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What are the changes in the recruitment processes in the age of big data?

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1. Introduction

Have you ever felt being rejected from a recruitment process before getting the first interview while you were convinced your profile was matching with the requirements of the job ad? Have you ever wondered why you were added by recruiters you never met on LinkedIn? Have you ever wondered if your Facebook or your Twitter account is screened by recruiters when you apply somewhere? One central trend links these questions: the use of big data and data analytics in recruitment. The answers to these questions will be discussed in this research as it aims at determining how the new hiring tools, linked to big data, are integrated in the classic recruitment processes of recruitment agencies in Belgium and how they impact these processes. This analysis is useful for both recruiters and candidates. First, it has a positive impact on recruitment offices as it analyses which tools are currently used by the Belgian market. Moreover, it also enables them to realize which development possibilities they have in the field as the literature review gathers the different tools that exist, while the results analyse where they could be integrated in the classic recruitment process. Secondly, applicants could also learn how to better succeed in their hiring processes in avoiding the pitfalls arising with the use of these new tools.

Big data is a buzzword that is often discussed in the literature (Gandomi & Haider, 2015; George, Haas, & Pentland, 2014; Hamel & Marguerit, 2013; Hsinchun, Chiang, & Storey, 2012; Mohanty, 2015; Morabito, 2015; Russom, 2011) and its ability to provide competitive advantages to the companies that are able to deal with it has been advanced a lot of times (Chen, Mao, Zhang, & Leung, 2014; Hsinchun et al., 2012; Morabito, 2015; Segal, Goldstein, Goldman, & Harfoush, 2014). Several papers suggest the opportunities brought by big data to HR management, such as the new information sources which are available (Mc Guire & Ladd, 2014; Naasz, 2015; Roberts, 2013; Sprague, 2007; Staney, 2014) but also the potential use of data analytics (Bradbury, 2011; Bridgeford, 2015; Carey & Smith, 2016; Chamorro-Premuzic, 2012; M. Ferguson, 2015; Kuncel, Ones, & Klieger, 2014; Naasz, 2015; Sorensen, 2012). In spite of that, a survey led by Althéa, Quantmetry, and DigilabRH (2016) in France showed that 80% of the HR professionals never used big data in their activity.

'A critical review of the literature about new technology in selection' written by Anderson (2003) already mentioned the popularity of company websites, internet based testing and the possibility to employ these technologies for pre-screening, assessment and other HR related activities. The spread of the data sources utilized by these techniques these last years has transformed them into hiring tools working with big data. Some additional tools using big data are now well known; this is the case for social media, for which there is an extensive literature (Carr & Walther, 2014; Cook, 2011; Davison, Maraist, & Bing, 2011; Jeske & Shultz, 2016; Madia, 2011; Martucci, Oldvader, & Smith, 2010; Samuel, 2009; Stoughton, Thompson, & Meade, 2015). At the moment, the most common social media used in recruitment and selection are social network sites such as Facebook (Brown & Vaughn, 2011; Caers & Castelyns, 2011; Curran, Draus, Schrager, & Zappala, 2014; Sameen & Cornelius, 2015) or LinkedIn (Bradbury, 2011; Caers & Castelyns, 2011; Chiang & Suen, 2015; R. B. Ferguson, 2013; Ha-Thuc et al., 2016; Halzack, 2013; Sameen & Cornelius, 2015; Sumbaly, Kreps, & Shah, 2013) but blogs are also often mentioned (Faliagka et al., 2014; Martucci et al., 2010; Samuel, 2009). Some tools facilitate the use of these sources of information for companies; this is the case for applicant tracking systems, which allow them to deal with job boards, social media and their own websites at the same time and so, imply dealing with big data (Fister Gale, 2015; Holderman, 2014; Laumer, Maier, & Eckhardt, 2014). Some papers suggest alternatives to these still classic hiring tools. These are behavioural analytics, web-scraping or gamification (Carey & Smith, 2016; Chamorro-Premuzic, 2015; Ibarra, 2013; Wozniak, 2015) but less is found about their effective utilization.

A study of Holm (2012) investigated the impact of e-recruitment on the design of the recruitment process in a way where e-recruitment is seen as "technology enabled management practices" (Holm, 2012, p. 5) and not as a potential recruitment source. She only looked at the recruitment process design and highlighted the contribution of e-recruitment as being the collaboration and the time and space independence of the process. I would like to discuss this topic in a different way from Holm (2012) in order to analyse the integration of these new tools, linked to big data, in the classic hiring processes, but also their impact. I found one paper which has partly covered the subject as it analysed the use of two social network sites, namely Facebook and LinkedIn, by professionals of recruitment in Belgium, without focusing on recruitment offices (Caers & Castelyns, 2011).

I decided to focus on labour market intermediaries such as headhunting firms, recruitment offices and interim management offices, because a lot of Belgian companies collaborate with external partners as far as their recruitment processes are concerned. According to the study of Buyens, De Schamphelaere, Verbrigghe, and Verhaeghe (2012), these external partners would better master the new technologies and the necessary creative ideas. These professionals have recruitment and selection as core business and should therefore be more advanced in the field than classic companies for which it is only a support function.

My research first focuses on the literature review in order to deepen my knowledge about the classic recruitment process, big data and the different hiring tools which use big data. It allows me to emit some hypotheses about the changes induced by these new tools in the recruitment process. The second step of my research is a survey I sent to Belgian recruitment companies to have an overview of their use of data analytics. According to this survey, more than 40% of the Belgian recruitment offices consider using data analytics in their daily business while only around 15% consider using big data. These results underestimate the impact of big data on HR practices as demonstrated by the number of recruitment offices I interviewed (5/8), which pretended in the survey that they were not manipulating big data in their business activities, while they were all at least using LinkedIn. This shed the light on the biggest problem stressed during my research: **recruiters are not always conscious they utilize data analytics and big data in their daily business**. This unawareness suggests that the new tools are not operated at their maximal efficiency because their work is not fully understood.

I then select some of these companies and interview them. These interviews enable me to determine in which steps of the recruitment processes the new hiring tools are employed and which impacts they have on these different steps. First of all, the job description step was only impacted by the additional available information, which enables a better market definition. Profile definition was influenced by the LinkedIn tool, “search by ideal candidates”, which helps to decrease subjectivity in case the ideal input profiles are chosen following a clear established procedure. Then, the number of available hiring sources increased a lot in the recent years. Job boards and job search engines are currently still part of the non-headhunting offices tools, but their importance seems to decline with the advent

of new recruitment sources. Indeed, LinkedIn is now used by all Belgian recruitment offices because it enables them to have a far broader and more actualized database than before. It is also a way to receive more referrals for the recruitment agencies. On the other side, Facebook and Twitter are still not efficient recruiting tools in Belgium. In order to easily manage these different recruitment sources, through a single platform, most recruitment offices have an applicant tracking system or a similar software.

Recruitment means were not influenced by the apparition of the new hiring tools. On the contrary, recruitment campaign was impacted by these new possibilities. Interaction between the potential candidates and the companies is now common thanks to social media. Belgian recruitment offices often communicate about their activities on LinkedIn, Facebook, Twitter, and in to lesser extent, on blogs. The selection step was also highly impacted by the integration of the new tools and data analytics. Automated pre-screening of resumes is now fully integrated in the recruitment process of the Belgian agencies with either the search of candidates who fulfil some required criteria on LinkedIn or in using queries in their own database. This could lead to discrimination based on the vocabulary used by the candidates in their resumes, assuming the applied semantic analysis is not extensive enough. Then, recruiters access now to more information, but also to more sensitive information about the candidates. The information candidates share on Facebook or Twitter is often non-professional related and could be taken into account when deciding to hire someone or not. Again, discrimination could arise as people are judged based on their pictures, connections or tweets, which means they are potentially judged based on their skin colour, age, politics or religious ideas, which could not be easily proved. Finally, the hiring decision is still made by the recruiters themselves, but it is based on information gathered during all the preceding steps of the process.

The fourth part of my report aims at analysing the validity of my research and I then conclude and make some recommendations in considering the different parts of my analysis. The main difficulty I faced with this research was the lack of knowledge of the human resources workers regarding data analytics and big data. It could have impacted the results and their completeness.

2. Literature review

This literature review aims at introducing the classic recruitment process, which will be the basis of my analysis, big data and data analytics, but also some new recruitment tools. These new tools are social media, hiring programs but also other tools such as gamification, behavioural analytics and web-scraping. The next parts of my research will analyse if these new hiring tools, which are linked to big data, are used by recruitment professionals in Belgium and how they are integrated in the classic recruitment process discussed in the following section.

2.1 Classic recruitment process

According to Breaugh (2013), a new definition for external recruitment is *"an employer's actions that are intended to (1) bring a job opening to the attention of potential job candidates who do not currently work for the organization, (2) influence whether these individuals apply for the opening, (3) affect whether they maintain interest in the position until a job offer is extended, and (4) influence whether a job offer is accepted".* Internal recruitment is also often used but will not be specifically discussed here. Indeed, the collaboration of companies with professionals of recruitment often means they try to hire someone from outside the organization.

Several questions should be answered before the beginning of the recruitment process. Recruitment practices are contingent and dependent on the context. There is not "one best way" to recruit and adaptation of the process is required according to hiring practices of other firms, labour market conditions, industry context, … (Dejoux, 2015; Orlitzky, 2008). According to Dejoux (2015), the recruitment process is divided into eight different stages that I will use in this study: job description, profile definition, recruitment sources, recruitment means, recruitment campaign, selection, hiring decision and integration.

2.1.1 Job description

The company should describe its needs and requirements according to the tasks to perform in the job to promote (Cadin, Guérin, & Pigeyre, 2007) and the expected results (Armstrong, 2006; Odell, 2002).This description should also include the contacts the person will have in his/her job and information about the competitive environment (Dejoux, 2015). Each task

should be labelled as essential or non-essential, measurements of accomplishment should be mentioned as well as the working conditions and the necessary experience (Odell, 2002).

2.1.2 Profile definition

The ideal person for one job does not exist so this profile is only a basis which contains the different points used to assess the potential candidates for the job position. Competencies are often used in order to be more objective and consider only the capabilities of the applicants. The aim is not to eliminate candidates based on stereotypes (Gold, 2012). Requirements could be prioritized in analysing what makes current post occupants efficient or not (Cadin et al., 2007).

2.1.3 Recruitment sources

Choice has to be made between hiring someone from the internal market, which means a current worker of the company, or the external one. The considered recruitment sources will depend on this decision (Cadin et al., 2007). Internal sources are job postings, promotions, mutations, job rotations, rehiring, repertoire of qualifications and job matching (Dolan, Saba, Jackson, & Schuler, 2002) but these sources will not be discussed. External sources can be national agencies, job fairs in universities, forums, internet, advertisements, job boards, walk-ins, referrals (Buyens et al., 2012; Cadin et al., 2007), social media (Buyens et al., 2012) but also newspapers, magazines or professional journals (Sangeetha, 2010).

2.1.4 Recruitment means

Considering the position for which recruitment is made, we have to choose who will be in charge of the recruitment: human resources department, hierarchy, recruiting firm or headhunting firm (Cadin et al., 2007). In each case, the recruitment tools have to be determined by the people responsible for recruitment:

- Interviews are a common way to meet potential candidates in the beginning or at the end of the process.
- Tests are often performed after a first interview in order to detect counter performance, to prioritize candidates according to several capabilities or to assess the personality discovered during the interview. These tests can be taken in assessment centres.

- Role playing games are also a way to highlight the competences of the candidates.
- Group interviews are useful to place applicants in a competition with others and to see more about their leadership, creativity, stress reactions, …
- School relations allow companies to have access to a school pool and this partnership could be crucial in time of tough labour market (Dejoux, 2015).

2.1.5 Recruitment campaign

This stage requires knowing the budget to allocate to the campaign, the key messages to transmit in order to both seduce the potential applicants but also to allow them to self-deselect (Dejoux, 2015).

2.1.6 Selection

Selection cost is quite high due to the cost of the selection process itself, the future cost of training new staff and the cost of labour turnover in case of bad hiring decision. Recruiters pay therefore attention to select their new recruits properly and the most often used method is the competency-based interviewing (Gold, 2012). Selection techniques must be evaluated with performance indicators:

- "*Reliability* refers to the extent to which a selection technique achieves consistency in what is measured over repeated use" (Gold, 2012, p. 229).
- "*Validity* refers to the extent to which a selection technique actually measures what it is set out to measure" (Gold, 2012, p. 229).
- *"Fidelity* refers to the life length of the responses" (Dejoux, 2015, p. 344).
- *"Sensibility* refers to the obtaining of heterogeneous results that should all be dispersed around the mean and avoid the situation where candidates have the same answer or evaluation*"* (Dejoux, 2015, p. 344).
- *"Practical qualities* refers to the acceptability of the tool by the candidate and the mastered cost*"* (Dejoux, 2015, p. 344).
- *"Scientific construction* refers to the fact that the tool should be able to rely on a theoretical corpus scientifically validated*"* (Dejoux, 2015, p. 344).

Selection is so made based on the tools we decide to use and it is recommended to use several of them as they all have their own strengths and weaknesses. Choice criteria have to

be well determined in the profile definition as the selection decision will be based on them. Discrimination should be avoided (Dolan et al., 2002).

2.1.7 Hiring decision

This decision is most of the time a collegial one and is taken by the hierarchy of the future employee, who selects one of the three to four persons who passed the selection phase (Cadin et al., 2007).

2.1.8 Integration

The integration period starts when the new recruit integrates the company. It is necessary to support him or her in order to increase the probability of success and keeping him or her in the organization. The culture and values of the enterprise should be clearly understood at the end of this period. Coaching, mentoring integration stages are used to fulfil these requirements (Dejoux, 2015). This step of the recruitment process will not be discussed as it is most of the time not part of the work of recruitment offices.

2.1.9 Conclusion about classic recruitment process

This recruitment process has some weaknesses. First of all, the selection is based on the determination of the firm's needs and the candidate profile. If there is an error made at theses stages, it cannot be corrected by the selection process itself. Then the wrong recruitment sources or a non-optimal recruitment campaign can lead to an applicant pool which does not possess the required skills or is too small (Cadin et al., 2007). An example of it was highlighted by Parry and Tyson (2008) who showed that companies often receive applications from unsuitable candidates when diffusing job ads via job boards. Normally, this should not happen as a lot of job boards, like Monster, Infojobs or Tecnoempleo, use ontology, that is "a formal specification of a shared conceptualisation" (Borst (1997) cited by García-Sánchez, Martínez-Béjar, Contreras, Fernández-Breis, & Castellanos-Nieves, 2006), to design their applications and provide semantic possibilities to the system. For example, each applicant is considered as an entity with specific attributes that should be filled in, such as date of birth, monthly salary, his/her abilities, ... The profile of the applicant will then be matched with job offers that need a similar profile. The first advantage of this ontology model is the possible verification of information entered by the users in the system in order

to avoid inconsistencies. This is possible thanks to some format constraints such as dd/mm/aaaa for the birth date. The second one is that an ontology-guided search engine can be defined. This means that the matching between the applicant profiles and the job offers, the searches for applicants and the searches for offers are all done semantically. The result is that offers shown to the applicants are only these that can match their skills and experiences (García-Sánchez et al., 2006).

Then, a recruitment process could be undertaken to legitimate a decision and so there could be a complete discrepancy between the results we could have achieved with a correct selection process and the taken decision. Finally, people only have a limited rationality, which depends on their own experiences that they use when forging opinions about the candidates and so taking decisions (Cadin et al., 2007).

New technologies and internet changed the way to recruit personnel. Employees can now improve their employability and look for opportunities by themselves. The advantages of e-recruitment are its cost-effectiveness, ease of use, ease of access for the candidates (Armstrong, 2006; Parry & Tyson, 2008) but also its ease to follow employees' network (Dejoux, 2015). In a report written by SilkRoad (2015) we learn that job search engines are the second source of hires after employee referrals. These are websites which "scour the web and aggregate job listings from job boards and employer websites" (Doyle, 2016), an example of it is Indeed. This success occurs thanks to the fact that job search engines are able to reach a large number of internet users with highly varied skills and talents (SilkRoad, 2015). Online solutions are the most productive sources of external recruitment according to the highlighted top 10 of the study. The importance of these hiring sources puts forward the utility of using data analytics to still improve their performance in providing the right talent for the right position.

2.2 Big data

"Big data is a collection of datasets so large and complex that it is difficult to use on-hand database management tools, or traditional data processing applications, for their processing that includes capturing, storage, search, sharing, transfer, analysis, and visualization" (Ubaldi, 2013, p. 7). Big data is often defined with the help of a 3V framework but some

other V's are sometimes added. The three most common "V" stand for volume, variety and velocity while veracity, variability and value could also be considered (Gandomi & Haider, 2015). The *volume* refers to the extremely important information quantity which is now stored using different technology products like computers, smartphones or tablets. Cloud computing, which allows to store the data, played an important role in big data advent (Hamel & Marguerit, 2013). The *variety* describes the different types of data we can find using the numerous possible sources: structured (spreadsheets), semi-structured (XTML) or unstructured (human language, videos, images) (Gandomi & Haider, 2015). *Velocity* is the last characteristic of the conventional big data definition. This speed might be seen as the frequency to which data is generated, and is very important due to the various digital devices it comes from. Data is now treated in real time and can even be analysed in streams (Russom, 2011). *Veracity* is linked to the high number of data sources, which induces that not all information is reliable because of its uncertainty or imprecision. *Variability* defines the changes in the stream velocity as it could reach peaks or bottom points (Gandomi & Haider, 2015). *Value* looks at the possible gain made in analysing the data (Hamel & Marguerit, 2013).

The ability of dealing with a huge number of data sources is considered as key in order to receive successful big data outcomes (Bean, 2016). To that purpose, it is necessary to be aware of the different existing types of data. George et al. (2014) classified big data into five categories. The first one is "public data", which is held by governmental organizations and local communities. Everybody cannot access this data which is sometimes secured. The second category is the one of "private data", which we can find in private organizations or are generated by individuals. There is then "data exhaust", which is collected with one particular purpose for which it does not have a lot of value but could be recombined with other data as a new source of value. The fourth category, "community data", is the information we convey in dynamic networks like social media. At any time these social media like Facebook, Twitter, Instagram and others are the places of millions of exchanges between their members and social trends can be determined based on these (Mohanty, 2015). Finally there is "self-quantification data", which we reveal when we evaluate or store our own behaviours and actions (George et al., 2014).

In fact, capturing the right data should be an organizational goal and not a technical one (Ransbotham, Kiron, & Prentice, 2016). Companies should follow different rules in order to better deal with data and make a successful transition to analytics. They should first capture legacy data sources that were not used until then (Bean, 2016). The organization should be aware of its data and responsibility about data accuracy should be given to employees. They should know the importance of analytics (Ransbotham et al., 2016). Secondly, unstructured data, in addition to numbers and variables, should be considered. Then, considering social media but also behavioural data sources would highly increase data variety while few companies dot it until now (Bean, 2016). Fourth, staying open to new ideas in order to remain innovative is capital. Finally, managers should rely more on analytics than on their intuition when making decisions, while keeping intuitiveness for developing new ways of using analytics (Ransbotham et al., 2016).

The value extraction from this information could be done with big data analytics, the analysis of this huge amount of data. Big data volume is a clear advantage in statistical analysis and data mining as big databases allow them to be more accurate. On its side, big data variety allows discovering and predicting things that were not possible before the availability of questionable data. Big data analytics is a useful tool for companies in several areas like business intelligence, consumer satisfaction and other analytic applications (Russom, 2011). Besides data analytics and thanks to the variety of big data, text analytics is now also possible. It uses natural language processing techniques in order to understand texts and detect events, follow trends, analyse feelings, … Finally, web analytics tries to improve internet-based services as much as possible while network analytics permits to predict links, make sentiment analysis or influence nodes with help of social media information (Mohanty, 2015).

We usually separate predictive and descriptive analytics. In predictive analytics we use historical data in order to build an analytical model which allows determining the future value of a target measure (Baesens, 2014; Gandomi & Haider, 2015). This technique could be used in human resources, for example to assess the potential performance of a candidate on basis of his/her resume (Burdon & Harpur, 2014). Descriptive analytics does not aim at

predicting a specific target variable but it aims at summarizing a situation (Baesens, 2014), which could for example give information about the current labour market.

The ability of capturing data from all these different sources and analysing it could bring a lot of advantages to companies. It improves decision making in using better quality of information, which can also improve business performance (Morabito, 2015). Regarding consumers, firms can collect a lot of information about their tastes, price sensitivities and locations. This makes customization possible. Organizations are also able to improve their efficiency in using collected information in what concerns operations, innovation, adaptability and resource allocations (Kshetri, 2014).

Nevertheless some risks also arise when using big data. Consumers do not have so much information about the firms' offers which leads to an asymmetric relation between them. They can suffer negative welfare effects from this relation which are still higher for poor and less informed consumers (Kshetri, 2014). Then, privacy should be reconsidered in a different way while our civil liberties could be violated. Finally, big data predictive analyses that aim at determining who we are and our future behaviour are based on human theories which could be erroneous (Morabito, 2015).

The rise of big data is a new opportunity to better use analytics in human resources management (Naasz, 2015). The goal in using big data in human resources is to take decisions based on this data and not only on intuition. The importance of data we can find in organizations is continuously increasing and comes from a lot of different sources, which is the biggest difficulty for HR (Roberts, 2013). An important field in which HR could use more data analytics is for hiring the right talent.

2.3 Social media in recruitment

Social media encompass social network sites, blogs, wikis, microblogging tools and forums (Osatuyi, 2013). As I did not find any literature about forums and recruitment, I will not discuss this topic. Conforming to a global survey led by the Society for Human Resource Management, there are several reasons for using social media in recruitment: search for

passive candidates, post job advertisements, contact the candidates or encourage employee referrals (SHRM, 2016).

2.3.1 Social network sites

Boyd and Ellison (2007, p. 211) define social network sites as "web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system". These social network sites are an instrument of the web 2.0 and web 3.0 defined by Wozniak (2015). In these generations of e-recruitment companies observe communications between potential candidates but there is also a multilateral communication between them.

According to Caers and Castelyns (2011), both Facebook and LinkedIn are used by Belgian decision-makers in the recruitment and selection process. As few papers discuss other social network sites for recruitment, I will focus on them. These social network sites have similarities but also differences, they can be used for different purposes. For example, they are similar in the fact that they allow seeing people's networks, they encourage connection sharing, social capital generation and communication, but they also enable the users to develop new connections and publish new content. Some differences are that LinkedIn is used in a professional context, to show professional skills, knowledge and experiments, to plan a career and follow our friends'. Facebook, for its part, provides the opportunity to connect with friends, meet new people and share personal information (Caers & Castelyns, 2011). Given that mass of information, LinkedIn and Facebook are both considered as examples of big data (Bradbury, 2011).

Both social network sites can be utilized for selection and recruitment in different ways. As far as passive recruitment is concerned, Facebook allows the organizations to share information about themselves in using fan pages (Caers & Castelyns, 2011) while LinkedIn also proposes company pages (Halzack, 2013). On LinkedIn, free analytics tools are available to evaluate the effectiveness of the company page by measuring engagement, knowing follower demographics and benchmarking with comparable companies (Lock & Reilly, 2016). The second tool LinkedIn offers for passive recruitment is the module "jobs you might be

interested in" which are selected according to the pages visited by the concerned member. The algorithm considers a broad set of variables, such as the current city of residence, the changes in occupied job or the current field, in order to suggest these jobs (Halzack, 2013). These recommendations are very personalized for regular visitors while occasional visitors are aggregated by algorithms into a homogeneous group which receives still directed but more general recommendations (R. B. Ferguson, 2013). Both social network sites could also be used for referrals as workers can easily contact their friends about open positions in their company (Caers & Castelyns, 2011).

Active recruitment is also easier thanks to the availability of workers' networks on Facebook and LinkedIn (Caers & Castelyns, 2011). Indeed, LinkedIn proposes a powerful search tool which enables users to find people in using criteria such as a job in a specific company, in a particular industry, the size of companies they work in, … A premium account allows users to add some criteria such as seniority level and the groups of which people are members. Advanced users also have the opportunity to use Boolean operators within the query box. Besides that, there is still the possibility to work with raw data, in order to look at it on the macro level, with the Application Interface Programming or in exporting data about your own network in a file (Bradbury, 2011). Since 2016, LinkedIn has launched the tool "search by ideal candidates" which makes it possible to easily find candidates who own the skills you want by comparing them to a list of good candidates you make. The system starts by extracting raw attributes from the ideal candidate profiles before passing them in a query builder. The raw attributes are there aggregated by types before being expanded to similar attributes. Top attributes which fit best with these of the input profiles are finally selected. The query is so generated and the searcher can accept it and search for results or decide to modify it. The search ranker will consider the input ideal candidates, the query but also career trajectory similarities (with the model "CareerSim") in order to rank the resulting profiles (Ha-Thuc et al., 2016).

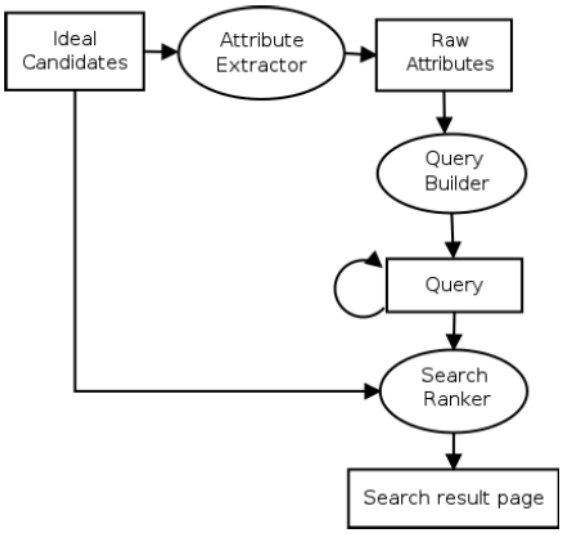

Figure 1: "search by ideal candidates", system overview (Ha-Thuc et al., 2016)

Then, besides the tools proposed by the websites, the online information might also be used when screening the candidates, 43% of the organizations would use social media or online search engines in order to screen candidates (SHRM, 2016). According to Chiang and Suen (2015), recruiters place a clear demand on job seekers' self-presentation on LinkedIn as person-job fit, person-organization fit and person-person fit perceptions depend on arguments quality and source credibility for specific self-presentation categories. There is no specific demand on Facebook where all available information is considered as potentially interesting and would be considered by some of the recruitment professionals (Caers & Castelyns, 2011). The consultation of these profiles can lead to see information about age, gender, race, ethnic origin, sexual orientation and so on, which means if the recruiters screen a person out after seeing this information, it could be necessary for them to be able to prove it did not influence their choice (Cook, 2011). Indeed, the additional information about the applicant can be used to decide whether or not to receive the concerned person for an interview (Caers & Castelyns, 2011). This information is also a means to compare internet posting and information from the resume and the cover letter (Davison, Maraist, Hamilton, & Bing, 2012).

The decision step can be influenced by information found on LinkedIn and Facebook profiles too. Information about training and professional experiences, number of professional connections and powerfulness of connections on LinkedIn have an impact on professional decision-making process (Caers & Castelyns, 2011). In fact, attributional certainty toward a

target candidate, that is the certainty that we know him and how he will behave, is reinforced by the information extracted from social media (Carr & Walther, 2014). This means that a positive impression about a candidate during an interview could be reinforced by having screened him before. Caers and Castelyns (2011) found that a significant part of Belgian recruitment professionals use LinkedIn for active recruitment while Facebook does not seem to be frequently used to that purpose.

2.3.2 Blogs

According to Merholz (2008), blogs are sometimes used by organizations as a diffusion means for job offers. It can lead to a lot of applying people in case you already have a lot of subscribers who follow the blog (Merholz, 2008) or by sending it to top bloggers in the industry or particular communities (Samuel, 2009). Secondly, blogs are also a good way for companies to educate people about what they do and how they do it. It draws the attention of the curious readers and makes it possible to reach a lot of passive candidates (Joos, 2008).

Blogs could also be useful for job seekers as it enables them to differentiate from others. In this case, they should link it to their career in posting their resume, presentation videos, comments of the previous employers and so on (Joos, 2008). Indeed, blogs can be utilized for the data they contain to do web-scraping, that is the use of algorithms to aggregate information left by people on the web in order to identify job potential or fit (see section 2.5.3) (Chamorro-Premuzic, 2015). Web-scraping is often employed to predict the personality of the candidates (Faliagka et al., 2014).

2.3.3 Wikis

“A wiki is a type of Web site that allows to collaborate on the information provided on the site; generally, if visitors register, they can easily edit or change the information on the site” (Joos, 2008, p. 54). It could be used by the recruiters in order to share what it is like working in the company and several employees could collaborate in its realization (Joos, 2008).

2.3.4 Microblogging tools

The main difference with blogging is that microblogging allows the users to share several posts a day thanks to the small size of the messages (Java, Song, Finin, & Tseng, 2007). As

Twitter is the third social media site which is used for recruitment according to SHRM (2016), 53% of the respondents employ it, this is the microblogging site that I will discuss.

There are two main ways to use Twitter in recruitment and selection. First, Twitter could be used in order to diffuse job ads and link it to a specific hashtag to facilitate the search of the tweet (Black, 2010; Vozza, 2013). Several companies offer their services in order to post these tweets in a strategic way according to the promoted function and the targeted area (Black, 2010). Secondly, Twitter could also be a means to screen candidates according to the subjects about which they tweet, their network, the quality of their tweets,… (Black, 2010; Vozza, 2013).

2.3.5 Conclusion social media

First of all, we lack information about how these social network sites influence the pool of applicants. Indeed we reach here passive job seekers (Bonet, Cappelli, & Hamori, 2013) who are considered as being well-qualified and stable employees but we do not know their quality comparing to active job seekers (Davison et al., 2011). Then, the pool of applicants we reach can be different according to the social network site used which could be surfed by different kinds of people. It allows the recruiters to reach more precisely the potential candidates and attract the more qualified ones (Madia, 2011).

Secondly, using social network sites to diffuse job ads could lead to violating civil right laws in case too many applicants do not have access to the opportunity the organization offers (Bonet et al., 2013; Davison et al., 2011). This is even reinforced when there are demographic differences between who has a profile and who has not (Davison et al., 2012). Discrimination could also arise in other ways. Indeed, HR managers who saw highly sensitive information, such as sexual orientation or a particular disability, cannot simply forget and disregard it when making a choice for an interview or a selection (Jeske & Shultz, 2016; Martucci et al., 2010; Zide, Elman, & Shahani-Denning, 2014). Normally, the Data Privacy Directive of 1995 which was created by the European Union limits the commercial use of personal data. Even if the directive is not focused on HR personnel, it still makes it more complicated to screen candidates. Indeed, a permission for searching personal information, such as information you can find on Facebook, should be given by the applicants (Massey,

2009). Then, the candidates could be discriminated in case they do not make their profile public (Hazelton & Terhorst, 2015) or they do not have any online profile (Jeske & Shultz, 2016). It effectively appears that certain recruiters form ideas about a potential candidate based on its personal preferences for privacy settings (Brown & Vaughn, 2011) or assimilate restricted profiles to negative hidden parts of the applicant life (Hazelton & Terhorst, 2015). While reading all these potential discrimination causes, it seems clear that companies incur an additional risk of being suited for privacy violation of the candidates (Jeske & Shultz, 2016) or for relying on erroneous information about criminality or deviance (Davison et al., 2012) when deciding to make use of social media for recruitment.

After that, the employment of social media could still possibly lead to often quoted biases which occur in the selection process while decision makers often draw conclusions about personality and behaviour when viewing profile pictures of the applicants or when looking at their networks (Caers & Castelyns, 2011). Moreover, network referrals recruitment can even be easier and so reinforced in using social media. According to Fernandez (2010), hiring managers already prefer recruiting referrals, even in comparison with persons sent by labour market intermediaries who build links with the companies. Persons who do not have any contact in the organization could be disadvantaged in a more important way as relationships become totally visible on networking sites. Base a decision on that could be a real problem as social media profiles do not capture all dimensions of relations and interactions between people. This means that interpersonal skills evaluation of the candidates based on social media cannot lead to right conclusion (Jeske & Shultz, 2016).

Then, regarding the screening process, validity and reliability of the content of these websites is questionable. People could try to “fake good or bad” according to the public they want to reach with their profiles (Davison et al., 2011). The accuracy of the public profile information is at risk as the companies cannot check the veracity of the background information (Davison et al., 2012; Hazelton & Terhorst, 2015). This information checking may lead to inconsistent selection in case of selective impression management used by the candidates (Jeske & Shultz, 2016).

Then, social media are not well suited for every kind of jobs. Their performance depends on education and skill levels of the persons to reach. In case of job postings related to minimum-wage jobs or low-skills jobs, a lack of computer literacy could lead to a small reachable applicant pool with social media. If you try to hire someone for a position that requires to work many hours, then this person will have no time for social media and will not probably be reached by your offer either (Joos, 2008). This is also suggested by Wozniak (2015) whose studies show online recruitment is better suited for persons with higher education.

2.4 Hiring programs using big data

2.4.1 Functionalities of the hiring programs

A talent acquisition software often includes analytics, career sites, talent communities, applicant tracking system and mobile-optimized recruiting tools (Lahey, 2015).

The applicant tracking system proposed by iCIMS is, like a lot of others, composed of many recruitment sources, such as job boards and job aggregators, social networks, search engines, career site and employee referrals (iCIMS, 2016a). An applicant tracking system (ATS) is an information system that aims at supporting each task of the recruitment process in the organization (Maier, Laumer, Eckhardt, & Weitzel, 2013). In the case studied by Maier et al. (2013), the recognition of a job vacancy by one of the departments signals the start of the recruitment process. The recruiter should then create a job advertisement which is automatically published by the ATS on the company website or on job portals. The next steps are the applicant CV reception and the storage in the database of the system (Maier et al., 2013). Indeed, the resumes are directly uploaded into the ATS database as the candidates apply via job boards or via the company website (Holderman, 2014). The recruiter will then select some resumes in utilizing the ATS and forward them to the responsible hiring manager before deciding together who to hire. This system permits to still keep an eye on performance indicators as everything is encoded (Maier et al., 2013).

Often, when people have a huge amount of applications to deal with, they all use different ways and speed in the process. We are also more likely to hire someone who looks like us,

who has the same experience and so on. Data analytics allows recruiters to go over these different considerations and look only at performance (Naasz, 2015). In the applicant tracking system proposed by iCIMS the pre-screening step is done automatically. The candidate answers questions and if s/he does not succeed s/he automatically receives a rejection email notification. This avoids human manipulation of resumes in the pre-screening step and recruiters can then view information about the qualified candidates (iCIMS, 2016b). It appears that a successful pre-screening system can increase the probability of recruiting a top performer between 38 and 75 percent (Refermat, 2007). We see in the study of Holm (2012) that recruiters are sometimes reluctant to use this automated pre-screening because they do not trust it and it would ask them too much work to put in place. ATS that are well-integrated should allow recruiters to find passive candidates through social media and proactively push job postings to them, without waiting for them to apply (Holderman, 2014).

These recruitment programs might also offer some additional functionalities. Workforce data analytics can help to better understand the market as a base for HR expectations but also to understand the forces and weaknesses of the current department strategy (M. Ferguson, 2015). Moreover, certain hiring programs can compare personality tests with a specific job profile in order to find the best possible job-fit (Stuart, 2015). In fact, according to Kuncel et al. (2014), a simple equation makes at least 25% better than humans do by themselves and that in every situation.

2.4.2 Recruiting metrics

Recruiting metrics are often included in talent acquisition software and ATS, the importance in defining recruiting metrics is to define the quality of hire in jobs which are significant in the organization. These recruiting metrics should have a meaning for management (Creelman, 2013). In order to encourage companies to utilize analytics in human resources management, the “Center for Talent Reporting” determined more than 500 HR metrics definition which allows to take standard measures in a subjective domain (Roberts, 2013).

Applicant tracking systems grant the ability to consider many different metrics. Source-of-hire is the best sourcing related metrics as it gives an indication about the effectiveness and the cost of the recruitment sources (iCIMS, 2015). The best recruiting related metrics is time-

to-fill, which is considered to be the number of days between the job request is open to the time it is accepted by the candidate (iCIMS, 2015; Sangeetha, 2010). Metrics also show the time spent by the resumes in each step of the hiring process and enable managers to detect problematic steps (iCIMS, 2015). The cost-per-hire is sometimes complicated to determine because there exist a lot of definitions (Sangeetha, 2010). In ATS the formula is clearly fixed to calculate the cost-per-hire of all kinds of positions. As far as onboarding is concerned, the useful metrics are quality-of-hire and new-hire turnover rate (iCIMS, 2015).

2.4.3 Conclusion about hiring programs using big data

There are varied advantages that a recruiting system based on big data can bring to a company. The first one is the possibility to reach passive candidates who are interested in the company, even if they do not apply for the job (iCIMS, 2016b). Nowadays companies are still having only a reactionary recruitment approach, which means that they only look for new employees when there are open job positions (Lahey, 2015). We see in the report of Buyens et al. (2012) that it is also the case in Belgium. This way, they miss a lot of better applicants who are not looking for a job in these particular periods. Using applicant tracking systems could help them to look actively for new employees and find passive candidates (Lahey, 2015). This leads to a bigger talent pool which is more suitable to the organization needs (TalentReef, 2014). The problem of applications from unsuitable candidates raised by Parry and Tyson (2008) is now easily tackled as screening of resumes is done by algorithms; this does not lead to heavy work anymore. Besides that, the resumes are kept in the system and each one could be searched for each new position opening (Holderman, 2014).

The second advantage is the decrease of the time-to-hire (Holderman, 2014; TalentReef, 2014). The company should quickly push the best talents in later phases of the recruitment process if it does not want to miss them, which is made possible by using the mobile solutions of the ATS (Lahey, 2015).

Moreover recruiting software facilitates the respect of the laws in the company's HR practices and Equal Employment Opportunity (EEO) (Hauser, 2011). This means there should be no discrimination and it is easier to deal with potential legal risks linked to recruitment. The assessment done by the system is the same for each applicant. The process relies on

objective, rational, computer-based decision making (Holderman, 2014). All the information is consolidated and recorded at the same place so that the records needed for compliance are still available (TalentReef, 2014).

These recruitment programs could nevertheless also lead to several disadvantages. The ATS could possibly reject an application due to a resume format that it cannot read. Smaller formatting choice of the resume also influences the way the system will grade it. For example, writing dates before the titles of your former jobs could lead the program to consider you have no experience supposing it expects to find those dates at the end of the sentence (Holderman, 2014).

Then, a new form of discrimination arises in using big data analytics. In fact discrimination can happen in determining the employee profile and putting it into analytics. The problem is that it could not be considered as discriminatory under anti-discrimination law. This law considers more gender or physical ability while nowadays discrimination is more about irrational correlation of information linked to the social or physical attribute of a given group. A lot of different informational attributes are being considered without we even know it. Determining where the discriminatory practice happens is highly difficult as it is embedded within a lot of different considerations. It becomes quite impossible to prove that we have been injured (Burdon & Harpur, 2014).

2.5 Other hiring tools using big data/sources of big data

2.5.1 Gamification

Online games are now sometimes proposed to collect data used for hiring decisions. These are more pleasant than traditional recruitment tools which increases the response rate in enlarging the applicant pool (Chamorro-Premuzic, 2015). These online games could have two different objectives. They can give a better idea of the work and its context to the potential candidates; in this case they work as a more realistic job preview (Wozniak, 2015). The second possibility is that the game includes analogous tasks and challenges to these of the work, which allows the HR department to collect useful information about the player (Wozniak, 2015) and to asses important personal traits (Carey & Smith, 2016).

The way of playing and information such as hesitation time before taking action, action choices and the way to tackle problems are collected by the organization. These will help to evaluate different competences such as creativity, persistence, capacity to learn rapidly from mistakes, ability to prioritize, social intelligence but also the personality (Ibarra, 2013) and the IQ (Chamorro-Premuzic, 2015). One problem concerning these online games is that women are far less active than men in this field, which could lead to gender gap in recruitment (Ibarra, 2013).

2.5.2 Behavioural analytics

Some firms identify intern talents by monitoring and measuring the daily activity of their employees. Algorithms allow the recruiters to diagnose individual, team or organizational performance. Profiles are created for the most successful employees, which is a good benchmark for outsiders who should be hired. The disadvantage of this technique is its important implementation cost (Chamorro-Premuzic, 2015).

2.5.3 Web-scraping

Web-scraping is the method which uses algorithms to aggregate information left by people on the web in order to identify job potential or fit. It makes it possible for employers to have information about the IQ and the personality of the candidates. The tests which are scientifically valid should attain an accuracy rate of 50%. The considered information is often found on social media, posted by the concerned persons or by others (Chamorro-Premuzic, 2015). This technique could lead to ethical and legal problems for the employers in case information is not wide-accessible. Chamorro-Premuzic (2015) suggests the possibility to avoid such a risk by letting the users own their data and disclose them to the recruiters who use particular applications or algorithms.

An example of web-scraping appears in the tool developed by Faliagka et al. (2014) which semantically matches applicant skills that are found on his/her LinkedIn profile with the related concepts asked by the recruiter in the job position. Their program also includes a personality mining module which retrieves information from the blog of the applicant, if the

URL is given, in order to make a linguistic analysis of it. The aim of their program is to rank the candidates who apply for the position.

3. Research methodology

I mainly aim at answering the three following questions:

- How is data analytics used by recruitment professionals in Belgium?

  I answered this question with a small survey I sent to recruitment professionals in Belgium in order to see what percentage of them effectively use data analytics and how they do so. I tested potential links between the different variables approached in the survey.
- What are the new recruitment tools linked to big data which are effectively used by recruitment offices in Belgium and how are they integrated in the classic recruitment processes?

  I answered this question based on the literature review and the practical information gathered during interviews with several recruitment professionals who are specialized in different fields of recruitment like headhunting, recruitment of all kinds of profiles and recruitment of specialized profiles.
- What changes were induced in the classic recruitment processes in Belgium due to the integration of the preceding tools linked to big data?

  I answered this question, like the previous one, with the literature on that subject and its confrontation with the current practices of professionals in Belgium.

I focus on the recruitment processes and tools used by professionals of recruitment in Belgium, which are recruitment offices, interim management offices and executive search offices located in Belgium. Indeed, according to the study of Buyens et al. (2012), a lot of Belgian companies collaborate with external companies as far as their recruitment processes are concerned. According to Bonet et al. (2013), the following graph (Figure 2) gives a definition of the most important types of labour market intermediaries (LMIs). We can see in the graph that the organizations I consider in my research are part of the “place and search firms” and the “temporary help service firms”. The online information exchanges, which are categorized as information providers by Bonet et al. (2013) and include online job boards

and social media sites, are here considered as tools used by the recruitment professionals in order to enrich their recruitment process.

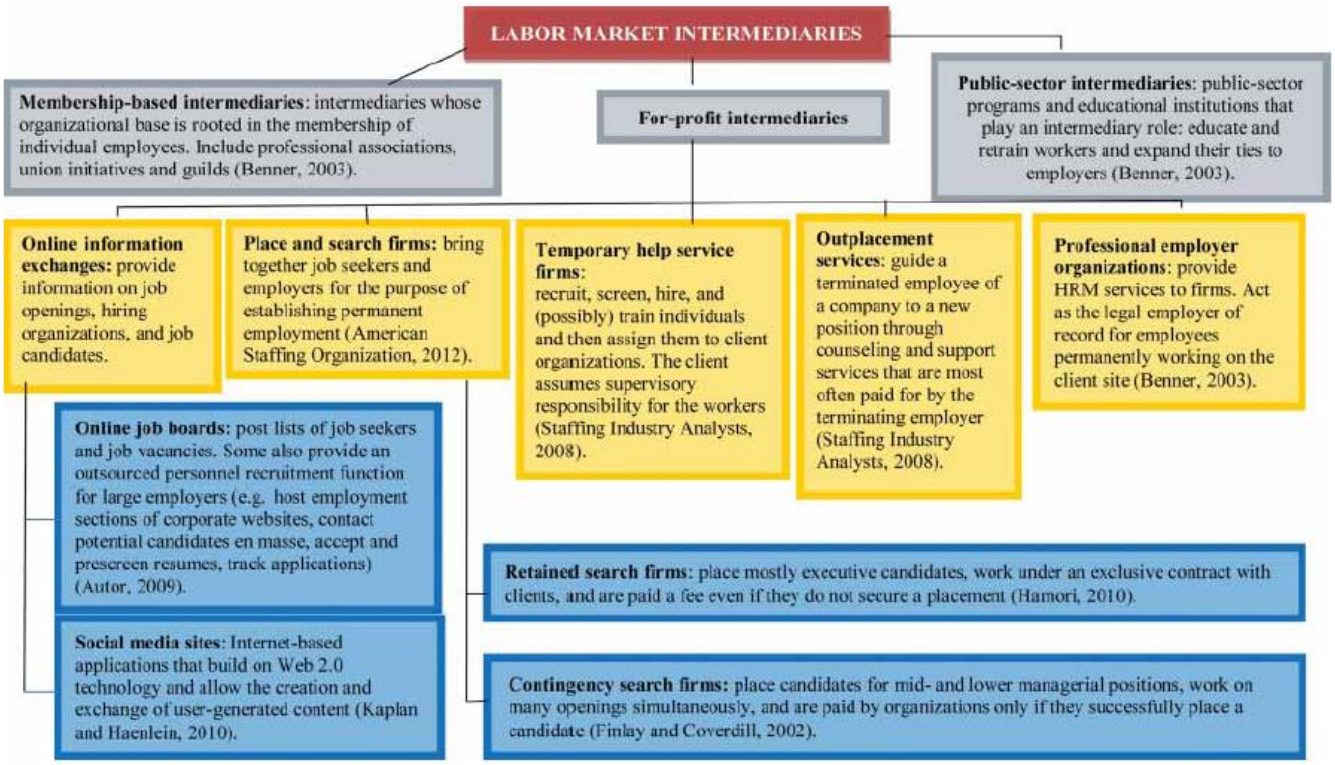

Figure 2: Types of labor market intermediaries (Bonet et al., 2013)

Based on the literature review and in order to answer my research questions, I make the following hypotheses which are all done regarding the professionals of recruitment who work in recruitment offices located in Belgium. The seventh first hypotheses are related to the second research question, the new tools which are employed and their integration in the recruitment processes, while the four last ones are related to the third research question, what changes are induced by the integration of the new tools in the recruitment processes.

H_1: LinkedIn is an unavoidable tool for both recruitment and selection.

The survey of Caers and Castelyns (2011) found that LinkedIn is used by human resources professionals for active recruitment but also in selection thanks to the information it makes available. I suppose the trend will be the same when focusing the research on recruitment offices.

H_2: Facebook is not usually used for recruitment but well for selection.

The survey of Caers and Castelyns (2011) found that Facebook is not commonly used for active recruitment. Nevertheless, recruiters still sometimes check information about the candidates on Facebook. I suppose the utilization of Facebook made by recruitment offices is the same as for recruitment professionals in general.

H_3: Blogs are not used by recruitment offices.

Indeed, the report of Buyens et al. (2012) which analysed trends in recruitment and selection in Belgium seems to show that blogs are only a means for organizations to promote their activity, such as suggested by Joos (2008). Nevertheless, recruitment offices should not do that for their clients and have less interest of doing it for themselves as they are not the future employer. Then, according to hypothesis 7, recruitment offices do not use blogs for web-scraping.

H_4: Wikis are not used by recruitment offices.

I did not find a clear way to utilize wikis in literature and neither the survey of SHRM (2016) nor the research of Buyens et al. (2012) spoke about it.

H_5: Twitter is used by recruitment offices for both recruitment and selection.

Indeed, according to SHRM (2016), Twitter is used by half the recruiters and is so the third social media website which is employed for recruitment. Recruiters have the possibility to share job ads on Twitter (Black, 2010; Vozza, 2013) but it also allows them to screen the candidates (Black, 2010; Vozza, 2013).

H_6: Gamification, in the way of collecting information about players to predict their performance at work, is not used by recruitment offices.

Games allow the recruiters to retrieve information about the skills and the personality of the candidates in order to compare these with the requirements for a specific function (Carey & Smith, 2016; Chamorro-Premuzic, 2015; Ibarra, 2013; Wozniak, 2015). Nevertheless, recruitment offices do not often recruit so many persons with exactly the same profile unless they are specialized, which means they do not need this kind of tool most of the time.

H_7: Web-scraping is not commonly used by recruitment professionals.

We see in the study of Althéa et al. (2016) that most of the recruitment professionals in France have never used big data, which implies they do not use web-scraping as it considers a lot of different data sources. We can suppose that Belgium has quite the same advancement in the field as France.

H_8: The use of social media leads to new forms of discrimination.

A lot of non-professional related information is now available online and could be used to evaluate a candidate. Sensitive information such as age, sexual orientation or disability could be visible online (Jeske & Shultz, 2016; Martucci et al., 2010; Zide et al., 2014), privacy settings of the online profile (Hazelton & Terhorst, 2015) but also the lack of online profile (Jeske & Shultz, 2016) might influence the opinion of the recruiters.

H_9: Automated pre-screening is now mostly part of the recruitment process.

Automated pre-screening might be done with LinkedIn tools which allow the recruiters to find some profiles corresponding to several different criteria thanks to verbal semantic and Boolean operators (Bradbury, 2011). It is also integrated in some applicant tracking systems (iCIMS, 2016b) and hiring recruitment programs (Faliagka et al., 2014). Most recruitment offices should use at least one of these tools and have the opportunity to pre-screen the candidates.

H_{10}: Connections people have on social network sites have a big impact when recruiting using social media.

Indeed, these connections become visible and are so considered by recruitment professionals. According to Caers and Castelyns (2011), the number of professional connections and the powerfulness of connections on LinkedIn impact professional decision-making process. Moreover, social network sites facilitate referrals as it is easy to share a job ad (Caers & Castelyns, 2011). These employee referrals are the first source of hires (SilkRoad, 2015) and should be reinforced by the advent of social media in recruitment.

H_{11}: Recruiting metrics allow the recruiters to evaluate their recruitment process and implement changes for the least satisfying steps or sources of recruitment.

An ATS allows the recruiters to register information about their actions and it offers a lot of metrics to analyse their work (iCIMS, 2015). These metrics give an objective view on the time spent by the resumes in the different steps of the hiring process and the cost of the different hiring sources (iCIMS, 2015; Sangeetha, 2010).This way recruiters can decide to reallocate their budget in order to be more efficient and they are also able to improve the bottleneck steps of the recruitment process.

I test these hypotheses in a qualitative way through interviews of recruitment professionals who work in recruitment offices located in Belgium (See the interview guide, Annex 2). I mainly selected recruitment offices which answered my survey in stating they use data analytics in their daily activity. These interviews allow me to determine what changes arise in the recruitment processes based on the employment of the different new tools.

4. Analysis of the research

4.1 Use of data analytics by recruitment professionals in Belgium

I started by reading the literature about the different uses human resources can make of data analytics. When I had a clear idea of the possibilities (Faliagka et al., 2014; Ha-Thuc et al., 2016; iCIMS, 2016b; Maier et al., 2013), I built a small survey of nine questions (see Annex 1) about the use of data analytics and big data. The choice of keeping the survey so concise was made in the hope of receiving more answers. The aim of this survey was to evaluate the utilization of data analytics by recruitment professionals in Belgium but also to determine which organizations could be interesting to interview given their particular advancement in the field. I sent it to 224 recruitment professionals located in Belgium, as 15 mails failed to reach their recipient, I effectively reached 209 companies.

I selected these companies in two ways: I first went on the website of the “Banque Carrefour des entreprises” and looked for companies which hold the codes 7810001 and 7810002 and were situated around the commune of Brussel (1000). These two codes correspond respectively to the following categories “the search, selection and placement of personnel to the attention of the potential employer or the jobseeker” and “the activities of executive search and placement (headhunters)”. I then found the website of the federation of HR service providers in Belgium, Federgon, and I completed my list by adding all the recruitment offices which are members of this federation under the title “commission recruitment search and selection”. I did not find the total number of recruitment offices in Belgium but I think it is a representative sample as all types of companies are represented. Maybe interim management offices are a bit underrepresented as I did not take the list of offices under the title “interim management” on Federgon website. In order to receive as many answers as possible, I randomly called some companies that did not answer the survey when only receiving it by e-mail. I did not call all the companies for a monetary reason. I finally received

answers from 47 companies which corresponds to a response rate of 22.49%. Two of these responses were incomplete which let me 45 exploitable answers. When I received several responses from different persons from the same company, I considered the response stating that data analytics was part of the most numerous steps of the recruitment process as the correct one. Indeed, I assumed people who do not respond they were using data analytics were simply not aware of it.

The analysis of these responses let us see that 44.44% of the responding companies consider using data analytics among which 17.78% use only descriptive analytics, 11.11% use only predictive analytics and 15.56% use both simultaneously. We can also see that 15.56% of these organizations consider using big data in their work.

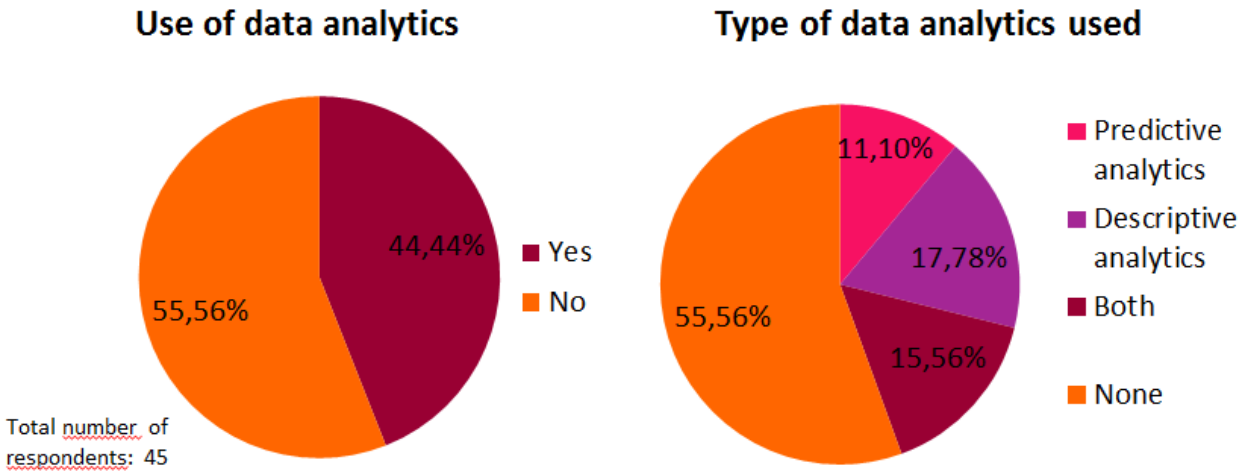

Figure 3: use of data analytics and type of data analytics used

With the questions of my survey I received responses under the form of nominal qualitative variables. That is why I looked at contingency tables to see if there is a link between the different variables. The independence between the variables is measured with the Chi-square statistics, with as null hypothesis the independence between the variables (Rakotomalala, 2011). In that purpose, I used the free data mining software “Tanagra”.

I first tested the link between the business of the organization and the use of data analytics. I simultaneously tested the link between data analytics and headhunting, interim management and specialization of the recruitment and obtained the following p-values: 0.3358, 0.4862 and 0.6067. We cannot reject the independence hypothesis for these

variables. The type of business does not seem to influence the use of data analytics. We can also test the predictive association between the variables using the Tau of Goodman and Kruskal or the U of Theil. We obtain respectively the p-values 0.3412, 0.4911 and 0.6107 for the Tau test, and 0.3333, 0.4846 and 0.6054 for the U test which means there is no association between the variables.

The second analysis is the one between the size of the organization and the use of data analytics. We see a p-value for the Chi-square of 0.0324 which is below the significance level of 5%. We reject the null hypothesis, the variables are not independent. When looking at the Chi-square contributions, we can see which cases of the contingency table are far from independence. The organization whose size varies from 50 to 200 persons seems to be more inclined than the mean to use data analytics while organizations with 0 to 10 persons seem to be less inclined than the mean to do so. This is confirmed by the Tau test whose p-value is 0.0354 and the U test whose p-value is 0.0262. There is here a predictive association between the size of the organization and the use of data analytics.

The third test done was about the relation between the internationality of the organization, measured by the presence of offices out of Belgium and the use of data analytics. The p-value of the Chi-square is 0.9465 which means we cannot reject the independence hypothesis between the variables. This is confirmed by the Tau and the U tests with p-values of 0.9471 and 0.9475.

The next test looks at the relation between the type of data analytics (predictive, descriptive or both) and the use which is done of data analytics. I focused on the responses where data analytics was claimed as utilized for this test. The p-values of the Chi-square obtained for the relations of the different uses of data analytics and the type of data analytics are listed below. These are all above 5% which means we cannot reject the hypothesis of independence. This was confirmed by the p-values of the Tau and the U tests.

Use of data analytics	P-value
Own market definition	0.1653
Client's market definition	0.1902
Profile definition	0.5514

Creation resumes for non-seeking	0.4694
Pre-screening of resumes	0.7228
Other	0.2062

The fifth test done is between the type of data analytics (predictive, descriptive or both) and the sources of data used for that. For social media, the p-value is 0.2164, it is 0.4147 for data from governmental organization and 0.0283 for data from local communities. The p-values are 0.8436 for the data given by the individual themselves and 0.8747 for other sources of data. We can see a rejection of the independence hypothesis between the use of information from local communities and the type of data analytics which is done. When we look at the contributions to the Chi-square we can see the relation between the utilization of both type of data analytics and the use as data from local communities as source is positive. This was confirmed by the p-value of the Tau test (0.0339) and the one of the U test (0.0141) which means the type of data used has an influence on the use of data from local communities as source.

The next test done was between the use of data analytics and the sources of data that are considered therefore. The p-values obtained for the Chi-square are the following ones:

Sources of data	Use of data analytics	p-value
Social media	Own market definition	0.5731
Social media	Client's market definition	0.7686
Social media	Profile definition	0.6903
Social media	Creation resumes for non-seeking	0.8913
Social media	Pre-screening of resumes	0.4924
Social media	Other	0.1171
Data from governmental org	Own market definition	0.1945
Data from governmental org	Client's market definition	0.9640
Data from governmental org	Profile definition	0.5820
Data from governmental org	Creation resumes for non-seeking	0.4132
Data from governmental org	Pre-screening of resumes	0.3428
Data from governmental org	Other	0.3534
Data from local communities	Own market definition	0.0581
Data from local communities	Client's market definition	0.0813
Data from local communities	Profile definition	0.8482

Data from local communities	Creation resumes for non-seeking	0.2123
Data from local communities	Pre-screening of resumes	0.8876
Data from local communities	Other	0.4515
Data given by the individuals	Own market definition	0.5731
Data given by the individuals	Client's market definition	0.0954
Data given by the individuals	Profile definition	0.6903
Data given by the individuals	Creation resumes for non-seeking	0.2187
Data given by the individuals	Pre-screening of resumes	0.0954
Data given by the individuals	Other	0.5018
Other	Own market definition	0.1967
Other	Client's market definition	0.3687
Other	Profile definition	0.6481
Other	Creation resumes for non-seeking	0.5312
Other	Pre-screening of resumes	0.8222
Other	Other	0.6080

We can see that none of the relations are significant as all p-values are above 5%. This is confirmed by the Tau test while the U test seem to give a link between own market definition and the use of data from local communities (0.0230) whose p-values are also near 5% for the Chi-square (0.0581) and the Tau test (0.0648).

The eighth test analyses the potential link between the sources of data utilized and the consideration of using big data for recruitment offices stating they employ data analytics. The p-values found are 0.9185 for social media, 0.4231 for data from governmental organizations, 0.0122 for data from local communities, 0.9185 for information given by the individuals themselves 0.4819 for data from other sources. The use of data from local communities and the consideration of using big data are not independent as the p-value is under 5%. This is confirmed by the p-values of the Tau and the U tests.

The last test done considers the type of data analytics utilized and the consideration of using big data. We find a p-value of 0.3081 for the Chi-square which means we cannot reject the hypothesis of independence for these variables, which is confirmed by the p-values of the Tau (0.146) and the U (0.0117) tests. The use of data from local communities should

influence positively the consideration of using big data according to the positive Chi-square contribution.

The lack of significance in the results could be due to the fact that the sample size was too small. Indeed, the first tests were computed with the consideration of 45 answers while the five last ones considered only 20 responses which is a really small sample size. Indeed, according to Howell (n.d.) the approximation of the Chi-square statistics with the Chi-square distribution worsens with small expected frequencies, these should be at least equal to 5 if we consider the general rule. The only tests which have no expected values below 5 are the first one and the third one. This would mean that the type of business and the internationality of a company do not influence its use of data analytics.

4.2 Integration of the new recruitment tools in the classic recruitment processes

I read several papers about these new recruitment tools (Caers & Castelyns, 2011; Chamorro-Premuzic, 2015; Faliagka et al., 2014; Joos, 2008; Maier et al., 2013) and I also looked for more commercial information on the websites of recruitment software providers (iCIMS, 2016a; TalentReef, 2014) to understand which functionalities they offer and how they work. As I did not find a lot of information about recruitment programs, I interviewed a software provider, whose software name is Beetween, to have broader information about its functioning. This way, I had a demonstration of the software which allowed me to visualize the functionalities about which I read on the different websites. I also interviewed seven companies which use data analytics and social media in a lot of different fields of their work, what I determined based on my survey, in order to better understand in which steps of the recruitment process the new recruitment tools are integrated and their impact on the way of doing business. In order to have a comparison point, I decided to interview also one of the companies which answered that they do not use data analytics at all. This company will be named X and is a headhunting firm. All these interviews were led under the form of semi-structured interviews, which means I knew which topics I wanted to discuss but I let the interviewees talking about it as they wanted and I reoriented the discussion when it was necessary. I had a first wave of interviews with four companies which are X, Russel Reynolds (Marionne Barge and Emilie de Terschueren), a headhunting firm, iStaffit (Pierre Mureau), a recruitment office which recruits different kinds of profiles and Planet Talent (Tatyana

Skoraya) which only looks for promising young graduates. I then realized I did not have enough information with these four interviews and I decided to have a second wave of interviews with Target recruitment (Joris Vivijs) which is specialized for IT, engineers and does also headhunting, Eric Salmon (Fiona Sautter), a headhunting company, Y, which is specialized in IT recruitment and Compusearch (Stef van Nieuwkerke), recruiting IT profiles but also sales and HR ones related to IT. I then sent a mail with additional questions to some of these recruitment offices when it was necessary. These interviews allowed me to test the hypotheses I emitted based on my literature review.

Recruitment steps	Trend tools potentially used
Job description	Professional information tool
Profile definition	LinkedIn "Search by ideal candidates", behavioural analytics
Recruitment sources	Social network sites (LinkedIn, Twitter,…), applicant tracking systems (job boards, social network sites,…)
Recruitment means	Gamification
Recruitment campaign	Social network sites (LinkedIn, Facebook,Twitter,…), blogs
Selection	Applicant tracking systems, social network sites (LinkedIn, Facebook,…), blogs, web-scraping
Hiring decision	All the preceding tools

Figure 4: insertion of the new recruitment tools in the classic recruitment process

The table above summarizes how the different trend recruitment tools and data analytics fit into the classic recruitment process described by Dejoux (2015). I based my reasoning method on the assumption that the core principles of the recruitment process did not change with the integration of these new tools, which was confirmed by Joris Vivijs (personal communication, July 25, 2016).

Job description is a step for which machines are still not well-suited. The only new tools recruiters utilize are professional information websites, such as "Dow Jones, Factiva" (Emilie de Terschueren, personal communication, July 12, 2016; Fiona Sautter, personal communication, July 27, 2016), "Hoovers" (Fiona Sautter, personal communication, July 27, 2016) or "Trends top" (Joris Vivijs, personal communication, July 25, 2016). The needs of the company and the specificities of a particular position should still be defined by humans as the literature does not mention any other possibility and the persons I interviewed either.

The profile definition can be carried out with data analytics, based on the profile of candidates who perform well in the targeted function. Two different tools make it possible: the “search by ideal candidates” on LinkedIn and behavioural analytics. The “search by ideal candidates” tool suggests an ideal profile for candidates, which is built by the system in considering the common skills of the input profiles. The recruiter might accept the suggested profile or decide to modify it (Ha-Thuc et al., 2016). Behavioural analytics is employed by companies to measure the daily activity of their employees in order to spot the best workers and create a profile of these employees. These profiles are then used as a benchmark for candidates to hire (Chamorro-Premuzic, 2015). During the interviews, I met several recruiters who are using the LinkedIn tool (Marionne Barge, personal communication, July 12, 2016; Pierre Mureau, personal communication, July 12, 2016; X, personal communication, July 5, 2016) and another one who considers doing it in the future (Stef Van Nieuwkerke, personal communication, August 8, 2016). Behavioural analytics, on its side, does not seem to be utilized by recruitment offices in Belgium. This seems normal considering the fact that recruitment offices do not have the required information about workers performance which is probably kept within their client companies.

The number of available recruitment sources has increased a lot in the recent years. Indeed, job boards are still an important source of resumes for some companies (Joris Vivijs, personal communication, July 25, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016; X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016), as it is the case for job search engines (Joris Vivijs, personal communication, July 25, 2016; X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016). On their side, social network sites, in particular LinkedIn, have become an important source of recruitment which is used by all interviewed recruitment offices (Emilie de Terschueren, personal communication, July 12, 2016; Fiona Sautter, personal communication, July 27, 2016; Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016, X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016). Recruiters from iStaffit even exclusively rely on

LinkedIn to search candidates (Pierre Mureau, personal communication, July 12, 2016). *This partially confirms H_1 as LinkedIn seems to be unavoidable as far as recruitment is concerned.* Pierre Mureau also tried to diffuse job ads on Facebook but stopped because he did not receive any interesting answer through this pathway (personal communication, July 12, 2016). Y has just began to post job ads on Facebook and said it only received a few interesting answers, while I did not see any real interaction of candidates on its Facebook page (personal communication, August 2, 2016). This could be due to the fact that Facebook is better suited for low profiles as suggested by Joris Vivijs, who does not find any of the profiles he hires on Facebook either (personal communication, July 25, 2016). Stef Van Nieuwkerke also posts job ads on "Talentme", which is the professional networking application of Facebook, but according to him, it does not work well because it has not had much success (personal communication, August 8, 2016). *These statements partially confirm H_2 as it means that Facebook is not used for recruitment.* Then, Twitter and blogs are also a new way to diffuse job ads for open positions but only Joris Vivijs, Pierre Mureau and Y told me they have already diffused job ads on Twitter. According to them, Twitter is not a media which brings any recruitment advantage in Belgium as none of them ever had good profiles which applied through this channel (personal communication, July 25, 2016; personal communication, July 12, 2016; personal communication, August 2, 2016). Stef Van Nieuwkerke also tried to reach candidates discovered by Talent Bin in sending them a message through Twitter but he did not receive any answer (personal communication, August 8, 2016). *This invalidates hypothesis 5 as it means that Twitter is not used as a recruitment tool in Belgium.*

According to Yvan Chevalier, an applicant tracking system, such as Beetween, allows the recruiters to deal with a lot of different websites at the same time, that is different job boards, social media and the company website on which job offers could easily be published (personal communication, July 11, 2016). I learned from the interviewees that most recruitment offices have either an applicant tracking system (Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016) or a "customer relationship management software" (Tatyana Skoraya, personal communication, July 13, 2016; Pierre Mureau, personal communication, July 12, 2016; Y, personal communication, August 2, 2016). Stef Van Nieuwkerke even works with a program he

designed himself which seems to be close to a customer relationship management software (personal communication, August 8, 2016). Another recruitment source which was influenced by the rise of social network sites is referrals. According to Joris Vivijs, Marionne Barge and X, the number of referrals increased with social media thanks to the facility people have to share an interesting job ad with their network (personal communication, July 25, 2016; personal communication, July 12, 2016; personal communication, July 5, 2016). On the other hand, Tatyana Skoraya did not see any particular evolution of the number of referrals with the development of social media (personal communication, July 13,201). *These statements validate hypothesis 10 as the connections people have on social network sites effectively influence recruitment in some cases.* Finally, another new recruitment source that I did not discuss in the literature review was mentioned by Stef Van Nieuwkerke: Talent Bin. This Monster's tool gathers information about passive IT professionals in order to build them a profile and allows the recruiters to see the topics on which they are active and the websites they attend. He tried it for three days but did not receive any positive results and decided not to subscribe (personal communication, August 8, 2016).

The recruitment means do not differ a lot when considering the tools linked to big data, only gamification brings a bit novelty in this field. Nevertheless, this practice does not seem to be utilized by the recruitment offices I interviewed. The only types of gamification they already considered are a kind of contest between programmers such as coding a game (Pierre Mureau, personal communication, July 12, 2016) or another contest whose aim is to tell a story related to the authenticity of the organization and does not seem to be web-related at all (Tatyana Skoraya, personal communication, July 13, 2016). *This confirms hypothesis 6, gamification is not used in order to retrieve information to predict work performance of the candidates.* This reaction from recruitment offices appears to be logical. In fact, on the website of Shaker (2016) we can read that simulation games are "best suited for high-volume hiring scenarios" and the games approached by the literature are focused on specific fields or positions, such as for example the IT contests organized on Kaggle (Carey & Smith, 2016). Consequently, it is not highly surprising that the recruitment offices in Belgium do not even consider gamification as they hire a lot of different profiles and not often a large number of persons with the same one. According to Joris Vivijs, gamification is better suited

for corporate institutions as they can reuse it. It is far too expensive for recruitment agencies because it would require a team of developers (personal communication, July 25, 2016).
The changes in the recruitment campaign appear in the media which are used to transmit messages. Indeed, organizations can have their own company page on both Facebook and LinkedIn. I found a LinkedIn page for all the interviewed companies while X has even created a specific profile of the organization (X, personal communication, July 5, 2016). I also found a Facebook page for Russel Reynolds associates, iStaffit, Target Recruitment, Planet Talent and Y. A few years ago, Stef Van Nieuwkerke built a Facebook profile for Compusearch but it did not bring any positive results and is not used anymore (Stef Van Nieuwkerke, personal communication, August 8, 2016). Next, Twitter could also be a means to interact with the candidates in order to increase the visibility of the company (Joris Vivijs, personal communication, July 25, 2016; Pierre Mureau, personal communication, July 12, 2016; Y, personal communication, August 2, 2016) and the recruiter (Fiona Sautter, personal communication, July 28, 2016). Blogs are also a good tool to achieve that purpose but the only company which has a blog is Target Recruitment (Joris Vivijs, personal communication, July 25, 2016). *This invalidates hypothesis 3 as some recruitment offices seem to use blogs in order to promote their company.*

The selection step is impacted by these new recruitment tools in several ways. First of all, an automated pre-screening of resumes is done when companies search for candidates on LinkedIn or in their applicant tracking system. LinkedIn enables the recruiters to do simple researches based on several criteria and, admitting they have the recruiter account, with the use of Boolean operators to precise their research (Pierre Mureau, personal communication, July 12, 2016). As said in the paragraph about profile definition, all companies use LinkedIn: Planet Talent without any professional account, Target Recruitment and Eric Salmon with the business plus account and the other companies have LinkedIn recruiter and its pre-screening tool. Whatever account they have, all recruiters use either the simple research of profiles which is available for everybody or the most advanced one (Fiona Sautter, personal communication, July 28, 2016; Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016; Pierre Mureau, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016; X, personal communication, July 5, 2016; Y, personal

communication, August 2, 2016). Some ATS also have this functionality and enable the recruiters to do a pre-screening based on verbal semantics (Fiona Sautter, personal communication, July 28, 2016; Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Y, personal communication, August 2, 2016) and Boolean search (Joris Vivijs, personal communication, July 25, 2016), while some others, like Beetween, only propose an "anti-spam system" which avoids reading resumes that did not contain precise mandatory key words (Yvan Chevalier, personal communication, July 11, 2016). Beetween has also a "form process" where a candidate receives a mail with some fields to complete like the years of experience or a salary, which is closer to pre-screening but still semantically limited (Yvan Chevalier, personal communication, July 11, 2016). *This confirms hypothesis 9, pre-screening is now part of the recruitment process of all recruitment offices: it is either integrated within their human resources software or within the LinkedIn research.*

Then, selection is also influenced by the available information about the candidates which could be found on social network sites, blogs, websites or through results from gamification. The utilization of LinkedIn and Facebook for screening candidates was confirmed by two recruitment offices during the interviews (Marionne Barge, personal communication, July 12, 2016; Pierre Mureau, personal communication, July 12, 2016) while most of them only focus on LinkedIn (Fiona Sautter, personal communication, July 28, 2016; Joris Vivijs, personal communication, July 25, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016; X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016). *This confirms H_1 as LinkedIn is used for selection by all recruitment offices. H_2 is invalidated because only a few recruitment offices use Facebook information to make decisions.* According to Pierre Mureau (personal communication, July 12, 2016), Twitter could also be a useful screening tool as people often post about professional topics and their interests, and this especially for people working in IT. The only interviewees who told me they forecast to screen candidates on this media in the future are Pierre Mureau and Tatyana Skoraya (personal communication, July 12, 2016; personal communication, July 13, 2016). *This nevertheless invalidates hypothesis 5 as Twitter is not used yet by recruitment offices in Belgium to screen*

candidates. Next, blogs are also a good means for recruiters to find additional information about professional skills of the candidates. Indeed, people specialized in IT quite often have blogs or websites which could be used for screening (Joris Vivijs, personal communication, July 25, 2016; Tatyna Skoraya, personal communication, July 13, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Y, personal communication, August 2, 2016). *This, again, invalidates hypothesis 3, recruitment offices do sometimes use blogs to screen the candidates.* Wikis are not employed by the recruiters I interviewed. *This validates hypothesis 4.* Next, some websites on which members collaborate and share code, such as GIThub or Stackoverflow, allow the recruiters to observe the contribution of a programmer about a particular topic (Joris Vivijs, personal communication, July 25, 2016; Pierre Mureau, personal communication, July 12, 2016; Y, personal communication, August 2, 2016) or to find new programmers with the same kind of competences that a specific candidate (Joris Vivijs, personal communication, July 25, 2016). Finally, Googling people remains an efficient way to find information about the candidates (Emilie de Terschueren, personal communication, July 12, 2016; Fiona Sautter, personal communication, July 28, 2016; Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyna Skoraya, personal communication, July 13, 2016). Web-scraping seems to be used by Joris Vivijs who told me he goes on Google in order to do Boolean searches which enable him to find information about the candidates (personal communication, July 25, 2016). *This nevertheless validates hypothesis 7 as web-scraping is not commonly used by recruitment offices.*

Hiring decisions are still made by humans. Nevertheless, the final decision is influenced by all the steps which precede it. This is why, all these recruitment tools, once they are part of the recruitment process, have an influence on the decision made about the candidate. Metrics are a good means to measure the efficiency of the recruitment process and to allocate budget to the right sources of candidates. Tracking all the actions taken in the process is a good way to improve it (Joris Vivijs, personal communication, July 25, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016). Eric Salmon recruiters also use some metrics, even if they name it KPI's, in order to evaluate their missions (Fiona Sautter, personal communication, July 27, 2016).

When we consider all these tools that are used by the recruitment offices in their recruitment process, we realize they are daily dealing with big data as they all employ social network sites but also sometimes blogs, information websites and Google. During the interviews, I realized that not all recruiters are aware they manipulate big data. Pierre Mureau, Tatyana Skoraya and Y do not consider using big data with their own databases while they do when using LinkedIn (personal communication, July 12, 2016; personal communication, July 13, 2016; personal communication, August 2, 2016). Stef Van Nieuwkerke and X are also fully aware that big data is part of their daily business (personal communication, August 8, 2016; personal communication, July 5, 2016). Marionne Barge and Fiona Sautter, as for them, are less conscious they use big data while they also screen candidates on Facebook and/or LinkedIn (personal communication, July 12; personal communication, July 28, 2016). For Fiona Sautter, big data even has no sense in headhunting (personal communication, July 28, 2016). Joris Vivijs was also more sceptical because he considers big data as hype, but he still often uses data analytics in his daily business (personal communication, July 25, 2016).

There seems to be a difference in the tools used by headhunting firms and other recruitment offices. Indeed, Emilie de Terschueren already affirmed it during her interview: “What is sure is that there will be a big difference between the headhunters and the companies which recruit at a lower level” (personal communication, July 12, 2016). The headhunting offices are the only ones which looks at information about the labour market and the different industries they work in (Emilie de Terschueren, personal communication, July 12, 2016; Fiona Sautter, personal communication, July 27, 2016; Joris Vivijs, personal communication, July 25, 2016). They also rely more on word of mouth and on their own database to find the candidates (Fiona Sautter, personal communication, July 28, 2016; Joris Vivijs, personal communication, July 25, 2016; Marionne Barge; personal communication, July 12, 2016; X, personal communication, July 5, 2016). Finally, most of them do not use job boards and job search engines as they do not post any job ads (Fiona Sautter, personal communication, July 27, 2016; Marionne Barge, personal communication, July 12, 2016).

	Job description	Profile definition	Recruitment sources	Recruitment means	Recruitment campaign	Selection	Hiring decision
X		Search by ideal candidates	Job boards, job search engines, LinkedIn		LinkedIn	LinkedIn	
Russel Reynolds	Professional information tool	Search by ideal candidates	LinkedIn, ATS		LinkedIn, Facebook	ATS, LinkedIn, Facebook, Google	
iStaffit		Search by ideal candidates	LinkedIn		LinkedIn, Facebook	LinkedIn, Facebook, collaborative websites	
Planet Talent			Job boards, LinkedIn		LinkedIn, Facebook	LinkedIn, blogs, websites, Google	
Target recruitment	Professional information tool		Job boards, job search engines, LinkedIn ATS		Blog, LinkedIn, Facebook	ATS, LinkedIn, collaborative websites, Google	
Eric Salmon	Professional information tool		LinkedIn		LinkedIn	ATS, LinkedIn, Google	
Y			Job boards, job search engines, LinkedIn, ATS		LinkedIn, Facebook, Twitter	ATS, LinkedIn, blogs, websites, collaborative websites	
Compus search			Job boards, LinkedIn, ATS, Talentme		LinkedIn	ATS, LinkedIn, blogs, websites, Google	

Figure 5: summary table of the tools effectively used by the interviewed recruitment offices

4.3 Changes in the recruitment processes due to these new tools

In this part of the results, I only consider the new recruitment tools which are used by Belgian recruitment offices in order to analyse the changes they induce in the classic recruitment process. I performed this analysis based on both the literature review and the interviews I had with the recruitment offices.

The only change that occurred in the job description is the better definition of the labour market, the different industries and their technologies, which is possible thanks to the additional information available for the recruitment offices (Emilie de Terschueren, personal communication, July 12, 2016; Fiona Sautter, personal communication, July 27; 2016 Joris Vivijs, personal communication, July 25, 2016). This additional information can help to write the job description in consideration of the right context.

The profile definition step is more influenced by data analytics. First of all, the automated profile definition of the “search by ideal candidates” tool should lead to a decrease in subjectivity. Nevertheless, a human error can still occur at the selection of the input profiles which is as subjective as before. Furthermore, there is also a possibility that the ideal profiles which are selected as inputs are not complete enough to identify important soft skills or knowledge, which are necessary, but seen as implicit by the employees. The system might not be able to detect missing information and the recruiter who has to confirm the profile built by the algorithm either. As far as the practice is concerned, one of the recruiters I interviewed was quite sceptical about the efficiency of this tool (X, personal communication, July 5, 2016) while another one was fully convinced by its added value (Pierre Mureau, personal communication, July 12, 2016). It is difficult to have a clear idea of the real contribution of the “search by ideal candidates” tool to profile definition as the main information about it comes from a paper written by people working at LinkedIn Corporation.

The recruitment sources are probably one of the two steps of the recruitment process which were the most influenced by the new tools using big data. Job boards are no more the predilection tool of the recruitment offices and I would even say that there exists the possibility of a substitution of the payable job boards for professional social network sites such as LinkedIn, which are either free or far cheaper. Indeed, within the companies that I interviewed, only four are still using payable job boards, that is Monster, Stepstone, Jobat but also more specialized ones such as Dice, theITjobboard or Onlyengineerjobs (Joris Vivijs, personal communication, July 25, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016). Pierre Mureau from iStaffit, on his side, totally changed his strategy in 2014 in order to exclusively work with LinkedIn and avoid the costs of the job boards paid before (personal communication, July 12, 2016). According to Joris Vivijs, the importance of the job boards is decreasing and he personally still posts job ads on a lot of them in order to have exposure of his brand (personal communication, July 25, 2016). I do not have enough information to know if iStaffit took an isolate decision or if several recruitment offices took the same one but it could be interesting to deepen this research. The utilization of LinkedIn has several advantages, for example it allows Pierre Mureau to reach passive candidates and

this way he increased his database of resumes from 10 000 resumes in 2012 to about 2.6 million of resumes in Belgium in 2016 (personal communication, July 12, 2016). Then, this information source enables the recruiters to find actualized profiles of the candidates, which is not the case in their own database (Fiona Sautter, personal communication, July 28, 2016; Pierre Mureau, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Y, personal communication, August 2, 2016). Next, as said in the preceding section (4.2), the number of referrals increased with the advent of social media in recruitment. A hiring program also seems to be utilized by a lot of recruitment offices, even the small ones. This automates their posts of job ads and removes them as soon as someone is hired (Yvan Chevalier, personal communication, July 11, 2016), but it also brings more transparency in the recruitment process as all actions are registered with their responsible recruiter (Marionne Barge, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016). Nevertheless, these hiring programs do not necessarily facilitate search of resumes through social media as at least some of them cannot access the databases of social network sites such as LinkedIn or Viadeo (Yvan Chevalier, personal communication, July 11, 2016).

Recruitment means utilized by the recruitment offices in Belgium have not changed fundamentally with the new recruitment tools. We can think that online games and contests will potentially be more current in Belgium in the next years as one of the interviewed recruitment offices already think about it for the future assuming a particular client would ask them to hire a lot of persons with similar profiles (Pierre Mureau, personal communication, July 12, 2016). Nevertheless, Joris Vivijs does not seem to agree with it as he thinks gamification would be better suited for corporate companies than for recruitment agencies (personal communication, July 25, 2016).

Recruitment campaigns changed seriously with the apparition of social network sites and blogs. According to Joris Vivijs, technology mainly changed the way to interact with people as it induces a potential multilateral communication between the candidates and the companies (personal communication, July 25, 2016). It is now less costly than before as companies do not have to pay for everything, for example a fan page on Facebook, or a

company page on LinkedIn or Twitter, are all free. Blogs are also a small cost as they might be hosted freely and they only need, like the company pages, someone to manage them. As I wrote in the preceding section, 5 out of the 8 interviewed companies have a Facebook page while all the companies have a LinkedIn page. The LinkedIn page could be used in both a professional way, in order to post job ads, brand these jobs, post articles written by the consultants, or in a funnier way to attract visitors (Fiona Sautter, personal communication, July 27, 2016; Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016; Y, personal communication, August 2, 2016). On its side, the specific profile created for the company X leads to more spontaneous applications (X, personal communication, July 5, 2016). Facebook does not aim at a professional utilization and that is why Target recruitment and Planet Talent use it in a funnier way in order to get brand exposure (Joris Vivijs ,personal communication, July 25, 2016; Tatyana Skoraya, personal communication, July 13, 2016). Y still uses it in a more professional way but sometimes adds funnier content (personal communication, August 2, 2016). According to Pierre Mureau, the most interesting tool to keep contact with the candidates pool on LinkedIn is the possibility of creating groups of candidates with particular profiles in order to post then interesting content in this group. It allows the recruiters to target specific communities (personal communication, July 12, 2016). Fiona Sautter also mentioned this possibility in order to ask questions to particular groups of people (personal communication, July 27, 2016). This is a way to keep interest about the company and increase interaction with the candidates. It is also a good means to broaden the candidates network as other specialists could be interested in the ongoing debates (Pierre Mureau, personal communication, July 12, 2016). Twitter mainly provides the recruitment offices with brand awareness (Fiona Sautter, personal communication, July 27, 2016; Joris Vivijs, personal communication, July 25, 2016; Pierre Mureau, personal communication, July 12, 2016; Y, personal communication, August 2, 2016). As far as blogs are concerned, Target recruitment is the only company which has one. This blog allows the company to keep contact with the candidates and managers in posting content linked to recruitment. The aim is to attract people to the website of the company in order to make them work with Target Recruitment (Joris Vivijs, personal communication, July 25, 2016).

Selection is the second step which was highly impacted by the new recruitment tools. It changed in different ways with the apparition of social network sites and automated pre-screening tools. The automated pre-screening proposed by LinkedIn recruiter or some human resources software leads to a more objective selection of the interesting resumes. Nevertheless, this automated pre-screening could lead to rejection of good candidates if it is only based on keywords and not on concepts, a safer method which is used by Faliagka et al. (2014). Indeed, the algorithm should consider that everyone would not utilize the same words to describe his/her function. Nevertheless, this "concept based" analysis does not seem to be implemented in all ATS as Beetween, for example, does not have a highly qualitative tool for semantic analysis of the resumes (Yvan Chevalier, personal communication, July 11, 2016). Some ATS include this functionality as does Joris Vivijs' one. Indeed, according to him, the ATS will look for a given word but will also consider ten to twenty synonyms when searching for resumes. An independent tool, Textkernel, which is a semantic search operator, could also be added to the ATS which do not include this advanced functionality (personal communication, July 25, 2016). Pierre Mureau confirmed me that false rejection of a LinkedIn profile could also arise in the case where a certain important term has not enough occurrences. He took the example of a recruiter who is in a hurry and looks for a SyncCharts specialist. When the different pre-screened profiles are given by LinkedIn, Pierre Mureau goes on each profile and does a simple ctrl F to see how many times the person repeats "SyncCharts". If the term does not appear several times, he does not even consider the candidate as a potential one in case he has no time to read the whole resume. In that event, a SyncCharts specialist could not be selected only because he does not sell himself well enough, which could be amplified if the candidates have different origins. Indeed, according to Pierre Mureau, an English SyncCharts specialist would write the word "SyncCharts" seventy times on his online resume on LinkedIn while a Belgian specialist with the same experience would write it only one to two times (Pierre Mureau, personal communication, July 12, 2016). *This demonstrates that discrimination can clearly occur based on the choice of the words the candidates do, which validates hypothesis 8, the use of social media in selection leads to new forms of discrimination.*

Secondly, the selection phase was influenced by the rise of the quantity and the variety of information about the candidates which is available even before the first interview. LinkedIn

is used by all the recruiters I interviewed in different measures (Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016; Pierre Mureau, personal communication, July 12, 2016; Stef Van Nieuwkerke, personal communication, August 8, 2016; Tatyana Skoraya, personal communication, July 13, 2016 ; X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016) but still five of them told me they would not look at Facebook profiles (Fiona Sautter, personal communication, July 27, 2016; Joris Vivijs, personal communication, July 25, 2016; Stef Van Nieuwkerke personal communication, August 8, 2016; X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016). X and Y consider Facebook as a private part of the candidate life and would not check it because of deontology (personal communication, July 5, 2016; personal communication, August 2, 2016) while Fiona Sautter told me the media is useless (personal communication, July 27, 2016). Joris Vivijs and Stef van Nieuwkerke, as for them, would clearly look at the Facebook profiles of the candidates in case they would recruit for their own offices (personal communication, July 25, 2016; personal communication, August 8, 2016). A third social network site which is an important source of information is Twitter. The tweets of the candidates allow recruiters to see information about their religion or political view as these are subjects which are often addressed on Twitter (Brady, 2012; Park, 2013; Wills & Fecteau, 2016). This online information is examined by recruiters in order to decide who to select for the job as it was confirmed by Marionne Barge (personal communication, July 12, 2016) who checks Facebook profiles to see if there is no compromising information about the candidate. One of the interviewed recruiters also admits that, even if he/she would not consider political or religious inclinations when hiring for his/her clients, he/she would do for hiring someone for his/her own recruitment office. *This reaction clearly shows that social network sites facilitate discrimination against some ideas which are not necessarily apparent during interviews or through a simple resume, which again validates hypothesis 8.* Moreover, most of the interviewed companies do not have any formal policy as far as the use of social network sites is concerned (Fiona Sautter, personal communication, July 27, 2016; Joris Vivijs, personal communication, July 25, 2016; Pierre Mureau, personal communication, July 12, 2016; Tatyana Skoraya, personal communication, July 13, 2016; Y, personal communication, August 2, 2016). According to Marionne Barge, they have to check all online information which is available at Russel Reynolds but she did not mention any particular way of doing it

(personal communication, July 12, 2016). Compusearch has a formal policy as far as the profiles of its recruiters are concerned, they should mention the company and keep elaborated profiles, but nothing is said about how to screen the candidates (Stef Van Nieuwkerke, personal communication, August 8, 2016). This lack of formal policy means no particular measures are taken by the recruitment offices in order to avoid discrimination. Then, connections are also put forward in a more explicit way than it was before the use of social network sites. Some of the interviewees told me they would consider both the number of relations someone has but also the kind of relations: only having horizontal connections on LinkedIn would seem suspicious, some managers should also be part of the network of the candidate (Marionne Barge, personal communication, July 12, 2016; Pierre Mureau, personal communication, July 12, 2016; Tatyana Skoraya, personal communication, July 13, 2016). Joris Vivijs and Y are the only recruiters for whom connections would have no impact on the hiring decisions (personal communication, July 25, 2016; personal communication, August 2, 2016). Joris Vivijs would simply look at these to find new interesting profiles and be easily introduced to them (personal communication, July 25, 2016). *This shows that connections are part of the information which is considered by the recruiters but they are also a useful means for these recruiters to find new candidates. It means connections have several impacts on recruitment which validates hypothesis 10 again.* According to Jeske and Shultz (2016), social media profiles do not make it possible to evaluate correctly interpersonal skills of the candidates as all dimensions of relationship are not captured. This means that taking profile connections into consideration when making a decision about a candidate could not be justified.

As far as selection is concerned, some reactions were also opposite to what I read in the literature. For example, the fact that people do not have any online profile was stated as a potential cause of discrimination in the paper of Jeske and Shultz (2016). I received mitigated responses as it does not seem to be seen as problematic by most of the Belgian recruiters I interviewed (Fiona Sautter, personal communication, July 27, 2016; Marionne Barge, personal communication, July 12, 2016; Tatyana Skoraya, personal communication, July 13, 2016; X, personal communication, July 5, 2016; Y, personal communication, August 2, 2016) while it could be for others who mainly use LinkedIn to find candidates or those who hire IT profiles, as an online presence is then required (Joris Vivijs, personal communication, July 25,

2016; Stef Van Nieuwkerke, personal communication, August 8, 2016). For what concerns the candidates choice of keeping their profile private, the Belgian recruiters mainly find it more responsible (Joris Vivijs, personal communication, July 25, 2016; Marionne Barge, personal communication, July 12, 2016; Pierre Mureau, personal communication, July 12, 2016) or simply their own choice (Tatyana Skoraya, personal communication, July 13, 2016; X, personal communication, July 5, 2016) while it was stated it could be seen negatively in the literature (Hazelton & Terhorst, 2015).

The hiring decision is still made by recruiters because, as some of them said, in recruitment, the human and the relational aspects still prevail (Emilie de Terschueren, July 12, 2016; X, personal communication, July 5, 2016). Nevertheless, this decision is taken based on different kinds of information from before. Indeed, the screening of the candidates considers much more personal information than before due to the availability of it on social media. The set of potential candidates which is considered could also be different from what it would have been without the automatization of the pre-screening step.

Another change that could appear is that LinkedIn replaces the ATS of the companies on condition that their ATS does not have any Customer Relationship Management module. I learned with Pierre Mureau that LinkedIn recruiter professional allows the recruiter to deal with his/her resumes library as does an ATS. Moreover, it also enables him to follow the journey of the candidates in the recruitment process through creating the phases of the process and assigning the corresponding status to the candidates. The customer relationship management module of his human resources software is the only reason why Pierre Mureau has not abandoned it yet (personal communication, July 12, 2016).

Then, I realized that sometimes, recruitment offices would not consider the same information sources when hiring for their own office or for their clients. Joris Vivijs and Stef Van Nieuwkerke would look at the Facebook of candidates who could work in their own offices while they would not do so when hiring someone for a client (personal communication, July 25, 2016; personal communication, August 8, 2016). Another recruiter would look at the content of the Twitter post of the candidates as far as religion or politics

are concerned in order to hire someone for his/her own office while he/she does not as far as the clients are concerned.

4.4 Research validity

As far as external validity is concerned, I cannot safely generalize the results of my study. Indeed, in order to learn which new tools are already used in Belgium, I mostly selected and met recruiters who answered the survey in stating they were dealing with data analytics in their recruitment processes. This way, I could have overestimated the utilization of the new hiring tools in Belgium as I interviewed the more advanced offices. Nevertheless, the only interviewee who pretended not to use data analytics in the survey actually searches candidates on LinkedIn recruiter. This tempers the overestimation risk as numerous other offices could have answered negatively the survey while they use some new tools in their daily business. Then, I realized during my research that classic recruitment offices and headhunting offices do not seem to employ the same tools, this should be checked before generalizing the results to all kinds of recruitment offices. Next, these results are also specific for Belgium and could not be extended to other countries as they could have different advancement in this field. Nonetheless, according to the survey led by Althéa et al. (2016) France seems close to Belgium as far as big data is concerned and other neighbouring countries could be too.

According to me, the offices which received the survey were a representative sample of the Belgian recruitment offices, only the interim offices could have been a bit underrepresented as stated above (section 4.1). Nevertheless, as nearly as many headhunting companies answered the survey (15) than the number of interim agencies which did (16) I think my answer sample is not totally representative of the Belgian market. Indeed, if I suppose a similar company mean size, there should be more interim management offices in Belgium than headhunting companies because the profiles researched by headhunters are less common. Self-selection of the recruiters who answered the survey could have played a role here: there are probably more recruiters who did not speak English or never heard about data analytics in interim offices than in headhunting companies, which hire more international profiles.

When we look at internal validity of the study, we can see I made a selection bias to decide which companies I would interview. Then, I asked both neutral and oriented questions to get the interviewee's opinion about some statements given by other recruiters. I think this gave me more settled answers than if I had not done it this way, but it also allowed me to receive better argumentation of their views. Next, all the interviews were not led in the same way. I sometimes went to the offices of the company but I also did some interviews by Skype or by phone. I think recruiters could have felt more confident when I went to their offices as some of those who did it by Skype were not used to it according to what they said. They could have been more reluctant to entrust me more sensitive information such as potential discrimination based on unusual criteria. The resulting internal validity of my study is so moderate but it nevertheless seems to be unavoidable when a research is led on the field and only a small part of the noise could have been reduced.

As far as the construct validity of my research is concerned, the survey I sent to offices might not have fully measured what it aimed to measure. The design of the survey was not optimal to check if the respondents answered correctly. Indeed, when I sent the survey to companies, some people diffused it to several of their colleagues. When this happened, I often received different answers from different persons working in the same office. In fact, I think that some people do not realize that they are using data analytics because they do not see the algorithms which are just part of the programs they manipulate. It could be the case when people use recruitment programs, or even "LinkedIn recruiter", where resumes are pre-screened. I can suppose that recruiters do not always have the required expertise to understand these hiring tools, what I did not conceived before launching the survey. Now that I know it, I realize that I could have let access to all questions, even if people claimed they were not using data analytics, in order to observe if this statement was right or not.

Then, I sent the survey at the beginning of my reflection on the subject and I decided to keep it short in the hope of receiving more answers. It could be interesting, starting from the overview given by this research, to dress a more complete survey containing all the different tools discussed in the literature review and asking in depth questions about their use. This approach was difficult to adopt without having first some qualitative and in-depth interviews to highlight the potential utilization of these tools and the changes they induced.

5. Conclusions

The aim of this research was to determine how the new hiring tools linked to big data are used by recruitment professionals in Belgium, but also how they are integrated in the classic recruitment process and how they influence the different steps of the process. It also gives an overview of the opportunities brought by existing tools which are not currently employed. The recruitment professionals I took into account were generalist, specialized or interim recruitment offices, but also headhunting companies.

We saw in this study that recruiters are not always aware they employ data analytics in their processes, while they could also fail to recognize some websites as sources of big data. Indeed, most of the recruiters who answered the survey claimed they did not use big data in their daily business but they all do so, at least when looking for candidates on LinkedIn. Then, several new tools are now part of the recruitment process, namely professional information websites, LinkedIn, Facebook, blogs, websites but also applicant tracking systems and their automated pre-screening functionality.

I observed in this research that there are potential problematic changes which arise with the utilization of these new tools when their functioning is not well understood by the recruiters. Indeed, looking for additional information on blogs or social network sites leads to see sensitive information about the candidates. Moreover, the semantic and Boolean searches which are possible on LinkedIn or in the databases need that the recruiters fully understand how these searches operate. Trainings should be proposed to all recruiters who deal with these different tools in order to be sure they make no mistakes which could lead to unintentional discrimination or misperceptions of the candidates. Next, a formal policy could also be written in order to frame the use of these social network sites by recruiters. Companies which recruit people, when using the “search by ideal candidates” tool to build an ideal profile, should also make sure their employees completely develop their LinkedIn profiles as these could be the basis to find candidates with the required soft and hard skills.

Some additional observations were highlighted thanks to the interviews. First of all, I observed differences in the utilization of the new hiring tools between headhunting firms

and classic recruitment offices. Indeed, headhunting companies are the only ones which care about market information and they rely more significantly on their own database and network. It would be interesting to do an in depth study of the recruitment processes of the Belgian recruitment offices in separating headhunting companies from the others in order to see if clear trends appear or if these observations were only a coincidence.

Secondly, it also appeared that recruiters would not consider the same kind of information when recruiting for themselves or for their clients. The risk of discrimination seems to be higher when they hire for their own office as they would consider more sensitive information than usually. This could lead to think that, provided it is the same for other companies, recruiting through a specialized agency would enable the companies to decrease discrimination in their recruitment process. Further research about the dissimilarities of the recruitment processes of agencies when hiring for themselves or for their clients would be useful to detect how the process is impacted when these agencies are directly affected by the results of their research.

Besides, some potential changes were also highlighted during the interviews. Indeed, the impact of LinkedIn on other tools seems to be varied: job boards importance would decrease due to social media and LinkedIn recruiter could replace the ATS in a near future as it encompasses its functionalities. It could be interesting to study what influences LinkedIn has on other tools employed by recruitment offices in Belgium.

This research suggests that recruitment offices should increase awareness of their recruiters about the possibilities brought by data analytics and big data in their field. A few tools are currently utilized by the Belgian market and it could be interesting to see how recruiters will adapt to deal with the increasing potential of data analytics in their field.

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