

Mind the AI Gap: Bridging the AI talent mismatch in education and industry

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Highlights:

- AI is at the forefront of industrial development, driving a rapid transformation of the labour market. On the one hand, it is giving rise to new professional profiles directly linked to the technology itself. On the other hand, it is reshaping the way the broader workforce operates, producing both profound and subtle shifts that impact industries across the board.
- A significant barrier to the adoption of AI technologies is the pronounced shortage of skilled professionals, especially as the integration of AI into the economy accelerates. Future competitiveness will rely heavily on the ability of territories and companies to adopt and harness AI technology.
- There is a total of 23 AI-related occupations, categorised into three groups: (1) Developers, professionals responsible for designing and programming AI systems; (2) Enablers, key professionals who facilitate the successful implementation and integration of AI within organisations; and (3) Enablers/Developers, professionals who can perform both functions.
- Both universities and VET are essential providers in training the AI-related workforce. Among the 23 identified profiles, 8 are exclusively linked to universities, 11 are exclusively linked to VET, and 5 are hybrid profiles that can be trained through either pathway.
- The successful adoption of AI technologies also depends on developing specific skills across the workforce to ensure their optimal, ethical, and responsible integration into the territorial economic structure. Key skills include effective prompting, data analysis and interpretation, and the ethical and responsible use of AI, among others.
- As a result of their agglomeration economies, cities serve as ideal environments for driving collaborative policymaking processes involving different stakeholders through an inclusive and sustainable approach- a key factor for responding to talent mismatch.

The age of AI

Strategic challenges for the labour market

AI stands as one of the primary forces that is rapidly transforming the labour market. This shift is leading to the creation of new job profiles and an increasing demand for AI-related skills.

Artificial Intelligence (AI) has the potential to profoundly transform processes, products, services, and the internal organisation of the business fabric, rejuvenating the economy and reshaping social organisation as previous waves of disruptive innovation have done. Future competitiveness will largely depend on the ability of territories and companies to adopt and leverage AI technologies.

AI is already fundamentally changing labour market dynamics. On the one hand, new professional profiles are emerging that are directly linked to the technology itself. On the other hand, the way the rest of the workforce operates is also being transformed, with varying degrees of intensity.

A transformation of such magnitude necessitates the incorporation of new knowledge and skills into the training system, which is primarily responsible for preparing the workforce through initial education and lifelong learning. In turn, the emerging occupational and skills framework associated with AI (much like with other technologies) is not static but evolves alongside the trajectory of the technology itself. In other words, it depends on the pace and extent to which AI becomes embedded in productive and social processes. **A significant barrier to the adoption of AI is the shortage of skilled professionals,** especially as its integration into the economy is advancing rapidly. This constitutes the main policy challenge addressed in this brief.

Given this scenario, **the training system must be sufficiently flexible to create pathways that enable effective adaptation to technological advancements.** This could involve fostering

strong connections with the productive sector to meet emerging training needs by designing courses in collaboration with skill providers such as VET Centres or universities. **Additionally, the emphasis should be on developing innovative models for reskilling and upskilling** as well as lifelong learning pathways to equip both current and future workforces with essential AI tools.

Bridging the gap between education and industry is critical to enhancing competitiveness in the emerging economic model.

On the basis of the above, this policy brief draws on insights from a long-term action research process conducted within **Bilbao Next Lab (BNL), the urban competitiveness laboratory** led by Bilbao Ekintza, the economic development agency of the Bilbao City Council, and facilitated by Orkestra-Basque Institute of Competitiveness. While the focus on AI is relatively recent, the experience gained in addressing talent mismatch through collaborative governance within BNL provides a strong foundation for this contribution.

Likewise, **the case of BNL shows the particularly valuable role of cities when addressing the AI talent mismatch between education and industry.** Their unique assets, such as the concentration of education and training providers, highly skilled professionals, and AI companies - considered Knowledge Intensive Business Services (KIBS), make cities ideal environments for fostering collaborative policymaking designed to tackle AI talent mismatch.

Bilbao Next Lab

Seven years of collaborative governance to tackle talent mismatch

Bilbao Next Lab (BNL) is an urban competitiveness policy lab established in 2013 to address Bilbao’s inclusive and sustainable competitiveness. It is led by the city council and Bilbao Ekintza, with Orkestra facilitating it.

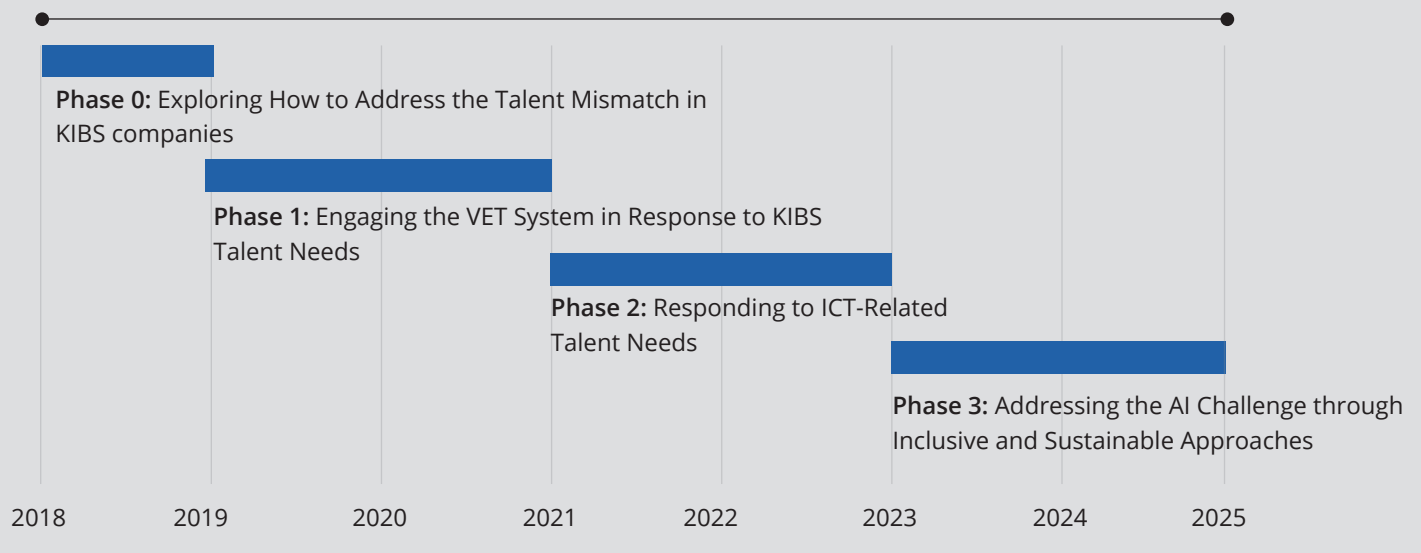
In 2013, Bilbao introduced a novel approach to urban competitiveness policymaking, which resulted in BNL. This project, led by Bilbao Ekintza and facilitated by Orkestra, applies **Action Research for Territorial Development** as its methodological approach within this urban policy laboratory in which **Knowledge-Intensive Business Services (KIBS)** have been a central pillar of Bilbao’s competitiveness strategy from the outset.

KIBS firms tend to cluster in urban areas, where they generate high-quality employment and act as drivers of urban development. Beyond their direct contribution, KIBS function as “innovation bridges,” playing a particularly critical role in strengthening territorial competitiveness, especially in manufacturing-oriented regions such as the Basque Country. Within this context, one of the main challenges addressed by the Bilbao Next Lab since its creation has been the

issue of **talent mismatches**. After several stages of work, the laboratory concluded in 2023 that one of the most pressing demands for KIBS was the shortage of skilled professionals in the field of AI.

In this regard, the **collaborative governance** frameworks established in BNL since 2018 have provided fertile ground for the emergence of innovative, **context-specific solutions to navigate this mismatch challenge in a more adaptive and systemic way**. These solutions go beyond traditional policy instruments, leveraging cross-sectoral knowledge, institutional trust, and experimentation to tackle these complex challenges.

The following section of this policy brief examines the different stages of the action research process undertaken at Bilbao Next Lab to respond to talent mismatch.



Bilbao Next Lab

Phase by phase

Each phase corresponds to a cycle within the action research process to address talent mismatch in KIBS, following the logic of praxis: reflection, action, and the emergence of new challenges that initiate the next cycle or phase.



Phase 0 (2018–2019): Exploring how to address the talent mismatch in KIBS companies



WHO

Bilbao Ekintza and Orkestra



REFLECTION/ANALYSIS

Exploration of the employment needs of KIBS companies and the educational offer available across training institutions.



ACTION

Involve the Basque VET ecosystem in the process to explore how the potential identified in VET can respond to the talent needs of KIBS.



Phase 1 (2019–2021): Engaging the VET system in response to KIBS talent needs



WHO

Bilbao Ekintza and Orkestra (facilitators), together with the Vice-Ministry of Vocational Education and Training of the Basque Government, VET centres, and KIBS companies.



REFLECTION/ANALYSIS

Analysis of the demand for VET profiles within KIBS companies (Albizu and Estensoro, 2020).



ACTION

- Launch of specialised VET programs (Vice-Ministry).
- Implementation of a shadowing initiative to foster KIBS-related vocations among young female students (Bilbao Ekintza).



NEW CHALLENGE

The growing importance of ICT skills across KIBS sectors calls for a more focused and coordinated response.



Phase 2 (2021–2023): Responding to ICT-related talent needs



Bilbao Ekintza and Orkestra (facilitators), together with the Vice-Ministry of Vocational Education and Training of the Basque Government, VET centres, and KIBS companies.



Identification of talent needs emerging from ICT-KIBS firms (Albizu and Estensoro, 2022).



Joint definition of technology priorities through collaborative governance spaces.



The relevance of Artificial Intelligence and the need to address the AI talent mismatch by incorporating a more inclusive perspective that also considers low- and medium-skilled profiles.

Phase 3 (2023–Present): Addressing the AI challenge through inclusive and sustainable approaches



Employment Working Group facilitated by Bilbao Ekintza (called KIBS Employment), involving members from:

- Education and training ecosystem, including universities, vocational training and lifelong learning.
- Urban, provincial, and regional government, their agencies and other agents (including Orkestra).
- Cluster associations and KIBS companies.



Exploration of the potential contributions of low- and medium-skilled profiles in AI profiles.

- Identification of the competences required by both AI developers and users, and analysis of how these are currently supported across the education and training landscape, with special attention to the VET system.



Collaborative actions are currently being developed and implemented.



The evidence

AI occupations and users

As a result of the analysis in phase 3, a total of **23 AI-related occupations** were identified that can be categorised **into three groups**.

1 AI Developers:

Professionals who are responsible for designing, programming, and applying coding techniques that support the development of AI.

This role includes creating algorithms and machine learning models, as well as integrating these models into practical applications.

- Computer Vision Engineers
- Embedded Systems Software Developers
- Software Developers for Industrial Mobile Devices
- Robotics Engineers
- Internet of Things (IoT) Developers
- Data Scientists
- AI Engineers

2 AI Enablers:

Professionals who facilitate the successful implementation of AI technologies by customising development processes, coordinating resources, and adapting management practices to different contexts.

Their role is crucial to ensure that AI models or solutions are effectively adapted, integrated, and applied to the realities and needs of organisations.

- Database Integrators
- Database Designers
- Cloud Architects
- Data Warehouse Designers
- Database Administrators
- User Experience (UX) Analysts
- User Interface (UI) Designers
- Cloud Systems Engineers
- Integration Engineers
- ICT Business Analysts
- Data Quality Specialists
- Cloud DevOps Engineers

3 AI Developer/Enabler profiles:

Professionals who can perform both functions (enablers and developers).

- Knowledge Engineers
- Data Analysts
- Data Engineers
- Software Developers

This occupational structure reflects the early stage of the sector's development, where activities and processes are still taking shape. Today, **AI-related professional roles are typically mixed and interdisciplinary, marked by functional specialisation and only partially defined responsibilities.** As the sector matures, it is expected that work will become more structured and roles more clearly specialised.

The complete analysis that led to this result can be accessed on Bilbao Ekintza's website by scanning the QR code or clicking [here](#).



1. Alignment with the educational and training system

An analysis of the connection between this occupational taxonomy and higher education providers, both vocational education and training (VET) and university, reveals several linkages.

This analysis shows that **university profiles are generally involved in the most abstract and theoretical stages of an AI project's life cycle.** They focus on designing, experimenting, and building the technological foundations by creating algorithms, selecting methodologies, and planning the overall system architecture.

Meanwhile, **VET profiles are responsible for implementing, maintaining, and adapting these solutions to specific operational environments.** Their role is essential in the emerging economic model and is expected to grow as AI technologies are more widely deployed and digital infrastructure maintenance becomes increasingly critical. **As these profiles gain experience and become more established within the companies' productive models, they could gradually perform functions related to developers** (Albizu and Estensoro, 2024).

	AI Developer profiles	AI Enabler profiles	AI Developer/ Enabler profiles
Vocational Training	<ul style="list-style-type: none"> • Software Developers for Embedded Systems • Software Developers for Mobile Devices 	<ul style="list-style-type: none"> • Database Integrators • Database Designers • Cloud Architects • Data Warehouse Designers • Database Administrators • User Experience Analysts • User Interface Designers 	<ul style="list-style-type: none"> • Software Developers
Vocational Training / University	<ul style="list-style-type: none"> • Computer Vision Engineers • IoT Developers 	<ul style="list-style-type: none"> • Integration Engineers • Data Quality Specialists 	<ul style="list-style-type: none"> • Data Analysts
University	<ul style="list-style-type: none"> • Robotics Engineers • Data Scientists • AI Engineers 	<ul style="list-style-type: none"> • Cloud Systems Engineers • ICT Business Analysts • DevOps Engineers 	<ul style="list-style-type: none"> • Knowledge Engineers • Data Engineers

2. AI users

The successful adoption of AI technologies depends largely on the development of specialised skills that enable their optimal, ethical, and responsible integration into the territorial economic structure.

Within this framework, particular emphasis is placed on **generative AI and machine learning**, the latter being one of the most in-demand branches of artificial intelligence in the manufacturing sector, which is of strategic importance for the Basque Country. Therefore, prioritising these areas constitutes a direct and natural response to the needs expressed by companies and industry stakeholders.

GENERATIVE AI

It's a set of technologies based on machine learning models, particularly deep neural networks, which allow for the creation of human-like data or content in the form of text, images, audio, or other formats, based on previous examples or prompts.

The following skills have been identified as being relevant:

- **Effective prompting:** Design and formulate clear, precise, and strategic prompts to optimise the performance of generative artificial intelligence tools. This includes knowledge of advanced techniques for interacting with AI systems.
- **Critical review and analysis of AI-generated products:** Rigorously evaluate and assess the outputs produced by generative AI tools. This involves identifying potential biases, errors, or areas for improvement, and ensuring quality and relevance standards.
- **Identification of optimal generative AI solutions:** Identify, analyse, and evaluate various generative AI tools and technologies. This requires a deep understanding of the features and applications of different AI solutions, as well as the ability to stay up to date with developments in the field.

- **Ethical and responsible use of generative AI:** Apply ethical principles, legislation, and professional standards, including the protection of intellectual property rights. This includes ensuring transparency, fairness, and accountability in the use of AI, as well as preventing and mitigating any negative impacts.

MACHINE LEARNING

It's a branch of artificial intelligence (AI) focused on developing algorithms and models capable of learning from data, identifying patterns, and making decisions with minimal human intervention. It is considered one of the most established and widely applied branches within the manufacturing sector. The skills required by users of machine learning are the following:

- **Identification of key variables:** Identify and recognise critical workplace factors that directly affect the functioning of AI solutions. This includes observing and understanding operational variables (e.g., production time, material quality, operating conditions, etc.).
- **Data collection relevant to AI solutions:** Identify, gather, and record accurate and meaningful data to feed AI systems. This involves the proper use of data collection tools and measurement techniques, along with an understanding of the importance of data quality and consistency.
- **Evaluation of AI-generated results:** Review and analyse the outputs produced by AI solutions. This entails verifying the accuracy and relevance of results in relation to operational objectives, identifying potential errors or deviations, and providing feedback.
- **Data analysis and interpretation:** Examine and understand data generated in the operational context. This includes identifying patterns, trends, and anomalies in the data, and translating findings into actionable insights for decision-making and continuous improvement of the production process.

Lessons learned

Insights for policymaking

The research carried out in BNL has yielded several lessons that may be relevant to addressing the AI Talent Mismatch.

1 A comprehensive educational approach is needed to develop AI-related skills across the workforce

Responding to the impact of AI requires a system-wide perspective that distinguishes between AI core occupations and user-oriented roles. While developers and enablers follow specialised paths through VET and universities, the rest of the workforce will need certain skills, such as effective prompting, data literacy, and critical thinking, which must be cultivated from the early levels of education. A comprehensive and coordinated approach is essential to ensure that all parts of the system contribute to future readiness, from early foundational education (e.g., maths and critical thinking in secondary school) to tailored training pathways and lifelong learning programmes.

2 Agile systems for mutual adaptation between emerging needs and training provision

Establishing dynamic mechanisms to detect rapidly evolving needs within KIBS and AI ecosystems can foster ongoing dialogue and mutual, in situ adjustment between labour market demands and training provision. This allows for solutions that are more responsive, fast, and context-specific. Sustained political will, supported by committed leadership and clear mandates, as well as the facilitation of public entities such as Bilbao Ekintza, are key to achieving this.

3 Skill taxonomies provide a foundation for adapting training provision

The taxonomy developed through the analysis of AI-related occupational profiles offers a practical starting point for rethinking the educational provision. It supports the creation of new training programmes and the redesign of existing ones, making it a key

tool for guiding transformation across the education and training system and tackling the shortage of emerging occupations crucial for the digital transition in the field of AI.

4 A shared language bridges reflection and action, enabling systemic collaboration

Developing shared skills taxonomies linked to clearly defined occupational profiles, such as the one presented above, not only helps connect training provision with labour market needs, but it also fosters mutual understanding among stakeholders. Skills can be used as a common language and key enabler for joint decision-making and coordinated action.

5 Ethical considerations are central to the responsible deployment of AI in the workforce

The study highlights that ethical issues will play a critical role in how AI is adopted and used across sectors. Ensuring that ethical awareness is integrated into training and decision-making processes is essential for the responsible, fair, sustainable and equitable use of AI technologies. This ethical dimension should not be treated as a separate issue but rather integrated into the mutual adaptation processes between training systems and emerging labour market needs.

6 Cities have unique and essential assets for addressing the issue of talent mismatch

As a result of their agglomeration economies, cities generate complementarities and synergies with the rest of the territory that are critical for tackling both urban and territorial competitiveness challenges. Moreover, they serve as ideal environments for driving collaborative policymaking processes involving different stakeholders, a key factor for responding to talent mismatch.

Next steps

Phase 3 of the project is currently underway. The KIBS Employment Working Group facilitated by Bilbao Ekintza remains active, and Orkestra will continue to participate in this collaborative governance space.

Targeted programs to address the talent mismatch

Over the coming months, specific projects and actions will be co-defined and implemented by the stakeholders involved, drawing on the analysis summarised in this policy brief as a primary input.

These initiatives will include targeted programmes to address the AI talent mismatch through inclusive and sustainable approaches and to coordinate and align the AI ecosystem in support of the competitiveness of Bilbao and the Basque Country.

Another key line of action will be the development of Zorrotzaurre Innovation District as a *KIBS hub*, with a particular focus on AI.

Evaluation of the collaborative governance

An evaluation system has been developed and is being implemented through action research in Bilbao Next Lab to assess the development and impact of the KIBS Employment Working Group and other collaborative governance spaces supporting the competitiveness of the KIBS sector, facilitated by Bilbao Ekintza.

This evaluation focuses on assessing the inputs, processes, outputs, and impacts of this collaborative governance approach, and integrates mechanisms to capture lessons learned and provide actionable insights for continuous improvement and agile decision-making.



Read more

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