INDEX MONITOR OF THE INTERNET INDUSTRY: INFLUENCE OF ARTIFICIAL INTELLIGENCE

Updated Report 2023

SEPTEMBER 2023
eco Association & Arthur D. Little have compiled an update of the study on the Internet industry in Germany for 2023-2025, with a special focus on AI

The eco / Arthur D. Little layer model for mapping the Internet industry continues to serve as the basis for the eco Index

### 1. Network, Infrastructure & Operations
- **Colocation & Housing**
- **Internet Exchanges**
- **Internet Backbone, Transit & CDN**
- **Fixed Internet Access Network**
- **Mobile Internet Access Network**
- **Satellites**

### 2. Services & Applications
- **Public IaaS**
- **Public PaaS**
- **Public SaaS**
- **Web Hosting & Domains**
- **Cybersecurity**
- **Edge / Fog computing**

### 3. Aggregation & Transactions
- **Online Advertising & Internet Presence**
- **Portals & Classified Marketplaces**
- **Billing & Payment**
- **E-Commerce B2B**
- **E-Commerce B2C**

### 4. Smart Industries & Paid Content
- **4a. Gaming & Gambling**
- **4a. Content & Streaming**
- **4b. Automotive & Mobility**
- **4b. Industrial IoT**
- **4b. Smart Buildings**
- **4b. Other Smart Industries**

*Source: Arthur D. Little & eco*
Incidents such as the Covid-19 pandemic, inflation, the Ukraine crisis and AI development have impacted the Internet industry

<table>
<thead>
<tr>
<th>Macro Factors 2020 et seq.</th>
<th>Artificial Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Covid-19 pandemic</strong></td>
<td><strong>4 Economic recovery &amp; AI developments</strong></td>
</tr>
<tr>
<td>• Covid-19 led to an upswing in TMT sector revenues, primarily due to work from home and, consequently, increased spending on TMT services by the population</td>
<td>• Recovery of German economy could begin end of 2023</td>
</tr>
<tr>
<td>• A €750 billion Covid economic stimulus package was introduced for the German economy, covering all sectors and partially financing the expansion of TMT</td>
<td>• Al take-off anticipated as governments and companies invest in advancing AI capabilities</td>
</tr>
<tr>
<td><strong>2 Inflation</strong></td>
<td>• Advanced language models that utilise artificial, neural networks for text generation (e.g. ChatGPT)</td>
</tr>
<tr>
<td>• Acceleration of total revenues across all four levels of the TMT sector, due to inflation and unit price increases</td>
<td>• Enhanced AI Regulation in the EU to ensure unified and ethical usage</td>
</tr>
<tr>
<td>• Expectation that the phase of high growth and inflation will be followed by a corrective phase in the short term</td>
<td></td>
</tr>
<tr>
<td>• The Federal Reserve increased the interest rate from ~0% to 4.75-5.50% (Q1 2022 to Q3 2023), while the EU raised interest rates from 0% to 4.50% (Q1 2022 to Q3 2023), resulting in higher borrowing costs for the TMT industry</td>
<td></td>
</tr>
<tr>
<td><strong>3 Ukraine-Russia war</strong></td>
<td>• Energy price spikes ($60/bbl $130/bbl 2021-2022) due to sanctions against Russia, which supplied 42% of European gas and 30-50% of European oil, also leading to TMT price increases</td>
</tr>
<tr>
<td>• Energy price spikes ($60/bbl $130/bbl 2021-2022) due to sanctions against Russia, which supplied 42% of European gas and 30-50% of European oil, also leading to TMT price increases</td>
<td>• Raw material and labour shortages causing delays and price increases in TMT projects</td>
</tr>
<tr>
<td>• Raw material and labour shortages causing delays and price increases in TMT projects</td>
<td></td>
</tr>
</tbody>
</table>

Source: Arthur D. Little & eco
We anticipate an advanced economic recovery, due to an atmosphere of optimism and a rise in consumer spending.

<table>
<thead>
<tr>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Q1 2023 shows higher 2022-2023 savings rates and lower expected 2024-2025 savings rates compared to Q1 2022</td>
</tr>
<tr>
<td>• Economic recovery in the Euro zone exceeds forecasts for Q1 2022, driven by the services sector</td>
</tr>
<tr>
<td>• The ifo Business Climate Index for Q1 2023 shows an increase of 8% compared to the previous year and thus an upward trend, indicating a revival of economic activity from Q3 2023 onwards</td>
</tr>
</tbody>
</table>

### Savings Rate

- % of disposable income

<table>
<thead>
<tr>
<th>Year</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td>8%</td>
<td>10%</td>
<td>12%</td>
<td>14%</td>
<td>16%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Q1 2022**

- Higher savings rate than expected in 2022-2023
- Planned savings rate in 2024-2025 lower than expected

**Observations**

- Higher savings rate than expected in 2022-2023
- Planned savings rate in 2024-2025 lower than expected

---

Source: Deutsche Bundesbank, Arthur D. Little & eco

Note: 1) The ifo Business Climate Index is based on approx. 9,000 monthly responses from the German business community. The companies are asked about their assessment of the current business situation and their expectations for the next six months; the net figures of the was calculated by getting the difference between the percentages of the responses "rather favorable" and "unfavorable."
Current forecasts predict a return to similar Internet industry growth rates of 10-11% by 2024.

Growth Rates of the German Internet Industry
% from year to year, for the 2020, 2022 and 2023 projected years

Projected years: 2020 2022 2023

- The effects of the pandemic have been greater than expected
- Internet industry returns to 10-11% growth, variances due to inflation and AI effects

Observations
- Growth rates for 2022-2023 revised downwards as inflation has lasted longer and economic recovery has been delayed until the end of 2023
- As a result of the adjustment to the new conditions, we expect a return to growth rates of 10-11% in 2024-2025, driven by a favourable business atmosphere and an expected increase in consumer spending and real wages

Source: Arthur D. Little & eco
In the short term, growth is fueled by inflation – In the medium term, we expect a higher organic growth rate of 9-11%
Based on positive signals on Germany's economic recovery and the implementation of AI, we anticipate a moderate increase in CAGR.
Adjustment of the previous forecast for 2023, based on a more conservative assessment of inflation and demand effects

1. **Network, Infrastructure & Operations**
   - 11% increase in revenue of Internet Exchanges due to a 25% increase in German data traffic in 2022
   - DE-CIX plans to expand its Internet backbone by 1,500 km in 2023, representing a 5% increase by the end of 2023

2. **Services & Applications**
   - Edge and fog computing: 35% growth expected by end of 2023
   - Moderate demand for public PaaS and SaaS due to high inflation and interest rates, as well as reduction of capital costs for own infrastructure

3. **Aggregation & Transactions**
   - Due to high interest rates, citizens will shop less online than envisaged, resulting in lower e-commerce revenues
   - Decline in e-commerce consumption will impact related areas such as payment transactions, portals and marketplaces

4. **Smart Industries & Paid Content**
   - Stronger focus on the medical & healthcare sector due to ageing population
   - High energy prices will lead to ~23% growth in smart buildings via energy-saving measures

---

**2023 Growth Forecast (Index 2022 vs Index 2023)**

- **Network, Infrastructure & Operations**: 11.3% vs 7.7%
- **Services & Applications**: 28.6% vs 22.1%
- **Aggregation & Transactions**: 16.7% vs 10.5%
- **Smart Industries & Paid Content**: 18.3% vs 19.5%

Source: Arthur D. Little & eco
Adjustment of our previous forecast for 2024-2025, given the expected recovery of the economy and the gradual adoption of AI layers

<table>
<thead>
<tr>
<th>Network, Infrastructure &amp; Operations</th>
<th>Services &amp; Applications</th>
<th>Aggregation &amp; Transactions</th>
<th>Smart Industries &amp; Paid Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main drivers: Mobile and fixed Internet access, with price increases by operators</td>
<td>Public PaaS and IaaS services poised for rapid growth (~20%) as the economy recovers</td>
<td>Forecast of an upturn from Q3 2023 onwards as growth in international trade impacts B2B e-commerce</td>
<td>Growth rate of 10-15% for paid content providers due to economic recovery</td>
</tr>
<tr>
<td>Modern mobile and digital applications require a higher level of data traffic</td>
<td>Higher deployment of AI in these tech-savvy, flexible companies</td>
<td>Growth in B2C e-commerce and marketplaces due to rising wages and household expenditure</td>
<td>Growth in smart buildings layer, as is the case in the USA</td>
</tr>
<tr>
<td>An expected incremental adoption of AI (e.g. in customer service)</td>
<td></td>
<td></td>
<td>Significant growth in AI-enabled biotech start-ups</td>
</tr>
</tbody>
</table>

2024-2025 Average Growth Forecast (Index 2022 vs Index 2023)

<table>
<thead>
<tr>
<th>Sector</th>
<th>2022 Growth</th>
<th>2023 Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network, Infrastructure &amp; Operations</td>
<td>1.0%</td>
<td>4.9%</td>
</tr>
<tr>
<td>Services &amp; Applications</td>
<td>9.1%</td>
<td>15.7%</td>
</tr>
<tr>
<td>Aggregation &amp; Transactions</td>
<td>-0.8%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Smart Industries &amp; Paid Content</td>
<td>2.6%</td>
<td>13.9%</td>
</tr>
</tbody>
</table>

Source: Arthur D. Little & eco
Small impact by AI on the Internet industry’s revenue in the short-term – we expect increased effects in the medium-, and significant growth contribution in the long-term

- Bot programs that can operate independently of humans (self-learning capability)
- Applications with the highest automation potential: process automation, virtual agents, data visualisation, recommendation systems, language analysis
- The decisive factor will be how AI can be used to automate and release capacities for value-added growth

- In Germany, AI-supported work may increase productivity annually by 0.8-1.4%
- Robot assistants serve as a means to bridge the age gap, resulting from demographic transition
- With LLMs, 15% of all work tasks could already be completed more quickly and with the same quality today; this share could grow to 56% in the future

- Rapid AI implementation ensures long-term competitiveness in international comparison and helps achieve growth targets
- AI can impact sustainability goals by focusing on sustainable data sources and infrastructures

LLM = Large Language Model
Source: ‘InData Labs Latest Development of Artificial Intelligence’ report, ‘GPTs are GPTs: An Early Look at the Labour Market Impact Potential of Large Language Models’, Arthur D. Little & eco
The development of artificial intelligence (AI) has been evolving for decades and is increasingly taking on a transformative role in a wide range of areas.

### Overview of Major AI Developments

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>Turing Test: Alan Turing devises an intelligence test for machines</td>
</tr>
<tr>
<td>1955</td>
<td>“Artificial intelligence” term defined by John McCarthy</td>
</tr>
<tr>
<td>2011</td>
<td>Convolutional neural network: Better performance than humans in a traffic sign recognition test</td>
</tr>
<tr>
<td>2011</td>
<td>Launch of Siri: Apple introduces Siri, an intelligent speech interface</td>
</tr>
<tr>
<td>2015</td>
<td>Tado Smart: Smartphone-controlled air conditioning system automatically adapts to the user</td>
</tr>
<tr>
<td>2016</td>
<td>Pinterest Lens: Visual AI search with the camera, e.g. for the recognition of products</td>
</tr>
<tr>
<td>2017</td>
<td>Cisco DNA Center: Integration of AI into network management</td>
</tr>
<tr>
<td>2018</td>
<td>Alibaba Cloud: Machine learning platform offering a wide range of AI services</td>
</tr>
<tr>
<td>2018</td>
<td>Pinterest Lens: Visual AI search with the camera, e.g. for the recognition of products</td>
</tr>
<tr>
<td>2019</td>
<td>Tado Smart: Smartphone-controlled air conditioning system automatically adapts to the user</td>
</tr>
<tr>
<td>2020</td>
<td>IBM Security QRadar 7.4: AI-powered security intelligence platform</td>
</tr>
<tr>
<td>2022</td>
<td>ChatGPT: Natural language processing tool</td>
</tr>
<tr>
<td>2023</td>
<td>ChatGPT-4: Multimodal model that accepts image and text inputs</td>
</tr>
</tbody>
</table>

### Future Outlook

- AI has reached another milestone and has already begun to significantly transform most industries.
- Public and private investment in AI will increase, in order to accelerate innovation.
- Further development of AI regulations and guidelines for the appropriate use of AI, in order to complement human intelligence and skills.
- Increased use of AI in various countries and industries.
- Defining ethics and morality in AI advancements.

Source: Arthur D. Little & eco
AI promises significant growth across all layers of the Internet industry in the short, medium and long term (1/2)

<table>
<thead>
<tr>
<th>Short term (0-2 years)</th>
<th>Medium term (2-5 years)</th>
<th>Long term (5+ years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Boost of AI-driven voice assistants like Amazon Alexa, Siri, Google Home...</td>
<td>• Performance of a medical image analysis for disease diagnosis and treatment planning</td>
<td>• Facilitation of predictive maintenance in manufacturing and healthcare</td>
</tr>
<tr>
<td>• Provision of personalised product recommendations and optimised pricing strategies</td>
<td>• Provision of AI-assisted virtual shopping assistants and upgraded product tips</td>
<td>• AI-assisted virtual try-on and augmented reality shopping experiences</td>
</tr>
<tr>
<td>• Provision of real-time threat data and security analyses</td>
<td>• Optimisation of cloud computing environments to ensure efficient use of resources</td>
<td>• Development of fully autonomous AI-driven cybersecurity systems</td>
</tr>
<tr>
<td>• Optimisation of network traffic and enhancement of network performance</td>
<td>• Network operations automation such as configuration management, device provisioning and software upgrades</td>
<td>• Development of cognitive network systems that can learn from data and make intelligent decisions</td>
</tr>
</tbody>
</table>

Source: Arthur D. Little & eco
AI promises significant growth across all layers of the Internet industry in the short, medium and long term (2/2)

1. Network, Infrastructure & Operations
   - Network optimisation
   - Network maintenance
   - Network design
   - Network traffic routing
   - Capacity planning
   - Satellite operations
   - Predictive maintenance
   - Network anomaly detection
   - Network automation
   - Service quality improvement
   - Network analysis
   - Network performance monitoring
   - Infrastructure planning
   - Disaster control

2. Services & Applications
   - Resource consumption
   - Application deployment
   - Bottleneck identification
   - Application performance
   - User experience
   - Customer support
   - Website performance
   - Website traffic
   - Security threat detection
   - User behaviour
   - Latency reduction
   - Data processing
   - Data storage
   - Cybersecurity

3. Aggregation & Transactions
   - Marketing campaigns
   - Customer selection
   - Experiential personalisation
   - Website design
   - Website content
   - Search functions
   - Discovery features
   - Content moderation
   - Fraud detection
   - Automated payment
   - Payment personalisation
   - Payment suggestions
   - Product recommendation
   - Pricing strategies

4. Smart Industries & Paid Content
   - AI game characters
   - Game design
   - Content recommendation
   - Content creation
   - Content moderation
   - Autonomous driving
   - Behaviour predictions
   - Predictive maintenance
   - Personalised driving
   - Quality control
   - Supply chain optimisation
   - Energy management
   - Facility management
   - System security

Source: Arthur D. Little & eco
Layer 1 revenue will regain the growth trajectory of ~7% in line with the general economic recovery (1/2)

**Layer 1: Network, Infrastructure, & Operations**

**EUR bn revenue 2020-25**

- Colocation & Housing
- Internet Exchanges
- Mobile Internet Access Network
- Internet Backbone, Transit & CDN
- Satellite Internet
- Fixed Internet Access Network
- 2022 Baseline (Ukraine Crisis & Inflation)

**Observations**

- Inflation has led all major German telecom providers (and others in Europe) to increase prices for fixed and mobile services by 5-10%, leading to 2-3% revenue growth in 2023 and beyond.
- Despite high energy prices, a strong demand for cloud storage and data centres persists, as digitalisation plans continue to grow, and remote work becomes more consolidated.
- AI will only have a marginal impact on telco revenue (~0.2% additional year-on-year increase), due to a reshaping of operational models to reap the benefits (better personalisation, etc.).

Source: Arthur D. Little & eco
Layer 1 revenue will regain the growth trajectory of ~7% in line with the general economic recovery (2/2)

Layer 1: Network, Infrastructure, & Operations
delta % points vs baseline (AI) growth

- Colocation & Housing
- Internet Exchanges
- Internet Backbone, Transit & CDN
- Fixed Internet Access Network
- Mobile Internet Access Network
- Satellite Internet

Observations

- In the medium term, Layer 1 revenues are expected to move towards baseline trends, as the layers represent a critical cost component for the services of Layers 2, 3 and 4; in turn, this results in a counterbalancing measure.
Data centres are steadily becoming more efficient and sustainable

**Energy Demand and Workloads of Data Centres in Europe**
2011 - 2021, European energy demand from data centres in TWh, workloads in millions

**Observations**
- The bulk of the energy in data centres is used to power the IT components. Approx. 30 per cent relates to the supply infrastructure.
- Data centres are steadily becoming more efficient. This is clearly evident in the 10-year comparison, from 2011 to 2021: **6.5-fold increase** in workloads with only a **1.5-fold increase** in energy demand.
- Newly constructed data centres will **accelerate this trend**, as they require even less energy per workload.

---

Workload: Set of computer resources required to perform a particular task, including data storage
Sustainable digitalisation: How data centre operators can fulfil their responsibility

Digital Realty Case Study: Portfolio of Sustainable Data Centres' Measures

Efficiency

- Efficiency through colocation
  e.g. high level of infrastructure utilisation

Integration of renewable energies and utilisation of waste heat

- e.g. via PPAs and the utilisation of waste heat as a source for local and district heating

Sufficiency

- Material and energy conservation
  e.g. sustainable building materials and rainwater harvesting

Continuity

- Continuity
- Integration of renewable energies and utilisation of waste heat
- Continuity

Challenges

- Data centres are an essential component of critical infrastructure
- Finding well-networked surfaces and making them quickly usable
- Finding suitable skilled workers
- Energy costs: Maintaining competitiveness and offering added value to international customers

Measures

- Waste heat utilisation
- Electricity from renewable energy sources
- Enhancement of biodiversity (species protection, new plantations)
- Measurement of the three sustainability pillars using intelligent data points, metrics and meaningful indicators
- Exchange between operators, partners, the public and policymakers
Layer 2 revenue increase forecasted due to inflation, energy prices, human resource challenges and digitalisation in the coming years (1/2)

Layer 2: Services & Applications
EUR bn revenue 2020-25

<table>
<thead>
<tr>
<th>Year</th>
<th>Public IaaS</th>
<th>Web Hosting &amp; Domains</th>
<th>Public PaaS</th>
<th>Cybersecurity</th>
<th>Public SaaS</th>
<th>Edge / Fog Computing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>14</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>2021</td>
<td>11</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>2022</td>
<td>20</td>
<td>20</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>2023</td>
<td>25</td>
<td>25</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>2024</td>
<td>29</td>
<td>29</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>2025</td>
<td>33</td>
<td>33</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>13</td>
</tr>
</tbody>
</table>

Observations

- Accelerated adoption of AI by PaaS and SaaS companies, driving medium-term and long-term revenue growth.
- Higher growth rates forecasted for 2024 and 2025 due to price increases and advancing digitalisation.
- Companies prefer public cloud services and are switching expenses from capital to operating costs.
- AI often offered in the Public PaaS, SaaS and in the cybersecurity segments.
- Long-term revenue effect expected, but no abrupt transition (e.g. not all call centre employees will be replaced by AI-based virtual agents in the short term).

Source: Arthur D. Little & eco
Layer 2 revenue increase forecasted due to inflation, energy prices, human resource challenges and digitalisation in the coming years (2/2)

Observations

- PaaS and SaaS firms are rapidly adopting AI, driven by staffing issues and margin protection, maintaining growth rates of 10-30% in the short term
- IaaS prices are rising by 15-100% due to energy costs and chip shortages (Google Storage PD Snapshot in Frankfurt experiencing a 90% price increase)
- Layer 2: Revenues are rising as cloud usage expands, with Layers 3 and 4 services relying on this
- Cybersecurity is anticipated to be a driving force in Layer 2 from mid-2023, with growth rates of up to 10%

Weak economic prospects had a negative impact

Delta Growth % vs Baseline Scenario

- Public IaaS
- Web Hosting & Domains
- Layer 2: Services & Applications vs Baseline
- Public PaaS
- Cybersecurity
- Public SaaS
- Edge / Fog Computing

Source: Arthur D. Little & eco
The data from Germany's largest Internet Exchange shows a significant increase in data traffic, which has intensified during the current crisis.

The volume of Internet data traffic is rising steadily:
- Peak (and average) Internet traffic at the DE-CIX Internet Exchange in Frankfurt is increasing at an average annual growth rate of approx. 21%.

Utilisation of secure Internet protocols is reaching new highs:
- Use of HTTPS already accounts for 89% of PC-based and 85% of mobile Internet traffic – an indicator of a major need to implement IT security on the part of the Internet infrastructure.
- Adoption of advanced TLS 1.3 encryption methods is at 66% with HTTP/2+ – 34% with HTTP/1.1.

Percentage of website tracking by third parties:

<table>
<thead>
<tr>
<th>Top 10 Third-Party Tracking</th>
<th>Traffic Share %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google analytics (site analytics)</td>
<td>65%</td>
</tr>
<tr>
<td>Google (advertising)</td>
<td>51%</td>
</tr>
<tr>
<td>Doubleclick (advertising)</td>
<td>55%</td>
</tr>
<tr>
<td>Facebook (advertising)</td>
<td>30%</td>
</tr>
<tr>
<td>Google adservices (advertising)</td>
<td>23%</td>
</tr>
<tr>
<td>Google syndication (advertising)</td>
<td>12%</td>
</tr>
<tr>
<td>Wordpress stats (site analytics)</td>
<td>6%</td>
</tr>
<tr>
<td>Twitter (social media)</td>
<td>6%</td>
</tr>
<tr>
<td>Adobe audience manager (advertising)</td>
<td>5%</td>
</tr>
<tr>
<td>Rubicon (advertising)</td>
<td>5%</td>
</tr>
</tbody>
</table>

Google dominates third-party website tracking, occupying four out of the top six positions.
- However, such dominance raises concerns about competition and privacy, as Google has been accused of anti-competitive behaviour and misuse of its access to user data.

As AI use increases, website tracking data will play an increasingly important role – usage parameters continue to trend upwards.

Source: DE-CIX, Arthur D. Little & eco
Artificial intelligence – a double-edged sword in digital threat protection: on the one hand, support for cybersecurity; on the other hand, a driver for cyber attacks in Germany

20,174 vulnerabilities in software products (13% critical), 10% more than the previous year

116.6 million new malware variants

207 days digital disaster in the Anhalt-Bitterfeld district, disrupting the provision of parental benefits, unemployment benefits and other services

• Enhanced detection and response capabilities
• Advanced threat prediction and assessment through data analysis
• Reduced workload for human analysts (currently about 80,000 positions remain unfilled)
• More accurate risk assessment by identifying vulnerabilities

20174 vulnerabilities in software products (13% critical), 10% more than the previous year

116.6 million new malware variants

207 days digital disaster in the Anhalt-Bitterfeld district, disrupting the provision of parental benefits, unemployment benefits and other services

• Increased efficiency in network scans and vulnerability tests
• Enhanced targeting through tailor-made attacks
• Greater inconspicuousness by evading hacker detection
• ChatGPT as an enabling malicious tool:
  - Improved “social engineering” through more convincing phishing emails
  - Polymorphic malware (lower detection rate)
  - Confidential information as an input (further attack surface)
  - More spreading of false information

Source: Federal Office for Information Security (BSI), Arthur D. Little & eco
Layer 3 services will regain their normal growth rate of 10%, supported by higher spending and the resumption of global trade (1/2)

Layer 3: Aggregation & Transaction
EUR bn revenue 2020-25

- Online Advertising & Internet Presence
- E-Commerce B2B
- Ports & Classified Marketplaces
- E-Commerce B2C
- Billing & Payment
- 2022 Baseline (Ukraine Crisis & Inflation)

Observations

- Layer 3 services will be more affected by inflation and macroeconomic factors than the services of Layers 1 and 2
- Inflation will have longer-lasting effects beyond 2023, although the magnitude of these effects is expected to diminish over time
- Our assumption is that advertising, portals and marketplace prices will rise in line with inflation
- Through enhanced personalisation, AI is expected to contribute an additional growth of 1-2% in online advertising, e-commerce and marketplaces
Layer 3 services will regain their normal growth rate of 10%, supported by higher spending and the resumption of global trade (2/2)

Layer 3: Aggregation & Transaction
delta % points vs baseline (AI) growth

- Online Advertising & Internet Presence
- E-Commerce B2B
- Portals & Classified Marketplaces
- E-Commerce B2C
- Billing & Payment
- Layer 3: Aggregation & Transaction vs Baseline

Observations

- Aggregate and transaction price inflation is projected to remain at lower levels (7-8% in 2023 compared to 9-11% in 2022), given that higher energy and transport costs are added to retail prices and the demand for services grows.

- A significant slowdown in inflation is forecast for 2024 (3.5%) and 2025 (2.6%) as the economy recovers and as business activities rise due to growing confidence in the future.

2022 and 2023 have produced poorer results than anticipated, as consumers and companies have curbed their spending in response to inflation.

Medium-term convergence towards the baseline as households and businesses increase their spending.
Layer 4a content services will face a strong inflation-driven increase in the short term before inflation levels off in the medium term (1/2)

Layer 4a: Paid Content
EUR bn revenue 2020-25

- Layer 4 is most heavily influenced by inflation and macroeconomic factors
- It is expected that AI will be able to analyse customer data and preferences more effectively, thereby providing improved personalised recommendations for the entire industry
- Projections for 2024 and 2025 exceed the 2022 baseline, as inflationary pressures from price increases become evident across the paid content segment (e.g. Netflix’s new price segments and price increase, and Sony’s price increase for the PS5 Digital Edition in Europe from €400 to €450)
Layer 4a content services will face a strong inflation-driven increase in the short term before inflation levels off in the medium term (2/2)

• Downward pressure due to inflation-related cost increases (not only for basic services but also for content providers), resulting in price increases, forcing customers to cut back on non-essential spending, e.g. for paid content or for subscriptions to multiple providers

• In the short term, there could be mildly positive effects from the development of AI innovations, as AI-powered systems analyse customer data more efficiently and are used to improve content recommendations, especially in sectors such as gaming, TV, video, music and radio.
Layer 4b smart industries are expected to grow due to the trend of cost saving in the short and medium term (“smartify-to-save”) (1/2)

Layer 4b: Smart Industries
EUR bn revenue 2020-25

- Layer 4 is the layer most strongly influenced by inflation and macroeconomic factors
- The rise in underlying energy prices is accelerating the shift to smart devices, especially for optimising energy consumption; industrial customers/cities/municipalities aim to make their networks smarter in order to reduce energy and raw material costs
- The expectation is that the shift towards “smart industries” will continue via AI, as AI-based systems are gaining traction and prevalence
Layer 4b smart industries are expected to grow due to the trend of cost saving in the short and medium term ("smartify-to-save") (2/2)

- Smart solution providers are shifting their revenues from one-off product sales to recurring services (e.g. €5/month for a smart thermostat that saves 30% energy).
- Furthermore, we anticipate that the EU will enact a similar incentive to the $369 billion US Inflation Reduction Act, which encourages the adoption of more sustainable building practices for energy security and climate change.
- The automotive and mobility sectors experienced a sharp increase due to inflation and raw material shortages – growth is forecast to level out in the short term.

Source: Arthur D. Little & eco
Short-term growth followed by medium-term expansion, driven by economic recovery, investments, and the implementation of AI in all industries

- In the short term (2023-2024), there will be a lower revenue than projected in the 2022 index, due to high interest rates and customers’ increased propensity to save, amid stagnating real wages.

- Little to no direct effects expected from AI in the short term, with tech-savvy and personalisation-oriented industries likely to reap greater benefits.

- In the medium term (2025), a “soft landing” is forecasted; growth at all levels driven by increased demand, inflation, real wage increases, investor interest and international trade.

- In the long term, AI will reshape the world of work in a sustainable manner and present companies with the choice to either embrace change or take the risk of falling behind.

Source: Arthur D. Little & eco, DE-CIX