



Project “New innovation models in Switzerland”
Sector brief: Information & Communication Technologies (ICT)

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Executive summary

This sector brief analyses how data, digitalisation, sustainability, regulation and collaboration shape innovation activities in the Swiss information and communication technologies (ICT) sector. It combines insights from a literature review with original empirical evidence from a sector-specific survey of Swiss ICT firms and two rounds of Delphi interviews with company representatives and experts. The results highlight both strong innovation capabilities within parts of the sector and structural bottlenecks that risk weakening Switzerland's innovation performance in ICT.

Literature review

The literature identifies ICT as a general-purpose technology that both enables innovation in other industries and undergoes continuous innovation itself. Data and digitalisation play a central role in this process. Big data analytics, artificial intelligence (AI), cloud computing (SaaS, PaaS, CaaS), digital twins and, to a lesser extent, blockchain and distributed ledger technologies form a mutually reinforcing technology bundle that reshapes innovation processes, business models and collaboration patterns.

Empirical research shows that data-driven innovation improves innovation performance through faster learning, predictive modelling, and closer alignment with customer needs. However, benefits are highly conditional on complementary capabilities such as data governance, skills, organisational routines and access to cloud infrastructure. AI acts as an innovation amplifier, enabling automation, optimisation and new digital services, but also raises governance challenges related to regulation, skills and dependency on global technology providers.

Sustainability-oriented innovation is increasingly shaped by regulation rather than intrinsic motivation, with a focus on energy efficiency, product longevity and circularity. Regulation has ambivalent effects: it can stimulate incremental and compliance-driven innovation, but also raises costs, uncertainty and entry barriers, particularly for SMEs. Collaboration – especially with universities, applied research institutions and industry partners – is consistently identified as a key driver of innovation in ICT ecosystems.

Survey Results

The sector-specific survey of Swiss ICT companies reveals a generally high level of innovation activity, with marked differences across segments (hardware, software, telecommunications, other IT). The survey results cannot be generalized to the Swiss ICT sector as a whole, as the responses overrepresent innovative companies.

Innovation outputs and R&D. Product innovation is more common in the dataset than process innovation across all ICT segments, and incremental innovations dominate over radical ones. Hardware companies stand out with very high engagement in R&D: over 80% conduct in-house R&D and nearly half contract out R&D, making them the most R&D-intensive segment. Software firms also show strong R&D engagement, though at a lower level, while telecommunications and other IT firms rely more on external R&D and show weaker internal R&D capacities. Correspondingly, hardware and software firms have the highest shares of R&D-based innovators, whereas telecommunications and especially other IT firms show higher shares of non-innovators.

Public innovation support. Overall use of public innovation support in ICT is moderate. Innosuisse is the main funding source, but its use varies strongly by segment. Hardware companies benefit most from public support, also from sources beyond Innosuisse. Software and other IT firms are close to the ICT average, while telecommunications firms report virtually no use of public innovation funding, indicating potential misalignment between funding instruments and sector needs.

Technology, market and customer dynamics. Technological change is perceived as the most important driver of innovation across all ICT segments. Software and hardware firms also

perceive strong customer-related dynamics but relatively lower competitive pressure, suggesting room for differentiation through innovation. Telecommunications and other IT firms show weaker and more heterogeneous perceptions of these dynamics.

Digital technologies. Service-based business models (SaaS, PaaS, CaaS) are seen as the most important digital innovation enabler by software, telecom and other IT firms, followed by AI and increased hardware performance. Hardware firms prioritise performance improvements first, then AI and service models. Big data is particularly important for software firms, while blockchain is relevant for a smaller subset of software firms as well.

Sustainability and regulation. Environmental sustainability dominates sustainability innovation across all segments, with hardware and telecom firms most active. Sustainability innovations are mainly incremental and focus on product redesign, lifecycle extension and efficiency gains. Regulation is perceived as highly influential but uneven in its effects: data protection dominates for software and other IT, product and process regulation for hardware, and market-related regulation for telecom. Many firms report higher costs, skill requirements and uncertainty due to regulation, with particularly strong negative effects perceived in telecommunications.

Collaboration. Innovation collaboration is most frequent in hardware and software, less so in telecom and other IT. Established firms are the most important partners across all segments, while academic partners are especially important for hardware and software. Other IT firms show the weakest collaboration patterns, reflecting lower absorptive capacity (internal R&D activities).

Delphi Interviews

The Delphi interviews deepen and contextualise the survey findings. Experts describe growing global competitive pressure and increasing dependence on US and Asian technologies, combined with relatively risk-averse behaviour and weak innovation demand – especially from the public sector – in Switzerland and Europe.

Digitalisation and AI are unanimously seen as indispensable for innovation and productivity, enabling faster prototyping, experimentation and new business models. However, regulatory uncertainty, hyperscaler (Google, Amazon, Microsoft) dominance and institutional inertia limit adoption. Barriers are often organisational and cultural rather than technological.

Sustainability is viewed mainly as a regulatory issue rather than a core innovation driver. While energy use of data centres and AI is recognised as problematic, sustainability currently affects innovation mostly indirectly through efficiency requirements and compliance.

Regulation is criticised as fragmented, slow and overly complex, particularly due to federalism and administrative burdens. SMEs are disproportionately affected. While regulation can provide planning security, it often shifts innovation towards incremental, compliance-oriented activities.

Collaboration and policy instruments. Universities of applied sciences are valued as pragmatic partners, and Innosuisse is regarded as important but overly bureaucratic and insufficiently aligned with business innovation and market entry, particularly in AI. In the second Delphi round, experts converged on four priorities: strengthening collaboration ecosystems, simplifying innovation financing, improving skills and talent development, and making regulation more innovation-friendly through harmonisation, faster procedures and process-based approaches.

Overall, the combined evidence shows a highly innovative ICT sector with strong technological opportunities, but also clear segment-specific weaknesses and systemic barriers.

1 Introduction

In autumn 2022, the State Secretariat for Education, Research and Innovation SERI commissioned a study to explore the decline in R&D-performing companies and trends in the innovation activity of Swiss companies by means of six hearings with representatives from industry sectors. This study revealed several factors that pose major challenges to companies' innovation activities (Barjak et al., 2023). These include, above all:

1. Growing centricity of consumers and generally clients in processes of innovation,
2. Widespread digitalisation of innovative products and services,
3. Marked demands for considering sustainability in innovation projects,
4. Increasing influence of regulations,
5. Transformation of the competitive environment (e.g., geographically, new entrants from technology industries, disruptive start-ups, etc.).

Most importantly the first study made clear that the conditions and contexts of innovation are to some degree sector-specific, and that a “one-size-fits-all” approach is neither suitable to understanding corporate innovation activities nor from a policy perspective appropriate to support them. Following this preliminary study, the National Council’s Committee for Science, Education and Culture submitted postulate 24.3009 ‘Declining innovation activities of Swiss companies. Identify the causes and remove the obstacles’, which was accepted by the National Council on 30.05.2024. The Federal Council was instructed by this postulate to analyse in detail the causes of the decline in innovation activities by companies in Switzerland and to provide answers as to how the obstacles in the innovation process can be removed.

SERI commissioned this research project to inform the Federal Council’s reply to this postulate. The project is dedicated to new sectoral innovation models and their consequences for innovation policies. Against this background, four key areas of adjustment were defined to better understand the new innovation models, identify potential weaknesses in the current (regulatory) policy framework and, if necessary, propose recommendations for Swiss innovation policy: 1) Data-related practices and needs in corporate innovation activities, 2) sustainability-related innovation activities and drivers and bottlenecks of such innovations, 3) collaboration practices and needs, and 4) regulations. The project has addressed these four themes and analysed the current situation and recent changes in six selected sectors. It thus enables in-depth and more specific analyses that are not possible on the basis of innovation surveys of the entire Swiss economy. The selected sectors are: 1) Medical technologies (ICT), 2) finance (banking, insurance, & fintech), 3) pharmaceuticals, 4) information and communication technologies, 5) MEM (metals, electronics & machine industries), and 6) food and beverages.

This sector brief is part of the larger project.¹ It presents the findings of the project for the information and communication technologies (ICT) sector, differentiating the survey data further for three segments and summarising the results of the Delphi interviews conducted with companies and industry experts.

2 Literature review

The information and communication technology (ICT) sector plays a central role in contemporary economic development while simultaneously contributing to significant environmental and social challenges. Rising energy consumption of data centers, rapid hardware obsolescence, and complex global supply chains have intensified concerns about the sustainability

¹ Barjak, F., Heimsch, F., Cornet, B., Foray, D., Wörter, M. & Schenckery, A. (2026). *New innovation models in Switzerland. Report on behalf of the Swiss State Secretariat for Education, Research and Innovation (SERI)*.

of ICT activities. At the same time, innovation in the ICT sector is increasingly characterized by collaboration across organizational and geographical boundaries. Against this background, this literature review synthesizes existing research on four interrelated themes:

- (1) regulation and standards,
- (2) sustainability-oriented innovation in the ICT sector and
- (3) data and digital innovation in the ICT sector
- (4) innovation collaboration and ecosystems in ICT.

The review integrates insights from academic literature and industry reports to provide a structured overview of drivers, processes, and impacts.

2.1 Innovation in the ICT sector

ICT are closely linked to many of the changes which other industries currently experience as they constitute general-purpose technologies (Bresnahan & Trajtenberg, 1995) which are widely used in many sectors (Heo & Lee, 2019): ICT provides the hard- and software that is necessary for digitalising products and processes, for collecting, processing, sharing, and analysing data, and much more. ICT companies have the skills and technologies for innovative digital offerings in financial markets, healthcare markets and energy markets among others.

However, ICT not only drives and enables innovation in other industries, but it is also the subject of constant innovation itself. For instance, two widely discussed topics that require innovation are a) cybersecurity and achieving resilience to cyberattacks and b) the sustainability of ICT products and services in terms of the materials used and energy requirements (Perrelet, Spizzo, & Dibbern, 2023; Thomson, 2023).

The results of the Swiss Software Industry Surveys (SSIS) suggest that at least in parts of the ICT industry the context of innovation is challenging – according to the latest and previous SSIS reports, R&D investments in software companies fell from more than 14% of total revenue in 2014 to merely 3.4% in 2021 and then rebounded to 4.4% in 2023 (Perrelet et al., 2023, 2024; Huber, Hurni, & Dibbern, 2015). This is even the more concerning as international studies have found that R&D correlates with high ICT invention rates (Lee et al., 2016). Further antecedents of ICT patents in this study were: income, broadband infrastructure, openness to international trade and education.

2.2 Regulation and innovation in the ICT sector

Regulatory instruments

Regulation influences innovation in the ICT sector through several interacting channels: (a) direct compliance costs (administrative, technical redesign); (b) appropriability and incentives (IP, competition law, ex-ante rules like the EU Digital Markets Act (DMA) that change market structure and rival incentives); (c) standards and interoperability (which can lower entry costs or raise compliance barriers); (d) data access and governance (privacy, data-sharing obligations or prohibitions); and (e) market structure effects produced by competition and sectoral regulators (e.g., telecoms regulators setting access obligations). Swiss companies are affected by the rules of the Swiss market and, if they are active in the EU, by the rules there. For this reason, the following discussion primarily refers to these two jurisdictions. The most important regulations include:

1. Regulations which establish requirements for placing ICT products on the markets, e.g. the Radio Equipment Directive (RED, on radio spectrum and essential requirements including new cybersecurity provisions)², or product/market rules such as CE marking,
2. Ex-ante competition/market-access rules, such as the EU Digital Markets Act (DMA) for platform gatekeepers, the EU European Electronic Communications Code (EECC) (and national transpositions) and Switzerland's OFCOM/ComCom regulations on access, spectrum, net neutrality, and market remedies for telecommunications,
3. Data protection laws and ordinances (GDPR in EU; revised Swiss FADP) which place constraints on personal data processing, profiling, tracking, and obligations,
4. Intellectual property and competition rules governing copyright, software patents (varies by jurisdiction),
5. AI-related legislation, such as the 2024 EU AI Act,
6. Environmental regulations referring to the restriction of hazardous substances (RoHS), and waste electrical and electronic equipment (WEEE). These regulations set safety, environmental, and increasingly cybersecurity and interoperability requirements for devices.

Effects on innovation

Hardware-related regulation affects device design and compliance costs – e.g. environmental (RoHS, WEEE) and security requirements impose direct design and lifecycle costs on manufacturers, which can be particularly burdensome for SMEs; yet they can also spur eco-design and sustainability innovations advancing circularity (recyclable materials, modular designs). Empirical case studies have shown that both, compliance burden and product redesign, drive incremental eco-innovation (Bogaert et al., 2008). Recent Radio Equipment Directive (RED) revisions, for instance, increasingly require cybersecurity measures for networked radio equipment,³ potentially raising development costs but also generating demand for secure hardware and firmware innovation in IoT.

Ex-ante competition rules (e.g., the EU Digital Markets Act)⁴ and enforcement actions can reshape incentives at the platform level – opening markets for challengers but also imposing costly compliance burdens on incumbents and ecosystems that may affect product roadmaps.

EU product and spectrum rules can foster common technical standards which are positive for scale and interoperability, but also create front-loading costs for firms to certify and test devices before market entry. Empirical studies have found that voluntary and consensus-driven standards create more benefits and less costs for innovation in highly dynamic and uncertain markets than mandatory regulation (Blind et al., 2017) – in markets with low uncertainty it is vice versa.

Different studies explored the impact of the EU General Data Protection Regulation (GDPR). Restrictions on data processing (consent requirements, purpose limitation) influence product development and service offers. For instance, they change what datasets are available for training Large Language Models. Studies show GDPR led firms to restructure data policies and often reduced access to granular tracking data, with measurable declines in some types of digital product experimentation (e.g., ad tech/startups), while prompting more privacy-preserving techniques (differential privacy, synthetic data) (Blind et al., 2024; Johnson, 2022).

² Radio Equipment Directive (RED). https://single-market-economy.ec.europa.eu/sectors/electrical-and-electronic-engineering-industries-eei/radio-equipment-directive-red_en

³ https://single-market-economy.ec.europa.eu/sectors/electrical-and-electronic-engineering-industries-eei/radio-equipment-directive-red_en

⁴ Digital Markets Act (DMA). https://digital-markets-act.ec.europa.eu/index_en

Data-protection rules may constrain the scope or radicalness of innovation but can also stimulate incremental adaptations, re-organisation, and market opportunities created by clearer rules (Blind et al., 2024; Johnson, 2022). This implies a shift from radical to incremental innovation and increase of compliance-driven innovation (e.g., improved privacy engineering), while also reducing some venture activity in data-intensive areas (ibid.). Similar effects are expected for AI-related regulations, i.e. the recent EU AI Act (Balcioglu et al., 2025; Lu, 2025).

Different studies on different types of regulations suggest that the net effect is sector- and firm-dependent: incumbents with compliance resources can adapt more easily, while small companies and startups may be more constrained (Balcioglu et al., 2025; Blind et al., 2024; Lu, 2025).

European vs Swiss situation. The revised Swiss Federal Act on Data Protection (FADP), effective 2023, tightened requirements and introduced stronger sanctions – aligning Swiss practice more with the GDPR, but with national specificities. Swiss software firms that sell into the EU must design for both rule sets.

While the EU hardware directives are mandatory in EU member states, Swiss manufacturers must often comply de facto with EU rules to access the Single Market. The Swiss Federal Office of Communications OFCOM manages spectrum and technical ordinances, e.g. the Ordinance on Telecommunications Installations.⁵ The national updates align with international/EU standards but the Swiss model can delay formal transpositions, causing compliance complexity for firms selling into both jurisdictions.

2.3 Sustainability innovation in the ICT sector

A recent Swiss Software Industry Survey (SSIS) 2023 put a spotlight on sustainability in Swiss software companies (Perrelet, Spizzo, & Dibbern, 2023). It found that sustainability is considered as a topic with opportunities and strategic potential which influences the planning and design of software (through use of the open standards of data formats and programming languages), the development of software (through reuse of code, continuous testing and integration, and standardization), or the maintenance of software (through extending its lifetime) (ibid.). However, it also obtained the result that sustainability matters rather little with regard to innovation capabilities and, above all, that sustainability-related R&D and management capabilities are not very well developed in the companies.

Conceptual Foundations of Sustainability Innovation

Sustainability innovation refers to the development of new or improved products, processes, services, or business models that simultaneously create economic value and reduce negative environmental and social impacts. This understanding builds on the foundational concept of sustainable development, defined as meeting present needs without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987). In the ICT sector, sustainability innovation is particularly relevant due to the sector's dual role as both an enabler of efficiency gains in other industries and a growing source of energy consumption and electronic waste (Malmodin et al., 2024; Vishwakarma et al., 2022).

Sustainability innovations in software companies. The literature highlights several sustainability-oriented innovation practices in software firms. Energy-efficient software development, often framed as “green software engineering”, focuses on optimized code, reduced computational complexity, and improved energy efficiency across the software lifecycle (OECD,

⁵ Ordinance on Telecommunications Installations, <https://www.fedlex.admin.ch/eli/cc/2016/24/en>

2009; Perrelet et al., 2023). Techniques such as code analysis, refactoring, and standardization are emphasized as important mechanisms for reducing energy consumption without altering software functionality (Perrelet et al., 2023).

Cloud computing has also emerged as a key area of sustainability innovation. Green cloud services, dynamic resource scaling, virtualization, and containerization improve server utilization and reduce energy waste (Energy Innovation and Policy, 2020; ITPro, 2024). In addition, sustainable data management practices, including data minimization and deduplication, contribute to lower storage and processing requirements. Beyond technological measures, software firms increasingly adopt sustainable business practices such as remote work, virtual collaboration, and sustainable supply chain management, which further reduce environmental footprints (Charter & Clark, 2007; Perrelet et al., 2023).

Sustainability innovations in hardware companies. In the hardware segment of the ICT sector, sustainability innovation is closely linked to product design, manufacturing, and lifecycle management. Energy-efficient design through low-power components and sustainable materials is widely discussed as a critical innovation pathway (OECD, 2009). Product longevity and repairability, enabled by modular design and upgradeability, are viewed as countermeasures to forced obsolescence and electronic waste (Michelino et al., 2019).

Manufacturing-related innovations focus on optimizing energy and water use, minimizing waste, and improving recycling processes. Supply chain sustainability, including ethical sourcing and transparency, represents another important dimension. Michelino et al. (2019) emphasize that sustainability innovation in hardware firms involves a balancing act between exploration (developing new technologies) and exploitation (optimizing existing processes), making R&D activities particularly central in this subsector.

Sustainability innovations in the telecommunications sector. For telecommunications service providers, sustainability innovation primarily targets network infrastructure and service delivery. Optimized network design, virtualization of network functions, and the use of energy-efficient data centers reduce reliance on physical hardware and lower energy consumption (OECD, 2009; ITPro, 2024). Green communication technologies, such as low-power devices and sustainable infrastructure, further contribute to efficiency gains.

Service-level innovations include energy-efficient cloud-based services, edge computing, and customer-oriented sustainability initiatives such as eco-friendly service plans and awareness campaigns. Many telecom firms also invest in renewable energy and carbon-offsetting programs to reduce the environmental impact of network operations (Perrelet et al., 2023).

Sustainability innovations in the other IT sector. Information services are implicated in growing electricity demand, materials use and end-of-life problems; postal and courier operations generate substantial transport emissions, packaging waste and urban externalities. The overarching and most pressing sustainability issue in the information service sector is energy consumption in data centers: recent analyses find that data-centre electricity demand is growing rapidly – driven by increased cloud services, streaming and AI workloads – and could double or more in the coming decade under plausible scenarios (IEA, 2025). This growth makes data centres among the fastest-growing sources of electricity demand in many jurisdictions and elevates the sector's indirect contribution to green-house gas emissions. New strategies are needed to raise the energy efficiency of data centers (Haskell-Dowland & Ghita, 2024).

Beyond environmental metrics, ICT raise social-sustainability issues: supply-chain labour conditions in hardware manufacturing, unequal access to digital services (digital divide), and the societal impacts of content platforms (misinformation, platform labour precarity). These social dimensions intersect with environmental outcomes through policy trade-offs and public legitimacy of ICT firms. Reports and sector initiatives emphasise the need for integrated ESG approaches (GESI & Deloitte, 2019).

Drivers, barriers, and impacts of sustainability innovation in the ICT sector

The literature identifies regulatory pressure as a major driver of sustainability innovation in the ICT sector. National regulations, export-market requirements, and sustainability demands from clients and suppliers play a central role in triggering innovation activities (Perrelet et al., 2023). However, several barriers persist, including technological complexity, limited financial resources, time constraints, lack of intrinsic motivation, and difficulties in measuring sustainability outcomes.

Empirical evidence suggests that sustainability innovation can positively affect business models. Reported benefits include cost reductions, improved resource efficiency, enhanced corporate reputation, and stronger relationships with customers, employees, and shareholders (Michelino et al., 2019; SSIS, 2023). These findings indicate that sustainability-oriented innovation can generate both environmental and economic value in the ICT sector.

2.4 Data and digital innovation in the ICT sector

Data and digitalisation have become central drivers of innovation in the global ICT sector, with data-intensive and cloud-based technologies reshaping hardware, software, telecommunications and information services business models. Systematic reviews of digital technologies and innovation highlight that big data analytics, cloud computing, AI, blockchain and IoT function as a mutually reinforcing “general-purpose technology bundle” that transforms innovation dynamics across sectors, including ICT itself (Jiao et al., 2025). In Europe and Switzerland, adoption of big data, AI and advanced cloud services is associated with higher innovation performance, but capability gaps and dependency on non-European providers still constrain the full realisation of this potential.

Big Data and analytics: mechanisms linking data to innovation

The notion of data-driven innovation (DDI) frames data as a core economic asset, where value creation depends on the capacity to collect, process and recombine large datasets to generate new products, processes and services. OECD (2015) work shows that ICT services are among the most data-intensive industries worldwide, with high shares of data specialists and R&D expenditure, underscoring their systemic role in DDI.

Empirical literature stresses positive relationships between data/analytics capabilities and innovation or firm performance, mediated by process improvements, faster learning, and market sensing (Niebel et al., 2019; Wamba et al., 2017). Mechanisms include pattern recognition and customer insight that guide product design; predictive modelling that shortens experimental cycles (e.g., predictive maintenance, demand forecasting); and data-driven process innovation that frees resources for upstream R&D or enables new service offerings. Several systematic reviews summarise these relationships and point to the role of organisational complements (skills, data governance, IT infrastructure). However, not all firms benefit equally. The literature emphasises complementarities—big data investments require analytics skills, data quality, and organisational routines to yield innovation gains. Empirical studies show substantial heterogeneity by firm size, sector and absorptive capacity (Niebel et al., 2019).

Artificial intelligence (AI) as an innovation amplifier

Artificial intelligence builds on big data and advanced algorithms to enable new forms of product and process innovation in the ICT sector. Reviews show that AI may support innovation through enhanced prediction (e.g. demand forecasting, network load balancing), automation (e.g. code generation, customer support) and intelligent optimisation (e.g. resource allocation in data centres) (Akter et al., 2022; Jiao et al., 2025). The ICT sector also provides enabling AI infrastructure and tools, such as machine-learning platforms and libraries, that diffuse into other industries and increase the returns to digitalisation.

In telecommunications, AI-based self-optimising networks and predictive maintenance are documented as major innovations that improve quality of service and reduce operating costs. In software and other information services, AI underpins recommendation engines, fraud detection, content moderation and automated news generation, enabling new services and revenue models for web portals and news agencies. Studies on European competitiveness argue that the economic impact of enterprise AI depends critically on cloud availability and access to high-quality data (European Commission, 2025), estimating substantial GDP gains if Europe can accelerate AI adoption across firms, including ICT providers (Implement Consulting Group, 2025).

2.5 Innovation collaboration in the ICT sector

Patterns of collaboration

Innovation in the ICT sector is increasingly driven by collaborative arrangements that combine internal and external knowledge sources. Studies show that a balanced approach integrating in-house innovation with external collaboration significantly enhances innovation success (Audretsch & Belitski, 2020). Notably, geographical proximity is not a decisive factor in the ICT sector, as international collaborations can be as effective as local ones.

Knowledge-intensive sectors such as ICT are particularly well positioned to benefit from collaboration due to their high absorptive capacity. Trust-based, long-term collaborations between universities and industry partners are highlighted as especially effective, as trust reduces uncertainty and facilitates open knowledge exchange (Bellini et al., 2019). In addition, both formal networks (e.g., structured agreements and joint projects) and informal networks (e.g., ad hoc interactions) contribute to innovation outcomes.

Global innovation networks and decentralized, modular collaboration structures are also characteristic of the ICT sector. The modular nature of ICT technologies enables extensive collaboration across organizational boundaries, reinforcing the importance of open innovation models (Zhu et al., 2023). Regional clusters and innovation ecosystems further support collaboration by fostering interactions between startups, established firms, and research institutions.

Collaboration mechanisms and knowledge transfer channels

The literature identifies multiple functional channels for knowledge transfer between firms and universities. These include joint R&D projects, consultancy arrangements, informal networks, and participation in conferences and innovation labs (Bellini et al., 2019). Digital platforms and ICT-based collaboration tools further enhance knowledge flows and coordination within innovation networks (Zhu et al., 2023). Universities and firms are connected through formal partnerships, co-location, technology transfer offices, and innovation infrastructures such as science parks and co-working spaces, which facilitate the translation of research into applications (Bellini et al., 2019).

Firms manage knowledge flows through appropriation mechanisms such as patents, licensing, secrecy, and contractual arrangements to mitigate collaboration risks (Audretsch & Belitski, 2020; Antonelli et al., 2010). Collaboration in the ICT sector is primarily driven by partnerships among software manufacturers, consulting firms, and technology service providers. The most notable constellations include collaborations between custom and standard software manufacturers, which collectively make up two-thirds of the industry, and consulting companies. These partnerships facilitate innovation by combining different expertise and resources, fostering an environment conducive to developing new and improved software solutions (Perrelet et al., 2023).

Impacts of innovation collaboration

Innovation collaboration generates significant benefits for ICT firms. Empirical studies show that external collaboration increases innovation output, particularly in terms of new products

and services, although diminishing returns may occur at very high levels of collaboration intensity (Audretsch & Belitski, 2020). Firms in knowledge-intensive sectors are better able to integrate diverse knowledge sources, resulting in superior innovation performance.

Beyond firm-level outcomes, collaborative innovation contributes to broader economic and social development. The recombinant generation of technological knowledge in ICT is associated with productivity growth and economic expansion, especially in countries with coherent and specialized knowledge bases (Antonelli et al., 2010). Collaboration also supports value co-creation, accelerated innovation cycles, and enhanced competitive advantage (Bellini et al., 2019; Zhu et al., 2023).

Support measures and policy implications

Firms generally evaluate existing support measures for innovation collaboration positively, particularly financial incentives, R&D grants, and supportive regulatory frameworks (Perrelet et al., 2023). However, the literature emphasizes the need for selective and strategic support to avoid excessive coordination and adjustment costs (Audretsch & Belitski, 2020).

Policy frameworks that encourage multilateral collaborations, foster trust, and support both national and international partnerships are considered crucial for maximizing the effectiveness of ICT innovation ecosystems (Bellini et al., 2019; Zhu et al., 2023).

3 Sector-specific survey results

3.1 Data basis and method

The survey data in this section draws on a dataset generated through an online survey of Swiss ICT companies in Dec. 2024–March 2025. Questions asked about the most recent time frame 2021–23, following the Swiss Innovation Survey and European Community Innovation Survey practice of collecting innovation data for a three-year time-period. In order to detect changes over time, questions were also asked about the previous period in 2020 and earlier. No precise time frame was specified, as it was assumed that events that occurred longer ago would be subject to memory errors and that any precision would only be apparent.

A gross sample of 1,019 UIDs (VAT numbers) was obtained from the Swiss Federal Office of Statistics (FOS) and Swico. 348 (34%) of the addresses were for micro enterprises with up to 9 employees, 281 (28%) for small enterprises with 10–49 employees. 296 mid-size enterprises with 50–249 employees made up 29% of the sampling frame and 94 large enterprises another 9%.

The responses to the survey identified 112 of the 1,019 ICT UIDs as outside the research population, e.g. not being companies but government offices or not-for-profit organizations, inexistent (e.g. companies that closed down), or several UIDs for one entity. From the resulting 907 ICT companies 249 responded to the survey, 30 rejected to participate, 73 could not be reached (non-functioning mail/postal addresses), and 555 did not respond. The response rate for the ICT sector is 27.5%.

In addition to the FOS NOGA code, which defines the industry of a company based on its main economic activity, we asked the respondents in the survey to self-assess their industry according to the NOGA classification. We then calculated fractional sector memberships per company, i.e. reducing the ICT weight for a company that self-classified belonging to further industries and raising it for companies which self-classified as ICT but belonged to a different main industry according to the FOS classification. This re-weighting resulted in 236.9 ICT companies. Table 1 shows the distribution of companies in the dataset by segment. The biggest overlap with the other segments is in the software segment: while 93.8 companies are only active in the software segment, 8.5 companies also produce hardware (23% of the

hardware segment), 7.0 are active in telecom (29% of the segment) and 24.8 in other IT (32% of the segment).

We also calculated the distribution by segment and size (Table 2). Software is the largest segment with 125.9 companies while telecommunications is the smallest segment with merely 21.5 companies. The hardware segment also consists only of 35.7 companies – the interpretations for hardware and telecommunications must take the small n into account. The other ICT sector companies combine information service activities (NOGA 63, e.g. data processing, hosting and related activities, web portals, news agencies, etc.) and postal and courier services (NOGA 53).

Table 1. Sample by segment membership (n and in %)

	Hardware (NOGA 261, 262, 268)		Software (NOGA 62)		Telecommunications (NOGA 61)		Other IT (NOGA 53, 63)	
	n	in %	n	in %	n	in %	n	in %
Hardware	23.8	64%	8.5	23%	1.5	4%	3.6	10%
Software	8.5	6%	93.8	70%	7.0	5%	24.8	18%
Telecommunications	1.5	6%	7.0	29%	14	57%	2.0	8%
Other IT	3.6	5%	24.8	32%	2.0	3%	46.5	60%

Note: As companies can belong to multiple segments, the total n is larger than the total n in the ICT sector of 236.9 and not shown.

Table 2. Sample by segment and size class (in %)

	4-9		10-49		50-249		250+	
	N	In %	N	In %	N	In %	N	In %
Hardware	6.5	20%	8.0	25%	12.8	15%	5.3	40%
Software	39.3	31%	38.8	31%	26.8	17%	21.0	21%
Telecommunications	5.0	23%	10.5	49%	3.5	12%	2.5	16%
Other IT	31.3	43%	17.5	24%	9.8	19%	13.0	13%
All segments	82.2	32%	74.8	30%	52.8	17%	41.8	21%

Note: As companies can belong to multiple segments, the total n is larger than the total n in the ICT sector of 236.9 and not shown.

Below we show the survey results differentiating the companies by segment. The results are only valid for the companies in the dataset as innovative companies are overrepresented.

3.2 Results

3.2.1 Innovation activities in the ICT sector by segment

Innovation outputs

Product innovations. The patterns with regard to product innovations by ICT companies are not very pronounced (Figure 1). Hardware companies more often introduced new or improved goods, whereas telecommunication companies introduced more often new or improved services and software companies introduced, both, goods and services, to about the same extent. Over time we see little change, except maybe a slightly stronger focus on services in telecom and hardware.

In terms of the degree of novelty, we distinguish between two types:

- radical or new to market product innovations and

- incremental or new to the firm product innovations

The pattern is quite similar in the different ICT segments: incremental innovations are introduced by considerably larger proportions of companies than radical innovations (Figure 2).

Figure 1. Product innovations in the ICT sector by segment

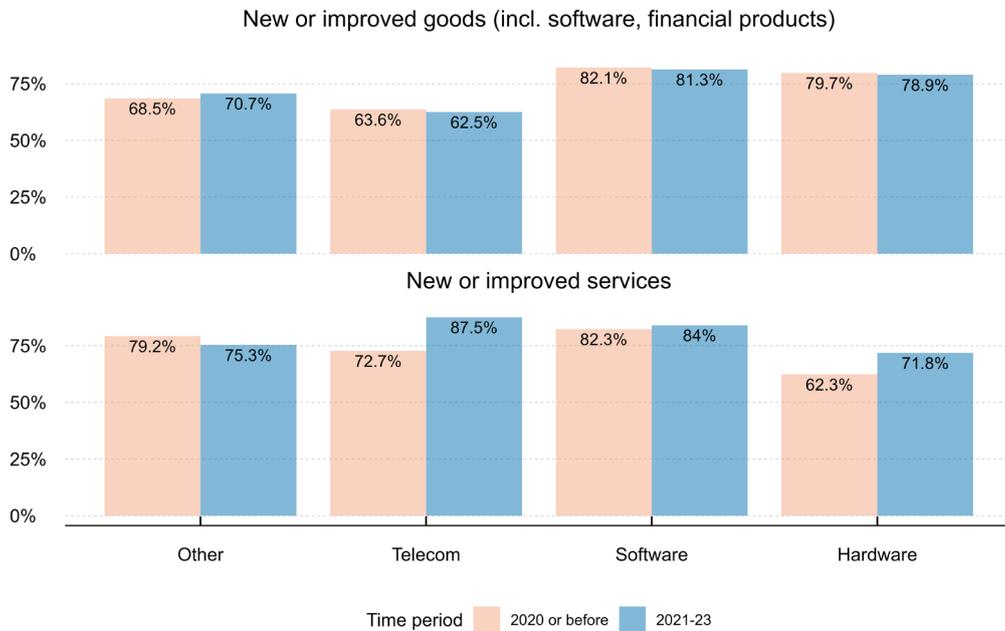
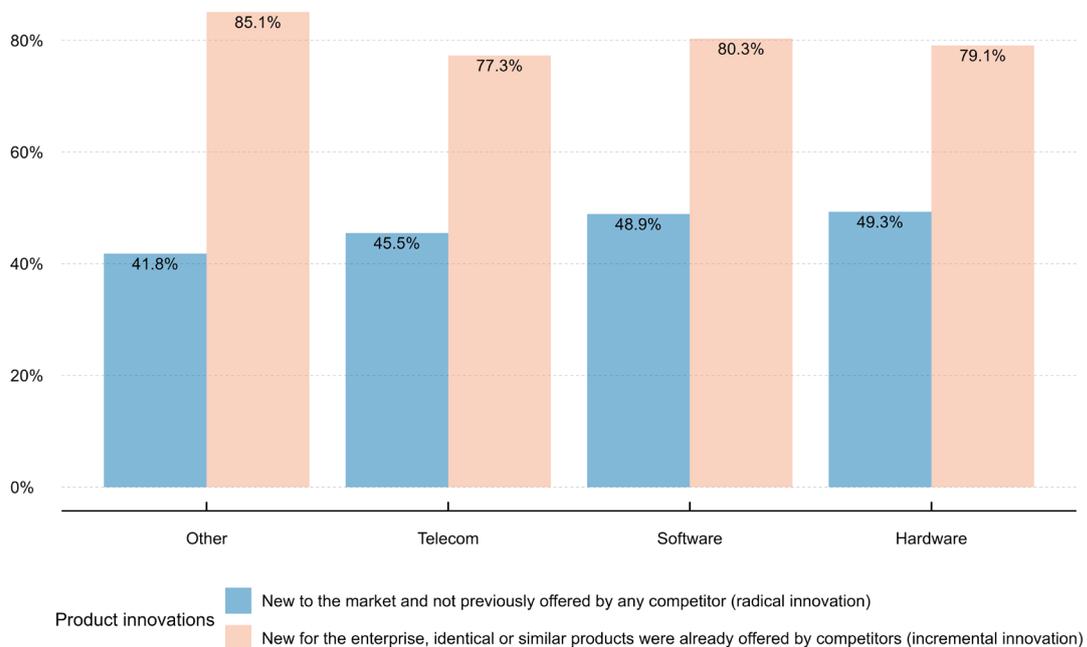


Figure 2. Radical and incremental product innovations in the ICT sector by segment (in %)



Process innovations. The importance of process innovations 2021-23 is lower than the importance of product innovation in all segments. Comparing the segments and comparing the two time periods 2020 and before and 2021-23 does neither point to a clear time trend nor to

notable differences between the segments (Figure 3) – except for a slightly lower commonness of process innovation in the Other IT segment.

Figure 3. Process innovations in the ICT sector by segment and time period

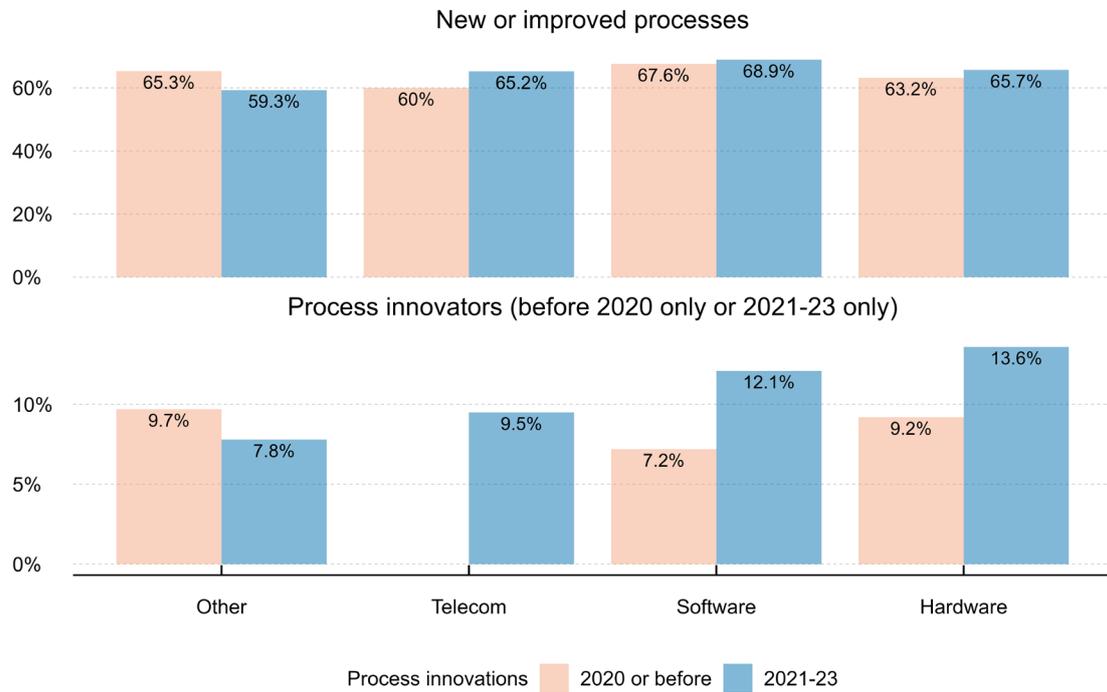
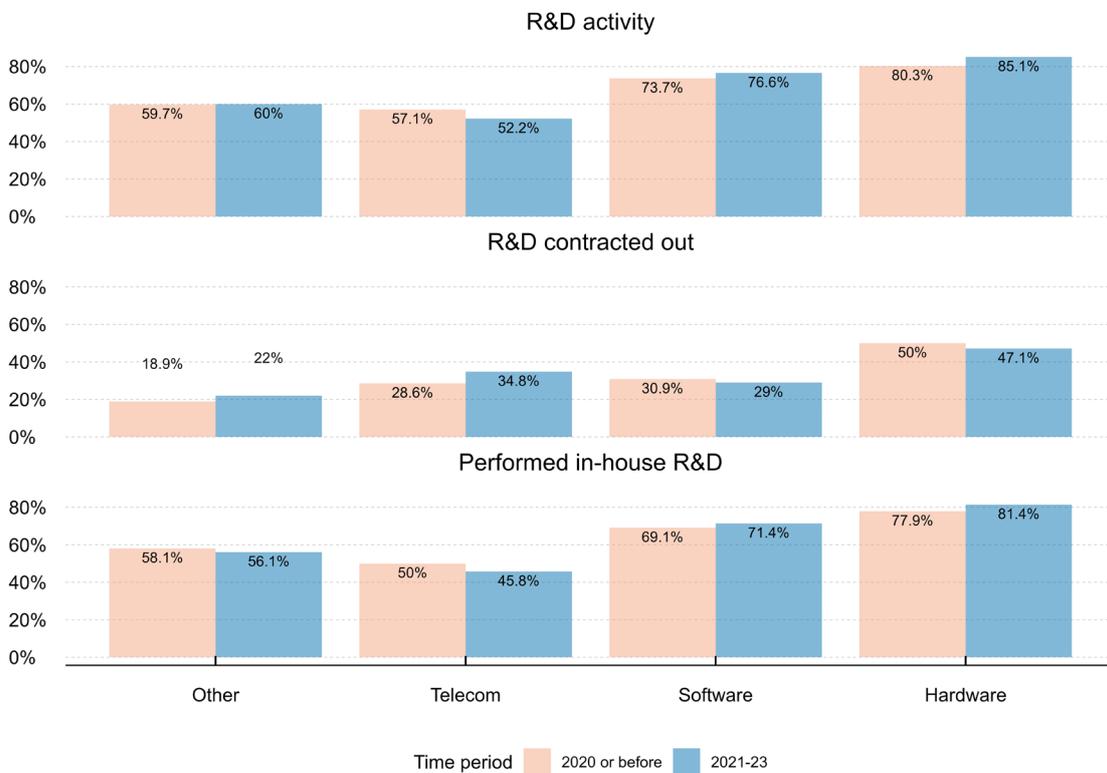


Figure 4. R&D activities in the ICT sector by segment (in %)



Research and development activities

Figure 4 (above) shows the share of companies with R&D activities (top panel), the share contracting out R&D (middle panel) and the share performing R&D in-house (bottom panel). The importance of R&D and where it is done differs between the segments but not over time:

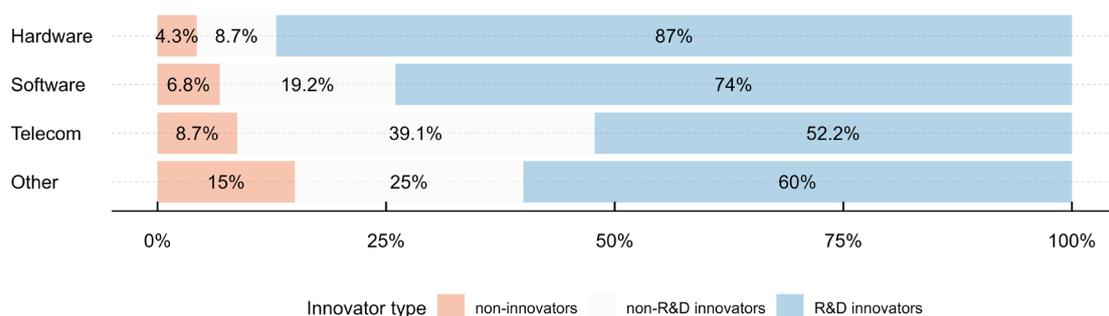
- The share of companies engaged in R&D is largest in the hardware segment with more than 80% conducting internal R&D and almost 50% contracting out R&D.
- In the software segment the numbers are a little bit lower, with 10% less doing in-house R&D and contracting out R&D.
- Among the other IT companies slightly more than half performed R&D inhouse, but less than a quarter contracted out R&D.
- The telecommunications companies in the dataset, on the other hand, conducted R&D inhouse least often among all segments, but used external R&D almost as often and more often than software companies.

Innovator types

Figure 5 shows the shares of three different innovator types by ICT sector segments:

- R&D innovators: companies introducing product or process innovation in 2021-23 and engaging in R&D (in-house or extramural),
- non-R&D innovators: companies introducing product or process innovation in 2021-23 but not engaging in R&D,
- non-innovators: companies not introducing product or process innovation in 2021-23.

Figure 5. Innovator types in the ICT sector by segment (in %)



Note: See Appendix table 1 on the data for all sectors in the dataset.

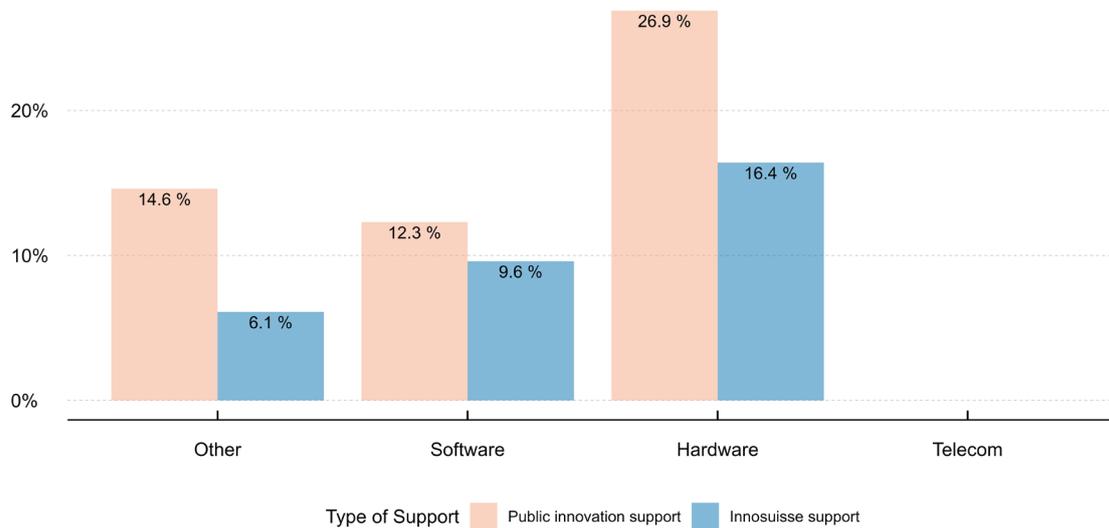
Nine out of ten hardware companies are R&D innovators and non-innovators hardly exist (Figure 5). In software companies three quarters of the companies are R&D innovators, 20% non-R&D innovators and the share of non-innovators is also negligible. In the telecom segment the share of non-R&D innovators is almost the same size as the share of R&D innovators and in the other IT segment, we find the largest share of non-innovators (15%). As the ICT sector is the one with the lowest share of non-innovators of all sectors in the dataset (see Appendix table 1, p. 32) hardware and software companies are among the most innovative segments.

Public innovation support

ICT companies benefitted from public innovation on average (see Appendix table 2, p. 32): 14% obtained public innovation support with Innosuisse being the main funding source (for 8.5% of the ICT companies). However, the differences between segments are notable. While the other IT and software companies more or less are in line with the ICT sector and total averages, Telecom companies did not obtain any Innosuisse funding or other public innovation support at all. Hardware companies benefitted from Innosuisse, but above all from other

sources: more than a quarter of the hardware companies said that they have obtained public innovation support.

Figure 6. Use of public innovation support and Innosuisse support in the ICT sector by segment (in %)



Note: See Appendix table 1 on the data for all sectors.

3.2.2 Technology, competition and market dynamics

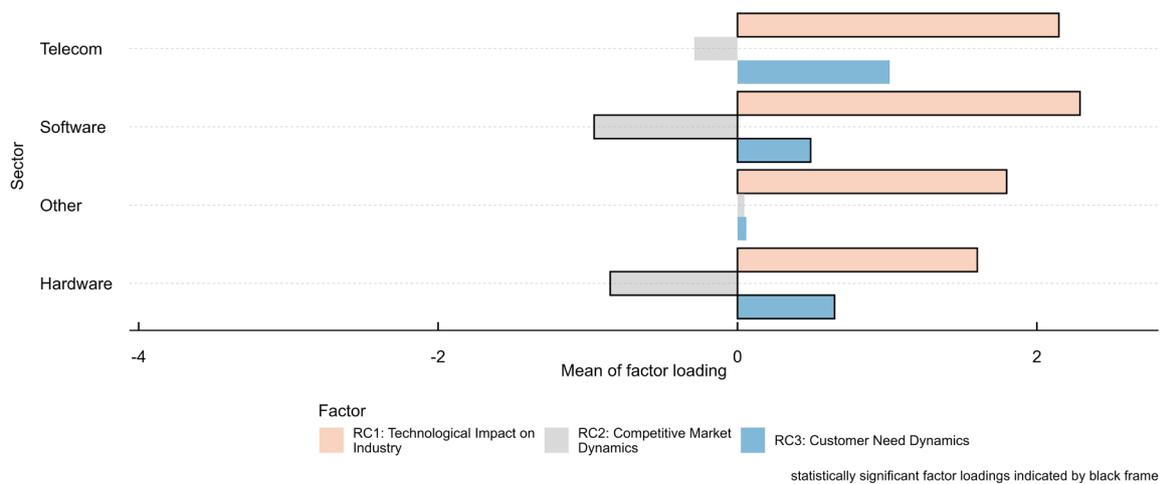
In order to identify the dynamics that companies see in their environment and whether this perception is linked to their innovation activities, the companies were asked five questions about each, the competitive environment and technological dynamics, and four on customer dynamics. These questions were then submitted to a principal component analysis (PCA) which resulted in three distinct components (see section 3.3 of the main report on further details):

- Factor RC1 primarily relates to the technological dynamics within the industry.
- Factor RC2 represents aspects related to price competition.
- Factor RC3 captures the shifting nature of customer demand and openness to new product ideas.

The factor loadings illustrate to what extent the segments are affected by these customer-related, technological, and competition dynamics. We find significant differences for the segments compared to the average across all sectors for all three types of dynamics (see Figure 7 and Appendix table 3). The opinions on the impact of technological dynamics on the industry (i.e. the assessments of speed and predictability of technological change, new technological opportunities, relevance of technological breakthroughs, and technological challenges and risks) are positive for all segments – indeed, all segments of the ICT sector have strong opinions on the relevance of these technological dynamics for their sector. Software and hardware companies perceive lower competitive dynamics, but higher customer-related dynamics than average. For Telecommunications and Other IT companies, the perception of these dynamics is not significantly different from all companies in the survey (the high mean value for telecom is insignificant due to the high variance of factor loadings, i.e. several companies which assessed this value as very low).

In sum, we see that technological dynamics are the most relevant innovation driver and customer-related dynamics affect two segments of the ICT sector, while (price) competition and the strength of competitors are rather of low relevance.

Figure 7. Mean factor loadings of customer, technology and market factors in the ICT sector by segment



Note: See Appendix table 3 on the data for all sectors.

3.2.3 Advances in digital technologies

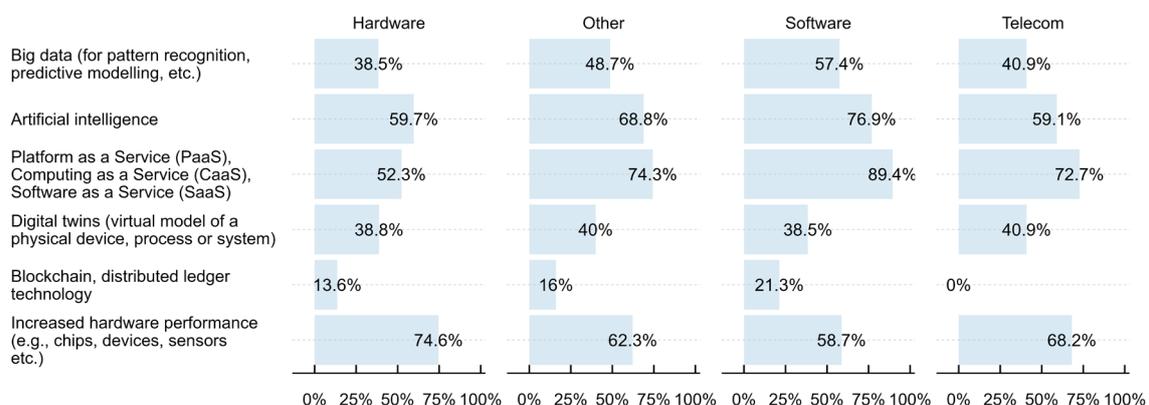
Further details on technological dynamics can be gleaned from the responses to the questions on the role of digital technologies for innovation.

The pattern varies by digital technology and segment (Figure 8):

- Software, telecom and other IT are similar, as they all three point to service-based business models (PaaS, CaaS, SaaS) as the most important advance of digital technologies, followed by AI in second, and hardware performance in third place.
- For hardware companies the order of importance is different, with increased hardware performance coming first, followed by AI and PaaS, CaaS, and SaaS.
- Big data is also perceived as important by more than half of the software companies which also give blockchain developments a role (even if only one out of five companies).

Service-based business models, AI and hardware seem to be the most relevant digitalisation enabler across all segments.

Figure 8: Share of companies perceiving advances in digital technologies as important in the ICT sector by segment

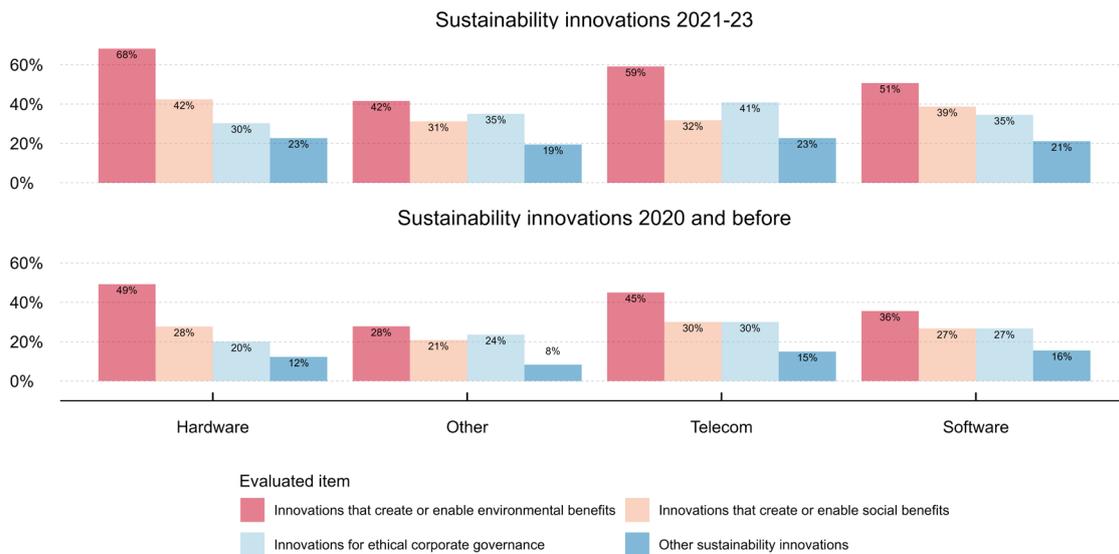


3.2.4 Sustainability innovations

The analysis of recent developments in sustainable innovation between 2021/23 and the period before 2021 reveals also some variation across the segments in both the extent and type of innovation activities (Figure 9).

For all segments environmental sustainability is the main issue, with hardware and telecom firms giving it higher prominence than software and other IT firms. For hardware and software firms, social sustainability comes in second place, whereas for Telecom and other IT firms ethical corporate governance matters slightly more often.

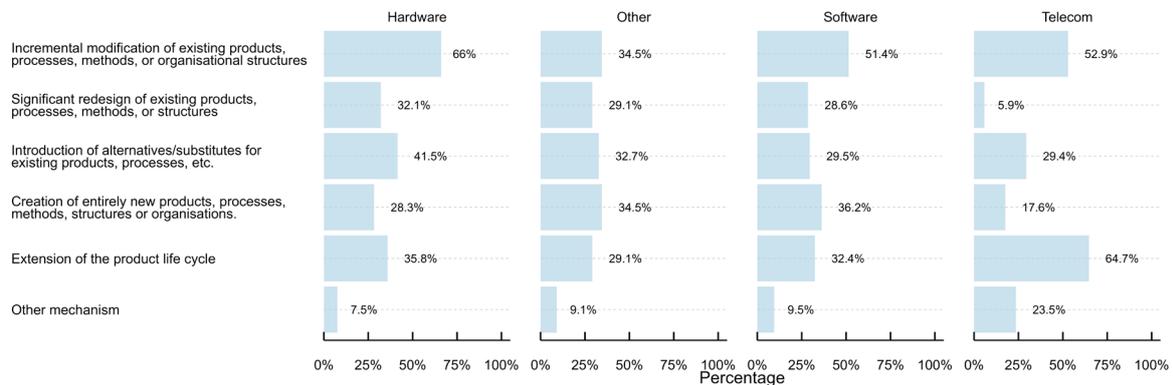
Figure 9. Sustainability innovations in the ICT sector by segment in 2021/23 and 2020 and before (in %)



The mechanisms used for sustainability innovations differ between the segments in the ICT sector (Figure 10):

- The use of all mechanisms of sustainability innovations is lower in other IT companies. Even incremental sustainability innovations, i.e. modification of existing products, processes, methods or structures, are only implemented by about a third of the responding other IT companies.
- Two thirds of the hardware companies pointed to incremental sustainability innovations but less than 30% introduced radical sustainability innovations. A more common approach in the hardware segment is the introduction of alternatives and substitutes and product redesign.
- The software segment shows a similar pattern as the hardware segment with a high importance of incremental modifications. Creation of entirely new products, processes etc. is also more common in the software segment than in the other segments.
- In the Telecom segment, the most common mechanism is the extension of the product life cycle followed by incremental innovations.

Figure 10. Mechanisms of sustainability innovations with benefits for the environment, society, or governance in the ICT sector by segment (in %)



3.2.5 Regulation and innovation

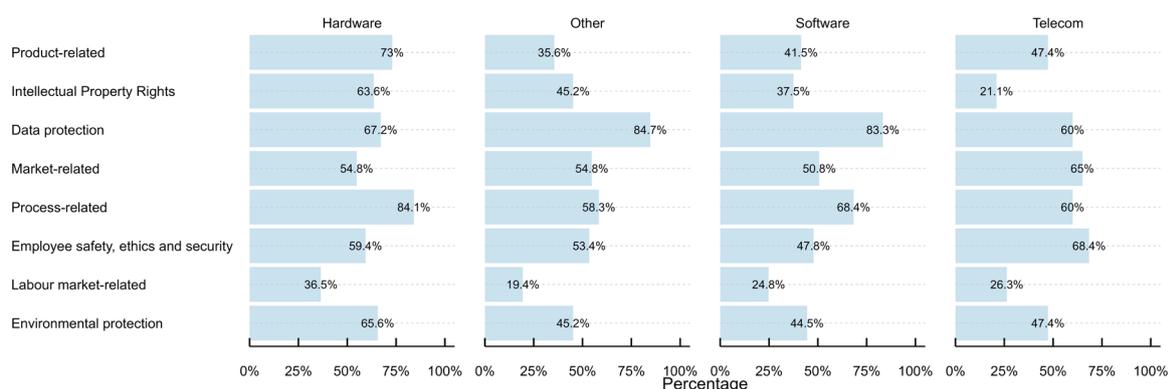
Two aspects of regulations can be differentiated by segments of the ICT sector:

- 1) Types of regulations by importance,
- 2) Impacts of regulations on innovation activities

Ad 1) *Types of regulations*. Figure 11 shows which types of regulations are perceived as influential by the surveyed companies for their innovation activities. The patterns differ between the segments, with software and other IT showing some similarities:

- *Software and other IT*. Data protection regulations are by far the most important ones for these two segments with more than four out of five companies in agreement. Process-related regulations (e.g. audits, Quality Management, supply chains, R&D, risk management, compliance, reporting, etc.) are second. The other regulations are of similar importance, except for labour market-related regulations which only one fifth to one fourth of the companies in the two segments evaluate as important.
- *Hardware*. Process-related regulations dominate for the hardware segment and product-related regulations (e.g. CE, premarket requirements, product components, functionalities, consumer/patient safety, etc.) also matter for three out of four companies. Intellectual Property Rights, data protection regulations, and environmental protection regulations also were important for two thirds of the hardware companies.
- *Telecom* companies are most affected by employee safety and security and market-related regulations (e.g. pricing, antitrust, licence to operate, capitalisation, liability), and data protection, process-related regulation are of almost identical importance.

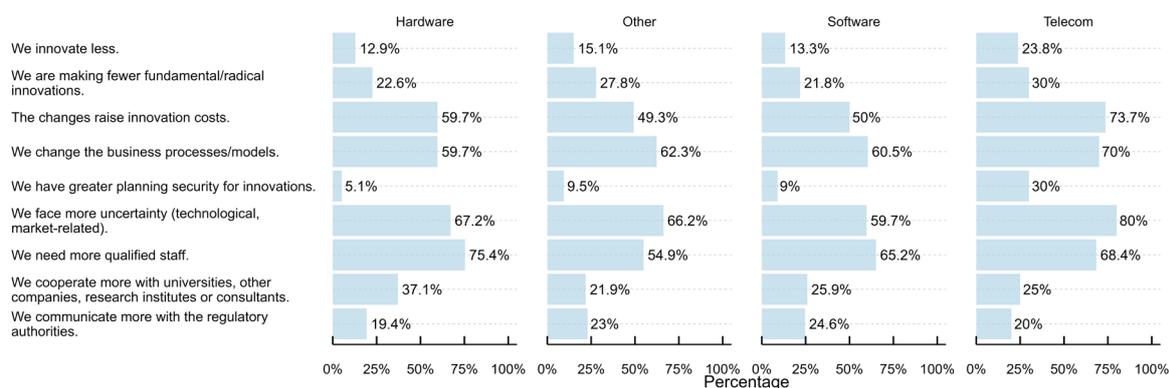
Figure 11. Important regulations for innovation activities in the ICT sector by segment (in %)



Ad 2) *Impacts of regulations on innovation activities.* Figure 12 provides an overview of how companies across segments have adjusted their innovation activities to regulatory changes between 2021 and 2023.

- Again, *Software and other IT* companies show a fairly similar pattern regarding regulation impacts: important are higher uncertainty, a need for more qualified staff, changes of business processes and models, and higher costs, while all the other aspects are of lower importance.
- *Hardware* companies most often pointed to the need for more qualified staff and cooperation to cope with regulation.
- *Telecom.* This segment seems to have implemented the strongest adjustments to deal with regulation with the largest proportion of firms agreeing to five out of eight negative impacts: less innovation, less fundamental innovation, higher innovation costs, more change of business processes and models. Four out of five companies pointed to higher technological uncertainty, however 30% perceived increased planning security due to regulation as well. Depending on the field of business, regulations can therefore have different effects.

Figure 12. Impact of regulation on the innovation activities in the years 2021-2023 in the ICT sector by segment (in %)

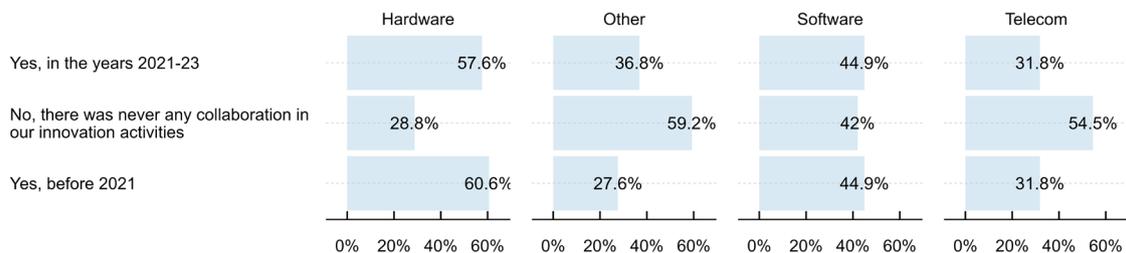


3.2.6 Innovation collaboration

In this section we report on the importance of collaboration and the main partners of the responding ICT companies by segments.

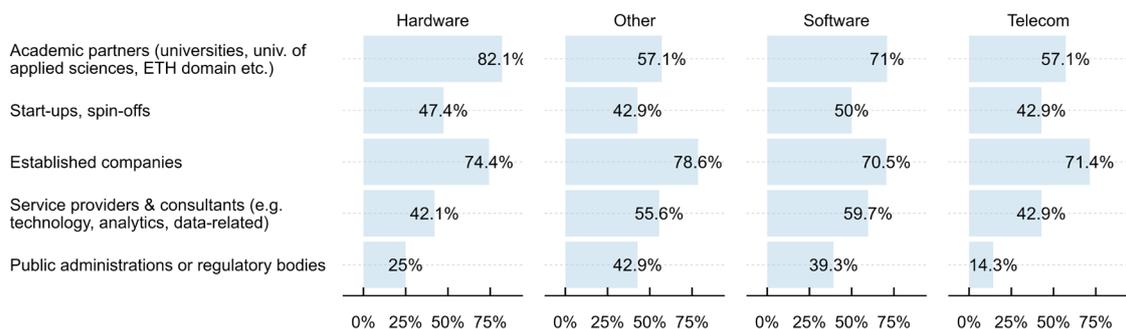
Collaboration frequencies clearly differ by segment (Figure 13). While less than 30% of the hardware companies have never collaborated in their innovation activities, the proportion is twice as high in the other IT companies. Innovation collaboration is most common in the hardware segment, followed by the software segment and less common in the Telecom and other IT segments.

Figure 13: Innovation collaboration in the ICT sector by segment (in %)



The importance of partners varies between the segments. Established companies are important for all companies (Figure 14). Academic partners are most important for hardware companies and for 70% of the software companies. Service & consulting providers are more important for software and other IT and less important for hardware and telecom. The pattern is similar for partnerships with public administrations or regulatory bodies.

Figure 14: Important collaboration partners in the ICT sector by segment (in %)



3.2.7 Summary

In Table 3 we tried to summarise the patterns from the survey per segment in a SWOT structure. The baseline of the comparison is the total set of answers from ICT companies in the dataset.

- Hardware and software:** The pattern in the table suggests that the hardware and software segments in the ICT sector are in a better position than the other two segments. While hardware companies have strong internal capacities with regard to R&D, engage in R&D collaborations with academic partners and other companies and obtain public innovation support for doing so, they face – in comparison to the other segments – few threats and have no clear internal weaknesses (out of the topics covered in the survey. Software companies have opened up their R&D, but show no clear further strengths. However, their strong perception of technological change and customer-related dynamics, the lower competitive dynamics and the strong perceptions of the advances of different digital technologies (new service models, AI, Big data, blockchain) may be considered as digitalisation opportunities (though, without doubt, they do not come without risks).

- *Telecom and other IT.* The picture is different for the other two segments. Telecom companies engage less in R&D-based innovation and collaboration and seem to struggle more with regulatory constraints. Likewise, other IT companies perceive some digital opportunities, but their absorptive capacities and external innovation focus are rather less developed.

Table 3. Strengths, weaknesses, opportunities & threats by segment

Hardware	
Strengths More companies with (open) R&D activities More R&D innovators Above average public innovation/Innosuisse support More fundamental sustainability innovators More innovation collaboration	Weaknesses
Opportunities Technological change Lower competitive dynamics High customer-related dynamics Increased hardware performance	Threats Technological change Higher staff need because of regulation
Software	
Strengths More companies with (open) R&D activities	Weaknesses
Opportunities Technological change Lower competitive dynamics High customer-related dynamics New service models AI as enabler Big data	Threats Technological change
Telecom	
Strengths More companies with open R&D activities	Weaknesses Fewer companies with internal R&D activities Fewer R&D innovators No public innovation/Innosuisse support Less innovation collaboration
Opportunities Technological change Positive effects of regulation on planning security	Threats Technological change Mostly incremental sustainability innovators Higher innovation costs because of regulation Higher uncertainty because of regulation
Other IT	
Strengths	Weaknesses Fewer process innovators Fewer companies with external R&D activities Fewer sustainability innovators Less innovation collaboration
Opportunities Technological change New service models AI as enabler	Threats Technological change

Note: All assessments are made relative to the ICT sector total.

4 Sector-specific results of the Delphi interviews

To further analyse the innovation-related problems in each sector and develop policy recommendations which could remove obstacles and support companies' innovation activities, we conducted two rounds of Delphi interviews with the management of companies from the sector. Round 1 consisted of individual interviews and round 2 of a group discussion.

The statements presented in this section are based on the contributions made during these interviews. They reflect the individual perceptions and experiences of the participants. The statements were not subjected to any further in-depth review or validation as part of this study.

4.1 Data basis and approach

Round 1: The data basis of round 1 are 11 interviews, four with small firms with up to 49 employees, 3 with mid-sized companies with 50-249 employees, and four with larger companies with more than 250 employees. The bilateral interviews with a company representative were conducted virtually, commonly by two researchers. The interviews used a semi-structured interview guide with 14 guiding questions (see also Appendix 12 of the main report).⁶ Each interview lasted between 20 and 30 minutes.

Round 2: In the group discussion in round 2 five companies, three further participants and the research team participated. Participants received before the discussion a two-page fact-sheet summarizing the main sector results of the survey and the Delphi round 1 interviews. During the workshop, they could select from the topics of round 1 and were then asked to discuss predominantly policy measures that would help to address the identified issues. The ICT discussions went beyond mere policy suggestions and participants also extended and deepened the analyses of round 1.

Brief summaries of both rounds follow below.

4.2 Results of Delphi rounds 1 and 2

Delphi round 1

General comments. The interviewed experts point to increasing competitive pressure from global developments. Supply chain legislation and sustainability requirements are seen as a disadvantage for Swiss and European companies compared to competitors in countries that are not subject to these rules. China is perceived as a leader in several areas of technology, with innovation increasingly taking place where supply chains and customers are located. Europe is described as somewhat weak in innovation, as it often adapts Asian innovations rather than driving the same innovations at the frontier. Swiss companies are generally considered risk-averse. The pace of innovation is described as largely unchanged, but customer

⁶ a) Are you observing a trend towards declining R&D in your industry or field of activity? b) In your opinion, are new policy measures needed to encourage companies to engage in or remain in R&D activities in Switzerland? c) What types of instruments or reforms do you consider particularly effective for your company? d) In your opinion, is one of these factors (digitalization, sustainability, regulation, collaboration) also decisive for innovation in your company? e) To what extent does digitalisation currently represent an opportunity for innovation in your company? f) How could Swiss policy support digitalisation? g) In your opinion, which regulations (types of regulations) are primarily a direct obstacle to innovation? h) Why regulations are an obstacle? What could be improved so that regulation supports innovation? i) Which regulations drive already innovation (e.g. innovation driven by compliance with regulations, setting of standards)? j) Do you consider sustainability to be a driver of innovation or more an obstacle in your company? k) What policy measures could strengthen sustainable innovation in your company/sector? l) How do you see this for your company: Do the costs/benefits of collaborating with academic organisations differ from the costs/benefits of collaborating with other companies? m) Should innovation policy support innovation cooperation between companies? n) What could innovation policy do to promote both types of innovation cooperation?

willingness to embrace innovation – especially in the public sector – is relatively low. Mentality and demand are seen as the main obstacles, rather than technology or regulation. Competence problems particularly affect SMEs, which are caught between large customers and suppliers, while large companies are expanding their capabilities. Internal training and “learning by doing” are considered effective. Several respondents highlight the growing dependence on US and Asian technologies and the lack of competitive Swiss or European suppliers. Opinions on the role of the state are divided: some see only limited scope for public intervention beyond supportive measures, while others emphasise that strong domestic demand, for example, can continue to drive innovation. Overall, there is a perceived gap between the innovation instruments of the public sector and the innovation realities of the private sector.

Digitalization. Respondents consistently describe digitalisation and AI as key drivers of innovation and productivity, enabling faster prototype development, experimentation and new business models. Technologies such as AI, increased computing power and IoT are highlighted as particularly important, with IoT gaining significance in practical applications such as smart infrastructure and billing systems. Several respondents emphasise that there are no innovative systems without digitalisation today and that it also contributes to sustainability, for example by reducing paper consumption. At the same time, the full potential of digitalisation is seen as limited by regulatory and institutional factors. Regulatory uncertainties related to data protection, foreign regulations (e.g. US Cloud Act, data issues in China) and the dominance of hyperscalers are leading to reluctance to engage in innovation activities. While some respondents consider the current regulatory environment in Switzerland to be less burdensome than the EU's GDPR and not yet a major obstacle, others warn that the proposed new data surveillance regulations go too far and that Swiss policy lacks a proactive, long-term digital strategy. Beyond regulation, major obstacles are identified within organisations and society. Resistance often arises from mindsets, social concerns and corporate policy – particularly fears of job losses and the loss of digital sovereignty – leading to a gap between what is technologically possible and what is actually implemented. In large and government organisations, resistance from interest groups and a lack of standardisation slow down adoption and scalability. Some respondents emphasise the need for coordinated long-term strategies, collaboration with universities and schools, and neutral promotion of digitalisation that is not dominated by large established players.

Sustainability. The topic of sustainability is addressed differently in the interviews and is generally not described as a primary driver of innovation. Sustainability is seen as being shaped by regulation, especially since intrinsic motivation alone is considered insufficient. Problems such as the high energy consumption of data centres and AI are recognised, but are not yet seen as a practical constraint on innovation. Some experts report that ESG requirements have gained in importance, but are complex to communicate and implement, especially for smaller companies. Concerns about greenwashing are expressed, and future sustainability reporting requirements are seen as a challenge. This requires public support. Overall, sustainability mainly has an indirect impact on innovation – often through efficiency gains resulting from digitalisation – while its direct influence remains limited and largely regulatory in nature.

Regulation. The experts surveyed generally criticise the Swiss regulatory framework for lacking strategic direction and coherence. Administrative burdens – particularly in relation to

standardisation, certification and compliance – are seen as a significant barrier to innovation, especially for SMEs. Regulation in areas such as AI and health is often described as fear-driven and overly cautious, leading to costs without clear innovation benefits. A recurring theme is fragmentation and complexity. Federalism with 26 cantonal implementations leads to uncertainty, inconsistencies, and high coordination costs. Public procurement regulations and international obligations (e.g. WTO guidelines) are seen as limiting the public sector's ability to commission truly innovative solutions. Switzerland's decentralised political system and comparatively pragmatic approach to regulation are appreciated. The lack of a uniform regulatory framework and slow reforms can hinder innovation. However, regulation is not always the main obstacle; mindsets, risk aversion and the lack of a culture of failure – both in companies and in public administration – are seen by some experts as more restrictive. At the same time, future regulation, especially for AI, should be based on practical experience, provide legal clarity and avoid premature or overly restrictive regulations. Clear guidelines, harmonisation and risk management models are considered essential. Finally, current public funding and regulatory systems are criticised for rewarding bureaucratic compliance and consulting activities rather than innovative content.

Collaboration. Universities of applied sciences are generally regarded as open, pragmatic and valuable partners, particularly through Innosuisse projects, while ETH institutions are described as global leaders in research. Collaboration with customers is an important driver of innovation for several companies. At the same time, small SMEs face resource constraints, particularly in terms of providing personnel for joint projects. Others engage in cooperation only selectively, for example through conferences or informal innovation scouting. Several respondents emphasise that cooperation should be simple, market-oriented and on an equal footing. Switzerland's strong association and network culture is seen as an advantage. However, there is a need for more cooperation structures that go beyond informal networking and do not involve excessive bureaucracy.

Criticisms on current policy instruments. Respondents acknowledge that Innosuisse is an important and generally high-quality instrument, but point out some weaknesses. Mandatory cooperation requirements can slow down innovation, there is a lack of feedback on rejected proposals, and monitoring during project implementation is seen as needing improvement. The co-financing rules are considered potentially problematic for very small SMEs. Another point of criticism relates to the limited support for business model development and market launch, particularly in the field of AI. Sandbox approaches are described as too far removed from the complexity of the real world. Some respondents point to the high administrative burden and unclear project selection criteria. Public funding is sometimes criticised for promoting a consultancy-oriented funding industry and disproportionately favouring universities, which contributes to a disconnect between science and innovation in the private sector. A risk-averse culture limits the effectiveness of innovation funding.

Delphi round 2

A summary of the first-round results for the sector was shared with the participants with an invitation to the second-round (group) discussion. When asked which results should be prioritised, the ICT sector company representatives agreed on four key themes: collaboration and partnership ecosystems; simplifying innovation financing across all stages; strengthening talent development, skills, and education; make regulation more innovation friendly. The areas

summarised below reflect these shared priorities and outline measures that policymakers could take to create a better, more future-oriented environment for innovation in the ICT sector in Switzerland.

1. Strengthen collaboration and partnership ecosystems

Experts point to a fragmented ecosystem that discourages SMEs from participating and slows down international scaling. In addition, they identify collaborative structures that are skewed in favour of academia and large established companies. So, they suggest the following measures:

- Make SIMAP⁷ and funding instruments more SME-friendly and risk-tolerant, e.g. introduce a culture of failure.
- Involve Swiss Global Enterprise and chambers abroad to support international scaling.
- Stress benefits of collaboration and create incentives for SMEs.
- Foster greater national coherence in ICT collaboration policies.

2. Simplify innovation financing across all stages

The experts consider the Swiss financing system to be too rigid, as it treats research and business innovation according to identical criteria. They also note that a lack of transparency and speed in promoting innovation discourages ICT companies, especially SMEs. They also spoke of a missed opportunity to leverage international cooperation (DACH, Nordic countries, EU). To address these and related issues, they propose the following measures:

- Improve feedback quality, publish anonymized funding decisions for collective learning.
- Differentiate criteria for fundamental research vs business innovation.
- Introduce fund-matching instruments (public funds triggered by secured private investment).
- Speed up procedures with fast-track approvals for ICT pilots.
- Explore regional harmonization (e.g. DACH) and align with EU platforms.

3. Strengthen talent development, skills and education

The experts emphasized the strong Swiss talent base. However, they also detect their vulnerability to brain drain. In addition, they identified a misalignment between academic curricula and industry demand and highlighted that SMEs are disadvantaged in talent attraction and retention. They made the following suggestions to address these and related issues:

- Introduce retention mechanisms (e.g. temporary stay obligations, as in medicine).
- Provide (over proportional) tax deductions for continuous education.
- Expand dual training, internships, and on-the-job labs.
- Strengthen coding education in schools and upskill teachers accordingly.

⁷ SIMAP stands for *Système d'information sur les marchés publics en Suisse*, i.e. the information system on public procurement in Switzerland.

4. Make regulation more innovation-friendly

The experts found that the regulatory system is too slow, too complex, and too fragmented to keep pace with the speed of ICT innovation. Furthermore, current regulations discourage foreign investors and make compliance difficult for SMEs. The experts make the following recommendations:

- Centralize and harmonize regulations, especially tax frameworks.
- Introduce fast-track regulation for emerging technologies
- Regulation should rely more on process-based approaches (e.g. engineering-driven data protection) rather than static rules.
- Modernize tax and company law to attract foreign investors.
- Establish a centralized information hub via industry associations.

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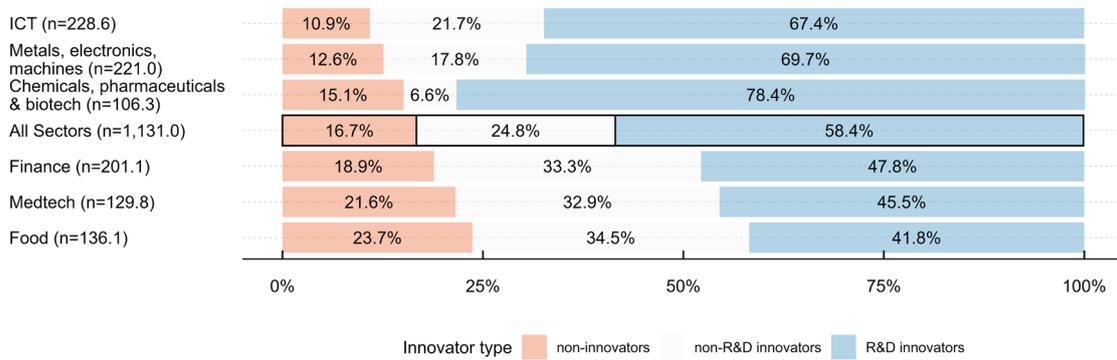
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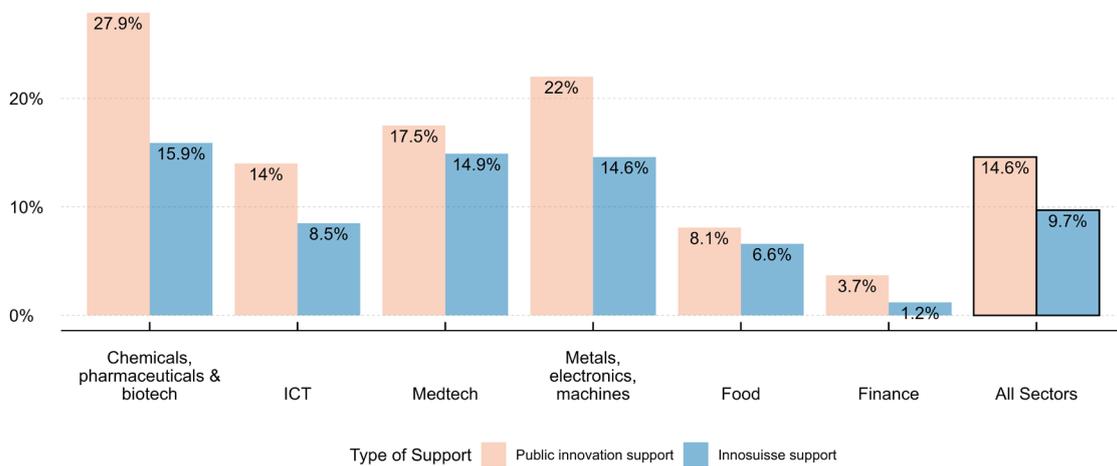
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Appendix

Appendix table 1. Innovator types by sector (in %)



Appendix table 2. Use of public innovation support and Innosuisse support by sector (in %)



Appendix table 3. Mean factor loadings of customer, technology and market factors by sectors

