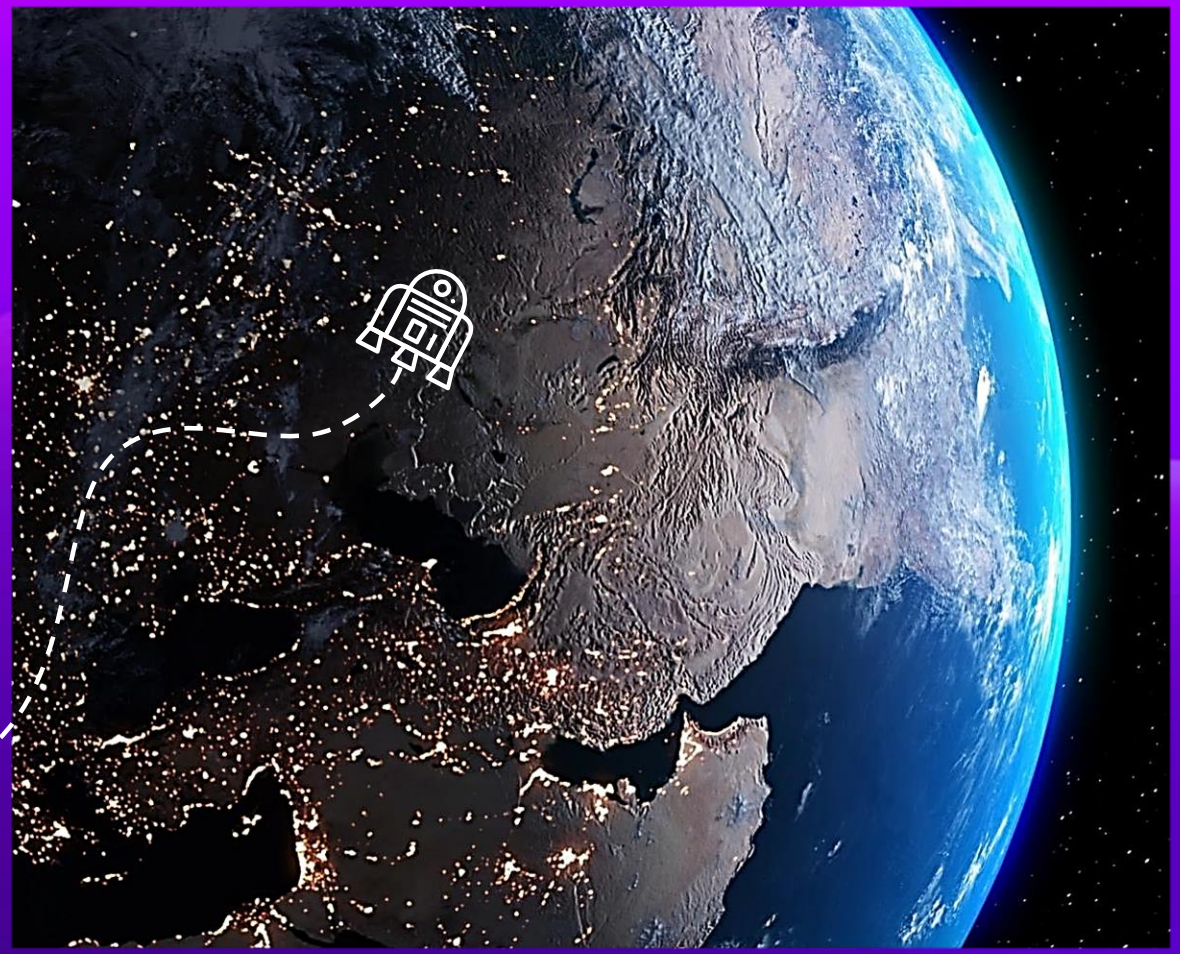
Metaverse Potential for Space

Accenture's Space Innovation Team &
Metaverse Continuum Business Group

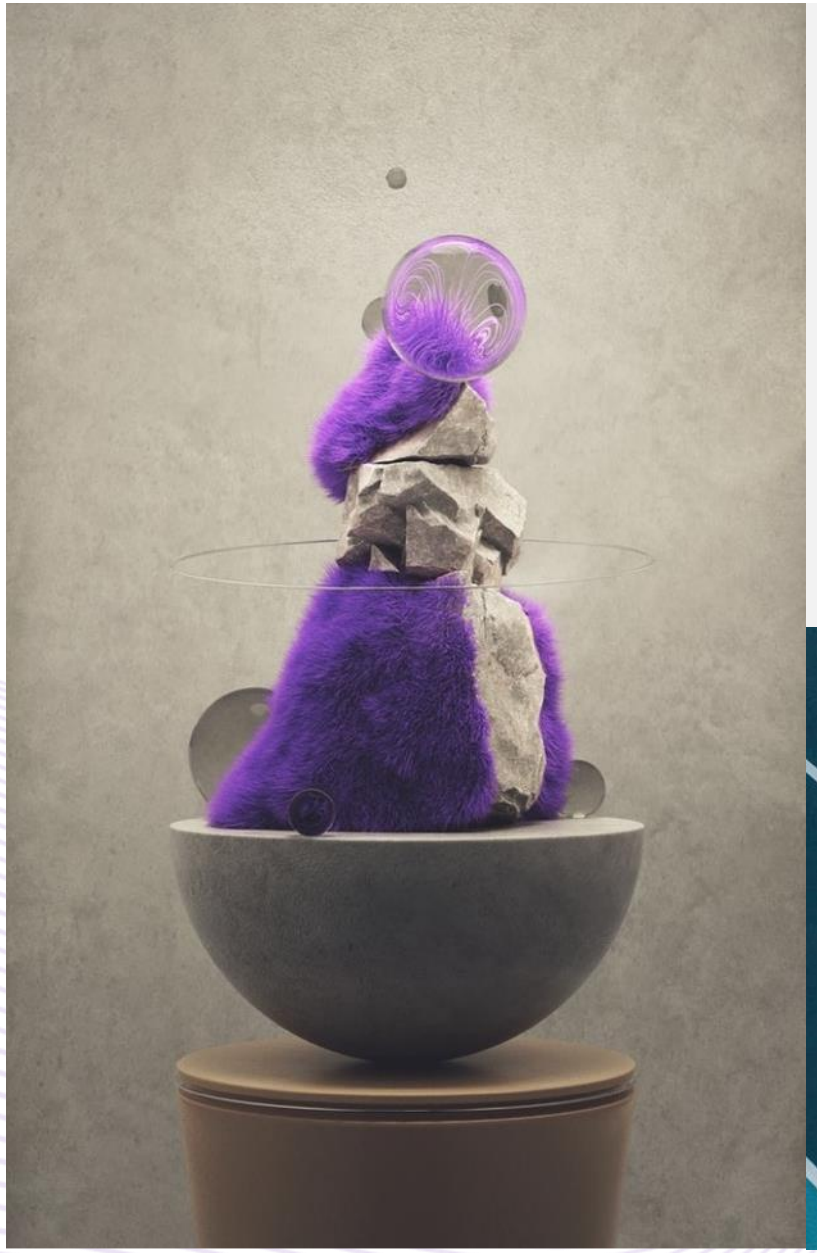
January 2023

accenture

Contents



01 Vision for the Metaverse



71%

of global executives state that the metaverse will have a positive impact on their organizations.

42%

believe the metaverse will be breakthrough or transformational.

The Metaverse Continuum.

The internet is being reshaped.

1990s

Internet of Data

Made vast amounts of information available for people to access anywhere anytime and search at ease

2000s

Internet of People

Connected people to people across vast distances and brought the digital social life to the forefront

2010s

Internet of Things

Connected machines together and laid the foundation for connecting those machines to people

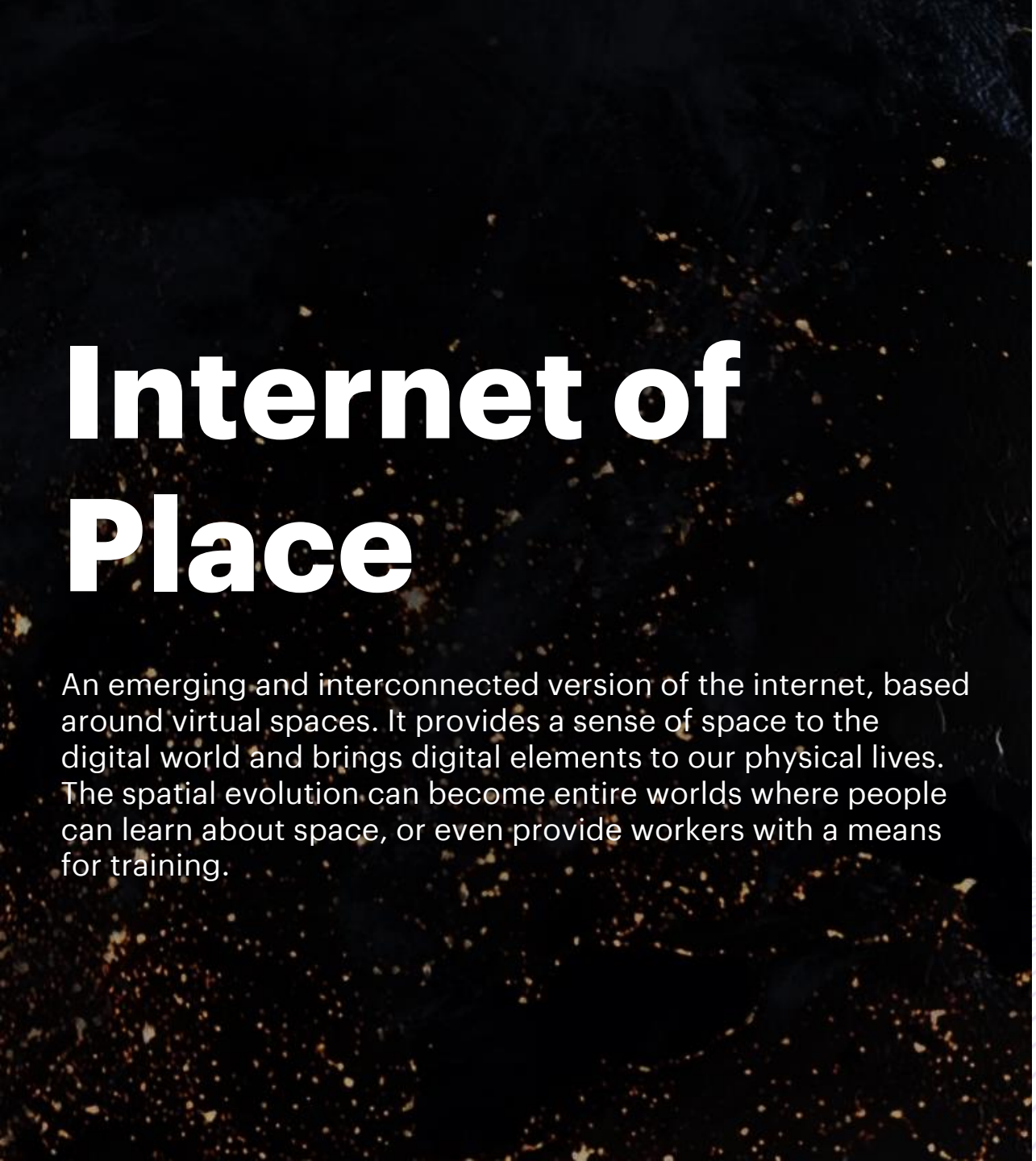
2020s

Internet of Place

Brings people, spaces and things in both the virtual and real worlds together to evoke a sense of belonging

Internet of Ownership

Bursting from the blockchain innovation wave, tokenization (e.g. NFT's) enabling unique, portable, persistent, digital objects can be created, exchanged and valued in a market



Internet of Place

An emerging and interconnected version of the internet, based around virtual spaces. It provides a sense of space to the digital world and brings digital elements to our physical lives. The spatial evolution can become entire worlds where people can learn about space, or even provide workers with a means for training.

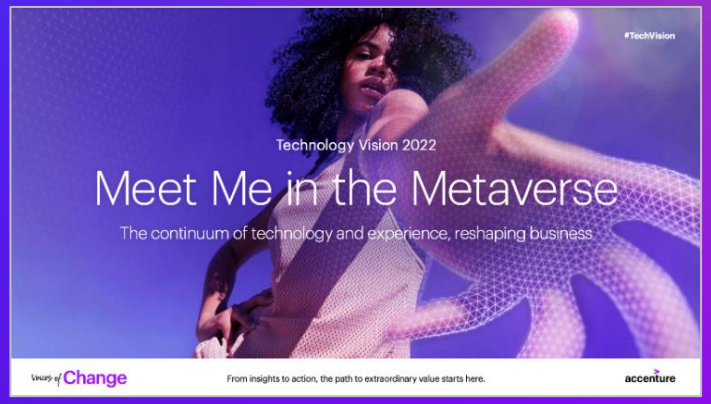
Internet of Ownership

A digitally native infrastructure powered by technologies such as blockchain, decentralized identity, confidential computing and more that creates the ability for people to carry their identity, money and objects from place to place in the digital world. These can help to form tight communities based around tokenised access, which may appeal to space enthusiasts.

The Metaverse is an evolving, expanding Continuum

"An evolution of the internet that enables us to move beyond 'browsing' to 'participating and/or inhabiting' in a persistent shared experience that spans the spectrum of our real world to a fully virtual world and in between."

+ From consumer to worker and across enterprise
+ From reality to virtual and back, in integrated fashion
+ From 2D to 3D, seamlessly
+ From cloud, AI to XR, blockchain, edge and more
+ Starting today, and evolving rapidly as Metaverse matures

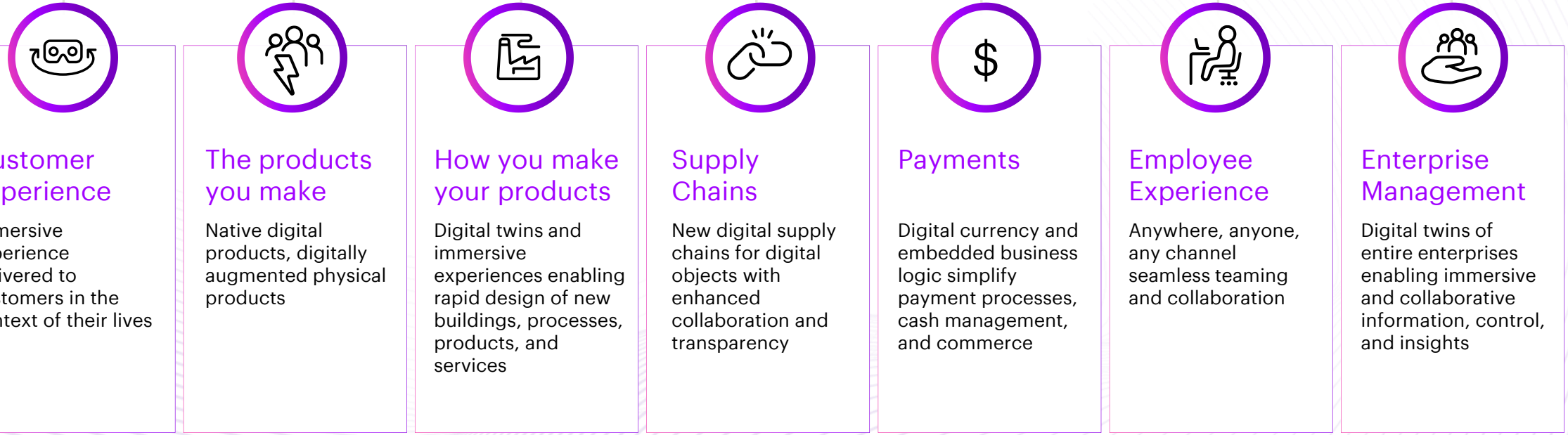


Read the Tech Vision

+ 2013: Every Business is a Digital Business
+ 2022: Metaverse Continuum

Massive transformation potential

The Metaverse is a fundamental transformation, affecting experience, revenue, cost and governance. Leaders will need to reimagine how they will approach their business for the next decade

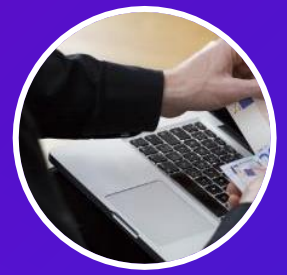


The convergence and proper use of numerous capabilities will be required to create the Metaverse

Extended Reality

DLT & Tokenization

Digital Currency



Digital Twin

Digital Asset Markets

IoT & Edge

Artificial Intelligence

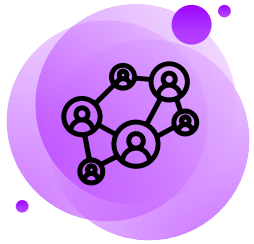
Digital Identity

Gaming / Graphics Engines

02 Metaverse for Space

Metaverse Applications for Space

The Metaverse is a new wave of disruption shaping the Space Industry's future. The below applications are meant to be thought provoking, and not exhaustive:



Integrated Simulation Training

Hyper-realistic training within the Metaverse could provide unique capabilities. Training in VR could overcome associated costs, pre-screen candidates, mitigate risks, and replicate scenarios that were otherwise impossible.

Potential scenarios:

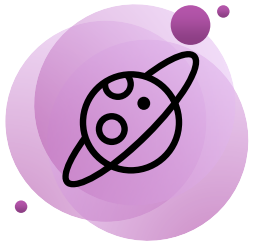
- Scaled Launch & Mission Control Simulations
- Component Level Authentic Astronaut Training
- Architecture & Layout Planning

Connected Worker

Extended Reality (XR) can dynamically connect workers to information enabling them to be more efficient, accurate and safer. From human-robot collaboration to digital twin overlays such as schematics or live sensor feeds.

Potential scenarios:

- Digital Twin Operations
- VR Human-Robot Collaboration
- Space R&D Inspiration
- Astronaut Remote Assistance



Consumer Experiences

The Metaverse presents a new channel to engage consumers with a diverse set of experiences, to form new kinds of communities. Ultimately, this can help players engage a new audience via an internet of place and ownership.

Potential scenarios:

- Interactive Space Museum
- Immersive Space Walk
- Form powerful communities via tokenised access

Geospatial Metaverse

A fusion of geospatial data and Metaverse capabilities can unlock entirely new possibilities. From precise location services to hyperspectral satellite imagery to photogrammetry to LiDAR scanning.

Potential scenarios:

- Lunar Surface Modelling
- Earth Oberservation Visualisation
- Smart City Planning
- Remote Areas Intelligence

Value of VR for Space R&D

A virtual reality collaborative experience to inspire innovation and simulate the experience of conducting Space R&D experiments in virtual locations:

Inspire

Ideation Inspiration

Inspire ideation for **potential experiments and mission life cycle improvements** through workshops in the virtual space

Mission Optimization

Identify **data-driven insights** to unlock opportunities for optimization of future space missions

Business Pipeline

Create **future business pipeline** for space missions by inspiring clients to uncover the benefits of R&D in space via a simulated mission on earth

Backlog Development

Enable the co-development of a comprehensive **backlog of scientific experimental concepts** to investigate in future simulations

AND

Simulate

Experimentation

Replicate space experimentation processes, such **as cell division or a bespoke experiment,** in virtual reality environment

High-Risk Steps

Mock steps in the virtual environment for planning purposes: defining requirements, **de-risking the mission, and estimating timeline to launch**

Communication

Practice clear communication with **mission control specialists, astronauts, and researchers** to ensure smooth integration a

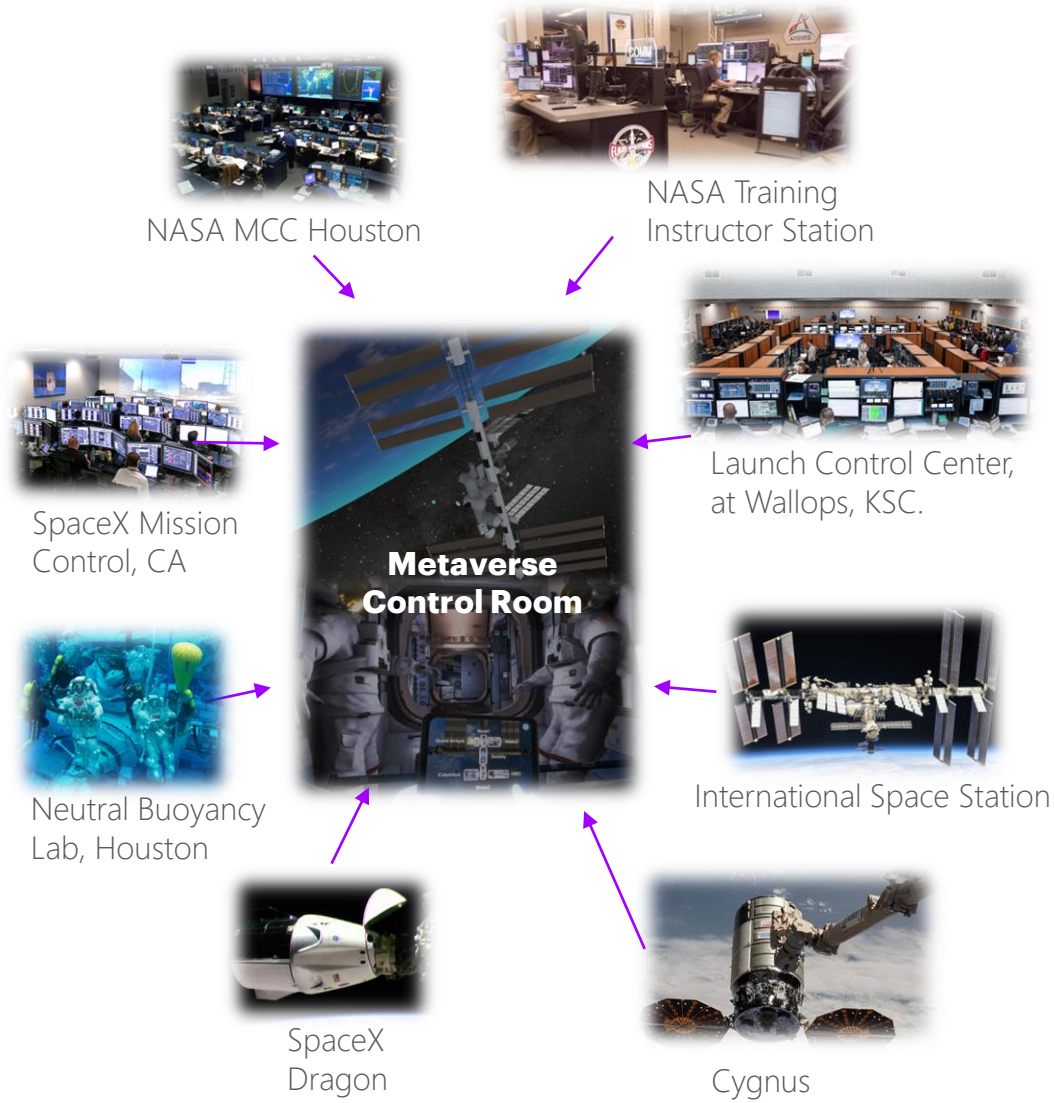
Payload Processing

Simulate following a payload in space or ISS, understanding the **mission parameters with data visualizations**

Area Of Opportunity: Training in the Metaverse

Build an **Integrated Simulation Training platform in the Metaverse (MetaSims)** that brings the crew, Flight Controllers and Launch Controllers, and instructors across multiple systems and locations together in the Metaverse to prepare for upcoming missions

- The **astronauts** execute a task in their Metaverse "space world" and communicate with the flight control teams as normal using the onboard crew displays and controls.
- **Flight controllers and launch controllers** are at their virtual consoles or real remote console, with real-time data displays fed by simulator data as in the real world.
- **Training instructors** observe or shadow both the crew and flight controllers in their environments as they perform their nominal procedures and respond to malfunctions activated in the simulation..
- They **communicate through simulated voice loops**, mimicking real missions, by listening to one-on-one conversations in one ear and multiple voice loops in their headset in the other.
- 3D models move based on virtual hand controllers or real-time telemetry from the simulation. **Backup Mission Control**
- This setup **enables collaboration**, creating a sense of all personnel being physically present in the control rooms.
- Has the potential to be **utilized in joint mission control rooms**, where flight controllers from all regional control rooms work together in one location.



03 Success Stories

Our Growing Metaverse Client Partnership

MARVEL STADIUM

بلدية دبي
DUBAI MUNICIPALITY

ESPN EDGE

MQDC
FOR ALL WELL-BEING

coinbase

WORLD ECONOMIC FORUM

Global Software & Technology Company

Global Apparel Company

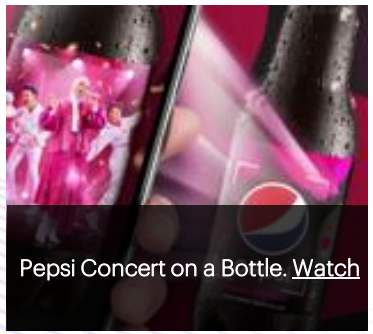
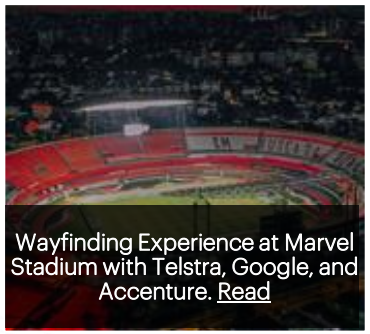
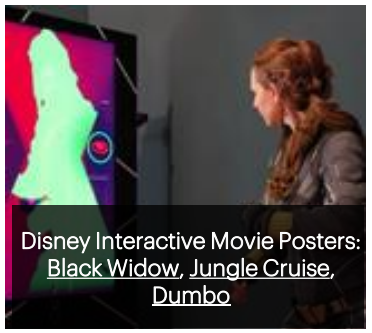
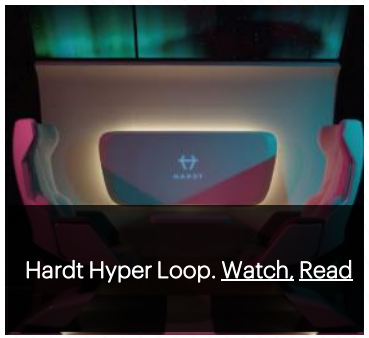
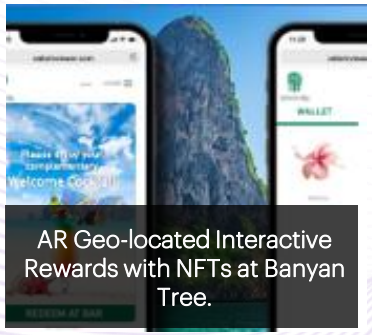
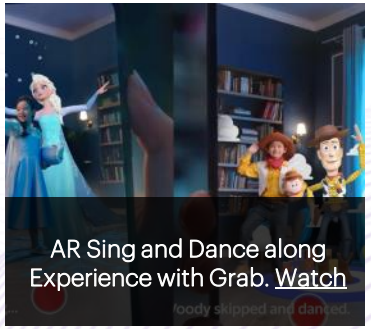
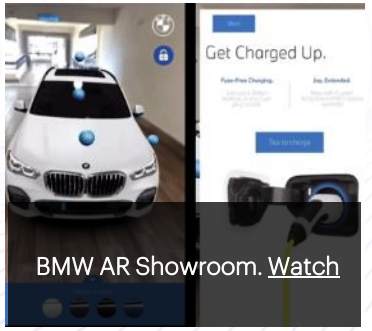
Global Entertainment/ Gambling Company

Global Media & Entertainment Company

Global Social Technology Company

Credentials: Augmenting the Physical World

Accenture focuses on augmenting meaningful experiences by defining modular journeys across a range of emerging technologies. We focus on making the building blocks fit rather than stack.

Augmented Products	Augmented Places	Augmented Performances	Augmented Reflections	Augmented Commerce	Augmented Workers
 Pepsi Concert on a Bottle. Watch	 Wayfinding Experience at Marvel Stadium with Telstra, Google, and Accenture. Read	 Increasing Accessibility for the hearing impaired with the National Theater in London. Watch	 Disney Interactive Movie Posters: Black Widow, Jungle Cruise, Dumbo	 Hardt Hyper Loop. Watch, Read	 Expedited AR Automobile Assembly. Read
 QR-code Branding for Nestle Coffee Empty Label Campaign Read	 AR Geo-located Interactive Rewards with NFTs at Banyan Tree.	 AR Sing and Dance along Experience with Grab. Watch	 AR Experience for Human Behavior Learning with Systain. Watch	 BMW AR Showroom. Watch	 Airbus Technician AR Assembly of Seat Installation. Read

Credentials: Harnessing Virtual Worlds

Accenture focuses on creating meaningful virtual experiences across a wide range of applications, driving new types of engagements and creating business value

Virtual Places

Teach young audiences about living in poverty on Roblox. Read

Immersive theater for audiences using VR. Watch

Virtual For Good

Conduct virtual interviews for Goodwill. Read

Case workers can check child welfare through virtual home visits. Watch

Virtual Twins

Mars develops digital twins across its manufacturing facilities. Read

Accenture Digital Twin Offices. Read

Virtual Collaboration

ESPN - Collaborate and design sports experiences of the future. Watch

CHM - Celebrate pioneers through a Hall of Game. Read

Virtual Worker

Kellogg's - Manage merchandise with eye tracking & mobile VR to collect consumer data. Read

Manage supply chain in control tower.

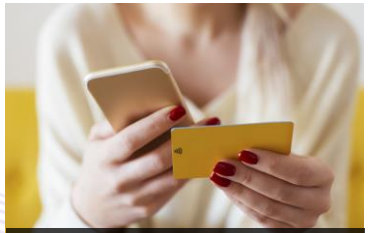
Training utility field workers for a utility company in a virtual environment. Read

Train critical employees on PPE. using VR. Read Watch

Credentials: Tokenizing the Economy

Accenture has been tokenizing people's identities, organizations and their assets/processes, and things (connected & unconnected)

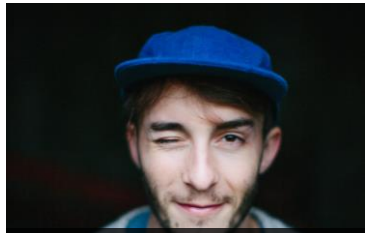
Money Tokenization



Exploring a United States Central Bank Digital Currency w/ the Digital Dollar Project.

Digitizing e-Krona for Sweden's Riksbank

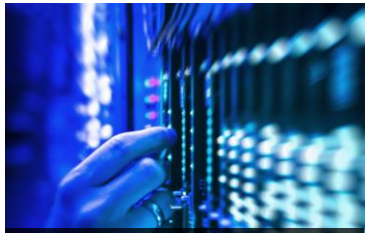
Identity Tokenization



Unlocking the potential of digital identity for secure and seamless travel w/ KTDI.

Sharing verifiable credentials w/ the government to reduce risk for KTB.

Supply Chain Tokenization



Inventory Transparency for the Azure Component Supply Chain w/ Microsoft and its partners.

Eliminating errors for pharmaceutical chargebacks w/ MediLedger.

Product Tokenization

Providing ingredient provenance and authenticity for Heineken.

Securing pork exports for the Food Standards Agency.

Loyalty Tokenization

Reimagining "earn and burn" for an Asian Airline.

A loyalty point clearinghouse to easily onboard and exchange between enterprise partners.

Asset Tokenization

Optimizing the United States equities clearing and settlement systems with DTCC.

Providing proof of ownership for a highly traded commodity market with Agrotoken.

Working with Partners to Achieve Joint Missions

Leveraging power of Accenture partnerships and investing into new capabilities via spotlight partnerships to enter space economy

PIXXEL

Accenture made a strategic investment in Pixxel, company based in Bangalore with a presence in Los Angeles. Pixxel is building the world's highest resolution hyperspectral imaging satellite constellation in order to offer industry AI-powered insights that discover, solve, and predict climate issues at a fraction of the cost of traditional satellites.

Accenture Newsroom

PLANET LABS

Planet revolutionized the Earth observation industry with the highest frequency satellite data commercially available. Planet provides clients with geospatial insights by equipping users with the data necessary to make informed decisions.

TITAN

Commercial space R&D platform offers computing power to increase the speed and efficiency of real-time data analysis in the field of medical research, climate technology, material science, and beyond. Titan wants to show potential customers the art of possible of space experiments, and, together with Accenture has developed a VR experience to:

- Conduct space R&D experiments in virtual rooms.
- Establish a space focused collaborative space.
- Simulate experiences that enable business ideation.

Accenture Newsroom

MICROSOFT - AMBG

Exploring offering opportunities via AMBG on topics including:

- **Azure Space:** Cloud Access Anywhere, Ground Stations, Analytics
- **Azure Orbital:** Ground Station-as-a-Service with Command, Control, and downlink to the cloud
- **Satellite & Private 5G Networks** End-to-end secure connectivity with satellite & private 5G core
- **Azure Orbital Analytics**: Space-born data access, object detection, land classification, change detection, depth perception, derived data sets + more
- **Methane Emissions Platform**
  - Credential: Duke Energy
- **Microsoft Mesh Metaverse** for Astronaut & Flight Controller Training
- **Space Lab:** Facility for joint demonstration of space capabilities

04 Next Steps

Exploring Tech Horizons: Metaverse Workshop

Through the below creative workshop, together Accenture and NASA could explore the art of the possible, prioritise a set of initiatives and determine a clear action plan:

Logistics

- **Date:** March 2023
- **Duration:** 180 mins
- **Audience:** NASA Goddard Space Centre as well as Accenture's Metaverse Continuum Business Group and Space Innovation
- **Location:** NASA Goddard Space Center

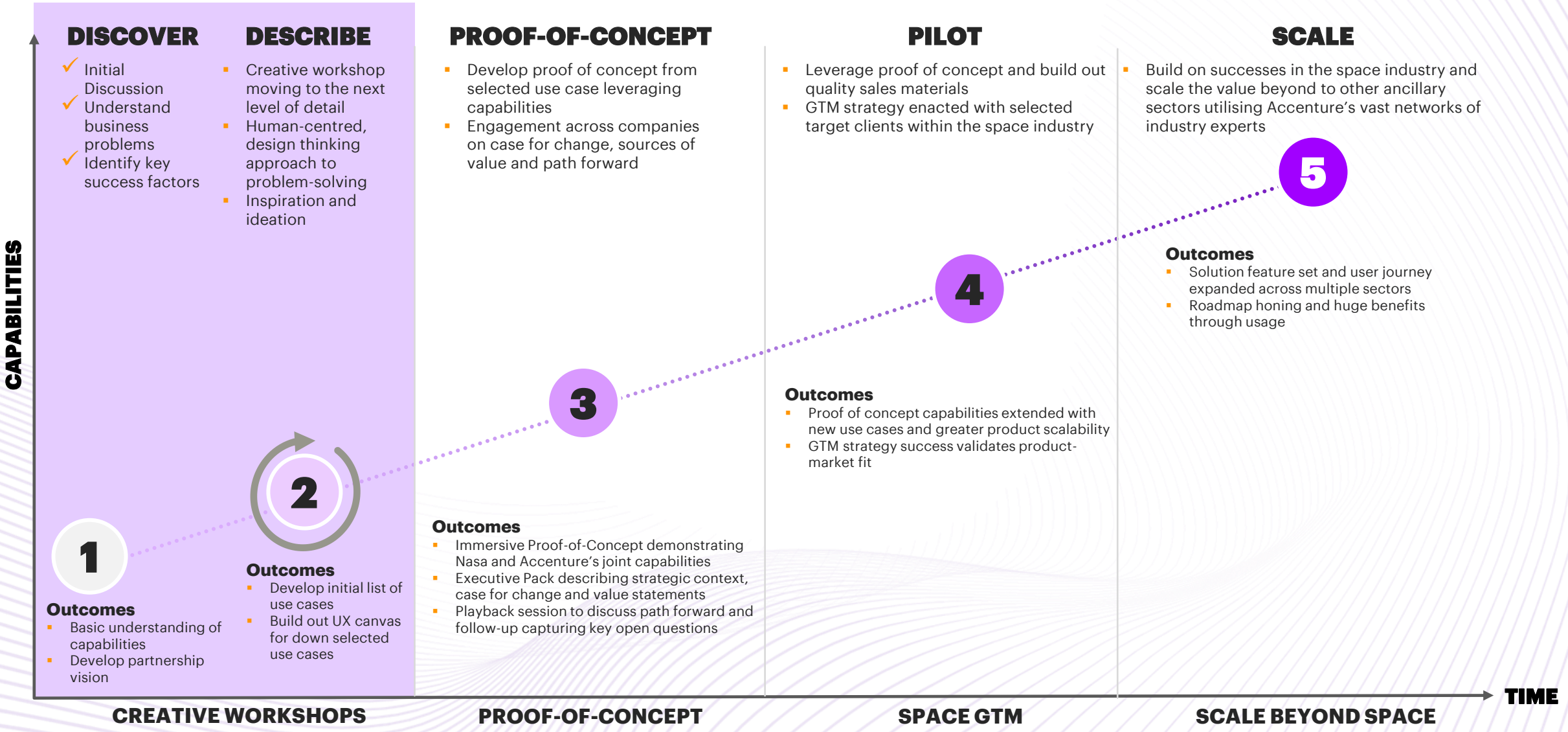
Context

- **Context:** NASA and Accenture are world leaders in their respective fields, both with their own unique distinctive expertise
- **Opportunity:** NASA and Accenture have an opportunity to pioneer and create something truly valuable leveraging the unique capabilities that the Metaverse offers

Goal

- **Align** on the North Star of this collaboration
- **Explore** the art of the possible, by looking beyond traditional boundaries
- **Co-create** viable and feasible ideas that maximize the potential of the Metaverse
- **Determine** next steps that can make this a reality

Illustrative High-Level Engagement Roadmap



Contacts

For additional context & materials or to be connected with our SMEs & industry experts, please reach out:

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Paul Thomas

Global Space Innovation Lead

Ron Kerr

North American Space Innovation Lead

Jonathan Cohen

Space Innovation Strategy Manager

George Stevens

Space Innovation Consultant

05 Who We Are

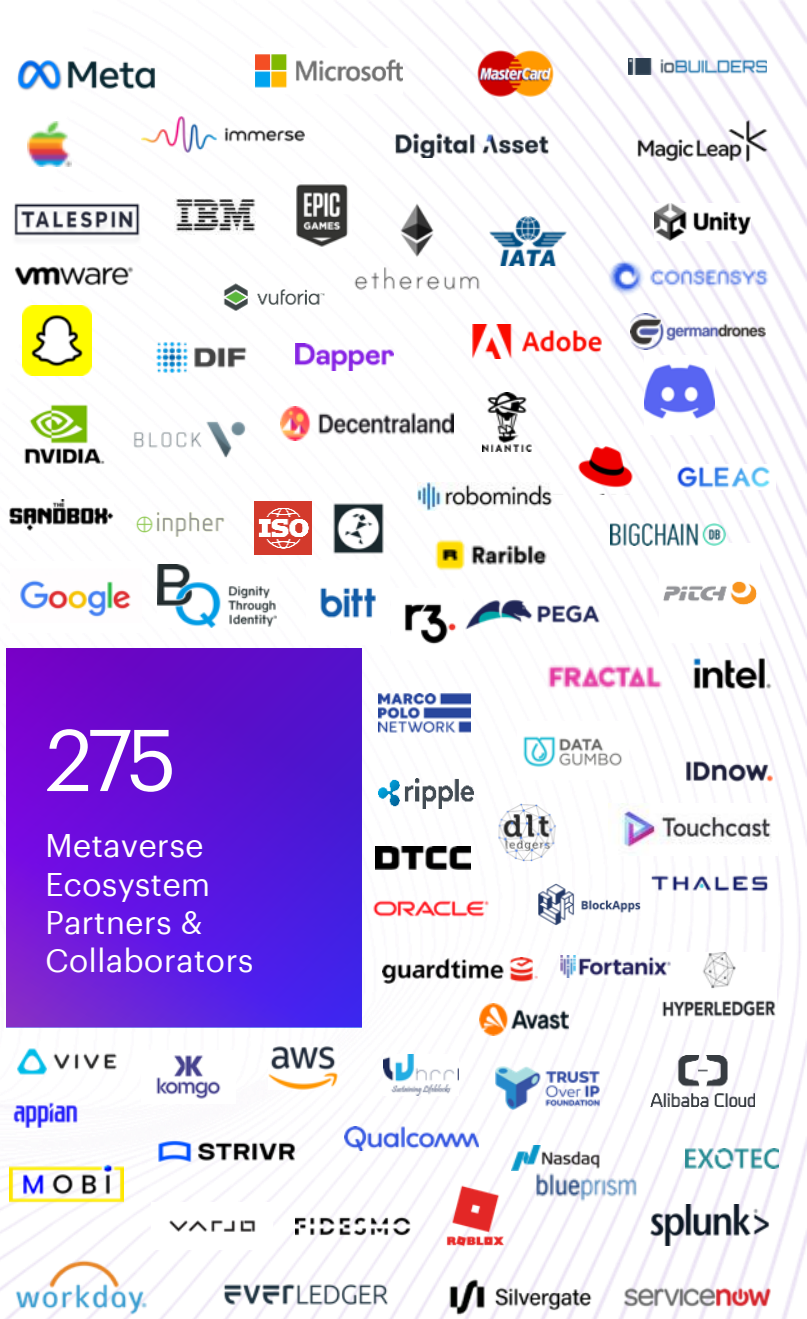
Accenture Metaverse Continuum Business Group

+14
years of experience in Metaverse related technology and experience

820+
Extended Reality & Blockchain projects

125+
Global Creative & Content Studios

185K+
Employees onboarded in the Metaverse



End-to-end Metaverse Capabilities

Designed to offer all the capabilities needed to thrive in the Metaverse Continuum.

Strategy

We help define differentiated strategies to get businesses ready for extended reality and multi-party systems.

By aligning business goals and human needs and expectations in new spaces.

New Growth Areas
Uncover opportunities to launch new businesses and reimagine the value chain

Omni-reality Transformation
Transform and redefine all aspects of a business with Metaverse at the core

Products & Services

We help imagine, design and deliver innovative experiences for users in the Metaverse.

By identifying and enabling innovative spaces for interaction and consumption.

Experiences Reimagined
Envision and define end-to-end experiences based on research and insights

3D Environments
Design and create digital spaces and objects for interactions in augmented and virtual reality

Digital Product Creation
Design, build, and launch digital native products that unlock value for audiences and business

Platform Integrity
Create trust and safety to drive positive interactions and moderate content at scale

Marketing & Comms

We reimagine a brand's purpose in the Metaverse and how to connect and engage with an audience

By rethinking how brands develop human connections within new spaces.

Translate Brand Purpose
Define how brand, products and services exist and are positioned in the Metaverse

Immersive Engagement
Create meaningful ways to engage audiences in a new and immersive channel

Content Production and Activation
Deliver and activate unique and modular creative content with agility, speed and efficiency

Commerce

We rethink the way commerce and transactions are done.

By transforming the way value is exchanged throughout in both physical and digital realities.

Evolving Commerce
Expanding how commerce models are activated

Rethinking Monetary Exchange
Transforming value exchange models and new currency adoption

Virtual Identities
Enabling secure interactions between realities

Supply Chain

We interrogate and reshape the end-to-end value chain to drive new and improved levels of efficiency.

By reshaping value creation throughout and across both physical and digital realities.

Efficient Operations
Transform and optimise processes across the entire value chain

Managed Systems
Create the right levels of trust and transparency across the operational processes and eco-system partners

Virtualized Manufacturing
Explore and redefine how products are sustainably manufactured to drive efficiency

Collaboration

We create new ways to foster collaboration and break through physical barriers by bringing people together virtually

By preparing for onboarding new realities across every business areas.

Employee Onboarding & Training
Set up to scale onboarding and training globally through new immersive spaces

Community Building
Create a sense of belonging by enabling new ways for people to meet and communicate

Virtual Events
Organise and coordinate virtual events across a business for any scale and purpose

Accenture's Space Innovation Team

Expanding traditional boundaries of the Space economy for existing participants and lowering barriers for new entrants.

Space technology has become more accessible, economical, and better positioned for global businesses. Participating in Space means more than exploration, it includes using **Satellite images and AI** for detection and predictions, **mission control** for **experiments** and payloads, providing **products and services** within the Space ecosystem, and developing the new **infrastructure**.

Change Triggers & Trends:

- Lower launch costs and flexible payloads offer affordable access;
- The democratization of Earth observation data from satellite providers;
- Collaboration between private and public entities;
- Expanding opportunities beyond the traditionally held boundaries

The identified pillars of focus will support our clients space economy journeys by accelerating experimentation, co-ideating mission concepts, facilitating strategic partnerships, and leveraging satellite data.

Earth to Space

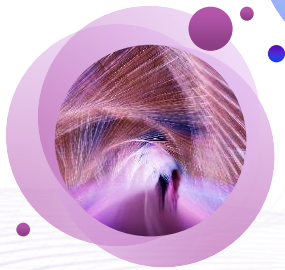
Utilizing familiar technologies to advance space operations and exploration, create new market opportunities, expand the scope of the possible in space, and enable upstream change:

- *Space-as-a-Service: Mission Control, human space flight, payload management, and more*
- *Manufacturing & Systems*
- *Expanding Products and Services into the Space Ecosystem*

Space to Earth

Providing access to traditionally difficult-to-access technology, such as satellites for EO data & insights, communication networks, and space IP to enable innovation for the benefit of life on Earth.

- *Earth Observation & Remote Sensing*
- *Sat Comms, Security, 5G, and Edge*
- *Repurposing Space tech for use on Earth*



Space & Beyond

Limitless opportunities to enable the space economy through exploration, tourism, destination planning, and new business development:

- *Space Tourism & Exploration*
- *New Tech Experimentation*
- *Space Supply Chain*