Reinventing Industries- An Academic Insight into Technologies Advancing Society

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Abstract – An overview of many newly developing technologies ready to revolutionize different sectors in the next years is given in this study piece. It covers topics ranging from quantum computers to multi-modal artificial intelligence to extended reality to edge artificial intelligence to small machine learning to advancements in artificial intelligence for communication and education. The study explores how IoT, industry, healthcare, agriculture, and more might all be impacted by these technologies. It emphasizes some practical uses, social and financial effects, as well as future competencies needed to take use of these developments.

Among the main points are:

- Introduction to quantum computing and quantum-ready programming to solve complex computational problems
- Applications of multi-modal AI in enhancing quality control and efficiency in manufacturing and healthcare
- Explaining extended reality (XR) and its ability to transform experiences across industries
- Edge AI and tiny machine learning to bring intelligence even to low-powered devices
- Use of AI advancements to improve communication, education, skill development and more

The paper ends with a list of important technologies to keep an eye on for 2025 and knowledge needed to be relevant in the future employment market shaped by artificial intelligence and other developing technology breakthroughs.

Keywords: Quantum computing, Artificial intelligence, Extended reality, Edge intelligence, tiny machine learning, Emerging technologies.

1. INTRODUCTION

The fast speed at which technology is developing is bringing an era of invention across many sectors. Many innovative technologies including quantum computing, artificial intelligence, extended reality and more are ready to revolutionize corporate processes, improve efficiency, find fresh prospects and challenge humanly achievable limits.

Some of these developing technologies, their practical uses, and their influence on the employment environment of the future are examined in this study paper It seeks to draw attention to important advances experts in many fields should be aware of if they are to remain relevant in the next years.
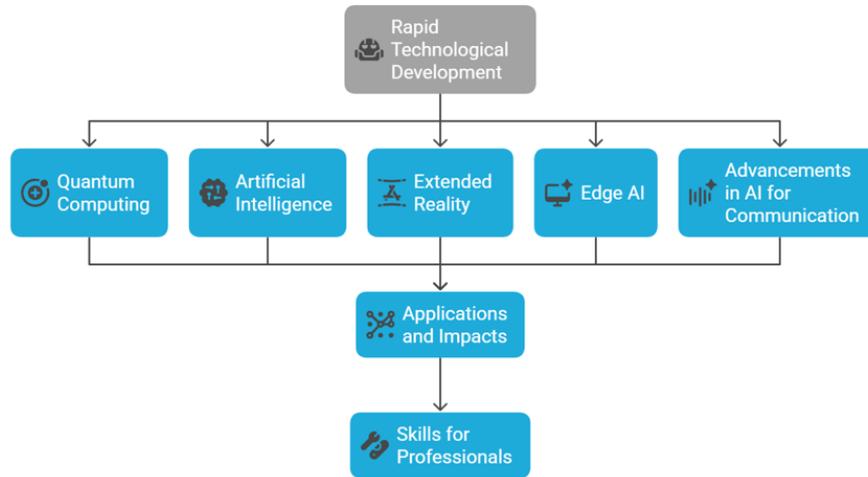
Fig -1: Emerging Technologies and Their Impact

The subjects addressed include:

- Quantum Computing and Quantum Ready Programming

- Multi-Modal Artificial Intelligence

- Extended Reality

- Edge AI and Tiny Machine Learning

- Advancements in AI for Communication and Education

- Real-World Impacts of Emerging Technologies

The article examines concepts, uses, challenges, future directions, and skills required to correctly implement every technology. It presents a point of view on how these advances might influence several industries and provide professionals with the knowledge to implement them for favorable outcomes.

2. QUANTUM COMPUTING AND QUANTUM READY PROGRAMMING

What is Quantum Computing?

Quantum computing utilizes quantum mechanical phenomena like entanglement and superposition to perform computations. It exploits the ability of quantum bits or 'qubits' to exist in multiple states simultaneously to conduct certain tasks much more quickly than classical computers.

Some of the key capabilities of quantum computing include:

- Very rapid searches and optimizations

- Efficiently modeling quantum systems

- Machine learning analytics

- Secure communication

Quantum computing promises to transform fields including financial modeling, weather prediction, medical research, automated driving and more even while it is still in its early days. Leading technology corporations including IBM, Google, Microsoft, Intel, and startups like Rigetti are creating quantum processors to enable the realization of these uses.
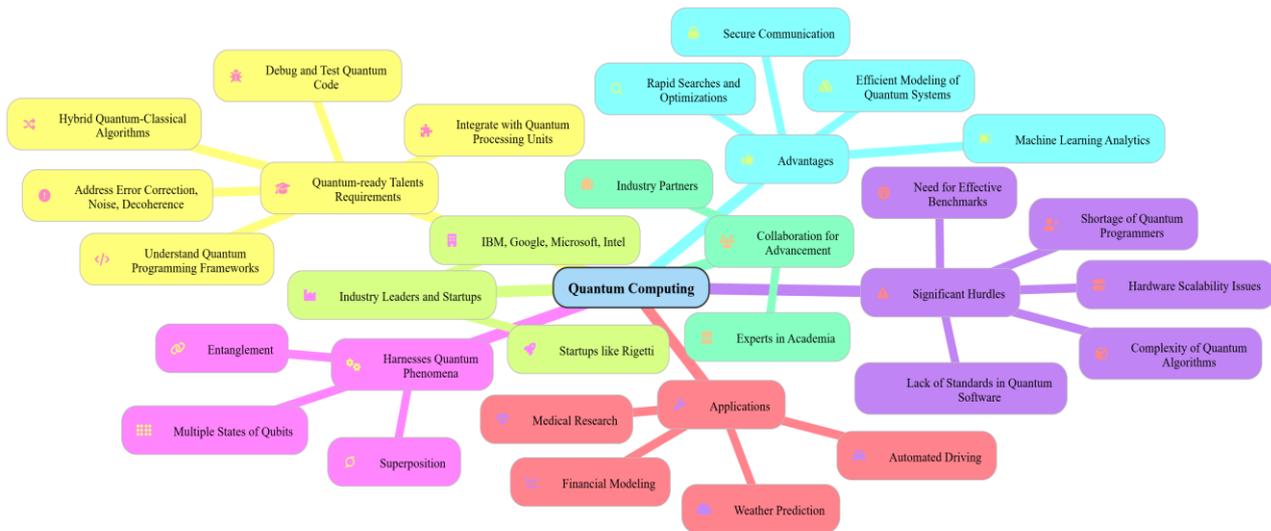

Fig –2: Quantum Computing

Quantum Ready Programming:

Software programs and algorithms must be developed expressly for this architecture if we are to benefit from quantum computing. This calls for quantum ready talents even among conventional programmers and engineers.

Some key aspects include:

- Understanding quantum programming frameworks like Q# and Qiskit

- Modeling optimization problems with hybrid quantum-classical algorithms

- Learning to debug and test quantum code

- Knowing how to integrate with quantum processing units

- Handling error correction, noise and decoherence

These skills will be critical to develop quantum-ready applications in domains like machine learning, cryptography, molecular modeling and optimization.

Challenges in Quantum Computing:

While promising, there are significant challenges to overcome before quantum advantage can be achieved. Some of these include:

- Hardware challenges in scaling quantum processors due to quantum noise, decoherence etc.

- Lack of standards and best practices in quantum software development

- Scarcity of quantum programmers and algorithm designers

- High complexity of quantum algorithms

- Effective benchmarks to estimate quantum speed-up

Overcoming these challenges requires collaboration between physicists, engineers, programmers and domain experts across academia and technology leaders.

3. ARTIFICIAL INTELLIGENCE AND MULTI-MODAL AI

Introduction to Multi-Modal AI:

Most real-world AI applications today rely on a single data modality - such as computer vision, speech recognition or natural language processing. However, higher accuracy can be achieved by combining multiple modalities.

Multi-modal AI leverages different data sources like vision, text, speech, sensor data to develop a richer understanding of the environment. Fusing these multiple streams of input data enables models to learn correlations and patterns that are not discernible from any single modality.
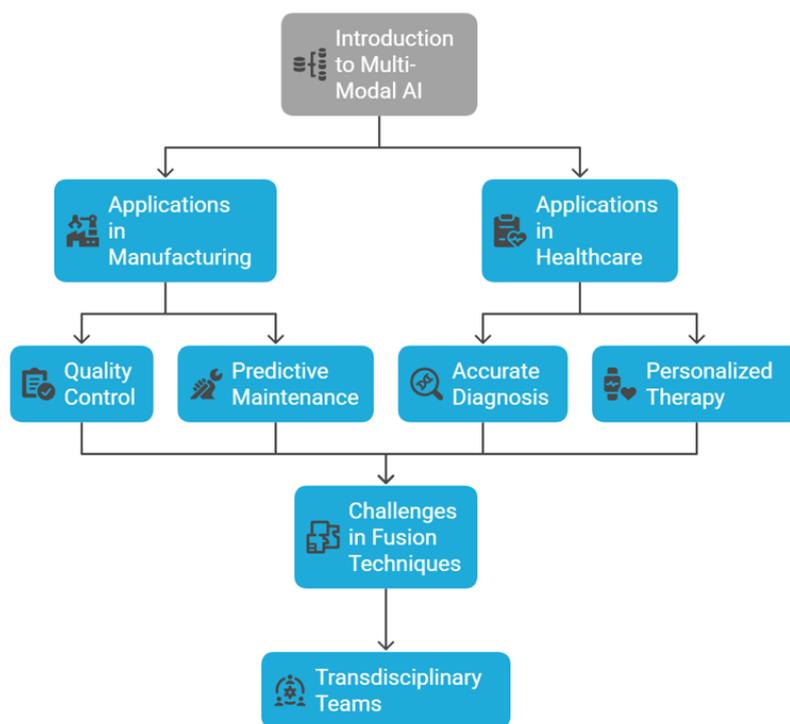

Fig -3: Multi-Modal AI Applications and Challenges

Some examples of multi-modal applications include:

- Visual and sensor inspection in manufacturing

- Facial analysis and speech recognition for enhanced video surveillance

- Reading patient health records while analyzing medical images to improve diagnosis

• Matching resumes to candidate profiles using CV text and video interviews

By emulating human understanding through different senses, multi-modal AI can enhance efficiency and accuracy across many domains.

Applications in the Manufacturing Sector:
Manufacturing is one industry that stands to benefit greatly from multi-modal AI applications. The fusion of visual, acoustic and sensor data can optimize quality control, predictive maintenance and ensure smooth plant operations.

Some examples include:

• Simultaneous visual inspection, acoustic signature analysis and extensive maintenance histories to accurately detect defective assembly line parts

• Monitoring multiple video feeds, thermal sensors and equipment logs to identify anomalies and prevent unplanned downtime

• Comparing CAD models, non-destructive test results and past failure data to predict life cycle of critical components

Such applications can reduce maintenance costs, minimize scraps and rework while increasing productivity. According to recent estimates, multimodal AI could enable over 40% reduction in downtimes, 35% better quality control and 25% higher output yield for manufacturers.

Applications in the Healthcare Sector:
Healthcare is another domain where leveraging different data modalities can significantly enhance patient outcomes. Some applications include:

• Combining patient health records, medical imaging like X-rays& MRI scans and genetic analysis for accurate diagnosis

• Tracking facial expressions, speech patterns and textual conversations to assess behavioral disorders

• Monitoring posture, exercise patterns and vital signs to develop personalized therapy programs

Such use cases can improve diagnostic accuracy by 30%, reduce assessment times by 25% and lower patient readmission rates. Thus, multi-modal AI can enable more evidence-based treatment decisions while optimizing clinical workflows.

Challenges in AI Development:
While promising, there are some key challenges in developing robust multi-modal AI models:

• Fusion techniques to integrate different datasets and learning joint representations

• Handling noise, errors and missing values across modalities

• Domain expertise to contextualize and validate model decisions

• Unavailability of labeled multi-modal training data

• Lack of flexibility to add or replace modalities

• Interpretability of model outputs

Addressing these challenges requires transdisciplinary teams spanning computer vision, medical physics, sensor technology, statistics and other specializations.

4. EXTENDED REALITY (XR): THE NEXT FRONTIER

Understanding Extended Reality (XR):

Extended Reality or XR refers to virtual, augmented and mixed reality technologies that combine the physical and digital world. It immerses users in interactive, multi-sensory experiences by integrating visual, auditory, haptic and other feedback.
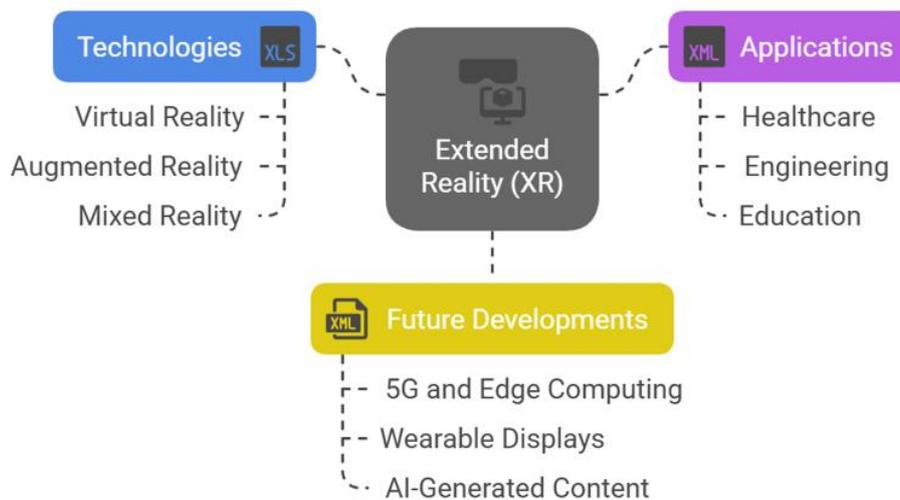
Fig –4: Exploring Extended Reality (XR) and Its Applications

While VR transports users to a completely virtual environment, AR overlays digital information onto the real world. Mixed Reality combines real-world elements with virtual holograms for hybrid experiences.

XR has the potential to revolutionize domains like healthcare, engineering, defense, education and entertainment with configurable environments tailored to deliver desired outcomes.

Some capabilities and features of XR systems include:

- Immersive 3D environments using head-mounted displays

- Gesture and motion tracking for interaction

- Multi-user networking in virtual spaces

- Ai-driven rendering and physics simulation

- Photoreal visual quality for enhanced realism

As XR headsets become more powerful, affordable and lightweight, these immersive technologies could soon become ubiquitous - marking the next major platform shift after mobile.

Applications of XR in Industries:

XR brings unique value in several sectors and use cases:

Training and Simulation:

Replicating dangerous real-world environments to train workers in industrial, aerospace and defense applications without safety risks or costs of physical mock-ups.

Healthcare:
Interactive 3D anatomy models for medical students. Virtual reality exposure therapy for phobias, PTSD. AR-guided surgeries and interventions.

Engineering and Design:

Collaborative design reviews allowing geographically dispersed teams to interact with virtual prototypes.

Education:
Engaging and immersive lessons in history, science and arts. Virtual field trips to expansive environments.

There are also applications in gaming and entertainment, virtual offices and meetings, marketing etc. Integrating IoT, digital twins, blockchain, AI and other technologies expands XR capabilities even further.

Potential Future Developments in XR:

Advancements in hardware and software will expand the possibilities of virtual and augmented worlds:

- •5G and edge computing enabling streaming of graphically rich immersive content

- •Increased adoption of wearable displays like smart glasses

- •Enhanced natural interaction through voice, eye tracking and brain-computer interfaces

- •AI-generated content and intelligent workflows in real-time

- •Multi-sensory experiences including visual, auditory and haptics

- •Integration with digital twins and enterprise systems

- •Blockchain protecting rights and identity in virtual worlds

As barriers of technology and cost reduce, XR could leapfrog existing interfaces across sectors to drive the next big digital transformation.

5. EDGE AI AND TINY MACHINE LEARNING (TINY ML)
What is Edge AI and Tiny ML?
Edge AI refers to artificial intelligence applications performed on local computing devices - rather than in remote data centers. This allows real-time responsiveness even without internet connectivity.
Tiny ML optimizes machine learning to run on microcontrollers - low powered computing devices with extremely limited memory and processing capability. Algorithms are shrunk to fit these tiny hardware footprints.

Together, they expand ML deployment reach - enabling intelligence on portable, battery-operated gadgets like smartphones, wearables, home automation devices and smart sensors.

Some common examples are:

- •AI on smartphones - face detection, AR filters, voice assistants etc

- Intelligent wireless earbuds - speech recognition, language translation

- Autonomous vacuum cleaners, lawn mowers

- Pest detection in farms, forest, vineyards via IoT devices

- Predictive maintenance using industrial internet of things

Thus, edge AI and tiny ML grant game-changing potential for sectors like manufacturing, agriculture, supply chain and smart cities - driving automation, optimization and smart decision capabilities.

Applications in Agriculture:

Edge AI and tiny ML are helping solve critical challenges in agriculture through intelligent applications on disconnected rural devices and equipment.
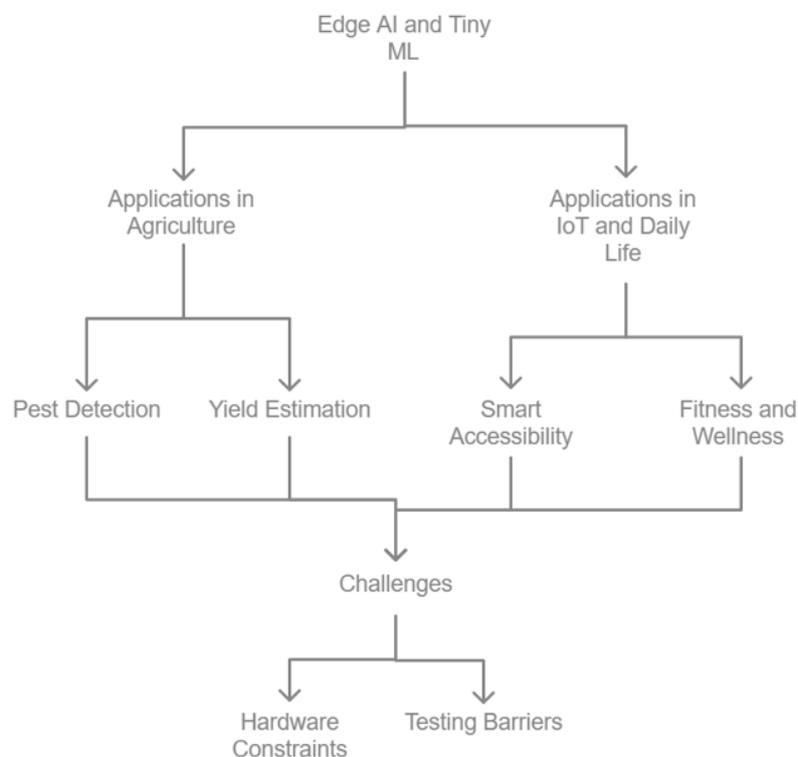
Fig −5: Edge AI and Tiny ML Applications and Challenges

Some agricultural applications include:

- Miniaturized ML for pest, disease detection and yield estimation using low-cost visual sensors

- Targeted watering, fertilizer using computer vision on irrigation systems

- Optimized greenhouses settings adjusting temperature, humidity and lighting

- Monitoring soil conditions, crop health and livestock behavior via distributed sensors

- Anomaly alerts like equipment fault or water leakage on remote devices

These localized intelligence minimizes costs and wastage while maximizing yields - creating sustainable and autonomous food production pipelines. With global food security concerns on the rise, they are indispensable technologies.

According to reports, edge/tiny ML adoption in agriculture could reduce pesticide usage by over 30% while improving crop yield by 25% for farmers.

Applications in IoT and Daily Life:
Edge AI and tiny ML also enable remarkable new applications by lending intelligence to portable IoT and consumer devices:

Smart Accessibility: Voice interfaces, text/image to speech chatbots, intelligent navigation assistance for visually impaired via wearables.

Fitness and Wellness: Real time exercise evaluation, rep counting, posture corrections via miniature smart gym equipment. Calorie counting, diet recommendations from smart cooking appliances.

Smart Assistants: AI capabilities for audio device interactions using wake word detection, continuous speech processing. Offline language translation supporting travel needs.

Entertainment: Automatic video highlighting for sports, movies etc. using metadata recognition on streaming devices. Music playback tailored to listener's context, mood and taste.

These reflect just some of the possibilities in daily scenarios - with potential to assist people uniquely the way centralized cloud platforms cannot fully address today.

Challenges in Edge AI and Tiny ML:
However, there are also substantial barriers in wider tiny ML proliferation:

- Hardware constraints of memory, power and computational ability
- Testing and simulation barriers for model design on unique architectures
- Difficulty debugging algorithms within devices post-deployment
- Limited flows of data from inexpensive sensors
- Standardization across vastly fragmented hardware ecosystems
- Thresholds for acceptable accuracy still higher than cloud
- Shipping and updating edge AI software at scale

Thankfully, rapid progress is being directed via initiatives like TensorFlow Lite, MLPerf and related compiler/runtime efforts to address these roadblocks.

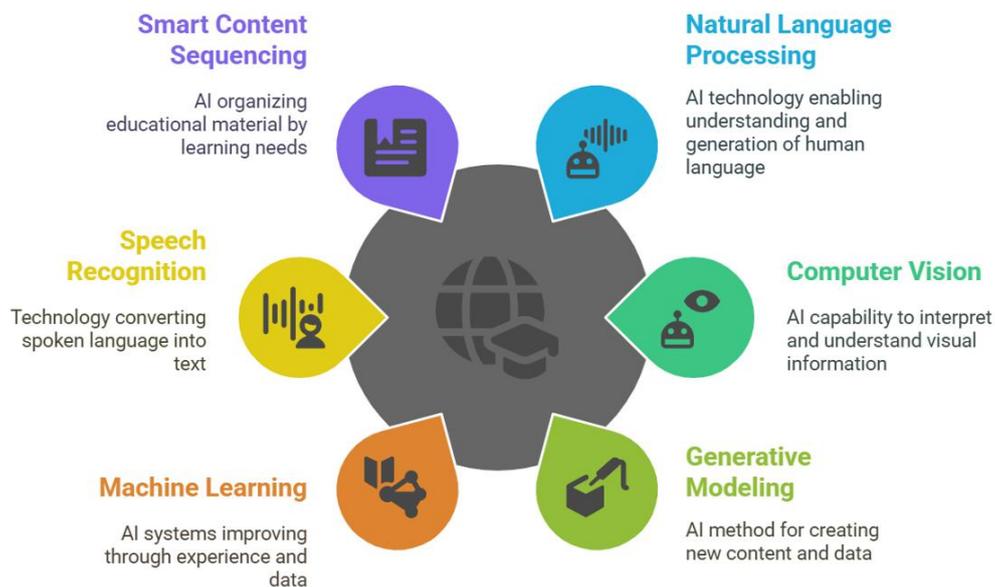## 6. ADVANCEMENTS IN AI FOR COMMUNICATION AND EDUCATION

AI in Communication:
Advancements in natural language processing, computer vision and generative modeling are revolutionizing human communication technologies:

- Videoconferencing platforms like Zoom, Microsoft Teams rely on ML for background blur, noise cancellation, speaker framing

- Voice assistants like Alexa, Siri and Bixby use speech recognition and NLP to receive commands, ask clarifying questions before responding or taking action

- Smart compose features auto-complete messages and replies in email clients, messaging apps using contextual word suggestions

- AI copywriting software generates marketing posts, landing pages, news articles tailored for specific audience interests

- Simultaneous speech translation bridges communication gaps closing divide across language disabilities

Such innovations have seen rapid adoption out of necessity during recent remote working trends. They significantly enhance workplace productivity, global business communication and accessibility for diverse linguistic groups.

Fig –6: AI Advancements in Communication and Education

AI in Education and Skill Development:

AI is also transforming tools for education, training and self-learning:

- Intelligent tutoring systems provide personalized guidance identifying knowledge gaps, learning obstacles and aptitude

- Education apps feature smart content sequencing aligned to student proficiency, thinking ability and concept grasp

- Video lecture smart indexing flags important talking points, whiteboard diagrams and topics requiring review

- Immersive simulations develop specialized occupational skills in teachers, healthcare workers without real-world pressures

- Voice interfaces enable hands-free access to digital learning assisting learners with disabilities

With a global shortage of skilled talent, such AI promises to make quality education and development opportunities far more accessible - especially across disadvantaged demographics.

7. REAL-WORLD IMPACTS OF EMERGING TECHNOLOGIES

Economic Impact:

The economic potential of technologies like quantum computing, AI, XR and edge computing is tremendous - influencing productivity, efficiency and output across industries.

Specific projections predict:

- Productivity gains from AI adoption creating about $3.7 trillion in overall value by 2030

- Quantum computing driving $850 billion in annual global output by around 2040

- Over $1.5 trillion in generative AI value creation possible by 2030

- $300 billion EDGE AI processor chipset market by 2026

Beyond direct value, cross-pollination of these technologies creates immense opportunity for entrepreneurs, innovators and technical specialists able to effectively harness them.

The resulting waves of innovation are poised to catalyze entire new markets, revenue streams, business models similar to past digital revolutions - while propelling existent sectors faster than ever before.

Social Impact:

Equally importantly, emerging technologies carry substantial potential for positive humanitarian impact:

- Clean energy quantum simulations accelerating carbon reduction goals

- AI amplification expanding accessibility for differently abled

- VR assistance overcoming mobility constraints

- Edge ML automation enabling responsive critical systems for all

- Lifesaving early diagnosis and precision treatment

- Personalized education at global scale

- Job creation avoiding technological inequality

Technical specialists should stay cognizant of social ethical considerations surrounding progress - ensuring historically marginalized communities also stand to benefit equitably from technological transformation.

Inclusive advancement and conscious collaboration will steer emerging innovation trajectories toward shared prosperity.

8. FUTURE TRENDS AND SKILLS FOR 2025

Key Technologies to Watch:

Based on their promise and progress, professionals should closely monitor developments in these key areas:

Quantum Machine Learning: Applying quantum techniques like optimization to machine learning for complex analytics and enhanced AI decision-making.

Generative AI: Using adversarial networks and diffusion models to generate synthetic data like images, videos, speech and text - with applications across sectors.

Bio-inspired Computing: Building circuits based on human brain structure and function to achieve efficiency closer to biological systems.

6G Communications: Bringing terahertz networking, high-density connectivity and intelligent network control advancing telepresence, IoT and extended reality.

AI Software 2.0: Moving towards modular reusable components and automation-driven software development usingAutoML, MLOps etc.

Keeping pace with iterations in such specialized niches early creates advantage - enabling one to foresee emergent use cases before competitors.

Skills Required to Stay Relevant:

To leverage leading-edge opportunities, developing expertise in the following will prove critical:

- Cloud platforms: Containers, serverless, microservices and managed services on AWS, Azure and GCP
- Edge computing and IoT protocols critical for embedded devices
- Cybersecurity: Encryption, blockchain, quantum-safe cryptography
- 3D simulations: Digital twins, CAD, animation and physics engines
- Cross-disciplinary thinking: Physics, biology, design with specialized CS skills
- Math: Linear algebra, statistics, calculus and discrete math
- Staying updated on paradigm shifts through ongoing learning

While individual technologies continue to evolve swiftly, cultivating versatility across computing foundations helps sustain employability across economic cycles.

9. CONCLUSION

Within the next ten years, the digital revolution promises to hasten society towards hitherto unheard-of technological upheaval. Quantum, Ai, XR, and its derivatives point to the beginning of a time molded by their transforming power. Still, their social promise stays in balance depending on careful cooperation.

Giving inclusive development top priority through ethical considerations and group efforts would help to highlight these new instruments as lighthouse guiding us ahead towards a more sophisticated civilization. Those clearing the path can guide paths for maximum worldwide benefit by laying seeds today through imaginative research, partnerships, conversations and teaching.

Economic Aspects of New Technologies Examining Costs and Returns

Every new technology has opportunities as well as hazards. Emerging technologies like quantum computing, artificial intelligence, and XR develop from fresh ideas toward real-world feasibility from practical economic concerns. Planning adoption roadmaps calls for rigorous examination of elements including total cost of ownership, return on investment timeframes, sustainability and interoperability with legacy systems. Further

complexity for technology decision-makers to consider upfront is specialist skills shortages, security risks, ethical restrictions, and competitive environments. Although innovations obviously create great value, using it calls for careful plans balancing several factors including infrastructure, operations, compliance, and human resources. Allocating trade-offs between modernizing projects and present standards also gets more difficult and calls for exact situations showing need. Therefore, beyond the hoopla, proving economic viability with data becomes absolutely essential before large resource commitments.

Change Management and Adoption Roads Maps

Once choices to implement are validated, roadmaps for implementation demand equal diligence matching to revenue sources. Generally speaking, gradual phase-in lets users get trained, helps capabilities to stabilize, and helps to eliminate integration issues. Securing buy-in among stakeholders depends on clear communication of timetables, active change management resolving of issues, and celebration of fast wins. If not managed sensibly, aggressive changes run the danger of causing backlash compromising viability. Creating cross-disciplinary teams to map adoption paths for new technologies often maximizes sustained value for big companies.

Still Nimble and Future-Ready

On the other hand, with less inertia, startups and younger companies usually show benefits in technical agility. Using horizontal skillsets, open ecosystems, and cloud infrastructure enables them to pivot onto new paradigms faster even with limited resources. Although their tests can reveal fresh use cases and disruptive technologies legacy players ignore, they nonetheless need tolerance for failure. Maintaining in-house R&D departments, building outside developer relationships, supporting bottom-up innovation by investing in emerging companies and therefore providing vital competitive protection against disruptions. This mix of focused adoption controlled by exploratory research helps balance profits today with futureproofing against approaching technology changes.

REFERENCES

[1] Artificial intelligence at Work: Transforming industries and redefining the workforce landscape. (2024). In Journal of Economics & Management Research (Vols. 5–2, pp. 1–4) [Review Article]. https://www.onlinescientificresearch.com/articles/artificial-intelligence-at-work-transforming-industries-and-redefining-the-workforce-landscape.pdf

[2] Barbosa, F., Woetzel, J., Mischke, J., Ribeirinho, M. J., Sridhar, M., Parsons, M., Bertram, N., Brown, S., & McKinsey & Company. (2017). REINVENTING CONSTRUCTION: a ROUTE TO HIGHER PRODUCTIVITY. https://www.mckinsey.com/~/media/mckinsey/business%20functions/operations/our%20insights/reinventing%20construction%20through%20a%20productivity%20revolution/mgi-reinventing-construction-a-route-to-higher-productivity-full-report.pdf

[3] Blundel, R. K., & Smith, D. J. (2013). Reinventing artisanal knowledge and practice: a critical review of innovation in a craft-based industry. Prometheus, 31(1). https://doi.org/10.1080/08109028.2013.770276

[4] Bornet, P. (2021, February 2). Council Post: Reinventing society with intelligent Automation. Forbes. https://www.forbes.com/councils/forbestechcouncil/2021/02/02/reinventing-society-with-intelligent-automation/

[5] Cain, D. (2024, January 29). Strategic Patenting: the evolving synergy of Industry-Academia partnerships in technology. https://www.linkedin.com/pulse/strategic-patenting-evolving-synergy-partnerships-technology-cain-kmxtc/

[6] Durgumahanthi, S. (2023, December 5). How Academic Societies are Reinventing Memberships | Researcher Life. https://researcher.life/blog/article/how-academic-societies-are-reinventing-memberships/

[7] George, D., & Dr.T.Baskar. (2024). The diminishing returns of Higher education in India: Examining degree inflation and employability. Zenodo. https://doi.org/10.5281/zenodo.10968319

[8] Edge, D. (1995). Reinventing the wheel. In SAGE Publications, Inc. eBooks (pp. 2–23). https://doi.org/10.4135/9781412990127.n1

[9] George, D. (2024b). Reimagining India's engineering education for an AI-Driven future. Zenodo. https://doi.org/10.5281/zenodo.13815252

[10] Finkhousen, D. (2024, December 21). Reinventing Education: Technology, Innovation, and the Future of Learning — Shoshin works. Shoshin Works. https://www.shoshinworks.com/podcast-episodes/beyond-paradigms-ultra-advanced-technologies-anomalous-phenomena-and-the-future-of-innovation-65cyk

[11] George, D. (2024a). The potential of generative AI to reform graduate education. Zenodo. https://doi.org/10.5281/zenodo.10421475

[12] Forward, L. (2024, March 2). Reinventing industries. LEAP Forward. https://www.leapforward.onegiantleap.com/reinventing-industries/

[13] George, D., Dr.T.Baskar, & Siranchuk, D. (2025). The Evolution of Education 5.0 in the Innovation Era: A Review of the Progression from Teacher-Centered Learning to Student-Driven Models. Zenodo. https://doi.org/10.5281/zenodo.14944042

[14] Hassan, M. U., Murtaza, A., & Rashid, K. (2024). Redefining Higher Education Institutions (HEIs) in the Era of Globalisation and Global Crises: A Proposal for Future Sustainability. European Journal of Education. https://doi.org/10.1111/ejed.12822

[15] George, D., & Pandey, D. (2024). The evolution of education as a tool for corporate utility: From Industrial Revolution to Present-Day Vocational Preparation. Zenodo. https://doi.org/10.5281/zenodo.13620931

[16] How technology is reinventing K-12 education. (n.d.). Stanford University. https://news.stanford.edu/stories/2024/02/technology-in-education

[17] George, D., George, A., & Dr.T.Baskar. (2024). Exploring the Potential of prompt Engineering in India: A study on the future of AI-Driven job market and the role of Higher education. Zenodo. https://doi.org/10.5281/zenodo.10121998

[18] Issues. (2022, July 1). Reinventing technology assessment. Issues in Science and Technology. https://issues.org/p_sclove/

[19] George, D., & George, A. (2024). Towards a Super Smart Society 5.0: Opportunities and Challenges of Integrating Emerging Technologies for Social Innovation. Zenodo. https://doi.org/10.5281/zenodo.11522048

[20] Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Gonzalez, E. S. (2022). Understanding the adoption of Industry 4.0 technologies in improving environmental sustainability. Sustainable Operations and Computers, 3, 203–217. https://doi.org/10.1016/j.susoc.2022.01.008

[21] Ownership unbound: Reinventing intellectual property in the open innovation age. (2024, November 4). Deloitte Insights. https://www2.deloitte.com/us/en/insights/topics/innovation/rethinking-intellectual-property-in-age-of-open-innovation.html

[22] PricewaterhouseCoopers. (n.d.). Reinventing the future. PwC. https://www.pwc.com/gx/en/issues/reinventing-the-future.html

[23] Reinventing Banking and Finance: Frameworks to Navigate Global fintech Innovation. (n.d.). Imperial College Business School. https://www.imperial.ac.uk/business-school/faculty-research/research-centres/centre-financial-technology/research/reinventing-banking-and-finance/

[24] Reinventing the Automotive Industry with Intelligence and Connectivity. (n.d.). Fujitsu China. https://www.fujitsu.com/cn/en/vision/insights/201811event/

[25] Technology Networks. (n.d.). Technology Networks Science Industry Insights | Page 36 | Technology Networks. https://www.technologynetworks.com/tn/blog/36

[26] Wawak, S., Domingues, J. P. T., & Sampaio, P. (2023). Quality 4.0 in higher education: reinventing academic-industry-government collaboration during disruptive times. The TQM Journal, 36(6), 1569–1590. https://doi.org/10.1108/tqm-07-2023-0219

[27] World Economic Forum & Boston Consulting Group. (2025). Frontier technologies in industrial operations: the rise of artificial intelligence agents. In Transformation of Industries in the Age of AI. https://reports.weforum.org/docs/WEF_Frontier_Technologies_in_Industrial_Operations_2025.pdf

[28] Yami, S., M'Chirgui, Z., Spano, C., & Barykina, O. G. (2020). Reinventing science and technology entrepreneurship education: The role of human and social capitals. Technological Forecasting and Social Change, 164, 120044. https://doi.org/10.1016/j.techfore.2020.120044