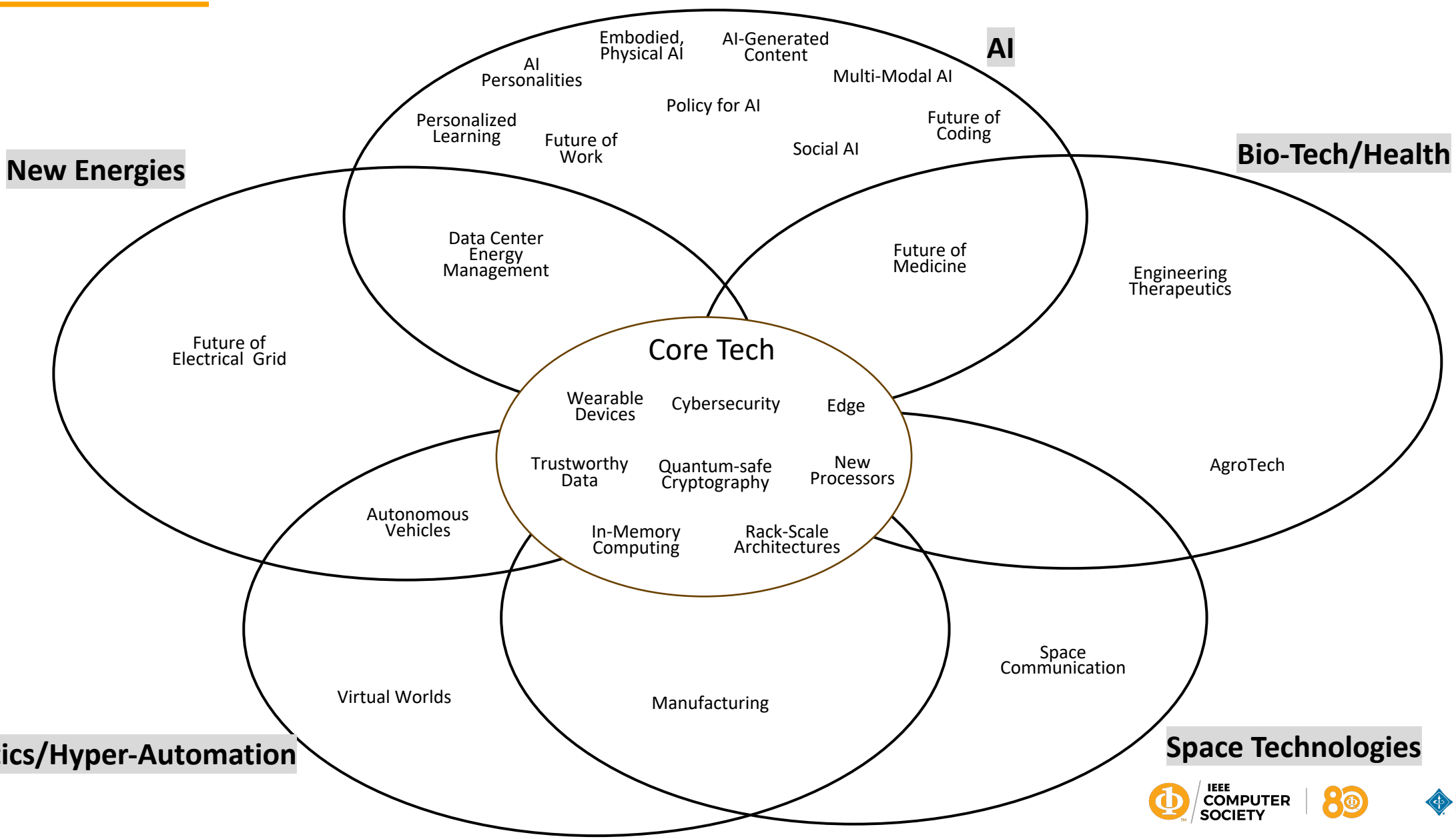
techno-nationalism

aging population, health

government tracking

A variation of this Figure was originally published in C. Bash, K. Bresniker, P. Faraboschi, T. Jarnigan, D. Milojicic and P. Wood, "Ethics in Sustainability," in IEEE Design & Test*, vol. 41, no. 1, pp. 25-32, Feb. 2024*

Technologies Mapped on FDC Megatrends



Impact on the Workforce (Individual Skills Evolution) of the Predicted and High Risk/Reward Technologies

Skills Impact Trending						
Core Technologies	**AI**	**Health/Bio-Agro-Tech**	**New Energies**	**Space**	**Robotics/ Hyper-Automation**	**Soft-Skills**
Wearable Devices ↑↑	AI-Generated Content ↑↑	AI & Future of Medicine ↑↑	Grid ↑↑	Manufacturing ↑↑	Autonomous Vehicles ↑↑	Social AI ↑↑
Cybersecurity ↑↓	AI & Future of Work ↑↑	Engineering Therapeutics ↑	Data Center Energy Mgmt ↑↑	Space communication ↑	Virtual Worlds →	Critical Thinking ↑↑
Edge ↑↑	Embodied, Physical AI ↑↑	AgroTech ↑↑	Sustainable fusion energy →	Electric Vertical Take-Off and Landing (eVTOL) →	Robotics ↑↑	Systems Engineering ↑
Trustworthy data ↑↑	Multi-Modal AI ↑	Synthetic Biology ↑↑	Carbon-Aware or Carbon-Negative Computing ↑		Convergence of Physical AI and eXtended Reality (XR) →	Adaptability and Flexibility ↑↑
Rack-Scale Architectures ↑	AI Personalities ↑	Non-Invasive Neurotechnology beyond Wearables ↑			Robot Scientists →	Emotional Intelligence ↑
New processors ↑	Policy for AI ↑	Non-Invasive Health Monitoring ↑			Low-Power Hot-Switching Devices →	Communication ↑
In-Memory computing →	Future of Coding ↑↑				Co-Evolutionary Intelligence Test (CEIT) of AI systems ↑↑	Collaboration ↑↑
Quantum-safe Cryptography →	Personalized Learning ↓↓				AI-Native Materials Discovery ↑	Managing change ↑↑
Quantum computing ↑	AI-driven scientific Discovery at-scale ↑↑				AI-Enabled Digital Twins ↑	Liability awareness ↑
Trust Infrastructure + post-quantum crypto →	Tighter Quantum–HPC–AI Convergence →					New learning patterns ↑

Impact on existing workforce

- ↑↑ *Substantial growth*
- ↑ *Growth*
- ↗ *Some growth*
- → *Stay the same*
- ↘ *Some decline*
- ↓ *Decline*
- ↓↓ *Substantial decline*
- ↓↑ *Skills change, some decline, some growth*

Color coding of the cell entries

Five megatrends identified in the forthcoming FDC Megatrends 2026 report

One of 26 technologies

Added risk-reward technologies

Added soft skills

Megatrends-Related Insights*

- **From Megatrends Perspective we have**
  - Dominant AI Megatrend: 9 exclusive AI technologies
  - 8 Technologies are core and address all megatrends
  - Each of the other 4 megatrends was represented by 2 or 3 technologies
  - There was a lot of overlap with technologies covering two megatrends
- **Socio-Political, Economic, and Ecological aspects continue to be deeply entangled, e.g.**
  - The ethical and socio-political aspects of policy for AI, AI personalities, and space technologies
  - Copyright issues are being addressed in AI-generated content
  - Regulatory aspects of trustworthiness and cybersecurity
  - Economic aspects of AI hardware, energy, and data center management

* See 2024 FDC's Megatrends Report https://bit.ly/get-megatrends, and also forthcoming 2026 Megatrends Report (to publish in Mar-Apr'26.

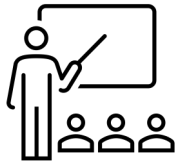
Targeted Recommendations

Industry

- The largest business opportunity across industry is in **AI-generated content** and **wearables**
- **Future of coding** is dramatically changing DevOps models
- Take advantage of new business opportunities and democratize entrepreneurship by embracing **Future of coding**. Deliver **AI Agents** to complement human labor.
- Leverage n**ew processors** and **in-memory computing** in tech evolution
- Explore r**ack scale architectures** as forthcoming business opportunity
- **Future of medicine** and **Policy for AI** will be slowed down by lack of regulation
- **Establish data sovereignty frameworks** (prioritize "open-weight" models and local hosting to protest corporate IP while using advanced reasoning agents)
- Build an **AI trust stack**: identity-first access (passkeys/MFA, PAM, least privilege), **secure agent operations**, provenance/content authenticity, and **audit-ready telemetry**

Government

- Regulate, sponsor, and encourage **Policies for AI** and **Medical Tech**
- Build "**AI-Ready**" infrastructure
- Invest in tools and policies for AI regulation applied to broad verticals, e.g. **AI generated content** and **autonomous vehicles**
- Understand, define, and regulate **trustworthy data**
- Invest in **future electrical Grid** and **manufacturing**
- Foster industry to drive **data center energy management**
- Invest in some of highest risk-reward tech, such as fusion energy and eVTOL
- Start modeling **Future of Work** impact on jobs, education needs, tax
- Standardize AI incident response (a federal-level capacity for reporting and mitigating AI-related failures)
- Leverage **Future of Coding** to reinvigorate and decentralize sustainable solution development
- Treat **governance as adoption infrastructure**: baseline incident disclosure, testable trustworthy-data requirements, and security controls that enable innovation while reducing legal/financial risk



Academia

- Research and prototype **space communication** and **engineering therapeutics**
- Make breakthroughs in **AI for the future of Medicine**
- Evaluate new approaches for **Policy for AI**
- Explore the near-/medium-term opportunities in **space computing**
- Increase cross-technology curricula in **trustworthiness**
- **Launch "Agentic Literacy" programs** (trans-disciplinary curricula; outreach to the general population too)
- **Adopt "Human-in-the-loop" assessment models** (Shift grading toward the process of inquiry and critical evaluation of AI outputs)
- Research on marking, detection and identification of **AI generated contents**
- **Update curricula** to adapt to new forms of digital literacy (e.g., expertise in communicating with AI systems vs writing code)
- Advance **measurement science** for deployment: evaluation frameworks for reliability/safety, synthetic-content marking/detection, and human–AI interaction safety for Social AI applications

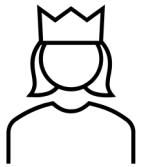
IEEE
Advancing Technology for Humanity

Professional Organization

- **Define "Identity Resilience"** standards (protocols (like P3923) to distinguish between human and AI-generated identities to prevent deepfakes and fraud)
- Formalize IEEE P3777 for **AI Agent benchmarking** (finalize standard metrics for evaluating the performance, reliability, and safety of autonomous agents in industrial settings)
- Introduce best practices and standards for **Future of Coding**
- **Standardize wearable fall and health detection** (P3925) (establish clinical-grade benchmarks for wearable devices to ensure they are reliable enough for medical-legal decision-making)
- Consider standardizing the protection and monetization of data
- Redefine traditional roles and refresh workforce training to adapt to job-market disruption caused by the **Future of Coding**
- Prioritize standards for **assurance at scale**: identity resilience and provenance, trustworthy data lineage, and agent/system benchmarking to support auditability and safe commercialization
- **Organize events in applied AI:** in health, energy, trust, coding, and many other areas

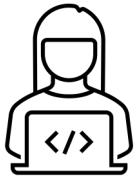
IEEE COMPUTER SOCIETY | 80 | IEEE

Targeted Recommendations, Cont.



End User

- Learn how to daily use **LLMs** and **AI agents** most effectively
- Upskill for using **AI and agents** in work
- Acquaint with **Physical AI** and **wearables UIs**
- Develop "**Verification literacy**" (cultivate the critical thinking skills necessary to audit and validate AI-generated outputs for bias, hallucination, or error)
- Learn how to use or interact with technologies or co-designed with AI
- Include **synthetic media + identity awareness** (deepfakes, spoofing, manipulated content) as part of verification literacy

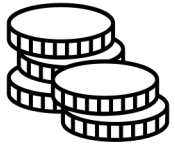


Developer

- Heavy **AI adoption** in development to increase productivity
- Increase **automation**
- Attention to **energy efficiency** in code development and operations
- Take advantage of the **Future of Coding** to focus more on intent than syntax and semantics
- Implement "**Evals**" as standard (beyond unit tests to building "**Evaluation Frameworks**" that measure the reliability and safety of non-deterministic AI features)
- Extend “evals” to **security + misuse**: prompt injection, tool abuse, data exfiltration, and software/model supply-chain integrity (SBOM, signed artifacts)

C-Suite

- Modernize workforce to learn how to use **using AI & AI Agents**
- Apply **AI-assisted-*** most any vertical
- Automate with new approaches, such as robotics
- Design "**Agentic-First**" business units (reorganize departments around intelligence leverage rather than headcount, where human-AI teams are the fundamental unit of work)
- Run AI like a critical system: set **outcome SLAs** (reliability + security), require eval gates, and maintain **audit-ready evidence** for compliance and risk financing



Investor

- Leverage unlimited opportunities with **AI**
- Explore business based on **new energy sources**
- Explore opportunities in **Smart Agriculture**
- Devise business models in new **transportation models**, **AI in health and biotechnology**
- Fund research in high-risk/high-reward technologies, such as: **new materials**; **synthetic biology**, **sustainable fusion energy**, **non-invasive monitoring**
- Favor ventures with **built-in trust/compliance** (identity, provenance, eval-driven safety) as a go-to-market advantage across regulated and human-facing markets.

Portfolio of Predictions

- Archive of annual IEEE CS Tech Predictions & scorecards
- IEEE Future Directions Megatrends Report: https://bit.ly/get-megatrends (over 3250 downloads), 2026 edition will be published in March-April 2026 time frame
- Special issues of IEEE Computer (, 2024, 2023, 2022, 2021, 2019, as well as the forthcoming 2026 outlook
- IEEE Computer "Predictions" Columns (…., Sustainability, Digital Transformation, Megatrends, AGI, Heterogeneity /Serverless, Performance, Energy4DataCenters, DigitalTwins, Convergence of IT & Energy Sector, Energy IT Modernization, Future of Supercomputing, Future of Data), entering the 6th year
- IEEE SCVS Industry Spotlights (Megatrends, AI, Sustainability, Digital Twins, Convergence of IT and Energy Sectors), co-sponsored by IEEE Santa Clara Valley Section, IEEE Future Directions, IEEE Computer Society, and IEEE Industry Engagement
- Special Features
  - IEEE SSE, "The Art of Prediction"
  - IEEE COMPSAC: "The Technology Megatrends Predictions Retrospective and Outlook"
  - IEEE Design and Test, "Ethics in Sustainability"
  - IT Professional "What Gets You Hired Now Will Not Get You Hired Then"
- Many webinars, podcasts, keynotes, invited talks, panels, etc.
  - SXSW panel: "AI: Prosperity or Doom for Human Workforce?"
  - CRA Panel on "AI Undergraduate and Graduate Education and Research"
- Course "High Performance Computing: Use of AI and Emerging Technologies in Science"
- Reports: IEEE CS Report 2022 (2015); Future of Workforce (2023); Future of Workforce in Africa forthcoming (2026)

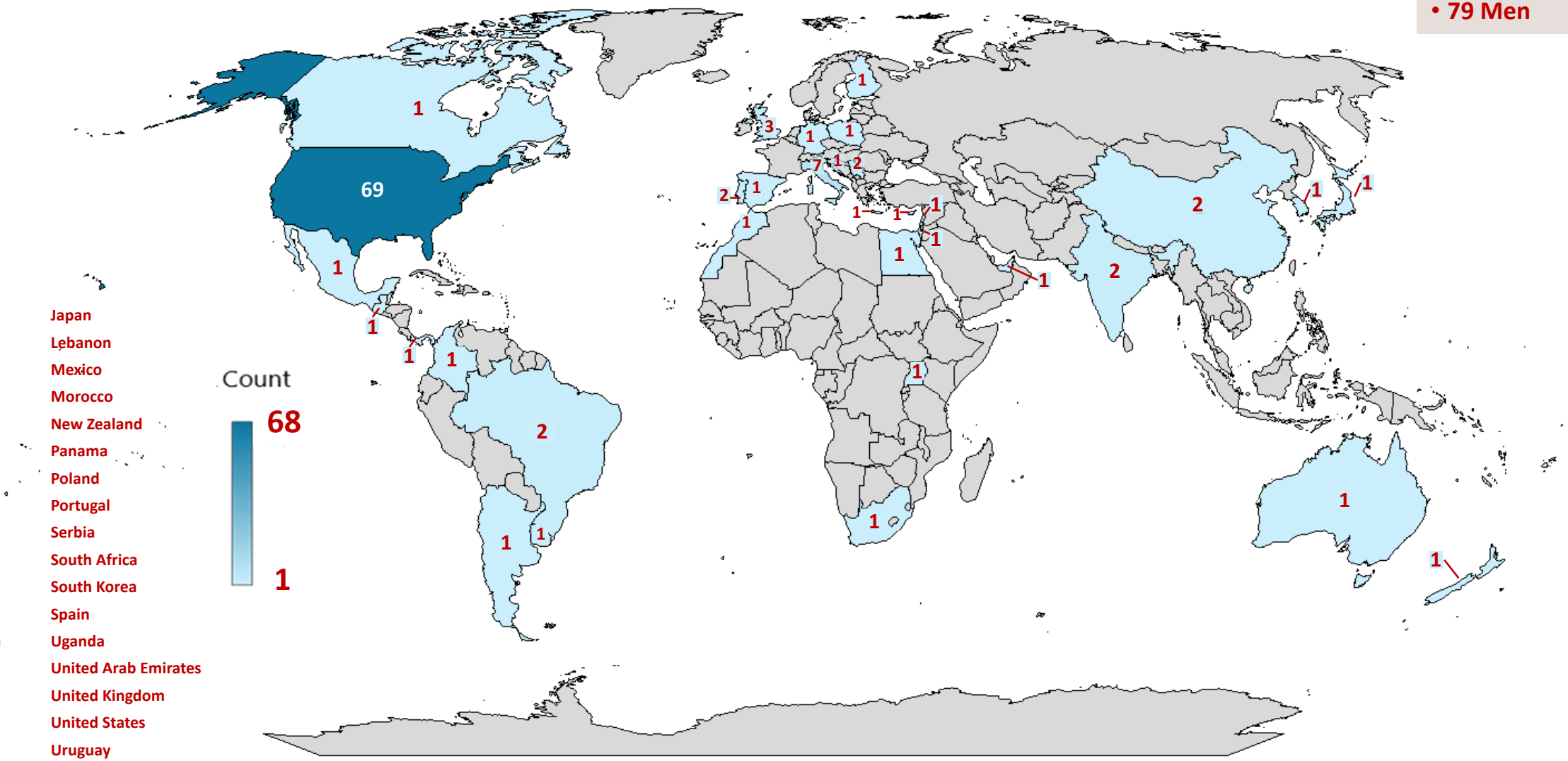
Summary

- **Outlook**
  - All technology advancements have been heavily fueled by AI and will continue to do so
  - AI has accelerated other megatrends, such as energy, health, space, and robotics sectors
- **Predictions**
  - We made twenty-six predictions in six broad areas (energy, applied computing, non-functional characteristics, applied AI, user-interfaces, and verticals)
  - We graded our predictions in terms of likelihood of technology success in 2026, impact to humanity, maturity in 2026, market adoption in 2026, and horizon to commercial adoption
  - Predicted technologies show a degree of correlation, but with a more diverse roster we got less correlation this year
- **Honorable mentions—technologies that barely did not make a cut**
  - Electric Vertical Take-Off and Landing (eVTOL), Digital Twins, and Extreme Surveillance
- **Future work**
  - We continue to eliminate bias, as demonstrated by correlation and standard deviation
  - At the end of the year, we will prepare a scorecard on how technologies succeeded against our predictions
  - To improve the depth and accuracy of future predictions, we aim to increase collaboration with industry experts, academic institutions, and regulatory bodies
  - We will show trends over time and compare with past outlooks
  - We will deepen the analysis of impacts, add risks and state of the art for each topic
  - We will continue to increase diversity on the Technology Predictions team (regional, topical, organizational, gender)
  - We are considering to complement team growth with conducting a broad survey
    we currently pilot this with the Megatrends effort (see slide 75)

Additional Materials

2026 Technology Predictions Team by Geography

6 Continents
33 Countries
114 Contributors
- 35 Women
- 79 Men



Argentina
Australia
Brazil
Canada
China
Colombia
Crete
Croatia
Cyprus
Egypt
Finland
Germany
Guatemala
India
Israel
Italy
Japan
Lebanon
Mexico
Morocco
New Zealand
Panama
Poland
Portugal
Serbia
South Africa
South Korea
Spain
Uganda
United Arab Emirates
United Kingdom
United States
Uruguay

2026 Technology Predictions Team by Topics & Employer

+

Academia **51**	**Government** **7**
Industry **47**	**Professional Organization** **9**

Process: Continued Improvements

- **Identification**
  - This year we expanded our team from 12 (2021), 16 (2022), 35 (2023), 46 (2024), and 54 (2025), to 114 (2026) members.
  - We further improved our diversity in terms of gender (35 women), geography (missing countries), and technology (energy, medical, etc.)
  - Authors made up to one prediction, resulting in 88 predictions
  - We then down-selected to 26, by each author giving one of 16 votes to 16 technologies
  - We then did another careful merging of some predictions
- **Grading: In the second round we graded each technology**
  - **We assigned a grade of**
    - [A+ to F-] for: Technology Success in 2026; Impact to Humanity; and Predicted Market Adoption in 2026
    - [Very early, prototype, incubating, emerging, mature, and commercialization] for Maturity
    - [1 year, 3y, 5y, 10y, 15y] for Horizon to Commercial Adoption
  - We express impact to humanity as a function of technology advancement; we quantify maturity, market adoption, and time-to-adoption
  - We calculate our confidence as standard deviation in voting; and bias as a correlation between individual grades
  - Finally, we tweak and optimize: we always normalized maturity, this year we also normalized market adoption and time-to-adoption
- **Risk-Reward Analysis**
  - Because of the tremendous speed of adoption of AI, this year we ended up with near-term horizons
  - To alleviate this, we introduced additional coverage of honorable mentions with favorable risk-reward ratios
- **Qualifying**
  - For each of the down-selected 26 technologies, we wrote a slide on problem/demand, opportunity, impact, & sustainable solution/business opportunity

1. AI and Future of Work

AI agents will become standard "team members" for most knowledge workers.
Competitive advantage shifts from headcount scale to intelligence leverage.

Problems/Demand

- Knowledge work does not scale linearly with people
- Shortage of skilled labor in engineering, healthcare, etc.
- Process latency and coordination bottlenecks dominate enterprise cost and speed
- Rising expectations for speed, personalization, and availability
- Large portions of work remain repetitive, manual, and rule-based

Opportunities

- Elimination of routine cognitive work at-scale
- AI-first organizations can out-execute incumbents structurally, not incrementally
- Software AI agents provide continuous execution (24/7, no marginal cost scaling) and allow problem-adaptive orchestration across functions and disciplines
- Teams can shift focus from task execution to problem framing, judgment, creativity, system-level decisions, and decision-making
- Improved knowledge transfer, onboarding and organizational learning with AI copilots as institutional memory.
- Long-Horizon Tasks: Agents moving from 10-minute tasks to 10-day projects
- Native Multimodality: Agents that "see" the screen, "hear" the meeting, and "read" the code simultaneously
- Self-Healing Workflows: Systems that detect their own errors and retry with a different strategy without human prompting

Impact

- Emergence of AI agents as collaborators, not tools
- Human-AI teams outperform either alone
- Entry-level and task-fragmented roles decline sharply
- New roles around orchestration, judgment, and systems thinking
- Increased risk of automation complacency with humans legally accountable but practically uninformed and disengaged.
- Faster error propagation as speed amplifies both success and failure.
- Unclear liability with increasing lack of transparency

Sustainable solutions / business opportunity

- AI-enabled work models that augment classic workflows
- Systematic up-skilling of engineers to supervise, validate, and integrate AI-generated outputs
- Creation of reusable, AI-assisted engineering assets (design patterns, test frameworks, system models)
- Vertical AI solutions deeply embedded in domain workflows, e.g. for healthcare, engineering, finance, industry

- **Enablers:** AI literacy, Advances in foundation models, agent architectures, and compute, regulatory clarity, high-quality, well-governed data

- **Inhibitors:** Organizational inertia, skill gaps, Blind trust in AI outputs, lack of explainability, competence erosion due to over-automation. Security, privacy, and IP are top inhibitors in regulated or R&D settings, especially where confidential documents and code are involved. Quality control and evaluation are a practical constraint that is not model capability alone, but verification, monitoring, and preventing silent failures.

2. Embodied Physical AI

Physical AI (Robots, Drones, Smart Devices): Physical AI will push intelligence into the real world, automating manufacturing, logistics, and urban infrastructure with autonomous, adaptive machines that sense, decide, and act dynamically—driving efficiency and safety.

Problems/Demand

- **Labor Shortage**: 42% of manufacturers cite automation as the top strategy to address skill gaps. Physical AI enables 30–50% reductions in labor costs while freeing workers for higher-value roles. [source]
- **Workspace Safely**: 2.3M annual work-related deaths globally. Physical AI eliminates human exposure to dangerous, repetitive tasks—reducing accidents by 68.5% and fatalities by 71%. [source]
- **Supply Chain Fragility**: 65% of organizations are vulnerable to disruptions. Physical AI prevents 70–85% of infrastructure failures through predictive maintenance, reducing logistics costs by 30–35% [source1] [source2]
- **Urban Infrastructure at Breaking Point**: $451.68B smart city market by 2034. Physical AI cuts maintenance costs 45–60% and enables autonomous, self-optimizing infrastructure management.[source]

Opportunities

- **Autonomous factories and logistics hubs**: AI-driven robots orchestrating end-to-end production and fulfillment.
- **Predictive maintenance for critical infrastructure**: Always-on inspection that fixes assets before they fail.
- **Smart cities with adaptive traffic and energy systems**: Citywide sensing that continuously optimizes traffic and power.
- **Disaster response and resilience powered by AI-driven robots**: Autonomous robots accelerating safe, real-time disaster response.
- **Human-centric service robots and mobility**: Service robots and AV fleets delivering on-demand help, care, and transport.

Impact

- **Economic**: $1.2T global productivity gains by 2030 from Physical AI adoption
- **Safety**: Workplace injuries reduced by 70% in high-risk sectors
- **Environmental**: 20–30% reduction in energy waste through AI-driven optimization

  Sources: PwC AI Economic Impact Study ; Accenture Tech Vision

Sustainable Solutions / Business Opportunity

- Physical AI systems orchestrated with renewable energy for low-carbon operations
- Robotics-as-a-Service models that make automation accessible to small and medium enterprises
- AI-driven energy optimization across factories, fleets, and city infrastructure

Enablers: Advances in Agentic AI for autonomous decision-making and adaptive behavior. Edge AI and low-latency 5G/6G networks. Affordable sensors and IoT platforms. Regulatory frameworks for autonomous systems. Model training pipelines that fuse high-fidelity synthetic data with rich sensor streams.

Inhibitors: Cybersecurity risks in physical systems. High upfront capital costs for SMEs. Workforce reskilling challenges. Limited interoperability standards. Regulatory uncertainty. Data privacy and safety concerns. Deployment at scale beyond tightly controlled environments.

3. Wearable Devices

New form factors for wearable devices will continue to integrate AI into everyday life in small, practical ways. These always-on, unobtrusive devices will push privacy concerns further to the fore.

Problems/Demand

- **An aging population** and the needs of those with disabilities demands not only health monitoring and control but also support for self-sufficiency in optimizing balance, body heat, breathing, eating habits, sleep, vision, hearing and more.
- **Leisure time:** More travel, sport, or hobbies with specific niche requirements for energy, communications, real-time language translation and many others, will be wearable supplied.
- **On-the-go task assistance:** Hands-free interaction with AI supports multi-tasking lifestyles.
- **Ubiquitous team integration** will be supported by wearable devices on helmets, gloves, glasses, suits, etc. for work and communities.

Opportunities

- **Connect industry and technology** to introduce strong interaction with textile, design, fashion, and uniform providers to engage users into new wearable dimension.
- **Advancing technology for humanity** by turning blind canes into vibrating and talking t-shirts, or auto-translating OCR spectacles.
- **Developing app ecosystems** open creative possibilities for wearable AI functions.

Impact

- Additional ways to monitor health, leading to earlier detection and cost-savings in medical interventions.
- Increasing consumer adoption in a market already familiar with smartwatches will boost growth.
- Smartphone functions increasingly distributed across ancillary devices.

Sustainable Solutions / Business Opportunity

- open-source code for rapid ecosystem development
- Design opportunities to make functionality aesthetically pleasing

- **Enablers**: Existing consumer familiarity with smartwatches make wearables acceptable; offloading functionality to phones; brain-computer interface (BCI) technology; AI vision
- **Inhibitors**: Privacy and ethical concerns, battery life, limited functionality given restrictions of small form factors.

4. Datacenter Energy Management

Scaling of datacenters to meet AI needs will force further innovation in energy production, management, and dissipation in datacenters.

Problems/Demand

- **Increasing demand for energy** to power AI datacenters amid **limited grid capacity** and **variability of renewable energy** resources.
- **Increasing heat dissipation** in datacenters due to increasing energy usage contributing to water consumption and global warming.
- According to the Eaton earnings call: *"Before the advent of gen AI, the power used in a typical rack was in the 10 to 15 kilowatt range. ... Nvidia's GB300 chip now uses 180 kilowatts per rack. And it's only increasing from there. Nvidia's Rubin chip is expected to use 600 kilowatts per rack, and its Feynman chip, 1,000 kilowatts per rack."*
- Hundreds of nuclear AI Data Centers may be constructed in the next decade for the advancement of AI and their applications.
- There will be sustainability risks from nuclear data centers.
- There will not be a sufficient number of experienced nuclear plant operators that can safely stop the reactors in severe accidents and make nuclear decommissioning in the glove.

Opportunities

- **Nuclear energy** can supplement renewable energy in powering datacenters because it is cleaner than fossil fuels and provides more reliability than wind and solar energy. Small modular reactors can be co-located with datacenters to alleviate load on national grids.
- **Two-phase cooling** can absorb more heat than single-phase liquid cooling.
- **Software and hardware co-design** as well as AI can enable more sophisticate ways to manage and regulate power consumption.

Impact

- Nuclear-powered data centers will become a major breakthrough, providing a sustainable solution for reliably supplying large and energy-intensive loads.
- Two phase cooling for high power chips will enable use of higher power GPUs in AI data centers at 3,000 watts or more, as well as megawatt size racks in AI data centers.
- The application software or the compiler will assist in controlling frequency, voltage, and/or power gating of millions of processing elements and cores in microseconds order automatically.

Sustainable Solutions / Business Opportunity

- Nuclear power coupled with renewable energy
- Two phase cooling

- **Enablers**:
  - Increased capital investment in energy technologies supporting AI
  - Energy development as government priority
- **Inhibitors**:
  - Regulations on nuclear energy
  - Public sentiment towards nuclear energy
  - National power grid capacities
  - Availability of water or other liquid resources

5. Social AI

Artificial Emotional Intelligence - AI assistants will be tuned to detect mood, tone, and sentiment to master "soft skills" such as resolving misunderstandings, negotiations, etc.

Problems/Demand

- Increased loneliness and social isolation
- Cost, stigma, and scarcity of mental healthcare
- Rising cost of education and the need for lifelong learning
- Rising need for caregiving of an aging population
- Current GenAI applications such as chat are being optimized for facts, objectivity, and accurate responses to user queries. But many human activities require “soft skills” such as empathy, and understanding human motivations and mental states
- Adding such skills to AI applications can overcome many limits, both in the models and in their human users

Opportunities

- AI teachers for both primary and lifelong learning
- AI Therapists, Mentors and Coaches - People will seek to AI for guidance on situations in their lives, whether work, school, health, etc. and obtain guidance from AI. The recent case on the AI-coached suicide does bring concerns, so emergence of public policies on AI coaches/mentors will be important.
- Related, more and better alerts for risky behaviors could be caught earlier by AI
- AI and robots for the care of an aging population
- AI Companions to complement human companions (already becoming popular in , but will significantly increase in 2026)
- First step towards conscious AI

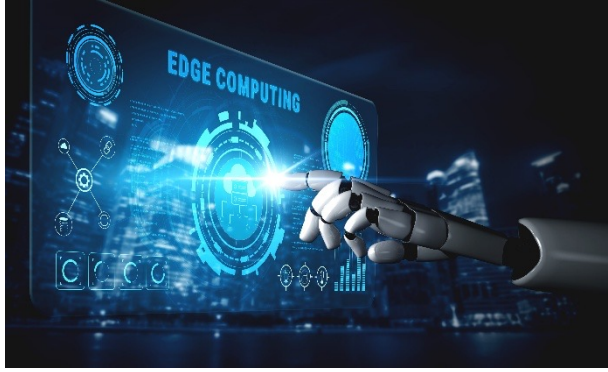
Impact

- Normalization of human-AI relationships, therapy, coaching, and education.
- Rapid growth in the domain of applications where AI assistants can augment a professional’s work, including teaching & training, negotiations, customer support, and some conflict resolution.
- Increased adoption of AI assistants and applications by a wider target audience.
- Negative: over-reliance on social AI can stunt the growth of social skills.
- Negative: exploitation of relationships to manipulate people for profit or political purposes.
- Negative: special consideration must be given to mitigating the increased risk of negative Human/AI interactions, such as overdependence and “AI psychosis”.

Sustainable Solutions / Business Opportunity

- AI assistants, education, companions, coaching, mental health, caregiving for an aging population.
- Automation of additional tasks and roles in the workforce, offices, governments, hospitals, retail, education, etc.
- **Enablers**: Current LLM foundation models with their conversational interface. Research into AI models with soft skills; Psychology research with emphasis on applications in AI;
- **Inhibitors**: Buggy or incomplete models with a negative net effect on adoption; social acceptance and pushback from users about interacting with human-emulating machines (“uncanny valley”); pushback from displaced professionals; regulatory headwinds

6. Edge AI



Edge AI will enable privacy-preserving, low-latency, energy-efficient, generative intelligence via small language models on resource-constrained devices, extending AI access to remote settings and extreme environments where continuous connectivity is not guaranteed.

Problems/Demand

- Many powerful AI models, especially generative AI models, are too large to be deployed on edge devices.
- Small models may suffer significant performance loss, which may not be tolerable for specific applications.
- Edge devices require close interactions with the environment and/or human, which demands high level of explainability, dependability, robustness, safety, etc.
- Edge devices often incorporate application-specific components to improve resource efficiency, making frequent updates to accommodate rapidly evolving AI models costly.

Opportunities

- Providing generative AI on prevailing resource-constrained edge devices
- Ensuring accessible and pervasive AI even when connectivity is scarce and limited
- Protecting the data privacy of AI users
- Customizing generative AI for individual users

Impact

- Edge computing devices are ubiquitous and account for more than 90% of all computing devices
- Adapting AI to devices with varying compute capabilities will open new directions for developing sustainable AI
- Supporting deployment of generative AI to help individuals facing physical and mental health challenges, particularly those in underserved communities

Sustainable Solutions / Business Opportunity

- Continuing improvements of small-scale generative AI models
- Developing general approaches that allowing techniques to trickle down from high-end systems to affordable platforms
- Advancing privacy-preserving, dependable and robust generative AI models

- **Enablers**: beyond von Neumann computing paradigms such as in-memory computing and in-sensor computing, emerging material and device technologies for memory and computation, hardware-algorithm codesign methodologies, increasing attention to small-scale AI models, low-power design techniques.
- **Inhibitors**: scattered investments, diverse edge application landscape, siloed research efforts, perceived as less prestigious, lack of public training data, privacy concerns.

7. Space Communications

Satellite direct to cell/device communications will be accomplished using existing radio protocols without extra hardware on the device. Both cellular & Zero-Trust approach in Space-based 6G networks will be very effective to overcome perimeter-based protection.

Problems/Demand

- 5G/6G enables frequency band and resource allocation that can be used to communicate with existing devices without the need for new hardware from non-terrestrial networks.
- Space is a key component of non-terrestrial based communications and especially LEO satellites deliver the required RF link budget.
- 6G envisages a multi-environment complexity, where a perimeter-based cybersecurity strategy could be critical.
- Space is a key component of the 6G integrated network: Zero Trust (ZT) cybersecurity strategy, that is non-perimeter-based, could be a good choice.

Opportunities

- While satellite voice communication & low data rate texting is already in use, the addition of data processing and routing in LEO satellites is new and opens new opportunities in IoT and shorter route latency. New satellite-based cell phone operators are coming and even data centers are planned to be physically located in space orbiting the earth.
- ZT strategy implementation in space will concur to AI-based space networks with deep penetration of software defined architectures.

Impact

- Increased reliability and coverage of cell phone, Bluetooth & other IoT. Connecting the unconnected with existing phones and FWA devices.
- Increased flexibility, resilience and cyber-protection in future space networks.

Sustainable Solutions / Business Opportunity

- Use of existing hardware designs for new services.
- Increased flexibility, resilience and cyber-protection in future space networks.

Enablers: software-defined networking and data storage, coordination among space players and cell phone providers. LEO electronics does not need to be hardened for cosmic radiation. Software-driven procedures, software-defined networking and data storage, coordination among space players.

Inhibitors: lack of will to coordinate among space players; hardware-centric traditional approach by space network communication companies. Competition from terrestrial cell phone operators and distributed data networks. Lack of coordination among space players; hardware-centric approach in the deployment of future space networks.

8. AI and Future of Electrical Grid

The future electrical grid will be AI-driven, predictive, and increasingly autonomous

Problems/Demand

- Growing penetration of renewables introduces intermittency and volatility that traditional grids struggle to manage
- Rising demand for reliability, resilience, and affordability amid climate change and extreme weather events
- Increasing complexity of distributed energy resources (DERs), electric vehicles, and prosumers overwhelms manual control and legacy automation
- Pressure to decarbonize power systems while maintaining grid stability and low operating costs
- Resilient power grids to address an increasing number of attacks, both physical and also cyber-attacks

Opportunities

- Digital transformation enables utilities to shift from reactive to predictive and autonomous operations
- AI-enabled microgrids can autonomously balance local generation, storage, and consumption in real time
- Autonomous power plant and grid operation reduces human intervention, improves fault response, and lowers operational costs
- Predictive intelligence enables better demand forecasting, asset health monitoring, and renewable integration
- Decentralized, consumer-centric grids empower communities to actively participate in energy markets

Impact

- More resilient grids with faster fault detection, isolation, and recovery
- Higher renewable penetration with improved efficiency and lower curtailment
- Reduced carbon emissions and energy costs through optimized generation and consumption
- Transformation of utilities from infrastructure operators to intelligent energy service providers

Sustainable Solutions / Business Opportunity

- AI-driven microgrid platforms for campuses, cities, and industrial parks
- Autonomous grid management software for utilities and independent power producers
- Energy-as-a-service models leveraging AI optimization for cost and carbon reduction
- Digital twins and predictive maintenance solutions for generators, substations, and networks

— **Enablers**: Digital transformation of utilities, pervasive sensing and IoT, asset health data and digital twins, machine learning and AI analytics, cloud and edge computing platforms, and growing organizational investment in data science capabilities.

— **Inhibitors:** Legacy infrastructure and operating models, fragmented and poor-quality data, integration complexity across heterogeneous assets, cybersecurity and trust concerns, regulatory constraints, workforce skill gaps, and organizational resistance.

9. AI and Future of Medicine: Adaptive Bio-AI Interfaces Listen to Your Body

Adaptive bio-AI interfaces that continuously sense and interpret human biological signals to adjust therapies, environments, or digital tools in real time will emerge as a breakthrough technology in 2026, marking the first true fusion of personalized health and intelligent computing.

Problems/Demand
- Rising *need* for continuous, personalized health insights rather than periodic check-ups.
- Growing *burden* of chronic conditions, stress disorders, and cognitive overload.
- *Lack* of real-time, closed-loop systems that connect what the body signals to what technology does.

Opportunities
- *Continuous non-invasive* biomarker sensing paired with generative AI enables *precision-tuned* responses.
- *New markets* in neuroadaptive wearables, metabolic coaching, rehabilitation, and mental health.
- *Bridges the gap* between digital health, consumer devices, and clinical-grade monitoring.

Impact
- Moves healthcare toward proactive, real-time adaptation rather than reactive treatment.
- Enables systems that *dynamically modulate biological processes* such as stress responses, focus, recovery, and metabolic balance.
- Uses *non-invasive technology*, relying on external sensors and wearables rather than implants or surgical devices.
- Transforms rehabilitation, stress management, and chronic disease monitoring.
- Establishes the first practical *human-machine physiological feedback loops*.

Sustainable Solutions / Business Opportunity
- Subscription-based bio-AI *platforms* (sleep, stress, metabolism, cognition).
- *Integrations* into smart environments (lighting, sound, HVAC responding to physiology).
- *Clinical applications*: neurorehabilitation, personalized dosing, closed-loop health systems.

Enablers:
- Advances in non-invasive multimodal biosensing (EEG - brain-wave activity, HRV - heart rate variability, skin metabolites, EMG - muscle activity).
- Generative and multimodal AI capable of interpreting noisy biological signals.
- Regulatory pathways maturing for hybrid medical-consumer devices.

Inhibitors:
- Regulatory constraints for adaptive therapeutic devices.
- Data privacy concerns around continuous physiological monitoring.
- Hardware limitations for non-invasive sensing (signal accuracy, battery life).
- Interoperability between different biosensor ecosystems

State-of-the-art: * ***Hardware maturity***: Consumer wearables (Apple, Oura, Withings) now include continuous glucose, cortisol, and HRV sensors. In 2026, multi-parametric biosensing (skin metabolites, EEG, EMG, microbiome-linked signals) will expand into clinical-grade devices. * ***AI integration*****:** Generative and multimodal AI can interpret bio-signals in context, identifying patterns related to mood, fatigue, or metabolic state rather than isolated metrics. * ***Regenerative and neuroadaptive applications***: Closed-loop systems that pair biosensors with adaptive AI - for neurorehabilitation, metabolic optimization, or stress modulation - are already in pilot trials.

10. Assurance Layers in AI Pipelines

Mandatory assurance layers (sandboxed tools, provenance tracking, misuse detection) become standard in foundation-model deployments.

Problems/Demand

- Increasing risk of inaccuracies (hallucinations)
- Misuse without detection
- Lack of runtime guardrails
- High-security pipelines are too slow
- Insufficient explainability in the assurance layer

Opportunities

- Continuous compliance engine
- Development of trusted AI deployments
- Emerging assurance tool ecosystem
- AI validation via enhanced model training
- Creation of relevant trustworthy datasets

Impact

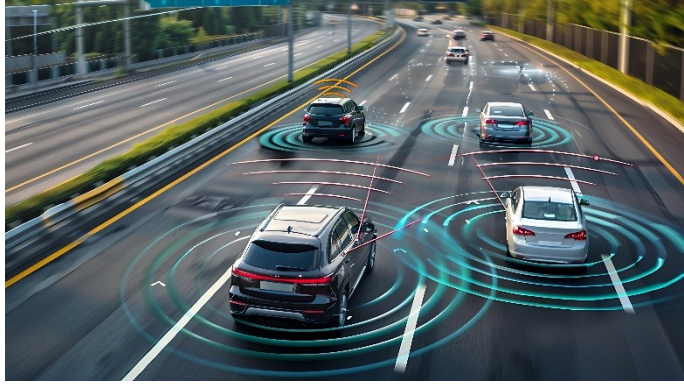
- Higher reliability of AI systems
- Risk mitigation
- Compliance across sectors

Sustainable Solutions / Business Opportunity

- Continuous assurance: real-time, automated verification
- Provenance: a transparent "paper trail" that tracks the origin of information and data
- Monitoring platforms: Centralized dashboards that track model performance
- Reduced human-in-the-loop cost

- **Enablers**: Policy requirements and instrumentation advances
- **Inhibitors**: Overhead, integration complexity, and the availability of accurate data

11. Autonomous driving: commercialization and adoption



Autonomous mobility shifts toward compute-heavy, capital-intensive robotaxi services in dense cities, driven by digital twin-based training, increased safety, and a novel AI stack

Problems/Demand

- City-scale autonomy: urban congestion, driver supply volatility, increased safety expectations, accessible mobility demand more vehicle autonomy
- Long-tail engineering dominates cost: the AV stack is now "good enough", but rare event interactions set the pace for rollout
- Compute is the new fuel: continuous training of foundation models and multi-sensor inferences pushes fleets into insatiable compute appetite
- Service economics require high utilization: robotaxi competitiveness hinges on uptime, mileage, and fast maintenance/operation loops
- Ageing population intensifies mobility needs: increasing demand for safe, accessible, on-demand transport beyond personal driving.
- Two business models diverge: "service autonomy" tolerates costs, while "consumer autonomy" must hit the right price and deal with liabilities

Opportunities

- Learn-by-operating: rapid scaling of Waymo's commercial footprint in US signals the strongest near-term flywheel
- Simulation-first training: digital twins + closed-loop simulation let teams mine corner cases (rare, unsafe, expensive to collect on-road)
- AI architecture shift: multimodal transformers, learned prediction, and AI-assisted planning (imitation + RL + constraints) will increasingly replace brittle rule forests, while still having to deal with safety
- Arbitraging Sustainability: while more complex AI adds compute emissions, electric robotaxi fleets lower energy costs vs private vehicles

Impact

- Mobility shifts from labor-intensive to capital-dominated, favoring operators that can sustain low utilization, and reshaping the mobility job market
- Shifts in urban planning and regulation: from reducing parking to pick-up/drop-off rules, driven by evidence-based safety + a volatile public trust
- Measurable Safety: comparisons claim lower crash rates than humans, accelerating regulator and insurer confidence (despite headline incidents)
- Digital twins become "the factory": better and faster than road testing, from scenarios to synthetic sensors, closed-loop replay, and safety updates
- Auditing of energy tradeoffs: the always-on inference cost will matter as much as training with fleets competing on TOPS/W, model compression, sensor fusion efficiency, and carbon-aware compute siting for cloud-based AI

Sustainable Solutions / Business Opportunity

- Market is bifurcating: US + China present the biggest short-term business opportunity and the strongest closed loop of deployment (Waymo in US metros; Apollo Go in China megacities). Europe focuses on consumer autonomy, with robo-taxis constrained by lack of harmonized certification
- **Enablers**: high-fidelity digital twins for corner case training, compute-efficient physical AI stacks, declining sensor and compute costs
- **Inhibitors**: regulatory fragmentation; liability uncertainty; public trust sensitivity to headline incidents; difficult corner cases; vandalism and passenger misconduct; cybersecurity and data privacy risks; high capital intensity and questionable economics outside dense areas

12. Cybersecurity

In 2026, identity-first, AI-assisted security becomes baseline as ransomware and supply-chain pressure force CTOs to consolidate platforms, prove MTTD/MTTR, and harden data/software supply chains under tighter regulation.

Problems/Demand

- Ransomware & BEC remain top loss drivers; software **supply-chain** exposure
- **Identity** attacks (MFA fatigue, session hijack); shadow **SaaS/AI** usage
- **Cloud** misconfiguration and data leakage; **OT/IoT** legacy risk
- **Regulatory pressure**: fast incident disclosure; NIS2/DORA-style controls
- Identify and **mitigate misinformation** and disinformation.
- Enhance robustness and resilience of systems such as utilities and critical infrastructure.

Opportunities

- **Identity-first** architecture: strong MFA/passkeys, PAM, least-privilege & segmentation
- **Detection/response**: EDR/XDR, MDR, AI-assisted SOC automation (SIEM/SOAR)
- **Data defense**: DSPM/DSSE, tokenization, confidential computing, data-centric controls
- **Software supply chain**: SBOM, ASPM, signed artifacts, runtime integrity controls
- **Resilience**: immutable backups, rapid restore, tabletop & chaos drills

Impact

- Revenue & operations at risk (downtime, extortion, safety incidents)
- Escalating breach costs; board & customer trust erosion
- **AI-accelerated** threats (deepfakes, hyper-phishing) widen attack surface
- Compliance, cyber insurance, and financing increasingly tied to posture

Sustainable Solutions / Business Opportunity

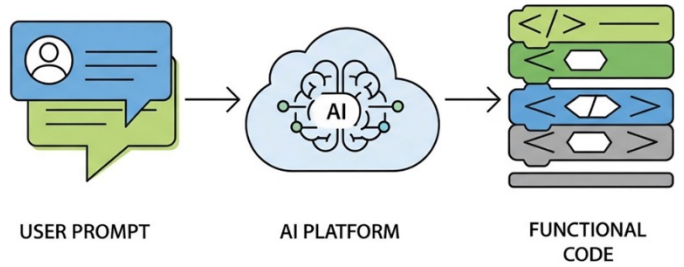
- **Platform consolidation**: reduce tool sprawl; integrate identity, data, and endpoint
- **Outcome SLAs**: dwell-time ↓, MTTD/MTTR targets, recovery objectives
- **Security-as-code & zero-trust** across cloud/edge/OT
- **Governance & proof**: continuous control monitoring, audit-ready evidence
- **Commercial models**: MDR/MSSP co-management; risk-based pricing

— **Enablers**: Board mandate & budgets • Regulation-driven programs • Open platform APIs/telemetry • Automation & LLM copilots in the SOC

— **Inhibitors**: Talent/skills gaps • Legacy/OT constraints • Tool sprawl & integration debt • Fast attacker adaptation • Uneven SME resourcing

13. Future of Coding

Vibe coding, facilitated by AI-native development platforms, will increasingly be used by non-developers to produce functional code using "prompts" and natural language descriptions, giving new meaning to low-code/no-code.



Problems/Demand
- Addresses problems such as
  - Technical barrier to entry for non-Developers
  - Non-expert developers having to focus on syntax and semantics at the expense of intent
  - Cost and resource constraints for developing software applications
- Caters to demand for
  - Personalized or industry-specific software solutions and business process automation
  - Rapid prototyping and experimentation
  - Domain-specific interactive educational and learning applications

Opportunities
- New business models (e.g., micro-SaaS niche markets, marketplace for AI-generated solutions, emerging ecosystems)
- Democratizing entrepreneurship (e.g., lower barrier to entry for tech startups, faster pivot capabilities by rapid testing of new ideas)
- New learning pathways (e.g., bridging domain expertise and software creation, reduced dependency on traditional computer science education)
- Rapid IP generation
- Empowering non-IT roles
- Shift-up (e.g., focus on systems, assertions, etc.) and shift-left (e.g., simulation) on top of coding

Impact
- Professional transformation (e.g., role evolution, more emphasis on certain skills, potential loss of skills)
- Economic transformation (e.g., job market disruption, wealth redistribution)
- Digital literacy redefinition (e.g., expertise in communicating with AI systems vs writing code)
- Technological acceleration and innovation velocity
- Heightened software quality, reliability and security risks, ethical and compliance concerns, muddying of IP ownership etc.

Sustainable Solutions / Business Opportunity
- Hyperlocal environmental monitoring (e.g., community-created air quality and water usage tracking applications)
- Resource optimization applications (e.g., custom supply chain optimization for local producers)
- Green technology enablement (e.g., custom IoT interfaces for renewable energy systems)

Enablers:
- Rapid AI enhancements, major vendor investment/competition, broad-based interest

Inhibitors:
- Quality/reliability concerns, security and compliance issues, limitation on complexity

14. AgroTech

Artificial Intelligence as a support tool to enhance and predict agricultural productivity, improving the quality of consumer products while reducing costs.

Problems/Demand

- Lack of digitalization and timely access to agricultural data for effective decision-making.
- Inefficient use of resources (water, energy, inputs) and limited predictive capacity for climate-related events.
- Need to improve sustainability and productivity across the agricultural sector.

Opportunities

- Digitalization of agricultural data and use of predictive analytics tailored to local and territorial needs.
- Implementation of AI models for intelligent prediction, failure prevention, and production planning.
- Integration of digital technologies to strengthen innovation and operational efficiency in the sector.

Impact

- Improved agricultural efficiency and productivity through data-driven decision-making.
- Reduced losses, optimized resource management, and increased sustainability.
- Greater transparency, improved access to information, and strengthened agricultural planning.

Sustainable solutions / business opportunity

- Development of smart networks and digital platforms for connected agriculture.
- Creation of predictive analytics services and decision-support tools for agricultural planning.
- Stronger collaboration among producers, technology providers, academia, and the public sector.
- **Enablers**: IoT sensors and satellite data, supported by AI and cloud/edge computing, enable efficient, data-driven agriculture.
- **Inhibitors**: Rural connectivity gaps, limited digital skills, and high initial investment slow adoption.

15. Rack Scale Architectures

Rack scale architectures optimized for the IT-Power on-off Grid domains cross-management will improve power and energy efficiency of next generation data centers, by shaving power peaks, balancing sources of power, individually and across multiple data centers.

Problems/Demand

- AI adoption has resulted in power demand that surpasses contemporary Grids and leading to Off-Grid solutions
- AI enables every facet of humankind, from sciences
- The size and the number of the workloads is substantially growing, surpassing traditional node capacity
- Software-hardware co-design is essential
- Power and energy envelopes are growing, making optimizations more appropriate at the rack scale

Opportunities

- Savings and utilization are higher when delivered across larger units of compute, performance is more optimal
- Standard solutions will
- Gradually increasing power of individual racks
- Optimizing interconnects
- Thermal coupling with infrastructure and power plants to use the overhead thermal energy

Impact

- Comparable reduced overall compute/power ratio
- Cost reduction in AI delivery
- Easier manageability

Sustainable Solutions / Business Opportunity

- Competitive market
  - **Enablers**: standards for hardware software interfaces, open-source management and software stack solutions
  - **Inhibitors**: fragmented markets with non-standard solutions; lack of regulation; delayed innovation in segments of products

16. Multimodal AI

Intelligent systems transcend single-modality constraints, unifying language, vision, audio, 3D, and sensor data for comprehensive understanding.

Problems & Demand

- Conventional AI limited by single-modality inputs
- Real-world scenarios require processing diverse data types (text, images, videos, audio calls, documents, logs) together
- As modalities expand, risks (privacy, deepfakes, misinformation, copyright) increase
- Greater resource needs with multiple modalities challenge deployment at scale and sustainability efforts

Opportunities

- Richer assistants with real-time abilities to ingest image/audio/video I/O and act (plan, search, execute, explain)
- Domain-specific multimodal analytics across healthcare (radiology + notes), industrial IoT (sensor + video + logs), finance (documents + charts + voice), education (lecture video + whiteboard + worksheets)
- Vision-language-action (VLA) models and agent research connect perception, language, and action to unlock advanced robots, AR/VR, and GUI automation
- High-quality cross-modal reconstructions and data fusion enabling new applications
- Unified models reducing task complexity and cost

Impact

- Unified multimodal copilots reduce context switching and manual extraction, improving decision velocity and quality
- Autonomous systems with human-like comprehension
- Healthcare diagnostics combining imaging, audio, and patient data
- Enhanced accessibility through seamless modality translation
- Robotics achieving sophisticated spatial understanding
- Natural, voice-and-vision interfaces expand accessibility and enable more inclusive digital services
- Increased demand for multimodal data ops (video/audio labeling, privacy), safety engineers (cross-modal watermarks/provenance), compound AI architects (orchestration, tool calling, evaluation).

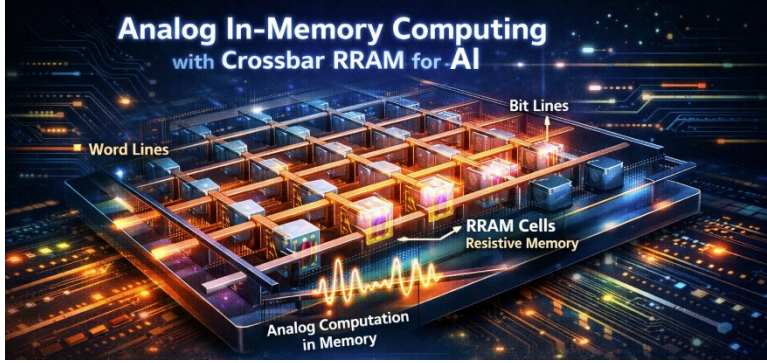
Sustainable Solutions

Enablers: Efficient neural architectures, edge computing advances, standardized multimodal datasets

Inhibitors: Energy demands, memory bandwidth limitations, integration complexity, data privacy concerns

Business Opportunity: Enterprise platforms for multimodal analytics, specialized hardware accelerators, consulting services for implementation

17. Analog in-memory computing for AI



Analog in-memory computing will bring computation directly into memory arrays, dramatically reducing data movement, the dominant source of power and latency in today's AI systems, delivering order-of-magnitude improvements in performance-per-watt from edge devices to data centers.

Problems/Demand

- AI performance is limited by memory latency and bandwidth, not by computation.
- Data movement also dominates energy consumption.
- GPUs/TPUs scale power and cost continuously.
- LLMs require massive memory capacity and access.
- Data centers hit power and cooling limits.
- Edge AI needs far higher efficiency.

Opportunities

- Compute directly inside memory arrays, eliminating most data movement.
- Achieve 10–1000× perf-per-watt.
- Scale AI with controlled power and cost levels.
- Enable development of efficient LLMs for the edge.
- Unlock sustainable AI growth.
- Development of memory technologies that will benefit not only AI

Impact

- Break the memory wall.
- Cut AI energy consumption dramatically.
- Reduce cost per token at scale.
- Enable always-on intelligence.
- Shrink data-center footprint.

Sustainable Solutions / Business Opportunity

- Deliver scalable, energy-efficient AI that lowers infrastructure, power, and carbon costs.
- Enable new markets across data centers, edge, and AR/VR through radically lower cost-per-compute.

- **Enablers**: Analog in-memory computing using multi-level non-volatile memory (e.g., RRAM, PCM, FeFET) integrates storage and computation at the device level, enabling ultra-efficient matrix operations with minimal data movement and scalable manufacturability in advanced CMOS nodes.
- **Inhibitors**: Analog control, device enabler, and ecosystem readiness (software, tools, and standards) have historically limited adoption, requiring careful hardware–software co-design and system-level integration to scale analog in-memory computing reliably

18. Policy for AI

Governments and organizations will impose ethical and responsible AI and will drive its use to unleash human potential and serve humanity in areas such as improving health while emphasizing fairness, transparency, privacy and human oversight to mitigate risks like bias.

Problems/Demand

- Foster a culture of ethical innovation with strong governance
- Establish AI policy and regulations that do not hinder innovation and give business clarity and protection
- Drive AI that aligns with human needs, values and a better future
- Adopt robust governance that drives transparency, risk management and the promotion of AI literacy programs
- AI regulations and policies are evolving globally to ensure ethics, safety, privacy and transparency, with the EU leading with the AI Act https://aiactinfo.eu/

Opportunities

- Optimize resource use to accelerate scientific discovery
- Build AI that reflects what is best about humans
- Drive innovation and breakthroughs in healthcare, finance, education and sustainability
- A balanced AI that serves humans and not just profits
- Elimination of bias in training data and AI models

Impact

- Eliminate bias in decision making such as in hiring and lending
- Provide roadmaps to businesses for a profitable but ethical AI
- Enhance customers' trust while reducing legal and financial risks for businesses
- Enable inter-government cooperation, UN, and even leadership offered by IEEE

Sustainable Solutions / Business Opportunity

- Efficiencies and cost savings
- New green products and environment monitoring
- Energy optimization and reduced fuel use
- Safe precision agriculture

- **Enablers**: Flexibility and balancing regulations with innovation
- **Inhibitors**: lack of regulations or heavy-handed regulations

19. AI-Generated Content

AI transforms how videos, music, presentations, documents and multimedia content are made and consumed. But it raises questions about authenticity, creativity, and economic disruption.

Problems/Demand

- Well-written documents take a long time for native speakers and are hard to do for non-native speakers
- Traditional audio/video content creation is expensive, time-consuming, and requires specialized skills and equipment
- Growing demand for personalized content at scale exceeds human production capacity
- Language and accessibility barriers limit global content reach
- Small businesses and individuals lack resources for professional-quality content
- Trust erosion in any content due to disinformation & fake content
- Increasing copyright infringements with AI generated code & media

Opportunities

- Anyone can produce professional-grade videos, music, & presentations
- Human-AI collaboration enables rapid prototyping and iteration for creative projects
- Reduced production costs by 90%+ for marketing, training, and educational materials
- Synthetic video & avatars: Product explainers, training, sales demos, and customer support without studios
- AI-generated audio & music: Voiceovers, podcasts, background music, and sound design at near-zero marginal cost
- AI-authored presentations: Slides + narration auto-generated from documents or meetings
- Hyper-personalization: Same content tailored by language, role, culture, or user behavior

Impact

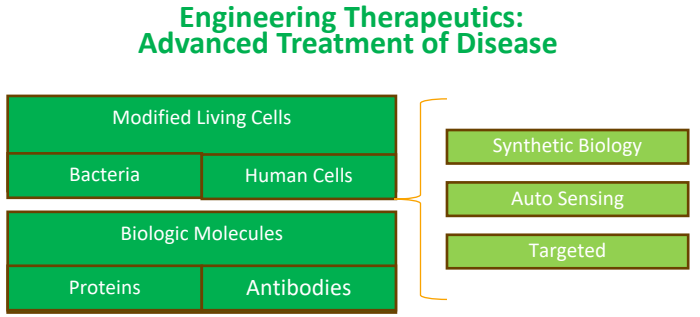
- Disrupts traditional creative industries (film production, music studios, voice acting, graphic design)
- Floods markets with content, making discovery and quality curation more challenging
- Misinformation and deepfakes erodes trust in media
- Shifts creative jobs from production to direction, curation, and prompt engineering
- Democratization: Non-experts can create professional-grade media.
- Speed & scale: Content cycles compress from weeks to minutes.

Sustainable Solutions / Business Opportunity

- Human-in-the-loop systems that augment rather than replace human creators, positioning AI as a creative assistant: AI does first draft, humans approve, refine, and brand-align
- Enterprise-grade trust layers: Watermarking, provenance (C2PA), and authenticity verification
- AI content services for underserved markets (small businesses, educators, non-profits) where traditional production was too expensive
- Vertical specialization: Regulated, high-value domains (education, healthcare, enterprise comms)
- Platform integration: Embed AI content generation directly into workflows (meeting summarization and action items, CRM)
- Usage-based economics: Pay-per-render, per-minute, or per-audience—aligned with value created.

20. Engineered Therapeutics

In 2026, we will see the use of genetic/synthetic biology for the treatment of medical aliments in humans. This will include Living Therapeutics (ETLs) and non-living molecules and materials.



Problems/Demand

- Human disease reduces the quality and span of life for the those impacted. The treatment of human disease places a large financial burden on society as a whole. New treatments that are more effective and less costly will improve the quality of life of the suffers and reduce the financial burden on society.

Opportunities

- Cancer treatment
  - CAR T-cells
- Gut health/infection treatment
  - Monoclonal antibodies
- Gene failure treatment
  - Zolgensma and Luxturna
- Targeted drug delivery
  - Biomaterials and/or hydrogels

Impact

- Engineered therapeutics are designed treatment systems which provide high precision in the targeting and treatment of diseased tissue. They have enhanced efficacy and lower risk of systemic toxicity than traditional medical treatments.

Sustainable Solutions / Business Opportunity

- CAR T-cells. Cells created to find and kill cancer cells.

- **Enablers**:
  - Advancements in synthetic biology and genetic engineering
  - Advancements in computational tools such as AI and biomedical data science
  - Supportive regulatory frameworks

- **Inhibitors**:
  - Opposing regulatory frameworks
  - Disease evolution/adaptation to evade the efficacy of engineered therapeutic treatments

21. AI personalities

2016 will see the rise of a range of AI generated actors, presenters, influencers, newsreaders, etc., which by late 2016 will not be easily distinguishable from humans fulfilling these roles.

Problems/Demand

- Demand from marketing and media organisations will likely be high
- As with the introduction of social networking, it is likely that AI personalities will be gradually introduced before taking off and becoming ubiquitous before much of society understands what is happening and the implications have been thought through

Opportunities

- Online services will go though another transformation, with users developing deeper relationships with real time video AI personalities, rather than today's audio or text chatbots
- Familiar online teachers will become the face of education
- Social care for the elderly will become more affordable and prepare the ground for human-like robots carrying out physical tasks within the home
- The movie/TV industry will go though a seismic shift

Impact

- Although many countries are likely (at least in the short term) to prohibit the use of AI personalities in certain roles such as newsreaders, and particular industries will seek to prevent AI personalities taking "their jobs", the shift to a hybrid world of humans and AI personalities is likely to have profound implications for how we interact online, trust, and even think of self

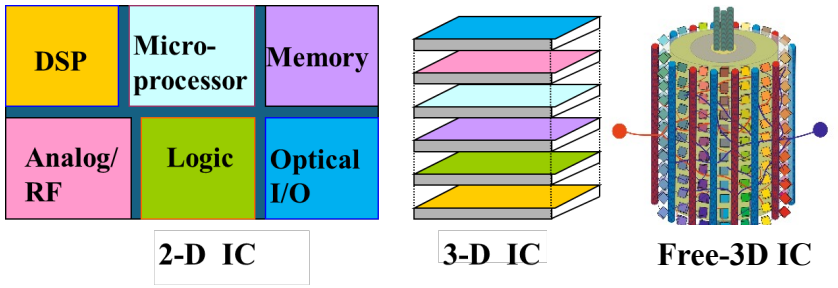
Sustainable Solutions / Business Opportunity

- Training and maintaining AI personalities will lead to huge demand for new datacenters, but also generate a sub-industry in tailoring such personalities for particular purposes

- **Enablers**: Datacenter capacity, low latency networking
- **Inhibitors**: Possible societal backlashes against what will be a very visible use of AI

22. New Processors

New processors should offer 1000 times performance improvement and 1000-fold power consumption reduction – This can be achieved by exploring and integrating new technologies and full free 3D architectures with support of AI-based design strategies.



Problems/Demand

- AI applications and high-performance computing require massive data flow and low power processing capabilities
- Current technologies are almost at their physical limits – in terms of devices, transistor scaling, floor-planning, packaging density
- Requirements of efficient interconnect and high fan-out between building blocks prevent from building more complex structures
- Power dissipation is one of the key limiting factors for for advance of integrated systems

- Most design approaches for IC design relay on well developed strategies dating back to their infancy: planar process principles, in-plane layouts
- Heterogeneous integration still in its infancy

Opportunities

- Heterogeneous integration encompassing full landscape of known technologies, "fat" full free-space 3D concepts offer new vistas and new solution opportunities and high-performance ICs with largely reduced power consumption of new chips
- Ai offers new unprecedented design opportunities and optimization of structures and performance

Impact

- Expected 1000x performace improvements in terms of processing efficiency and 1000-fold power dissipation reduction will be key enablers for new applications in AI sector, communications, autonomous transport smart homes and smart cities

Sustainable Solutions / Business Opportunity

- VLSI Symposium indicates shift in industry focuses eg. towards 2D materials, full 3D integration, chiplet platforms

- **Enablers**: new innovative, ambitious spin-off companies IC producers, leading EDA companies, system integrators

- **Inhibitors**: Currently foundries provide advanced versions of standard technologies, well developed. Innovative new approaches and introduction of disruptive technologies require not only big investments but also change of mentality in the community

23. Quantum-safe Cryptography/ Post-Quantum Cryptography

Quantum-safe cryptography will be a key area of development and standardization to de-risk the increasing threat of quantum computing breaking current encryption algorithms.

Problems/Demand

- Potential risk from large-scale, fault-tolerant Quantum Computers which, in the future, can break current public-key cryptography standards that secure global communications, finance, and critical infrastructure.
- Data with long shelf life is already at risk due to the potential of it being harvested now for future decryption. This phenomena has been named 'Harvest Now, Decrypt Later' (HNDL).
- Increasing regulatory pressure from Governments and international bodies to transition to post-quantum standards.

Opportunities

- Early development adoption of Post-Quantum Cryptography (PQC) algorithms will allow organizations to become market leaders in secure digital resilience.
- Implementing hybrid approaches (combining legacy and PQC algorithms) offers a flexible transition pathway to manage risk and protect against future attacks.

Impact

- Ensures the long-term confidentiality and integrity of all digitally secured data, including financial records, health information, national security communications, and personal data.
- Requires the discovery, inventory, and migration of billions of cryptographic instances embedded in software, hardware, and protocols globally.
- Restores public trust in digital systems, preventing a global economic disruption stemming from broken encryption.

Sustainable Solutions / Business Opportunity

- Potential for high demand for services and tooling that can manage the end-to-end cryptographic inventory and automate the PQC migration process across the enterprise.
- Creation of new security products and services, such as PQC-as-a-Service offerings, secure digital identity solutions, and quantum-resilient VPNs.
- Significant revenue opportunity for specialized consulting and system integration firms to guide complex, multi-year migrations, especially in regulated industries like finance, healthcare, and defense.
- **Enablers**: Standardization & policy drivers.
- **Inhibitors**: Migration complexity & scale.

24. AI-Driven Virtual Worlds

Autonomously generated, adaptive, and personalized Virtual Worlds created by AI models that synthesize 3D content, narrative, and social interactions, driving system decisions and behaviours in real time.

Problems/Demand

- High cost and time to design, author, and maintain large-scale 3D worlds.
- Lack of adaptation to user context, actions, and real-world data.
- Growing need to simulate complex socio-technical systems before deployment through digital twins (i.e. in cities, factories, healthcare etc).
- Limited accessibility and inclusivity in current virtual experiences.
- Need for real-time remote collaboration on complex assets/applications
- Need for human sense-making of multi-dimensional data.
- Need for controlled testbeds for AI agents and robotics.
- Risk-free rehearsal simulations for rare or hazardous operations
- Rising expectations of the digital-native young generation users for persistent, personalised, and social virtual experiences.
- Entertainment industry demand virtual worlds that are always-on, personalised, immersive and offering cross-platform experiences.

Opportunities

- Generative AI for automatic 3D asset creation, scene layout, and behaviour.
- Hyper-personalised training, education, entertainment, and social spaces.
- Safe sandboxes for testing industrial and autonomous systems, robotics, and simulations with real or synthetic data.
- New "*Virtual World as a Service*" platforms for industry, education, public services, and culture.
- Always-on digital twins of buildings, cities, and infrastructures for monitoring, decision support, and what-if analysis.
- Inclusive, accessible and user adaptive words.
- New creator and data economies around AI-authored content, virtual goods, and cross-world interoperability.
- Cross-world marketplaces for virtual goods, services, compute credits etc.
- New types of Human-Computer-AI interactions.

Impact

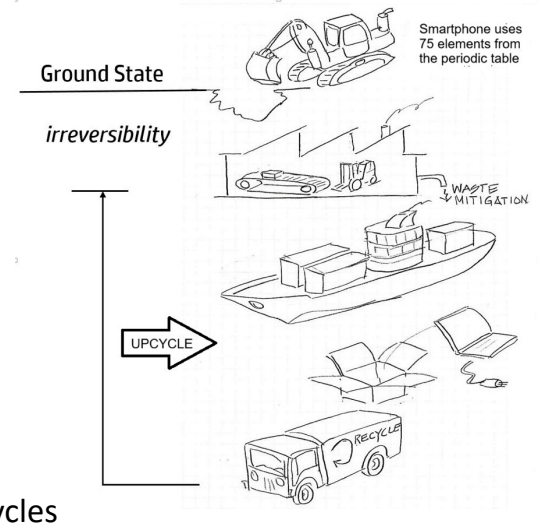
- Human–AI co-creation at scale
- Data-to-decision continuity
- Public safety and resilience
- Sustainability and resource efficiency
- New modalities for social presence, cross-cultural interaction, lifelong learning
- Productivity gains in design, engineering, and remote collaboration

Sustainable Solutions / Business Opportunity

- Faster innovation cycles and time-to-market
- Economic value creation, unlocking new IP, services, and creator-led markets
- Virtualisation of travel-intensive activities i.e. training, and events
- "Simulation as a Service" and other service oriented ecosystems
- Energy-aware AI optimised where and how generation runs (edge/cloud)
- Reusable world "templates" and domain models licensed across sectors
- Circular content economies
- **Enablers**: Advent on generative AI and models for 3D, text, vision, etc. Open-source ecosystems for generative models, engines, and tools. XR devices, haptics, and spatial interfaces, high-bandwidth 5G/6G, edge computing. GPU acceleration, increased computing and networking speeds. Interoperability standards for assets, avatars, and worlds (OpenXR, OpenUSD). Advances in real-time simulation, physics engines, and digital twins. Public and private investment in AI/XR testbeds, sandboxes, and regulatory pilots.
- **Inhibitors**: Fragmented standards, limited interoperability between platforms. Siloed virtual worlds that lock in identity, assets, social identity across games/platforms. High compute and energy costs for training and serving multimodal generative models. Scarcity of high-quality labelled 3D and multi-agent interaction datasets. Security, safety, privacy, and IP risks, combined with evolving regulation. Skills gap in AI, 3D graphics, and systems engineering. Latency, jitter, and QoS constraints in dense or remote environments. Content moderation, misinformation, and harmful behaviour in persistent worlds.

25. Future of Manufacturing

Enabling least lifetime-energy products.



Problems/Demand
- Manufacturing requires significant amounts of energy, produces waste, and product shipment can be very costly
- Supply chains can very volatile (geopolitics, pandemics, climate events) especially when relying on single (or limited) suppliers and regions
- Availability of rare materials
- Tension between centralization vs. decentralization, mass production vs. unique products (repetitive tasks vs. tailored products)
- Need to manufacture, build, or deliver to places where this is difficult
- Current complex manufacturing supply chain, while resulting in low-cost goods, has become an ecological burden to society
  - Over provisioning and waste (products on the shelves)
  - Pollution (energy, waste disposal)
  - “One size fits all” products often don't fit individual needs

Opportunities
- Efficient smart manufacturing, with optimized use of energy, minimal waste, and minimal impact to the environment
- Data-driven decision making. Collaborative robots. Digital production.
- Enhanced, efficient manufacturing of "custom, one-off" products
- Building products at locations where they are needed (especially where delivery is costly or impractical) such as space-stations in Earths orbit
- True cost of a product measured in lifetime “Joules of available energy” consumed, not in local currencies.
- Totalizing the Joules consumed in extraction, manufacturing, waste mitigation, transportation, use-phase, upcycling, recycling
  - Waste mitigation implies determination of Joules of available energy required to clean up pollution (CO_2, other gases, water, land, etc)
  - Cost of a laptop is 9 GJ (lifetime available energy), not US $1000
- Efficient mass customization such as efficient production of personally fitted orthotics and prosthetics

Impact
- Better forecasting
- Shorter development cycles
- Local production
- Reduction in waste
- Flexible manufacturing (reducing storage and transportation)
- Deglobalization if human resources such as those skilled in trades, manufacturing, are available locally i.e. Joules in human beings
- End-to-end Automation, new materials, design for upcycling
- Provisioning based on demand
- Those with available Joules, and minimized lifetime Joules, will lead
- More functional products tailored to individual needs
- Enabling fully customized least lifetime-energy products

Sustainable Solutions / Business Opportunity
- Energy efficiency, lower impact on the environment
- Lifecycle-based end-system optimized design solutions
- On-demand manufacturing solutions driven by automation, physical AI
- AI-enhanced computational design systems
- **Enablers**: AI, robotics
- **Inhibitors**: lack of (local) materials; lack of local computational design expertise as an obstacle for decentralized / local manufacturing

26. Personalized Learning

Long desired in pedagogical theory and practice, teaching that can be adapted to the path and pace of an individual student can be a better experience and result in better outcomes for the learner. AI tools and capabilities are making this possible in valuable and cost-effective ways.

Problems/Demand

- Problems with current models for educators
  - Limited ability to focus on individual learners
  - Unable to assimilate and guide each student's areas of passion
  - Differentiation at scale
  - Students not taking ownership of their education
- Problems with current models for learners
  - Falling behind the class and struggling
  - Getting ahead of the class and becoming bored
  - Education that does not adapt to the way they learn
  - Personalized tutoring is cost prohibitive

Opportunities

- AI tools for self paced learning
- Mastery based opportunities, making the best use of the time learning and not rehashing that which is already assimilated
- Individual learner data makes targeted intervention more effective
- Mass data and information on larger sets of learners allows for faster adaptation to better teaching models
- Faster adaptation to cultural differences of learners

Impact

- Deeper learning for students
- Improved student outcomes
- Faster time to mastery in areas of passion
- Lower priced access to personalization
- Teachers can shift more towards the role of a coach/facilitator as they benefit from greater availability of teaching tools and knowledge
- Low resourced areas will get access to better tools

Sustainable Solutions / Business Opportunity

- Expanding learning management systems into learning experience systems
- Adaptable AI driven learning paths and learner journeys
- Data analytics to create learning insights
- Opportunities throughout the entire life cycle (early childhood through corporate training)
- **Enablers**: Schools and school systems, Government education standards groups, Venture capital, Education technology companies
- **Inhibitors**: High costs of initial implementation, entrenched educational structures, student adoption, technology hurdles when aiming to do at scale

To Learn More

Written by our Team Members

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Additional Statistics

2026 Technology Predictions, Detailed Comparison

Rank	Success in 2026		Impact to Humanity		Maturity in 2026*		Market Adoption (2026) **		Commercial Adoption Horizon***	
	Technology	Grade	Technology	Grade	Technology	Grade	Technology	Grade	Technology	#Years
1	AI-generated Content	A-	AI and Future of Medicine	A	AI-generated Content	B+	AI-generated Content	A/B	AI-generated Content	15
2	Wearable Devices	A/B	Cybersecurity	A-	Wearable Devices	B	Cybersecurity	A/B	Cybersecurity	14.4
3	Future of Coding	B+	Policy for AI	A-	Autonomous Vehicles	B	Wearable Devices	B+	Wearable Devices	12.6
4	Multi-Modal AI	B+	AgroTech	A/B	Cybersecurity	B	Future of Coding	B+	Future of Coding	11.2
5	Autonomous Vehicles	B+	Engineered Therapeutics	A/B	Future of Coding	B-	Edge	B+	Edge	9.58
6	Cybersecurity	B+	AI and Future of Work	A/B	Data Center Energy Management	B-	Social AI	B+	Social AI	9.41
7	Edge	B+	AI and Future of Electrical Grid	A/B	Edge	B-	Data Center Energy Management	B	Data Center Energy Management	9.15
8	Personalized Learning	B+	Assurance	A/B	Personalized Learning	B-	Autonomous Vehicles	B	Autonomous Vehicles	8.75
9	Data Center Energy Management	B+	Data Center Energy Management	A/B	Multi-Modal AI	B-	Multi-Modal AI	B	Multi-Modal AI	8.52
10	AgroTech	B	Embodied, Physical AI	A/B	AI and Future of Work	B/C	Personalized Learning	B	Personalized Learning	8.32
11	AI and Future of Work	B	Personalized Learning	A/B	Social AI	B/C	Rack-scale Architectures	B	Rack-scale Architectures	7.57
12	Rack-scale Architectures	B	Wearable Devices	A/B	AgroTech	B/C	AgroTech	B	AgroTech	7.37
13	Social AI	B	AI and Future of Manufacturing	A/B	Rack-scale Architectures	B/C	AI and Future of Work	B-	AI and Future of Work	7.2
14	AI and Future of Manufacturing	B	Autonomous Vehicles	B+	AI and Future of Manufacturing	B/C	AI and Future of Manufacturing	B-	AI and Future of Manufacturing	6.88
15	AI Personalities	B	Multi-Modal AI	B+	AI Personalities	B/C	AI and Future of Electrical Grid	B-	AI and Future of Electrical Grid	5.56
16	AI and Future of Electrical Grid	B	Social AI	B+	AI and Future of Electrical Grid	B/C	Assurance	B-	Assurance	5.39
17	Embodied, Physical AI	B	AI-generated Content	B+	New Processors	B/C	AI and Future of Medicine	B-	AI and Future of Medicine	5.28
18	AI and Future of Medicine	B	Edge	B	Assurance	B/C	AI Personalities	B-	AI Personalities	5.05
19	New Processors	B	Quantum-safe Cryptography	B	AI and Future of Medicine	B/C	New Processors	B-	New Processors	5.02
20	Assurance	B	New Processors	B	Embodied, Physical AI	B/C	Policy for AI	B-	Policy for AI	4.67
21	In-memory Computing	B-	Future of Coding	B	In-memory Computing	C+	Embodied, Physical AI	B/C	Embodied, Physical AI	4.59
22	Policy for AI	B-	Space Communications	B	AI-driven Virtual Worlds	C+	In-memory Computing	B/C	In-memory Computing	3.87
23	Space Communications	B-	In-memory Computing	B-	Engineered Therapeutics	C+	Engineered Therapeutics	B/C	Engineered Therapeutics	3.24
24	Engineered Therapeutics	B-	Rack-scale Architectures	B-	Policy for AI	C+	Space Communications	B/C	Space Communications	2.32
25	AI-driven Virtual Worlds	B/C	AI Personalities	B-	Space Communications	C+	AI-driven Virtual Worlds	C+	AI-driven Virtual Worlds	1.89
26	Quantum-safe Cryptography	B/C	AI-driven Virtual Worlds	B/C	Quantum-safe Cryptography	C	Quantum-safe Cryptography	C+	Quantum-safe Cryptography	0

** Maturity has been normalized ever since introduction, due to the impact of averages. Normalization is slightly adjusted every year.*

*** Market adoption was linearly normalized from inputs to increase spread between bubble size. The comparative size of bubbles was not affected, what matters.*

**** Horizon to commercial adoption was linearly normalized from inputs to [0,15] years.*

Correlation, Average, Range across Technologies, ‘23-’26

INSIGHTS FOR 2026

- Compared to previous year, corelation was varied due to the growth of the team.
- There seems to be an implicit correlation between Technology Success Likelihood (horizontal axis) and relative market adoption (size of bubble) s well as maturity (colors).

	Success in 2026	Impact to Humanity	Maturity in 2026	Market Adoption’26
Success in 2026	1	0.13 (↓↓)	0.95 (↑)	0.95 (↑)
Impact to Humanity	0.13 (↓↓)	1	0.09 (↓↓)	0.17 (↓)
Maturity in 2026	0.95 (↑)	0.09 (↓↓)	1	0.93 (→)
Market Adoption in 2026	0.95 (↑)	0.17 (↓)	0.93 (→)	1

	Success in	Impact to Humanity	Maturity in	Market Adoption’25
Success in	1	0.30 (↓)	0.90 (→)	0.89 (↓)
Impact to Humanity	0.30 (↓)	1	0.22 (↓)	0.21 (↓)
Maturity in	0.90 (→)	0.22 (↓)	1	0.93 (→)
Market Adoption in	0.89 (↓)	0.21 (↓)	0.93 (→)	1

	Success in 2024	Impact to Humanity	Maturity in 2024	Market Adoption’24
Success in 2024	1	0.47 (↑)	0.90 (↓)	0.96 (↑)
Impact to Humanity	0.47 (↑)	1	0.36 (↑)	0.44
Maturity in 2024	0.90 (↓)	0.36 (↑)	1	0.93 (↓)
Market Adoption in 2024	0.96 (↑)	0.44 (↑)	0.93 (↓)	1

	Success in 2023	Impact to Humanity	Maturity in 2023	Market Adoption ‘23
Success in 2023	1	0.09	0.92	0.88
Impact to Humanity	0.09	1	0.13	0.28
Maturity in 2023	0.92	0.13	1	0.94
Market Adoption in 2023	0.88	0.28	0.94	1

Success in 2026		Impact to Humanity		Maturity in 2026		Market Adoption in 2026		Horizon to Commercial Adoption (#years)	
Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
B (→)	[A-, B/C]	B+ (→)	[A, B/C]	B/C (→)	[B+,C+]	B (↑)	[A-, C]	4.33 (↓)	[1.87-7.13]

This year (2026)

Success in		Impact to Humanity		Maturity in		Market Adoption in		Horizon to Commercial Adoption (#years)	
Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
B (↑)	[A-, C+]	B+ (↑)	[A, B-]	B/C (↑)	[B,C]	B- (↑↑)	[A-, C-]	4.81 (→)	[2. 49-9.69]

Last year (2025)

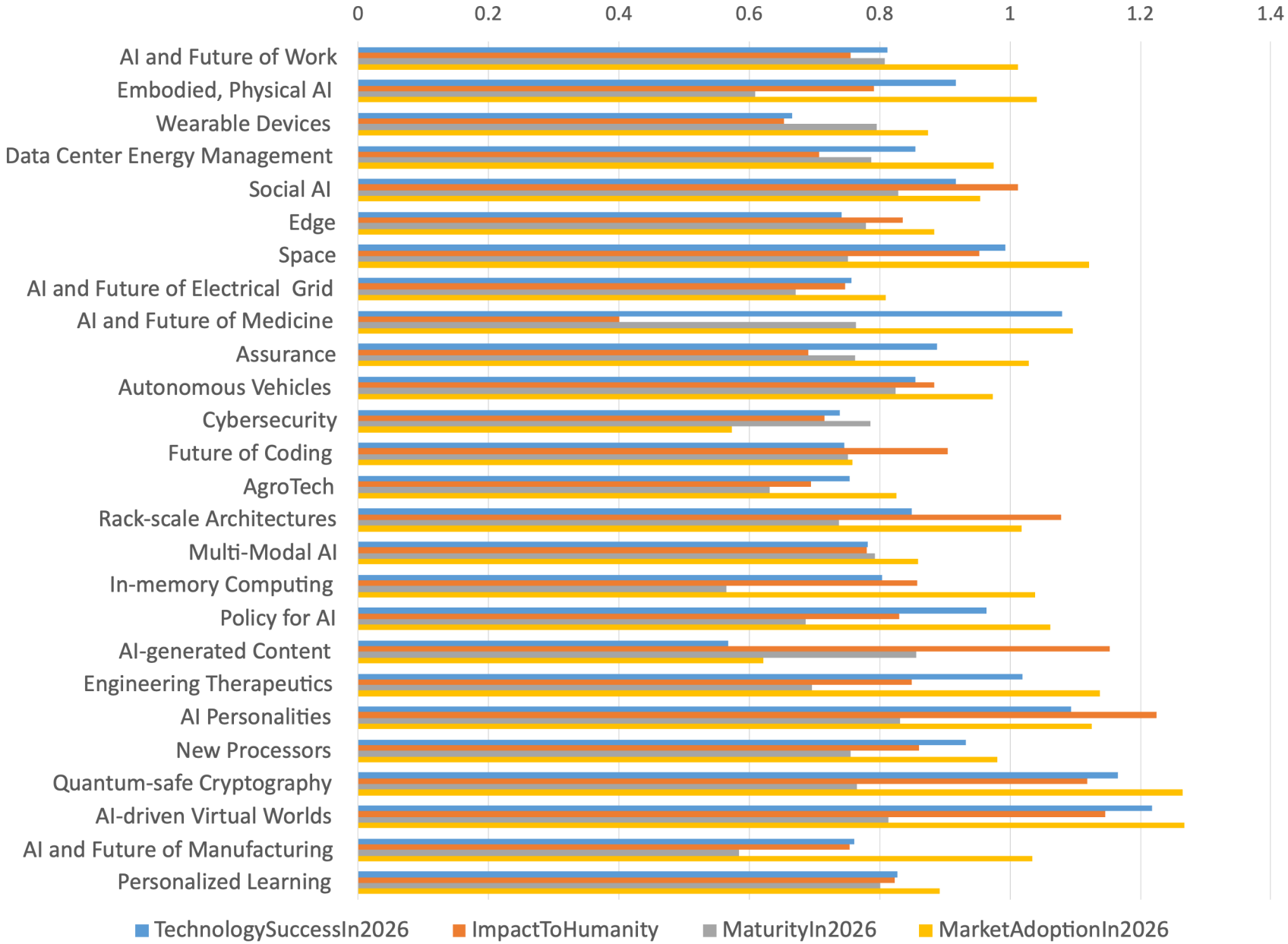
Success in 2024		Impact to Humanity		Maturity in 2024		Market Adoption in 2024		Horizon to Commercial Adoption (#years)	
Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
B- (↑)	[A/B, C/D]	B (→)	[A-, C]	C+ (→)	[B+,C/D]	C+ (→)	[B+, D]	4.81 (↑)	[2. 29-9.66]

Two years year (2024)

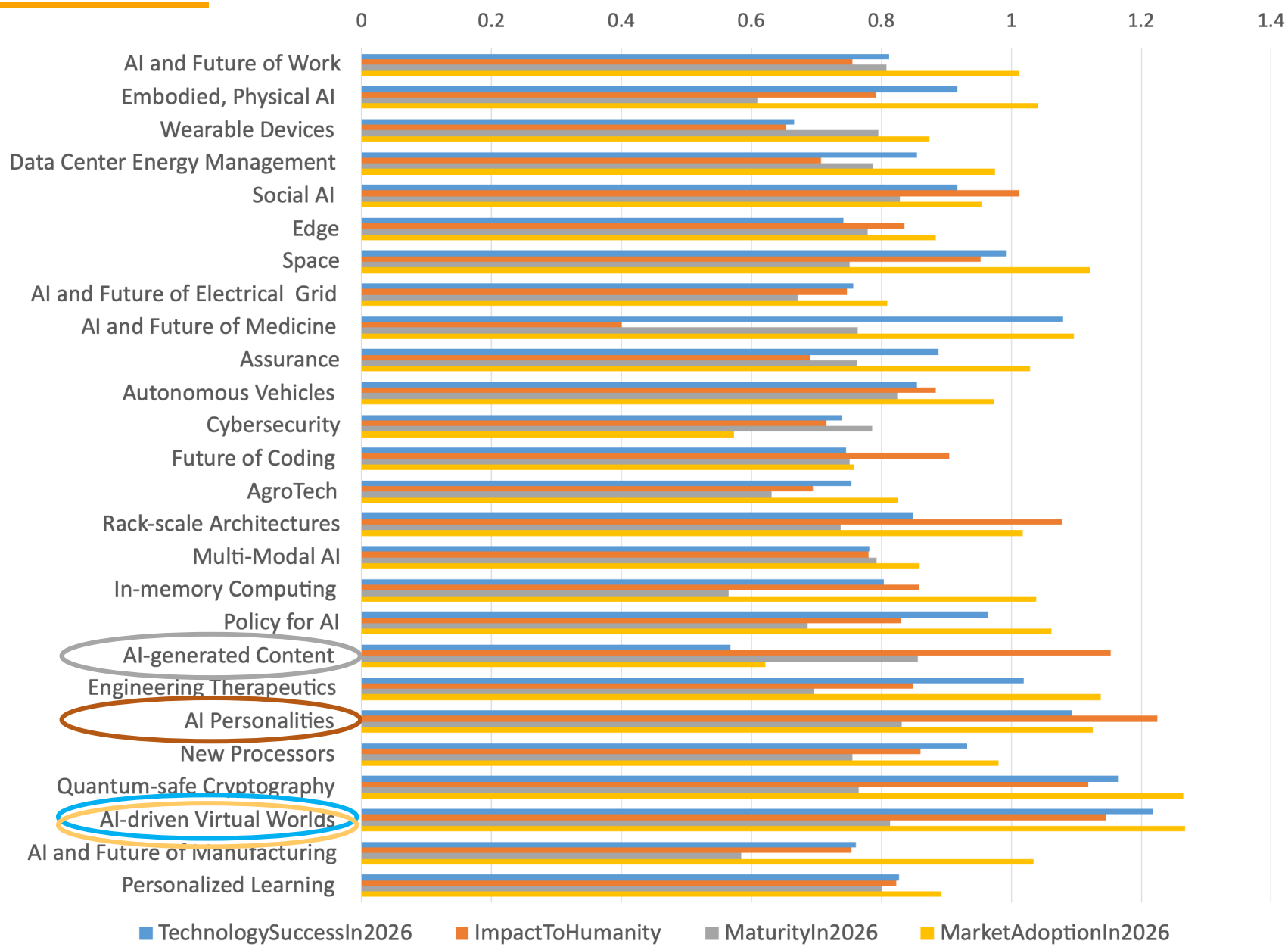
Success in 2023		Impact to Humanity		Maturity in 2023		Market Adoption in 2023		Horizon to Commercial Adoption (#years)	
Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
B/C	[B+, C/D]	B	[A, B/C]	C+	[B,D+]	C+	[B+, D]	5.54	[2.4-11.1]

Three years ago (2023)

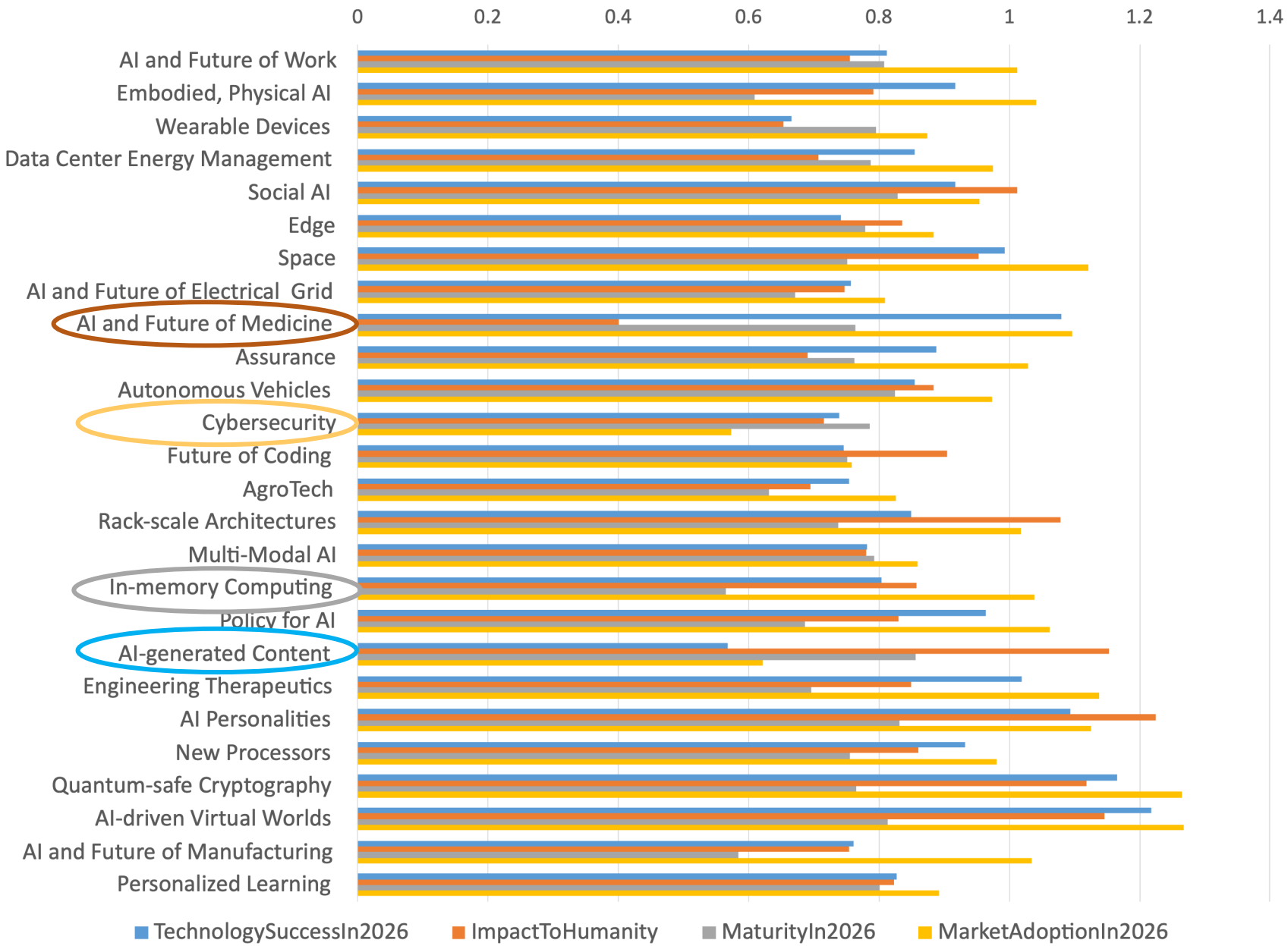
Standard Deviation



Standard Deviation, Largest (Least Confidence)



Standard Deviation, Smallest (Most Confidence)



Technology Predictions Scorecard

Scorecard for Technology Predictions*

The IEEE Computer Society Predictions Team self-grade A- in their scorecard**

Original predictions are available here:

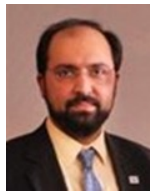
https://www.computer.org/press-room/-technology-predictions

The Key Findings:

- This year showed dramatic increase in core AI (AI Agents) and applied AI (autonomous vehicles, wearables)
- Managing misinformation continues to have a large volatility year-over-year, largest drop in predictions
- There was drop in energy-related and space-related technology progress
- Year-over-Year, there were fewer instances of drop, but when they took place, they were large

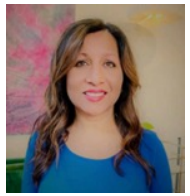
** Disclaimer: the scorecard presented represents the repeated prediction at the end of the year for which original prediction was made*

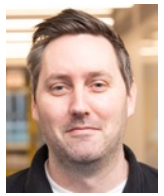
*** Explanation of A- grade: For 80 of the 88 predictions (90%) for 22 technologies, our December scorecard varied by less than one standard deviation from the December 2024 predictions, hence the A- grade. For "AI Agents", the predictions varied less than 2 standard deviations for 3 of the 4 categories. Only for LLM deployment, maturity varied by more than 2 standard deviations form one prediction out of four.*


Ali Abidi, Univ. of Maine


Mohamed Amin, Nokia


Cherif Amirat, Stevens Inst. of Tech


Jyotika Athavale, Synopsys


Kyle Chard, Univ. of Chicago/ Argonne Nat'l Lab


Mary Baker, HP Inc.


Greg Byrd, NC State, Raleigh

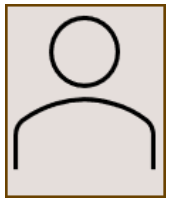

Tom Coughlin Coughlin Associates


Izzat El Hajj, American Univ. of Beirut


Paolo Faraboschi Hewlett Packard Ent.


Nicola Ferrier Argonne Natl Lab


Rafael Ferreira da Silva, Oak Ridge Nat'l Lab


Eitan Frachtenberg Hewlett Packard Ent.


Jean-Luc Gaudiot, UC Irvine


Ada Gavrilovska, GaTech


Alfredo Goldman University of São Paolo


Mike Ignatowski, AMD


Lizy K. John, Univ. of Texas at Austin


Vincent Kaabunga AKEM Consulting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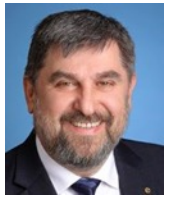
Avi Mendelson Technion


Cecilia Metra Bologna University


Dejan Milojicic (chair) Hewlett Packard Ent.


Puneet Mishra, U R Rao Satellite Center


Chris Miyachi, Nuance Communications


Khaled Mokhtar IEEE CPC Chair

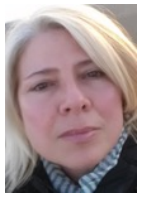

Chengappa Munjandira Hewlett Packard Ent.


Bob Parro River North Solutions

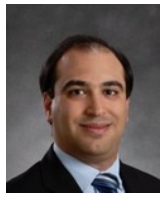

Sudeep Pasricha, Colorado State Univ.


Nita Patel, Otis


Alexandra Posoldova Founder, Sigma Services


Marina Ruggieri, Univ. of Rome, Tor Vergata


Tomy Sebastian Halla Mechatronics


Farzin Shadpour, VC Partner


Sohaib Qamar Sheikh, Proptech and CRETech

Saurabh Sinha, Univ. of Canterbury

Vesna Sossi Professor, UBC

Luka Strezoski, Univ. of Novi Sad

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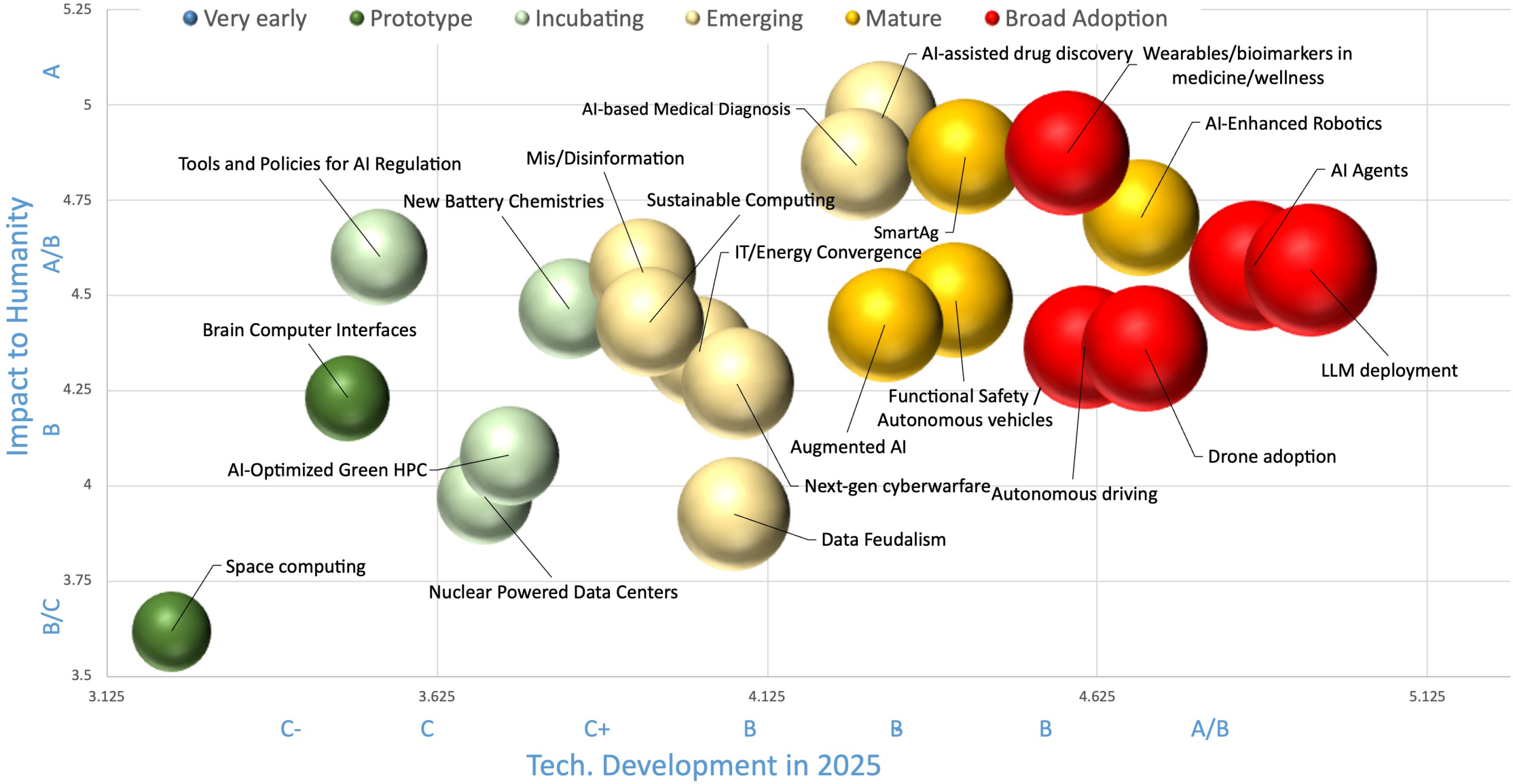
Gerd Zellweger, Feldera Inc.

Ying Zhang, META

Technology Predictions 2025 Team

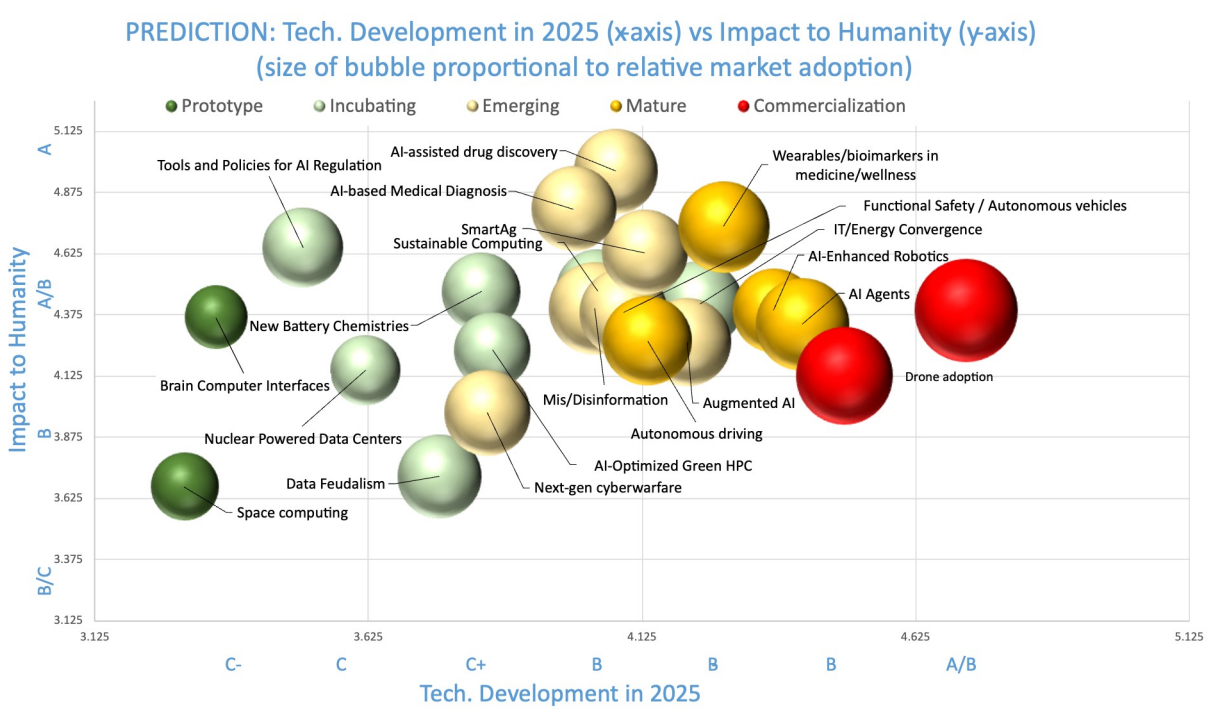
Statements in this slideset express opinions of authors themselves only and not of their employers

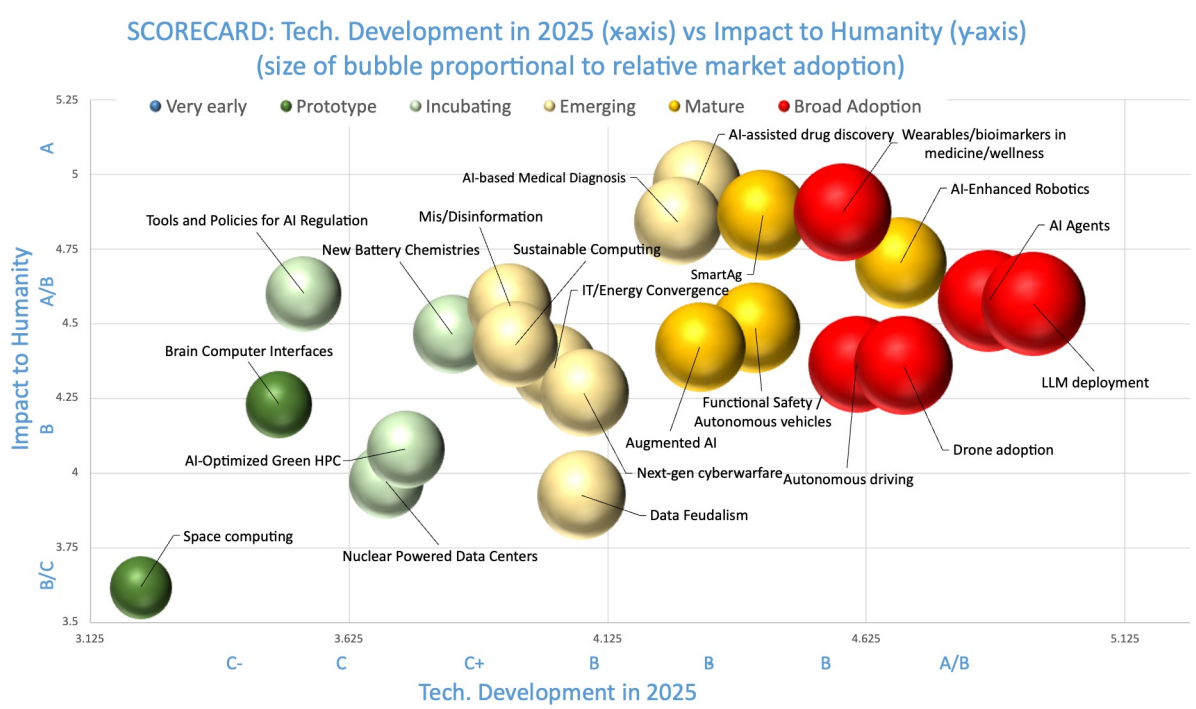
SCORECARD: Tech. Development in 2025 (x-axis) vs Impact to Humanity (y-axis) (size of bubble proportional to relative market adoption)



Disclaimer: the scorecard presented represents the repeated prediction at the end of the year for which original prediction was made

Original Predictions vs Scorecard Grades for 2025





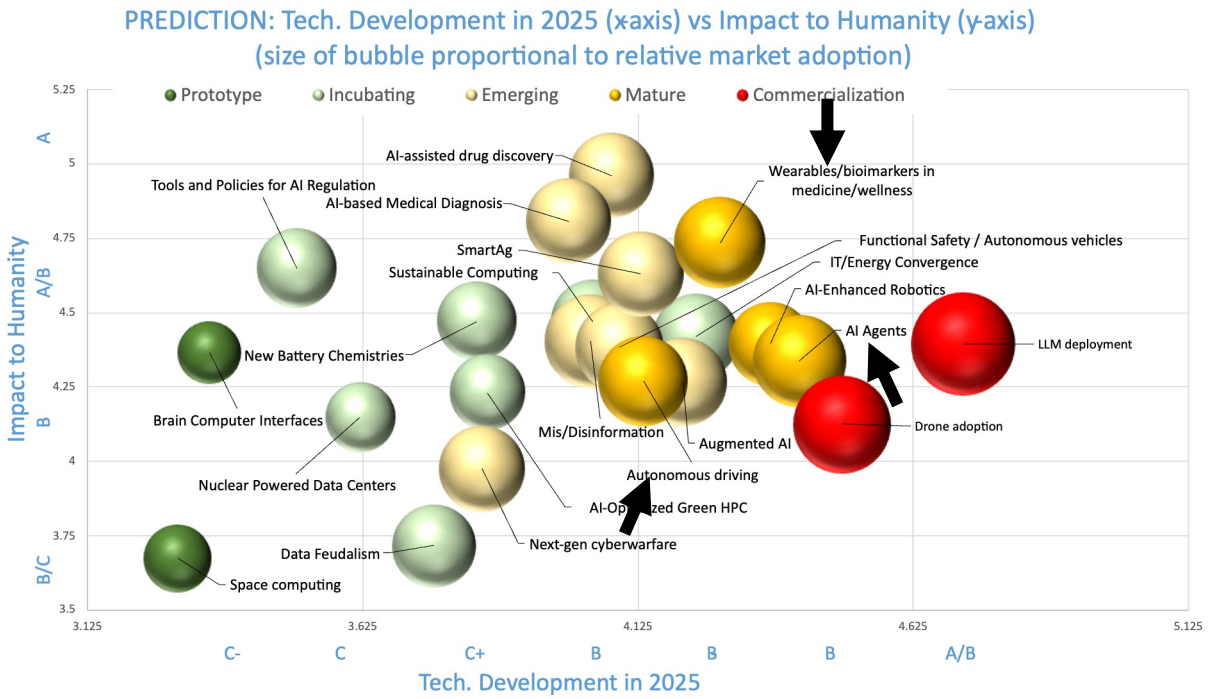
Original Predictions made in December 2024

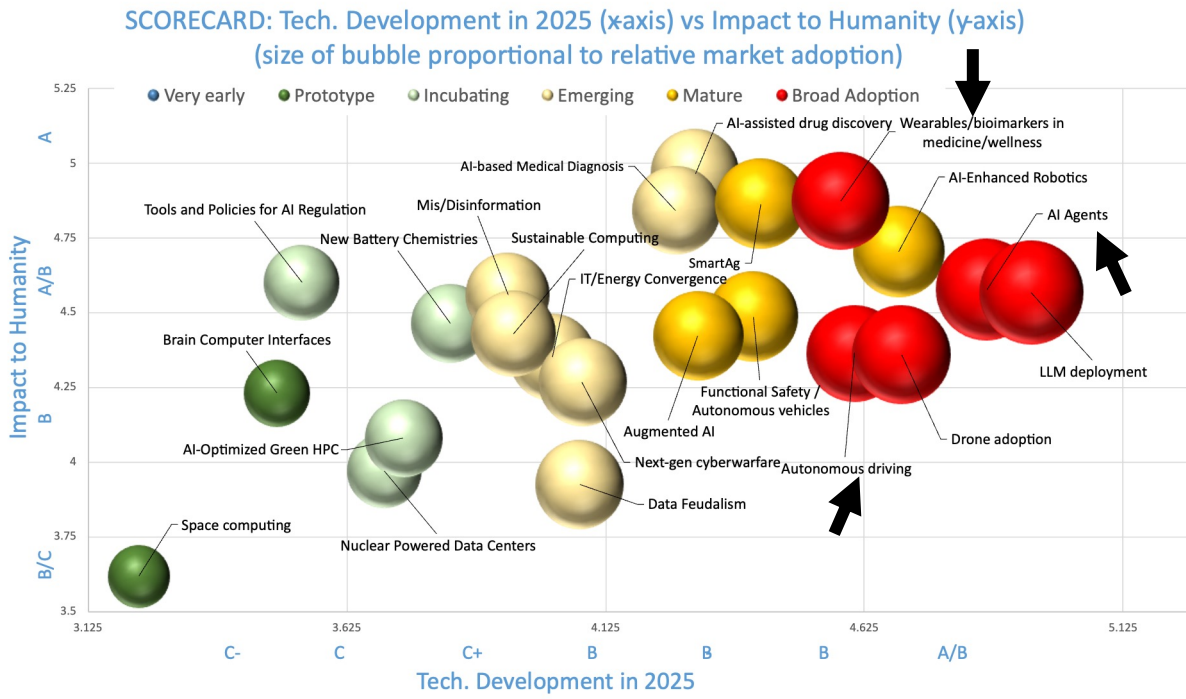
Scorecard, made in December 2025

Shows increase in the pace of innovation triggered by AI during 2025

- There is increase in maturity (many more red and light-yellow bubbles)
- There is an increase in likelihood of technology success (bubbles shifted to the right)

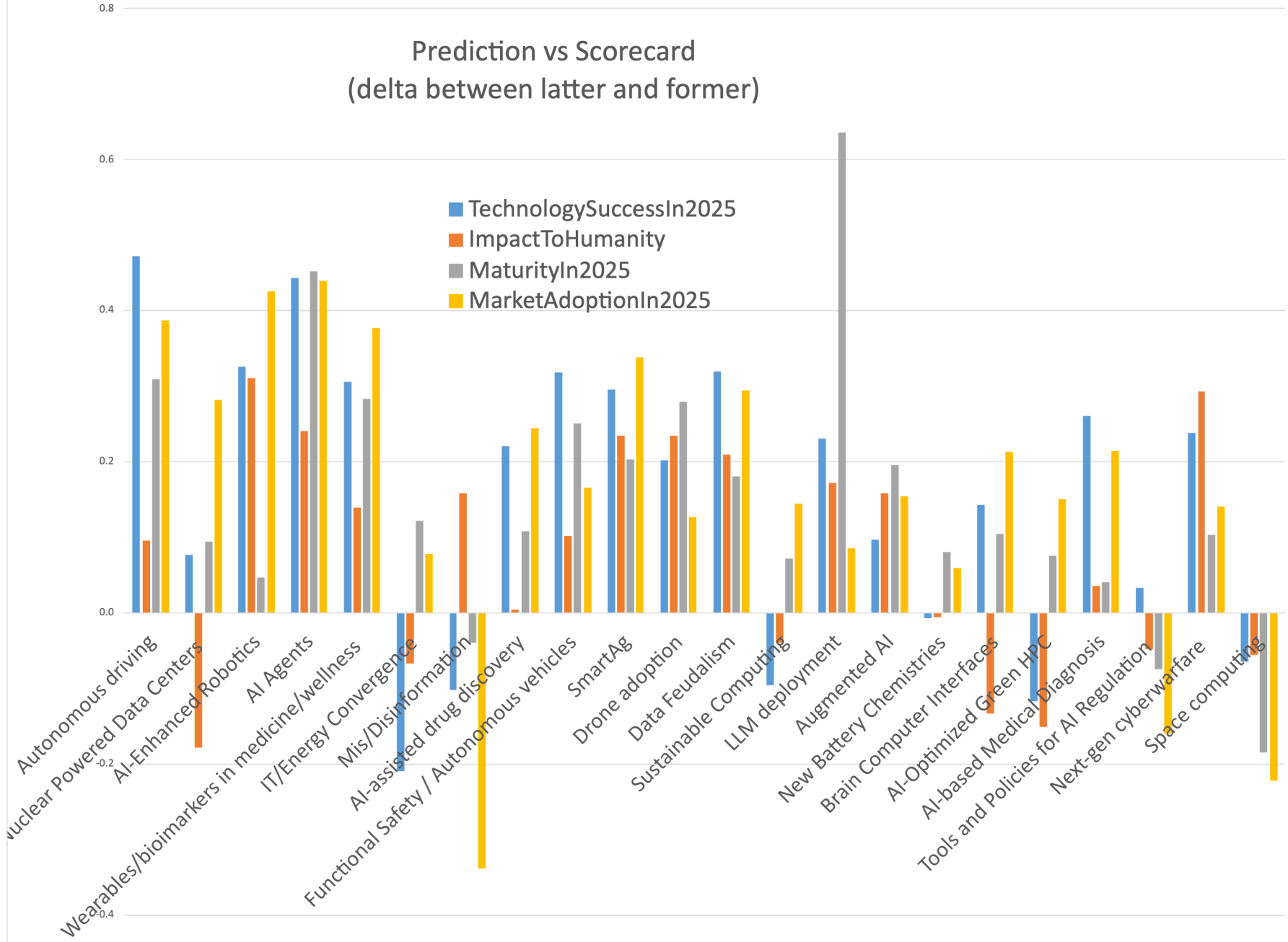
Original Predictions vs Scorecard Grades for



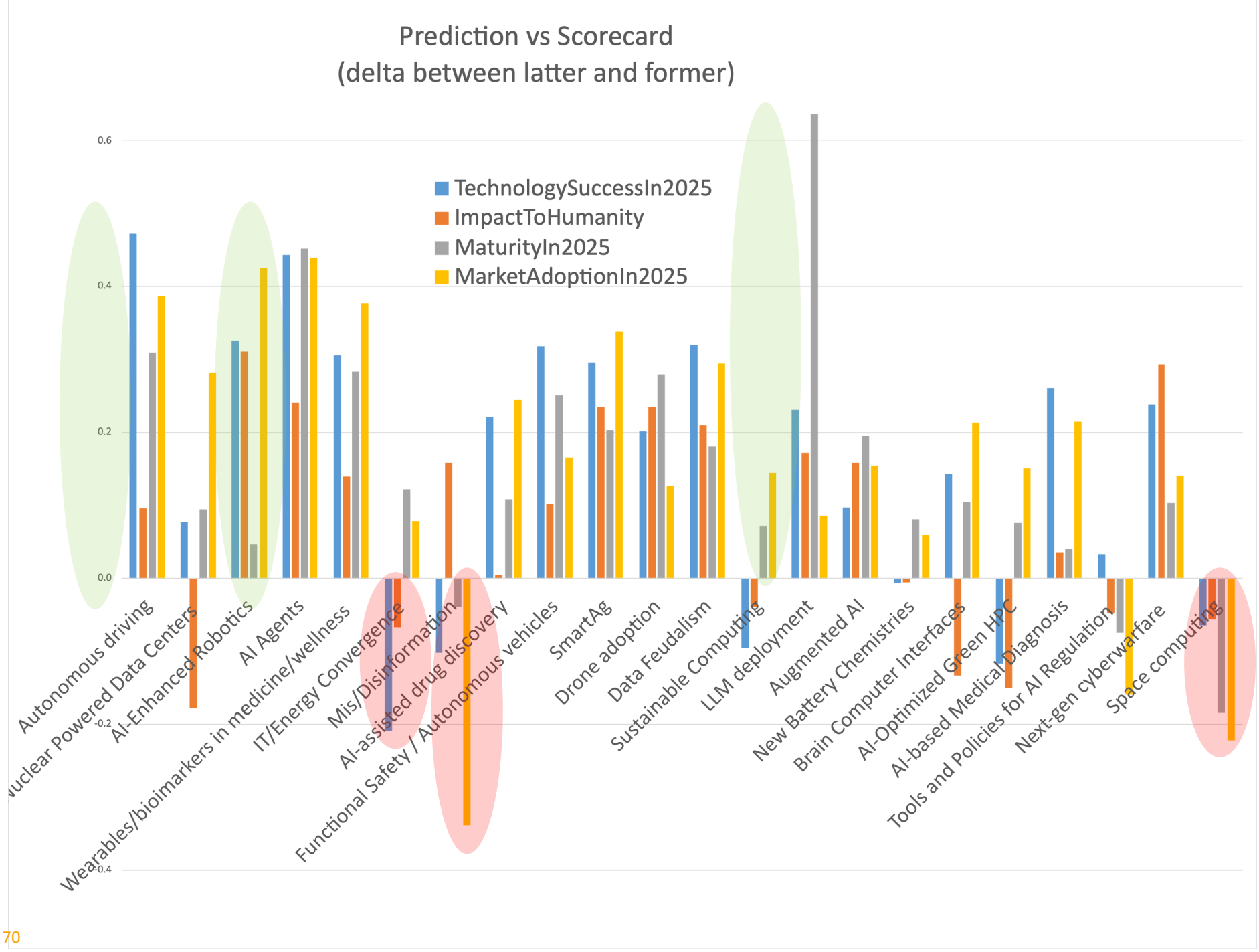


Original Predictions made in December 2024

Scorecard, made in December 2025



A+	5.25
A	5
A-	4.75
A/B	4.5
B/A	4.5
B+	4.25
B	4
B-	3.75
B/C	3.5
C/B	3.5
C+	3.25
C	3
C-	2.75
C/D	2.5
D/C	2.5
D+	2.25
D	2
D-	1.75
D/E	1.5
E/D	1.5
E+	1.25
E	1
E-	0.75
E/F	0.5
F/E	0.5
F+	0.25
F	0
F-	-0.25



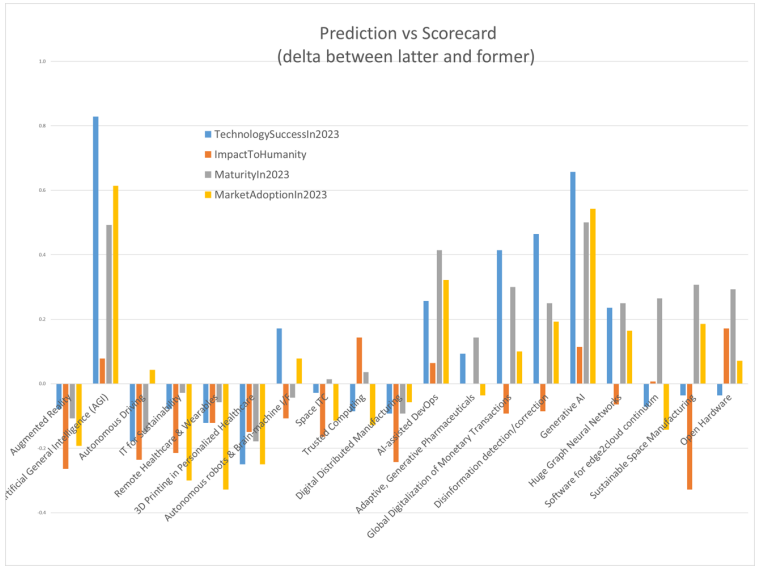
decrease

increase

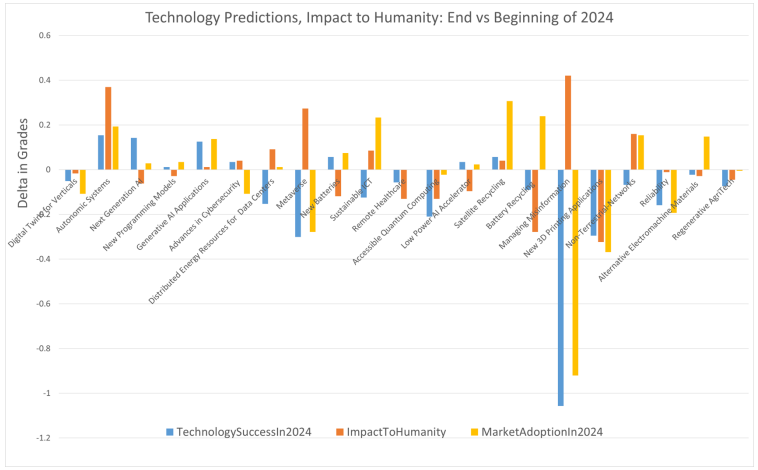
A+	5.25
A	5
A-	4.75
A/B	4.5
B/A	4.5
B+	4.25
B	4
B-	3.75
B/C	3.5
C/B	3.5
C+	3.25
C	3
C-	2.75
C/D	2.5
D/C	2.5
D+	2.25
D	2
D-	1.75
D/E	1.5
E/D	1.5
E+	1.25
E	1
E-	0.75
E/F	0.5
F/E	0.5
F+	0.25
F	0
F-	-0.25

Scorecard Delta Progression Over Past 3 Years

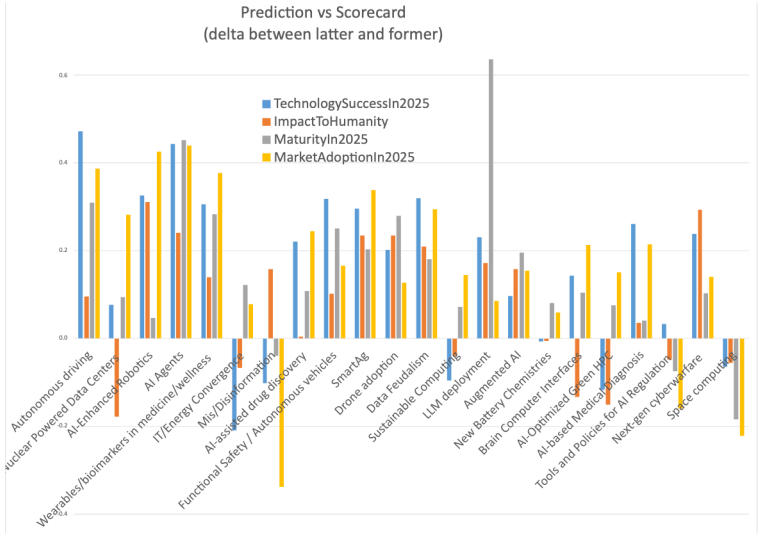
2023 Scorecard



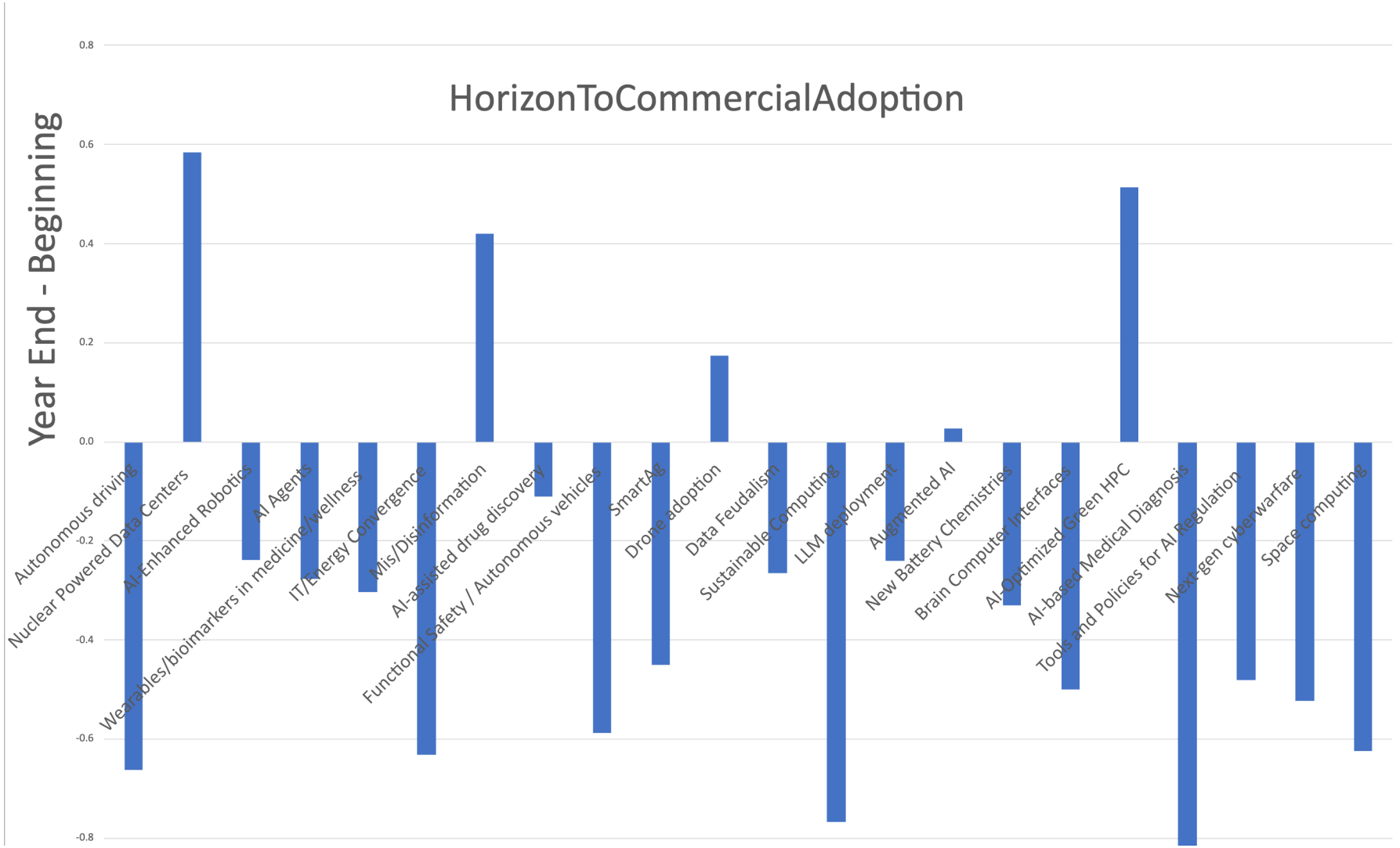
2024 Scorecard



2025 Scorecard



- In 2025, there are fewer decreases and many more increases compared to ‘23, ’24
- This speaks to the aggressive technology development during last year



- Decrease in horizon to adoption also speaks to increased speed of tech development during
- This is primarily due to AI fueling development of all other technologies

Insights

- **Largest positive deltas in prediction between last two years and now**
  - The biggest increase was for LLM deployment, especially in terms of its maturity. This reflects reality on the ground.
  - The next two are for I Agents and autonomous driving, which are both fueled by AI
  - Largest drops are in managing misinformation, which is traditional and space computing which may be related to unfulfilled high expectations.
- **The best (expected) predictions were for**
  - New battery chemistry, sustainable computing, and tools and policies for AI regulation
- **Most technologies advanced at higher speed than what we expected at the beginning of the year, one notable exception is space computing. Space computing advanced at lower speed across all dimensions**

Thank You!
Questions?

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PREVIEW: Megatrends 2026 (March-April'26)

- Built upon and evolved from Megatrends 2024 Report
- Outcomes of:
  - 4 in-person meetings in Santa Clara Valley Section
  - 6 FDC IAB meetings at IEEE Board Series
  - Broad survey to be conducted

Hyper-automation (robotics)

prototype

Space -tech

New energy

incubating

Bio-tech

emerging

AI

Sustainability

mature

Digital Transformation

commercialization

2010 2020 2030 2040

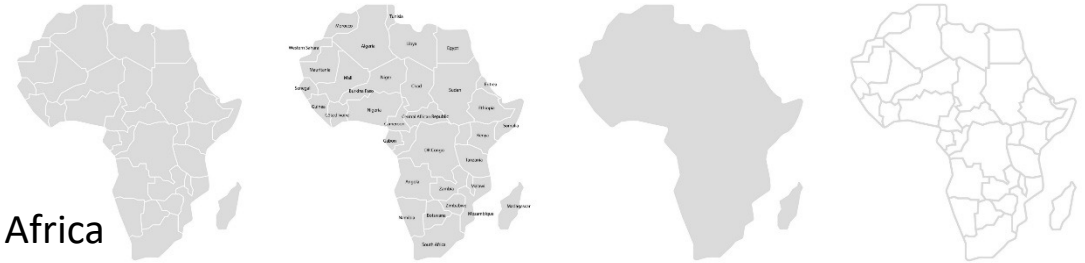
IEEE FUTURE DIRECTIONS

IEEE COMPUTER SOCIETY

IEEE Santa Clara Valley Section

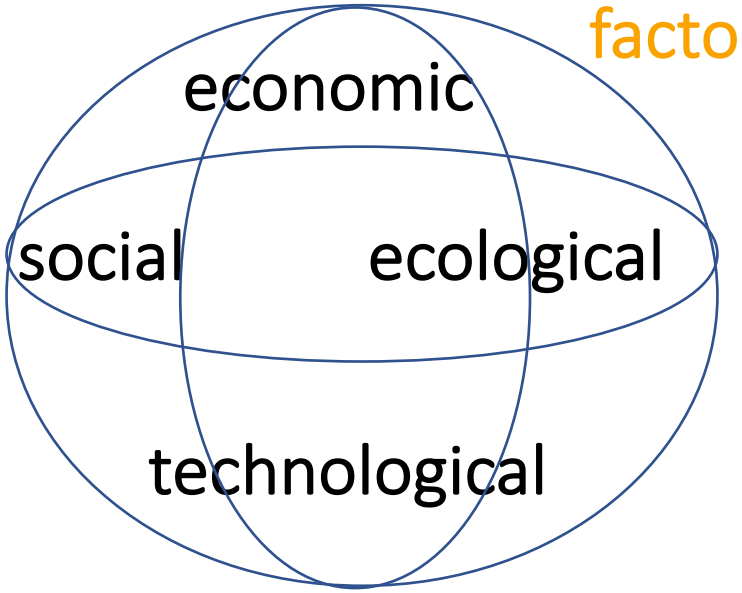
PREVIEW: Future of Workforce in Africa (May'26)

- Built upon Future of Workforce report in 2023
- Outcomes of:
  - 4 in-person meetings in West/North/East/Southern Africa
  - Broad survey to be conducted



1. world is changing

factors



2. technology is evolving

technologies

automation

security

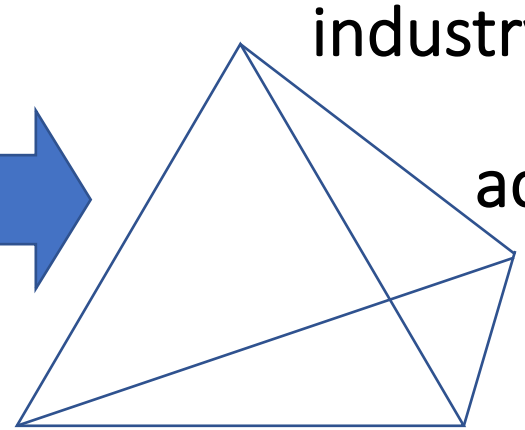
verticals/apps

infrastructure

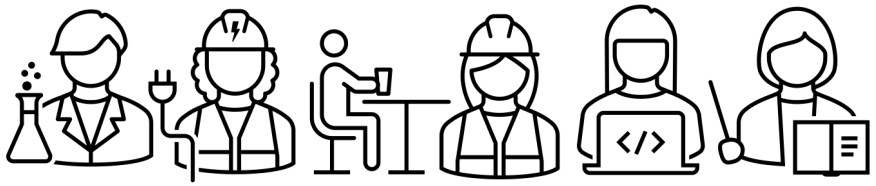
3. stakeholders can help

our primary goal!

recommendations



workforce skills *our secondary goal!*



4. skills need to adapt

IEEE Industry Engagement Committee

IEEE FUTURE DIRECTIONS

IEEE COMPUTER SOCIETY

Forecast Activities in IEEE:

Organization, *Time period*, *Product*, *Key Resource*

Computer Society
(Since 1999)
Technology Predictions
Members, Magazine pubs
Marketing

Future Directions
(Since 2021)
Megatrends
IEEE FDC Community

Industry Engagement
(Since 2020)
Future of Workforce
IEEE Industry Community, Surveys

IEEE FUTURE DIRECTIONS

IEEE Industry Engagement Committee