Existing Technologies in Online Job Matching Tools and Their Potential Usage for Disadvantaged People

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Abstract Online job matching tools to support HR functionalities in organizations is increasingly becoming popular. Fast and efficient employment solutions for disadvantaged groups are especially important since they are a part of social inclusion. Employment process of disadvantaged groups is different than regular job finding processes because these individuals may not have physiological, cultural, economic, technical and/or political resources to reach the candidate evaluation process. Even if they can reach to this process, they can be discriminated because of the prejudices. This might end up with sub-optimal solutions since the disadvantaged individual may be forced to find employment not relevant to their qualifications while the employers may face skills shortages. Solution to this problem requires new approaches to employment process. The objective of this paper is to make a process modeling of the existing employment systems for the disadvantaged people and suggest possible improvements to these systems.

Keywords Disadvantaged people • Employment • Job matching • Process modeling

1 Introduction

The strategic significance of matching high quality employees to high quality jobs for enhancing the competitive advantage has been the focus of many studies (Boxall and Purcell 2003; Breaugh and Starke 2000). Although traditionally recruitment has been an activity achieved by the HR functions of an organization, electronic automation techniques offered by online recruitment systems have started to substitute many of these functions. When they first emerged in the mid-1990s, popular management press heralded these systems as a 'recruiting revolution' (Boydell

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M.H. Bilgin et al. (eds.), *Innovation, Finance, and the Economy*, Eurasian Studies in Business and Economics 1, DOI 10.1007/978-3-319-15880-8_18

2002). Despite this hype, however, some critics (e.g., Harris et al. 2003; Kehoe et al. 2005; Stone et al. 2013) have noted that these systems are still not an efficient alternative to traditional methods because of their unintended dysfunctional consequences. For example, their focus on cost-efficiency may cause them to overlook the task of matching the most qualified applicants to high quality jobs (Kehoe et al. 2005; Pearlman and Barney 2000). Moreover, poorly designed websites may divert the qualified job seekers from important job opportunities (Pastore 2000). Last but not the least, research has also found that these sites are too complicated to use successfully by most stakeholders.

Online recruitment systems were found to be implicitly discriminating especially for some disadvantaged groups and SMEs (e.g., Reynolds and Dickter 2010; Stone et al. 2003). These systems are usually designed by a "core team" of experts set out to create a tool that satisfies the standards of certain individuals and organizations and unaware of the needs and requirements of specific groups. There is a danger that members of some disadvantaged groups could be excluded further as they might not share standard requirements. These concerns have initiated some efforts for building online recruitment systems specifically designed for disadvantaged people such as the Czech initiative "The online job centre for foreigners" (MPSV 2014); KC4 ALL—Key Competences for All and the Employability Toolkit[1]; "Surfenzum Job—Digitale Chancen auf dem Arbeitsmarkt" (Surfing to the Job—Digital Opportunities on the Labour Market)[2] and the "ePortfolioSkane" run by the Swedish city of Malmö.[3] Match Project for Immigrants' Employability (MATCH 2014) worth especially mentioning since it includes state of art tools exploiting semantic technologies. Specifically designed for the immigrants, the system allows job seekers to annotate their knowledge, skills and competences in a shared format. A particular feature which makes the project interesting is the inclusion of a tool targeting to overcome lexical and semantic differences in the descriptions of qualifications, résumés and job profiles to form a knowledge base enabling the automatic matching of job seekers' qualifications with companies' requirements.

Although an important step for addressing the specific needs and requirements of the disadvantaged groups, current online systems for the disadvantaged groups tend to have a rather narrow focus and are not customizable to address the specific issues that may be faced by certain individuals. One of the most fundamental issues these systems have been facing is their inefficiency in attracting job offers, especially for highly qualified job seekers (Bridge-it 2014). Majority of the job offers on these platforms have either been for unskilled secondary labor market positions or found to be unreliable. This is mostly due to the cognitive cost of using these platforms for the SMEs and skilled disadvantaged people. Usually, using online tools require

[1] Please see Employment Toolkit 2014 http://www.keycompetences.eu. [Accessed 20 April 2014].

[2] Please see Jobsuche Online Open 2014 http://www.surfen-zum-job.de. [Accessed 20 April 2014].

[3] Please see Eportfolioskane 2014 http://www.eportfolioskane.se. [Accessed 20 April 2014].

"extra work" and cognitive investment which has opportunity costs for some skilled groups who find inefficient to dedicate some time and effort for learning these extra skills (Sitzmann et al. 2010). Majority of these costs does not come from learning 'internet skills' and understanding technical features as these groups are highly technologically literate. The deficiency comes from the 'content-related internet skills' (relating to searching for information and using such information strategically), as these groups can hardly dedicate extra time and effort to develop strategic internet skills and making the internet work for a specific purpose besides their general internet use skills. Traditional search engine techniques are inefficient in terms of information retrieval as they are not capable to recognize and respond to the implicit requirements of a user who has untypical statements in a search query. Simple information retrieval systems depending on Boolean queries cannot handle these requirements which has to be done in a more fuzzy and complex manner (Drigas et al. 2004). Such systems are usually dependent on the user to provide an adequate entry of their requirements, which is a difficult task for the members of some disadvantaged groups. This brings into fore the importance of more flexible, smart and customizable expert decision systems with personalization techniques capable of considering user preferences as a means of classifying retrieved results as relevant or irrelevant.

This gap in current systems has attracted some academic attention. In the rest of the paper, we will concentrate on the literature investigating such intelligent online match-making systems. Following this, we will analyze the existing online recruitment systems in Turkey and finally we will offer some suggestions to combine the reviewed intelligent systems to the state of art for more flexible and personalized employment solutions.

2 Literature Review

Intelligent systems allowing flexible and customizable solutions have recently become widely used in the areas such as speech/natural language processing, robotics, medical diagnosis, e-commerce and information retrieval. On the other hand, literature on the application of these solutions to online recruitment systems is sparse and has only recently started to take-off. We can basically classify the existing literature into five major categories: semantic, fuzzy, multi-criteria decision making, machine learning and optimization approaches.

2.1 Semantic Approaches

Semantic approaches basically perform analysis and categorization of unstructured textual materials such as CVs, case scenarios and job offers by using automated filtering, lemmatization and natural language processing techniques. For example,

Trichet and Leclère (2003) propose a knowledge management based matching system mining the Semantic Web context. The proposed system first builds reference systems for particular domains, then identifies, formalizes and represents competency profiles and finally matches these profiles. In a similar manner, García-Sánchez et al. (2006) underline an intelligent web portal which serves as a service provider in recruitment tasks. An ontology represents the recruitment domain knowledge and it is used to guide the design of the application and to supply the system with semantic capabilities. The ontological component of the system provides intelligent matches between job offers and job seekers. Bizer et al. (2005) investigate how online recruitment processes can be facilitated using semantic web technologies and build a scenario for supporting these processes and summarize the potential impacts of semantic technologies for predicting their influence on the recruitment process for the markets, companies and job-seekers.

2.2 Fuzzy Sets

Fuzzy sets theory initially developed by Zadeh (1965) provides a mathematical representation of uncertainty and enables developing formalized techniques for handling problems that contain imprecision. In the field of engineering, decision making and computational intelligence there are various techniques and applications of fuzzy sets. For recruitment systems, fuzzy sets are generally used to integrate linguistic and fuzzy assessments into the evaluation of the job seeker. In that respect, Golec and Kahya (2007) suggest a comprehensive hierarchical structure for selecting and evaluating right employee. A competency-based fuzzy model is used to match an employee with a certain job. Through this model, the system can constitute employee selection to fulfill the objectives of an organization, identify the suitable factors, measure indicators, and set up an evaluation standard for facilitating the decision process. Similarly, Lin (2009) proposes to improve a job placement using a two-way choice frame that takes into account fuzzy assessments. The author focuses on internship decision process between enterprise and students. Enterprise-student matches and student- student combinations are evaluated. A mixed integer programming model is applied to fulfill the "efficient fit from the right" policy. In a fuzzy environment, personnel evaluation and placement problems are tackled by Liang and Wang (1992). A fuzzy multiple-criteria personnel evaluation algorithm is used to get a more convincing and accurate decision-making process. In addition to this, a Kuhu-Munkres based polynomial time algorithm is developed by combining the concepts of fuzzy set theory and the weighted complete bipartite graph for personnel placement. Fuzzy sets are also used for advanced expert systems, Drigas et al. (2004) presents a hybrid expert system for the assessment of the unemployed at certain offered job posts. The expert system uses Neuro-Fuzzy techniques to analyze a database of job-seekers and enterprises profile data. As training phase directly effects the results in neuro-fuzzy systems, the system was trained by using old historical records containing

job-seeker, rejected or approved information. Consequently, the system evaluates the suitability of a candidate for the certain job with more accuracy. The literature is not limited to the analysis traditional personal properties. For example, Overbeek et al. (2008) propose a formal framework for using cognitive instead of personal data in order to improve fit between actors and tasks. They initially categorize several actor and task types based on cognitive characteristics and then implement the proposed framework for matching the actors to the tasks. In the proposed framework, suitability of an actor to fulfill a task is calculated by functions based on fuzzy assessments.

2.3 Multi Criteria Decision Making (MCDM)

Multi Criteria Decision making (MCDM) is a method used for complex problems where more than one criteria should be taken into account during the decision making process. In the field of online recruitment, the expectations from the candidate (such as education, skills etc.) constitute the criteria. In the literature, MCDM techniques are generally used to complement other methods. For example, Li et al. (2010) utilize a model that combine a five-factor personality inventory, support vector machine (SVM), and TOPSIS to improve the quality of match-making. The online questionnaire personality testing developed by the International Personality Item Pool (IPIP) is utilized to identify the personality traits of candidates and SVM is used to classify the candidates according their fitness degrees. In a similar manner, Faliagka et al. (2012) suggest a MCDM based online recruitment system to automate job-seekers' pre-screening. The proposed system employs Analytic Hierarchy Process (AHP) on the basis of criteria that can be extracted from the applicant's LinkedIn profile and performs linguistic analysis on applicant's blogs in order to infer their personality characteristics. The job seeker's fit for a position is determined according to individual selection criteria and their relative significance is controlled by the recruiter.

2.4 Machine Learning

Machine learning, concerns the construction and study of systems that can learn from the past data to solve problems such as classification, clustering, regression anomaly detection, and association. In one of the recent studies in job match making field, Park (2013) presents a matchmaking system that adaptively adjusts the recommendation model reflecting the user's implicit and explicit preferences. While the system provides recommendations for new users on the basis of their assigned explicit preference weights, it then automatically adjusts the weight of each attribute by analyzing their previous behaviors using logistic regression. Labate and Medsker (1993) designed Skills Analyzer Tool for solving management

problems concerning the employee's assignment into several projects. The tool combines neural networks and rule-based analysis to match the employees to certain tasks of new projects. Rafter et al. (2000) apply collaboration filtering techniques to the search engine of the JobFinder website. The proposed model consists of two parts, a profiling system that creates the user profile according to his/her behavioral characteristics learned by the machine and an automated collaborative filtering engine for recommendations.

2.5 *Mathematical Optimization*

Mathematical optimization is the selection of a best solution from a set of available alternatives with the aim of maximizing or minimizing an objective function by choosing input values from an allowed set. Calì et al. (2004) presents an ad-hoc optimization algorithm based on a logical framework for matching job profile demand and supply. Algorithm takes into account the deficit between demand and supply when the profiles can have missing or conflicting information. Kavitha et al. (2011) study matching applicants to jobs under one sided preferences which means the applicants rank a subset of jobs. The study is based on mixed design polynomial time algorithms Chen et al. (2012) models the competent choices of each party by using skylines. The term skyline is defined as all possible trade-offs between the evaluation inputs (i.e. experience and qualification or salary and benefits) that are superior to others. In order to make recommendations to all job seekers a series of skyline view queries are proposed and the algorithms are improved to answer these queries in batch.

The studies examined in the literature review are summarized in Table 1.

Table 1 Classification of the techniques used for job matching

Classification	Related studies
Semantic approach	Trichet and Leclère (2003), Bizer et al. (2005), García-Sánchez et al. (2006)
Fuzzy approach	Liang and Wang (1992), Golec and Kahya (2007), Lin (2009), Drigas et al. (2004), Overbeek et al. (2008)
Multi criteria decision making	Faliagka et al. (2012), Li et al. (2010), Liang and Wang (1992)
Machine learning	Álvarez de Toledo et al. (2014), Park (2013), Li et al. (2010), Labate and Medsker (1993), Rafter et al. (2000)
Optimization	Kavitha et al. (2011), Chen et al. (2012), Calì et al. (2004)

3 Research: Existing Online Recruitment Systems in Turkey

3.1 Method

In this section, we investigate current online recruitment systems for disadvantaged people in Turkey and Istanbul to model their process flows. Process modeling (PM) is an analytical illustration to help document, communicate, or improve an organization's work processes. PM is also used for requirements elicitation as part of software design processes. It illustrates processes with work-flow diagrams that can be shared by both system designers and organization managers. We collected the data for process modeling through the document analysis of the materials related to the online employment process. The document corpus covers three main areas: (1) leading online recruitment tools used in Turkey, (2) online tools which focus on disadvantaged groups, (3) interviews with municipality level employment agency officials. The existing applications and studies are examined according to their target groups, core functionalities provided to job seekers/employers, and methods of job matching.

The activities of ISKUR, the employment agency of Turkey, and two Municipality Employment Services in Istanbul are examined in terms of their current process flows and their use of the intelligent systems proposed by the literature.

3.2 Finding: Process Flow Models

The employment agency of Turkey (ISKUR) is an independent legal entity which is a subsidiary of the Ministry of Labour and Social Security. All the private employment agencies in Turkey can only operate with the authorization of ISKUR. ISKUR provides and maintains an electronic database which can be reached from all agencies in Turkey. According to the regulations, there are three groups which are treated by ISKUR as disadvantaged: disabled people, ex-convicts and terror victims. After verifying they belong to one of these groups, individuals can be classified as disadvantaged and can apply for the suitable job offers. The agencies store job seeker and job information and match them according to a filter based technique. This system uses none of the mentioned intelligent methods. The work flow of ISKUR is presented in Fig. 1.

In the city level, Istanbul municipalities have their own employment centers which are connected to ISKUR. ISKUR does not force a general policy to these employment centers, they are autonomous in their operations. Besides ISKUR, some sub-municipalities have their online recruitment systems. In order to get the process flow of the existing online job-matching systems for the disadvantaged, we have conducted interviews with two of these sub-municipalities.

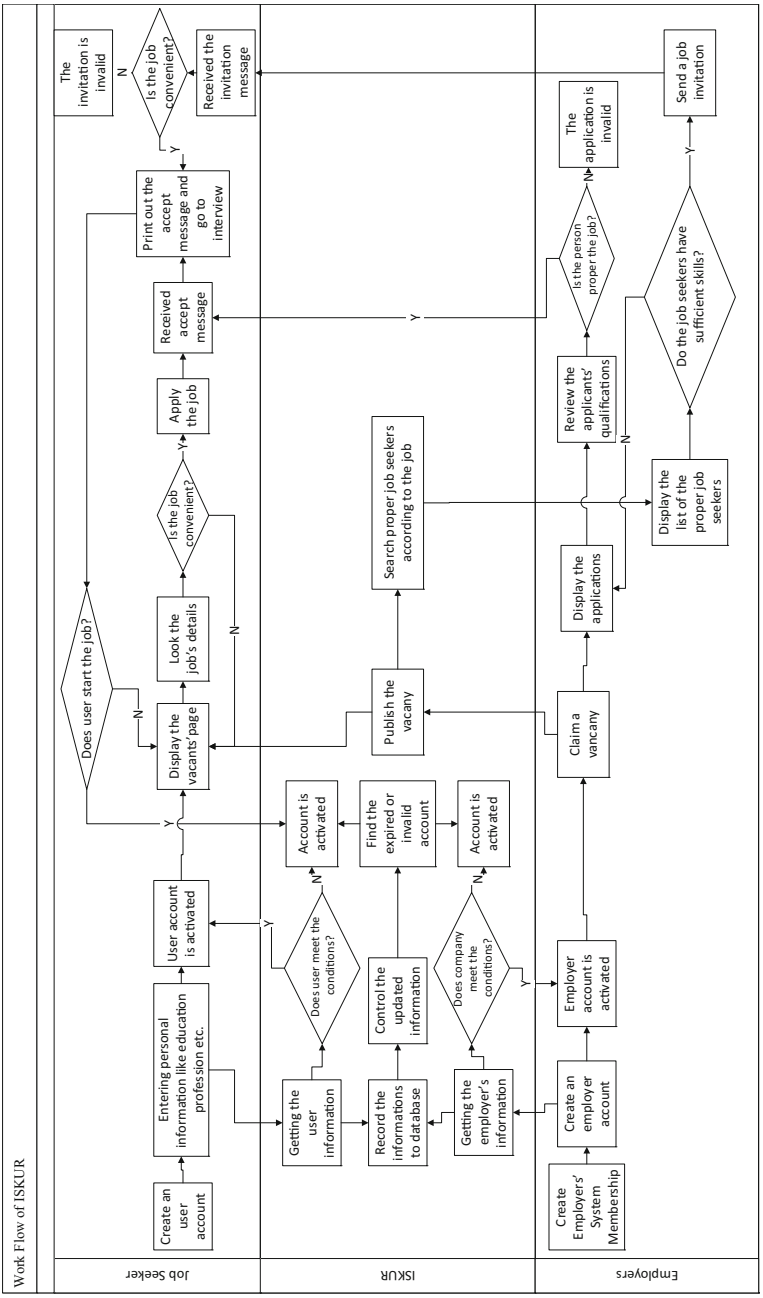

Fig. 1 Work flow of ISKUR

3.2.1 Beyoglu Municipality

BEYIM[4] is the acronym for employment service of Beyoglu Municipality. BEYIM actually applies an employment model which aims to match the job-seekers who are living in Beyoglu with employers from the same district. With this model, BEYIM aims at lowering the transportation costs and improving employee satisfaction. There are nearly 4,000 job-seekers enrolled to the system and nearly 250 matching have already been achieved. BEYIM also organizes specialized courses based on the needs of the employers, such as cookery, waiter and hotel staff trainings. The job matching process is done manually by database search and the work flow of BEYIM is represented in Fig. 2.

BEYIM defines disadvantaged groups as disabled individuals, housewives, young retirees and families of martyrs. BEYIM tries to give priority to the disadvantaged groups by arranging part time jobs and internships, but there is no affirmative action concerning these groups. In general, if a company employs a disadvantaged job-seeker from BEYIM, it gets an incentive such as being exempt from social security payments.

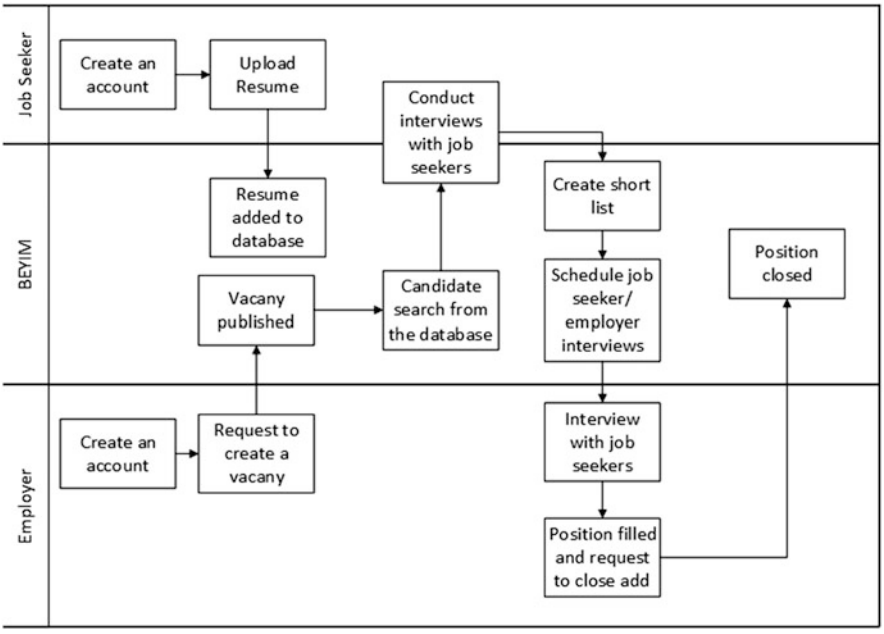

Fig. 2 Work flow of BEYIM

[4] Please visit http://www.beyogluistihdam.com. [Accessed 20 April 2014].

3.2.2 Kadıköy Municipality

Kadıköy municipality operates two service centers about employment; ESDEM (Education and Social Support Center)[5] and EngelsizIs.[6] ESDEM organizes trainings such as computer literacy, handcraft trainings focused on underqualified people, especially for housewives and retirees. ESDEM plans to build an online job matching platform but haven't started the operations yet.

EngelsizIs, the other initiative of Kadıköy municipality, is an employment service that concentrates on disabled people. The office was founded as a part of a European Union project in 2005 and operates since then. EngelsizIs aims to get in personal touch with disabled job-seekers, motivate them about the jobs and give instructions about a successful interview process. Also, EngelsizIs periodically organizes courses on computer literacy, accounting, and graphical design for disabled people. The office also gets in direct contact with employers, tries to learn about the potential jobs and matches them with existing job-seekers. Again no automatic match making systems are used. The workflow of EngelsizIs is represented in Fig. 3.

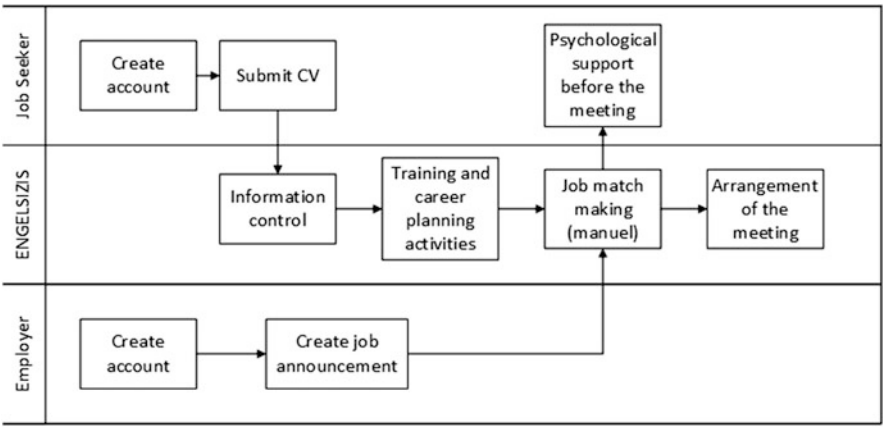

Fig. 3 Work flow of EngelsizIs

[5] Please visit http://www.esdem.kadikoy.bel.tr. [Accessed 20 April 2014].

[6] Please visit http://engelsizis.kadikoy.bel.tr. [Accessed 20 April 2014].

4 Conclusion

In this paper, we reviewed the recent literature on intelligent systems allowing flexible and customizable online employment solutions and modeled the process flow diagrams of existing online job-matching systems in Turkey. Our findings suggest that present systems are limited to basic functions and need essential improvements to fulfill needs and requirements of specific groups. The dominant ISKUR system maintains a centralized database and does not provide customized solutions for disadvantaged groups. Decentralized systems offered by the sub-municipalities do not provide extensive database solutions and do not allow sophisticated match-making possibilities. A future system design customized for disadvantaged people should take into account intelligent job matching systems. This requires *high quality process modelling with the active participation of all the stakeholders that ensures the development of a shared vision of the system processes*. Hence, process innovation cannot be done solely by top-down model engineering of systems but also requires the involvement of needs and requirement analyzes during different stages to ensure participation of stakeholders. The data obtained from these analyzes can be applied to build the various intelligent systems proposed by the literature into the existing systems. Future research needs to take this into account to complement the process flows obtained in this paper towards a more intelligent, flexible and customizable system architecture.

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