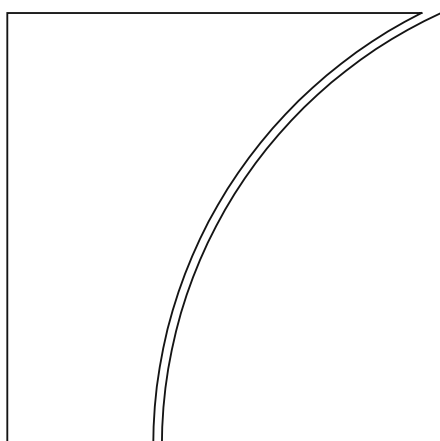




FSI Insights

on policy implementation

No 70

Smart supervision: sound capacity development approaches for tech-savvy supervisors

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November 2025

JEL classification: G28, I21

Keywords: capacity building, capacity development, learning and development, training

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ISSN 2522-249X (online)

ISBN 978-92-9259-899-0 (online)

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Smart supervision: sound capacity development approaches for tech-savvy supervisors¹

Executive summary

The rapid and continual advancement of technology is transforming the financial industry, requiring financial sector supervisors to keep pace. From a supervisory perspective, technological advancements present both risks and opportunities. On the risk front, technologies such as artificial intelligence (AI) can introduce new risks or amplify existing ones as firms leverage these tools to develop innovative financial products, enhance services and improve internal operations. Breakthroughs in quantum computing, while still on the horizon, could significantly impair cyber resilience of firms in the future, with potential systemic implications. All these developments require supervisors to stay on top of the underlying technology to be able to understand and address potential risk implications for supervised financial institutions and the financial system as a whole.

At the same time, supervisory technology (suptech) presents opportunities for supervisors to improve the efficiency and effectiveness of their processes. Technology can automate processes, cutting down the processing time and resources needed to supervise firms effectively while augmenting supervisory capabilities to achieve better supervisory outcomes. For example, AI has the potential to disrupt regulatory/supervisory functions, redeploying resources to high-value activities such as real-time supervision. To achieve these benefits, supervisory staff need to have not only the necessary knowledge but also confidence on the responsible use of AI in supervision. Both the risk and opportunity dimensions of technology require authorities to cultivate tech-savvy supervisors who can understand the technology and use suptech effectively.

An effective capacity development (CD) framework on technology should be steered by a clear strategy that is well aligned with an authority's strategic objectives and priorities. The framework should be operationalised through a structured process and be adaptable to technological developments. Given the rapid pace of technological advancements, authorities need to institutionalise a flexible framework that can be adapted and adjusted to remain relevant. This requires flexible CD processes, which should be iterative, identifying training needs, delivering training and assessing outcomes to improve the identification and delivery of CD activities. External factors such as technological advancements, policy changes and evolving business models should be continuously taken into account, shaping the CD framework as needed.

To support technology adoption and enhance organisational efficiency and effectiveness, authorities can foster an innovation-friendly culture as part of their technology-related (tech-related) CD strategies. Authorities with an innovation-friendly culture will find staff who are technologically adaptable and open to embracing new technology responsibly to augment their capabilities and improve their efficiency. An innovation-friendly culture requires promoting cross-functional collaboration and embedding innovation in organisational values. Having an institutional digital or technology policy can help to reinforce top-down steer on an authorities' level of ambition and, thus, clarify the necessary tech-related skills needed to achieve the ambition.

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Fundamental to supporting tech-related CD activities is an effective CD function to implement a tech-tailored CD approach, working closely with tech experts across the organisation.

While it might not be proportionate to establish a unit dedicated solely to tech-related CD, the general CD function needs to adopt a tailored approach for tech-related CD. Close collaboration with functional or specialist teams is crucial to identify training needs and source subject matter experts to deliver CD activities. Such internal cross-collaboration is essential to address specific details about individual authorities, such as their unique suptech tools or unique risks arising from tech-adoption by firms in their jurisdictions.

Unlike other CD areas, identifying tech-related training needs presents unique challenges.

As technologies advance rapidly, training needs can change very quickly. Emerging technologies can be complex, as can their implications for the financial sector. The complexity of the topics makes it challenging to pinpoint specific skills or knowledge gaps. This is because to do so requires a deep understanding of both the technology itself and its potential impact on the financial industry. Compounding these challenges is the potential difficulty of fostering an innovation-friendly culture in a typically risk-averse environment with staff at varying levels of readiness. An effective way to identify training needs is through structured competency frameworks that are aligned with institutional priorities. Such frameworks can be used to define role-specific technical and functional skills, identify gaps and guide targeted training initiatives. These frameworks should address varying proficiency levels and support both tech-specific and non-tech roles.

Given the nascency and constant evolution of most tech-related topics, the delivery of tech-related CD requires a range of approaches to access the necessary knowledge and skills. A key challenge in sourcing appropriate training on tech-related topics is the limited pool of high-quality, context-specific training providers in emerging or rapidly evolving areas. As a result, authorities need to combine in-house and external training, leverage external partnerships and rely on non-training activities such as secondments, research collaborations and other knowledge-sharing initiatives to build well-rounded, tech-savvy staff.

Assessing the effectiveness of tech-related CD programmes is crucial given the time and monetary and human resources involved – both by CD providers and by recipients. Unlike other areas of CD delivery, tech-related CD relating to suptech tools can yield tangible productivity benefits in terms of accomplishing tasks more efficiently or delivering better output. In this sense, measuring CD benefits for tech-related topics appears relatively more feasible than CD on other topics. In contrast, the impacts may manifest over an extended period, creating a time lag between the training and the application of newly acquired skills. Authorities can employ diverse methods – such as pre- and post-training assessments, feedback mechanisms and benchmarking – to evaluate the impact of CD activities on organisational goals. At an institutional level, evaluating the maturity of tech-related CD programmes can be useful to identify gaps and refine strategies.

Tech-related CD is a crucial enabler to transform supervisory approaches. The evolution of supervisory approaches, from compliance-based to risk-based, took years to achieve, not only upskilling technical competencies but also changing mindsets that place greater reliance on the exercise of sound judgment. As the financial supervisory world enters the next wave of technology-driven transformation, tech-based supervision will require tech-savvy supervisors. New supervisory capabilities can revolutionise how and when firms are supervised, potentially even delivering efficiency gains from reduced compliance burden. Nevertheless, to fully reap the benefits of AI and other emerging technologies, reskilling supervisory workforce will take time and needs to start now. Smart supervision – leveraging advanced technologies to further enhance oversight capabilities – can be a reality only with skilled and knowledgeable tech-savvy supervisors who can support effective implementation of supervisory priorities.

Section 1 – Introduction

1. **Rapid and continuous advancements in technology are transforming the financial sector.** Financial institutions continue to use tools such as artificial intelligence (AI), machine learning (ML), distributed ledger technology, cloud computing and application programming interfaces, often in novel ways. While technologies like cloud computing and many ML techniques are already well-established, institutions are increasingly exploring innovative applications of these tools. Among these technologies, AI stands out for its particularly transformative impact, offering opportunities to enhance operational efficiency, strengthen risk management and improve customer experiences. However, these technological advancements bring both opportunities and risks, not only for financial institutions but also for the supervisors tasked with overseeing them.
2. **As financial institutions continue to innovate, supervisors need to keep pace with technological developments to effectively identify and address emerging risks.** The evolution from compliance-based supervision, which focused on adherence to specific rules, to risk-based supervision marked a significant transformation in supervisory approaches. Risk-based supervision, which has been a foundational approach for some time in certain jurisdictions, emphasises data proficiency and the use of technological tools to support informed supervisory judgment. As the supervisory landscape continues to evolve, the focus is now shifting towards smart supervision, leveraging advanced technologies to further enhance oversight capabilities. At the same time, technology has become a more prominent supervisory priority, as new digital technologies transform business models and processes of financial institutions. To safeguard the safety and soundness of firms and maintain financial stability, supervisors are challenged to continuously adapt their approaches. This evolving landscape underscores the importance of a solid understanding of the underlying technology, pointing to the critical role that capacity development (CD)² plays in this context as part of an organisation's workforce planning strategy.
3. **Against this backdrop, supervisors can leverage technology to enhance the efficiency and effectiveness of supervisory processes.** Supervisory technology (suptech) tools leveraging technology such as AI can enhance predictive analytics, improving detection capabilities of supervisors to enable timely interventions.³ At the same time, automating routine tasks can free up resources, allowing a focus on high-value activities like real-time monitoring of firms. These tools offer the potential for more forward-looking and less invasive supervision, potentially reducing compliance burdens for firms while improving oversight quality. Nevertheless, to fully harness these benefits, supervisors need to develop the technical skills and confidence to use these tools responsibly.
4. **Technological developments make CD essential to equipping supervisors with the necessary skills and expertise.** CD plays a critical role in the adoption of technology in supervision. From a supervisory perspective, a lack of knowledge of relevant technologies and how financial institutions are using them could lead to blind spots in regulatory and supervisory frameworks. For example, as the use of AI becomes ubiquitous within financial institutions, supervisors need to understand how AI models work for critical use cases to be able to assess the potential threats to safety and soundness of financial institutions. To avoid regulatory/supervisory gaps, CD is critical to upskill supervisors on key technologies that are changing the risk profiles of firms.
5. **Nevertheless, authorities face several key challenges in building internal capacities on technology, mainly due to the rapid pace of change of the topics and their complexity.** At an

² In this paper and in line with Crisanto et al (2022), we use the term “capacity development” (CD) to cover activities through which authorities enhance the skills their staff need to effectively carry out their functions. We consider training to be one form of CD activity, generally involving in-person, virtual or hybrid training events (eg seminars or online courses). Other CD activities could include secondments, on-the-job training, peer-to-peer learning and participation in international working groups.

³ Bains et al (2025) discusses the imperative for financial supervisory authorities to enhance their toolkit through the use of AI and provides a practical project management methodology for its implementation.

institutional level, authorities may face challenges fostering an innovation-friendly culture and overcoming staff resistance to new technologies, particularly in traditionally risk-averse supervisory environments. At the same time, the rapid pace of technological advancements makes it difficult to keep training content current; and the complexity of the topics may make it challenging to source high-quality, context-specific training providers. Nevertheless, adapting existing sound practices on a general CD framework can serve as a good starting point in addressing some of these challenges. Annex 1 lists the different types of challenges, interpreted in the context of technology-related (tech-related) CD.⁴

6. **Relying on a sound institutional CD framework provides a strong foundation for addressing tech-related CD needs.** In Crisanto et al (2022), the Financial Stability Institute (FSI) took stock of the experience of financial authorities in providing supervisory CD. It was highlighted that while traditional financial capabilities (eg finance, accounting and risk management) remained core to financial supervision, other skills such as those related to the digitalisation of finance had not only increased in importance but were also expected to become more important over the years. The paper also emphasised that authorities were responding to these changes by putting in place sound institution-wide CD strategies that rely on certain key enabling practices (see Table 1).

Key factors for effective capacity development (CD) strategies			Table 1
CD strategies – sound practices	Key factors enabling sound CD strategies		
Aligned with institutional mandates and regulatory/supervisory priorities	Strong support from top management; alignment with line managers, who allow sufficient time for staff training	Public disclosure of key aspects of the strategy	
Cover technical and non-technical skills (eg soft skills)			
Led by a dedicated function (or ideally, by a dedicated unit)	Well-resourced CD function (ie appropriate expertise, budget and technological infrastructure), aided by strong governance with clear roles and responsibilities	Subject to efficient operational processes (eg for procuring training services from external experts and learning technologies)	
Formulated in close consultation with, and with the participation of, relevant internal stakeholders	Involvement of senior management and heads of departments/units	Input from front-line staff and subject matter experts	
Comprehensive, including learning opportunities beyond training (eg secondments, internal rotations)	Flexible delivery formats and design of learning content	Transparency about available CD opportunities	
Designed in a holistic way (eg identify required staff capabilities; implement appropriate organisational structure and learning culture as well as adaptive and forward-looking approaches)	Clear linkage between CD activities and incentive mechanisms for learners and internal subject matter experts that serve as trainers Assessment framework to measure effectiveness of CD strategy and associated programmes and activities	Integrating learning and development approaches as part of broader institutional people strategies (eg succession planning)	

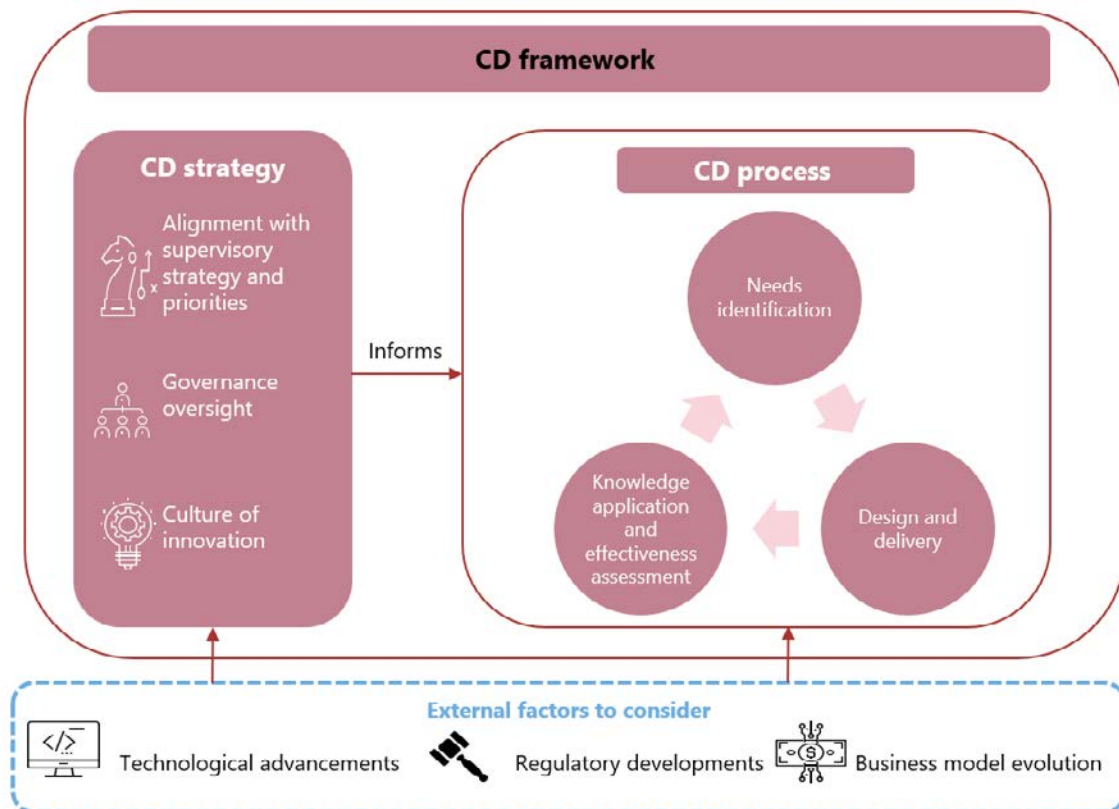
7. **Another foundational way to overcome tech-related CD challenges is to ensure that CD efforts are effectively aligned with institutional mandates and regulatory/supervisory priorities.** To achieve this, it is important to understand how various elements of the CD process interact and adapt over time. As illustrated in Graph 1, an organisation's overall CD framework should be guided by a well-defined strategy that takes into account external factors such as advancements in technology, policy changes and evolving business models. These factors should be continuously monitored and incorporated into CD

⁴ In this paper, tech-related CD refers to CD activities on technology-related topics including technology-related skills.

programmes to ensure their ongoing relevance and effectiveness. The CD process, which is based on the strategy, is inherently iterative, beginning with the identification of training needs, followed by the design and delivery of training. The effectiveness of CD activities is then assessed, with the outcomes informing adjustments to both the identified needs and the training delivery methods.

Illustration of key components of technology-related capacity development (CD)

Graph 1



8. **This paper lays out a range of good practices on how financial supervisory authorities can establish tech-related CD frameworks that enable supervisory staff to become tech-savvy.**⁵ In most cases, such frameworks are part of broader CD efforts. Nevertheless, given rapid technological developments, authorities are keen to dedicate specific attention to building capacity on tech-related topics. This paper has been informed by practices in nine authorities that responded to a survey conducted in early 2025: Bank of Zambia; Bank of Spain; Bank of Ghana; Financial Services Authority (OJK) Indonesia; Office of the Superintendent of Financial Institutions (OSFI) of Canada; Superintendency of Banks, Insurers and Pension Funds of Peru (SBS); European Central Bank Single Supervisory Mechanism (ECB SSM); Monetary Authority of Singapore (MAS); and Bangko Sentral ng Pilipinas (BSP). Section 2 provides an overview of the strategies and governance surrounding tech-related CD; section 3 covers how authorities identify training needs on tech-related topics; section 4 explains how CD programmes can be designed

⁵ In the subsequent sections, this paper highlights specific good practices as “observations” based on examples shared by the surveyed authorities. These observations are not intended to be comprehensive nor exhaustive.

and delivered; section 5 lays out approaches to assess effectiveness of CD programmes and section 6 concludes.

Section 2 – Capacity development governance

Capacity development strategy and function

Observation 1: A tech-related CD strategy constitutes a key part of the overall CD strategy, and its defining feature is flexibility to adjust and respond to technological advancements.

9. **A well-defined CD strategy, which is closely aligned with the institutional mandate and priorities, is particularly critical in the context of technology.** Given the vast array of potential tech-related CD topics, aligning the strategy with an authority's regulatory and supervisory mandates, priorities and objectives helps focus resources on the most relevant areas. This alignment ensures that enhanced skills and expertise are leveraged effectively to achieve institutional goals. For instance, the Bank of Spain's New Strategic Plan 2030 establishes digital transformation as one of its fundamental pillars, placing particular importance on AI, data management and technological modernisation. This strategy informs the institutional initiative, Training for the Future, and constitutes the foundation upon which the tech-related CD is structured, thereby aligning institutional objectives and staff competencies.

10. **Tech-related CD is an essential component of the overall CD strategy since it supports authorities' digitalisation objectives.** While tech-related CD has unique aspects – such as adaptability to the rapid pace of technological developments – that may require tailored approaches, it remains an integral part of the overall CD strategy to maintain consistency and coherence across the organisation. For instance, some authorities have adopted an explicit digitalisation strategy (eg on AI) to transform their institutions to leverage technology to improve efficiency and effectiveness.⁶ Having such a strategy helps to sharpen the focus of CD efforts, ensuring they are closely aligned with broader strategic objectives. The BSP, for instance, has an AI Roadmap that explicitly ties to their CD efforts, targeting 25% of staff to attend AI workshops by 2025 and 90% of staff to achieve advanced AI capabilities by 2029.

11. **All surveyed financial authorities have a process in place to align their tech-related CD activities with their strategic objectives and institutional priorities.**⁷ This CD alignment process generally takes place annually and, in a few cases, on a multi-annual basis. The outcome of this process, typically an annual CD plan, is normally approved by senior management of the organisation. The plan is usually publicised internally and is subject to regular monitoring and evaluation to ensure that it continues to meet institutional objectives and priorities.

Observation 2: A dedicated CD function can leverage technological expertise across the organisation to effectively design and deliver tech-related CD activities.

12. **The CD function is expected to ensure alignment of CD activities with the CD strategy, institutional objectives and priorities.** All surveyed financial authorities have a dedicated function responsible for overseeing, managing and monitoring CD activities, including those related to technology. This function is responsible for planning, organising, coordinating and tracking CD activities as well as

⁶ Gambacorta et al (forthcoming) show that a holistic digitalisation strategy supported by data and suptech strategies is a more effective driver of suptech deployment than a standalone suptech strategy. For example, from 2021 to 2023, the SSM fostered digital innovation to transform European banking supervision following the Digitalisation Blueprint (see ECB (2023)). Since 2024, the SSM Tech Strategy has been in place with a five-year horizon and the ambition to deliver "supervision at your fingertips" (ECB (2024)).

⁷ Bank of Zambia (2024) and Bank of Ghana (2018) included human capital management and training in their multi-year strategic plans.

providing periodic reports, collecting feedback and assessing effectiveness. Given the nature of tech-related CD, the CD function often relies on subject matter experts from across the organisation to design effective programmes. For example, following a capability needs assessment, the SBS developed a data management training programme with input from experts across the organisation. This input is channelled and coordinated by the SBS Learning and Development Department, which is responsible for the structure, design, delivery and evaluation of the programme.

13. **Although the institutional set up of the CD function varies across authorities, close coordination between the CD function and functional or operational areas is crucial.** While most authorities include the CD function as part of overall human resource responsibilities, some have established dedicated units, such as standalone departments, academies, institutes or universities. Others have embedded the CD function within functional or operational areas.⁸ Regardless of the chosen governance approach for tech-related CD, close coordination between the CD function and functional/operational areas is a common feature across surveyed authorities. For instance, the Indonesian OJK Institute has learning partners in each department that are responsible for, among other things, identifying CD needs, while the Bank of Ghana's Human Capital Development Department works closely with the Banking Supervision Department and the Fintech and Innovation Office to ensure the relevance of tech-related training activities.

14. **To further reinforce alignment between tech-related CD activities and institutional strategy and priorities, some authorities have set up complementary governance arrangements.** For instance, the SBS has set up a Digital Governance Committee, which aims to contribute to the development and articulation of an institutional digital strategy that aligns with the mandates, vision, strategic objectives and cultural values of the SBS. Another example is the BSP's Artificial Intelligence Council. This is a dedicated body tasked with providing direction, oversight and guidance on the adoption, use and scaling of AI within BSP. While training priorities are defined by individual departments, the council helps ensure that these initiatives are aligned with the BSP's overall AI strategy and governance standards.

Innovation culture

Observation 3: Authorities can foster an innovation-friendly culture as part of their tech-related CD strategies to support technology adoption and enhance organisational efficiency and effectiveness.

15. **CD plays a critical role in supporting an innovation culture by providing structured opportunities for learning, collaboration and experimentation.** By integrating innovation into CD efforts and providing structured learning, collaboration and experimentation opportunities, authorities can equip their workforce with the necessary technical skills and mindset to adapt to a rapidly evolving technological landscape. This fosters an innovation-friendly culture by creating an environment where staff are encouraged to experiment with new ideas, embrace change and think creatively about how technology can be leveraged to improve regulatory and supervisory practices.

16. **Some authorities have taken an institution-wide approach to promoting an innovation-friendly culture.** Practices range from a holistic and formalised transformation journey to a dedicated department mandated to promote an innovation culture. The MAS, for example, has formalised its internal transformation journey, covering different areas such as culture and leadership, technical skills, customer centricity, industry engagement, agile ways of working, data management and adoption of new technologies. Bank of Zambia has explicitly reflected innovation in their organisation's value system⁹ and

⁸ For instance, ASBA (2021) recommends a "special training function" integrated into the supervisory departments. The special function can be carried out by a newly created unit, a committee, or an individual representative from the agency's supervisory units.

⁹ This is represented by the acronym ACTIONE, which stands for accountability, commitment to excellence, timeliness, integrity, objective, new ideas (innovative) and equity.

in establishing change management guidelines. SBS created an Innovation Department that is mandated to foster a culture of innovation and encourage the development and implementation of innovative and more effective work solutions. The European SSM partners with an external organisation to offer an Entrepreneurial Training Programme that, among other things, aims to foster a start-up culture within the organisation.

17. **Continuously keeping staff updated on technological developments can contribute to an innovation-friendly culture.** By keeping employees informed about the latest advancements, trends and tools in technology, authorities can support their staff in using technology in their day-to-day work. Regular updates – through training sessions, workshops, knowledge-sharing initiatives and internal publications – not only enhance technical skills but also foster a mindset of openness to innovation. In this context, many authorities have established organisation-wide knowledge-sharing initiatives to raise organisational awareness of tech-related projects. For example, MAS promotes cross-departmental collaboration and sharing of use cases through Communities of Practice and organisation-wide learning events; the Bank of Spain has established an AI Network with representatives from various directorate generals, including a subgroup dedicated to training initiatives; and the BSP organises hackathons to provide staff with hands-on opportunities to collaborate on technology-driven projects and strengthen their technical skills through experiential learning.

18. **Internal staff publications are used by most of the surveyed authorities to raise awareness about topics related to technology and innovation.** The SSM, for example, publishes *SSM Tech Insights*, which is an internal newsletter dedicated to technology and innovation topics, including the opportunities these present and their potential impact on the daily work of supervisors. BSP, meanwhile, publishes *Fintech Expanse*, a weekly internal newsletter providing updates on fintech developments. The Bank of Ghana has raised staff awareness about tech-related topics by putting up banners and other forms of visual communication in common staff areas.

19. **Cross-functional collaboration provides a strong foundation for fostering an innovation-friendly culture.** Cross-functional activities can promote teamwork, innovative thinking and practical application of emerging technologies, as well as foster alignment on and shared ownership of common projects. Such activities can build tech-related capacities, complementing formal training programmes. All surveyed financial authorities strongly encourage collaboration across different functions on tech-related topics in various ways:

- a. **Embedding coordination mechanisms in the organisation.** Some authorities follow a hub-and-spoke model for their technology/innovation work. Examples include the following:
 - The ECB has a Suptech Hub that identifies synergies and needs across the SSM. National competent authorities and ECB staff work together in agile innovation teams on the development of suptech tools. The teams typically consist of both supervisory and information technology (IT) experts. The spokes are the business owners or the users of the suptech tools, who take ownership and play a leading role in developing specific use cases for their business areas.
 - MAS has a Data and Tech Architecture Department (serving as the hub) that launched its first Enterprise Data Science Platform in 2023. This enabled data scientists in various units (the spokes) to build and deploy both predictive AI and generative AI (GenAI) products in a secure, scalable and collaborative manner.
- b. **Creating ad-hoc cross-functional teams.** Some authorities create these teams to work on specific projects.
 - The BSP's Regulatory Sandbox Oversight Team is composed of representatives from various departments and is responsible for evaluating sandbox applications, monitoring test outcomes and guiding decision-making throughout the sandbox lifecycle. In addition, the BSP's project to put in place a Digital Supervision Platform is a coordinated effort of the supervision, IT, data governance and analytics teams. Other projects that required close coordination between

- regulatory, operational and technical units were related to open finance, blockchain analytics and AI-enabled supervisory tools.
- The development of Bank of Ghana’s E-Cedi central bank digital currency (CBDC) and Online Regulatory and Analytical Surveillance Software supervisory tool involved a team from the IT, banking supervision and policy units.
- The Bank of Zambia has working groups on digital transformation, fintech and CBDCs.

Section 3 – Identification of capacity development needs

Observation 4: Tech-related CD needs identification involves all relevant internal and external stakeholders, especially technology experts within the organisation to ensure the capacities developed meet business needs.

20. **Similar to the identification of overall CD needs, tech-related CD needs can be identified using bottom-up approaches but with special attention to input from technology experts.** Technology experts within the regulation/supervision area can serve as a bridge between the technical domain and the organisational needs, as non-experts – such as those usually in the CD function – may lack the necessary understanding of technical specificities. Authorities with dedicated technology or innovation teams can draw upon their expertise to identify tech-related training needs. A bottom-up approach involves gathering input from functional departments and staff on their training needs. In addition, feedback from participants and other stakeholders on the usefulness and relevance of CD initiatives can serve as input in identifying CD needs. Examples of bottom-up approaches include:

- BSP’s Individual Performance Scorecards: These identify performance goals and development needs, including those related to technology, for individual staff. The scorecards include an Individual Development Plan outlining the necessary interventions to develop each personnel’s competencies needed to perform current or projected tasks. This output feeds into the annual training catalogue and CD priorities.
- Bank of Ghana’s Training Needs Assessments: These are conducted through departmental interviews to identify areas for improvement.
- ECB’s supotech team: This team cooperates closely with the human resources department to define, on a yearly basis, key topics for tech-related training and to search the market for suitable cooperations.
- MAS’ ground-up learning needs assessments: Involving MAS Academy learning partners, these assessments collect and aggregate information from department heads on knowledge and skills gaps.
- OJK’s annual training needs analyses: These are conducted to identify competency gaps requiring CD. These studies collect and analyse relevant data on technological capabilities, supported by inputs from learning partners.¹⁰ CD themes are refined through these analyses, focus group discussions with learning partners across departments and alignment with institutional priorities. To support technological expertise, OJK has specialist teams and units, such as IT specialist supervisors and the Innovation Digital Financial Asset Unit.

¹⁰ Competency gaps are assessed in three key areas: leadership, technical skills and behavioural competencies, with the results forming the basis for human resource development policies.

- OSFI's regular consultations with internal stakeholders: These include organisation-wide and sector-specific tech-related units to evaluate organisational needs and skill gaps.

21. **As is the case in the overall identification of CD needs, authorities typically complement bottom-up approaches with input from heads of departments/units about their technological skills needs.** Such a top-down approach is crucial for prioritising tech-related skills development with organisational priorities. Various organisational arrangements can be used to seek line management input, such as dedicated CD planning committees, cross-departmental workshops or interviews conducted by the CD function.

Observation 5: A structured competency framework on technology can be useful in specifying the skills and knowledge required for specific roles that are aligned to an authorities' strategic objectives and priorities.

22. **A competency framework on technology can serve as an effective tool to set expectations on the functional and technical competencies needed for staff to perform their tasks effectively.** Within a competency framework, proficiency levels can help authorities identify skill gaps and design targeted CD initiatives. Several authorities have implemented dedicated frameworks to assess and enhance technological competencies. Following are examples¹¹ of role-based competency frameworks:

- BSP: BSP's Financial Supervision Sector follows a five-set competency framework as a guide for executing roles and responsibilities effectively. These competencies include the ability to contribute to the team's goals, protect information and behave ethically, understand the supervisory framework, know the banking business and its operating environment, and use good judgment. Technological competencies are captured in many of these general competencies. For example, being able to utilise digital technology can contribute to the team's goals, while familiarity with new technological developments improves knowledge of the banking business and its operating environment.
- Bank of Ghana: The Bank of Ghana has a three-tier training framework for its Banking Supervision Department, offering foundational, intermediate and advanced courses.
- ECB: The ECB has a Role-Specific Competency Development Framework,¹² which defines role profiles to guide staff in career planning and development, alongside a capability framework that identifies behavioural and technical core competencies.
- MAS: MAS's Functional Competency Frameworks process specifies the required technical competencies for various roles and seniority levels.¹³ Six areas of digital competencies are required for all staff – AI literacy, cyber security and data protection, data literacy, digital literacy, digital adoption and understanding of digital products. Its Tech Talent Framework defines the functional competencies required for technology-specific roles across various departments.¹⁴ Under this framework, supervisors and staff collaboratively identify competency

¹¹ The Bank of England has launched a new data fluency foundation training, aimed at all roles. The programme is integrated in its graduate and experienced hire inductions. It has also put in place in-depth apprenticeship programmes from school leaver to master's level. See Benford (2025).

¹² See ECB (2017). Competencies on "focusing on results", "thinking analytically" and "managing change", as well as "adding value for stakeholders" in the context of project management, are particularly relevant from a technology point of view.

¹³ The Functional Competency Frameworks development process involves collaboration between functional leaders, the People Development Department and the MAS Academy.

¹⁴ The Tech Talent Framework covers over 150 functional competencies for all tech roles within MAS. For example, on cyber security, the relevant competencies for a cyber security consultant are cloud security, policy and strategy, cybersecurity risk assessment and management, security design and engineering, and cyber security programme management. Each functional competency will have its general descriptors as well as descriptors at each proficiency level (from 1 to 5). More senior staff in the same role will generally be expected to demonstrate a higher proficiency level of each relevant functional competency.

- gaps and discuss targeted learning interventions to address them. For non-tech roles, it has a Functional Competencies Framework that identifies tech competency requirements or those that are aspirational to acquire.
- OSFI: OSFI's data literacy strategy aims at building a strong foundational and advanced understanding of data literacy. As part of the strategy, it introduced a Data Literacy Competency Model and established a Foundational Data Literacy Training programme.
 - OJK: The OJK has developed tailored competency frameworks for different roles to ensure staff possess the necessary knowledge and skills. Specifically in relation to technological developments and innovation in the financial sector, the OJK has developed Functional Competency Development Programmes for different roles, supported by specialised training initiatives across clusters such as supervisory innovation, digital fraud and tracking techniques.¹⁵
 - SBS: In February 2025, the SBS formally launched a programme to develop data management skills across the organisation. This programme is based on a data management competency-based model aiming at assessing and developing staff skills related to data collection, processing, analysis and visualisation. Six months into the programme, a self-assessment on data management skills was conducted¹⁶ and an initial technical skills assessment is planned for 2026. This model facilitates the development of personalised learning paths tailored to employees' roles (both technical and non-technical) within the data life cycle.

23. **Authorities tend to incorporate the identification of tech-related skill gaps into their performance review processes.** For instance, the BSP conducts an annual assessment of its personnel's performance. This evaluation, guided by a defined competency framework, also reviews each employee's development needs, which includes an assessment of their technological proficiency. This way, areas for improvement are systematically identified across the institution, and a skills and competency inventory has been established to support these efforts.¹⁷ Similarly, the Bank of Zambia incorporates development planning into its performance management process, offering targeted learning interventions where necessary. At the ECB SSM, staff have the flexibility to choose training based on business or job requirements or following the official human resources performance cycle during which individual learning needs are identified.

¹⁵ OJK (2021) sets out a dedicated blueprint for human resource development in the financial sector that aligns directly with the authority's goal to support a healthy, stable and competitive financial industry in Indonesia. Although not applicable to the authority, the blueprint sets out useful guidance that may be relevant for supervisory authorities, including a digital competency dictionary.

¹⁶ The purpose of the self-assessment was to identify training gaps among staff enrolled in the programme who had an assigned role in the data life cycle. The results of this exercise showed that the largest gaps were in data analysis and data processing, which are expected to be mitigated by 2026.

¹⁷ This inventory enables management to effectively align personnel development with the organisation's supervisory and regulatory responsibilities.

Section 4 – Design and delivery of technology-related capacity development

Training sources

Observation 6: Authorities can adopt a multi-faceted approach to technology CD, leveraging both in-house and external resources while fostering partnerships to address evolving technological skills needs. Reliance on external expertise can be more pronounced than other CD areas given that rapid technological developments are centred in tech firms and the academia.

24. **Authorities employ a variety of training sources to develop technology skills, often combining in-house programmes with external training providers or partnerships.** In-house training allows institutions to tailor content to their specific needs more easily and quickly, while external providers or collaborations offer access to specialised expertise. For instance, MAS offers a mix of in-house training through its MAS Academy and courses provided by specialised government agencies such as the GovTech Digital Academy¹⁸ and the Singapore Civil Service College, which deliver both online and in-person programmes. The Bank of Spain primarily relies on in-house training for CD, alongside programmes offered by the SSM and the EU Supervisory Digital Finance Academy.¹⁹ The SBS offers a combination of three training modalities: in-house courses designed with the Peruvian financial context and practical approaches in mind; external courses for highly specialised topics; and self-paced learning courses designed to reach its broad employee base.

25. **The selection of training programmes is a process that balances the nature and complexity of the skills being developed with practical factors such as format, cost and quality.** For instance, the Bank of Zambia prefers in-person training for practical skills requiring hands-on activities, while online training is favoured for longer programmes, especially those leading to certification examinations. Similarly, institutions like OJK prioritise effectiveness and efficiency in their selection process, considering factors such as expenditure, the quality of training materials and the reputation of training providers. Additionally, the SSM emphasises the importance of market research in selecting tech-related training, though it faces challenges in identifying trainers who can meet specific institutional needs.²⁰

26. **Authorities can leverage internal technical experts to deliver tech-related CD by tapping into their specialised knowledge, practical experience and understanding of organisational systems.** Relying on internal experts ensures that the training is relevant, cost-effective and directly aligned with an authority's goals. Structured initiatives, such as "Train-the-Trainer" programmes, can equip these experts with the necessary teaching skills and resources to deliver impactful training. For example, the SBS has introduced a Train-the-Trainer programme, bringing together employees who are experts in data management and interested in sharing their knowledge with colleagues. This programme offers training, didactic support and the necessary facilities to ensure the effectiveness of its courses. At the MAS, specialist teams work closely with MAS Academy by providing inputs to learning strategies and delivering training to staff on tech-related topics.

27. **Authorities avail themselves of a variety of external training opportunities through collaborations with various organisations.** These collaborations could be in the form of leveraging

¹⁸ [Home – GovTech Digital Academy](#).

¹⁹ For more information, see [EU Supervisory Digital Finance Academy – European Commission](#).

²⁰ An example of in-person training is the Mission Impact Academy's one-day onsite programme, which equips ECB banking supervision and central banking staff with foundational knowledge and practical expertise on artificial intelligence (AI). In contrast, longer online courses, such as the Innovation and AI training provided by the Institut Européen d'Administration des Affaires (INSEAD), span several weeks to deliver in-depth learning.

training programmes offered by those external agencies, co-developing joint training programmes or identifying skills needs.²¹ Examples of such partnerships include the following:

- Academic institutions:
 - The BSP has established partnerships with various academic institutions to offer specialised courses in emerging and critical areas such as cyber security, suptech and AI. The BSP has sent staff to participate in forums organised by the Cambridge Suptech Lab and suptech and data analytics programmes offered by University of Cambridge Judge Business School. It also partners with De La Salle – College of Saint Benilde to offer the Executive Diploma Program on Cybersecurity.
 - The Bank of Spain offers its supervisors a one-week summer school, and junior economists a full training programme – including data science and AI topics – through the Center for Monetary and Financial Studies. It also collaborates with the Supervisory Digital Finance Academy. Recently, it partnered with the European Commission to launch a training programme on GenAI, which includes a state-of-the-art technical course, executive seminars and a hackathon.
 - The ECB has collaborated inter alia with the European University Institute, Institut Européen d'Administration des Affaires (INSEAD) and Massachusetts Institute of Technology in supporting delivery of training to staff and leadership on AI-related topics. The ECB offered the INSEAD innovation and AI online training programme (two months) to all staff (limited to 300 participants per cohort) – the programme covered innovation techniques and non-technical fundamentals of AI.
 - The OJK partners with Cambridge Centre for Alternative Finance to conduct suptech training for staff across various departments to integrate technology into regulatory and supervisory functions.
 - MAS collaborates with the Temasek Foundation's Lee Kuan Yew School of Public Policy to offer the Association of Southeast Asian Nations (ASEAN) Financial Regulators' Executive Programme.
- Peer central banks: Bank of Ghana participates in training, including on tech-related topics, offered by the Bank of England.
- Public sector agencies: The EU Supervisory Digital Finance Academy and Singapore's GovTech Digital Academy offer programmes that are open to financial authorities in those jurisdictions.²²
- Research institutions: The Bank of Spain has a memorandum of understanding with the Barcelona SuperComputing Center.
- Consultants: The Bank of Ghana's consultant that developed its Operational Risk Assessment and Surveillance System provided training to its staff on data visualisation and scenario analysis for operational risk monitoring.
- Regional/international institutions: International Monetary Fund's African Regional Technical Assistance Centre (Afrítac)²³ helped the Bank of Ghana to develop a competency framework for

²¹ Financial support from external organisations can help with the delivery of authorities' CD programme. For example, SBS Peru received a grant from the Swiss Cooperation to develop courses on data management. It also secured partial scholarship from a multilateral organisation to collaborate with the Cambridge Suptech Lab to develop projects to improve supervision through the use of AI.

²² Annex 2 provides an overview of the areas covered in the two programmes.

²³ The second AFRITAC (West 2), is a collaborative effort between the IMF, recipient countries and several bilateral and multilateral partners. See [the IMF Afrítac West 2 Home](#).

its banking supervision department, including a training needs assessment on tech-related topics and a structured curriculum. It also provided workshops and technical guidance for building internal training capacity. The Bank for International Settlements (BIS), through FSI, offers an online course on technology²⁴ and tech-related FSI Connect tutorials.

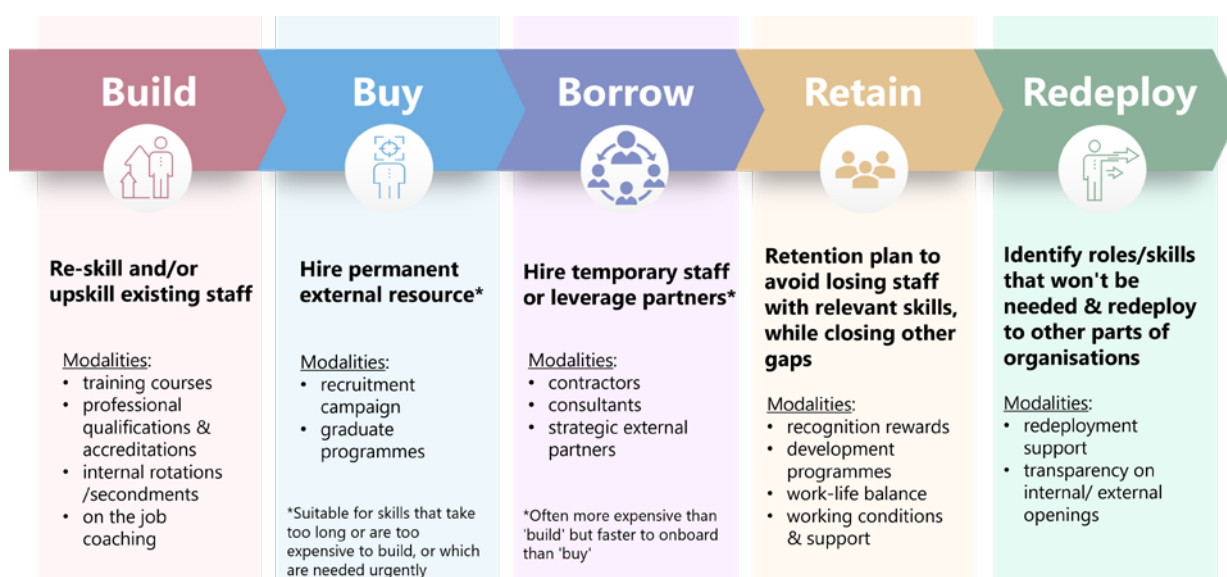
- Other organisations: Certain authorities have partnered with technology firms including big techs in sourcing relevant tech-related training for their staff. Such partnerships can fill the gap of skills or knowledge on the latest technology that is available only from private sector technology providers.

28. **External training provided by specialised providers includes both certification and non-certification programmes.** Amongst the surveyed authorities, certification programmes offered to staff include Certified Information Systems Auditor, Certified Information Security Manager, Certified in Risk and Information Systems Control, Certified Information Systems Security Professional and various cryptocurrency certifications.²⁵ Non-certification programmes focus on a range of tech-related topics, such as cyber security, GenAI for risk management, digital literacy, data science, data analytics and data visualisation.

29. **Filling identified tech-related skills gaps need not rely solely on upskilling using internal or external expertise – other options exist.** While upskilling is generally the preferred approach, external hiring is done when internal resources cannot bridge competency gaps within the necessary time frame. For example, MAS brings in new staff when gaps must be addressed quickly or cannot be resolved through upskilling. Likewise, BSP leverages performance assessment results to decide if external experts are needed to meet immediate technical demands and support operational objectives. Graph 2 (adapted from the Skills Gap Analysis Toolkit of the UK Financial Services Skills Commission) provides options on how skills gaps can be addressed, not only through CD programmes.

Options to close technology skills gaps

Graph 2



²⁴ The FSI organises an online course on financial innovation and technology (BIS-FIT) on an annual basis. The course covers topics such as AI, cyber resilience and cryptoassets.

²⁵ OJK mentioned that some of these certification programmes may be conducted through in-house training.

Content of technology-training programmes

Observation 7: Tech-training programmes can be tailored to different levels of proficiencies, addressing competencies aligned to institutional priorities. Foundational digital literacy can be essential for all staff as technology permeates all supervisory processes.

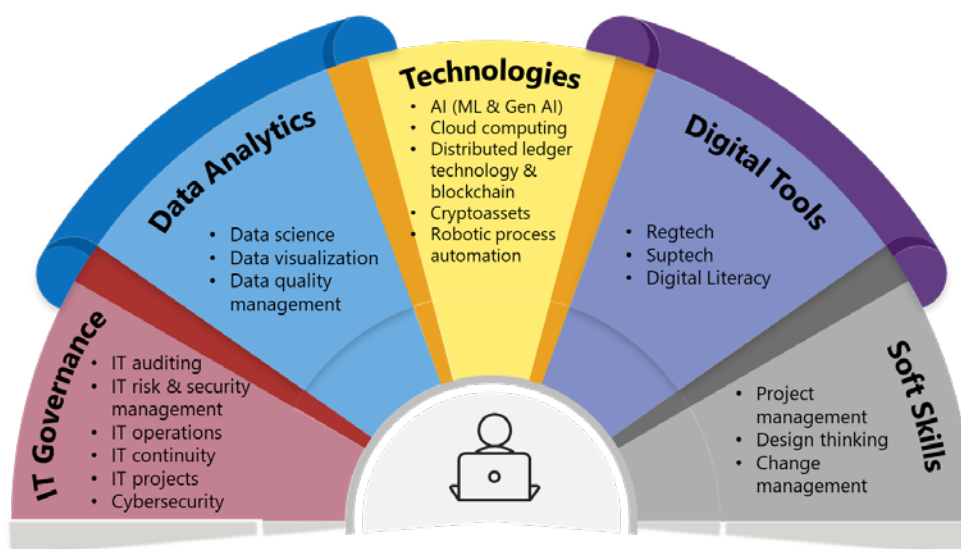
30. **Authorities seeking to leverage technology and promote innovation typically have a structured tech-related training programme.** This is the case with many of the surveyed authorities but with different emphasis or focus, possibly reflecting their institutional priorities and their views on core competencies crucial for supervisors. The different focus areas include the following:

- digital transformation: data, technology and customer centricity
- digital competence: cyber security,²⁶ GenAI for risk management, data science, data analytics and visualisation
- data management
- innovation and AI

31. **A comprehensive tech-related CD programme should cover relevant technologies and tools, digital competencies and related areas, such as IT governance and soft skills.** Graph 3 below summarises the topics covered in the surveyed jurisdictions' tech-related CD programmes. This chart illustrates the multifaceted skillset required for a tech-savvy supervisor, highlighting five domains: emerging technologies, digital tools, data analytics, IT governance and essential soft skills. These topics are interlinked – technologies serve as the foundation for digital tools, which can be applied in day-to-day supervisory activities. Data analytics requires leveraging technological tools to extract supervisory insights from information and financial data. IT governance is critical for secure and responsible use of technologies and tools. Soft skills enable appropriate implementation and adoption of technology in supervisory activities.

Stylised example of topics in technology-related capacity development programmes

Graph 3



²⁶ Bank of Ghana (2024) cited cybersecurity and technological developments as high priority areas covered in its CD programme in 2024. OSFI (2025) mentioned that its 2024–27 Human Capital Strategy includes growing employee skillsets in data literacy and information integrity and security. It plans to enhance its training programmes to develop technical and specialised skillsets in new supervisory fields arising from their expanded mandate covering integrity and security.

32. **CD training programmes cater to different roles within supervisory authorities.** OJK offers a leadership refreshment programme focused on digital transformation and leadership. The programme aims to develop leadership capabilities aligned with technological advancement and innovation. It covers topics such as strategic problem-solving, creative and innovative thinking, and coaching and mentoring. The SBS has a dedicated programme for staff involved with data management (data users, data analysts, business intelligence developers, data scientists) including both technological and non-technological professional profiles. This programme differentiates specialised courses from those cross-functional ones that are required at a general level to drive a cultural shift in data management across the institution.

33. **CD training curriculums cover either a broad range of topics on technology and innovation or specialised areas.** For example, a curriculum can cover a broad subject matter (eg data, technology, customer centricity, governance, risks and auditing, and IT management) or comprise specific learning pathways for each subject matter. A broad curriculum fosters general awareness and cross-functional understanding, while targeted pathways allow staff to develop specialised expertise relevant to their roles. Some authorities may adopt a hybrid approach, combining foundational training for all staff with advanced modules for specific skill development. Some authorities have dedicated modules/segments on technology as part of a broader training programme. For example, the BSP has an internal course on technology risk supervision as part of its Professional Excellence Program for Bank Supervisors for banking supervisors. Given heightened interest on AI deployment within supervisory authorities, Box A discusses how authorities can develop a curriculum on AI.

Box A

Developing a curriculum on artificial intelligence for financial regulators/supervisors

Many financial authorities are increasingly focused on equipping their staff with the skills needed to harness artificial intelligence (AI) to enhance their operational efficiency and effectiveness and to strengthen their oversight of financial institutions' risk exposures.^① As AI tools become more accessible, affordable and capable of performing complex tasks, authorities have the opportunity to strategically optimise both financial and human resources. The use of AI will enable authorities to augment the capabilities of their staff and redeploy human resources to higher-value tasks, fostering innovation and productivity.^②

To realise these benefits, a capacity development (CD) strategy on AI should be well-aligned with an authority's strategic direction and governance framework for AI.^③ Some authorities have established a high-level steering committee to drive the adoption of AI within the organisations. An effective CD strategy should support the implementation of an authority's AI roadmap, addressing internal policies on responsible AI use and providing staff with the necessary knowledge and confidence to fully leverage available AI applications. More mature institutions may leverage CD initiatives to promote innovation among staff, providing them with the necessary skills to propose, develop and deploy AI solutions to address real world problems and tasks. Alignment with human resource planning will also be critical to ensure staff are appropriately reskilled and upskilled to take on transformed roles impacted by AI.

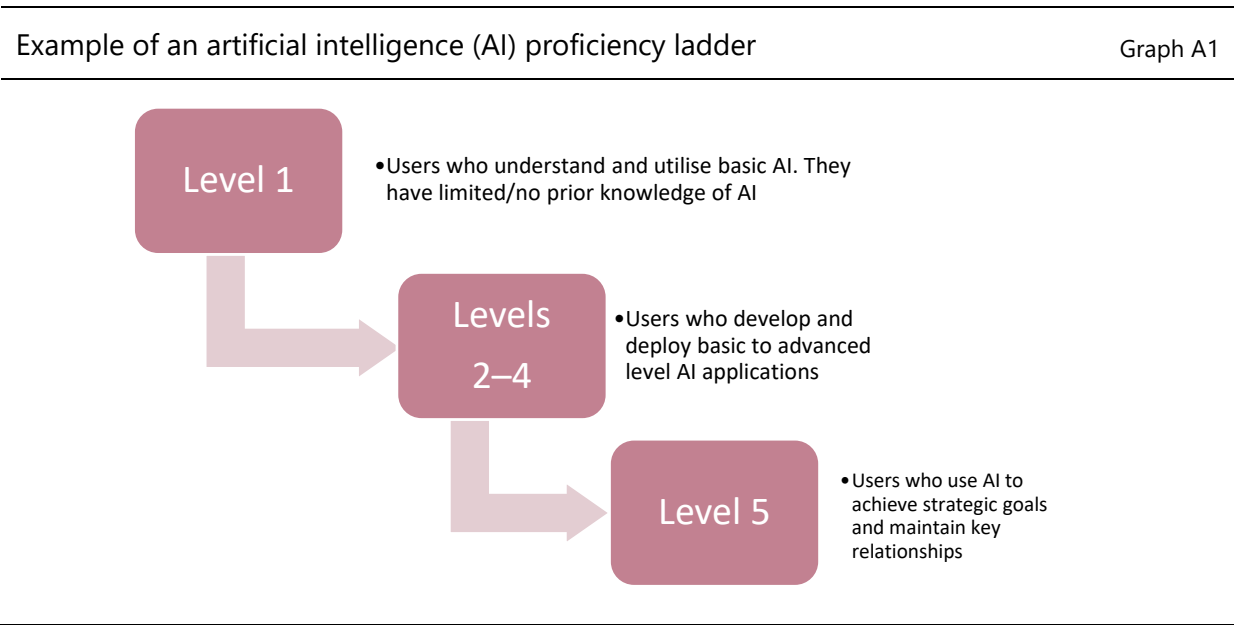
AI has the potential to benefit all job roles within a financial authority, from front-line supervisors to human resource teams. For instance, large language models (LLMs) can summarise meeting minutes, while machine learning (ML) models can predict firms' financial positions. These tools offer vast opportunities to transform supervisory organisations. However, the associated risks must be carefully managed. Risks such as hallucinations in LLM outputs or inadvertent disclosure of confidential information underscore the importance of training staff to use AI tools responsibly, while understanding their limitations and potential pitfalls.

Training efforts should extend beyond technical skills to encompass essential guardrails, such as data privacy policies, copyright considerations and ethical guidelines. In addition, measures should be put in place to support the cultural and mindset shifts that may be needed to shape staff members' attitude towards AI, which may in turn influence their interest and willingness to engage in AI CD.^④

From a regulatory and supervisory perspective, policy and supervisory staff need to keep abreast of AI including ML use cases in banks and insurers. Critical or high-risk use cases (for eg in banking of insurance

underwriting, or regulatory capital requirements calculations) require a good grasp of the underlying model in order to assess compliance with relevant requirements.

As a result, it is important to establish a structured CD programme to enable successful implementation of AI strategy within financial authorities. Such a programme should be tailored to the different personas within a supervisory organisation, for example, not all staff need to understand the ML algorithms underlying an AI application. Bank of Spain (2025) outlined a training approach as part of its 2030 strategy, including the establishment of AI and data academies with multiple levels of competencies to enable staff to progress gradually through different subjects according to their needs. Reserve Bank of India (2025) proposes the creation of an AI Institute to support capacity building for regulators and supervisors, recognising the critical need to understand AI technologies to avoid inadvertently curtailing innovation or issuing policies that fail to provide appropriate safeguards. Table 4 in Annex 3 provides a stylised example of AI-related competencies^⑤ mapped across staff groupings. Kazinnik and Brynjolfsson (2025) proposed grouping job roles according to “exposures” to LLMs and mapping the roles to three pathways – literacy (foundational awareness of AI even for those with limited interaction), upskilling (for those whose deepening of AI competencies will significantly improve productivity) and reskilling (for those whose skills might be replaced by AI). Another way to structure training on AI is to segment staff according to their level of AI proficiency. The UK’s Financial Services Skill Commission’s Future Skills Framework is one example of such an approach, as shown in Graph A1.



A key challenge in establishing a CD programme on AI is keeping pace with rapid technological advancements. AI-related skills can quickly become obsolete as new AI applications increasingly automate tasks. For example, coding skills may diminish in importance as AI systems evolve to generate code based on simple text prompts. Striking the right balance between a “wait-and-see” approach – avoiding premature investments of time and resources – and the “fear of missing out,” where authorities aim to seize opportunities to harness AI capabilities, is not an easy decision.

① For example, Board of Governors of the Federal Reserve System (2025) acknowledge that education and training of staff are critical to keep (central bank) employees at the technological frontier. Bank of Spain (2025) places high priority on using technology to achieve cultural and organisational transformation in its 2030 strategy. It expects to significantly improve productivity through the use of GenAI with appropriate training for its employees on how to use the tool. ② Hybrid intelligence is an emerging field that seeks to bridge the gap between human intelligence and AI by combining both strengths to create systems that outperform humans and machines working independently. In the area of education research, hybrid intelligence seeks to strike a balance between mitigating the negative impacts of AI while supporting learners’ reskilling and upskilling. See Järvelä et al (2025). ③ Consultative Group on Risk Management (2025) outlines the governance of AI adoption in selected central banks, some of which have regulatory functions. ④ See Chee et al (2024). ⑤ The OJK sets out AI competencies for the financial sector – basic: ability to understand and explain basic technological concepts related to AI and its use cases; intermediate: ability to process digital data by utilising AI to generate relevant output for a specific job responsibility; and advanced: ability to use and interpret results from AI applications.

34. **To facilitate the uptake of training programmes, authorities are leveraging technology.** For instance, the BSP has created an online platform called BSP Education in the Digital Generation (EDGE), which provides employees with access to a variety of training sessions. Similarly, the SBS has established customised learning paths within its Massive Open Online Course platform aligned with its competency-based framework, which give users a certification after completion.

35. **Authorities are introducing various incentives to encourage participation in training programmes.** Progress in developing tech-related skills is often considered when evaluating career opportunities, promotions, salary increases or performance bonuses. Many authorities also provide certificates upon successful completion of tech-training programmes as an added incentive. Additionally, staff members' efforts in CD are recognised through award ceremonies and recognition programmes. A McKinsey staff report assessed how organisations successfully accelerate AI adoption and found that the role of social recognition was as powerful as financial incentives, if not more, to encourage meaningful AI adoption among staff.²⁷ Related to this, the SBS publishes a monthly leaderboard to recognise employees who have made the most of its learning platforms during that period, as well as the teams that have demonstrated outstanding participation in training programmes. Some authorities also offer financial support schemes to aid staff in their learning and development. For example, MAS sponsors formal qualifications ranging from certificates to postgraduate degrees, as well as advanced studies through master's or doctoral programmes.

Non-training capacity development activities

Observation 8: Authorities adopt a range of CD approaches to complement formal training programmes, enabling staff to gain knowledge and skills that go beyond what traditional training can provide.

36. **Authorities can build in-house knowledge on technology by participating in domestic, regional and international forums, networks and collaborations.** Reliance on such "alternative" sources of CD to supplement formal training could enable exchange of knowledge and experiences and staying abreast of global trends. The surveyed authorities engage in initiatives such as the SupTech Roadmap for ASBA (Association of Supervisors of Banks of the Americas), the SSM Tech Expert Group and the FSI Informal SupTech Network. These engagements span various themes, including capacity building, technological advancements, conferences and bilateral exchanges. Within the EU, regular national competent authority supotech roadshows and the BIS Innovation Hub hackathons provide additional platforms for collaboration, while innovation hackathons offered by academic institutions allow authorities to explore new technologies and improve supervisory tools. Another form of peer exchange is participation in BIS's Open Tech initiative, collaborating with peers on digital solutions for common use cases.

37. **International and regional forums on capacity building can provide useful platform for authorities to exchange good practices on tech-related CD.** By participating in these forums, authorities can stay informed about emerging trends, build professional networks, exchange tips on ways to address common challenges and enhance their ability to design and implement effective tech-related CD programmes. Forums mentioned by surveyed authorities include the FSI Informal Supervisory Capacity (SupCap) Network, the ASEAN Steering Committee on Capacity Building, IMF-STI Directors of Training meetings, the IMF-BIS Symposium on Capacity Building and the SSM's Steering Group for Supervision Training.

38. **Many authorities provide secondment opportunities internally and to other central banks and financial authorities as part of their staff's learning and development initiatives, including for tech-related skills.** Institutions offering secondments use them as a tool for knowledge-sharing, capacity building, professional development and acquisition of technical expertise. The gained knowledge enables

²⁷ Sternfels and Atsmon (2025).

the seconded staff member to make a greater contribution to their home institution. Furthermore, knowledge transfer mechanisms – such as formal reports, debriefing sessions or workshops – are frequently employed to ensure that the knowledge gained during the secondment benefits a broader group of staff. Examples of secondment programmes include the South African Development Community Committee of Central Bank Governors exchange programme and the FSI's Fellowship programme.²⁸ The OJK promotes internal collaboration through internal assignments, for example, temporary assignment of a staff to a specific department to gain hands-on experience or assignment to a special project or working group.

39. **Research partnerships and sandboxes can also contribute to CD in authorities.** The BSP collaborates with the ASEAN+3 on policy and operational recommendations on open finance. It also has a memorandum of understanding with the Korea Financial Telecommunications and Clearings Institute on regulatory sandbox development, open finance and AI innovations, providing a platform for shared expertise and experimentation. Bank of Ghana's regulatory sandbox facilitates shared learning with fintech firms on digital risk management, data protection and suptech. These initiatives allow authorities to explore emerging technologies in a controlled environment, refine regulatory approaches and build internal expertise.

40. **Many institutions actively organise conferences, workshops and forums to engage staff on tech-related topics.** Examples include conferences and fintech festivals, including the Singapore Fintech Festival,²⁹ the Indonesia Fintech Summit & Expo,³⁰ the 3i Africa Summit and the SSM Supervision Innovators Conference.³¹ Authorities also conduct workshops and training programmes that draw on industry practitioners, such as the MAS Information Technology Supervision Workshop (ITSW)³² and the Bank of Ghana's Cybersecurity Awareness Week.³³ Additionally, targeted engagements with industry are common, such as the BSP's focused group discussions on specific topics and Bank of Zambia's regular meetings with chief information officers from financial institutions.

41. **Many authorities are also leveraging knowledge-sharing activities to keep staff updated of new developments.** These include discussion groups, podcasts, townhalls and "showcases" (eg hands-on learning events and experiential workshops). For example, MAS regularly hosts industry experts for knowledge-sharing sessions that are open to all staff. The US Federal Reserve³⁴ has organised a cross-functional, cross-organisational AI expo where early AI adopters shared their experiences. The event supports the promotion of cultural norms of responsible AI usage, recognising the types of problems AI is better or worse at solving. The OJK arranges knowledge-sharing sessions around suptech to facilitate structured discussions and awareness-building on the topic.

²⁸ See [FSI Fellowship programme](#).

²⁹ This festival is a large-scale event that MAS supports to bring together different stakeholders to share insights and discuss challenges in the financial technology industry.

³⁰ In 2024, the event facilitated discussions on the latest developments and emerging issues in fintech and digital financial innovation, involving both domestic and international regulators and industry practitioners.

³¹ The ECB Banking Supervision Flagship Event in 2025 will mark the sixth edition of the conference, focusing on "AI in Action: Shaping the Future of Banking and Banking Supervision." The event is expected to bring together over 1,000 experts from leading technology companies, academia, the banking industry, central banks and supervisory authorities from around the globe.

³² The ITSW is a three-day workshop organised by MAS that is designed for financial regulators and supervisors with IT supervision responsibility. It focuses on enhancing supervisors' understanding of technology risk management issues and information security. Topics such as developments in cyber security and emerging IT risks in the financial industry are covered. MAS has conducted 14 runs of the ITSW, and more than 400 financial regulators and supervisors have attended the ITSW thus far.

³³ Organised annually by the Bank of Ghana in partnership with the Cybersecurity Authority and other financial sector regulators. The event covers cyber risk management in financial institutions, regulatory expectations under the Bank of Ghana's Cyber & Information Security Directive, and the use of technology in fraud prevention.

³⁴ See Board of Governors of the Federal Reserve System (2025).

Section 5 – Effectiveness assessment

Observation 9: At the individual CD initiative level, authorities can employ different methods to assess the effectiveness of those CD activities in meeting organisational goals to ensure that the human and financial resource investments are commensurate with the outcomes.

42. **Assessing the effectiveness of CD activities is crucial for ensuring that these initiatives deliver meaningful value and align with an organisation’s strategic objectives.** Assessment allows authorities to determine whether the knowledge, skills and competencies gained through CD efforts are being applied effectively to achieve desired outcomes, such as improved regulatory oversight, enhanced technological capabilities or stronger risk management. Certification from formal training can be useful to ascertain attainment of a certain level of competency. Without such assessments, there is a risk of misallocating human and financial resources to programmes that may not meet an authority’s needs or address emerging challenges. Evaluating effectiveness also helps identify gaps in current CD strategies, enabling authorities to refine their approaches, update content and adopt innovative methods to stay relevant in a rapidly evolving landscape. Furthermore, regular assessments foster accountability, transparency and continuous improvement, ensuring that staff development initiatives remain impactful and contribute to building a skilled, adaptable and forward-looking workforce capable of navigating increasingly complex regulatory and financial environments.

43. **In general, methods to assess effectiveness of tech and non-tech-related CD are similar.** Crisanto et al (2022) outlined common evaluation methods such as collecting feedback from participants and monitoring key performance indicators.³⁵ Nevertheless, in certain cases, the outcomes of tech-related CD may be more visible than other CD activities, in terms of adoption rates of certain tools (eg AI applications). The BSP is beginning to explore these outcome-oriented checks. For example, when it comes to staff trained on AI/ML, these checks include whether they are able to produce useful tools, whether these tools result in efficiency gains and are being used by the intended users. These checks provide insights on the effectiveness of CD activities in translating to applied skills, producing tangible improvements in operations and responding to organisational needs.

Observation 10: At the institutional level, authorities can aim to advance their tech-related CD framework by adopting good practices from peer institutions. An assessment of the level of advancement of an authority’s tech-related CD programme can be useful to identify measures needed to improve its CD approach.

44. **Authorities use various methods to gauge their institutional level of “maturity” or effectiveness of their tech-related CD programmes.** It is important that effectiveness assessment of a specific CD programme is tied back to the authority’s strategic priorities.³⁶ The surveyed authorities employ the following methods, though not exclusively to tech-related CD programmes:

- External review: Bank of Spain underwent an external evaluation of its suptech function. This review assessed the governance of its technical and human development processes, ensuring alignment with the institution’s mandate and objectives. They also evaluate coordination and interaction with the SSM in the suptech domain.³⁷

³⁵ For example, the OJK evaluates the effectiveness of all CD programmes, both tech and non-tech, using the same approach. The ECB’s CD teams for tech-related skills cooperate closely with the team addressing generic banking supervision training needs. Both teams use methods such as surveys and targeted interviews as key tools for assessing training effectiveness.

³⁶ OSFI (2022) highlighted the importance to link performance information and feedback on training programmes to the authority’s strategy and measure against established goals.

³⁷ See report, action plan and other material about the evaluation at [Evaluation of the suptech function – Evaluations – Banco de España](#).

- Landscape scanning: The BSP conducts regular scans of the regulatory and industry landscape to stay informed about global trends and best practices. Through gap analysis, it identifies areas where its current CD initiatives fall short of meeting global standards or institutional priorities. These insights guide the design of new training tools and programmes tailored to the specific needs of its departments and employees.
- Benchmarking: The Bank of Ghana uses training needs assessments and competency frameworks to identify skills gaps in tech-related areas. It collaborates with organisations such as IMF Afritac, the Alliance for Financial Inclusion and the Bank of England to benchmark its training content, delivery models and strategic focus areas. Similarly, OJK aligns its institutional competencies with domestic and global trends in the financial industry (eg banking, capital market and non-bank financial industry) by benchmarking CD maturity at basic, intermediate and advanced levels.
- Peer learning: Peer learning forums provide a platform for authorities to share insights on CD practices. For example, the Bank of Ghana and the Bank of Zambia participate in regional peer learning initiatives with other central banks, enabling them to adopt CD best practices to address regulatory challenges.
- Feedback: Bank of Ghana gathers post-training evaluations, supervisor feedback and performance appraisals to assess learning outcomes and practical applicability of skills to inform refinements of future programmes.
- Staff progression: SBS Peru monitors staff progression data to measure the impact of training. By comparing the level of competence gained by staff members against their career progression, the authority identifies further training needs and ensures alignment with professional development goals.

Box B

Elements of a mature technology-related capacity development framework

A mature tech-related capacity development (CD) framework typically has the following features:

- Strategic alignment: CD programmes are linked directly to an authority's strategic objectives and regulatory/supervisory priorities, such as supervision of AI and cyber security, and modernisation of supervisory processes through supotech adoption.
- Structured learning pathways: Well-defined, tiered training programmes (eg foundational, intermediate and advanced) are tailored to different job functions and technical specialisations.
- Integrated learning ecosystem: The framework uses blended learning methods, including online courses, in-person workshops, sandbox simulations and scenario-based exercises. A central or integrated knowledge management system is crucial to facilitate easy access by staff.
- Strong governance: Dedicated senior management or committees provide oversight and sponsorship and departmental heads are continuously involved in defining training priorities and evaluating impact.
- Knowledge retention and institutionalisation: Mechanisms such as internal presentations, knowledge-sharing sessions, staff networks and on-the-job application of skills ensure that capacity built is retained and scaled across the institution.
- Stakeholder engagement: Close collaboration across departments and with external partners (eg universities, industry and international financial institutions) ensure diverse perspectives and up-to-date content.
- Adaptability to technological changes: Regular evaluation of CD outcomes with feedback loops informs adjustments in content, delivery methods and learning pathways. Regular updates to training

content and CD priorities reflect current and emerging issues such as digital transformation, cyber security, data governance, AI, supotech and regtech.

- Long-term view: Continuous professional and technological development is embedded in CD strategy to keep pace with technological developments and enhance the skills of tech-savvy new hires (as more universities incorporate data science and machine-learning skills into core curriculums).^①

^① See Wylie (2025).

Section 6 – Concluding remarks

45. **To address the risks and harness the opportunities of rapid technological developments, authorities need an effective CD framework for technology.** This framework should be guided by a clear strategy aligned with their objectives and operationalised through structured, flexible and iterative processes. An innovation-friendly culture can encourage staff to embrace technology responsibly and enhance organisational efficiency and effectiveness. This culture can be cultivated through fostering cross-functional collaboration, embedding innovation in organisational values and reinforcing ambition through a clear digital or technology policy. Central to these efforts is a dedicated CD function, which, while not necessarily exclusive to technology, should tailor its approach to tech-related needs. Close collaboration with operational teams is critical to ensure that training is relevant, draws on suitably qualified subject matter expertise and addresses the specific challenges of each authority, including unique supotech tools and jurisdictional risks.

46. **An effective tech-related CD framework needs to remain adaptable to technological advancements and leverage cross-disciplinary collaboration and strategic partnerships to remain impactful.** Unlike general topics that often focus on established frameworks, policies or compliance procedures, technology training needs to keep pace with rapid innovation, evolving risks and complex technological systems. Authorities need to institutionalise adaptable frameworks that evolve with external developments such as technological advancements, policy shifts and changing business models. As a result, tech-related CD requires more frequent updates, cross-disciplinary collaboration and, often, partnerships with external experts or tech providers. Partnerships with international and regional bodies to co-develop training content and regionally relevant programmes can also bring valuable insights and expertise to the organisation. Developing role-based competency frameworks can ensure that training aligns with evolving job roles and technological developments.

47. **The importance of tech-related CD as a factor in staff retention is likely to grow significantly in the coming years, particularly as the competition for tech-savvy talent intensifies.** With the rapid pace of technological advancements and the increasing reliance on technology in financial regulation and supervision, the demand for skilled professionals who can navigate this evolving landscape will only increase. Financial authorities face the dual challenge of attracting such talents while also retaining them in an environment where private sector opportunities may offer better incentives. To remain competitive and avoid falling behind the technology curve, authorities will need to prioritise and expand their investments in tech-related CD.

48. **The effective application of technology by supervisors has the potential to transform the supervisory landscape.** By leveraging advanced tech tools, supervisors can apply a less invasive approach to oversight that benefits both firms and authorities. Real-time data analytics powered by AI can enable supervisors to monitor firms more dynamically and reduce the reporting and compliance burdens placed on firms. This shift aligns with the broader objective of enhancing competitiveness and simplifying

regulatory and supervisory frameworks. Nevertheless, overhauling the supervisory approach will require skilled expertise and a change in mindset and supervisory culture that is pro-innovation and digital-first.

49. **Tech-related CD is a critical enabler to transform supervisory approaches in the face of rapid technological advancements.** The move towards smart supervision – leveraging technology to make supervision more efficient and effective – will require a tech-savvy workforce, with technology embedded in the DNA of all supervisory staff. While technology such as AI holds the potential to revolutionise the regulatory and supervisory landscape and potentially reduce compliance burdens for firms in support of competitiveness goals, these benefits will not bear fruit without suitably skilled staff. As a result, doubling efforts on tech-related CD – in close partnership with peer authorities, regional partners and international organisations – will be critical to keep pace with the next chapter of financial sector supervision.

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Annex 1: Challenges faced in technology-related capacity development

Authorities face wide-ranging challenges in implementing effective tech-related training strategy. Some of the challenges and potential ways to overcome them based on input from the surveyed authorities are summarised in Table A.1 below:

Challenges faced in technology-related capacity development			Table A.1
Challenges	Description	Ways to overcome	
Innovation-friendly culture / varying levels of readiness	- Staff resistance to adopting new artificial intelligence (AI) tools; different comfort levels with tech across groups/depts - Traditionally risk-averse, compliance-driven supervisors - Tension between fostering innovation and operational stability	- Create functional competency frameworks for each job role, with clear interventions (formal training, social learning, on-the-job application); staff appraisal to assess proficiency levels - Set up internal digital literacy campaigns (eg inspire-innovate-include summit) and including staff in innovation projects to build enthusiasm and ownership - Designate internal champions and cross-functional working groups to drive cultural change - Encourage culture of innovation and do not penalise experimentation - Break down data silos to promote cross-functional collaboration while ensuring data security and compliance	
Pace of technological developments	- Difficulties in change management and aligning the organisational mindset to embrace new technologies - Need for continuous learning and adaptation to keep course content and frameworks current - Difficulty of adopting tools that remain relevant over time	- Develop modular training content that can be easily updated - Engage in international working groups and peer networks to identify emerging trends - Encourage learning via online platforms and short modular courses on new developments that can be deployed rapidly - Invest in continuous learning and development programmes	
Sustained engagement	- Problem of converting interest into sustained practice/implementation; and of ensuring learning translates into practical application	- Create sustainable learning systems (eg Communities of Practice) to share knowledge - Sponsor professional memberships in relevant associations to keep tab of latest industry trends - Offer bit-sized, just-in-time learning to drive practical application; demonstrate tangible benefits/productivity gains - Change management process; offer consistent publicity of new learning initiatives; engage with leadership	
Impact / effectiveness	- Difficulty measuring impact and utility of capacity development activities - Difficulty of objectively measuring impact of training on performance and institutional capacity	- Use pre- and post-training assessment, supervisor feedback, integrating training goals in performance appraisals - Link training outcomes to departmental key performance indicators	

	- Time lag between training and the application of newly acquired skills - Often subjective, qualitative and not easily quantifiable outcomes	- Use the following metrics: - o Programme level evaluation – evaluate performance of individual participant - o Budget analysis – compare capacity development spending against planned budgets - o Return on investment – evaluate correlation between human capital investment and improvement in overall institutional performance - o Department level evaluation – evaluate the impact of training on staff understanding and job performance
Training resource / skills gap	- Limited pool of high-quality, context-specific training providers in emerging areas (regtech, AI, blockchain)	- Partner with international bodies to develop curated training content and co-develop regionally relevant programmes - Collaborate with external tech experts
Training competency framework	- Resource-intensive and complex framework to align with evolving job roles and tech developments - Different needs of different departments means that standardised approach does not work	- Develop role-based competency framework for key departments (supervision, IT), with continuous refinement based on feedback
Partnership arrangements	- Formal arrangements, long-term planning and sustained relationships required by strategic partnerships with academia, tech firms and other regulators - Challenges in cross-departmental collaboration	
Budget / resource constraints	- Limited resources for training	- Demonstrate effectiveness (eg measure competency levels achieved against expected profiles)
Institutional knowledge	- Knowledge gaps and loss of experience due to staff mobility, retirements and project-based work	- Offer knowledge-sharing sessions, post-training presentations and internal documentation to capture/institutionalise learning - Use a mentorship programme to support knowledge transfer
Internal process	- Data protection: long and complex data protection assessments for each use case and project phase - Internal processes that are not up to the speed of digital innovation, in particular formal budget and traditional project management processes	- Enhance cyber security measures - Foster a culture of innovation and adaptability within the organisation - Simplify IT landscape (eg improved user interface and experience across tools) - Use generative AI to bridge skills gap (eg coding)
Time of staff	- Limited time for staff to undergo training; and for subject matter experts to provide training - Continuous learning adds to a heavy workload	- Leverage delivery methods (eg e-learning) that allow staff to consume content on-demand - Provide incentives for subject matter experts to contribute to training activities, such as performance recognition

Annex 2: Comparison of public sector technology-related training programmes

Financial authorities can leverage tech-related training programmes offered by public sector agencies as part of their CD offerings. Table A.2 compares two of such programmes offered by the EU Supervisory Digital Finance Academy and the Singapore GovTech Digital Academy. Note that the topics listed in the table are not exhaustive and have been edited for brevity. Singapore's programme is open to the public sector generally while the EU programme is specific to the financial sector. The former has an intermediate level, which is not reflected here as the EU's programme does not have such a level. In addition, Singapore's advanced topics cover certification and hands-on sessions.

Comparison of public sector technology-related training programmes		Table A.2
	EU Supervisory Digital Finance Academy	Singapore GovTech Digital Academy
Foundational		
Market developments	- Digital transformation of financial services - Digital business models - Cross-sectoral trends	
Technology	- Introduction to AI - AI Use cases in financial services - Risks and benefits of AI to consumers - EU AI Act	- Applications development (eg Microsoft 365 copilot) - Application management (eg cloud practitioner essentials) - AI (eg AI for business leaders, code free ML, data visualisation)
Operational resilience	- Cyber security overview - Cyber risks for consumers - EU Digital Operational Resilience Act (DORA)	- AI cyber security - Vulnerability assessment - Security essentials – network, endpoint, cloud
Cryptoassets	- DeFi, tokenisation and cryptoassets - EU Markets in Crypto-Assets Regulation (MiCA)	
Advanced		
Business model	- Data-driven business models - Data sharing in finance - Open finance - Big techs	- Digital product strategy - Coaching clinic for product management - CIO leadership in the digital age
Technology	- Suptech - Distributed ledger technology	- CompTIA Security+ (global certification)
Regulation/Supervision	- Supervising and regulating AI - Regulation of cyber risk - Relevance of MiCAR to blockchain	

Annex 3: Illustrative example of artificial intelligence-related competencies

Table A.3 provides an example of AI-related competencies that might be relevant for supervisory authorities.

Illustrative example of competencies related to artificial intelligence (AI)					Table A.3
	All staff	Front-line supervisors	Policy analyst	AI engineer	Management
Needs/ competencies	- Able to use basic AI tools (large language models, LLMs) for work productivity - Understands the basics of ML and its limitations - Observes internal policies on responsible use of AI	- Able to use AI-based suptech tools in supervisory activities - Able to have an informed discussion with firms on their AI use cases and the associated risks - Understands how existing rules are applicable in AI context	- Understands how AI/ML risks can impact safety and soundness of financial institutions and financial stability - Able to interpret existing rules in AI context - Understands implications of relevant regulatory instruments on firms' AI activities	- Able to identify suitable AI solution for organisation - Supports business areas to deploy AI applications securely	- Guides organisation's AI strategy and resource planning - Oversees governance of responsible deployment of AI (including suptech tools) across functions - Understands strategic risks and opportunities of AI - Champions CD of staff
Topics	- Fundamentals of AI - Overview of types of ML - How LLMs work - Responsible use of AI	- Basics of data science - Overview of ML algorithms - ML model risks - Practical application of ML in financial services	- International regulatory standards on AI - AI governance frameworks	- AI systems and engineering - ML model development and validation - Model risk management	- Business transformation using AI - AI governance principles