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SWOT Analysis regarding Factor 5:

COLLABORATION & ENGAGEMENT

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1 Context

Factor 5, **"Collaboration & Engagement"**, examines mechanisms for coordination and alignment among European initiatives, between European and international actors, and across public-private partnerships. This factor addresses fragmentation and seeks to ensure that the computing continuum becomes a genuinely European endeavour rather than a collection of disconnected national, institutional or sectoral projects. Collaboration and engagement determine whether Europe's technological, regulatory and infrastructural components are orchestrated into coherent strategy or remain isolated efforts.

Europe has established multisectoral collaboration initiatives (Sylva, CAMARA, ApeiroRA) that bring together leading European telecommunications, technology and manufacturing companies. The IPCEI-CIS initiative, with a combined public and private investment of €2.6 billion and more than 100 industrial partners from 12 Member States, demonstrates the capacity for coordination on a continental scale. Additionally, Europe has begun developing strategic partnerships with aligned international actors, particularly Japan, where alignment on data protection, digital sovereignty and values-based governance creates potential for collaborative innovation. However, significant weaknesses persist: fragmentation among overlapping EU initiatives that duplicate efforts rather than coordinate; ineffectiveness of Digital Innovation Hubs in supporting SMEs and startups; limited participation from SMEs in large initiatives; and dependence on established US cloud contracts that lock-in public sector buyers and limit room for European alternatives.

The central challenge for collaboration is to convert Europe's numerous initiatives into coherent ecosystem where participants understand their roles, avoid duplication and coordinate toward shared objectives. This requires governance mechanisms that ensure transparency, accountability and alignment; it requires explicitly including SMEs and startups in governance, not merely as beneficiaries of projects designed by large companies; and it requires strategic partnerships with aligned international actors that create genuine reciprocity rather than one-way dependence.

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2 STRENGTHS

2.1 Multisectoral Collaboration Initiatives Demonstrating Coordination Capacity

Europe has developed multisectoral collaboration initiatives such as Sylva, CAMARA and ApeiroRA, that bring together leading European telecommunications, technology and manufacturing companies around shared objectives for digital sovereignty and secure infrastructure. These initiatives facilitate knowledge exchange, align technical strategies and establish governance models where companies with historically competitive relationships can collaborate on shared problems. The existence of these platforms demonstrates that European companies possess capacity and willingness to collaborate on strategic challenges, overcoming competitive silos that might otherwise prevent coordinated action.

These collaboration initiatives are strengths because they establish working relationships and governance mechanisms that can scale beyond individual projects. When telecommunications companies collaborate on interoperability standards through CAMARA, they create technical foundations that SMEs and startups can build upon without duplicating standards development work. When companies collaborate through Sylva on open connectivity standards, they establish trust relationships and governance practices that can be extended to other domains. For the computing continuum, these multi-sector initiatives are crucial because the continuum inherently requires coordination between telecommunications, cloud, edge, IoT and application layer companies, domains that have historically operated independently.

2.2 IPCEI-CIS as Large-Scale Coordinated Investment Model

The Important Project of Common European Interest on Cloud Infrastructure and Services (IPCEI-CIS) represents an unprecedented scale of coordinated European investment: €2.6 billion in combined public (€1.2 billion) and private (€1.4 billion) investment across over 100 industrial partners from 12 Member States. This scale of coordination demonstrates that European actors can overcome fragmentation and align around shared objectives when institutional mechanisms (IPCEI structure) and political commitment (Member State support) enable it.

IPCEI-CIS is particularly significant because it explicitly aims at creating alternatives to non-European cloud providers while maintaining interoperability standards that prevent vendor lock-in. By pooling resources at IPCEI scale, European companies achieve investment levels that no individual company or Member State could justify independently. The initiative creates common infrastructure, shared standards and collaborative governance that benefit the entire European ecosystem. Additionally, IPCEI-CIS demonstrates viability of the IPCEI model for computing continuum: the success of IPCEI-CIS has already prompted planning for additional IPCEIs in AI and cloud infrastructure, extending the model to adjacent domains.

2.3 Federated Service Model Demonstrated by International Partners

Japan's approach to providing telecommunications and infrastructure services demonstrates the viability of federated service models, in which multiple independent providers operate under common standards and governance frameworks to compete while maintaining interoperability. This model proves that "natural monopoly" arguments used to justify consolidation can be overcome through federated governance that enables competition while preventing fragmentation.

This international example is relevant to the computing continuum because Europe is pursuing similar federated approaches (Gaia-X) but lacks operational precedents at large scale. Japanese experience provides proof of concept that federated models can function in practice, maintain service quality and foster innovation despite apparent advantages of unified provision. By studying Japanese federated infrastructure approaches, European policymakers and companies can accelerate learning about governance mechanisms, competitive dynamics and risk mitigation strategies appropriate for federated continuum infrastructure.

2.4 Aligned International Partnership with Japan on Digital Governance

Japan's alignment with European digital policy, particularly on data protection, digital sovereignty and values-based governance, creates opportunity for genuine strategic partnership. Japan's influential industrial association (Keidanren) often aligns more closely with EU digital policy than with US policy; Japan has adopted data protection frameworks similar to GDPR; and Japan faces similar strategic autonomy challenges relative to US technology dominance. This alignment suggests potential for deep partnership on continuum governance rather than superficial collaboration.

The EU-Japan Digital Partnership provides institutional framework for this collaboration. Additionally, Japan's strengths in automotive and industrial sectors align with European strengths, creating potential for joint solutions addressing Industry 4.0, edge intelligence and distributed manufacturing. Most importantly, Japan's independence from US technology ecosystems and commitment to alternative technology pathways creates possibilities for joint development of continuum technologies that neither Europe nor Japan could develop independently but together could create. This is particularly significant for areas like open hardware, federated governance models and values-based AI development.

2.5 Japanese Government and Industry Openness to Interoperability

Recent developments in Japan, including the IT Promotion Agency's (IPA) development of its Edge/IoT strategy and Fujitsu's success in securing major government cloud contracts in competition with US providers, demonstrate the Japanese government's openness to supporting local alternatives to dominant US providers. This openness creates opportunity for EU-Japan collaboration where both regions pursue alternatives to US technology dominance through mutually beneficial technological partnerships.

This openness is significant because it indicates that Japan is not content with accepting US technology dominance and is actively seeking alternatives. When combined with European commitment to digital sovereignty, this creates potential for genuine "coopetition" where European and Japanese actors collaborate on continuum technologies that serve both regions' interests in maintaining technological alternatives to dominant global providers. Such collaboration could address specific domains (edge computing, IoT connectivity, AI processing) where neither region has achieved parity with US dominance but together could establish credible alternatives.

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2.6 EU-Japan Digital Partnership as Strategic Foundation

The EU-Japan Digital Partnership provides institutional foundation for advocating pooled digital sovereignty and market interoperability. This partnership has established working relationships, shared objectives on data protection and digital governance, and mechanisms for discussing technology policy. Building on this foundation, the partnership can become vehicle for advancing computing continuum collaboration that serves both regions' interests in achieving technological autonomy while maintaining alignment on values-based governance.

This partnership is a strength because it provides existing institutional mechanism to formalise continuum collaboration without requiring entirely new governance structures. By explicitly expanding the partnership to address computing continuum development, Europe and Japan can coordinate investments, align technical standards and create market opportunities for both regions' companies. For SMEs and startups, EU-Japan partnership coordination creates larger addressable markets and access to complementary technologies without requiring them to navigate complex international partnerships independently.

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3 WEAKNESSES

3.1 Ineffectiveness of Digital Innovation Hubs in Supporting SMEs and Startups

Digital Innovation Hubs (DIHs) were established to facilitate innovation adoption and digital transformation support for SMEs. However, their effectiveness has been limited: DIHs have not achieved intended outreach to SMEs; their impact on actual business transformation remains modest; and they struggle to attract SMEs and startups to participation. DIHs remain primarily oriented towards universities and large companies rather than serving their main intended beneficiaries: SMEs and startups seeking to understand and adopt digital technologies.

This weakness undermines Europe's capacity to democratise access to continuum technologies. If DIHs were effective, they could serve as local touch points where SMEs could access support in adopting continuum infrastructure, understanding compliance requirements and transitioning business models to continuum capabilities. Without effective DIHs, SMEs lack local support infrastructure and must navigate adoption alone or rely on large vendor support (often hyperscalers). This perpetuates the pattern where large companies advance while SMEs remain stuck in legacy computing models or forced into hyperscaler dependence.

3.2 Large Initiatives Attracting Large Companies and Universities Rather Than SMEs

Major European initiatives (Gaia-X, IPCEI-CIS, Horizon Europe projects) primarily attract large companies and research universities, not SMEs and startups. This reflects structural features: large initiatives require significant administrative capability to participate; funding mechanisms favour established organisations with grant writing infrastructure; governance structures are designed by large companies for large company participation; and startup voices are marginalised in decision-making.

This weakness is particularly problematic because SMEs and startups are crucial for innovation and ecosystem diversity. When large initiatives exclude SMEs, the result is that European computing continuum development becomes a project of large incumbents rather than emerging innovators. This risks creating continuum solutions that serve large companies' needs while marginalising use cases and applications important to SMEs. Furthermore, the lack of SME participation in large-scale initiatives means that they do not develop the relationships, understanding and advocacy skills necessary to influence subsequent initiatives, thereby perpetuating their marginalisation.

3.3 Fragmentation and Lack of Coordination Among Overlapping Initiatives

Multiple European initiatives address overlapping continuum domains - Gaia-X, IDSA, DOME, SIMPL, IPCEI - but they do not communicate effectively or coordinate their objectives. This fragmentation results in duplicated work, incompatible technical standards, competing for limited funding and participant attention, and absence of coherent ecosystem strategy. Individual initiatives pursue their own agendas rather than aligning toward shared continental objectives.

This fragmentation is a critical weakness because it creates confusion for potential participants (which initiative should I join?), undermines credibility with external actors (how can Europe coordinate if Europeans cannot coordinate among themselves?) and dissipates resources across parallel rather than complementary efforts. For companies trying to engage with European continuum initiatives, fragmentation creates burden: participating in multiple initiatives simultaneously is costly; choosing among initiatives creates risk of backing the wrong initiative. This fragmentation is particularly damaging for SMEs who lack resources to monitor and participate in multiple initiatives.

3.4 Lock-in from Existing US Cloud Contracts in Public Sector

Long-term public sector cloud contracts with US providers (AWS, Azure, Google Cloud) create lock-in that prevents public sector transition to European alternatives. These contracts, backed by substantial financial resources and often including multiple services integrated into public sector operations, create dependencies that extend over years or decades. Public procurement budgets committed to existing US contracts are unavailable for European providers, reducing demand signals that would incentivize European provider development.

This lock-in is consequential because public sector procurement is typically large and stable, enabling infrastructure providers to justify sustained investment. When public budgets are captured by US providers through long-term contracts, European providers lack the demand visibility necessary to justify investment in competing services. Additionally, lock-in prevents experimentation: public sector organisations bound by existing contracts cannot easily shift portions of their workload to European alternatives even if those alternatives become available. Breaking this lock-in requires explicit policy action (e.g., procurement rules favouring European providers or contract restructuring incentives).

3.5 Low Japanese Participation in Open-Source Software Development

Japanese participation in Free/Libre and Open-Source Software (FLOSS) projects is notably lower than European or US participation. Additionally, Japanese government support for FLOSS infrastructure development may be insufficient relative to support for proprietary software and commercial technologies. This low participation limits collaborative innovation with Japan on open-source foundations that are increasingly central to the computing continuum.

This weakness affects EU-Japan collaboration because open-source development and maintenance is central to European computing continuum strategy. If Japanese actors do not develop significant expertise and engagement with open source, their ability to contribute to collaborative open-source continuum projects is limited. This creates asymmetry where Europe invests heavily in open-source development but lacks equal Japanese participation to distribute maintenance burdens and share responsibility for critical infrastructure. Addressing this weakness requires not only Japanese policy support for open source but also cultural shifts in Japanese industry toward viewing open source as strategic.

3.6 Weak Capital Markets in Europe Limiting SME Scaling

Europe's capital markets remain insufficient to support SME development at the scale necessary for European companies to compete globally. Venture capital investment is available but in smaller amounts than in US markets; growth-stage funding is harder to access; and private equity is more conservative about supporting high-risk technology ventures.

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Without adequate capital market support, European SMEs cannot scale to the size necessary to compete with larger non-European competitors or to absorb the investment necessary for continuum technology development.

This structural weakness constrains Europe's ability to develop an ecosystem of medium-sized technology companies that could serve as alternatives to dominant hyperscalers or specialists in niche continuum domains. Instead, European SMEs either remain small specialists or sell to larger non-European acquirers. This creates a gap in the European technology ecosystem: too large to remain startup but without sufficient capital to achieve global scale. For computing continuum development, the absence of this missing middle means that European infrastructure and services are provided either by large multinational companies (often non-European) or fragmented small companies without resources for quality, reliability and scale.

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4 OPPORTUNITIES

4.1 Japan's Association with Horizon Europe

An opportunity exists for Japan to formally associate with Horizon Europe, the EU's primary research and innovation funding programme. Japanese association would enable Japanese researchers and companies to participate in Horizon Europe projects, creating collaborative R&D partnerships and shared access to European research infrastructure. This would create evaluable partnerships in research, innovation and technology, as well as enhanced market access within Europe.

This opportunity is significant because it would formalise EU-Japan collaboration on continuum technologies at research and innovation level. Japanese participation in Horizon Europe would bring additional funding, diverse research perspectives and Japanese technology expertise to European continuum research. Additionally, Japanese companies participating in Horizon Europe projects would develop relationships with European partners and gain market knowledge enabling easier transition to European market deployment.

4.2 EU-Japan Cooperation on Data-Driven Society Standards and Platforms

Cooperation between Europe and Japan on data-driven society standards and platforms, particularly collaboration between Gaia-X (European data infrastructure initiative) and DATA-EX (Japanese data ecosystem initiative), could generate synergies developing a sovereign and secure data ecosystem serving both regions. Rather than each region developing isolated data platforms, collaboration could create interoperable frameworks enabling data flows between regions while maintaining sovereignty and protection.

This opportunity addresses a key computing continuum challenge: how to enable data sharing across regions and organisations while maintaining data protection and sovereignty. European and Japanese collaboration on this problem could produce solutions with broader applicability, potentially becoming standards adopted internationally. For companies in both regions, interoperability between Gaia-X and DATA-EX would enable them to serve customers across both regions without duplicating platform development.

4.3 Strengthening Collaboration with Japan, South Korea and Extending to Like-Minded Partners

An opportunity exists to systematically strengthen collaboration with Japan and South Korea (countries with demonstrated commitment to technology sovereignty and values-based governance) and extend collaboration to other like-minded countries (Canada, New Zealand, Australia, potentially others). Rather than viewing international collaboration narrowly, Europe can build broader coalitions of countries committed to alternative technology pathways and digital values alignment.

This opportunity addresses the challenge that Europe alone cannot achieve technology scale comparable to US or China. However, coalitions of countries with shared values and complementary capabilities could collectively develop technologies serving substantially larger markets. Such coalitions could coordinate standards, share infrastructure investments and collectively negotiate with dominant global technology providers from position of greater strength. For the computing continuum, a Europe-Japan-Korea-Canada-New Zealand coalition would represent substantial technical capability, large combined markets and shared commitment to values-based digital governance.

4.4 Coordinating Technical Standards at the EU Level for Edge, IoT and APIs

An opportunity exists to deliberately coordinate technical standards at EU level, particularly for network APIs, edge computing interfaces and IoT deployment. This coordination would establish common reference frameworks and promote convergence around open, interoperable standards. Clear European standards would reduce fragmentation, lower integration costs for developers, facilitate scaling across borders and strengthen Europe's influence in international standard-setting bodies.

This opportunity directly addresses fragmentation among initiatives by providing common technical foundation that multiple initiatives can build upon rather than creating competing technical frameworks. When standards are clear and coordinated at EU level, smaller initiatives can focus on application layers rather than reinventing foundational standards. For the computing continuum specifically, coherent technical standards are essential to avoiding fragmentation into incompatible regional systems.

4.5 Leveraging Japan's Edge/IoT Strategy Development

The IT Promotion Agency (IPA) in Japan is beginning to develop an Edge/IoT strategy, creating opportunity for EU-Japan collaboration on Edge/IoT development and deployment. Japanese interest in NexusForum.EU and European continuum initiatives indicates openness to collaboration. By explicitly engaging Japanese strategy development, Europe can influence Japanese commitment to interoperability and values-based governance in edge/IoT domains.

This opportunity is significant because edge and IoT are foundational to the computing continuum, and Japanese advances in manufacturing, automotive and industrial IoT could complement European capabilities. Joint EU-Japan Edge/IoT strategy could accelerate deployment of both regions' capabilities while establishing coordinated approaches to interoperability and governance.

4.6 Leveraging Market Dynamics to Promote Interoperability and Reduce US Dependence

Fujitsu's success in securing major Japanese government cloud contracts in competition with US providers indicates that Japanese government is willing to support alternative providers. This market signal can be leveraged to promote broader interoperability and reduce dependence on dominant US providers. By coordinating EU and Japanese procurement policies to favour providers demonstrating interoperability and values alignment, both regions can create market incentives for providers to invest in cross-regional compatibility and shared standards.

This opportunity uses market mechanisms to achieve policy objectives: rather than imposing technical mandates, creating procurement preferences for interoperable solutions incentivizes providers to develop solutions serving multiple regions. For companies, demonstrating interoperability across EU and Japanese infrastructure becomes market advantage. For both regions, coordinated procurement policies multiply the market available to alternative providers, justifying greater investment.

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4.7 Using Industry Advocacy to Advance Interoperability and Prevent Dominant Market Abuse

There is an opportunity to leverage the influence of the rest of the economy. mobilising SMEs, mid-market companies, the public sector and industry associations across diverse sectors, to push for interoperability and portability requirements that prevent market abuse by dominant technology providers. When diverse industry voices collectively advocate for interoperability, they create political pressure that single companies or small coalitions cannot generate independently.

This opportunity harnesses the natural interests of diverse economic actors in preventing lock-in and maintaining competition. By facilitating coordination among these actors and amplifying their voices, Europe can create political environment where interoperability becomes expected rather than exceptional. This approach is less confrontational than direct regulation and leverages market participants' own interests rather than relying on regulatory mandates.

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5 THREATS

5.1 Global Competition Without Replicating US or China Dominance

A fundamental threat exists that Europe cannot create computing continuum capabilities competitive with US and China while maintaining democratic governance, rule of law and values-based regulation. Creating innovation ecosystems comparable to US tech hubs requires accepting certain dysfunctions (regulatory arbitrage, tax avoidance, monopolistic concentration) that Europe explicitly rejects. Creating state-level coordination comparable to China requires state direction of private investment and reduced political pluralism that Europe values. This creates a genuine strategic dilemma: Europe cannot compete by copying US or China models without abandoning values that define Europe.

This threat is not easily solved through conventional policy. It requires finding innovations in governance, economics and organisation that create competitive capability without compromising European values. In principle, this is possible, but it requires sustained creativity and a willingness to experiment with novel institutional forms, posing a challenge in European politics which is oriented towards consensus.

5.2 Dependence on Non-European Technologies if European Alternatives Are Not Developed and Maintained

Despite European efforts to develop continuum alternatives (Gaia-X, IPCEI-CIS, open-source initiatives), significant risk exists that these initiatives will not achieve sufficient maturity, adoption and competitive capability to constitute true alternatives to non-European technologies. If European initiatives remain niche while non-European dominance consolidates, Europe will be immersed in continuum alternatives that will never reach critical mass, while dependence on non-European technologies will increase.

This threat reflects the fact that developing technology alternatives requires not only initial research and development but sustained maintenance, continuous innovation and market adoption. Early success does not guarantee long-term viability. Without sustained political commitment and public investment, European initiatives can stall, decline or fragment, leaving Europe technically further behind than before initiatives began.

5.3 Japanese Isolationism and "Not Invented Here" Attitudes Hindering Collaboration

Japan's historical tendency toward isolationism and preference for domestically developed solutions can hinder international collaboration necessary for EU-Japan partnership. Japanese companies may be reluctant to integrate with European technologies; Japanese government may prefer domestic solutions; and Japanese research communities may see collaboration as diluting intellectual property advantages. Overcoming these attitudes requires not only policy-level agreements but cultural shifts in Japanese industry and government toward viewing international collaboration as strategic advantage rather than threat.

This threat reflects genuine cultural and institutional differences between Europe and Japan that cannot be overcome through policy alone. Addressing this threat requires long-term relationship building, demonstrated mutual benefits and explicit management of intellectual property and credit attribution concerns.

5.4 Competing with Free or Low-Cost Entry-Level Solutions

A significant threat exists that emerging technologies and solutions, whether developed in other regions by dominant global providers offering loss-leader pricing or by innovative startups in less-regulated jurisdictions, will undermine European alternatives at entry level. Customers evaluating computing continuum solutions often choose based on immediate cost rather than long-term considerations like vendor independence or data control. This cost-based competition threatens European alternatives that must sustain long-term maintenance and support.

This threat requires addressing not only through superior quality or capabilities but through customer education and value proposition communication. Customers must understand that data control, interoperability and vendor independence have economic value, not merely compliance or values-based value. This is a market development challenge requiring sustained messaging and customer engagement.

5.5 Market Dominance by Hyperscalers Extending to Edge and IoT Domains

A critical threat exists that existing cloud hyperscalers will extend their dominance into edge computing and IoT domains, leveraging their existing customer relationships, financial resources and integrated service capabilities. Hyperscalers have demonstrated capability to suppress or integrate competing services; they can offer edge and IoT services integrated with their existing cloud platforms, creating advantage over standalone European competitors. If hyperscalers achieve dominance in edge and IoT before European alternatives mature, European alternatives may never achieve critical mass.

This threat is urgent because the computing continuum depends on integrated edge, cloud and IoT capabilities. If hyperscalers control the integration layer, they effectively control the continuum despite fragmentation at individual component level. Addressing this threat requires ensuring European alternatives achieve sufficient functionality and market adoption before hyperscaler dominance becomes insurmountable.

5.6 CRA Liability Concerns Chilling FLOSS Development

The Cyber Resilience Act's provisions create concerns among FLOSS developers and organisations about potential liability if their software is used in critical infrastructure and subsequently found to have security vulnerabilities. This liability uncertainty is chilling investment in open-source development: developers and organisations are reducing participation in critical projects, some are ceasing maintenance, and NPOs and public sector organisations are becoming cautious about FLOSS adoption. This dynamic directly undermines the open-source foundation that European computing continuum strategy depends upon.

This threat reflects regulatory design that had unintended consequences. The CRA was intended to improve cybersecurity, but its application to open source created perverse incentives that reduce security-critical infrastructure vitality. Addressing this threat requires regulatory refinement to clarify FLOSS liability frameworks and provide safe harbours for good-faith open-source development.

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6 Synthesis

Factor 5, "**Collaboration and Engagement"**, characterises a landscape where Europe possesses institutional capacity for large-scale coordination (demonstrated by IPCEI-CIS and multisectoral initiatives), emerging strategic partnerships with aligned international actors (Japan, potentially others) and mechanisms for continent-level collaboration. However, significant weaknesses persist: fragmentation among overlapping initiatives that fail to coordinate, ineffectiveness of support mechanisms for SMEs and startups, lock-in from existing non-European cloud contracts and insufficient capital markets to support SME scaling. Additionally, efforts to build European alternatives to dominant technology providers occur in context of global competition that favours consolidation over fragmentation and of geopolitical uncertainty.

Concrete opportunities exist to deepen international partnerships (Japan association with Horizon Europe, EU-Japan standards collaboration, broader coalitions with like-minded countries), to improve internal European coordination (clarifying standards, strengthening SME inclusion), and to leverage market dynamics and industry advocacy to advance interoperability. Threats, including hyperscaler dominance extension into edge/IoT, regulatory chilling effects on open source and inability to compete without compromising European values, underscore the need for sustained, coordinated strategy that sustains political will over years despite geopolitical uncertainties.

The central strategic question for Factor 5 is whether Europe can create collaboration mechanisms and international partnerships sufficiently robust to maintain momentum toward alternative technologies despite external pressures toward consolidation and dominance, while maintaining European values-based governance and democratic pluralism. This requires both external partnerships with like-minded actors and internal coordination that overcomes European fragmentation, a dual challenge requiring sustained political commitment.

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