


e-HRM in a Cloud Environment Implementation and its Adoption: A Literature Review

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ABSTRACT

As the digitization of HR processes in companies continues to increase, at the same time, the underlying technical basis is also developing at a rapid pace. Electronic human resources (e-HRM) solutions are used to map a variety of HR processes. However, the introduction of such systems has various consequences, which are not only technical but also imply organizational and functional changes within the organization. Additionally, the cloud environment contributes to enhancing e-HRM capabilities and introduces new factors in its adoption. A systematic review of the available literature on the different dimensions of electronic resources management was conducted to assess the current state of research in this field. This review includes topics such as the evolution of e-HRM, its practical application, use of technology, implementation as well as HR analytics. By identifying and reviewing articles under e-HRM, IT technology, and HR journals, it was possible to identify relevant controversial themes and gaps as well as limitations.

KEYWORDS

Cloud Computing, Digital HRTransformation, e-HRM, HR KPI, HRCloud, HRIS, Technology adoption

1. INTRODUCTION AND OBJECTIVES

The subject of this systematic literature review is the digital transformation of human resources (HR) processes into new cloud-based environments. Armstrong (2014) defines human resource management (HRM) as the comprehensive approach to the recruitment, development, and management of individuals based on a variety of philosophies and theories, with a critical aspect of HRM being on and contribution to the efficiency of an organization. The operationalization of HRM takes place through HR processes (Browne, 2000) that reflect the range of procedures from “hire to retire” (Dessler, 2013). The digital transformation of HRM processes using electronic HRM solutions (Bondarouk and Ruël, 2009), is increasing rapidly (Harris and Spencer 2018). Electronic HRM (e-HRM) is defined as the use of information technology to network and support at least two individual or several actors in the execution of HR activities (Strohmeier, 2007). Its role, as well as capabilities, have evolved steadily over the last 60 years, from the simple provisioning of information (DeSanctis, 1986) to process automation (Martinsons, 1997) to the transformation of HR (Lengnick-Hall and Moritz,

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2003). The impact of e-HRM adoption goes hand in hand with the expectation of positive effects such as cost reduction, process quality improvement and also the repositioning of HR as a more strategic partner (Lengnick-Hall and Moritz, 2003). The technological evolution of e-HRM systems has not only improved process digitization (McFarlane, 1984; Lin and Chen, 2012) and thus influenced the way HR departments work (Snell, 1995; Stone and Dulebohn 2013), it has also raised new questions with regard to data security of personal data (Zafar, 2013; Lehnert and Dopfer-Hirth, 2016) or other legal concerns (Wong and Thite, 2009; Zafar, 2013). One of the newest trends is cloud-based e-HRM solutions (from now on HR Cloud). Cloud computing is “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” (Mell and Grance, 2011). This new technology offers the possibility of comprehensive digitization of all HR processes within one single system, resulting in new ways of process integration as well as improved analytic capabilities for the HR department while at the same time reducing the implementation and maintenance efforts for the IT department (Harris and Spencer, 2018; Ziebell et al., 2018). One question that arises with this new technology and the resulting process mapping is whether a new project management methodology (PMM) (Wagner 2011) approach should also be chosen during the digital transformation and how to measure project success (Ziebell et al., 2018).

Although e-HRM is a comparatively young field of research (Strohmeier, 2007; Johnson et al., 2016), there have been a few articles since 2006 representing comprehensive literature research. Ngai and Wat (2006) focus on the perceived benefits as well as barriers to implementation and conclude that a large part of the study is based on conceptual studies. Strohmeier (2007) examines the literature and finds that the research field of e-HRM is vastly and that the research methodology is empirical rather than theoretical. Bondarouk and Ruël (2009) focus on the e-HRM definition and show how future research will be. This review includes consideration of the multidisciplinary approach, as both HRM and IT are affected, as well as the repeated indication that theory-building research has been neglected so far. Strohmeier (2009) reviews the literature regarding the consequences of e-HRM and concludes that more in-depth research into that topic is needed. Marler and Fisher (2013) examine the relationship between e-HRM and strategic HRM and suggest more empirical research. Another approach is that of Geffen, who examine e-HRM literature in the context of multinational companies and conclude that the majority of research covers post-implementation questions such as e-HRM outcome and adoption. Also, they call for research in the e-HRM field to be oriented towards “larger” disciplines such as research in the IT area. Ruël and Bondarouk (2014) address in their review that although the number of researchers covering the e-HRM field increases, there is still a lack of theoretical background. Johnson et al. (2016) review the evolution of academic research as well as the practical application of e-HRM. They conclude that although research is progressing in the e-HRM field, the “interesting” questions such as how to effectively deploy e-HRM in an organization are not covered fully yet. They urge researches from both distinct disciplines, HR and IT, to work together to answer these questions. Wirtky et al. (2016) examine the literature regarding the question of what effect the digital HRM transformation should theoretically have; what impact it currently has and conclude that even more potential could be tapped. The latest review is conducted by Bondarouk et al. (2017b) who call for more research into adoption, which according to their findings depends less on generic than on human factors, and in the field of the consequences of e-HRM. Also, like some of the previous literature research, they demand more theory before new empirical research can take place and consider a multi-level analysis approach by starting to analyze the factors influencing adoption and effectiveness of e-HRM on the individual level up to the whole organization.

This literature review aims to give an overview of the evolution and definition of e-HRM in general and of the HR processes digitized in it. Furthermore, the implementation of e-HRM, as well as the accompanying barriers and resulting benefits, are researched, with an emphasis on the adoption of these solutions. The literature on the associated legal and security issues is additionally revised.

Finally, the topic of HR analytics which is enabled by new e-HRM technologies and impacts HR work significantly (van den Heuvel and Bondarouk, 2017) is analyzed. The review concludes with the identification of research gaps within these diverse e-HRM topics with the aim to provide an impulse for further research. The objective of this review is to shed light on other aspects of e-HRM in addition to the area of evolution and adoption which are already extensively covered in other literature researches. These new aspects include digitized multi-functional HR processes, legal and IT security aspects as well as HR analytics. This systematic literature research is the first to comprehensively examine issues of the digitization of HR processes in cloud-based e-HRM solutions as well as the resulting legal implications and new requirements for IT security.

2. RESEARCH METHODOLOGY

“A systematic literature review is a means of evaluating and interpreting all available research relevant to a particular research question, topic area, or phenomenon of interest. Systematic reviews aim to present a fair evaluation of a research topic by using a trustworthy, rigorous, and auditable methodology” (Kitchenham and Charters, 2007). Hart (1999) adds to that definition, maintaining that a systematic literature search provides an overview of what is already available in a specific field of interest, states what is currently being researched and identifies research gaps, which are then contrasted by own findings. Kitchenham and Charters (2007) divide the process of systematic literature research into three phases: planning, conducting and reporting the review, whereby the first two phases are iterative.

We could resume the research questions behind the literature review in the following:

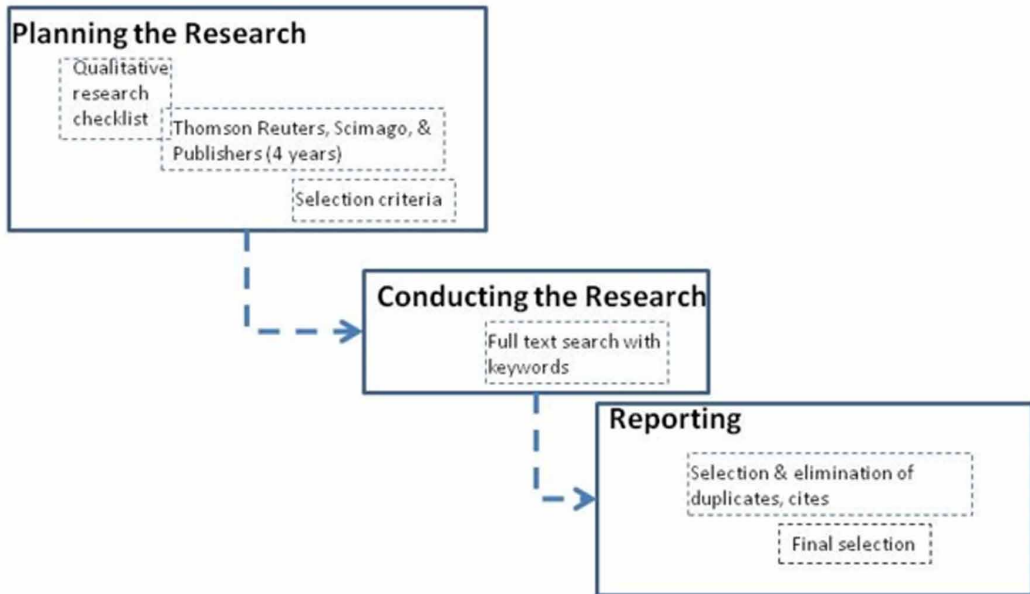
- How could e-HRM be defined? Which has been its evolution?
- Which HRM processes have been predominantly digitized?
- How may e-HRM be implemented? Are there any adoption patterns? Which are the barriers and facilitators?
- What is the impact of e-HRM?
- What are the legal, regulations and security barriers?
- Which are the main e-HRM metrics?
- Which are the main characteristics of e-HRM in a cloud environment?

Figure 1 depicts the flow diagram followed to select the final papers.

2.1. Planning the Review

The qualitative research checklist (Critical Appraisal Skills Program, 2013) was chosen as the basis for the selection of qualitatively relevant literature. Among other things, this checklist questions whether the studies indicate the research objectives, whether the right research methodology is chosen, whether the data collection fits the research question and whether the research itself is a valuable contribution to the scientific community. The focus is set on primary and secondary studies in reputable, peer-reviewed, journals to meet these requirements, as it is assumed that the peer review ensures compliance with the quality criteria listed above and thus also secures the reputation of the journal through its positioning within the scientific rankings such as the Thomson Reuters JCR 5-year impact factor and the Scimago Journal & Country Rank. The aim of narrowing the range of publications under review to ensure their internal as well as external validity. Also, prominent publishers (Emerald insight, Elsevier, IEEE explore and Taylor & Francis), which include the publication from the different e-HRM dimensions, were also used for literature research. Conference proceedings, as well as books, were included. Literature was accessed via the Web of Science and Google Scholar.

Figure 1. Literature selection flow diagram (authors)



The timeframe used for the search interval differed according to the specific topic. Articles published over 40 years ago were used, e.g. Tetz (1974) to provide a comprehensive picture of the historical development of e-HRM and its predecessors, with the increasing practical adoption of e-HRM from the late 1990s onward (Stanton and Coovert, 2004; Strohmeier, 2007; Johnson et al., 2016; Bondarouk et al., 2017b), during this time period research in this field increases as well resulting in more articles published. Newer topics, such as the use of cloud computing in the e-HRM context, are relatively new research areas and therefore there are no publications that date back more than five years. In general, however, articles published between 1974 and 2018 were considered.

During the literature review, a review protocol was created, which contained the search queries, the sources as well as the inclusion and exclusion criteria. For example, articles relating exclusively to HR management without reference to a digitalized environment were excluded from the study.

2.2. Conducting the Review

Following the defined strategy in the planning phase, several search criteria were established. A full text search was carried out with the help of search terms that not only contained general terms such as e-HRM, Human Resources Information System, HR Cloud, and HR Transformation, but also more extensive and combined search keywords such as talent management, recruiting, E-Learning, HR Process Transformation, (e-HRM) IT adoption or unique aspects such as legal implications and IT security. The latter, to avoid a too selective approach (Rodgers and Hunter, 1994), narrowing down the search and the results too much. The definition of the search terms was developed in the course of multiple discussions by e-HRM experts.

Table 1 gives an overview of the general search terms used in the systematic review. These terms were combined both alone and in combination with the general search terms. For each of the individual subject areas (e.g., adoption, legal) search terms were defined and concatenated with the general search terms.

Table 1. Search terms

General terms	Evolution /definition e-HRM	Digital HR processes	Talent Management	Implementation methodology	Adoption of e-HRM	Impact / Success & Barriers of e-HRM	HR analytics	Safety & security of e HRM	e-HRM in cloud
Digital HRM	Definition e-HRM	Digital HR processes	Competence assessment & e-HRM	Implementation of IT in HRM	Successful Adoption of HRIS	Effectiveness of e HRM	Business analytics	HRM & Security compliance	HRM & cloud computing
e-HR	Evolution e-HR	Digital e-HR processes	Talent management & IT	HRM Implementations	Factors influencing HRIS adoption	Efficiency of HRM	Domain driven data mining	HR & Security HR & Safety	e-HR & cloud computing
e-HRM	Evolution e-HR	Digital HRM processes	Talent management & KM	e-HRM challenges	e-HRM services	e-HR outcomes	Key performance indicators	HR & Security compliance	HRIS & Cloud computing
HRIS	IT & HRM	Digital e-HR processes	Competence management & IT	HRM practices	eHRM innovation	e-HRM outcomes	Multicriteria business analytics	HR & Security	Cloud computing & Management
HRIT	HRM Innovation	Digital e-HRM Processes	Strategic Talent management	HRM project management	HRM & technology	e-HRM & performance	Personnel analytics	Cloud & safety	
Human resource information system	HRM & IT		Succession management	HR implementation		HRIS impact	Talent metrics	e-HRM & ethical issues	
Virtual HR				IT Project management		e-HRM & HRM effectiveness	Workforce analytics		
Virtual HRMJ				e-HRM conflict			Strategic HRM Measurement		
HR Cloud				HR & SaaS			HRM metrics		

The systematic approach, which uses search terms and defined quality requirements to make limitations in advance, can lead to relevant literature being left out (Boell and Cecez-Kecmanovic 2015), but it still guarantees the replicability and quantification of research (Webster and Watson 2002; Torracco 2005).

2.3. Reporting the Review

The procedure for reporting the results was that the general search terms were used first and the duplicates (e.g., if the article is listed several times with different keywords) were removed from the results. Then categories were formed based on which the specific search terms (e.g., HR Analytics) were derived. The procedure was then repeated. The articles that did not fit into the e-HRM topic area were later removed.

The following table summarises the results of the systematic literature review.

A total of 365 unique documents were found to be relevant. These were categorized according to the following criteria:

- **e-HRM in general:** these are articles that deal with the evolution and definition of e-HRM as well as the HR processes that are currently digitized.
- **Implementation and outcomes** research that deals with the application of e-HRM, how technology is adopted as well as its impact are reviewed here. A particular focus is put on the project management methodology to conduct the implementation as well as legal and security issues arising from it. The review concludes with a closer look at HR analytics and the impact of technology in e-HRM.

Table 2. Overview of the review scope

Area of research		# of papers
e-HRM in general	Evolution and definition	60
	Digital HR processes	46
Implementation and outcomes	Implementation and project management methodology	60
	Adoption, barriers and impact	121
	Legal and security issues	33
	HR Analytics	60
	e-HRM in a cloud-based environment	19
Total unique documents reviewed		365

During classification, an article can also be assigned to several subject areas, since different topics have been addressed. Not all the items found during the review are referenced in the results section below since the same issue was dealt with in several articles but treated qualitatively differently. In these cases, the choice was in favor of the more cited items, but the references were retained.

3. RESULTS

In the following paragraphs, the results of the literature search, divided according to the individual e-HRM dimensions, are presented. The general e-HRM topics, their implementation as well as the outcomes are reviewed.

3.1. e-HRM in General

In the following paragraphs, the results of the literature research on the evolution and the definition of e-HRM are presented.

3.1.1. Evolution and Formal Definition of e-HRM

It is argued that e-HRM began with the advent of the first computers in 1940 (Tetz, 1974; McFarlane, 1984; DeSanctis, 1986; Raiden et al., 2001) and has evolved over several decades from information provisioning, to transaction automation (Mathys and LaVan 1982; Lederer 1984; Magnus and Grossman 1985; Weigert et al., 2017), to become the enabler of HR transformation (Kavanagh et al., 1990; Lengnick-Hall and Moritz, 2003; Manuti and de Palma, 2018; Petry, 2018); as a result, it has become increasingly important to implement corporate strategy (Pyburn, 1983; Marler and Parry, 2016) and since 1995 a subject in academic literature (Strohmeier, 2007). Lengnick-Hall and Moritz (2003) divide the evolution of e-HRM into the phases of information publication, process automation, and organizational transformation. Several articles reference the historical development of digitalizing HR processes as part of the literature review (DeSanctis, 1986; Lengnick-Hall and Moritz, 2003; Maatman, 2006; Ruël and Bondarouk, 2014; Fındıklı and Bayarçelik, 2015; Johnson et al., 2016; Wirtky et al., 2016), but so far none has been found that exclusively covers that topic. Current application and technological trends of e-HRM are reviewed continuously in the yearly Sierra-Cedar 2017-2018 HR Systems Survey (Harris and Spencer 2018), which gives a comprehensive look at the possible adoption of e-HRM. More than 1300 companies of different sizes and from different sectors provide insight into how the digitization of HR is progressing. The new trend in e-HRM is cloud-based solutions (Johnson et al. 2016; Harris and Spencer 2018) which are not as widely researched in academia. The concept of the “Expert Cloud” for which an IT architecture is proposed, in which cost savings and efficiency improvements are identified is one of the few ideas that establishes a connection between cloud computing and HR (Navimipour, 2015; Jafari Navimipour et al., 2015a,

b). In this concept, however, the focus is less on mapping the entire HR process cluster (Ziebell et al., 2018) in a cloud environment and more on an isolated application case in HR. Zapotocny (2015) demonstrates the advantages of a cloud-based Software as a Services (SaaS) solution for e-HRM but focuses above all on the benefits of IT such as the new licensing model or the externalization of maintenance efforts.

Various names are used in the context of e-HRM, for example, HRIS (Human Resources Information Systems) (Kavanagh et al., 1990) or “virtual HR” (Lepak and Snell, 1998). Differentiation takes place according to the user of the HR system (Zafar, 2013); either the HR department or all the employees of a company. Additionally, operational, relational and transformational characteristics are subject to their respective definitions (Lepak and Snell, 1998). Strohmeier (2007) defines e-HRM as “the (planning, implementation and) application of information technology for both networking and supporting at least two individual or collective actors in their shared performing of HR activities.” Concerning the definition of the e-HRM term, Bondarouk and Ruël (2009) aptly state that this is an “umbrella term”, which includes the integration between HR and technology to increase the value of the organization for employees. The exact definition and unambiguous definition of the term e-HRM is not clear from the literature, and so Bondarouk and Ruël (2009) demand a standardized definition. One of the newer definitions is given by Marler and Parry (2016) which state that “e-HRM consists of configurations of computer hardware, software and electronic networking resources that enable intended or actual HRM activities (e.g., policies, practices, and services) through the coordination and control of individual and group-level data capture and information creation and communication within and across organizational boundaries.”

3.1.2. Digital HR Processes

In the context of the processes to be digitized, research focuses on several of them out of the HR process world (refer to Figure 2., adapted and translated by permission from Springer Vieweg, Cloud Computing - Die Infrastruktur der Digitalisierung, (Vom traditionellen Personalmanagement hin zu e-HRM in der Cloud. Implementierungsansätze einer digitalen Transformation) (Ziebell et al., 2018) @2018).

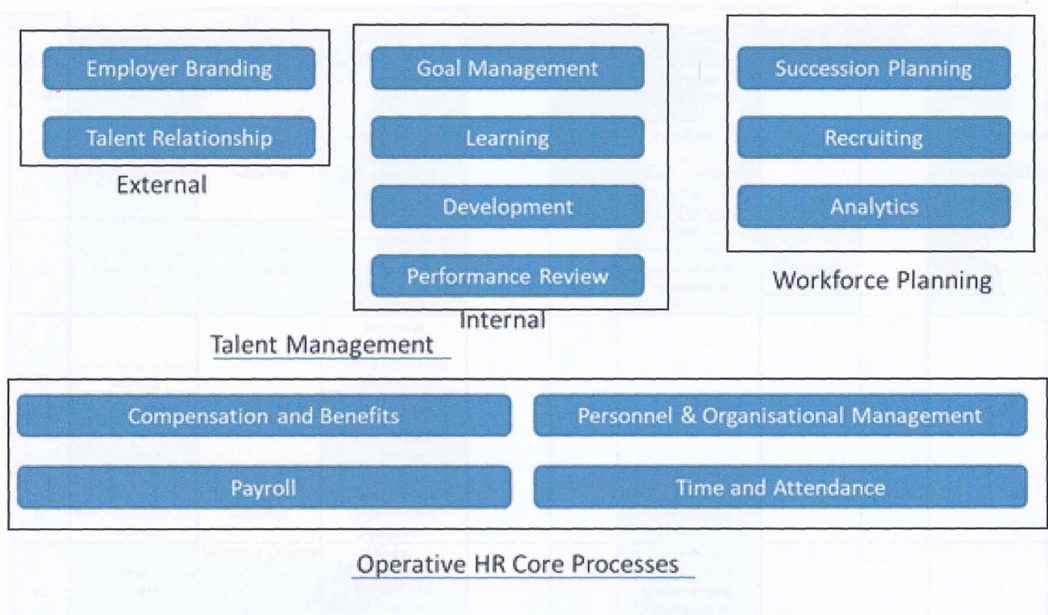
Generally, the processes that are digitized in e-HRM can be classified into two types, according to their usage: “unsophisticated” and “sophisticated,” whereby operative core processes are considered as being “unsophisticated” while talent management and workforce planning are classified as “sophisticated” (Nagendra and Deshpande 2014).

3.1.3. Talent Management & Workforce Planning

Research in the area of talent management and e-HRM is quite diverse ranging from articles about human capital management, including performance management (Herington et al., 2013; Nura and Osman, 2013; Tornack et al., 2014; Pilarski et al., 2016; Bohlouli et al., 2017) or the general value of e-HRM in the talent management context (Wiblen, 2016) to specific research about e-Learning (Nichols, 2003; Clark et al., 2003; Pocatilu et al., 2010; Stone et al., 2015; Fındıklı and Bayarçelik, 2015; Colchester et al., 2017) or employee relationship management (Strohmeier, 2013). Some particular issues in certain processes are addresses for example how e-Learning can be made more efficient (Nichols 2003; Clark et al., 2003) or if its digitization is expedient (Pocatilu et al., 2010). It has also been emphasized how Competency Management is unbalanced in e HRM applications (Echavarren, 2011).

Combining different disciplines such as business process management in the context of recruiting and researching its impact is also a variation in that research area (Laumer et al., 2014). Bohlouli et al. (2017), for example, suggest the use of mathematical models to evaluate competencies. Tornack et al. (2014) note that the topic of competence management is already well supported, but succession planning has so far been less digitized. In succession planning, Pilarski et al. (2016) point out that digitization can help both to promote and retain (Nura and Osman, 2013) internal talents better and

Figure 2. HR Process world (Ziebell et al., 2018)



to acquire external talent. Girard et al. (2013) examine the influence of new web technologies on recruitment practice and discover that the topics of employer branding and reputation management have been expanded. Wiblen (2016) draws attention to the extended analysis possibilities of e-HRM and the evidence-based decision-making possibilities in talent management based on it. At the same time, she questions why there have been few studies in the academic world on the role and influence of technology in talent management up to date. In the workforce planning cluster, recruitment is the dominant research topic (Pin et al., 2001; Furtmueller et al., 2011; Dhamija, 2012; Girard et al., 2013; Maier et al., 2013; Laumer et al., 2014), followed by several articles about analytics (see 3.2.4. HR analytics for a complete review) and succession planning (Brad Neary, 2002; Nagendra and Deshpande, 2014). These articles cover different aspects such as how the digitization of these processes contribute to the improvement of process quality and efficiency (Pilarski et al., 2016) or how digitization influenced a process change (Holm, 2014).

3.1.4. Administrative Core Processes

The research regarding the administrative core processes in e-HRM is somewhat limited, although the Sierra-Cedar Survey 2017-2018 (Harris and Spencer, 2018) states that the practical adoption rate of payroll solutions in companies is 98%. It is assumed that e-HRM solutions can deliver those background processes (Strohmeier, 2007), but the non-administrative application such as talent, workforce or strategic management (Grant and Newell, 2013) are focussed in recent research. Dulebohn and Marler (2005) note that companies use e-HRM typically to automate the payroll, design the compensation system and administrate the compensation and benefits. The added value of using a system is the increase in accuracy and reduction in errors regarding the payroll processes (American Payroll Institute, 2010). Using this data to get an overview of the pay structure is another benefit (Fay and Nardoni, 2009). Dery et al. (2013) research the problems that occur when implementing an e-HRM system focussing on the payroll function. Additionally, administrative core processes, due to

their standardized nature offer the chance to be outsourced completely to leverage costs efficiencies (Dickmann and Tyson, 2005).

From the cloud providers point of view, it has been pointed out that there is sufficient offer of malleable and efficient assets for the new technologies in the e-HRM field (Wright et al., 2012).

3.2. Implementation and Outcome

The following subsections deal with the implementation of e-HRM systems, its adoption, addressing the barriers as well as the general impact. Legal and security issues are then discussed. The chapter closes with a literature overview of HR analytics and the impact of cloud technology on e-HRM.

3.2.1. Implementation and Project Management Methodology

Not many studies deal alone with the application of e-HRM and those who do so deal with the lessons learned from these projects (Bondarouk, 2011; Heikkilä et al., 2014) as well as with the influencing factors (Banerji, 2013; Dery et al., 2013; Ngoc Duc et al., 2013; Heikkilä et al., 2014) rather than focus on each implementation step. Heikkilä et al. (2014) research the challenges when they introduce e-HRM in a multinational corporation and identify various barriers and challenges during the implementation process. They point out the unique role of the consultant and the possible micro-political problems (e.g., power struggles between departments) in implementation. Also, possible conflicts caused by a lack of IT knowledge or by the organizational balance of power are also addressed.

The following are also analysed: which strategic decisions generally influence the implementation of e-HRM (Schalk et al., 2013), to what extent an application is related to individual HR processes (Maier et al., 2013; Eckhardt et al., 2014) or how innovation can be enabled during the implementation process (Tansley et al., 2014). The few studies on the models deal with the question of the extent to which an implementation offers a competitive advantage (Beckers and Bsat, 2002) or how the added value and the consequences of e-HRM could be measured (Stone et al., 2006; Stone and Lukaszewski, 2009; Strohmeier, 2009). While Roberts (1999) tries to develop an approach to calculate the return on investment but finds that much of the value is intangible, Strohmeier (2006) even deals explicitly with the contradictory statements about the advantages realized.

Research on project management methodology (PMM) is broader, including articles about PMM evolution (Garel, 2013), classical (Neugebauer, 2004; Wagner, 2011) and agile (Boehm and Turner, 2004; Komus, 2013; Torrecilla-Salinas et al., 2016; Vlietland et al., 2016), mixed so-called hybrid approaches (Habermann, 2012; Špundak, 2014) or adoptions by companies (Schollerer, 2016). All these different approaches bring advantages or disadvantages depending on different decision factors (project type, project size, industry, etc.) and thus have a direct influence on project success (Cooke-Davies and Arzymanow, 2003; Wells, 2012; Komus, 2013; Joslin and Müller, 2015). The maturity of the PMM in the industry is evaluated (Cooke-Davies and Arzymanow, 2003) as well as how efficient specific approaches are (Schoeneberg, 2011; Wells, 2012; Joslin and Müller, 2015). Only a few articles directly connect e-HRM with a precise methodology (Schuessler, 2008; Wilson-Evered and Härtel, 2009; Mohapatra and Patnaik, 2011). Ziebell et al. (2016) conclude that a mix of different approaches, supported by strong change management, is the best way to meet the needs of HR Cloud transformations.

3.2.2. Adoption, Barriers, and Impact

3.2.2.2. Adoption

The adoption of IT, also in the context of e-HRM has been examined more widely. In principle, the factors influencing IT adoption are individual, external, organizational and technological while Bondarouk et al. (2017b) differentiate between technical, organizational and social factors affecting adoption.

The individual acceptance of technology, i.e., one's perception, motivation, and attitude, are examined in various studies (Rogers, 1995; Thong, 1999; Martinsons and Chong, 1999; Voermans and Veldhoven, 2007; Delorme and Arcand, 2010; Troshani et al., 2011). External factors such as regulations or competitive pressure within an industry, the country where the company is based, the culture as well as legal requirements have an influence on the adoption of IT (Olivas-Lujan et al., 2007; Sophonthummapharn, 2009; Panayotopoulou et al., 2010; Oliveira and Martins, 2010; Low et al., 2011; Masum et al., 2015), the latter factor being an under-researched subject (Choi, 2017). With regards to organizational determinants, company size, the skills, and attitude of the workforce, individual roles, individual positions, as well as management commitment must be mentioned (Hussain et al., 2007; Voermans and Veldhoven, 2007; Teo et al., 2007; Bondarouk et al., 2009; Strohmeier and Kabst, 2009; Troshani et al., 2011; Bellou, 2016). In the context of technology, the technological readiness of an organization, the quality of the e-HRM operation and the IT skills of the employees are discussed (Ruël et al., 2007; Voermans and Veldhoven, 2007; Oliveira and Martins, 2010; Low et al., 2011; Maier et al., 2013). Finally, an additional view of the e-HRM adoption factors affecting their effectiveness and applicant acceptance has been debated by Stone et al. (2013).

Different theoretical approaches to measuring the adoption of e-HRM are used. The Technology Acceptance Model (TAM) (Davis, 1986, 1989), which combines the perceived benefits of a system with its simplicity of use, is one of the approaches chosen (Maatman, 2006; Voermans and Veldhoven, 2007; Erdoğan and Esen, 2011; Nura and Osman, 2012; Yusliza and Ramayah, 2012). Yusliza and Ramayah (2012) use the TAM in their empirical study with 154 HR professionals and find that the attitude towards e-HRM correlates with the variables examined (e.g., the perceived use/contribution of e-HRM and the perceived ease of use of the system). Nevertheless, they point out that there are many more variables to be investigated and give recommendations for practical implementation and use. They also find that e-HRM is not suitable for every organization. Snicker (2013) applies the model the HR employee self-service at TAP Portugal airlines. A combination of the TAM approach with the Theory of Acceptance and Use of Technology (Venkatesh et al., 2016) is also used in e-HRM (Viridiananto et al., 2017). Other models such as the Technology Organisation Environment Framework (Tornatzky et al., 1990; Alam et al., 2016), the TOP Framework (Technology, Organisation and People) (Bondarouk et al., 2017a), or derived and combined models (Al-mobaideen et al., 2013; Chakraborty and Mansor, 2013; Masum et al., 2015) are also used to evaluate the adoption. Njoku (2018) combines TAM with several other theories to analyze the contribution that e-HRM makes to business performance. Another scientific approach: the "regression analysis" is used by Lin (2011), who finds that e-HRM depends both on IT adoption and on the adoption of a virtual organization, where the entities of an organization are detached but collaborate with the help of IT. He concludes those both have a positive influence on organizational innovation and derives recommendations for practical implementation.

Other studies focus on different aspects of the practical application and the influence of socio-cultural adoption. Thus, e-HRM application is differentiated according to countries (Ngai and Wat, 2006; Hooi, 2006; Panayotopoulou et al., 2007; Teo et al., 2007; Olivas-Lujan et al., 2007; Lau and Hooper, 2009; Troshani et al., 2011; Nura and Osman, 2013; Eckhardt et al., 2014; Masum et al., 2015; Alam et al., 2016; Bondarouk et al., 2016), company size (Hooi, 2006; Nagendra and Deshpande, 2014), the private (Ruël et al., 2004; Voermans and Veldhoven, 2007; Olivas-Lujan et al., 2007; Kumar and Lalitha, 2016) and the public sectors (Bondarouk et al., 2009; Troshani et al., 2011; Alam et al., 2016) but also according to business processes (Varma and Gopal, 2011; Eckhardt et al., 2014). A combination of the individual points to be investigated, such as the country, method, and sector or technology, is implicit. For example, Kumar and Lalitha (2016) examine the recruitment processes in the private banking sector in India while Johnson and Diman (2017) focus on the adoption of cloud technology in small and medium-size companies (SMEs).

3.2.2.3. *Barriers & Impact*

Studies on the impact of e-HRM, on the other hand, are common and can be divided into operative and strategic outcomes. Operative advantages include process automation to enable the efficiency of HR, cost savings due to headcount reduction as well as service improvement through the better quality and integrity of the provided information (Tansley et al., 2001; Lengnick-Hall and Moritz, 2003; Ruel et al., 2004). Enabling the employee and make them a part of the HR process is named as well (Kovach et al., 2002; Beckers and Bsat, 2002). Improved decision making from a broader and better database also offers as an advantage (Kovach and Cathcart, 1999; Raiden et al., 2001; Raidén and Neale, 2005). The practical realization of these advantages is confirmed in various case studies (Stone et al., 2013; Laumer et al., 2014; Thite, 2014; Fındıklı and Bayarçelik, 2015). Barriers mentioned include lack of funds or insufficient management commitment (Kovach and Cathcart, 1999; Bondarouk et al., 2009; Tomanna et al., 2018), initial project costs and maintenance (Beckers and Bsat, 2002), and lack of know-how in both HR and IT (Ngai and Wat, 2006; Kumar et al., 2013).

Chapman and Webster (2003), on the other hand, find that the use of technology has limited impact and success. In general, positive arguments such as possible efficiency gains and cost savings (Dhamija, 2012; Kumar and Lalitha, 2016) predominate, but disadvantages such as the exclusion of specific target groups, e.g., top management (Pin et al., 2001) through process digitization also named.

The improvement of the strategic orientation and strategic partnership (Lepak and Snell, 1998; Davis et al., 2000; Ruël et al., 2004) of the HR department is also mentioned frequently but research on how e-HRM can support this strategic transformation and its assessment, is more recent (Bondarouk and Ruël, 2013; Grant and Newell, 2013; Thite, 2014; Bellou, 2016; Marler and Parry, 2016). Marler and Parry (2016) research whether technology enables strategic HRM or whether IT is just another instrument for implementing the strategy. In their empirical study, they find evidence for both, but these vary depending on the context (e.g., the external environment), and they conclude that the influence of external stakeholders must also be considered.

3.2.3. *Legal and Security Challenges*

The processing of personal data, which is the routine day-to-day work in the HR environment, requires particularly secure handling. The data protection requirements are typically set by national legislators (One Hundred Seventh Congress of the United States of America, 2001; Pouillet, 2006; Public Law 107-347, 2007), who define a legal framework within which the e-HRM systems must be adapted (Strohmeier and Kabst, 2009). Hubbard et al. (1998) point out the ethical and legal implications in the context of e-HRM and conclude that the continually changing legislative and regulatory requirements demand that both HR and e-HRM managers are aware and deal with these requirements, as otherwise there is the possibility of legal action. Zafar (2013) discusses the basic needs for IT security in the e-HRM environment and how it can be improved. Lehnert and Dopfer-Hirth (2016) address the new requirements for e-HRM in the context of the late General Data Protection Regulation (GDPR) and above all how these are to be implemented technically. Other research focusses on the human factor in IT security in the e-HRM context (Eddy et al., 1999; Wong and Thite, 2009).

Some authors have analyzed, from a management perspective, which essential HRM procedures are required for improving the information safety performance from the perspective of IT professionals (Kumah, Yaokumah, & Buabeng-Andoh, 2018).

Other articles deal with data security and legal requirements based on the technology used, such as cloud-based environments (Chow et al., 2009; Kandukuri et al., 2009; Kaufman, 2009; Pearson and Benameur, 2010; Chonka et al., 2011; Subashini and Kavitha, 2011; Zissis and Lekkas, 2012; Lothar Determann, 2012; Chen and Zhao, 2012; Rong et al., 2013; Wei et al., 2014; Odun-Ayo et al., 2017), but do not specify, with single exceptions (Choi, 2017), a particular (e-HRM) business process.

3.2.4. *HR Analytics*

Assessing performance measurement cannot be conducted without defined metrics (Van Looy and Shafagatova, 2016) which Lawler et al. (2004) differentiate between “HR analytics” and “HR metrics”. HR metrics typically measure the outcomes of HRM that is to say: its efficiency, effectiveness or

the impact of certain actions. HR analytics represent a statistical and experimental approach that can also be used to show the results of HR activities. Nevertheless, there are vague definitions of terms in the literature that use the terms “metrics” and “analytics” interchangeably or combined (Pape, 2015; Bassi and McMurrer, 2016).

It is assumed in the literature that a combination of key figures from the area of finance (Huselid 1995) and the field of human resources such as employee turnover and absence (Guthrie, 2001), employee satisfaction and commitment (Macky and Boxall, 2007) can be applied to measure the efficiency of HR management. During the literature research, a focus was placed on the analysis of HR key figures made possible through the implementation of e-HRM and thus contribute to the measurability of efficiency.

Technological progress and the increasing availability of HR data have created the relatively new and aspiring field (Acito and Khatri, 2014) of HR analytics, meaning the use of metrics to analyze HR data (Boudreau and Ramstad, 2002; van den Heuvel and Bondarouk, 2017). Until now, many companies have lacked the skills to implement HR analytics in the organization (Wolfe et al., 2006; Carlson and Kavanagh, 2008). Nevertheless, it is questioned to what extent data analysis can offer added value for the organization and it is certain that a clear definition of the questions to be answered in advance is necessary (King, 2016). However, answering questions about organizational problems must also lead to management’s action, as this is the only way to create a beneficial situation for the organization (Carlson and Kavanagh, 2008). Angrave et al. (2016) are critical of the use of HR analytics if the goal is to increase strategic influence at the management level (Lawler et al., 2004) while maintaining the current practices of HR working methods while McIver et al. (2018) propose a way to realize organizational success when applying analytics. Research has also dealt with concrete applications of analytics in practice (Wei et al., 2015; Bassi and McMurrer, 2016; Simón and Ferreiro, 2018), its interpretation and impact (Chhinzer and Ghatehahorde, 2009; Khan and Tang, 2016; Schiemann et al., 2018). The latest review which has been conducted by Marler and Boudreau (2017), concludes that since the possible adoption of HR analytics is rather limited, research has so far also been less extensive.

3.2.5. *e-HRM in Cloud-Based Environments*

The literature dealing with the topic of e-HRM in cloud-based solutions is somewhat limited. Wang et al. (2016) develop a model for the implementation and usage of cloud technology for HRM in SMEs.

Pande et al. (2012) review open source e-HRM solutions of which some are cloud-based and point out that this cloud technology offers SMEs the possibility to scale up their applications without having to invest in hardware which makes adoption more likely. Taniser (2016) examines the differences between on-premise and cloud-based e-HRM solutions and discusses different aspect such as the implementation or adoption of these practices and suggest managerial as well as theoretical implications. Other literature researches a specific HRM process, like the cloud-based HRIS reporting (Hota and Mishra, 2012) or skill and knowledge sharing via a cloud-based framework (Jafari Navimipour et al., 2015a, b). Some literature points out the relevance of future cloud-based e-HRM systems in theory (Bhargava, 2012; Chakraborty and Mansor, 2013) and practical application (Zapotocny, 2015; Alamelu et al., 2016; Kansara et al., 2016). Chen (2014) defines a comprehensive architecture to use cloud technology for HR while adoption is researched as well (Johnson and Diman, 2017; Seo et al., 2019). Ziebell et al. (2018) propose a process model for successful e-HRM transformation into a cloud-based solution. Finally, Harris and Spencer (2018) conclude a technological shift from on-premise to cloud-based e-HRM solutions.

In relation to the cloud infrastructure, a contingent approach between e-HRMs applications requirement and cloud infrastructure selection has been proposed (Wright et al., 2012). The adaptation of cloud services to user requirements has been discussed as well (Ezenwoke, Daramola, and Adigun, 2018).

4. CONCLUSION, RESEARCH GAPS, AND FUTURE RESEARCH

The most diverse aspects of the e-HRM research field has already been examined, and this is also confirmed in various works which review the literature on this subject (Ngai and Wat, 2006; Strohmeier, 2007, 2009; Bondarouk and Ruël, 2009; Marler and Fisher, 2013; Ruël and Bondarouk, 2014; Johnson et al., 2016; Wirtky et al., 2016; Marler and Boudreau, 2017). However, the most recent literature review from Bondarouk et al. (2017b) as well as older ones (e.g., Ngai and Wat, 2006b; Strohmeier, 2007) cover publications up until 2010. In our research we include literature up to the year 2018, discussing recent publications that address topics related to new technologies (e.g., Technological development of cloud-based e-HRM solutions) and thus contribute to research.

However, current literature deals with the historical development of e-HRM, its adoption and the potential that can be tapped after its introduction. Many of the publications studied are empirical (e.g., case studies), and there is a lack of theory building, and Strohmeier (2007) concludes that “the main and most detrimental inadequacy of current research is its primarily non-theoretical character.” Our literature review confirms this assumption, goes along with the findings of the previous literature researches and agrees with Bondarouk et al. (2017b), who advocate more theoretical analysis before more empirical research can follow.

The influential adoption factors are classified as follows: technology, organization, and people. The consequences of e-HRM are divided into three categories: operational, relational and transformational outcomes. Bondarouk's work in the current review of e-HRM does this (Bondarouk et al., 2017b), and it is confirmed by our research. Further research could differentiate between e-HRM processes and how they differ in adoption and consequences, in the same way, this article separates the process clusters in talent management, workforce planning, and administrative core processes. One of the findings resulting from the differentiated consideration of the process clusters is that the talent management cluster is examined more intensively than the administrative core processes; which may be because the administrative core processes are considered commodity, meaning to be perceived as standardized services (Harris and Spencer, 2018). So far, HR suites that enable the mapping of entire HR process landscapes and their interaction with one another have not been found in current research.

While Bondarouk et al. (2017b) focus on the adoption and consequences of e-HRM procedure, this literature review contributes to the e-HRM topic by mentioning other aspects as the HR analytics and the cloud-related elements.

As the practical application of cloud-based solutions is gaining momentum (Harris and Spencer, 2018), research-oriented towards its use in organizations cannot keep pace. Therefore, one of the contributions this review makes is to investigate the combination of e-HRM and cloud-based solutions while pointing out that further research in that field is necessary. New ways of implementing and adopting e-HRM due to the benefits cloud technology bring along as well as the practical implications for HRM, in general, need to be further investigated. It was found that so far there is little research in the area of process models for digital HR transformations. Especially cloud-based e-HRM solutions require a different approach, which is similar to ERP implementations with their strictly defined process (Luo and Strong, 2004; Ziebell et al., 2018). There are further possibilities for research here because the cloud-based e-HRM transformation will continue to advance (Harris and Spencer, 2018). Legal aspects involve the requirements for the handling of personal data and the use of technology. This fact, in turn, requires safety aspects that must be considered (Kumah et al., 2018). Until now, the scientific discussion has been conducted based on the technology, i.e., the legal implications of cloud solutions in general and on-premise HCM solutions. Research in cloud-based e-HRM solutions and the resulting legal and security-related topics is rare.

This consideration also applies to other topics such as HR analytics, which benefit from new technologies. Although the adoption rates of HR analytics are comparatively low, research is not taking the lead here and investigates this topic in depth. It could open additional research fields,

Table 3. Journal rankings

e-HRM Journal articles		Category	# articles
1	The International Journal of Human Resource Management	HR	20
2	Human Resource Management Review	HR	18
3	Human Resource Management	HR	14
4	Employee Relations	HR	12
5	Personnel Review	HR	10
6	Journal of Strategic Information Systems	IT	7
	Procedia - Social and Behavioral Sciences	Social Sciences	7
	MIS Quartely	IT	7

for example, those that describe which key figures are relevant, or which key values can be used to measure the success of HR transformation projects.

Furthermore, it can be confirmed that e-HRM is a multidisciplinary topic in both HR and IT research. This is also reflected in the following table which shows that the publications take place in both HR and IT journals. Only journals with 5 or more publications that were found during the review are included in that list.

The International Journal of Human Resource Management and Human Resource Management Review are those most prominent journals publishing reviews on e-HRM topics. It is noticeable that most e-HRM articles are published by HR journals, and only two IT journals appear on the list. This fact confirms the assumption that e-HRM is a scattered, multi-discipline research field (Strohmeier, 2007), but that HR discipline is mainly in the lead while IT journals have not dealt sufficiently with the subject. However, the research field e-HRM affects even more disciplines than HR and IT. There are overlaps with the disciplines of law and general project management, which are examined in this article.

About the findings, generally, the evolution of e-HRM is ongoing at a fast pace, with a broad practical adoption (Harris and Spencer, 2018) which research is trying to catch up with and as several research disciplines are involved, there are still opportunities for further study at the points at which these various disciplines overlap.

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