Blockchain in Recruitment – Greek Public Sector Analysis and the QualiChain Solution

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Abstract **- A significant challenge for public sector human resources management in Greece is to optimize the civil personnel recruitment procedure regarding both process effectiveness and perspective employee quality while continuing to enforce, beyond any doubt, the principles of transparency, participation and accountability. Blockchain, perceived as a disruptive technology by design, has evolved beyond traditional payment solutions in the finance sector and offers a potential for transforming many sectors including human resources and recruitment. This paper analyses gaps of the current process of Greek public sector recruitment and describes the expected benefits of utilizing blockchain through a pilot case of QualiChain project.**

Keywords – Blockchain; Public sector recruitment; Qualification; Verification; Evaluation.

I. INTRODUCTION

Public sector organizations are expected [1] over time to fulfill mandates revolving around objectives such as qualitative and cost-effective service delivery as well as accountability in the management of various types of resources. To achieve that, effective assessment in recruitment of the most qualified personnel is of the essence. Carrying out this complex procedure with the use of multiple assessment tools and information collected from diverse sources is expected to provide a more comprehensive approach of the candidates being assessed and to further add value to the recruitment system overall. Securing access to the candidates' work and educational background as well as performance reviews in a credible way is argued that it will substantially improve the current recruitment process in view of the aforementioned mandates.

Blockchain technology is regarded as a game-changer in several sectors including the domain of Human Resources (HR) and recruitment, mainly because of its inherent characteristics of decentralization, transparency and immutability. There are currently numerous business and research, private and public sector endeavors to explore both the theoretical and practical implications (technical, political, socio-economic, legal and cultural) of the blockchain technology. Extending the work in [1], the first purpose of this paper is to present some of these initiatives.

The novel integration of technology and business flows that blockchains have brought, represents [2] both challenges and opportunities for enhancing digital services in civil service recruitment but, so far, Greek public sector has lagged behind other sectors in both research and exploration of this technology. So, this work further describes public sector recruitment in Greece, analyzing the current process and explaining the areas where blockchain could provide solutions through pilot cases of QualiChain project initiative for decentralizing academic and employment qualifications. In addition to that, QualiChain platform will implement other innovative features that could be deployed in the recruitment process, such as Multi Criteria Decision Methods (MCDM) and visualization tools, providing insight, flexibility and scientific foundation to existing evaluation procedures.

This paper continues in Section II with an analysis of the need and the advantages of blockchain in recruitment. Section III elaborates on public sector recruitment in Greece describes the current process, the challenges and the areas of necessary improvement. Section IV analyses the QualiChain case. The acknowledgement and conclusions close the article.

II. BLOCKCHAIN IN RECRUITMENT

Despite Bitcoin being the most well-known applied paradigm, the blockchain technology has evolved beyond traditional payment solutions in the finance sector and offers a potential for transforming many sectors including the public sector.

A 2018 OECD (Organisation for Economic Co-operation and Development) Working Paper [3] on Public Governance argues that blockchain technology has the potential to catalyze a major shift in public service delivery and internal government strategies and states that potential fields of application range from decentralized identity management to personally managed data storage for the health, insurance, and financial sectors, on to decentralized power on the basis of neighborhood energy trading solutions, and through to new voting procedures.

Conceptually, the blockchain is [4] a distributed database containing records of transactions that are shared among participating members. Each transaction is confirmed by the consensus of a majority of the members, making fraudulent transactions unable to pass collective confirmation. Once a record is created and accepted by the blockchain, it can never be altered or disappear.

A. The need

One of the sectors that should consider the above benefits that this technology delivers – such as trustworthy

verification of counterparties' identity and documents without the involvement of a third-party – is [5] HR, by identifying problems and areas of inefficiency in existing operations that could be addressed through blockchain. The processes most appropriate for transformation through blockchain are likely to be those that are slow, labour-intensive and expensive due to the need for significant data collection and third-party verification, such as recruitment.

Moreover, repeatedly, in both research and grey literature, increasing amounts of fraud and corruption related to applicants' credentials have been reported, shaking not only the trust in the education system [6][7] but also in the entire recruitment process, as well as in the employees themselves. Falsified information is often related to references, diplomas/degrees, previous salary, certifications or work experience.

In a 2015 report (by Business Insider) 17 incidences were listed where high-level business people (even CEOs) lied about their credentials on their resume. A 2017 survey [8][9] claims that "over half of the curricula and job applications (53%) contain falsifications and over three quarters (78%) are misleading". According to different articles (HireRight's 2017 employment screening benchmark report, 2017 CareerBuilder US Survey), more that 75% of employers / HR managers have found a lie / misrepresentation on a resume or job application. It is also reported that 2 out of 5 HR managers initially spend less than a minute looking at a resume, while 19% spend less than 30 seconds so, the case is that sometimes HR professionals do not even check a candidate's qualifications so they do not take the necessary precautions to avoid a bad hire.

The estimated cost of a bad hire to a business or organization can be significant but the cost can be more than just financial because of the reputation impact an underqualified recruit could have on their operations.

Therefore, it is clear that one of the biggest gaps in the hiring process is verifying the applicant's credentials (both academic and work history) and that is why, in the current work we focus on this cumbersome HR task, i.e., recruitment, where Blockchain could have a major impact on both sides of the employment relationship, from recruitment process for the potential employer to the ability for people to maintain – and control access to – a comprehensive, trustworthy blockchain-based record of their education, skills, training and workplace performance.

The possible connection between applicants evaluation and blockchain has very recently been verified in a recent publication [10] where participants discussed their desire to utilize blockchain in checking performance appraisals of candidate employees to verify their performance potential and suitability for the advertised job stating that "it would be beneficial to know the employee's performance appraisal and misconduct in his previous jobs from the blockchain…it will be useful in achieving transparency, planning and accessing trusted data that can help with allocating employees for internal vacancies" or "we have a problem since in spite of the well-written CVs presented by the candidates during the recruitment phase, when they join work, they show poor performance…so if we can verify performance appraisals from the blockchain, it will make a big difference".

In public sector the problem is even more intense because the formal procedures of verifying credentials integrity and authenticity are stricter and more bureaucratic due to the need for non-digital (required paper form etc.) or non-real-time communication between public authorities. Moreover, when mistakes or oversights do happen in the selection, the administrative process of replacing the employee is definitely more time consuming than in private sector.

It should be noted that the general problem of documents verification is not a new one and several existing technologies can be used to tackle some of the aforementioned issues. For example, the digitization of academic certificates in combination with digital signatures and Public-Key-Infrastructure is a partial solution but with drawbacks (centralized nature of necessary Certificate Authorities, national central authority still needed for academic certificates). Another alternative is the use of interoperability (web services technologies, e.g., WSDL, SOAP) but either bilateral agreement among issuers and recruiters or a trusted third party in both national and international level is necessary. Taking into consideration other factors that add to the complexity of the problem such as diversity (geographical, administrative, technological) of academic (or professional) institutions, cybersecurity, scalability, transparency it is clear that blockchain pillars of immutability, decentralization and transparency, by design, provide a common viable solution worth exploring as shown in the following paragraphs.

B. Related Work

On one hand there are research originated projects [6][8] addressing the problem of qualifications such as:

- The combination of Blockcerts [11] with Open Badges [12] technologies. Open Badges are verifiable, portable, digital badges with embedded metadata about skills and achievements. Blockcerts consists of open-source libraries, tools, and mobile apps enabling a decentralised, standards-based, recipient-centric ecosystem, enabling trustless verification through Blockchain technology. Blockcerts uses Open Badges as certificates and Blockchain addresses as recipient identification.
- The European Blockchain Services Infrastructure (EBSI) [13] is a joint initiative from the European Commission and the European Blockchain Partnership (EBP) to deliver EU-wide cross-border public services using blockchain technology. One of the four use cases that have been selected for 2019 was centered on diplomas, aiming to give control back to citizens when managing their education credentials as well as significantly reducing verification costs and improving authenticity trust.
- University of Nicosia [14] decided to store the academic certificates, for all the students who successfully completed the course "Introduction to Digital Currencies", on the Bitcoin blockchain.

- Rooksby and Kristiyan [15] that have implemented a blockchain system based on Ethereum for use by a university to store student grades.
- EduCTX [16] proposed as a blockchain based global higher education credit platform based on the concept of the European Credit Transfer and Accumulation System (ECTS). It constitutes a globally trusted, decentralized higher education credit, and grading system that can offer a globally unified viewpoint for students and higher education institutions (HEIs), as well as for other potential stakeholders, such as companies, institutions, and organizations. The authors also present a prototype implementation of the environment, based on the open-source Ark Blockchain Platform as proof of concept.

On the other hand, several companies and startups have been quick to recognize the potential in blockchain and are exploring ways to leverage the technology in HR systems:

- APII is a career verification platform, putting employee background checks and resume verification on a secure blockchain. Their goal is to help speed up the background check process tagging the blockchain's distributed ledger capabilities to make sure that employees have accomplished what they claim to.
- Jobeum is using blockchain technology to create a 'LinkedIn-like recruitment tool'.
- Peoplewave wants to revolutionize the recruitment and background checks with verifiable data on the blockchain. It implements Wavebase platform, which is a blockchain solution using smart contract to tackle the problems of authenticating an employee, their performance, their history and information across multiple companies, roles and managers.
- Zinc is an automated reference checking tool, built with blockchain, where candidates are empowered to own and control their reference data that's reusable throughout their career.
- TrustLogicsTM is an award-winning technology solution, powered by distributed ledger technologies that enable professionals to build credible global profiles, facilitate pre-screening and allow private networking supported by artificial intelligence. Using blockchain, TrustLogic's goal is to root out the usual suspects that increase the cost of hiring: phony resumes, incomplete information, not enough verifiable data, and so on. Job-seekers can get their credentials verified, and employers will know they are drawing from a legitimate candidate base for better matches in the hiring process.
- Indorse leverages the blockchain to solve two persistent problems in HR: the lack of trust in skill verification, and users giving up their data for little or nothing in return. Techwise, Indorse.io is a Dapp built on Ethereum and is using the Inter Planetary File System (IPFS) as the storage mechanism.
- Aversafe leverages the accuracy, security and transparency of the blockchain to offer decentralized credential issuance and verification services on a global scale. Aversafe's digital certificates and verified work histories are recorded on the blockchain, a tamperproof distributed ledger, so that anyone can confirm their authenticity and origin.
- HireVibes is a low-cost recruiting tool that increases employee and peer referrals from a global network of recruiters. It can be viewed as a collaboration platform being built for the global talent community. It's powered by a native digital currency called HireVibes Tokens (HVT), which are utility tokens based on the EOS.IO blockchain. HVT is held by over 200,000 accounts and can be used to vote on community funds and proposals, pay for hires and send peer-to-peer.
- In 2019, a new consortium announced the building a global clearinghouse or database, called the Learning Credential Network (LCN) [17], which would use blockchain technology to store permanent, verifiable records of job seekers' skills and academic qualifications.
- In a more recent (2020) announcement by a cooperative non-profit entity, Velocity Foundation, the vision to harness distributed ledger technology to build the "Internet of Careers", is highlighted [18]. Velocity is a utility layer that globally connects career related data processors — HRIS (Human Resources Information Systems), contingent workforce management, freelancer platforms, student information systems and other vendors — and allows for interoperability, transparency and portability of trusted, verified data.

Of course, the lists above are not all inclusive but it is interesting to note that many other cases have been reported in literature or press these last few years that have no online presence any more or remain as stale references. Besides, so far, to the extent of our knowledge, most initiatives are oriented to academic institutions or private sector while no HR public sector authorities have any related ongoing projects.

III. PUBLIC SECTOR RECRUITMENT IN GREECE

In this section, we elaborate on public sector recruitment in Greece describing the legal framework, the current process, as well as challenges and potential areas of improvement.

A. Legal framework

The Supreme Council for Civil Personnel Selection (ASEP) is an independent authority that acts as the institutional guardian for the principles of transparency, publicity, objectivity and meritocracy regarding civil service staff hiring, in Greece. It is an independent body provided under the Greek constitution [19], entrusted with performing public administration recruitment processes for project

agreements as well as fixed-term and short-term employment agreement positions at all levels.

Under the current legal framework, ASEP is entrusted with performing public administration recruitment processes in Greece, apart from certain exceptions provided by law. More specifically, certain Greek public entities are empowered by the said legislation to proceed with recruitment of personnel, either supervised by ASEP or not.

ASEP is supported by a high-end electronic information system managing the vast volume of applications, vacancies, news releases, results and most importantly candidates involved in ASEP selection processes records. Candidates are evaluated based on the score they achieve in written exams, the outcome of their interview and their qualifications overall. Some of the tools missing from ASEP's day-to-day business are functionalities that could relieve the public from the bureaucratic burden (such as achieving validation and confirmation of authenticity of university degrees) and further enhance qualitative and cost-effective service delivery and accountability (by way of, amongst others, simplifying the already complex recruitment process of Highly Qualified Civil Personnel).

B. *Current Process*

Vacancies in the civil sector are made public by ASEP through newsletters, its official website (www.asep.gr) and the press, in a non-personalized way whatsoever. Citizens can make queries via its website about announced vacancies, looking for those that better match their qualifications. Following announcement, citizens sign in to the ASEP Registry where they fill in their qualifications and submit an e-application regarding the announced vacancies. The e-application itself does not suffice as the candidates are further expected to print out their e-application and send it to ASEP along with the hardcopies of all supporting documents and certificates. Only recently, in 2020, a legislative modification attempts to alleviate the obligation for hardcopies, replacing them with digital/scanned documents, but its application is still in early stages and of course the full need for validation still exists. ASEP's Central Committee then issues and publishes interim results in the form of tables containing all necessary information, which may be appealed by those with vested interest. ASEP's Council Members in composition review the appeals and the interim results, issue and publish the final results.

Vacancies in the public sector addressed to highly qualified candidates, although announced and handled similarly with the rest (online application process, interim and final results and so forth), are significantly more complex to the extent that some stages are added in the recruitment process, just before the issue of the interim results, as represented in Fig. 1.

More specifically, in the first round of candidates' evaluation, some are rejected based on legal requirements (fee, online submission etc). This stage is executed by the respective organization department.

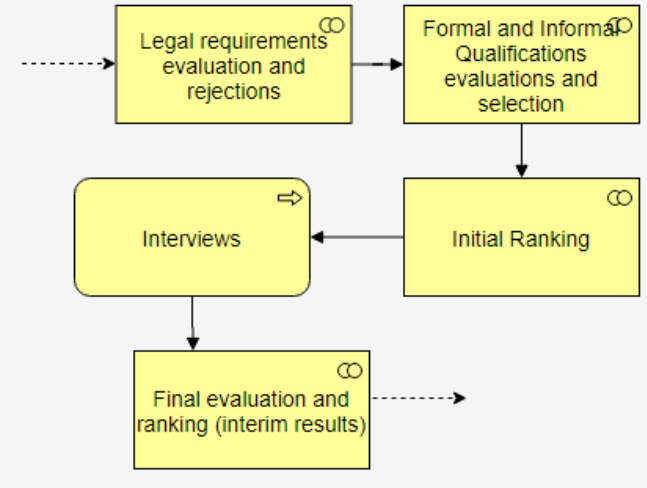

Figure 1. Specific steps for HQP.

Then, in the Second round of candidates' evaluation, some are rejected based on both formal and informal qualifications, e.g., experience and postgraduate degree minimum requirements as well as pertinence to specific vacancy needs. This stage is executed by an Evaluation Committee comprised mainly by Council Members and University Professors where one member (as an industry expert) provides a preliminary assessment.

In the Third round, an initial ranking, evaluating candidates' declared qualifications, is issued by ASEP's Evaluation Committee (for internal use only). This is based on an assessment methodology that varies each time, as law leaves it to the Committee's discretion to decide upon. The candidates ranking higher are then called for an interview.

Candidate Interviews take place in Next stage.

In the last round of candidates evaluation, the Committee, taking into account the interviews along with all previous stage results, issues and publishes interim results in the form of tables containing all necessary information (e.g., name, ID number, credits collected per qualification etc.).

Then the normal flow resumes where interim results may be appealed by those with vested interest. ASEP's Council Members, in composition, review the appeals and the interim results, issue and publish the final results.

Following the announcement of the final results in both scenarios as described herein above, the public entities who triggered the recruitment process proceed with hiring the prevailing candidates as per ASEP's results and validating their qualifications. In case of fraud detection, public entities may submit, within three years from the final results publication, a request to ASEP for replacement.

C. *Current process challenges and areas of improvement*

Qualifications' evaluation and validation by ASEP (initially by the Central Committee or the Evaluation Committee as per the case and later by the Members in composition) is a time-consuming process as it is performed in a non-automated way.

In the case of education credentials, a challenge [6] that slows down the connection between academia and the labour market is the fact that they are largely resisting the pull of technology often requiring paper documentation and time consuming manual processes for their verification, mainly related to

- the fact that higher education institutions (HEIs) keep student data in centralised databases and dedicated online systems
- the fact that, although administratively all HEIs are under the supervision of a common authority (Ministry of Education), no single point of reference exists so far for student degrees.
- the fact that while interoperability technology (i.e., web services) is mature enough to tackle the connection problem, only a small percentage for HEIs offer some kind of service and even then as isolated cases without achieving semantic interoperability neither among themselves nor with public labour market.

As a result, Qualifications' validation by the public entities who trigger the recruitment process and ultimately hire the prevailing candidates as per ASEP's results is also performed in a non-automated, almost non-deterministic, way, requiring communication by telephone, exchange of letters and, in certain cases, circulation of hardcopies, with all the cost that the stakeholders at issue incur with regard to time and money.

In fact, during formal and informal discussions with stakeholders in Greek public sector, it has been communicated that, the verification of authenticity and validity of a certificate, issued by a Greek HEI, has a time range of five to thirty days depending on the HEI's responsiveness. In the case of certificates issued by non-Greek HEIs where, sometimes the respective embassy intervention is necessary, the delay has, reportedly, been extended to five months in the past (although recently it has decreased down to three months). In the case of foreign language titles (i.e., issued by respective institutes) the estimated validation time is twenty days and may incur additional cost for the candidate.

On top of that, when the validation fails for any reason, the replacement process itself is also time-consuming and linked with both direct and indirect costs.

Regarding the evaluation of candidates, in the case of Highly Qualified Civil Personnel, as already described, every Evaluation Committee, before, during and after the interview process, may decide on different evaluation criteria and assessment methodology, for both formal and informal qualifications. Furthermore, coordination between different steps of this multi-stage procedure is through an excel based exchange of documents. However, as stated in the literature [20], personnel selection, depending on the recruiter's specific targets, the availability of means and the individual preferences of the decision makers (DMs), is a highly complex problem, whose multi-criteria nature makes MCDM methods ideal to cope with, given that they consider many criteria at the same time, with various weights and thresholds, having the potential to reflect at a very satisfactory degree the preferences of the DMs. As a result, in the current process, there is no common scientific ground onto which the DMs' assessment and the results from different evaluation processes can be based, compared and cross-evaluated even for vacancies with very similar requirements, even when the same applicants participate in more than one of these vacancies proclamations.

These are the gaps on both validation and evaluation procedures that the current work aspires to bridge within the QualiChain research project as explained below.

IV. THE QUALICHAIN CASE

QualiChain is a EU funded research project that targets the creation, piloting and evaluation of a decentralised platform for storing, sharing and verifying education and employment qualifications and focuses on the assessment of the potential of blockchain technology, algorithmic techniques and computational intelligence for disrupting the domain of public education, as well as its interfaces with private education, the labour market, public sector administrative procedures and the wider socio-economic developments.

A. Public Administration Recruitment Pilot and goals

As shown in Fig. 2, out of the four distinct key areas that QualiChain is targeting [21] for exploring the impact of decentralisation (i.e., lifelong learning, smart curriculum design, staffing the public sector, providing HR consultancy and competency management services), the Greek pilot, is under the "Public Sector Staffing" use case.

Figure 2. QualiChain key areas and ASEP pilot target.

Qualichain pilot goals in relation to public sector recruitment are the following:

- Demonstrate the QualiChain concept and technological solution, by piloting the combination of disruptive technologies involved in the context of staffing the public sector.
- Assess the impact, i.e., the benefits and risks of the QualiChain technological solution on the full spectrum of stakeholders towards which it is addressed in public administration.

B. Stakeholders

The stakeholders involved in the ASEP use case are the following:

1) ASEP Council Members and Employees:

As publishers, evaluators, validators, and decision makers with regard to the candidates' qualifications and the entire selection process in general.

2) Citizen/Candidate:

As the main participant of a selection process and the owner of qualifications.

3) Public Entity:

As "customer" of ASEP selection process and the future employer of the candidate.

4) Qualifications' issuing/accrediting institutions and their personnel:

As (indirect) providers of qualifications or on the receiving end of requests for verification, by public entities.

C. Expectations

The recruitment and competency management services of QualiChain will be exploited to enhance not just the check of the candidates' declared qualifications, but also their screening leading to a short list of those to be interviewed and ultimately to the identification of the best possible applicant for the role.

Specifically, this pilot has the following main expectations as illustrated in Fig. 3:

- To provide personalised candidate notifications for job vacancies by matching individual profiles with available jobs in the civil sector.
- To utilise the solution's Blockchain based digital ledger in order to validate (i.e., confirmation of authenticity) formal academic qualifications of individual candidates, thus freeing the public sector from the relevant bureaucratic burden. Of course, this functionality may extend in the future to other qualifications (professional qualifications, informal academic ones, etc). In any case, the expected benefit against the current system (as reported in Section III) is significant since the delays are anticipated to be reduced by orders of magnitude, i.e., from days/months to minutes.
- To improve efficiency of the selection process in terms of time, credibility and flexibility by utilizing value adding services provided by "Analytics and DSS" QualiChain component. To this end several multi-criteria decision making methods will be implemented, such as ELECTRE, TOPSIS, Promethee, so that appropriate qualitative (e.g., interview performance, cooperation/communication skills, experience pertinence) and quantitative criteria (e.g., months of experience, graduation degree) as well as other necessary parameters can been embedded in the form of a comprehensive evaluation management system.

D. Use case flow

The expectations above will be met through the execution of the Highly Qualified Civil Personnel recruitment process steps, in the context of the pilot, as illustrated in Fig. 4. The main steps are the following (note that the terms Citizen/Candidate are used interchangeably):

1) The issuing organization issues a qualification component (either an academic qualification or a work experience certificate) for a citizen.

2) The isssuing Organization, after obtaining the candidate's consent, uploads the qualification component in QualiChain and notifies Citizen.

3) Citizen signs up to QualiChain and fills in preferences for notification

4) ASEP announces positions/vacancies and required qualifications on QualiChain.

5) Citizen/Candidate gets notified of new vacancies via a Data Analytics Tool embedded in QualiChain.

6) Candidate signs up to ASEP's Registry (if not already registered), fills in his qualifications, uploads the relevant proof of qualifications declared (e.g., university degree) and applies for the vacancy he/she is interested in.

7) ASEP confirms the validity of the proof of qualification declared and potentially its metadata (e.g., year of graduation) and updates ASEP backend (marking the qualification so that this process does not have to be repeated).

8) ASEP uses QualiChain ΄s MCDSS (Multi Criteria Decision Support System) to get an initial ranking of candidates.

9) Based on this initial ranking, ASEP proceeds to the stage of interviews.

10) ASEP uses QualiChain MCDSS to get the final ranking and ultimately the interim results.

E. Pilot Challenges

Several challenges have been identified from the beginning as follows:

- Friendliness and usability of user interface provided by Qualichain, given that it will be, mainly, used by ASEP'S Members and employees, of no technical background whatsoever.
- Pilot planning and integration with internal ASEP procedures.
- Technical limitations of Blockchain technology related to performance and scalability, such as Quality of Service or throughput. However, the estimated impact for the pilot is expected to be minimal since the cornerstones of ASEP use case are transparency and immutability, both of which are among the pillars (and more popular characteristics) [22] of Blockchain.
- Semantic interoperability between Greek terms used by ASEP information systems (e.g., institution

names, qualifications, certifications, job descriptions and so forth) and QualiChain terminology.

- Convincing field experts, committee members and ASEP decision makers that more precise, sufficient, detailed and complete justification of ASEP committees' decisions can be achieved using QualiChain DSS features.
- Compliance with Greek and EU regulation, e.g., General Data Protection Regulation (GDPR).

Beyond the scope of the Greek pilot, it is interesting to see whether the current stiff legal framework safeguarding personal data in the EU will ultimately adapt to the blockchain's nature, in order to make the most of the decentralization notion, as well as how interoperability and blockchain can co-exist or consolidate within an organization.

V. CONCLUSION

In order to achieve effective assessment in recruitment of the most qualified personnel in the public sector, methods and tools must be constantly developed and tested to educate and train everyone in line with new developments, in our case, with the blockchain technology, so that their benefits can be fully realized by all stakeholders.

Several solutions / proposals aspire to promote the use of blockchain in recruitment but are still in the research / proof of concept phase or are mainly focused on private sector.

By participating in QualiChain project, as a pilot for staffing the public sector, ASEP will have the opportunity to embed state of the art tools, not only to achieve validation (i.e., confirmation of authenticity), of university degrees, utilising blockchain technology to free the public sector from the relevant bureaucratic burden, but also to provide personalized information to citizens/potential candidates and explore ways to bring most value to the highly qualified personnel selected, enabling, effectively a breakthrough in contemporary recruitment processes in Greek civil service.

In the future, ASEP aspires to extend the capabilities of QualiChain to other qualifications as well as explore other components / concepts totally foreign to public sector recruitment operations such as gamification or artificial intelligence.

ACKNOWLEDGMENT

This work has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 822404 (QualiChain).

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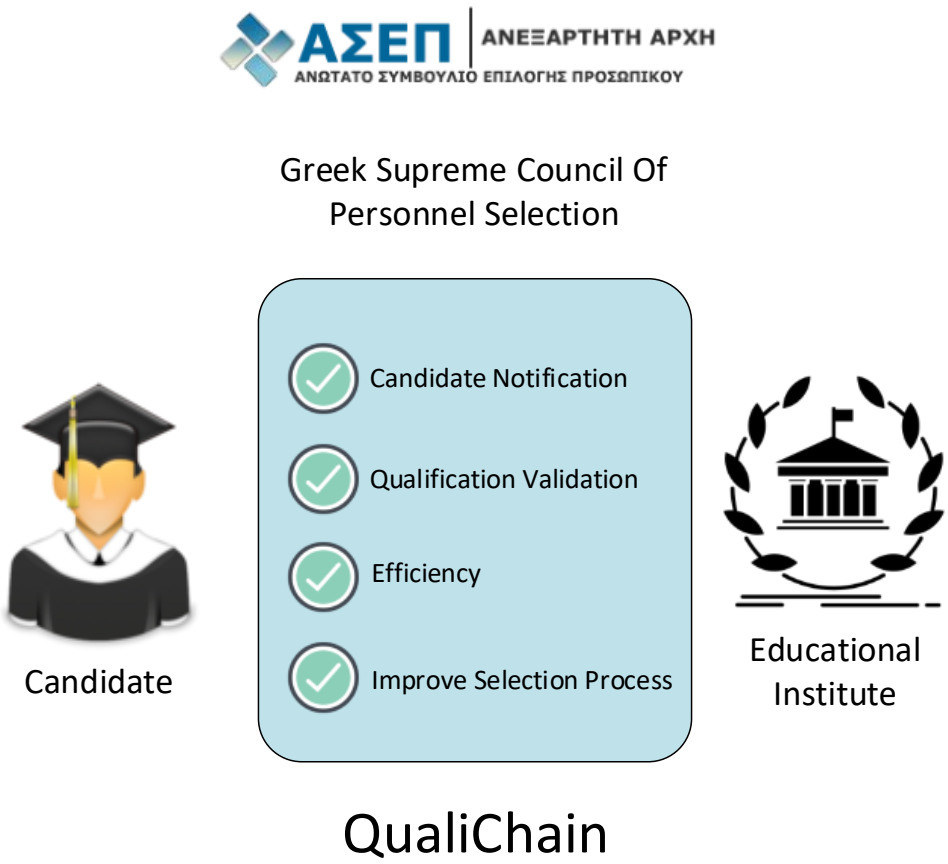

Figure 3. Pilot expectations.

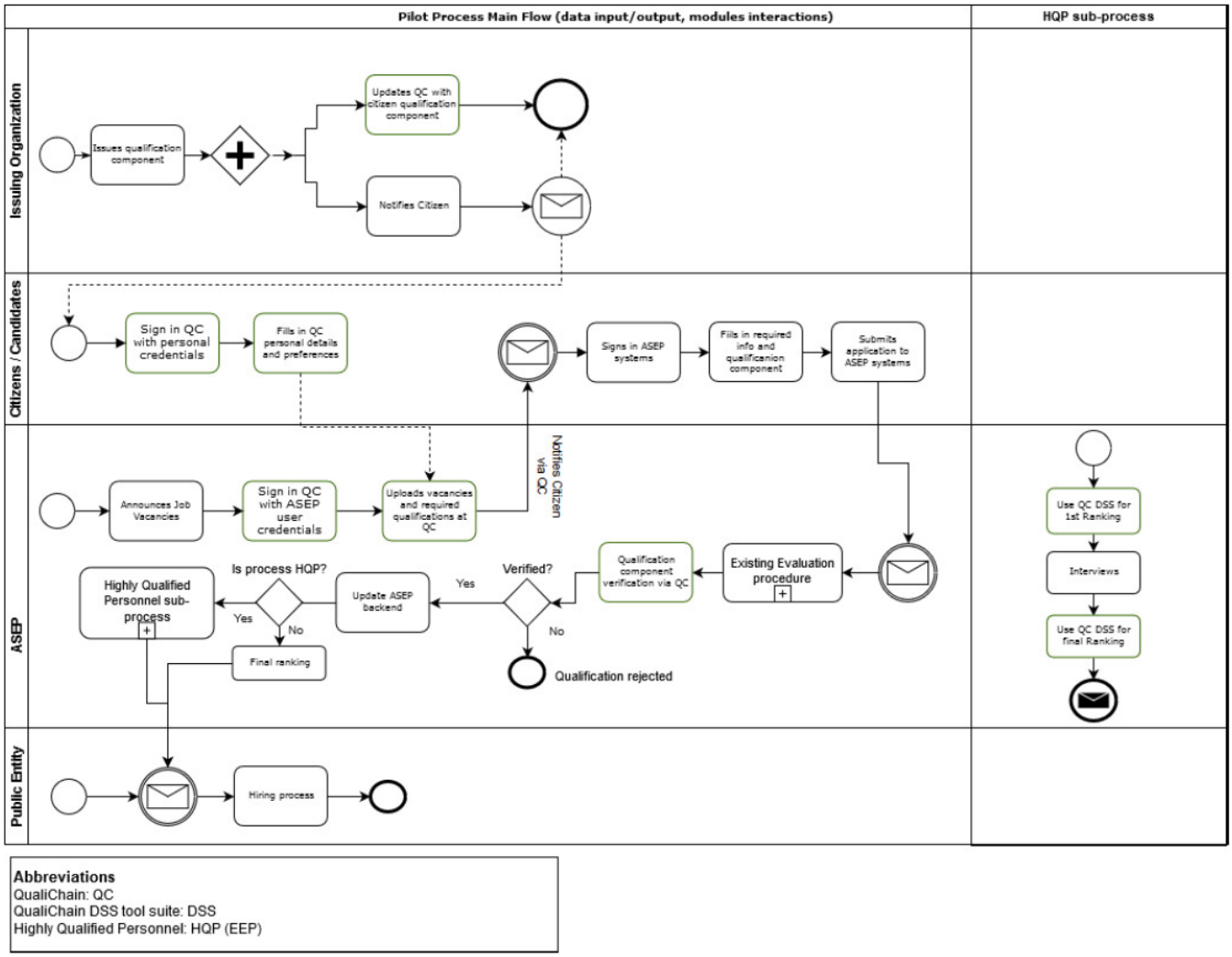

Figure 4. QualiChain ASEP pilot BPMN workflow.