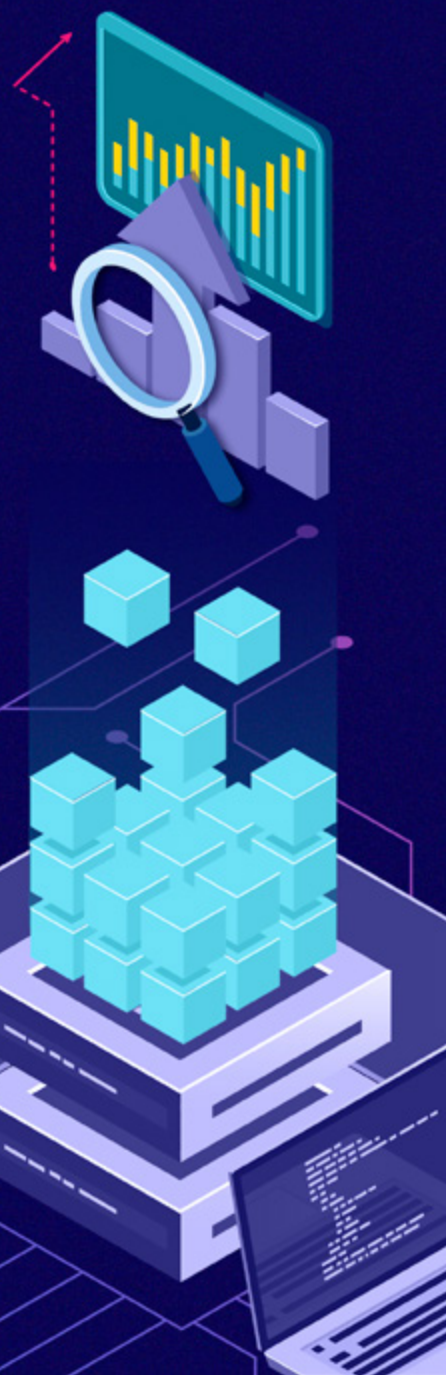# Artificial Intelligence for job seeking

How to enhance labor intermediation in Public Employment Services

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1. Introduction

Most countries count on labor intermediation services aimed at improving the matching between labor supply and demand, as well as reallocating workers in more productive positions[1]. These services comprise the labor intermediation systems (LIS) including public employment services (PES), private services such as private employment agencies (PEA), and civil society organizations participating in intermediation and linkage processes (ILO, 2009).

In particular, PES are the contact point between citizens and employment policies, coordinating the entire offer of related services in a logic that pursues the achievement of better employment routes. The spectrum of services offered are diverse, from traditional job boards linking job seekers with company vacancies, to services aimed at the insertion of migrants into the labor market.

New technologies --artificial intelligence in particular-- not only represent a very important opportunity to increase PES's efficiency and effectiveness, but they also bring great challenges in terms of adoption and usage. Additionally, AI can be useful for supporting other services provided by the PES. Some of these services are related to improving the management of job counselors in profiling, adequately advising employability routes to job seekers, or conducting better employment matching for people with disabilities (pwd).

2. Basic components of Public Employment Services and the opportunities created by new technologies

According to the International Labor Office (ILO), PES design and implement many of the active labor market policies seeking to help employees enter the labor market. They also promote adjustment; and mitigate the impact of economic transitions. Additionally, PES provide relevant labor market information; and offer assistance in job seeking, along with placement services and the management of unemployment insurance and other labor market programs (ILO, 2016).

Labor markets are not perfect because there are information asymmetries between employers and job seekers. Some employers do not get, or take longer time to get employees with the necessary skills, and, on the other hand, some applicants fail to find jobs requiring their skills. This market failure justifies and makes necessary the existence of employment services since the information asymmetry generates inefficiencies in the economy and social welfare (ILO, 2016). New technologies are the window opportunity to enhance the efficiency and effectiveness of each PES function.

Nowadays, market labor challenges and complexities are greater due to the number of new occupations and the specific requirements and skills these demand from job seekers. In this regard, PES functions are broader. These include labor intermediation; the provision of labor market information; labor market adjustments; management of unemployment benefits; and the management of labor migration[2].

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1 See IDB (2016).
2 IDB, (2015).

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Main actors of PSE

PES have two main users (clients): job seekers and companies or employers. Consequently, they offer specializing services to each client depending on their characteristics and needs. In general, PES offer services to job seekers such as profiling and segmentation services; support services for job seekers through the matching with vacancies; job orientation; referral to job training; and differential services for pwd inter alia. Meanwhile, employers have access to services such as preselection of suitable candidates; organization of job fairs; and vacancy registration services.

Graph 1. PES key actors
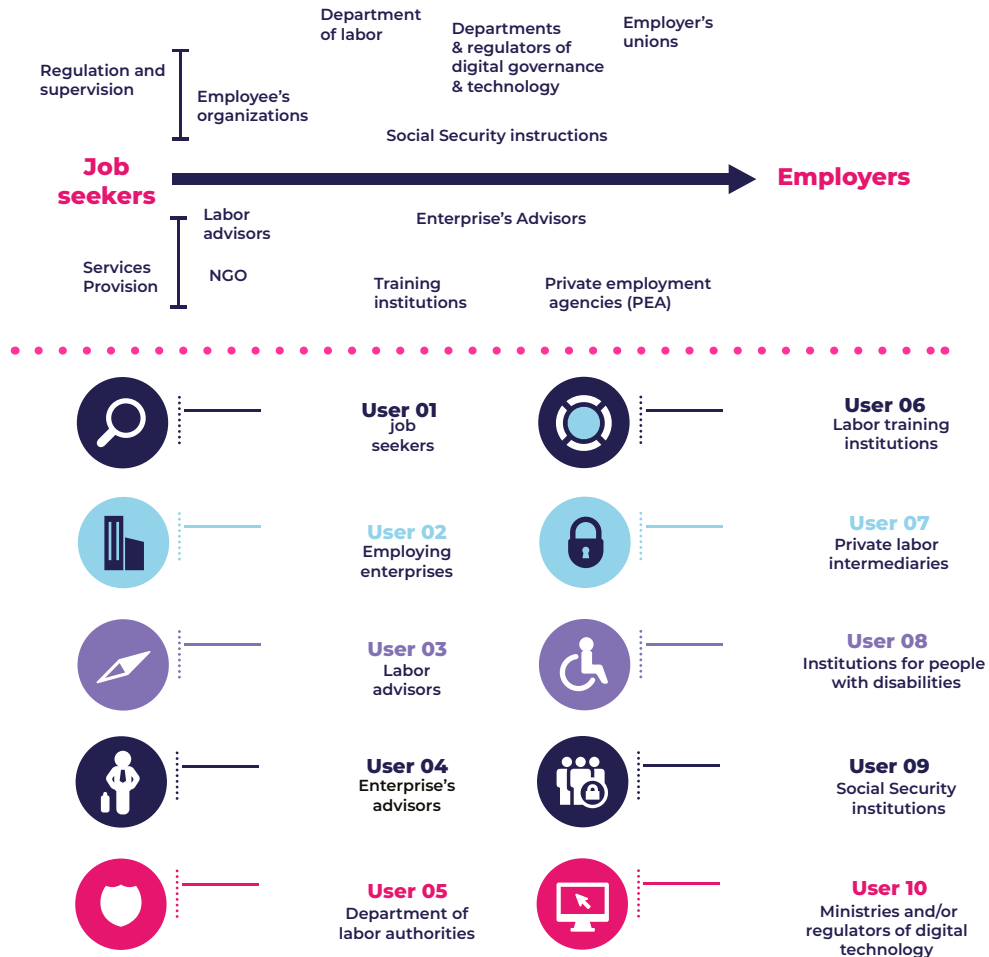
Artificial Intelligence for job seeking

The channels through which these services are offered can be face-to-face, digital and through service centers (call centers), or online websites self-managed by job seekers. The proper articulation of interactions among job seekers, public employment services, social security services, and all other actors allows for the generation of orderly, complete and organized records. On the opposite side, the government finds itself in front of a single citizen with consistent, unified, and integrated information.

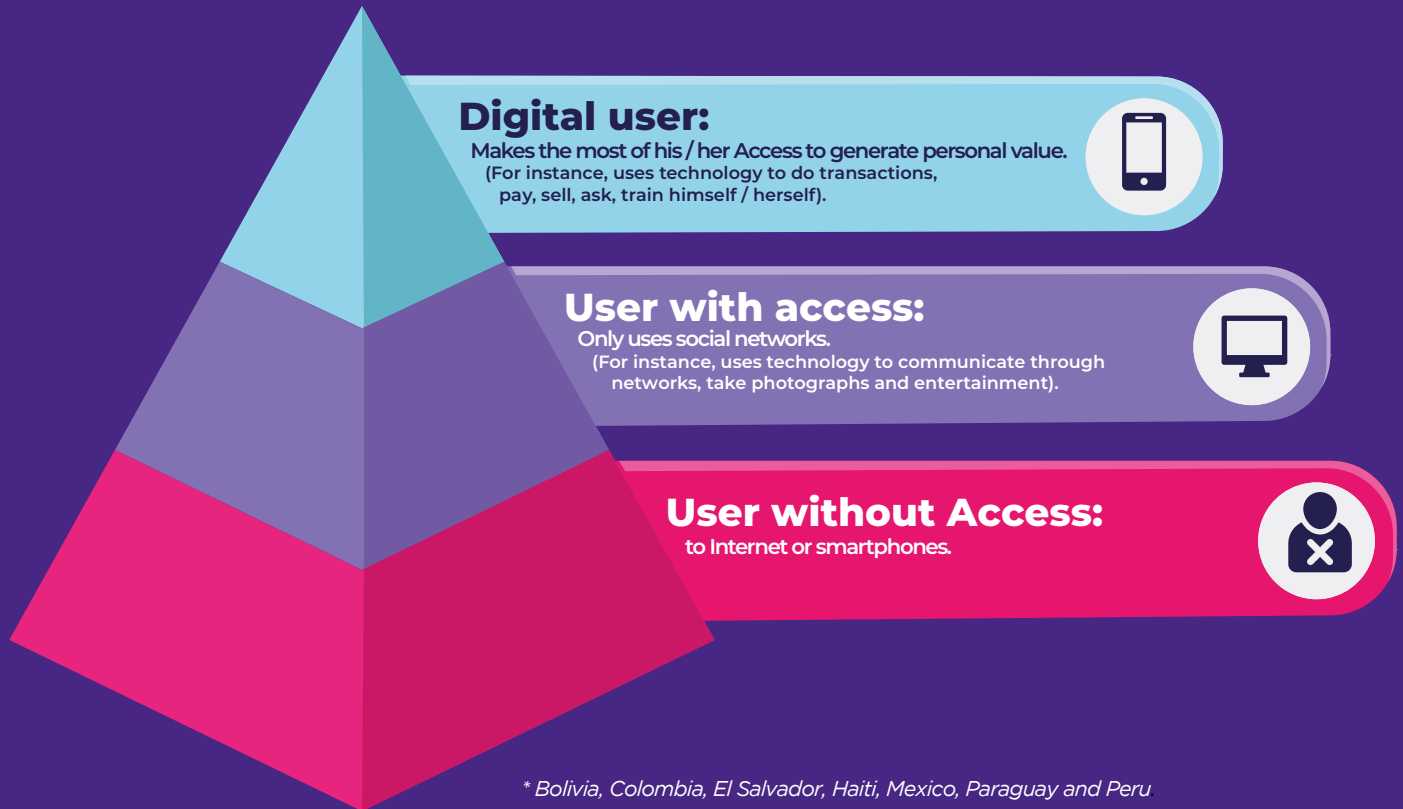**Levels of digital adoption by key actors**

It is essential to understand the levels of digital adoption that job seekers and employers have in order to maximize AI´s use and adoption of technologies by PES. In this sense, it is possible to think about digital adoption in three levels:

• User without access to Internet or smartphone.

• User with access to social networks: for instance, mostly use technology to communicate and entertain himself or herself).

• Digital User: makes the most of his / her access to generate personal value meaning uses technology to do transactions, ask, train himself / herself, etc.

The different channels used by PES to offer their services include various technological options, which in turn may have different levels of technological and digital maturity. For example, a PES office can offer services to job seekers by means of: (i) manual registrations, printed forms and manual matching mana-gement between labor supply and demand; (ii) basic technologies as the e-mail or Word processor; (iii) advanced technologies as AI, robots or chat-bots, virtual advisors, and other supporting those services offered.

The most important aspect is to ensure job search services available through digital technologies do not end up discriminating people without Internet access. Accordingly, whenever such circumstance is detected, the first step should be to ensure job seekers with no Internet can use conventional means as face-to-face applications and other traditional tools.

Graph 2. Levels of digital transformation by PES key actors in seven LAC countries*

Digital user:
Makes the most of his / her Access to generate personal value.
(For instance, uses technology to do transactions,
pay, sell, ask, train himself / herself).

User with access:
Only uses social networks.
(For instance, uses technology to communicate through
networks, take photographs and entertainment).

User without Access:
to Internet or smartphones.

* Bolivia, Colombia, El Salvador, Haiti, Mexico, Paraguay and Peru.

Levels of Technological Maturity of PSE

Regional PES[3] have various degrees of technological maturity and digitalization[4]. In those countries where digital maturity is higher, AI can play a key role in several functions, processes, channels and technologies. Graph 3 displays some areas where AI implementation supports the PES staff in their work.

3 Information collected in Bolivia, Colombia, El Salvador, Haiti, Mexico, Paraguay and Peru.
4 Digitalization is "the adoption or increase the use of digital technology or computing science by an organization, industry or country".
Source: https://www.epsu.org/sites/default/files/article/files/EPSU%20position_Smart%20Public%20Services%20in%20the%20Digital%20Age%20016.04.19-20%20-%20ES.pdf

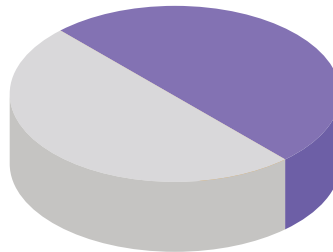**Graph 3. Levels of technological maturity at PES**

Incipient
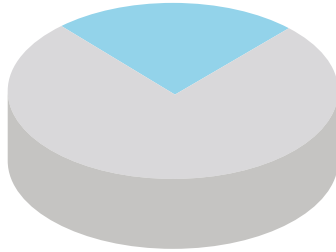
- Paper forms.

- Management dependent on the Advisor´s criteria.

- Manual processes for the derivation to other institutions.

- Low capacity to carry out the follow-up.
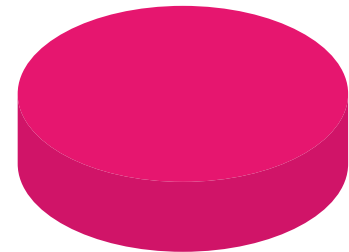
Established

- Support to office automation (email, Word, Excel).

- Information systems with forms, website for the Advisor, workflow.

- System for detection reporting and follow-up.

Digitalized

- AI for gaps detection and recommendations for the Advisor.

- AI to carry out the job seekers segmentation.

- Multiple area levelling engine.

- Digital channels for attention and notification.

- Data science for preventive management, indicators, and trends.

● **Opportunity for AI use**.

3. Using Artificial Intelligence in Public Employment Services

Given that it is currently skills - not qualifications - that are at the core of the forecasting and matching processes carried out by employment services, the arising question is "how could PES improve the processes of collecting, analyzing and broadcasting information on current and future demand of labor skills through the use of emerging technologies?"

PES can use AI and other technologies in several of their services and functions to make them more efficient and effective. Thus, it is possible to set up the algorithms of AI systems to learn and recommend according the specific needs of the labor market. Using information from the support and decision-making systems correctly and responsibly, besides speeding up services processes and customizing them, mitigates all possible biases that could generate any kind of discrimination.

Artificial Intelligence for job seeking

One of the success stories in incorporating AI is the PES of Paraguay. The ParaEmpleo platform, launched in 2018, uses AI to analyze the skills of each job seeker and matches them to job offers. Using deep learning techniques and knowledge graphs, the platform analyses the occupation and employment data to find job vacancies efficiently and precisely according to the profile created by each user online.

The information collected and used by the ParaEmpleo algorithm utilizes various sources of information. Likewise, by collecting and analyzing the development of the most repeated and required offers, ParaEmpleo identifies the technical knowledge mostly demanded for each profession, and suggests users courses in order to acquire the necessary training to achieve the demanded knowledge or skills[5].

Potential use cases

The PES services that could receive some AI added value are (i) matching labor supply with demand; (ii) detection and matching of skills' gaps with available training supply; (iii) matching job seekers' aptitudes with skills required by future jobs or with development opportunities in the most dynamic industries of the labor market; (iv) segmentation of the applicant to facilitate the task of the job adviser or employment consultant; (v) defining job seeker's eligibility for active market programs such as scholarships, internships or grants; (vi) identifying employment opportunities for disabled people; identifying employment opportunities, according to their skill profiles, for people seeking to re-enter the labor market after being imprisoned; and, (vii) labor inspection and other work and employment areas.

The use of AI in the match of labor supply and demand can be seen in vacancy boards; in the matching portals or platforms based on term concurrence; in websites or matching platforms based on multiple criteria and the use of ontology and semantics; and in matching platforms with extended modules.

Using AI in other services provided by PES

It is important to establish the contribution of AI to automation or the rules of information systems that support these services. While the latter records data, it also applies configurable rules to generates results, AI provides knowledge-based system that, as data increases and algorithms adjust, provides recommendations based on such information, adding value, but also changing, to the rules that will be applied by information systems themselves. It is noteworthy that for AI tools to work correctly, interoperability with external systems accessing and managing the necessary data is required[6].

Below some examples of AI use, beyond the matching of job seekers with vacancies:

> • **Correct segmentation of job candidates as a support to the labor advisor.** To provide this service, the system using AI can collect information from external databases. In this context, the relation-based system is a support tool allowing PES staff to determine the appropriate client segmentation. An illustrative example would be the AI engine already containing relations created on the basis of socioeconomic, health, education, judicial, migration, past employment, and social security data systems.

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5 Janzz technologies Documents.
6 For cases other systems' data is utilized, the required authorization consent must be obtained and follow any effective regulation for personal data protection –or, should not any regulation exist, apply international good practices.

• **Identifying eligible active employment programs or subsidies.** AI can help improve the identification of potential beneficiaries of subsidized programs. External data bring information for the algorithm to learn, the outcome data from previous programs and subsidies similar to the information of the client add up. Then, such AI engine-made relations and recommendations generate more effective actions and subsidies based on the candidate's profile[7].

• **Identifying potential vacancies offering comparative advantages for pwd.** The use of AI allows the identification of vacancies suitable for pwd. This option accepts additional information, such as the distance between the job seeker and the working site; transport availability; possibilities to work from home; among others. Some AI platforms also allow the configuration of algorithms aimed at recommending specific matching for pwd.

• **Identifying clients who are about to finish their imprisonment period and need to be inserted into the labor market.** By using AI together with this segment's records of skills, the appropriate actions and job opportunities available can be identified. AI can be fed back from the results of previous insertions to become aware of the most successful profiles inserted in the labor market and learn about services in labor training and insertion management to finally obtain the best results.

AI benefits for PES

AI assists PES in making more efficient their processes so they can offer their variety of services. The potential benefits of AI are detailed below:

Matching labor supply and demand

• **Greater equity:** AI is capable of identifying profiles with a good level of information it assists in the detection needs, so that the job seeker is better prepared and his incorporation into the job is sustainable over time.

• **Matching in several dimensions:** considers the geographical proximity, working hours, type of contract, etc., gives the job seeker more information to choose a vacancy that has a positive impact on the other aspects of their life.

• **Greater labor inclusion of vulnerable groups:** by adjusting its algorithms in certain dimensions, the characteristics of vacancies can be coupled with the barriers of the candidates.

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7 Although it seems likely to asign benefits by means of AI, there are important ethical implications when doing it, as it will be clear later. Preferably, AI should furnish information to trained personnel in order they are the ones making decisions taking into consideration other factors as well. Similarly, AI presents the imperative need of evaluating periodically the data it uses, the process of its usage along with all other factors involved in the feeding of information with the purpose of asuring no bias could affect beneficiaries or users adversely, or else, there is reputation-related risks for the institutions.

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• **Greater efficiency:** the lower use of face-to-face applications, which in turn encourages greater and better registration of digital applications. In addition, it facilitates the follow-up of labor market insertion and the monitoring of results. Availability of labor market information.

• **Better information on job seekers' potential geographical migrations:** AI is a useful tool for collecting and providing information on labor market conditions. This is done by improving the information on job seekers' potential geographical migrations, for instance, and comparing their skills in relation to remote vacancies that would improve their working conditions.

• **Analysis of unwanted events based on data.**

• **Better manage and monitor information of interventions:** since AI's predictive models enhance referrals and the use of active labor market programs.

Management of active labor market policies

• **Better recommendations on job seeker's training needs.**

Management of unemployment benefits

• **Monitoring of programs and services outcomes**.

• **Identification of the best practices of active employment programs:** identification of actions that generate the best results for both segments: job seekers and companies. Consequently, actions with better returns are enhanced and actions with ineffective results are eliminated.

• **Better processing of subsidies' applications or unemployment benefits:** the definition of eligibility based on information the AI provides through its access to other databases allows a better management of information.

Management of labor migration

• **Identification of better employability route options for migrants:** based on their profiling, matching with vacancies, detection of skills gaps, market information, and active support programs.

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The future of AI in PES

The Fourth Industrial Revolution – where AI belongs along with other advances –, added to the phenomena as globalization and hyper connectivity-- is going to change the way PES operate and offer their services. Among the trends that could be imposed in the future are the following[8]:

> • **Organization in the use of AI with equivalent institutions and other sectors at regional and municipal levels[9].** This organization could increase data flows and generate better results for labor intermediation at PES. This interinstitutional organization trend can already be noticed in several Latin American countries, under the concept of interoperability or information exchange systems (IES)[10].

> • **AI strategy, regulations and legislation in governments.** In the near future, the ethical use of data must be prominently included in each country's digital strategy. This will demand the definition of standards, restrictions, and self-regulation along with governance mechanisms for proper usage.

> • **Services improvement and customization.** As more and better data become available, algorithms will be better fed and become upgraded, allowing job seekers' recommendations to be more accurate. Cloud services availability[11] will open the possibility to create virtual assistants that, in turn, will free up PES staff time.

> • **Forecasting unemployment in regions, sectors and industries.** The widespread use of AI in labor intermediation systems (LIS) will enhance the effectiveness of support plans aimed at mitigating unemployment and youth unemployment rates as well as predicting situations in sectors or industries.

> • **Adoption of AI as the available service in the cloud for labor intermediation.** The use of AI will continue to expand and, in the near future, it is expected to be available on platforms with cloud services. In that regard, access will be possible from multiple public and private applications for the purposes of matching, detecting missing skills, and providing customized training, among other services.

4. Critical factors PES must consider when adopting AI

For AI's incorporation to improve PES activities, certain factors are required to ensure its success. These include quality and volume of the obtained data, the protection of their property and privacy, and the guarantee of its legitimate and non-discriminatory use.

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8 See Pombo et al, (2019) for future AI trends at PES and countries.
9 See Ogwalgroup (2019) for a shared vision of the developed mapping.
10 See Pombo et al, (2019) for the ABC of the State's services interoperability.
11 See IDB (2020) for further information about best practices for hiring cloud services.

Data collection and usage

The following must be considered for the correct implementation of AI:

> • Availability of quality, standardized, complete, relevant data, without duplication and with all the required attributes.

> • Obtaining data through technologies which capture sufficient information so that AI engines are equipped with the learning levels that can generate more accurate results and recommendations.

> • Accumulation of sufficient labor market data, so that algorithms can be more accurate based on the detailed industry information; geolocation; ideal profiles for human talent development; training offers including skills; skill certifications; salaries; qualification system; and, active labor market programs, inter alia.

> • Provide feedback on PES actions results to generate learning and continuously upgrade algorithms.

Basic principles for data usage

When AI is implemented, PES should put into practice certain basic principles on the use of data feeding into information systems. Such principles ensure respect for the privacy and ownership of individuals' data and avoid discrimination that may result from its leakage or misuse. The basic principles for data usage are of: equality, access, legality, privacy, responsibility, technological adaptation, proportionality, conservation, reutilization and efficiency[12].

Achieving the necessary interoperability

PES can provide a complete range of services to job seekers and enterprises as well as to other key actors such as training centers and other public institutions. However, the former requires their integration or interoperation. In the case of PES, different institutions generate useful information, i.e., social security; ministries of labor, education and health; private employment agencies; and, social programs, inter alia.

Besides facilitating access to information and to the above institutions' management records, interoperability has the function to connect data with those records generated from the interactions taking place in the field of employment. All this information can be made available to institutions via interoperable systems, which helps to reduce the time needed to enter the information into the system.

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12 "Bases para una Estrategia Iberoamericana de Interoperabilidad".

Risks derived from AI usage

Although AI is a useful tool for PES, it also carries significant risks due to its technological nature. Nonetheless, its adequate management and mitigation strategies will allow the expected value. Among the main identified risks are those related to digital transformation and aptitudes formation; discrimination and exclusion; possible biases in the algorithms; data leakage or information misuse that may affect individuals and enterprises; implicit elements in the technological strategy chosen; and, elements derived from insufficient and imperfect data.

The difference in digitalization of users; lack of coverage or access; lack of adequate training of PES personnel to manage job seekers of vulnerable populations; biases in the data; and the potential errors in the design and execution of the algorithms and strategies are some of the specific challenges that may arise while incorporating AI.

In order to mitigate these risks, several actions can be taken. Mitigation of these risks involves the development of measurable indicators for labor advisors; PES personnel performance evaluation; executing audits and adjusting the algorithm; and use the correct use of proven methodologies for the life cycle of information systems (i.e. systems' architecture[13]).

In different countries of the region, these services face specific challenges, including insufficient budgets, lack of continuity, lack of personnel, along with a low level of public outreach and market participation.

5. Conclusion

New technologies, in particular AI, offer an excellent opportunity for PES in LAC to increase their efficiency and effectiveness, regardless that their proper use entails challenges that must be mitigated or eliminated.

This technical paper discusses the main potentialities and challenges of AI adoption at PES. These potentialities will allow the region's PES to better understand the benefits of adopting AI-based systems while capitalizing the lessons learned from the Paraguayan case. Nevertheless, there are related risks involved like the discrimination of users, who may not be prepared to adopt digital processes or to count on the correct configuration of AI algorithms. For the neutralization of such risks, the efforts must be directed to the selection of systems or providers that have proven to have the standards of AI-based matching systems along with the readiness to prepare PES staff.

Considering the changing labor scenario will keep generating more new occupations, skills, and capabilities will be the key to matching jobs with vacancies. AI will not only be a fundamental support tool to matching job seekers' skills (or those they can develop over time), with job offers that can consume them but also AI usage will generate more and better opportunities for the parties involved, achieving sustainable jobs over time. PES together with key actors will require technologies and digital transformation for their processes.

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[13] See IDB (2020) for using systems' architectures in employment services. New technologies to overcome old challenges. Entrepreneurial architecture for Public Employment Services PES.

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