

# chaise

blockchain skills for Europe

**D2.5.1:**  
**Study on skills  
mismatches in the  
European  
Blockchain sector**

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## Abbreviations

AF	Application Form
BC	Blockchain
D	Deliverable
DG	Directorate General
EACEA	Education, Audiovisual and Culture Executive Agency
EQF	European Qualification Framework
EC	European Commission
EU	European Union
D	Deliverable
ICT	Information and Communications Technology
KPI	Key Performance Indicator
M	Month
MOOC	Massive Open Online Course
OER	Open Educational Resources
PM	Project Management
PMT	Project Management Team
PT	Points
QA	Quality Assurance
SC	Steering Committee
SME	Small and Medium-sized Enterprise
SSA	Sector Skill Alliance
T	Task
TL	Task Leader
VET	Vocational Education and Training
WP	Work Package
WPL	Work Package Leader

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## Management Summary

*“Whereas most technologies tend to automate workers on the periphery doing menial tasks, blockchains automate away the center. Instead of putting the taxi driver out of a job, blockchain puts Uber out of a job and lets the taxi drivers work with the customer directly.”*

*- Vitalik Buterin, Co-Founder of Ethereum*

Europe is in a leading position in many sectors that can successfully apply blockchain or other Distributed Ledger Technologies. At the same time, the lack of digital skills throughout Europe threatens to hamper and slow down innovation.

CHAISE is a Sector Skill Alliance, funded by the European Commission, to set forward a sectoral approach to Blockchain skills Development. CHAISE will formulate and deliver a European strategy to address skill mismatches and shortages in the Blockchain Sector and deliver appropriate and future focused training, qualifications, and mobility solutions, geared to sectoral realities and needs.

### European Blockchain market

The market analysis has shown that the Blockchain market is undergoing a rapid development. The main messages about the BC market and ecosystem can be summarised as follows:

- Almost all member states have a growing environment of networks and associations on national level.
- The BC market is dynamic, growing and can be differentiated vertically (across industries) and horizontally (in applications/ services)
- There is a lack of national and EU-wide funding, strategies and regulations in the BC sector.
- There are significant differences between EU countries in terms of the maturity of the Blockchain ecosystem and national regulations.

### European Blockchain labour market

The labour market analysis has shown that the demand for qualified employees in the field of Blockchain technology is increasing. The main messages about the BC labour market and workforce can be summarised as follows:

- BC labour can be defined and differentiated according to industry, users and providers, job profiles and skill requirements.
- Blockchain job offers are placed on common job platforms and are primarily advertised by Blockchain service providers.
- Increase in demand for Blockchain experts with a business, financial or legal background.
- The quality of available information on the BC market and the BC labour market in European member states varies from country to country, often lacking publicly accessible registers.
- An official definition for Blockchain professionals is missing.
- The education level of existing BC professionals and that of targeted BC professionals do not match. The level of experience requested suggests that companies are trying to keep the entrance barriers for BC professionals as low as possible due to a lack of talents.

### Blockchain skill demand

The skills demand analysis showed that the demand for Blockchain-specific qualification is very high and can vary depending on the role. The skills and roles defined in the survey reflect the needs stated in the

job advertisements and can be used as a basis for creating training programmes and modules. The main messages can be summarised as following:

- More than half of the companies surveyed have recruiting problems due to a lack of or insufficiently qualified applicants.
- BC specific skills are considered very important
- The three previously defined roles of Blockchain Architect, Blockchain Developer and Blockchain Manager differ strongly in their skill focus
- For the BC Architect, all technical skills are important, but a special focus should be placed on the conception and design of Blockchain solutions and use cases. In terms of business skills, a need for strategic and conceptual skills can be identified.
- For the BC Developer all technical skills are important, but a special focus is placed on software development and coding, especially of BC-specific applications, such as DApps or Smart Contracts. In terms of business skills, the BC Developer primarily needs operational skills (e.g. marketing and finance).
- For the Blockchain Manager an overview of the technical background of the Blockchain technology is beneficial, but there is no need to know how to code or develop Blockchain solutions. All business skills should be trained for this position.
- A skill shift can be observed. Transversal skills are the new hard skills and are considered important for all roles.
- Industry and sector-specific knowledge is becoming increasingly important for the development of BC applications.
- The fast-moving environment of BC technology requires a regular update of the skill demand, an international Blockchain Skill Hub would be useful to adapt the training offers

### Blockchain skill supply

The skills supply analysis showed that there is a great lack of formal education in the field of Blockchain, but also that informal education cannot fully cover the qualification needed. Communities and fora offer a useful exchange platform, but are not sufficient for the education and training of Blockchain experts. The main messages of the skill supply analysis can be summarised as following:

- Most BC Educational and training offerings have a duration from 1 day up to 15 weeks.
- The target audience of BC VET courses are ICT professionals or a general audience interested in the theory.
- Over half of all VET courses relate to the discipline of Computer Science and Informatics
- Almost three quarters of VET courses are produced by private providers
- The majority of VET courses are designed for beginners and have a subject-specific orientation
- Blockchain is not yet offered as a separate course of degree, but only as a superficial specialisation module for mainly ICT courses.
- For the most part, formal programmes do not follow the latest trends.
- Communities and forums provide an important source of information for Blockchain experts, but the content usually lacks integrity and professionalism
- Social media platforms also enable the possibility of socializing and active exchange of opinions
- Blockchain training contents are mainly developed by private companies and institutions.
- Business and Transversal skills are often missing in educational and training programmes
- Due to the lack of official training programmes no preferred training method can yet be identified.
- Transversal skills are rarely considered and discussed in the forums and communities

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## Introduction

If Europe is to play a leading role in the future of digital technology markets, European policy and member states will have to craft an efficient and effective strategy to set up an environment for Blockchain technology implementation. One important component of this environment will be the provision of skills for professionals in order to foster the future innovation development of Europe's industries, services and society at large. The current report is the result of the currently largest globally available analysis of skill needs and demands for the Blockchain sector, covering all of 27 European member states. It has been developed through a committed consortium of industry and science partners supported through the European commission and is presenting the state of play of Europe's current Blockchain capabilities and future demands.

The multi-mix, multi-method and multi-channel study has been designed by the next education research group of the Baden Wuerttemberg cooperative state university, the largest southern German university, and implemented through the team of Professor Ulf-Daniel Ehlers and a strong partner correlation of several countries: Université Claude Bernard Lyon (France); Inatba (Belgium); Fujitsu (Belgium); The Ministry of Education and Religious Affairs (YPAITH) (Greece); ECQA GmbH (Austria); DIGITALEUROPE (Belgium); IOTA Foundation (Germany); Universitat Politècnica de Catalunya (Spain); DHBW (Germany); CIMEA (Italy); INTRASOFT International (Luxembourg); CPI (Slovenia); DIGITAL SME (Belgium); University of Tartu (Estonia); University of Ljubljana, Faculty of Electrical Engineering, Laboratory for Telecommunications (Slovenia); BerChain (Germany); Italia4Blockchain (Italy); ANC (Romania); ACQUIM (Germany); EXELIA (Greece); INDUSTRIA (Bulgaria); Crypto4all (France); Economic and Social Research Institute (Ireland)

## Chaise – Blockchain skills for Europe

Blockchain is at the core of the EU strategy to advance digital transformation, benefitting society and businesses and stimulating sustainable growth. The European Blockchain Sector is well placed to acquire global leadership; still its competitiveness largely relies on the availability of a competent and versatile workforce. Whereas the demand for Blockchain skills is steadily increasing, employers face a shortfall of skilled professionals that prevents the sector from unleashing its full potential. The Blockchain sector is challenged by a talent shortage, global competitive pressures, the limited connection between education and the market, and low responsiveness of formal education to new workplace requirements.

CHAISE is a transnational initiative or a Sector Skill Alliance, funded by the European Commission, to set forward a sectoral approach to Blockchain skills development. CHAISE will formulate and deliver a European strategy to address skill mismatches and shortages in the Blockchain sector and deliver appropriate and future focused training, qualifications, and mobility solutions, geared to sectoral realities and needs. The major objectives of this initiative are:

- Improve Blockchain skills intelligence and document prevailing skills mismatches at the EU level.
- Set up a collaborative approach to monitoring the evolution of workplace requirements and anticipating future Blockchain skill needs, to act as an early warning information mechanism for imbalances between demand and supply.
- Design a European learning outcome-oriented modular VET programme and educational resources on Blockchain to address technical, non-technical and cross-discipline (horizontal) skills requirements.
- Define EU-wide occupational requirements for the Blockchain workforce to address fragmentation in the labour market.
- Establish a sectoral qualification linked to the new Blockchain specific occupational profile to set standard educational requirements for Blockchain skills across the EU.
- Connect job seekers and Blockchain companies to support professional transnational mobility and increase the attractiveness of the Blockchain sector.
- Set up a post-project permanent cooperation network to systematically monitor labour market and skill developments and keep the European Blockchain skills strategy up-to-date and relevant.

## Methodological design and context of the study

The CHAISE project aims to create a new basis for a European skills strategy in the Blockchain field. The first step is to analyse in depth and detail the need and demand for qualifications, their specificity, their labour market boundaries.

The research activity line of the CHAISE project has therefore defined a robust and valid research strategy capable of providing the necessary information and involving a group of people representing multiple stakeholders, experts and stakeholders from business, the public sector, research and policy. The research strategy is to propose a triangulation of methodologies (see Fig 1), perspectives and data sources in order to gain a deeper understanding of what capabilities are needed to advance the European Blockchain field.

### Chaise Research Methodology Map – Triangulation of Data

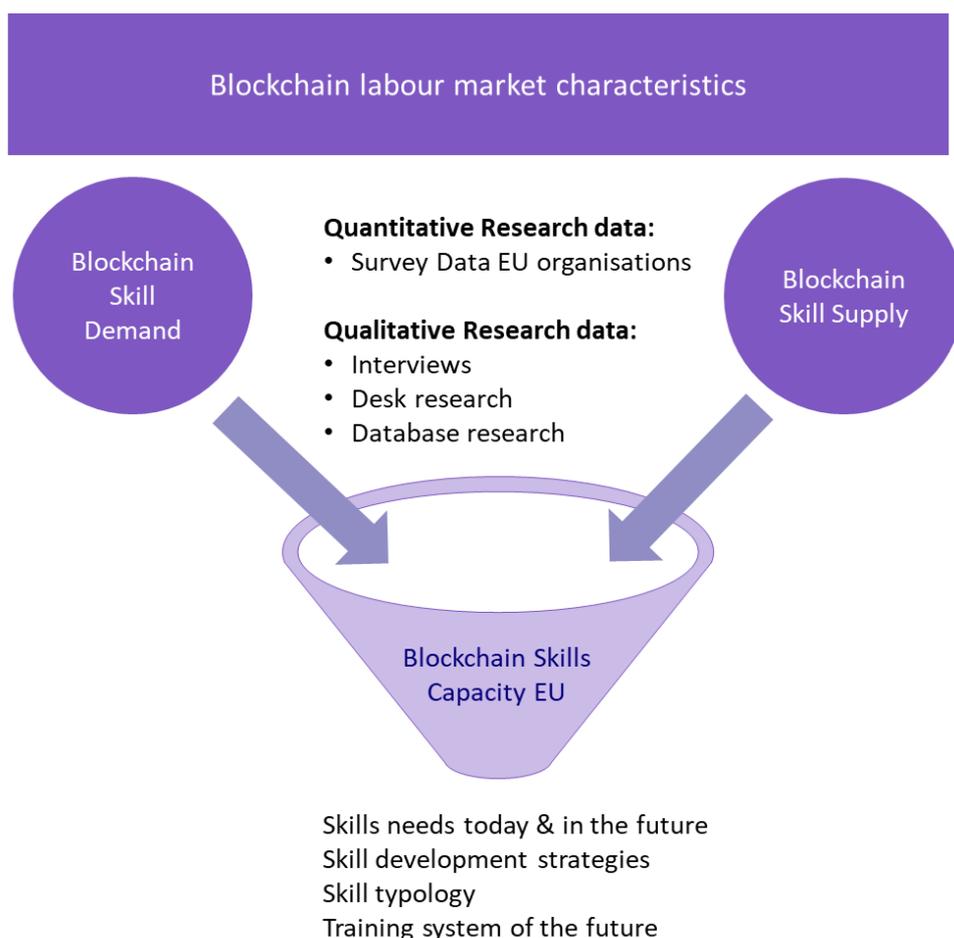


Fig. 1: Chaise Research Methodology Map

This study is providing an in-depth analysis building on detailed surveys and research of Blockchain qualification demands and relating them to Blockchain skill supply, which has been investigated through a multi-channel, multi-method and multi-stakeholder research design. Figure 2 shows an overview of the different research activities. During the Chaise research activity process three studies and two registries, based on qualitative interviews with Blockchain experts and training and education providers, Blockchain job ad analyses, Blockchain community and fora analyses and a Europe-wide skills survey, have been developed. These results form the basis for this Blockchain skill mismatch study. The evidence from skills gathering activities and relevant conclusions of this report have been validated by the CHAISE Expert Advisory Board.

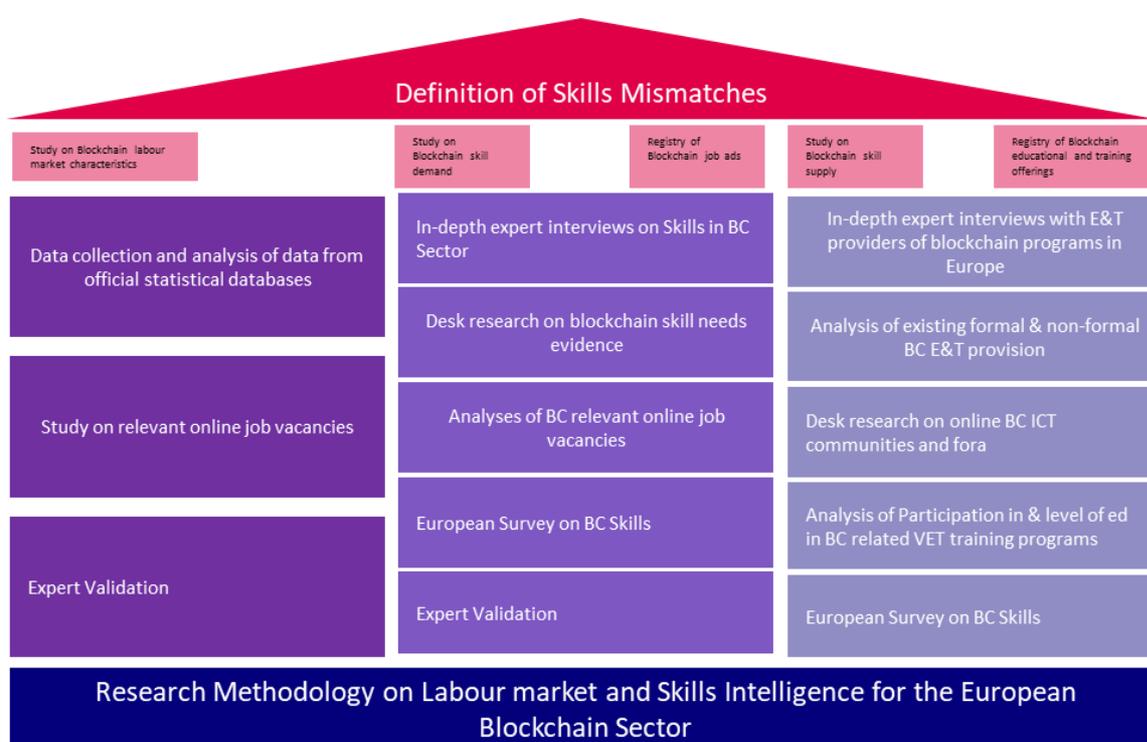


Fig. 2: Chaise Research Methodology and Study design

The skill Mismatch report is an amalgamation of the different research studies of the BC market, BC skill supply and BC skill demand. The in-depth analysis of the Blockchain Market, the Blockchain skill demand and supply can be found here:

- [Study on Blockchain labour market characteristics \[D2.2.1\]](#) will be referred to as S1
- [Study on Blockchain skill Demand \[D2.3.1\]](#) will be referred to as S2
- [Study on Blockchain skill Supply \[D2.4.1\]](#) will be referred to as S3



# The European Blockchain Market

## The European Blockchain Market

### Blockchain develops in an ecosystem

**The Blockchain ecosystem:** An ecosystem describes a group of actors and institutions that work together to create a specific environment. The Blockchain ecosystem consists of start-ups, companies, government institutions, clusters, think tanks, networks and associations that create legal frameworks for the technology, promote and advocate Blockchain technology or are active in the Blockchain sector. The Blockchain ecosystem is at very different stages of maturity within the EU, and consists of both small start-ups and large, internationally operating organisations, which is an indicator of the growing acceptance of the technology within the industry (S1, 2; S1, 3.3). When describing the Blockchain ecosystem, it is important to note that Blockchain collaborators and legal entities are distributed across different locations and therefore cannot always be precisely assigned to a local environment.

### Large diversity of strategy and regulation maturity across Europe

**Blockchain regulations:** Currently, there is a lack of EU-wide regulations for the Blockchain sector. The uncertainty about the occurrence and impact of such regulations leads to insecurity and inhibits further development and investment in Blockchain use cases from industry sides. Especially since many Blockchain industries focus on the financial services sector, they are dependent on general financial compliance rules and directives, which are usually adopted at the EU level. The European Anti-Money Laundering Regulation is one of the few legal regulations that specifically relate to the use of Blockchain technology (S1, 3.2).



#### Recommendation for policy-makers:

*The European Union should develop an Europe-wide regulation framework for the Blockchain market.*

**Blockchain strategies:** Blockchain technology can be used in many different areas and industries, therefore government regulation and policies are necessary to define the scope of the usage of the technology, to create a fair competition and to ensure the correct and legal application. As of today, there are no EU-wide guidelines and strategies for dealing with Blockchain technology, the consequence is that companies, organisations and research institutions have to follow national guidelines. Although many countries are already developing Blockchain projects, most of them do not have a clear Blockchain strategy. Among the countries with Blockchain-related strategies are Luxembourg, Estonia, Germany

and France, while Italy and Austria are still in development (S1, 3; S1, 3.1; S1, 6). Developing a regulatory framework and defining a clear Blockchain national strategy seems strongly correlated with Blockchain projects' success (S1, 3.4.1; S1, 3.4.1).

**Blockchain ecosystem maturity:** When comparing the ecosystem maturity with the regulatory maturity of the individual countries, a significant difference can be observed between the European countries (see Fig. 3). Furthermore, it can be emphasised that there is a clear connection between regulatory maturity and ecosystem maturity. Clarity about the regulatory framework and policies promotes confidence in the ecosystem and leads to increased investment in technology research and development (S1; 3.2.3).

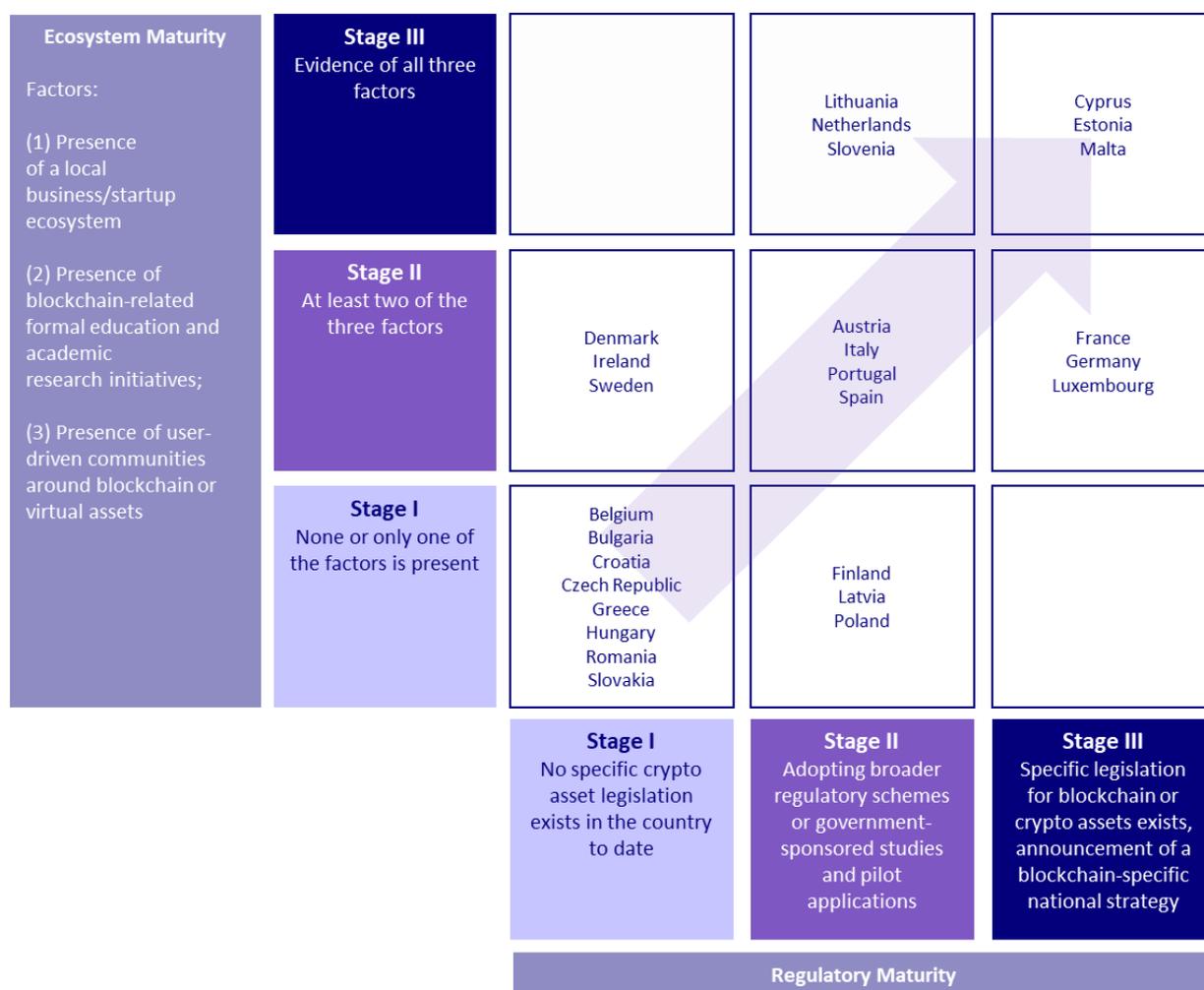


Fig. 3: Snapshot analysis of the BC ecosystem and regulatory maturity of EU countries (S1, 3.2.3)

## BC industries and use cases are the largest growth sector within the ICT industry

**Perception of importance of Blockchain technology:** The market success of the technology depends, not only on the national and international regulations and strategies but also on the perception of the importance of Blockchain technology from the industry side. As the data indicates, companies already perceive Blockchain technology as "very important" today. This opinion reinforced with a further look into the future. Around 92% (n=279) of the respondents stated that the Blockchain technology will be very important for their organisation in the next 5 years (S2, 3.5.2). A Deloitte study from 2020 found that companies consider the lack of use of Blockchain technology in their company as a competitive disadvantage (S2, 3.5.1).

**Size of the Blockchain market:** The analysis of the European Blockchain market reveals that its size has been growing exponentially in recent years. According to forecasts, the Blockchain market will account for 10% of the GDP in 2025. However, our investigation clearly shows that its growth is strongly dependent on national and international funding programmes to drive research, development and business innovation in this area. Additionally, this rapid market growth already highlights the increasing need for skilled Blockchain professionals who can drive technological development forward (S1, 3.4.3; S1, 6).



### Recommendations for policy-makers:

*To position the EU as a global leader in the Blockchain market by 2030, funding programmes and subsidies in Blockchain research and innovation projects should be increased through dedicated national and European funding frameworks.*

## BC Technology has broad horizontal (industry) and vertical (use cases) areas of application

**Blockchain industries and use cases:** The industry with the most Blockchain applications continues to be the ICT sector and the finance and insurance industry, but in recent years other sectors have been tapped. A steady increase in investments can be observed in the areas of information and communication, retail, real estate and supply chain management as well as energy, research and education. There is also growing interest in the pharmaceutical and healthcare sectors for applications of Blockchain technology, for example for storing health information and patients' records (S1, 3.3; S2,

3.1.2). With a few exceptions, despite obvious use cases (e.g. e-signature, cybersecurity, digital rites, asset management services, certification of documents, tokenisation of assets, or digital identity etc.), there are not many applications of Blockchain technology in the public sector (S1, 3.3).

Blockchain technology has many different use cases. The data primarily highlights asset transfer, certification, business process efficiency and data security were identified as Blockchain use cases within the companies (S2, 3.1.2).



**Curricular recommendation:**

*To increase the innovation potential of BC technology in the public sector, modules for research and development of potential use cases and applications of Blockchain technology in the public sector should be integrated in BC education programmes.*

**The average profile of a BC company:** The existing data also shows the average profile of a Blockchain company in the EU is a young (<5 years) and small (<10 employees) start-up, operating in the financial services sector and located in a large city (S1, 3.5).

## EU Blockchain Market in a nutshell

The market analysis has shown that the Blockchain market is undergoing a rapid development and the demand for qualified employees in this field is increasing. The main messages about the BC market and ecosystem can be summarised as follows:

1. Almost all member states have a growing environment of networks and associations on national level, but only five European member states have official BC strategies in place. Even if the existence of such strategies is strongly connected to the success of Blockchain projects.
2. The BC market is dynamic and growing and can be differentiated vertically (across industries) and horizontally (in applications/ services)
3. There is a lack of national and EU-wide funding, strategies and regulations in the BC sector. Above all, the lack of regulations leads to uncertainty within the industry and inhibits innovation.
4. There are significant differences between EU countries in terms of the maturity of the Blockchain ecosystem and national regulations.



# The Blockchain labour market

## The Blockchain workforce grows exponentially

**The Blockchain labour market:** When talking about Blockchain markets, the labour market is an important factor for the innovation advantage of a country. A labour market is a place where employers and workers interact with each other; employers compete to hire the best, and workers compete for the most satisfying job. A labour market in an economy functions with demand and supply of labour where both are influenced by changes in the bargaining power. Although the European Blockchain sector is well placed on acquiring global leadership, its future development highly depends on the availability of a skilled workforce. (S1, 4.1; S1, 6).

The analysis of LinkedIn data shows that most Blockchain professionals work in the ICT sector and the financial sector. Another smaller share of the Blockchain workforce works in consulting and higher education. At the end of the list are the banking, marketing, research and telecommunication sectors. However, in these areas, workforce demand can still be expected to increase, as there are many valuable use cases for the technology (S1, 5.2.1).

Within the different organisations, over 40% of all Blockchain workers are employed in the areas of product development, solution architecture, business development, BC technical engineering or research (S2, 3.2.1).



### Curricular recommendation:

*The wide range of usage of the technology within different departments of a company should be reflected in the modules of Blockchain education programmes. Especially the area of product, system and business model development should be integrated.*

**Blockchain worker share:** The data indicates that if a company has more than just Blockchain business models (as it is the case with Blockchain start-ups), it usually has only a small Blockchain worker share in relation to its overall size (S2, 3.2.2). This indicated that BC technology is still at a low level of maturity within organisations.

**Form of employment:** Regarding the form of employment of Blockchain professionals, no clear preference for full-time employees, part-time employees or external freelancers could be identified (S2, 3.2.4).

**National and international BC workforce databases:** Apart from the already mentioned LinkedIn data, the only publicly available labour market data is on general ICT occupations. There are almost no

**national or international databases** that give an overview of the employment situation in the Blockchain labour market (S1, 4.1; S1, 5.2.5).



**Recommendation for policy-makers:**

*In order to identify new market trends at an early stage an EU-wide database with labour market data specific to the Blockchain sector should be created.*

**The future development of the labour market:** In addition to the status quo, the future development of the labour market is of particular interest for this report. In the last two years, the Blockchain labour market has grown exponentially and is one of the fastest growing working areas in the technology sector. In 2017, ads for Blockchain positions on the social media platform LinkedIn quadrupled (S2, 3.3.1). In the Chaise study, 51% of respondents said the size of the Blockchain workforce will “slightly increase” and 30% said it will “significantly increase” in the next two years (S2, 3.5.2).



**Recommendation for policy-makers:**

*The growing labour market needs of Blockchain professionals should be considered when making policy decisions in the education sector.*

**Insourcing of workforce through service providers:** Most Blockchain job offers are placed on common job platforms, such as LinkedIn or Indeed, an emerging trend are Blockchain specific job platforms, such as Blockchain4Talent or Bitstamp (S2, 3.1.3). In the period of the survey, over 30% of the respondents stated, that their company had open job offers for Blockchain positions advertised (2, 3.3.2). An analysis of job ads showed that Blockchain positions are primarily advertised by Blockchain service providers instead of Blockchain service users. The adaptation of the technology in other industries will probably lead to an increase in the demand for skilled workers on the user side. This also indicates that currently most companies rely on external Blockchain service providers rather than building up the BC competences within their own company (S2, 3.1.1; S2, 2.1).

## Immerging Topography of Blockchain Occupation and job Profiles

**Blockchain professional profile:** As the number of professionals operating in the Blockchain industry is not particularly high at the moment, companies do not necessarily offer specific Blockchain-related positions or search for Blockchain-specific skills. They rather assign a general ICT position with Blockchain-related tasks (S1, 4.2; S1, 5.2.5).

When these jobs for Blockchain-related tasks are advertised, Blockchain is often not mentioned in the job title but in the job description. An analysis of job descriptions shows that the most common job advertised with BC tasks is Developer, followed by Engineer, Consultant, Manager and Architect (S2, 3.1.2).

If job profiles have the term Blockchain in their name, they are very diverse in terms of job description and cannot be directly compared with each other. Such a list of Blockchain jobs can be found in the study of BC market characteristics. Experts state that a clear understanding of a BC professional profile does not exist and that it is necessary to first develop a definition for the different BC roles as well as standardised job to further promote the development of the Blockchain sector. At the moment a typical employee in the field of BC development is an expert in the field of programming (ICT), who acquired additional competencies in the field of BC by participating in short seminars, analysing existing literature, and doing practical work in the field or in projects (S3, 4.2.1)

### Recommendation for policy-makers:



*To improve the search for talent, a clear understanding of the tasks and roles of Blockchain specific job profiles is needed. This requires an official definition of the different professional roles in the Blockchain sector. A definition of the different Blockchain roles should be included in the ESCO database.*

**Blockchain occupations outside of ICT:** An analysis of the changes in Blockchain occupations on LinkedIn shows that there is a trend for the demand of Blockchain related knowledge in job descriptions such as Data Analyst / Engineer, Sales Manager, Marketing Manager, Product Owner, which also indicates a shift of technology from the technical to the business area (S1, 5.2.5). In interviews with experts, Blockchain jobs with business backgrounds such as consultant and manager are increasingly mentioned, but also lawyers or bankers are associated with the technology (S2, 3.1.4).



**Curricular recommendation:**

*Blockchain modules should not only be attended by aspiring ICT professionals, but also by business majors. Additionally, management, business, legal skills but also communication skills are becoming increasingly important and should be included in the curricular.*

## Characteristics of the Blockchain professional

**Age:** Some public statistics suggest that the average Blockchain professional is between 24 and 49 years old. However, the trend is towards younger employees (S1, 5.1). In the survey, more than 70% of respondents stated that Blockchain professionals are between 26 and 35 years old (S2, 3.2.2) These demographic groups are at the same time more open to expanding their knowledge through participation in courses and training, and are also predisposed by their fast-paced environment to continuously learn and develop their skills (S1, 6).



**Curricular recommendations:**

*Due to their digital affinity, this young target group offers the opportunity to use new learning formats and learning technologies.*

**Education and experience:** When examining the status quo, the data shows that over half (65%) of employed BC professionals have at least a postgraduate degree. 22 participants also state a PhD as the education level of BC professionals (S2, 3.2.2; S3, 4.2.1). The literature analysis also indicates that Blockchain professionals are usually people with a tertiary education (S2, 3.2.1; S2, 3.2.4). In the job advertisements analysed, however, a different picture emerges: although most Blockchain-related professions also require a tertiary education degree in the form of a bachelor's or master's degree, there is also a significant number of job advertisements that do not require any formal degree (S1, 5.2.4).

This illustrates a discrepancy between targeted and existing Blockchain employees, as existing BC professionals are more likely to have a higher university education, but when looking for new BC professionals, educational attainment does not seem to play a significant role. This could be an indicator that for a large proportion of Blockchain employers, the possession of specific professional skills and/or labour market experience is of much higher importance than academic qualifications (S2, 3.2.3).

However, a closer look at the required work experience of BC professionals in job advertisements shows that companies and enterprises are already satisfied with at least 3 years (31%) or less (22%) or even

no work experience (12%) (S1, 5.2.3; S2, 3.2.3). The compromise in formal qualification and experience requirements is probably due to the high demand and lack of supply for Blockchain professionals. This should not be interpreted as a signal of lack of demand or irrelevance of formal education, but rather as a momentary concession of the economy towards the labour market. This again highlights the urgency of Blockchain skill development programmes.

**Gender:** Typical for most ICT and STEM industries, the sector is primarily male-dominated. The male/female ratio can be translated to the Blockchain sector in exactly the same way (S1, 5.1; S2, 3.2.1). Survey respondents indicated that in their companies over three-quarters of the Blockchain teams have less than 20% female employees (S2, 3.2.2).



**Recommendation for education provider:**

*The general support of women in technology and computer science should be strengthened e.g. by mentoring, coaching or communities. The introduction to technical practice should already start in the early childhood education.*

**Wage:** According to literature review, depending on the industry and country the salary of Blockchain Developers is up to 20% higher than the average salary of non-Blockchain Developers, (S2, 3.2.4). However, due to stigmatisation of wage discussions in the western world, it is still difficult to make an accurate assessment. The differences vary greatly by industry and the existing wage comparison platforms rarely offer a representative overview.

Fig.4 gives an overview of the average Blockchain employee, the data is derived from the survey data and the analysis of the job advertisements (S3, 4.2.1; S3, 4.2.4; S3, 3.2.5).

## The average Blockchain employee 2021

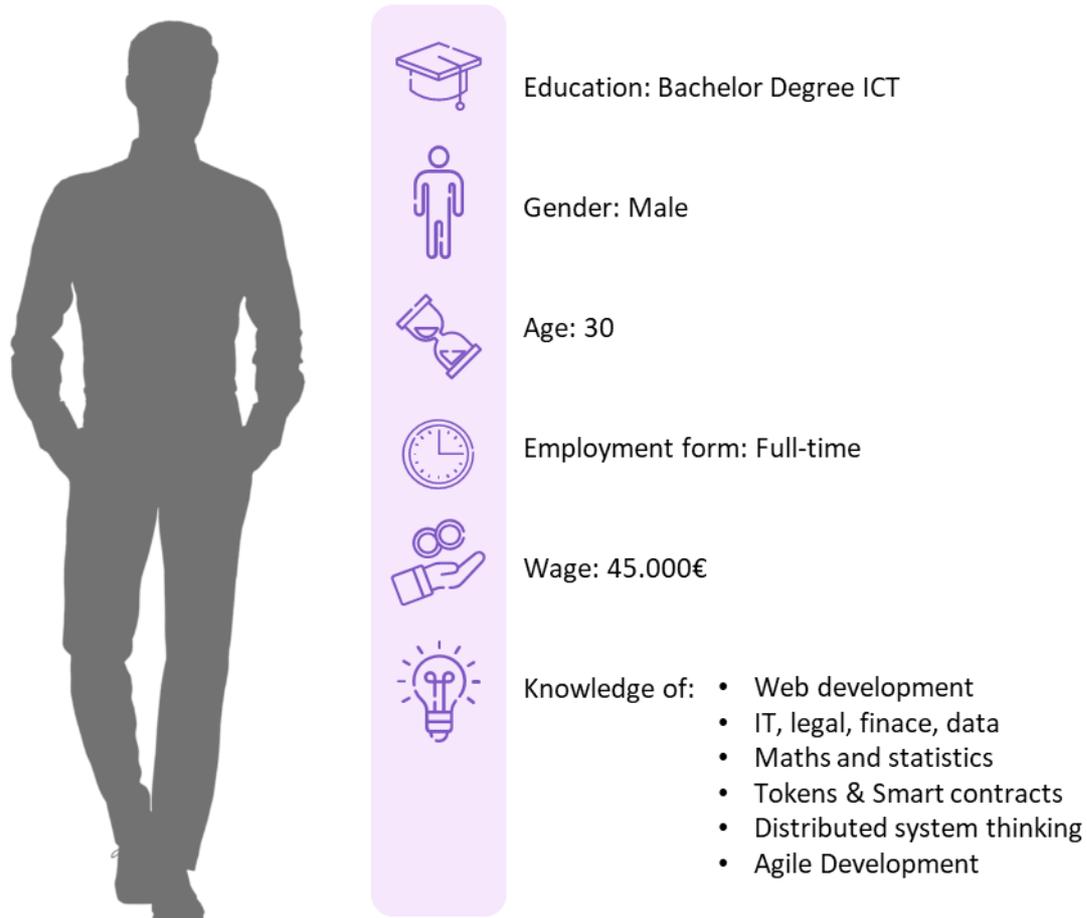


Fig. 4: The Average Blockchain Employee based on research data

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## EU Blockchain workforce in a nutshell

The labour market analysis has shown that the Blockchain market is undergoing a rapid development and the demand for qualified employees in this field is increasing. The main messages about the BC labour market and workforce can be summarised as follows:

1. Similar to the BC market the BC labour market is also growing and can be defined and differentiated according to industry, users and providers, job profiles and skill requirements.
2. Blockchain job offers are placed on common job platforms and are primarily advertised by Blockchain service providers.
3. The labour market is primarily demarcated and characterised through the market demand (job ads). Information about labour market supply are often missing.
4. In the past, Blockchain jobs were almost exclusively related to ICT job profiles, but nowadays an increase in demand for Blockchain experts with a business, financial or legal background can be observed.
5. The quality of available information on the BC market and the BC labour market in European member states varies from country to country, often lacking publicly accessible registers.
6. An official definition for Blockchain professionals is missing.
7. The education level of existing BC professionals and that of targeted BC professionals do not match. The level of experience requested suggests that companies are trying to keep the entrance barriers for BC professionals as low as possible due to a lack of talents.



# Blockchain Skill Demand

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## Blockchain skill Demand

**Recruiting situation:** Labour market intelligence deals with defining skills, which are the driving force for innovation in a sector. For the Blockchain field this is the necessary condition for European countries to develop and implement innovation through Blockchain and play a future leading role in a global context. The current data shows that more than 50% of the firms indicate, that they have problems recruiting BC professionals. 75 firms (50%) state that there is a low number of applicants with the required skills, while 65 firms (43%) indicate a low number of applicants in general (S2, 3.3.2; S1, 6).

**Three different Blockchain job profiles:** In the survey, 71% of companies stated that Blockchain skills are important to them (S2, 3.2.2). In order to meet the demand for Blockchain experts through future educational programmes, it is necessary to clearly define which professions need which qualifications and skills. The survey focused on three different job profiles, which were already increasingly mentioned in the job ads. These are the Blockchain Architect, the Blockchain Developer and the Blockchain Manager. For the analysis, the participants were shown different skills from the skill clusters "Technical & Blockchain Specific skills", "Professional / Business skills" and "Transversal Future skills", which they were asked to classify as important or unimportant for the individual roles. Fig.5 gives an overview of the different skills.

**Blockchain skills:** A job ad analysis and a job profile analysis conducted on basis on more than 20.000 LinkedIn job profiles shows that clear skills can be defined, which are important for the emerging Blockchain professionals. They are divided in "Technical & Blockchain Specific skills", "Professional / Business skills" and "Transversal Future skills"(S2, 3.3.3). The technical skill "Coding" also refers to other programming languages, such as Solidity.



Fig. 5: Overview of the skills listed in the survey

## Blockchain Architect

The Blockchain Architect is comparable to the role of the solution architect. This role designs the multi-levelled architecture of a large Blockchain system and software landscape and ensures the coherence of all aspects of a project as an integrated system. Furthermore, the BC Architect assures the overall technical quality of the BC application. Fig. 6 gives an overview of the skill Index of the Blockchain Architect.

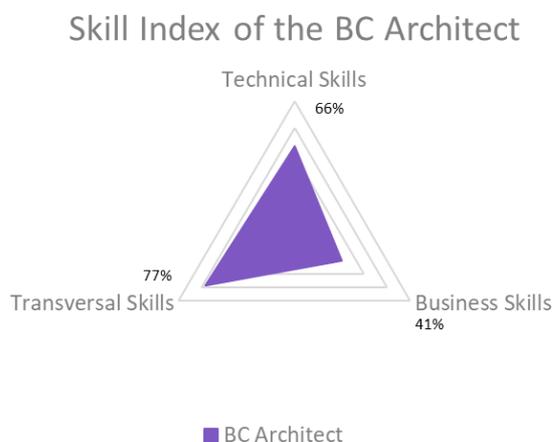


Fig. 6: skill Index of the BC Architect

## TECHNICAL & BLOCKCHAIN SPECIFIC SKILLS

With over 50% all Technical skills except "Frontend & Backend Development" were rated as important for the Blockchain Architect.

The very important (>75%) Technical & Blockchain specific skills for the Blockchain Architect are "Blockchain Solutions Design", "Data / Network Security Design" and "Cloud Infrastructure Design". These are mainly design- and concept-oriented skills.

The missing skills (>35%) for Blockchain Architects were "Blockchain Solution Design", "Cryptography Development", "Distributed Network Engineering skills", "Smart Contract Development" and "Development of Decentralised Apps". These are not necessarily the priorities for Blockchain Architects, especially in the case of coding skills, but there seems to be a lack of basic understanding (S2, 3.3.2).



### Curricular recommendations:

*The Blockchain Architect should be trained in all Technical & Blockchain Specific skills. A specific focus should be set on the conception and design of Blockchain solutions.*

## PROFESSIONAL / BUSINESS SKILLS

The important Professional / Business skills for the Blockchain Architect (>50%) are "Business Needs Analysis", "Product Development skills", and "Product Management skills".

Very important (>75%) is "Blockchain Use Case Development".

"Business Needs Analysis", and skills for "BC Use Case Development" were indicated as missing (>35). For these skills, a good understanding of Blockchain technology and applications is required. This highlights the need for Blockchain specific skills. However, skills in "Legal & Compliance Matters" were also indicated as strongly lacking with almost 50%, although this skill was not indicated as very important for this role (S2, 3.3.2).

### Curricular recommendation:



*Business Needs Analysis, Product Management, Product Development and Business / Use Case Development should be included in the course for BC Architects. Operational business skills such as Marketing, Finance or Human Resource Development are less relevant for this role and do not necessarily need to be covered.*

## TRANSVERSAL FUTURE SKILLS

All transversal skills were indicated as important for the Blockchain Architect with at least 60%.

The most important skills (>75%) were “Learning literacy & Metacognitive skills”, “Self-efficacy & Self-confidence”, “Self-determination & Autonomy”, “Decision Competence & Responsibility-taking”, “Design-thinking Competence”, “Innovation & Creativity skills”, “System & Networked Thinking”, “Future Mindset & Willingness to Change”, “Cooperation Competence” and “Communication Competence”.

These most important skills are in line with the previous image of the Blockchain Architect - this is a very creative and innovative role that needs to develop new business ideas and use cases for Blockchain technology.

The following skills were rated as missing by more than 35%: “Decision Competence”, “Ambiguity Competence”, “Innovation & Creativity skills”, “Future Mindset & Willingness to Change” and “Communication Competence” (S2, 3.3.2).

### Curricular recommendation:



*All Transversal skills are important for the BC Architect. There should be a strong focus on creative projects in the area of product and use case design. Both, the micro and the macro perspectives are important and should be developed.*

## Blockchain Developer

The Blockchain Developer codes the Blockchain applications and takes care of problem solving at the micro level. Fig. 7 gives an overview of the skill Index of the BC Developer.

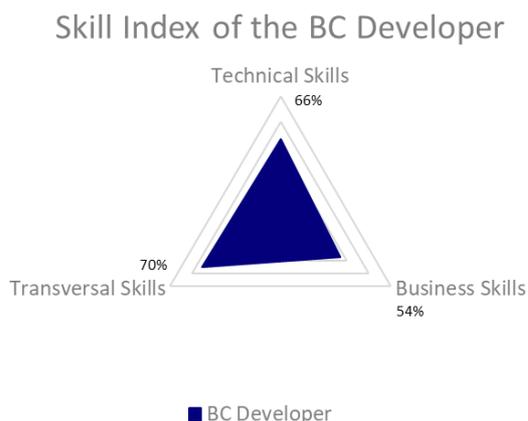


Fig. 7: Skill Index of the BC Developer

### TECHNICAL & BLOCKCHAIN SPECIFIC SKILLS

All Technical & Blockchain specific skills except “Blockchain Solution Design” (40.7% - note over 80% for BC Architect) and “Data Analysis” (46.3%) were indicated as important (>50%).

The most important Technical skills (>75%) for BC Developer are: “Coding (C++, Java, Python)”, “Cryptography Development”, “Frontend & Backend Development”, “Smart Contract Development”, “Development of decentralised Apps”.

The very important technical skills for the BC Developer are mainly programming and development skills and not conceptual skills as it is the case for the BC Architect, which can be derived from the lack of importance of “BC Solution Design”.

For the BC Developer, the following skills are listed as missing (>35%): “Maths and Stats”, “Blockchain Solution Design” (one of the least important skills for this role), “Distributed Network Engineering skills”, “Protocol Engineering”. It should be highlighted, that “Cryptography Development” was listed as missing with over 50%, and “Smart Contract Development” as well as “Development of decentralised Apps” with over 40%.

The analysis of missing Technical & Blockchain specific skills indicates a need for specialised Blockchain development training. The "normal" software development skills (e.g. Coding) are mostly covered by the professionals but Blockchain specific skills (e.g. Cryptography Development, Distributed Network Engineering, Smart Contract Development, or Development of decentralised Apps) are indicated as missing (S2, 3.3.2).



**Curricular recommendations:**

*General software development skills are very important for the BC developer. However, great emphasis should be placed on the development skills of Blockchain technology and applications. This specialisation should be covered in several modules.*

**PROFESSIONAL / BUSINESS SKILLS**

The important Professional / Business skills (>50%) for the BC Developer are "Product Development skills", "Product Management skills", "skills in "Legal & Compliance matters", "Finance and Controlling skills", "Human Resources Development skills", "Customer Success Design" and "Affiliate Marketing". "Marketing skills" rated to be very important (>75%).

"Business (Needs) Analysis", "Business Development skills", skills for "(Blockchain) Use Case Development", "Product Development skills", "Product Management skills" are listed as missing (>35%), but it should be noted that these skills are not stated to be important for the BC Developer. Missing skills which were previously classified as important are: skills in "Legal and Compliance matters", "Marketing skills", "Finance and Controlling skills", "Customer Success Design" (S2, 3.3.2).



**Curricular recommendations:**

*The important Professional / Business skills for the BC Developer are primarily operational business skills. One consideration could be to divide the business skills into two different modules: conceptual/strategic business skills and operational business skills.*

## TRANSVERSAL FUTURE SKILLS

For the Transversal skills, all skills are considered important with over 50%. The most important skills (>75%) are “Self-efficacy & Self-confidence”, “Self-determination & Autonomy”, “Self-management/organisation/regulation & Self-responsibility”, “Cooperation Competence” and “Communication Competence”.

The following skills are indicated as missing (>35%) for the BC Developer: “Self-efficacy & Self-confidence”, “Self-determination & Autonomy”, “Self-management”, “Decision-making Competence & taking Responsibility”, “Initiative and Performance competence”, “Ambiguity competence”, “Design Thinking competence”, “Innovation & Creativity competence”, “Future orientation & Willingness to Change”, “Cooperation Competence” and “Communication Competence” (S2, 3.3.2).



### **Curricular recommendations:**

*All transversal skills should be included and trained in the modules of the BC Developer.  
Above all, self-managed work is very important for this role.*

## Blockchain Manager

A Blockchain Manager leads groups of developers and architects. The tasks of the Blockchain Manager are to track implementation progress and maintains close cooperation with business managers or marketing professionals to identify the market requirements for new Blockchain systems and applications. Furthermore, this role must monitor the process quality to ensure that products meet their technical and business objectives and communicate with other stakeholders, such as department managers and marketing professionals. Fig. 8 gives an overview of the skill Index of the BC Manager.

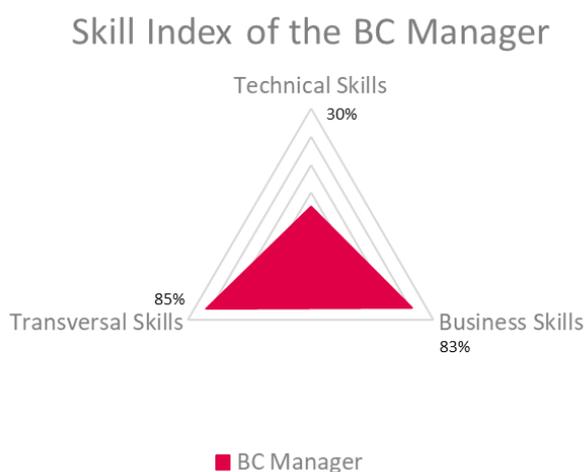


Fig. 8: Skill Index of the BC Manager

### TECHNICAL & BLOCKCHAIN SPECIFIC SKILLS

As expected, technical skills are not rated as important for the Blockchain Manager as for the BC Architect and BC Developer. “Blockchain Solution Design” and “Data Analysis” were indicated as important (> 50%). There are no technical skills, which were identified as very important (> 75%).

The following technical skills are listed as missing (>35%) for the BC Manager: “Maths & Stats”, “Blockchain Solution Design”, “Protocol engineering”, “Smart Contract Development”, “Development of decentralised Apps”. Because of this, it can be suggested that for the BC Manager a general technical understanding of Blockchain technology is desirable, but can be superficial (S2, 3.3.2).



#### Curricular recommendation:

*The Blockchain Manager does not require general programming knowledge. However, an overview of the functional and technical background of Blockchain technology and its applications would be beneficial and should be included in the training programme.*

## PROFESSIONAL / BUSINESS SKILLS

In the case of Professional / Business skills, all the skills listed are considered important for the BC Manager by more than 50%. Furthermore, all skills except “Product Development skills” achieve over 75% and can be classified as very important.

The following business skills are indicated as missing (>35%) for the BC Manager: skills for “Blockchain Use Case development”, “skills in Legal & Compliance matters” (S2, 3.3.2).



### Curricular recommendations:

*The Blockchain Manager needs an economic and business-oriented education that covers all Professional / Business skills.*

## TRANSVERSAL FUTURE SKILLS

As with the other Blockchain professionals, all Transversal Future skills were indicated as important for the Blockchain Manager with over 50%. The following skills were indicated as very important (>75%): “Self-efficacy & Self-confidence”, “Self-management/organisation/regulation & Self-responsibility”, “Decision competence & Responsibility-taking”, “Initiative and performance competence”, “Ambiguity competence”, “Ethics & Environmental competence”, “Innovation & Creativity competence”, “Sensemaking”, “Future mindset & Willingness to change”, “Cooperation competence” and “Communication competence”.

The following skills are reported as missing (>35%): “Ambiguity Competence”, “Ethics & Environmental Competence” and “Innovation & Creativity Competence” (S2, 3.3.2).



### Curricular recommendations:

*As with previous profiles, all Transversal Future skills should be included in the Blockchain Manager's training programme. A focus should be given to the ethical reflection of possible areas of application of the technology.*

## Overview of skill distribution for the individual roles

The following tables give an overview of the importance, as well as the lack of the different skills.

**Technical and Blockchain specific skills:** Table 1 shows an overview of the Technical and Blockchain specific skills. There are no technical skills that are considered as unimportant (<50%) for all the three roles. Therefore, all skills should be covered in some form. BC Architect and BC Developer have no overlap in the most important technical skills (>75%). It might make sense to have two different modules for the different roles - but it is important to keep in mind that both have a high importance for technical skills, so it might be worth considering basic and advanced modules for the key qualification areas. For BC developers, the focus should be more on development and programming, while for Blockchain Architects the priority should be on solution design, conception and use case design. The Blockchain Manager only needs a broad understanding of the underlying technology, but no programming skills.

Tab. 1: Overview Importance and Missing of Technical and Blockchain Specific skills

Technical and Blockchain specific Skills	BC Architect		BC Developer		BC Manager	
	Imp.	Mis.	Imp.	Mis.	Imp.	Mis.
Maths and Stats	+		+	*	0	*
Coding (C++, Python, Java)	+		++		0	
Blockchain Solution Design	++	*	0	*	+	*
Protocol Engineering	+		+	*	0	*
Cryptography Development	+	*	++	**	0	
Distributed Network Engineering	+	*	+	*	0	
Frontend & Backend Development	0		++		0	
Data Analysis	+		0		+	
Data / Network Security Design	++		+		0	
Smart Contract Development	+	*	++	*	0	*
Development of Decentralised Apps	+	*	++	*	0	*
Cloud and Infrastructure Design	++		+		0	
UX Design	+		+		0	
Scientific Computing	+		+		0	

Importance: 0 < 50; + >= 50; ++ >=75; Missing: \* >= 35%; \*\*>=50%

**Professional / Business skills:** In the case of the Professional / Business skills (see tab. 2), there is hardly any overlap between the required business skills for BC Architects and BC Developers. Two different modules should be offered here as well. The Blockchain Manager needs a deep understanding of all listed Professional / Business skills.

Tab. 2: Overview Importance and Missing of Professional / Business skills

Business skills	BC Architect		BC Developer		BC Manager	
	Imp.	Mis.	Imp.	Mis.	Imp.	Mis.
Business (Needs) Analysis	+	*	0	*	++	
Business Development	0		0	*	++	
(Blockchain) Use Cases Development	++	*	0	*	++	*
Product Development	+		+	*	+	
Product Management	+		+	*	++	
Skills in Legal & Compliance Matters	0	*	+	*	++	*
Marketing	0		++	*	++	
Finance and Controlling	0		+	*	++	
Human Resources Development	0		+		++	
Customer Success Design	0		+	*	++	
Affiliate Marketing	0		+		++	

Importance: 0 < 50; + >= 50; ++ >=75; Missing: \* >= 35%; \*\*>=50%

**Transversal Future skills:** The transversal future skills (see tab. 3) are the only skill set where each skill is important for all three roles (>50%). We see a clear demand for transversal skills, which must be reflected in the modules for the different roles. This also corresponds with the companies' assessment of how important transversal skills will be today and in the next 3 years. In both cases, more than 90% of the respondents describe them as either "somewhat important" or "very important" (S2, 3.3.2). A clear skill shift from hard skills to transversal skills can be observed in this area. Blockchain professions predominantly require transversal skills, which is also related to the many changes and innovations in the Blockchain sector. It requires professionals who can continuously adapt to their fast-moving environment. Transversal skills are indispensable in this context (S2, 3.3.1).

Tab. 3: Overview Importance and Missing of Transversal Future skills

Transversal skills	BC Architect		BC Developer		BC Manager	
	Imp.	Mis.	Imp.	Mis.	Imp.	Mis.
Learning literacy & Metacognitive skills	++		+		+	
Self-efficacy & Self-confidence	++		++	*	++	
Self-determination & Autonomy	++		++	*	+	
Self-Management / Organisation / Regulation & Self-Responsibility	+		+	*	++	
Decision Competence & Responsibility-taking	++	*	+	*	++	
Initiative & Performance Competence	+		+	*	++	
Ambiguity Competence	+	*	+	*	++	*
Ethical & Environmental Competence	+		+		++	*
Design-Thinking Competence	++		+	*	+	
Innovation & Creativity skills	++	*	+	*	++	*
Systems & Networked Thinking	++		+		+	
Sensemaking	+		+		++	
Future Mindset & Willingness to change	++	*	+	*	++	
Cooperation Competence	++		++	*	++	
Communication Competence	++	*	++	**	++	

Importance: 0 < 50; + >= 50; ++ >75=; Missing: \* >= 35%; \*\*>=50%

**Skills rated as important or missing for all roles:** Generally, it can be observed that there is no skill that was not rated as important for any of the three roles. Even though the BC roles differ in their skill focus, the following skills are rated as important (> 50%) for all roles: “Product Development”, “Product Management” and all Transversal Future skills. With regard to the skills identified as "missing" (>35%), an overlap between the roles can be identified. The following skills were indicated as missing for all three roles: “Skills in Legal & Compliance Matters”; “(Blockchain) Use Cases Development”; “Development of Decentralised Apps”; “Smart Contract Development”, “Blockchain Solution Design”, “Innovation & Creativity skills” and “Ambiguity Competence” (S2, 3.3.2). It is noticeable that even skills that were not previously indicated as important for a role were reported as missing. One possible reason is that these skills are generally lacking in Blockchain teams and that it is important that at least one of the roles inhabits these skills. The missing skills are primarily Blockchain-specific skills or legal skills that, according to the interviews, also play an important role in the development of Blockchain use cases (S2, 3.3.4).

## Further Roles

**Comparison with Job Ad roles:** Analyses of the job ads show that there is an overlap between the defined BC roles and skills in the survey and the different jobs and the skills requested by the companies in their job offerings. For example, **BC Developers and Engineers** have a similar ratio between technical and business skills. Here, over 90% technical skills, around 50% business skills and 70-90% transversal skills are required. The Architect, on the one hand, has a greater demand for business skills in the job ads than the BC Developer, which contradicts the survey data, in which the BC Developer requires more operational business skills and the **Blockchain Architect**, on the other hand, conceptual and use case design-oriented business skills. The **Blockchain Consultant** is also a frequently requested function. In comparison to the BC Manager the BC Consultant has a stronger customer focus (S2, Annex Tab. A 4).

Despite the differences in job descriptions, the skills in demand within the companies can be well covered by our previously defined Blockchain roles. Nevertheless, in this fast-moving environment, it is important to repeatedly check whether the skills that are taught still match the skills demand (S3, 4.1.1.1).



### Recommendation for education provider:

*Regular reviews of the skills in demand in industry and the public sector.*



#### Recommendation for policy-makers:

*A national/international community (vertical Blockchain Skill Hub) should be established and sponsored by the EU to collect all skills and compare them with market needs in order to quickly identify short-term changes in this fast-moving technology and to be able to adapt training offers.*

In addition to the three roles, the training of **Blockchain educators** should be enhanced. As outlined above, there is often a lack of teaching and training staff to promote Blockchain skills and explain areas of application. The Blockchain educator should have a comprehensive knowledge of the Blockchain topic and be familiar with the relevant business and programming areas.



#### Recommendation for education provider:

*Introduction of a training and qualification programme for Blockchain educators that covers all Blockchain-relevant skills in the transversal, business and technical areas.*

**Importance of industry-specific skills:** In the interviews, it was emphasised that in addition to the requested skills, industry-specific skills, e.g. from the finance and insurance industry, supply chain management or the public sector, are particularly advantageous. Especially in solution and use case design, extensive industry knowledge is a basic requirement (S2, 3.3.4; S3, 4.2.5).



#### Curricular recommendation:

*Projects on the primary Blockchain industries (supply chain, finance, legal, public sector, etc.) should be worked on in order to get an overview of use cases and industries. An internship integrated into the study programme can also provide a practice-oriented learning approach.*



#### Recommendation for education provider:

*Establishment of EU funds for inter-faculty summer camps between technical and non-technical disciplines*

## Blockchain Training Demands

**Industry training demands:** Although there are not many official training programmes and forms of certification for Blockchain skills, 80% of the surveyed BC experts state that the role of certificates and training will play a major role in the future (S2, 3.4.2). The need for training courses relates primarily to technical courses, more specifically to industry-specific use cases and solution architecture modules, which can also be derived from the skill needs of the different Blockchain professions. A small proportion of the participants demand further transversal skill courses (S2, 3.4.2).

In the interviews, experts expressed that training at a young age is seen as particularly valuable because the learning process can usually be made faster and more efficient (S2, 3.5.3).

## Large share of informal and non-formal education<sup>1</sup>

**Formal education needs:** As far as formal education is concerned; the experts are divided. In many job ads, an academic education in the field of computer science or informatics is required, but some experts do not find traditional education particularly important and refer to Blockchain short courses offered by numerous e-learning platforms such as Udemy and Coursera. On the other hand, these courses are also criticised for being too generic and superficial. In many cases they offer only a surface introduction to the topic. There is also a lack of face-to-face training sessions with supervision, which can be useful for practical training. Furthermore, there is a need for more Blockchain training courses in the business sector, especially to develop suitable Blockchain use cases (S2, 3.4.4).

### Curricular recommendation:



*It was clearly emphasised that training and education programmes should be as interactive as possible. The focus should be on practical application, dealing with real world problems and working on concrete projects. But also, entrepreneurial skills and working in interdisciplinary teams were highlighted as important for the learning process. If three different training programmes are designed for BC Architect, Developer and Manager, it is very important to give them the opportunity to work together as a team.*

<sup>1</sup> **Informal learning:** Learning resulting from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is in most cases unintentional from the learner's perspective.

**Non-formal learning:** Learning which is embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which contain an important learning element. Non-formal learning is intentional from the learner's point of view. It typically does not lead to certification (Cedefop 2014).



#### **Curricular recommendation:**

*Courses should be offered, which simulate the entire process of Blockchain projects, from order acceptance, planning, design, programming to testing and implementation. The scope outside of technical development is also very important for all BC roles.*

### **Need for specific in-house training provision**

**In-house training:** For effective in-house training, the possibility of knowledge sharing was emphasised and the company should allow employees time to train themselves. However, hands-on projects such as interdisciplinary Blockchain hackathons were also mentioned as good training opportunities. In-house training is also described by some as the only useful training option, but this is very time and money consuming, which increases the investment risk for companies (S2, 3.4.4).



#### **Recommendations for companies:**

*Companies should try to integrate as many learning opportunities as possible into the daily life of their employees. Collaboration opportunities with other companies in the form of hackathons can provide a good exchange platform for BC professionals*

In terms of roles, the BC Architect is expected to have a deeper involvement and a higher willingness to learn than the BC Developer, as the latter only needs to partly adapt his skills, while the BC Architect needs to understand the underlying technology of the Blockchain at a larger scale (S2, 3.4.4).

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## Blockchain skill demand in a nutshell

The skills demand analysis showed that the demand for Blockchain-specific qualification is very high and can vary depending on the role. The skills and roles defined in the survey reflect the needs stated in the job advertisements and can be used as a basis for creating training programmes and modules. The main messages can be summarised as following:

1. More than half of the companies surveyed have recruiting problems due to a lack of or insufficiently qualified applicants.
2. BC specific skills are considered very important.
3. The three previously defined roles of Blockchain Architect, Blockchain Developer and Blockchain Manager differ strongly in their skill focus.
4. For the BC Architect, all technical skills are important, but a special focus should be placed on the conception and design of Blockchain solutions and use cases. In terms of business skills, a need for strategic and conceptual skills can be identified.
5. For the BC Developer all technical skills are important, but a special focus is placed on software development and coding, especially of BC-specific applications, such as DApps or Smart Contracts. In terms of business skills, the BC Developer primarily needs operational skills (e.g. marketing and finance).
6. For the Blockchain Manager, an overview of the technical background of the Blockchain technology is beneficial, but there is no need to know how to code or develop Blockchain solutions. All business skills should be trained for this position.
7. A skill shift can be observed. Transversal skills are the new hard skills and are considered important for all roles.
8. Industry and sector-specific knowledge is becoming increasingly important for the development of BC applications.
9. The fast-moving environment of BC technology requires a regular update of the skill demand, an international Blockchain skill Hub would be useful to adapt the training offers.
10. Introduction of a training and qualification programme for Blockchain educators that covers all Blockchain-relevant skills in the transversal, business and technical areas.
11. Formal training and certifications are seen as increasingly important by companies.
12. Training courses should be practical, interactive and interdisciplinary and cover Blockchain projects from beginning to end.
13. Organisations should offer their employees more learning opportunities and promote an exchange with other companies, e.g. in the form of hackathons.



# Blockchain Skill Supply

## Blockchain skill Supply

There are a few official Blockchain education programmes within Europe. These do not meet the quantitative demand for Blockchain qualification offerings (S1, 3.6.1).

**Education and training strategy for Blockchain:** Besides an official European BC strategy, most EU countries also lack a national / regional framework or an official strategy for Blockchain education and training. The existing BC courses have all emerged from market demand and are not officially regulated or validated (S3, 4.1.1.3).

**Lacking education of policy-makers:** Lack of information and stigmatisation of BC technology (e.g. for illegal activities), inhibit the willingness of policy-makers to support educational projects with adequate financial subsidies. In order to develop appropriate regulations and make strategic decisions on the Blockchain issue, policy makers need to be educated on the application, opportunities and risks associated with the implementation of Blockchain technologies (S3, 4.1.1.4).



### Recommendations for policy-makers:

*Decision makers in politics and jurisdiction need to be educated on the topic of Blockchain technologies in order to be able to make informed decisions.*

The existing discussions about Blockchain education programmes are not on a public level, but are rather between private companies, institutions and BC communities (S3, 4.1.1.4).



### Recommendation for policy makers:

*Blockchain collaborations and communities within the EU-countries should be identified, streamlined and included in further Blockchain decisions. This could be a very practical and future-oriented bottom-up approach.*

## State of play EU Blockchain educational and training provision

**Blockchain qualification offerings in Europe:** For this report, 120 BC educational and training programmes were analysed within the EU. Figure 9 gives an overview of the content and structure of the analysed training programmes.

The analysis shows that the BC related educational and training programmes are mostly offered by private providers and have a duration between one day and 15 weeks. In expert interviews, a duration between 3-6 months is recommended (S3, 4.2.1). Most courses have no official certification or only a certificate of attendance or completion. The majority of courses are online courses designed for beginners. The focus of the courses is usually ICT-related and the target group is generally BC interested learners as well as ICT professionals (S3, 4.1.1.1).

**Learning content and intended learning outcome:** Furthermore, the courses were analysed according to their learning content and intended learning outcomes to investigate the coverage of Technical & Blockchain skills, Professional / Business skills and Transversal Future skills. As shown in Fig. 10, it can be observed that most of the modules focus on Technical skills (85% “consider” or “strongly consider”), 50% of the courses also teach Transversal Future skills, while only 40% of the courses focus on Business skills. A similar distribution can be observed for the learning outcomes (S3, 4.1.1.1).

### Recommendations for education providers:



*VET courses should cover a period of 3-6 months and include both online and in-person lectures. The individual lectures and teaching content should be dedicated to a specific topic and a related task each week. The course should be certified. Transversal and Business skills should be included in the program*

## Overview Blockchain educational and training offerings

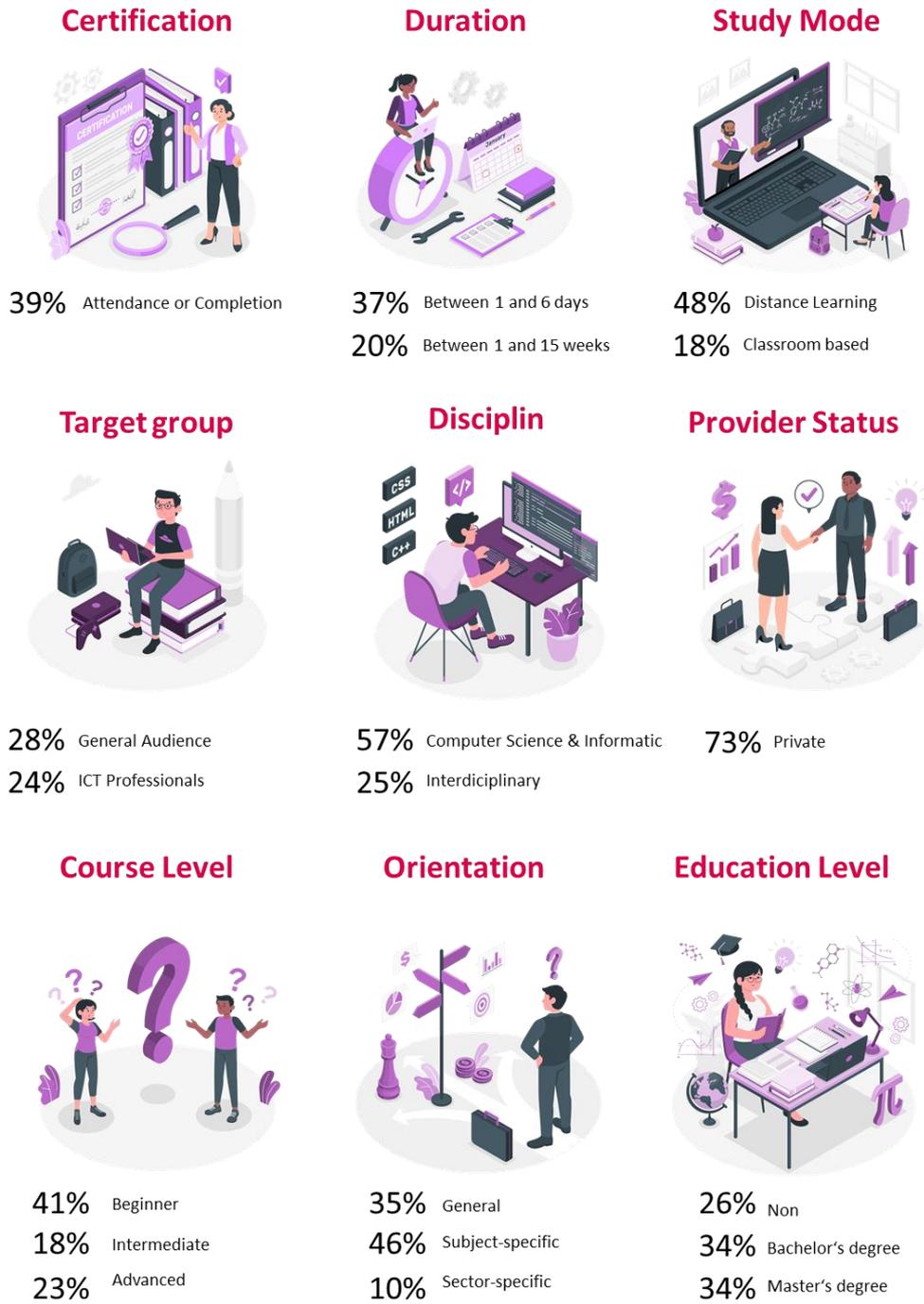


Fig. 9: Overview Blockchain educational and training offerings

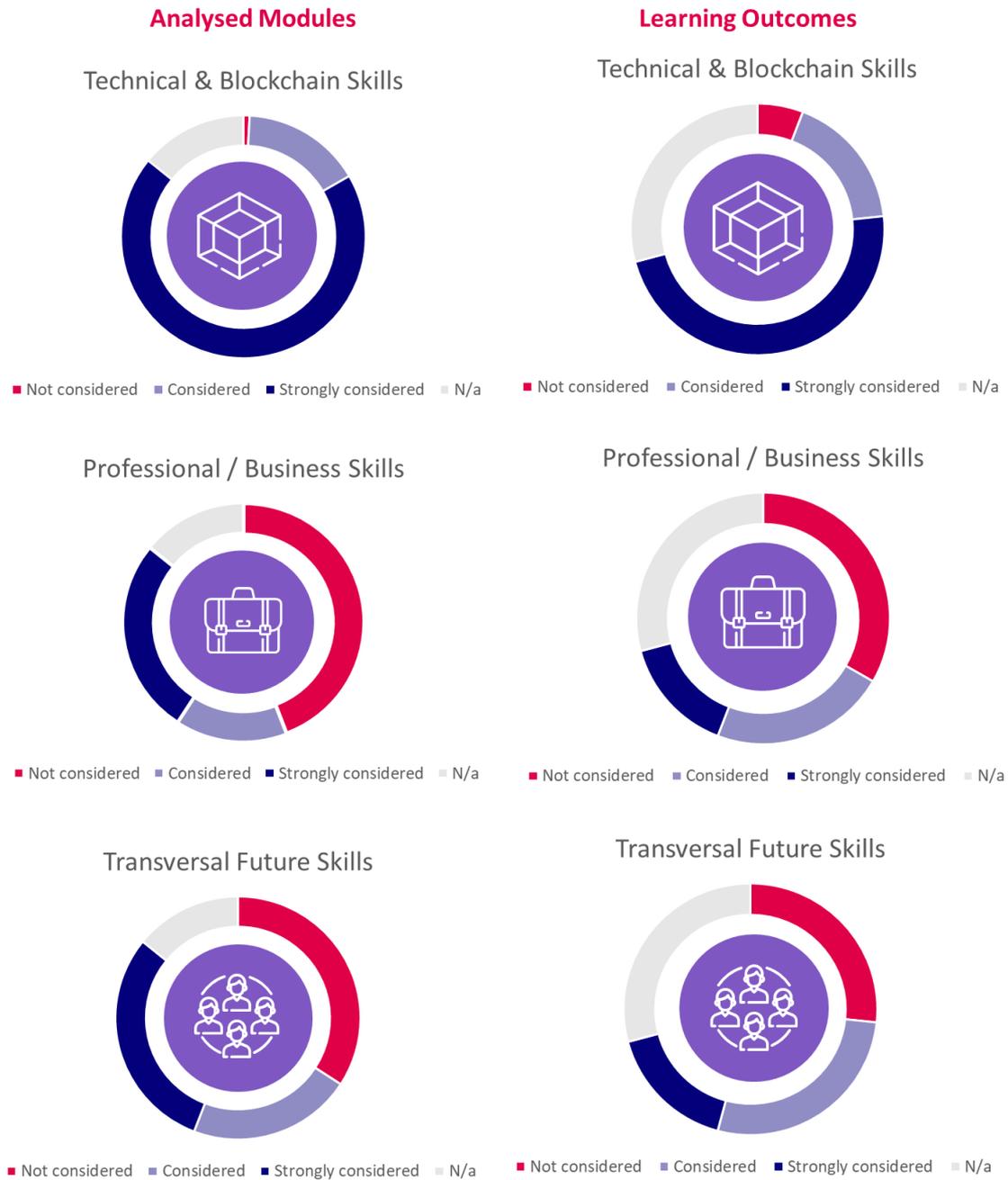


Fig. 10: Analysis of Learning Content and Outcomes from 120 BC Training programmes

## Formal Education and Training provision in Europe

Up until now, almost three-quarters of Blockchain education content providers are from the private sector. The public sector currently provides only around 25% of Blockchain training units. Private content producers include companies, institutes but also laboratories (S3, 4.1.2.4). Most of the more in-depth and longer Blockchain training programmes are organised by private providers (S3, 4.1.1.3).

## Lack of EU Blockchain certification

There is no official regulated Blockchain certificate, even if formal certification is mentioned to be essential for the further development of professional profile in the field of BC technology (S3, 4.1.2.3). Existing certificates are usually only certifications of participation that have no formal value (S3, 4.1.1.3). Especially for learners, an official certification can play an important motivational role and provide an incentive for further training in the field of Blockchain technology (S3, 4.1.1.3).



### Recommendation for education provider:

*There is a need for official certification as a Blockchain expert.*

**Blockchain qualification for trainers and educators:** There is currently no official Blockchain coaching certification for trainers and educators. There is a significant gap in teacher training and education in this area. A strong practical orientation would also be highly recommended in this context (S3, 4.1.2.3).



### Recommendation for education provider:

*A training programme for Blockchain coaches and trainers is needed.*

## Emerging structure of formal educational programmes

**Blockchain programmes at universities:** Existing Blockchain programmes at universities are often short courses that deal only superficially with BC technology and are embedded in other existing study programmes (e.g. ICT). So far, there is neither an international nor a national standard for structuring Blockchain courses within the EU. Experts describe the quality of existing programmes as poorly, which

is also due to the lack of training opportunities for instructors (S3, 4.1.1.3; S3, 4.1.1.1). Experts mention, that a gamification approach could be suitable for the young, digitally savvy target group.



**Curricular recommendation:**

*Gamification can be a useful tool for teaching Blockchain skills. Cooperation with innovative start-ups in this field is recommended.*

**Continuing education programmes:** In addition to basic training, there is also a great lack of official continuing education programmes (CET). Again, there is a lack of quality, concrete project reference and official certification that serves as proof for employers and their clients (S3, 4.1.1.3). Cooperation with companies can offer great added value in CET programmes (S3, .4.1.2.1).



**Recommendation for education providers:**

*Blockchain training programmes for lifelong learners should be offered. Continuing education is crucial for many new technologies and training in the Blockchain field should not be reduced to a basic education e.g. in the form of a university degree.*

**Course formats:** Due to the Corona pandemic, previous training offers were primarily provided online. Experts agree that online formats make sense for the digital nature of Blockchain technology but should be complemented with workshops and face-to-face teaching units in small groups. Furthermore, online courses pose problems with credibility and certification of performance (S3, 4.1.2.1; S3, 4.1.2.2).



**Curricular recommendation:**

*Blockchain courses should be offered as hybrid models in presence and online.*

## Demand for integrated content for Blockchain programmes

**Content for Blockchain programmes:** For training programmes, the need for not only technical implementation skills but also an understanding of BC use cases was again highlighted (S3, 4.1.1.3). In terms of content, a combined approach of theoretical and practical learning should be preferred. Theoretical knowledge of the basics of Blockchain technology should be taught as well as project-related

skills. The involvement of experts and needs from the public sector and the economy offers further added value. However, self-learning in forums and via videos should also be encouraged, as future BC professionals need to continuously develop themselves on the job and should internalise this ability to self-learn in their formal education (S3, 4.1.1.3).



**Curricular recommendation:**

*Blockchain related education programmes should include practical references and a focus on real-world projects. Self-learning skills should be strengthened among learners.*

**Lack of transversal skills:** Currently, lack of transversal skills in official programmes can be observed. These skills are particularly important when BC professionals work in decentralised or self-organising teams, but they are also indispensable in customer contact (S3, 4.1.1.3).



**Curricular recommendations:**

*The following areas should be covered within a Blockchain programme: Infrastructure, SW distributed architecture, decentralised SW architecture, P2P; Distributed Ledger Technology; Deep analysis of use cases: Bitcoin, Ethereum, Cardan, Ada, Polka Dot and their applications/evolutions; Smart contract & token economy; Self-sovereign identity (SSI); Decentralised business models for enterprise & citizens' networks, both at local, national and international level; Cooperation game theory and transferrable utility; Distributed consensus, decentralised architectures' economy; Decentralised Finance (DeFi); On-chain & quadratic voting; Tokenomics*

## Non-formal education and training provision in organisations

Up to now, there have been hardly any cooperation between companies and educational institutions to promote Blockchain training for employees (S3, 4.1.1.3).

Cooperation between different Blockchain companies will become increasingly important in order to keep Blockchain professionals up to date with the latest technology (S3, 4.1.1.3).



### Recommendations for companies:

*Cross-company education collaborations should be encouraged, as well as projects and learning programmes between companies and educational institutions.*

**In-house Blockchain skill development:** The following opportunities were mentioned to promote Blockchain skill development within companies: Senior employees train new employees; In-house training; Blockchain literature; Online tools; Peer - learning; External training; IBM Garage; Working in SCRUM-based decentralized teams; Cooperation between universities and BC companies; Online MOOCs; Meetups with local BC developers; You tube; and Foras. Sharing of information - weekly meetings; Literature; Pilot projects; Meetups with local BC developers; Hackathons; Peer learning; Online courses; Training on the job; Time to learn (employees) & Permanent training courses on the latest technological innovation (S3, 3.3; S3, 3.4)



### Recommendation for companies:

*Companies should establish personal training paths for the different Blockchain professional roles and actively accompany and support them in their development process.*

Within companies, it is also important that decision-makers are familiar with the technology in order to be able to make informed decisions (S3, 3.5).

In the survey, self-managed teams and agile frameworks were mentioned as the most used working models for Blockchain teams (S3, 4.2.2).



**Curricular recommendation:**

*New Work methods such as self-managed teams and agile frameworks should be explained in formal education and made more comprehensible to students.*

Most Blockchain experts are currently trained on the job and receive support from more experienced Blockchain experts who have usually self-acquired their knowledge. Again, practical relevance plays a major role, as most university students have a gap between theory and practice (S3, 4.2.3.1).

Hybrid online and face-to-face models are preferred by companies as they can be better scheduled by employees and allow for more flexible time management (S3, 4.2.3.1).



**Recommendation for education providers:**

*The provision of hybrid training opportunities allows learners to manage their time flexibly.*

## Individual and informal education and training strategies

Experts state that formal programmes do not follow the latest trends. Social media platforms on the other hand offer the possibility of socializing and exchange information and opinions across company borders (S3, 5). Communities and forums provide an important source of information for Blockchain experts, but the content usually lacks integrity and professionalism (S3, 4.1.1.3). However, there is a lack of structure and the learner must show great initiative in order to categorise the information correctly (S3, 4.1.1.3).

In 17 BC ICT communities, more than 7.7 million members were counted. Blockchain communities are often sub-forums of large social media platforms such as Facebook, LinkedIn and Reddit (S3, 3.2.1). Fig. 11 provides an overview of the content of the three most used forums and the thematisation of the different skill categories.

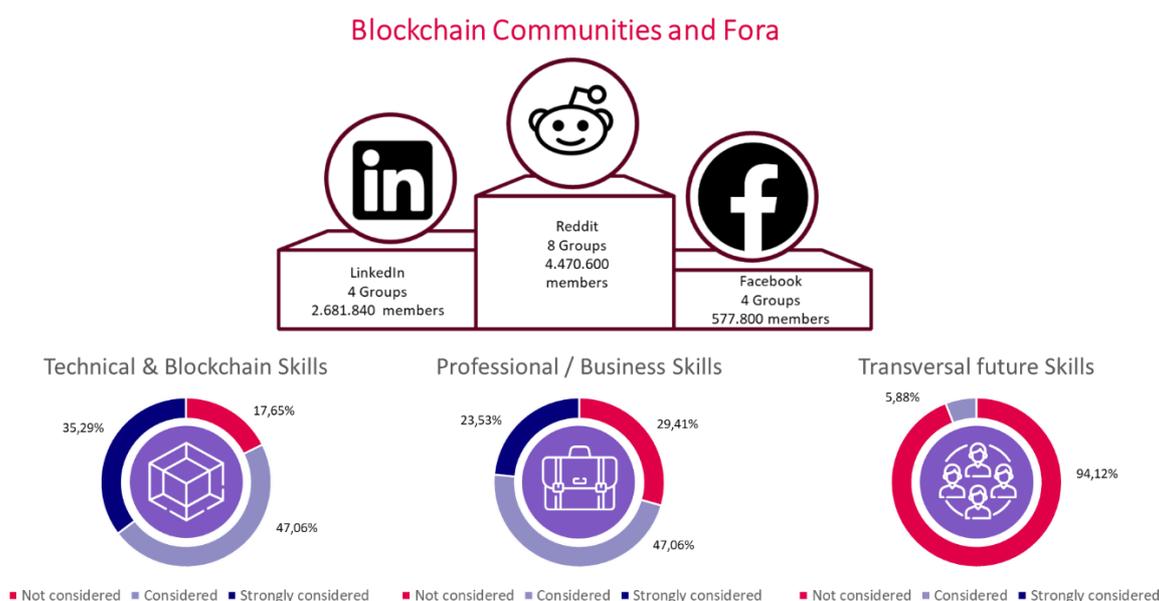


Fig. 11: Overview Blockchain Communities and Foras

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## Blockchain skill demand in a nutshell

The skills supply analysis showed that there is a great lack of formal education in the field of Blockchain, but also that non-formal education cannot fully cover the qualification needed. Communities and fora offer a useful exchange platform, but are not sufficient for the education and training of Blockchain experts. The main messages of the skill supply analysis can be summarised as following:

1. Most BC Educational and training offerings have a duration from 1 day up to 15 weeks.
2. The target audience of BC VET courses are ICT professionals or a general audience interested in the theory.
3. Over half of all VET courses relate to the discipline of Computer Science and Informatics
4. Almost three quarters of VET courses are produced by private providers.
5. The majority of VET courses are designed for beginners and have a subject-specific orientation.
6. Blockchain is not yet offered as a separate course of degree, but only as a superficial specialisation module for mainly ICT courses.
7. For the most part, formal programmes do not follow the latest trends.
8. Communities and forums provide an important source of information for Blockchain experts, but the content usually lacks integrity and professionalism.
9. Social media platforms also enable the possibility of socializing and active exchange of opinions.
10. Blockchain training contents are mainly developed by private companies and institutions.
11. Business and Transversal skills are often missing in educational and training programmes.
12. Due to the lack of official training programmes, no preferred training method can yet be identified.
13. Transversal skills are rarely considered and discussed in the forums and communities.



# The Future of the European Blockchain Skill Strategy

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## The Emerging Blockchain Professional

After summarising the existing reports, a detailed picture of the Blockchain market's status quo emerges. In the following, we want to show a vision of the future when all the previously mentioned recommendations have been implemented.

### The future Blockchain ecosystem

There are EU-wide regulatory frameworks for the use of Blockchain technology for different industries and application areas, e.g. for the financial sector, supply chain management and for the public sector.

Each EU country has a national strategy that is aligned with the EU-wide Blockchain strategy. EU-wide communities and exchange platforms as well as a Blockchain skill Hub for Blockchain experts and researchers are in regular exchange with policy-makers and educational institutions to address the latest trends and developments in the Blockchain sector. Blockchain development projects and research are funded by the state and the EU, especially projects in the public sector that promote the common good. For state funding, Blockchain projects should be in line with the sustainability goals of the EU; projects that are harmful to the climate or the common good and only pursue primarily economic interests will not be funded. The emancipative effect of Blockchain should be prioritised. National and international communication strategies help to educate the public about the potential of Blockchain technology and to strengthen trust in the technology.

In order to have an overview of the labour market developments, an EU-wide BC Workforce database has been developed, which serves as a monitor for the skills and employment situation within the EU and can be used for policy decisions in the education sector.

### The three Blockchain personas

The EU defined 3 different Blockchain Employee Roles, the BC Developer, BC Architect and the BC Manager / Consultant. These are registered in the ESCO database.

Figures 12, 13 and 14 show three people working in the different Blockchain jobs, give an overview of the job description and their skill level as well as the three most important skills in each area.

In addition to these three roles, the training of Blockchain educators should be enhanced. As outlined above, there is often a lack of teaching and training staff to promote Blockchain skills and explain areas of application. The Blockchain educator should have a comprehensive knowledge of the Blockchain topic and be familiar with the relevant business and programming areas.

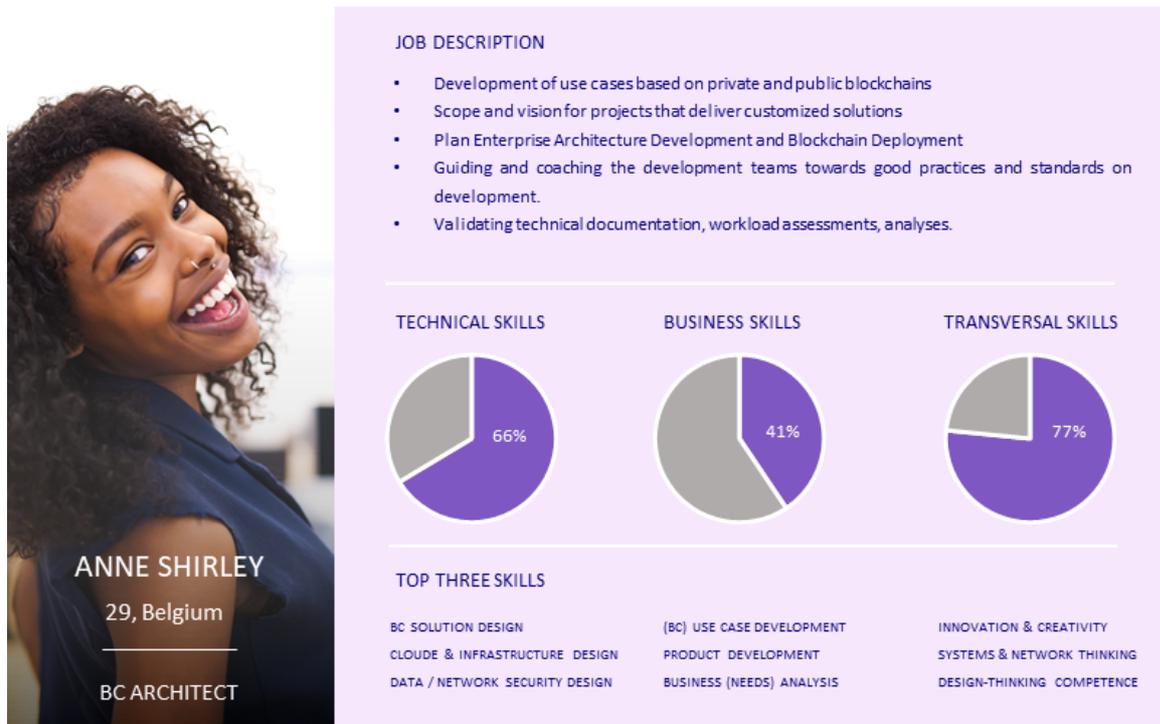


Fig. 12: Blockchain Architect Persona

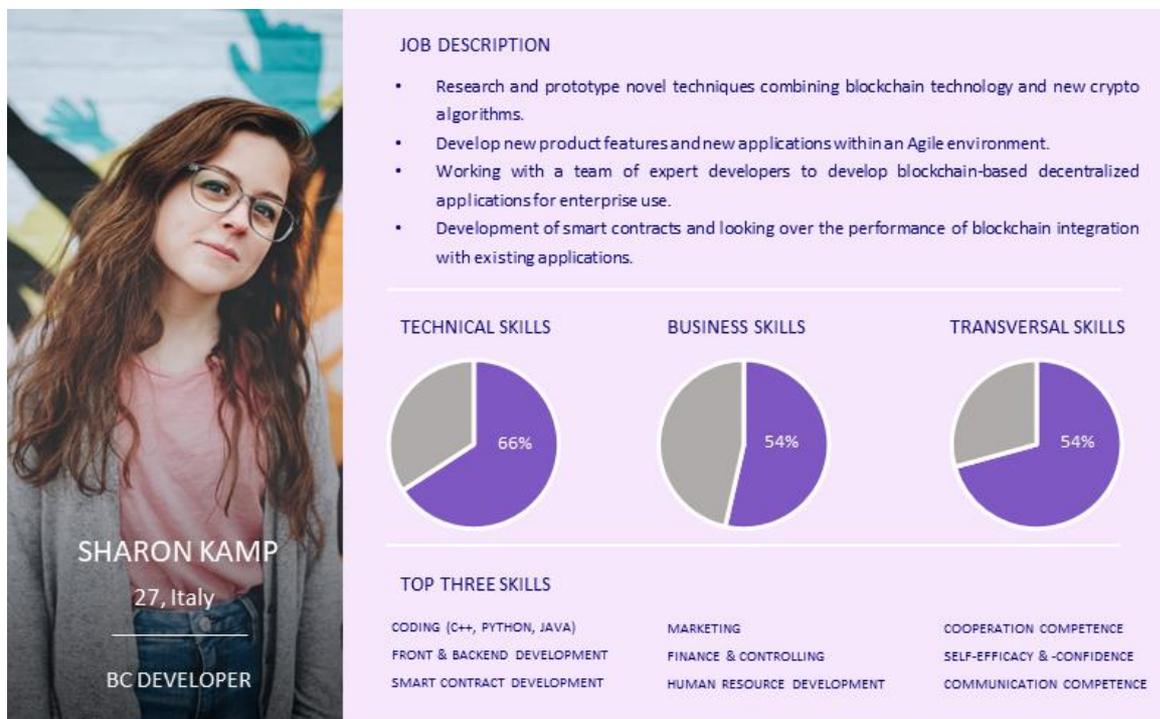


Fig. 13: Blockchain Developer Persona



Fig. 14: Blockchain Manager Persona

## The future Blockchain education

The roles of BC Architect, BC Manager and BC Developer cover a large part of the demanded Blockchain qualifications. Due to the different specialisations, it is necessary to offer different modules in order to train the professionals. Fig. 15 gives an overview of a possible composition of learning modules. Transversal skills should be continuously addressed in the curriculum, as they are essential for all three job profiles. Basic modules on technical and business understanding should also be attended by all roles.

Technical in-depth modules are mainly of interest to BC Developers and BC Architects. Business in-depth courses, meanwhile, should be attended by the BC Manager. Business courses can be further divided into Strategic Business Management and Operational Business Management. For the BC Manager, both modules are important, while the BC Architect should attend the Strategic Management module and the BC Developer the Operational Management module. Further technical specialisations modules can be divided into Conception and Use Case Development for the BC Architect and Software Engineering and Development for the BC Developer.

All three roles should regularly work together in interdisciplinary industry-specific projects in order to get to understand the different application areas of the Blockchain technology. Another focus should be on researching applications in the public sector and the ability to inform others about the technology. Furthermore, self-learning in forums and via videos should be encouraged, as future BC professionals need to continuously develop themselves on the job and should internalise this ability to self-learn in their formal education. The use of new learning technologies and hybrid learning models that are partly F2F and digital is standard in this field. Inclusivity Strategies and Mentoring programmes increase the diversity of participants of the different Blockchain educational programmes. A practical phase within the degree programme offers a practice-oriented learning approach. Student and faculty member should be encouraged to participate more in Blockchain events to be up to date about Blockchain policies and the evolving sector.

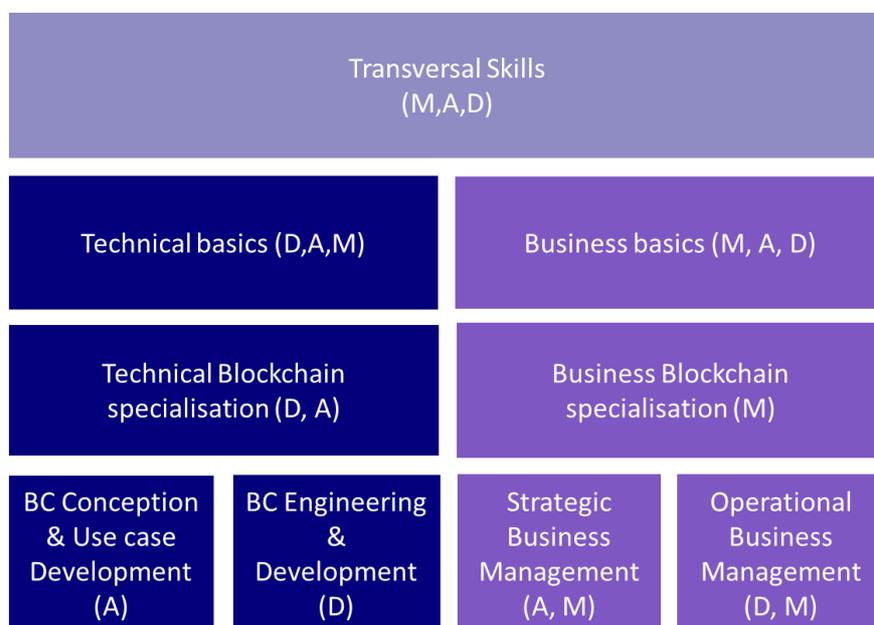


Fig. 15: Educational Modules for BC Architect (A), BC Developer (D) and BC Manager (M)

## The future Blockchain workplace

The Blockchain Professionals work with agile methods in interdisciplinary, self-managed teams. Employees can work both on-site and remotely and have flexible working hours.

Each BC employee develops a personalised learning path together with a mentor and the company provides the appropriate learning units and training courses. The learning units are offered in hybrid form and the employees can flexibly schedule them. Blockchain service providers and users are in

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constant exchange and annual cross-company hackathons are offered, which deal with new trends in the Blockchain area and serve as an exchange platform for BC experts. Furthermore, there is the possibility to deepen the knowledge in the field of Blockchain within different courses at a lifelong learning university. In addition to the further education courses, official training courses to become a Blockchain trainer are offered.

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## References

Cedefop (2014). Terminology of European education and training policy: a selection of 130 terms. 2nd ed. Luxembourg: Publications Office.

References of the reports can be found here:

[Study on Blockchain labour market characteristics \[D2.2.1\]](#) will be referred to as S1

[Study on Blockchain skill Demand \[D2.3.1\]](#) will be referred to as S2

[Study on Blockchain skill Supply \[D2.4.1\]](#) will be referred to as S3