Tampere Metaverse Vision 2040

The World's First People Centred Metaverse Strategy

1st June 2023

THE METAVERSE INSTITUTE

Foreword

The metaverse is the next generation of the internet which is predicted to generate an economic impact worth $13 trillion by 2030, as predicted by the Citigroup. It will transform the daily life and work of everyone in the world. Over half (55%) of the world currently resides in major urban areas. By 2050 the UN estimates that number will grow to 80%. With proximity and access to networks, cities have been engines of innovation for centuries, providing a clear path from poverty to prosperity for many.

Increasingly, more and more cities are piloting different technologies within the metaverse ecosystem to provide more inclusive cities development to ensure the needs of diverse community groups are fully represented and proactively engaged at all levels. How cities can use the metaverse to develop a more people-centred strategy to maximise positive impact of various technologies and minimise their risks is becoming increasingly important.

This report forms a picture of "Our world in 2040", based on technologies that are likely to have developed and matured by then influencing the development of the Tampere Metaverse Strategy 2040. We examine how the emergence of various key technologies within the metaverse ecosystem can be used to support the key five priorities identified in collaboration with the Tampere municipal governments: happiness, governance, sustainability, equality, wellbeing and healthcare and develop one reasonable and likely scenario per identified priority.

We form a "technology map" when certain technologies mature with a timeline, covering key technology applications for different industries along with their ethical and societal implications.

The exponential growth of generative AI has had a profound impact on our human society. We examine the social, ethical and geopolitical possibilities and issues raised by the broad group of technologies currently generally referred to as AI with particular attention being paid to its impact on inequality, systems of production, distribution and consumption, new landscape of skills and occupations as well human pursuit of higher purpose. How to develop a responsible, ethical and sustainable digital future where the happiness and wellbeing of people are put at the very centre of our digital future becomes more important than ever before.

We hope this report can help drive ongoing dialogue about the development of the metaverse for city governments, help them to better understand its potential, identify strategic imperatives, and act as a force for public good that can benefit all.

Dr Christina Yan Zhang
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The Metaverse Institute

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About The Metaverse Institute

The Metaverse Institute is made up of a group of pioneers in the Metaverse, Digital Twins, AI, Smart Cities and related technologies. The benefits of the Metaverse promise to deliver step changes in increased revenues alongside reducing cost, leading to effective and efficient profits. The Institute identifies and evaluates against best practice, the most innovative companies seeking to operate in this field, focusing on those who wish to benefit from these technologies to generate positive impacts in the real world. Our acknowledged thought leaders utilise evidence-based, rigorous and pragmatic methodologies to assist organisations exploring the Metaverse in order to maximise its benefits.

The Metaverse Institute works collaboratively with UN agencies, Governments, NGOs, private sector companies and research institutions to define Metaverse strategies, business models, target operating models, and governance and compliance audit controls.

About The Authors

Dr Christina Yan Zhang

Christina is a metaverse pioneer since 2006 when she started a PhD in using digital twins in the metaverse to augment the AEC industry. With 17 years of experience turning forward-thinking ideas into high-growth businesses, she has sat on 20+ committees for UNESCO, World Bank, Commonwealth, EU, and UK Governments on innovation policies. She is Vice Chair of UN's ITU Metaverse Working Group on Sustainability, Accessibility & Inclusion. She recently chaired the opening panel for The World Intellectual Property Organization's summit on IP and Metaverse and addressed UNESCO on metaverse for education. She advises governments and UN agencies to use metaverse, AI, and Smart cities technologies to improve the real world.

Nicholas You

Nicholas is a leading authority on urban innovation. He has 50+ years of experience as an advisor to mayors, central governments and utilities globally. He has worked for 30+ years at the UN and International Financial Institutions on municipal finance, management and planning. In 2012, he helped establish the Guangzhou Institute for Urban Innovation, a think-and-do tank devoted to the accelerated exchange of knowledge, expertise and experience in urban sustainability. He has trained and advised 1000+ city officials in 80+ countries, including 300+ mayors in 30+ countries. He regularly contributes to high-level policy documents for intergovernmental fora.

Danil Kerimi

Danil is an experienced tech, IP, finance, public administration, and economic diplomacy executive. After working with the United Nations Terrorism Prevention Branch and the Organization for Security and Cooperation in Europe, Danil joined the World Economic Forum (WEF) during the Global Financial Crisis and over the period of 12 years served on the Leadership Teams in the Centers for Global Industries, Global Technology Governance and Regional Strategies. He currently serves on the Independent Oversight Committee of the World Intellectual Property Organization and the World Smart Sustainable Cities Organization's Board of Advisors.

Dr Ahmed El Adl

Ahmed is a world-leading expert on digital twin. In collaboration with MIT, he coined and published the concept of "Cognitive Digital Twin" in 2016. Between 2017 and 2019, he led Accenture Global AI Tech, Digital Twin, and Intelligent industry solutions practice. He was previously in the global CTO-Manufacturing Industries at DXC Technology (Formerly CSC) for the $2.3B manufacturing industries. He was SAP's Global Vice President, Enterprise Mobility Solutions. He has led initiatives with the US Airforce, and Space Force on the "Cognitive Digital Twin" strategy. He has a PhD in Computer Science (AI/Computer Vision) and Post Doc. in AI and mobile industrial Robotics.

Rav Roberts MBA

Rav has 25 years' experience in successfully leading, designing & delivering complex, global digital technology strategy & digital governance operating models, programmes, projects and software implementations for Governments (state and municipal), Management Consulting for Accenture & CapGemini, Diageo as Global Head of Digital Governance & Compliance (including GDPR & ePrivacy, cyber security and social listening), Private Equity and Digital Startups. Rav has also founded and been the CEO/COO of innovative leading-edge tech companies in San Francisco where he lived and worked for 6 years, London and Frankfurt, including Generative AI, Digital HealthTech and Internet of Things Middleware startups.

Acknowledgements

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Requests to reproduce extracts of this publication should be submitted to christina@metaverse-institute.org

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List of Abbreviations

Abbreviation	Explanation
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
BCI	Brain Computer Interface
BME	Black and Minority Ethnic
COVID-19	Coronavirus Disease 2019
FDA	Food and Drug Administration of the US
GDPR	General Data Protection Regulation
GPT	Generative Pretrained Transformers
HCI	Human-Computer Interaction
IoT	Internet of Things
M&A	Merger and Acquisition
ML	Machine Learning
TMS	Tampere Metaverse Strategy
VR	Virtual Reality
SDGs	Sustainable Development Goals
UBI	Universal Basic Income

Executive Summary

To enhance interoperability, transparency, and inclusivity of the nascent Metaverse, Tampere will require a framework, strategy and benchmarks that would inform its stakeholders on their options including preparing citizens for nuanced interactions with vendors, commercial platforms, and government services.

Having identified the five areas that serve as guiding principles for any future development (happiness, health and wellbeing, governance, inclusivity, sustainability), the current report looks at the ways various technologies could help or hinder the progress towards these goals. It makes assumptions on how these technologies will develop short, medium and long term (until 2040) including on their convergence, which may enhance some and make others obsolete.

Through a number of interactive workshops, we focused on thought-provoking scenarios that intended to serve as stepping stones for strategy development for various stakeholders as we strongly believe that "the best way to predict your future is to create it".

Two centuries ago, Tampere was the birthplace of the Finnish industrial revolution. Today marks the day it made the first steps towards becoming the cornerstone of the national, Nordic, European and global Metaverse-Industrial complex.

Introduction

The urban metaverse will bridge administrative silos and territorial jurisdictions to realise true economies of scale and engage in predictive urbanism. It will enable a systems approach to Happiness, Equality, Governance, Sustainability and Well-being and Health by rendering the interdependencies between these domains visible and their relationship with the physical and spatial world transparent. It will empower people and communities by providing them with the tools and the information - in visual form - to engage in evidence-based policy dialogue and development.

The beginning of the 2020s seemed like one persistent poly-crisis affecting our profit, planet and people. From black swans to grey rhinos, from black jelly to the elephants in the room, it seems we live in a jungle of risks and opportunities that drain our energy, pockets and attention. Some of us get motivated, others discouraged. And yet between all the hype and fear, conviction and uncertainty, one thing is clear- there will be other crises and opportunities in the future. How can future thinking help us learn, become more resilient and prepare better for what is yet to come?

Context

Metaverse has been arguably the word of 2023. Much media attention has been on trying to avoid the mistake of Web 1.0 and 2.0. All the same, cities from Dubai to Seoul are rushing to announce their pilots that help serve citizens in the metaverse, expand their local and global presence, and attract Web 3.0- focused businesses. Metaverse today is where the internet was in the 1970s - early pioneers building computer networks that could only talk within a small number of similar devices. We are yet to witness the rise of the Metaverse Protocol that would allow diverse systems to exchange information. We will need the World Wide Web of metaverses that would truly live up to the original meaning of the term. Meanwhile, we are already witnessing commercially and politically driven visions that disagree on everything, including core terms and definitions. To enhance interoperability, transparency, and inclusivity of the nascent commercial platforms, governments and citizens worldwide will require better frameworks that would inform their procurement and interactions with vendors. It is mission-critical to ensure that transparency and inclusivity is at the core of the development of urban metaverses.

Tampere Metaverse Vision 2040

Vision 2040 - To be the City setting the leading global benchmarks in happiness, equality, governance, sustainability and well-being/health by 2040 and beyond. A community that embraces diversity, healthy lifestyles, composed of empowered individuals and egalitarian groups that promote a strong sense of belonging.

Objectives

The Metaverse Institute will:

A. Advise on creating the required infrastructure, processes, pilots, and partnerships.

B. Work hand in hand with stakeholders to prepare the citizens, utilising for change management and cultural transformation good practices to help Tampere:

    1. become a showcase for attracting international talent;

    2. feature AI-driven talent platform in the Cityverse that identifies gaps and opportunities, and matches students, seekers and businesses through a personalized and targeted upskilling;

    3. help local enterprises achieve global competitiveness through best practices on use of Metaverse for new ventures and social impact;

    4. predict, prepare and provide for the needs of citizens across their different life phases including in healthcare and sustainable mobility;

    5. define and enforce ethical rules and social norms for body implants to promote health, safety, and privacy;

    6. promote intelligent solutions to narrow the digital divide, through utilising fully-featured digital twins of inhabitants, objects and processes. These will help enable people-centric governance mechanisms;

    7. pilot creative governing and public services models that use insurance, procurement and tax as incentives for nudging citizens, companies and the city toward inclusive, sustainable and healthier choices.

Figure 1: Tampere Cognitive City 2040

1. People live in a world where the convergence of the physical and digital worlds become more prevalent. Humans will have accepted technology and Digital Twins, augmented humans, and intelligent objects. These will interact continuously, intelligently, seamlessly and flawlessly across the metaverse and the real world.

2. New models of metaverse interface will become mainstream. This will be represented by Human-Computer Interaction (HCI), particularly Brain-Computer Interface (BCI), extended/enhanced/ augmented/virtual and hybrid modes of sensing and communication. This will make the user interface of the metaverse more immersive, interactive and intuitive. New generations of hardware will likely involve a combination of human-friendly wearable, implanted and external devices all connected by 6G+ technologies.

3. It is widely anticipated that quantum technologies will enter the mainstream with quantum computing, communications and sensing all playing significant roles at differentiated timelines. Intel pointed out in 2021 that we needed at least another 1,000 times more computing power to unleash the full potential of the metaverse. The smooth operation of the metaverse will be solved by the increasingly powerful development of high-performance computing machines, such as quantum computing. Similarly, Quantum sensors and Quantum communications will also massively empower existing and future IoT sensors to provide more real-time data acquisition and transmission between the cognitive digital twins linking the real world and the digital world.

4. Cybersecurity in the metaverse especially Cityverses will be a key factor in adopting Metaverse and Cognitive Digital twin-based solutions and services. It is expected that quantum computing will be mature enough to be used in strategic areas such as cyber security for physical and digital systems. Quantum computing brings both opportunities and challenges for cybersecurity. Quantum computers will have the potential to break many if not all of the widely used encryption algorithms we use today to secure our digital systems. To mitigate the risks posed by quantum computing, new cryptographic algorithms that are resistant to attacks by both classical and quantum computers are being developed. Adopting post-quantum cryptographic algorithms will be crucial to ensuring the proactive protection and security of communications and data across the Metaverse.

5. Metaverse governance and compliance will be automated, self-learning and leverage AI-driven algorithms including: AI-algorithms, software, APIs and hardware technologies quality assurance & compliance; rollout of new Metaverse laws and technologies; cyber-threat proactive detection, elimination and/or mitigation; digital identity assurance; metaverse dispute resolution and arbitration; privacy and data protection; harassment and identity theft protection; digital contracts assurance; Digital Twins end-of-life protocols and more.

6. Life extension and healthcare technologies will have achieved major breakthroughs with services such as predictive, preventative, and precision healthcare. Drug discovery will be significantly shortened and many serious human diseases could be eliminated. Extending human life expectancy through technology and medical advancements will be available to those who can afford it. This will lead to a two-tier society which policymakers need to address. According to UN predictions, the average life expectancy in Finland will rise from 82 years today to 85 years in 2040. Our education, work, life, and welfare systems will all need to reform to meet this new demographic structure.

7. More governments worldwide will be working hard to champion gender equality and quality of life so that women will be more willing to have babies, which helps to solve the issue of shrinking populations and our ageing society.

8. Clean energy, including potentially hydrogen power, and nuclear fusion, will become a norm in most parts of the world, as countries rush to fulfil their net-zero commitments and safeguard their energy security.

9. The prevalence of AI and robots will have a major impact on our economic structure. Several current industries including financial services, healthcare, law, education, audit & accounting, and even software development will be severely disrupted to such an extent that they may no longer exist as professional vocations.

10. The development of AI and blockchain will be mature and self-learning by 2040. AI will have replaced most of the repetitive lower-skilled jobs. AI will increasingly become co-pilots of humans in daily work and life. We will be living in a world where humans and robots are learning to live and work in harmony with each other to achieve sustainable development and planetary health.

11. Universal Basic Income (UBI) will be in place, leading to both opportunities & challenges. People will have time to explore noble and fun pursuits, both in the real world and the metaverse. However, not every country will have the same UBI levels in place, leading to global inequality and migration pressures. People who inherit property or other financial assets will be able to exist in a more enhanced environment, leading to a two-tier society.
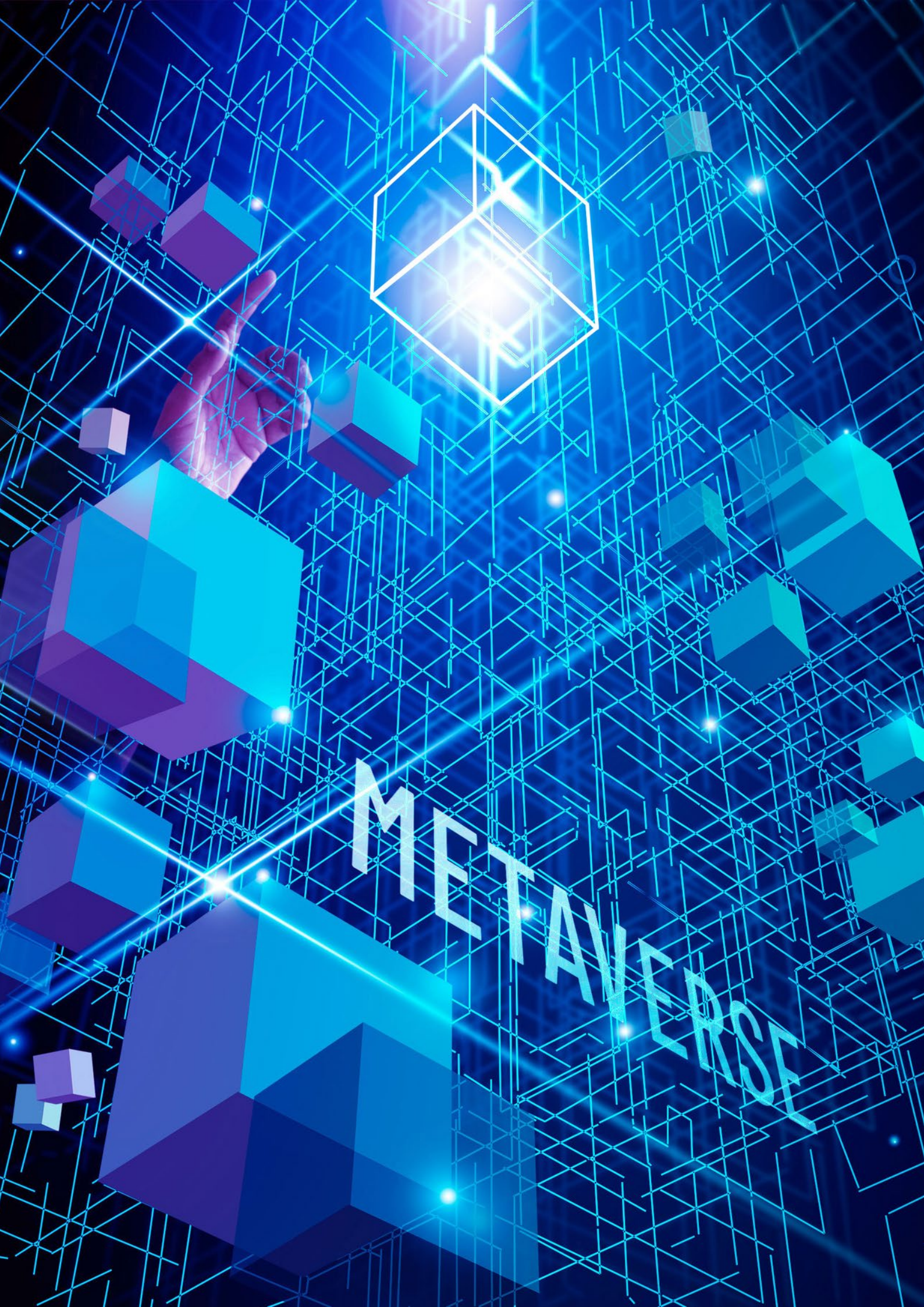
Tampere Metaverse Strategy (TMS)

We should look at the convergence technologies that may influence the trajectory of technological, economic, social, political, legal and environmental developments.

1. The push will be to become increasingly interactive, including by adding olfactory and other sensory capabilities to vision and auditory, either through traditional (nose, skin, etc) or direct through Brain Computer Interface inputs.

2. Increased interactivity will require a rethink and readjustment of the societal norms including what constitutes such important cultural differences as notions of personal space, acceptable behaviours in public spaces and other social norms.

3. New policies and norms on articulating, preventing and prosecuting of harassment, bullying, theft, discrimination, insult and other anti-social behaviour will have to be developed.

4. Similarly, policies on political campaigning, working environments, public and private spaces in the interconnected metaverse will require politicians, employers, workers, countries, companies, consumers and citizens to all come together to define a metaverse social contract.

5. Some may wish to escape reality altogether and exist solely via their digital twins. This could have profound implications for human society.

6. We have developed one reasonable and likely scenario per identified priority: Happiness, Equality, Governance, Sustainability, Well-being and Health, which we will now explore.

Happiness

My city is a fun place to live, work and play

- The World Happiness Report has ranked Finland as the happiest country in the world six times in a row. Governments, businesses and communities can leverage AI to direct services promoting happiness, thereby increasing people's contentment & satisfaction.

- However, The World Health Organisation put Finland as the world's No.9 most depressed country and according to the EU, it is estimated that 7% of Finnish adults suffer from depression, anxiety and alcohol-related disorders. AI can help individuals better understand the reasons for and deal with their depression, substance abuse and anxieties.

- AI can help with the integration of non-Finnish speakers, immigrants and people from BME backgrounds by overcoming language barriers and to better understand cultural differences.

- Use of E-sports in the metaverse will provide more opportunities for people of all ages to exercise and socialise and maintain positive mental and physical health.

- The Universal Basic Income trial in Finland made people happier but did not lead to job creation. More AI assisted research can help explore new vocational opportunities and usher in a metaverse New Deal for all.

- AI will further enhance wellbeing for everyone by offering more individualized options for education, care and support. It will also provide a more tailored marketplace for housing and improve community safety and security, one where all people feel at home and that they belong.
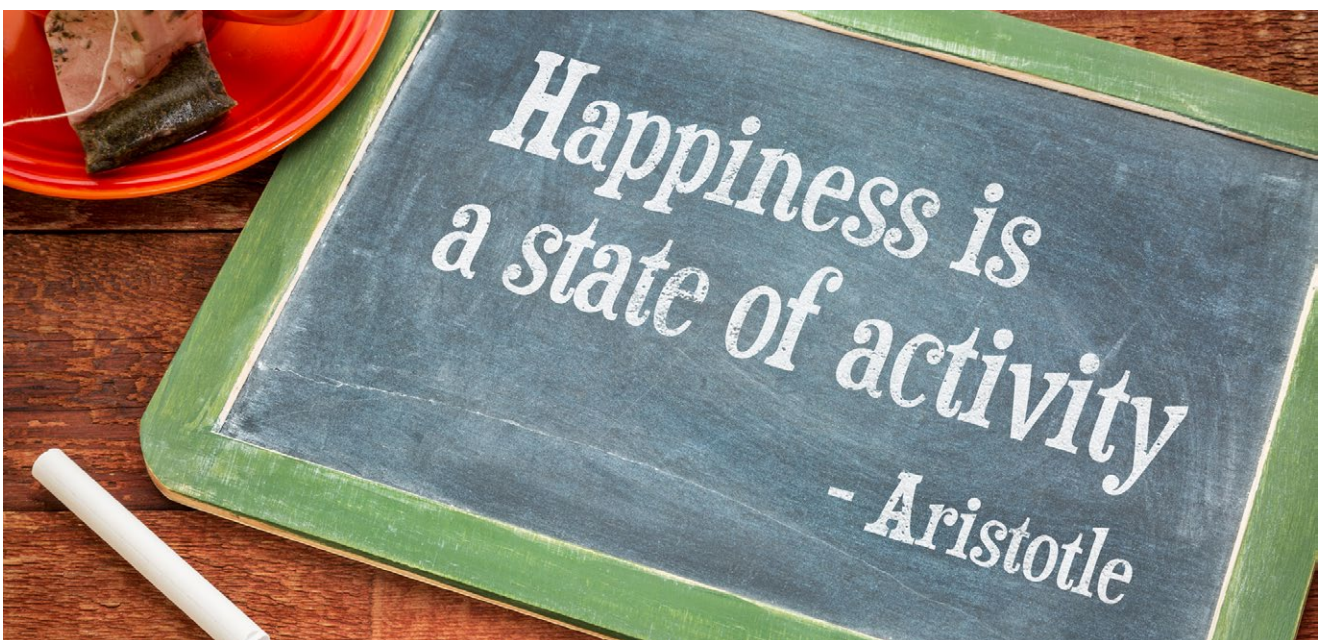
Equality

My city is inclusive and leaves no one behind

- 2040 will present an interesting picture of inclusivity and equality despite multiple recent geo-political, geo-economic and technological disruptions. Some of the challenges will be familiar including integration of the migrant population, an ageing society, social mobility, international competitiveness, etc. Some of the issues will be novel, including digital residency, sovereignty and self-determination questions in the metaverse. As more municipal, regional and national level entities make their metaverses accessible to people around the world, new policies on how to deal with meta-tourists and meta-refugees, meta-town halls and meta-slums, meta-crime and meta- education will be designed & emerge every day. As Tampere develops its urban metaverse, a priority will be placed on accessibility to people of all ages, beliefs, preferences, levels of physical and cognitive ability, in order to leave no-one behind.

- Important debates will continue on the rights and responsibilities of artificial, enhanced and hybrid lifeforms (e.g. humans with neuro-implants and advanced prosthetics, additional digits and limbs, etc; domestic robots, grief chat-bots, AI-enhanced pets and many other manifestations of increased cognitive capacity in biological and non-biological entities).

- Tampere will pilot a new initiative that allows investors, tourists and migrants to experience the city, learn the language, meet the stakeholders well ahead of their planned arrival, tapping new sources of capital and talent.
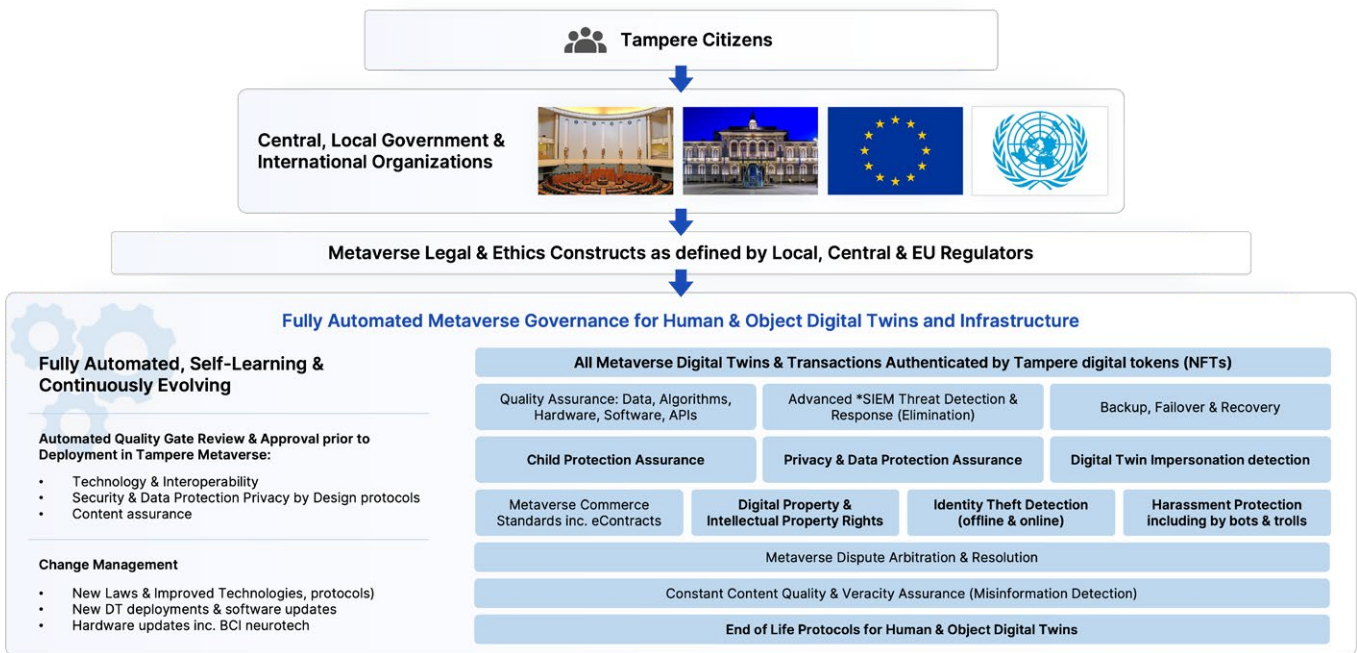
Governance

My city listens to me and engages me in decisions affecting my life and livelihood

In 2040, the Tampere Metaverse governance will be fully automated, self-learning and continuously evolving. Tampere Citizens will vote for each piece of local and national metaverse legislation, similar to the current Swiss form of direct democracy. Indeed, citizens will be able to learn about the nature and impact of new legislation and model different scenarios and outcomes in Tampere's Metaverse instance itself. International bodies such as the EU and UN will also inform metaverse governance (like the GDPR and the Cookie Directive today!).

However, when it comes to implementing any new rules and maintaining governance and compliance, these aspects will require little, if any, human intervention in 2040.

The model illustrated in Figure 2 on page 25 shows the key different facets of Tampere's Governance and Compliance Operating model.

- Humans' safety, including that of children, will be ensured through advanced 'social listening' algorithms coupled with automated dispute arbitration, resolution and, if required, disciplinary action. This action could be confined to a period of expulsion from the Metaverse to real-world repercussions for more serious infringements.

- Personal data, including of Digital Twins, will be secured and protected from unauthorised use and content veracity and quality will be guaranteed.

- Digital identity of human and machine Digital Twins will be pre-validated via a Tampere Digital Token - Digital Twin impersonation of humans & objects will be impossible.

- Quality assurance of all technology components: data, algorithms, hardware, software and APIs will be pre-validated and continuously assured, and new components will be automatically gated prior to Metaverse deployment.

- Likewise, security and other non-functional (e.g. user experience, performance, accessibility, backup & recovery etc.) requirements will also be automated and continuous.

- Digital Intellectual Property rights will be transparent and robust.

Fully Automated Metaverse Governance for Human & Object Digital Twins and Infrastructure

Rav Roberts MBA, 2023 TMI

Figure 2: Tampere Metaverse Governance 2040

While this automated Metaverse Governance model is the desired (and inevitable) outcome by 2040, in the liminal space of the near to medium-term there will need to be manual intervention across the majority of these Metaverse Governance functions. To address this, functions will need to be prioritised & workarounds devised, some together with other municipalities, the national government and private enterprises too, to pool resources, share knowledge, devise common processes & standards, and lower function costs by achieving economies of scale. This will ensure value-for-money for Tampere citizens as the Metaverse evolves.

The Metaverse Institute is working together with the City of Tampere to define the Metaverse Governance Operating Model and associated processes and audit controls that will be implemented. Tampere also looks forward to working with citizens, governments, businesses and research institutions in designing this city metaverse governance model.

Sustainibility

My city is a regenerative city, it is carbon negative, produces zero waste and is in harmony with nature

- Tampere becomes the world's first truly regenerative city – a city that lives in harmony with its surroundings, gives back to nature, is carbon negative (takes out more CO2 than it produces) and produces net zero waste.

- With well-planned physical and metaverse components, the city enjoys the trust of its inhabitants and shares its experience with global audiences.

- Predictive urbanism and a human focused approach, enable Tampere to become a truly cognitive city. By creating a digital twin of the city, replete with social, economic and environmental datasets, city officials, stakeholders and inhabitants can simulate scenarios and visualise their impact on people, places, the economy and nature.

- AI and metaverse will finally enable Tampere to bridge traditional silos and share data and resources across all sectors including infrastructure and housing, transport and mobility, water and energy, solid and liquid waste, boosting cost efficiencies, cost-effectiveness, responsiveness and resilience.

- Data rich approaches enable a systemic and real-time view on Happiness, Equality, Governance, Sustainability, Well-being and Health by rendering the interdependencies between these domains visible and their relationship with the physical and spatial world transparent. This will empower the community by providing it with the tools and the information - in visual and other sensory forms - to engage in evidence-based policy dialogue and development.

- Through an affordable, resilient and easy to operate grid of sensors, capable of providing real-time data on the air/water/soil quality, Tampere will operate an effective defence against natural and human-made disasters and future pandemics.

- The increased energy consumption associated with enhanced computing comes from the sources that are net neutral, accompanied with deployment of various negative emissions technologies.

Health and Well-being

My city is clean, green and safe

Healthcare is one of the areas which relies heavily on science and technologies and benefits from them greatly. The recent advances in different areas in science and technology are making a full and rapid transformation of the whole healthcare ecosystem possible. For example, AI is transforming Drug and Disease research on a global and local level. Personalised medicine is becoming highly possible in the very near future. However, one of the most important benefits of those recent advances is enabling measures and creating an environment where Humans will be able to live a healthier life, which will in turn increase the overall life quality of humans.

The Cognitive Digital Twin (CDT): Key Capabilities
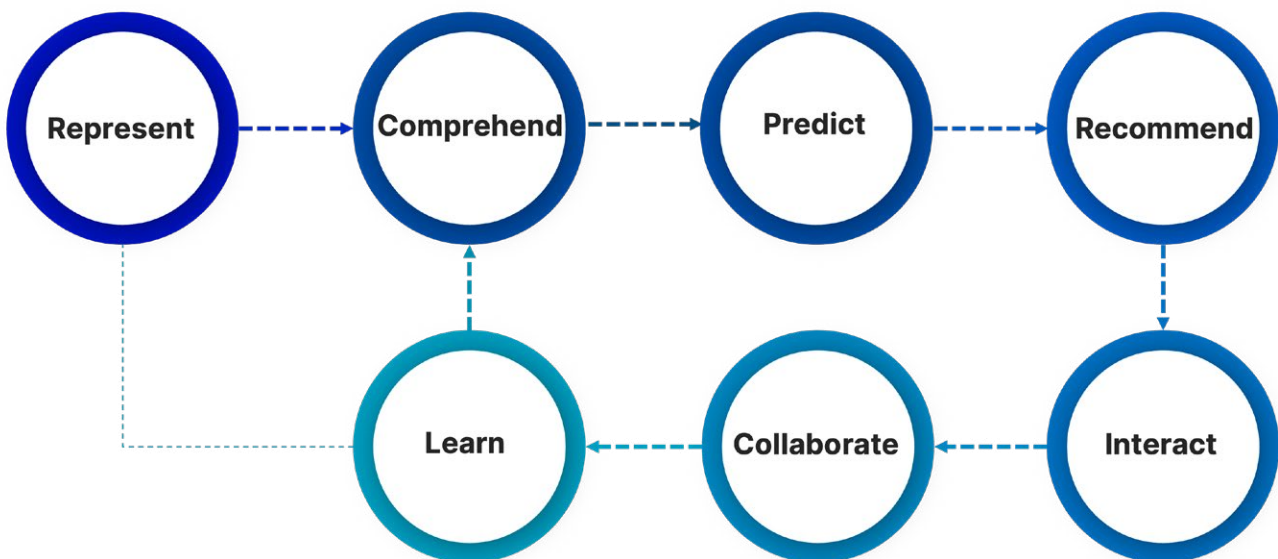
Figure 3: The Cognitive Digital Twin Key Capabilities

Over the next few decades, technologies such as AI/ML, Cognitive Digital Twin, Metaverse, Quantum computing and Brain Computer interfaces (BCI) are going to mature very quickly and converge to completely disrupt and transform healthcare sectors as follows:

Drug & Disease Research

Quantum computing and advanced AI capabilities such as deep machine learning, reasoning, and advanced simulation techniques will make it possible to simulate the effect of different chemical compounds on organisms on the molecular level. This will simplify the overall process of Drug discovery,

lower the costs of creating new effective drugs, and reduce the time taken to market approval and patient use dramatically. (We've already witnessed this during the development of the Covid-19 vaccines and treatment over the last few years).

Collecting, enriching, comprehending, and visualising large amounts of data about drugs, diseases, and patients in real-time is becoming possible. This will make it feasible for example to predict and even prevent epidemics or pandemics in the very near future.

The Metaverse and Digital Twins are transforming our Citizens quality of Healthcare and Wellbeing
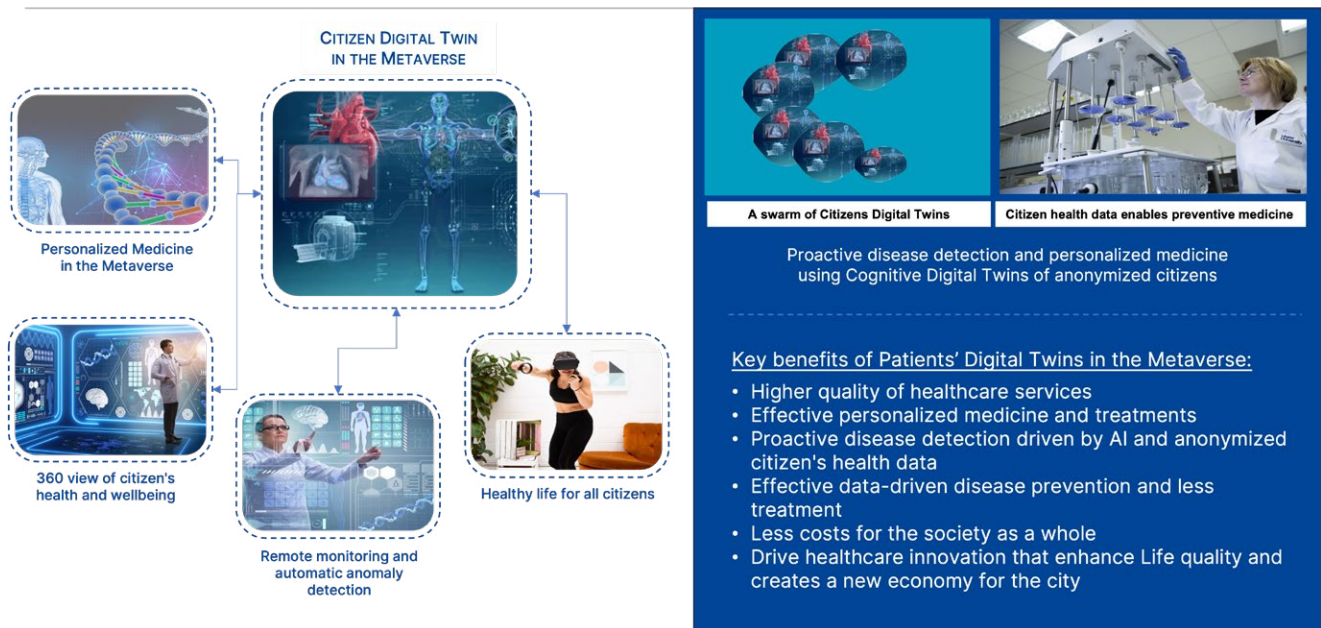
Figure 4: The Metaverse and Digital Twins are Transforming our Quality of Life

Medical Equipment

Embedded intelligence inside medical equipment is increasingly becoming a major differentiating factor between suppliers and healthcare services providers. For instance, the adoption of scanning and automatically analysing medical images with high precision, using advanced machine learning algorithms, is increasing exponentially across the globe. This compensates for the lack of highly experienced radiologists and doctors, reduces costs, and enhances the healthcare equality index amongst all humans.

Different providers of medical equipment have started to build digital twins for their own equipment in the Metaverse. This will lead to more efficient and effective designs, reducing the time and cost associated with the development process. Also, one is able to monitor equipment performance, predict failure, as well as remotely fix many problems.

Remote training of healthcare professionals on those critical equipment and virtual simulations, based on Digital Twins in the Metaverse, will provide a safer environment for them to practise different scenarios. This is going to enhance the skills and confidence of healthcare practitioners, ensuring that they are proficient in using advanced medical devices in real world scenarios.

This innovative technology combination is going to enhance the overall Healthcare of Tampere inhabitants and create a new generation of innovative cost effective healthcare services.

Healthcare Services

Telemedicine isn't new, however AI, Digital Twins, and the Metaverse are revolutionising Telemedicine as we know it today. A new generation of intelligent expert systems driven by new technologies such as advanced AI capabilities, Generative Pretrained Transformers (GPT), Advanced medical robotics systems, and Cognitive Digital Twins will assist medical doctors, their staff, and patients in real-time in the Metaverse. These new systems will make it possible to offer high-quality medical services anywhere, anytime in a highly cost-effective way, to all citizens. These services will span a whole range, from remote monitoring and simple diagnostics to complex surgeries.

Healthcare professionals will be able to interact with patients virtually, providing consultations, diagnosing conditions, and even conducting remote surgeries through immersive virtual environments. The metaverse will also offer innovative approaches to mental health support and therapy. Virtual environments will be designed to create calming and therapeutic experiences, helping individuals in managing stress, anxiety, and other mental health conditions. Rehabilitation and physical therapy is another healthcare area which is going to be fundamentally transformed using Metaverse technologies.

The Patients and Organs Twins

According to the U.S. Food and Drug Administration (FDA), the percentage of patients for whom medications are ineffective ranges between 38% to 75%. One of the most promising advances in healthcare is using the architectural principles of cognitive digital twins to create digital twins for patients based on their biology, genetic code, and health history. A Patient's Digital Twin will help doctors to replace the current "hit or miss" therapy methods which have many side effects with high precision personalised medicine. Connected wearables and Brain Computer interfaces (BCI) are going to continuously feed up-to-date data into the patient twin, keeping it an exact representation of the patient's health.

Digital Twins of patients will help doctors to test therapeutics on the digital twin of a specific patient before actually prescribing it. Digital Twins of organs such as heart and lungs are already possible today. The Digital Twins of patients and their organs will simulate specific surgical interventions and guide surgeons in the metaverse to precisely carry out such surgeries. It will also be able to recommend

less invasive or even non-invasive alternatives based on the knowledge of the patient twin and its accumulated experience from similar situations.

The Cognitive Digital Twin (CDT)
New Paradigms For Systems, Solutions, and Business
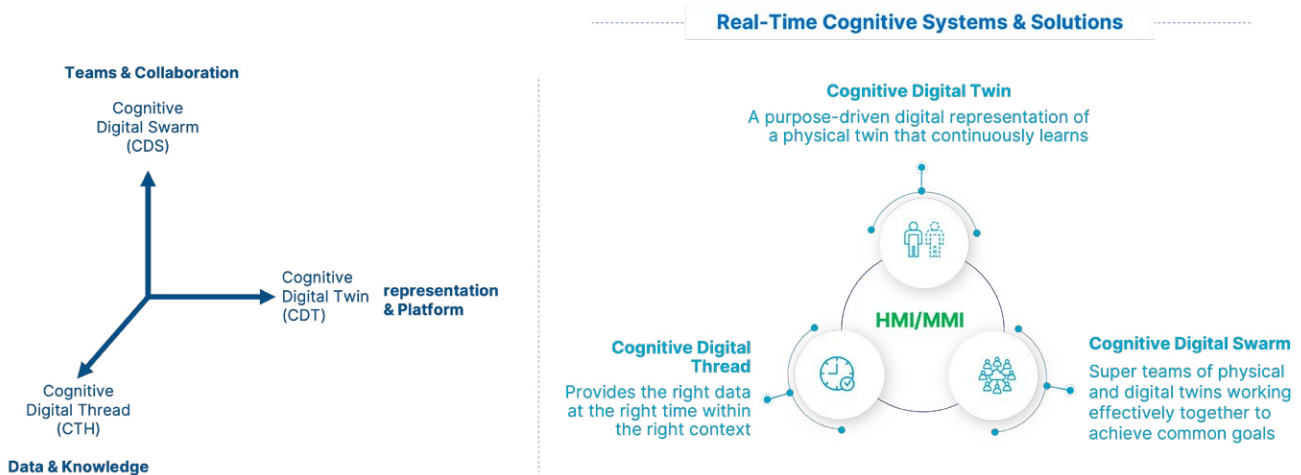
Figure 5: The Cognitive Digital Twin - New Paradigms for Systems, Solutions, and Business

While some think that such solutions that depend heavily on personal data would create Data Privacy issues, we believe that the same intelligent technologies will enhance data privacy and overall cyber security more than the traditional healthcare information systems we currently have.

These advances in technologies and the innovative convergence of them will not only extremely enhance the health and wellbeing of the inhabitants of Tampere, but also are going to drive healthcare innovation and create new economic opportunities that will position Tampere as a leader of quality-of-life related innovative solutions and services throughout the 21st century.

Vision 2040: Tampere Technology Map

Macro Strategy

We have formed a "technology map" depicting when certain technologies mature, which covers key technology applications for different industries along with their ethical and societal implications.
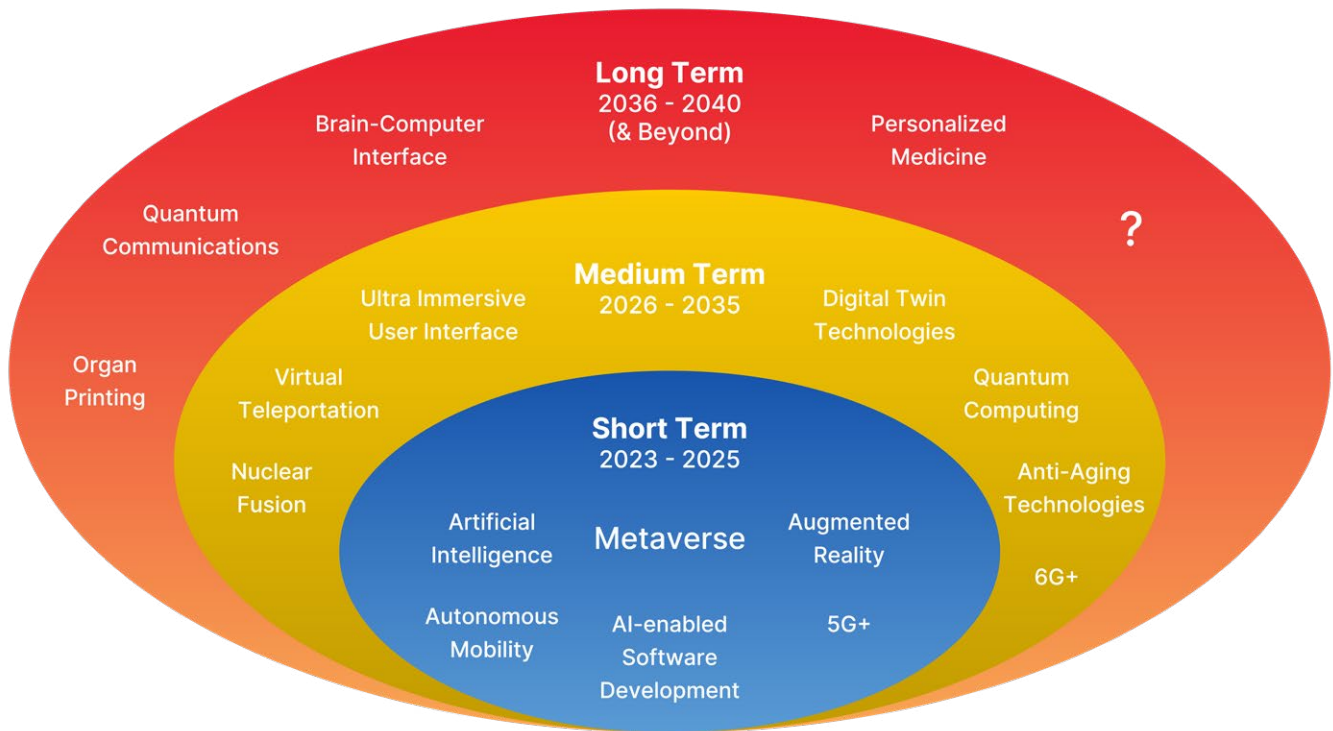

Long Term
2036 - 2040
(& Beyond)

Brain-Computer Interface

Personalized Medicine

Quantum Communications

?

Medium Term
2026 - 2035

Ultra Immersive User Interface

Digital Twin Technologies

Organ Printing

Virtual Teleportation

Quantum Computing

Short Term
2023 - 2025

Nuclear Fusion

Anti-Aging Technologies

Artificial Intelligence

Metaverse

Augmented Reality

6G+

Autonomous Mobility

AI-enabled Software Development

5G+

Figure 6: Tampere Metaverse Vision 2040 Technology Map

Short Term 2023-2025

As technologies tend to go through a hype cycle, the main purpose of the technology roadmap is to cut through the noise and focus on delivering achievable pilots, projects and products on time and on budget. Tampere will create a technology coordination council that brings its administrators, business executives and academic experts to take stock of local capabilities, decide on its comparative advantage and work on creating a cluster of specialised firms that can become global champions.

Engaging local stakeholders is the key element for this phase. Tampere's renowned Police University College, which serves all of Finland, will be an ideal partner to ensure that tech focused pilots that the city develops include a strong focus on safety and security. Such a pilot will also build the capacity of future law enforcement officials to deal with this new medium into their day-to-day work.

By focusing on defence applications, Tampere will further build up the existing cluster of specialised suppliers, paving the way to becoming NATO's Metaverse Defence Hub.

By focusing on narrow areas that spark collaborative tendencies of local businesses, Tampere will serve as a venture accelerator by not only marketing itself to certain segments of population, but also by targeting specific capabilities that will help local businesses (for example, licencing a specific tech that would be made available for all local players, supporting reallocation of a firm that could serve as a critical supplier for a local ecosystem, attracting technology experts and promising academics to build a pool of local highly specialised talent, etc).

The idea is to develop a municipal M&A strategy to serve all of the stakeholders in the region that would in turn help them become more competitive. These two years will serve as a critical initial policy design stage of such efforts, which will prove invaluable in the following two periods below.

Medium Term 2026-2035

This is a period of rapid building of the new industries and revitalizing the old ones, whilst ensuring that all efforts are aligned with Tampere's five priorities (happiness, governance, sustainability, equality, wellbeing) through the mechanism described above.

Since TMS is the key focus of the exercise, particular attention should be paid to attracting metaverse related academics and businesses, while actively supporting the population at large in adjusting and actively participating in metaverse pilots. As part of TMS, Tampere could offer to become "a New Zealand"(a small, technophile country is a great place to test digital products) of metaverse pilots, on the condition that companies launching the products among this most sophisticated metaverse population will be subjected to a stringent co-evaluation of potential impacts of their products.

TMS will call upon authorities to think holistically about the needs of citizens in the metaverse and support not only devices and platforms, but also in establishing strong partnerships with content designers for the metaverse. To pursue its TMS, local educational institutions should be on the forefront of educational experiments deploying metaverse for learners, from kindergartens to care-homes, while actively developing and certifying new professions (metaverse gaming engineers, metaverse architects, AI auditors, etc).

Long Term 2036-2040

This is the period where Tampere will be harvesting the benefits of its efforts and investments from the previous two phases. Recognised as a global leader in the metaverse, it boasts a healthy business metaverse cluster, a vibrant community of developers, citizens and users of the metaverse, hosts MetaOscars and/or cultural and tourist events.

Akin to the Cannes film festival, its e-sports teams continue to be fans' favourites all over the world. Its democracy not only survived the advent of deepfakes and other dystopian visions, but actually

managed to become stronger, more inclusive and equitable, healthier and wealthier, happier and better governed city. Now is the time to take stock, learn the lessons and build the strategy for the next couple of decades to ensure that Tampere does not become a victim of its own success, but rather pivots as needed based on the current state of political and economic affairs as well as technology convergence.

Operations: Data and Interoperability

Current datasets are not fit for purpose for Tampere 2040, therefore it is important that Tampere revisits & reviews data standards on an ongoing basis. This will help to ensure that data quality & quantity are of a high enough standard for metaverse and digital twin use cases. By adopting the concept of "Cognitive Digital Threads", Tampere will be able to implement an AI-enabled framework of technical, legal, and ethical protocols to guarantee a continuous enforcement of what the city inhabitants expect for their data and knowledge.

1. **Short Term 2023-2025**

The period 2023-2025 will be critical for unpacking the goals, ensuring broad-based ownership of these goals, and developing new data sets and new indicators for monitoring their realisation. These new data sets and indicators will be crucial to monitoring progress towards the 2040 goals and beyond. They will also require new thinking, new ideas and new competencies for using them effectively in policy and decision-making.

2. **Medium Term 2026-2035**

The period 2026-2035 will be critical for testing the new data sets and indicators, and for developing the competencies for using them to adjust planning, programming and budgeting. This will require considerable "out of the box" thinking and constant innovation and improvisation. These are not conventional skill sets found in public administration, and as the first results from the new data sets and indicators come in, considerable adjustments will need to be made to implement findings and, more importantly, the reasons for doing so will need to be communicated effectively to all stakeholders.

3. **Long Term 2036-2040**

This phase will be crucial for a medium-term review and more forward-looking thinking and planning. Results matter less than processes and what those processes were able to achieve, were not able to achieve and why. Lessons learned will be critical for future policies and strategies.
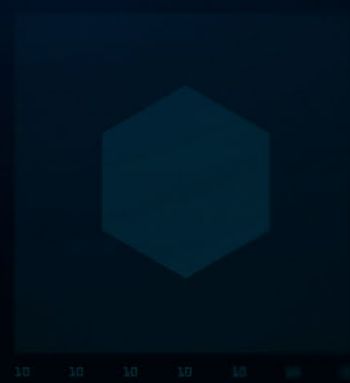
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Opportunities and Challenges of Artificial Intelligence

We examine social, ethical and geopolitical possibilities and issues raised by AI (inequality, unprecedented abundance of goods, loss and creation of jobs, and human pursuit of higher purpose).

1. Recent advances in AI raise profound questions about its positive and negative impacts, attracting a great degree of interest from political, economic, academic and religious authorities.

2. There are many benefits AI will bring to Tampere, liberating people from repetitive jobs, improving healthcare and mobility, and enhanced education and elderly care. People will have more time to explore creative expression and to spend time with their family and friends for leisure. More people will get involved in charitable and philanthropic activities to make our world more inclusive, equitable and sustainable.

3. The key discussion focuses on the "underlying values" that we build into our AI models. This leads to issues of quality training datasets, data leakage/poisoning and other issues. Data privacy and surveillance are already major issues. These will become more serious when considering the bias of AI models. People who develop AI models are not bias and discrimination free, which can cause AI to discriminate against certain groups of people and widen inequality. Tampere will lead the way through insisting on deployment of systems that only meet its core values and closely monitoring the intended impact through regular audits and assessments by The Metaverse Institute.

Risks and Challenges of AI

Misuse and Malicious use

Ethical risks

Privacy and security

Transparency and Explain ability

Employment disruption and Economic Inequality

Dependence and Overreliance

Advanced AI capabilities create new risks and offer the solutions in the same time
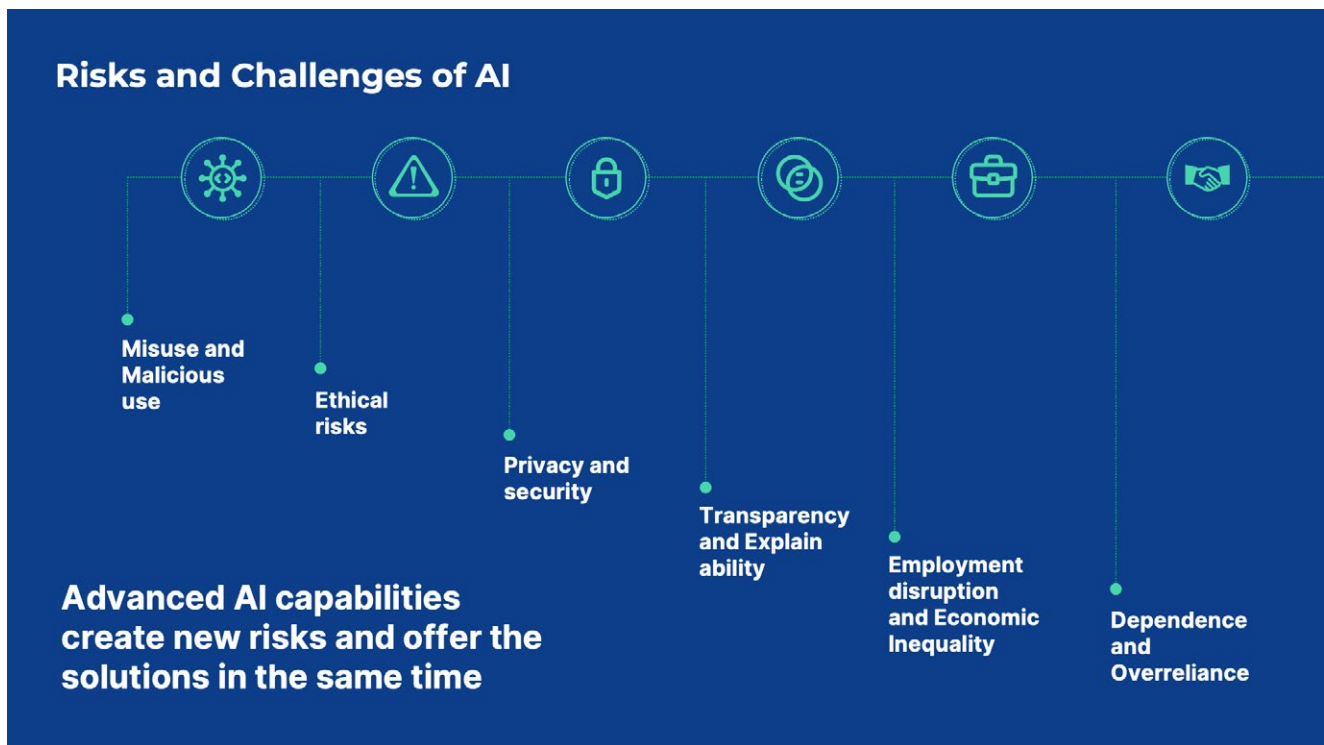
Figure 7: Risks and Challenges of AI

4. The group of countries who have the most advanced AI technologies will have major advantages on the future world order. While the geopolitical implications of AI will largely be assessed by national and EU/NATO/UN level institutions, Tampere will set an example in areas such as industrial AI as well as human-AI collaboration in safety, security and law enforcement. The global AI race will accelerate the arrival of singularity, when the intelligence of machines exceeds the intelligence of humans. Tampere will need to define the respective roles and rights of humans and robots as AI becomes more generative and self-aware.

5. AI will have multiple and wide-ranging social, economic and ethical impacts. One critical issue is the time frame for responding to emerging issues, versus the time frame for policy making. Whilst the impacts of AI will tend to accelerate, there is a significant risk that policy-making will be far slower. A critical challenge will be to accelerate innovation in policy-making, resource allocation and planning to match the pace of AI deployment. For example, AI will create most of the information humans process everyday. Fake news could become prevalent. People who know how to use AI to assist their daily work and life will have a big advantage over others. Major job losses as a result of automation will require massive investment in retraining which will have to become more agile and continuous. Several industries, such as financial services, education & healthcare will be greatly disrupted - will anyone even need a formal education anymore? Policy-makers need to be prepared to deal with these issues.

6. There will be UBI, but it won't be at the same level globally, which will cause geopolitical tensions. Additionally, a two (or more) tier society will exist, with people who have inherited property & financial assets living alongside people on UBI. Unlike today though, it will be almost impossible to improve your financial situation once AI has sufficiently matured. To end on a good note, people (at least some people) will be able to pursue a higher purpose.
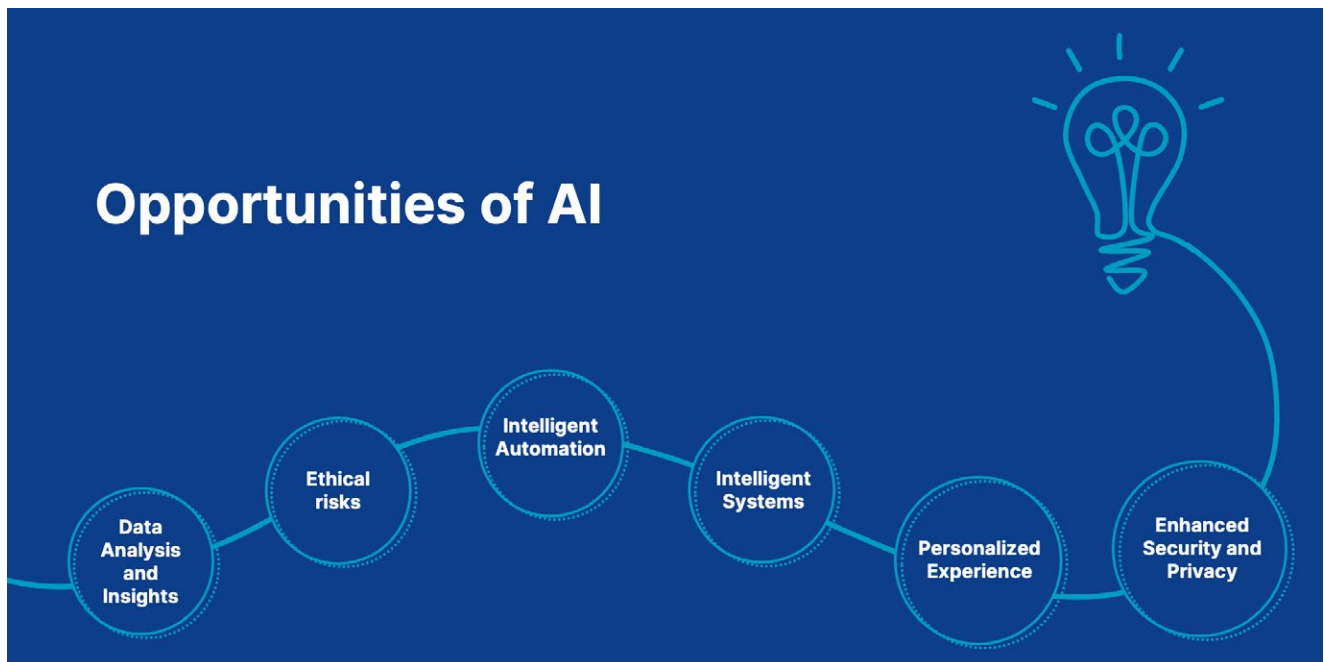

Figure 8: Opportunities of AI

Conclusion

The development of key technologies within the metaverse is growing fast. Tampere will continue to work closely with stakeholders at home and overseas to review the above strategies and proposals on an on-going basis. These partnerships will help sustain efforts towards its metaverse projects and inform interactions with vendors in a nuanced and people-focused manner. It will help government, businesses, and civic society advance inclusivity, interoperability and sustainability as key pillars of their metaverse initiatives.

Through these exercises, some interesting stories will emerge about the impact of technology on segments of urban inhabitants in cities around the world that can be shared widely. Enhanced Reality as a combination of augmented and virtual reality, remote presence, digital twins, other modes of human-computer interactions, as well as new modes of production, consumption and ownership will affect how people live and the role cities are expected to play in our lives.

From retail to culture, from healthcare to education, our cities are ill-prepared for the disruption that the metaverse will bring upon them. On the other hand, the metaverse could use the experience of thousands of years of collective experience in aggregating into ever expanding settlements to avoid meta-ghettos, meta-pandemics, meta-pollution and other evils that have plagued our cities in the physical world.

Cities around the world are trying to find the ways to turn the pandemic disruption into opportunities, to capture value offered by the new medium of the broader Web 3.0 technologies and industrial and urban metaverses. Cities will need help to ensure that the urban metaverse is more people-centred than our current political and governance systems.

The social, economic and ethical challenges associated with the urban metaverse will require strong leadership on behalf of Tampere municipality. Stakeholder education and engagement will be crucial to overcoming resistance to change and to ensuring that public policies are able to keep abreast of rapid technological advancements. Education, effective top-down and bottom-up communications and fully-facilitated dialogue at all levels will be required to ensure broad-based ownership and buy-in.

AI-assisted predictive planning can help Tampere overcome existing urban problems and meet future challenges on an unprecedented scale, while helping other cities and communities to do the same. Tampere should become a metaverse learning laboratory and platform, devoted to sharing knowledge, expertise and experience for the benefit of humankind.

Tampere will need to adjust its governance ecosystem on a continuous basis. It will need to develop new datasets, new policies and strategies, new business models and new forms of partnerships. A continuum of AI-assisted knowledge-creation and sharing will be required to capture lessons learned from real-world and metaverse-world(s) experience.

Putting the wellbeing and happiness of people at the very centre of its metaverse strategy, Tampere will work closely with citizens, business, universities, research institutes, NGOs, and governments worldwide to explore, identity and optimise its metaverse vision 2040 for the benefits of Tampere, Finland, the EU

and the international community alike. Through collaboration at home and overseas, this strategy can help to identify an efficient people-centred digital future that will ensure an equitable, inclusive and sustainable future for us all.

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