



Research Article

Human Resources Information Systems – Current State of Art Regarding the 4th Industrial Revolution

Martin POLIVKA and Lilia DVORAKOVA

University of West Bohemia in Pilsen, Department of Finance and Accounting,
Pilsen, Czech Republic

Correspondence should be addressed to: Martin POLIVKA; polivkam@kfu.zcu.cz

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Abstract

This paper presents results of the systematic literature review conducted on the topic of human resources information systems. As the current situation is commonly referred to as the era of fourth industrial revolution, special emphasis was put on the influence of the technologies of this revolution on the human resources information systems. Literature review was based on the methodology consisting of six successive steps, which allowed the authors of this paper to identify, classify and analyse academic papers dealing with the human resources information systems from the last five years. Five main topics and nineteen subtopics were identified in the content of the investigated papers. Technologies related to the fourth industrial revolution occurred among these topics rather rarely, mostly represented by the web-based, cloud-hosted systems and by the analysis of big data. Therefore, the systematic literature review as well as the following analysis shows that the technologies of the fourth industrial revolution have not been in the center of the discussion regarding the human resources information systems so far. It also means that there definitely exists a research gap in this field, open for future studies.

Keywords: Industry 4.0, HRIS, Human resources information systems.

Introduction

Human Resources Information Systems “HRIS” represent a topic that has been rather marginal for a long time compared to the other corporate systems. As stated by Johnson et al. (2016), although the first employee personal data filing systems started to be used in the USA back in the 1940s, they only contained basic paperwork for a long time, and the main interest of

companies was primarily focused on the development of software that could be used for accounting and payroll, production management or inventory records. This trend corresponded to the relatively low interest of the academic community in HRIS, as by the 1980s, only a small number of researchers were dealing with this subject. The potential of the information technology application in the human resources was

fully appreciated both in academia and in the industry in the course of the 1990s.

The application of information technology in the human resources management is currently just a routine in most companies (though the rate of such application depends on the company itself). HRIS, whether in the form of single-purpose software or as a part of an integrated ERP system, is a major part of the corporate "IT landscape", which is a set of the corporate information and communication technologies and systems (for more, see Leyh et al., 2017).

We have recently been witnessing a massive development of new technologies, such as big data, cyber-physical systems, cloud, fast 4G and 5G mobile data network, internet of things, etc. The advent of these technologies, which is generally referred to as the "fourth industrial revolution" or as a transition to "Industry 4.0", naturally impacts the corporate information systems, which must be able to use these new technologies or (e.g. in the case of cyber-physical systems) function directly as a part thereof.

The focus of attention is currently the impact of such technologies on production and logistics (after all, the whole idea of "Industry 4.0" originally focused mainly on manufacturing companies with the main concept thereof being the "smart factory" (Alcácer and Cruz-Machado, 2019)). Thus, the above-described situation is being repeated, to a certain extent, when the HRIS issue rather lags behind compared to the other information systems. However, it is obvious that some of the "fourth industrial revolution" technologies will also have an impact on the form, technical nature or required functionalities of HRIS. The main objective of the research conducted was, therefore, to chart, analyse and evaluate the current state of the academic discussions about human resources information systems. This main objective was sub categorized into two intermediate objectives:

1. To identify, classify and evaluate the basic subjects of the papers researched;

2. To evaluate the impact of the fourth industrial revolution technologies on the human resources information systems or, if applicable, the reflection thereof in the papers researched.

Definition of the Problem and Method

Definition of the Human Resources Information Systems

The term "Human Resources Information Systems" appears in the literature in two basic meanings, one deals with the micro-level when this term is used to identify the information systems dealing with the human resources (whether the current resources in the form of the existing employees or potential job candidates) of a specific company or organisation. However, there is another meaning focusing on the macro-level when this term identifies the public service information systems, keeping information about the population as a whole, e.g. its demographic structure, health condition, etc. (see e.g. Were et al., 2019). With respect to the scope of this review, the HRIS term is logically understood only in the former meaning.

The issue of HRIS as a corporate information system also needs to be further specified because it can be perceived either in a wider or in a narrower perspective. In the narrower perspective, it is only the software itself– for example Puspitarini et al. (2018), with reference to Roach (2017), defines HRIS as "integrated information systems designed for the purposes of performing activities associated with the flow of information related to the company human resources."

However, some authors construe the human resources information systems as a wider term that, in addition to the software and data, contains a number of other elements. For instance, according to Lovric and Horvat (2016) or Moussa and Arbi (2020), HRIS contains not only documents, procedures, and processes, but also employees who are somehow related to obtaining, keeping, evaluating or distributing information about the company's human resources. For

the purposes of this paper, the narrower perspective will be applied hereinafter as the authors consider it more clearly defined and thus better formulated.

In the process of conducting the review, the term "HRIS" was perceived as the software for the human resources management in the organisation. It may not necessarily be only a separate single-purpose information system but a specialised module of an integrated ERP system. The reasons for that perception include the fact that this concept corresponds more to the understanding of HRIS in corporate practices, as well as the fact that the wider perspective is so general that it also includes elements that are normally a part of other information systems. Therefore, HRIS, in this perspective, does not have clearly defined boundaries.

Methodology of the Review

In order to map the current academic discussions concerning HRIS, a systematic literature review was conducted. The review was conducted by a method based on the procedure of Soni and Kodali (2011) and Manoharan and Singal (2017) in six steps:

1. Specification of the study time range.
2. Selection of source databases.
3. Selection of sources – periodicals, books and collections.
4. Selection of specific papers.
5. Classification of papers.
6. Detailed analysis of classification.

Study Time Range

The period of 2015–2020 was determined as the time range of the study. The reason for this time limit is the dynamic development of the information system technologies that made the studies in this field become obsolete very fast. Older papers were therefore excluded from the review as the content thereof no longer corresponds, by definition, to the current state of the subject researched.

Selection of Source Databases

The researched papers were retrieved using the Web of Science and Scopus citation databases. In the initial stage, the retrieval included all types of sources, i.e. both the papers in periodicals or chapters in books and entries in conference proceedings.

Some referenced sources that did not correspond to the focus of the review on academic texts were subsequently excluded in step four. These were several promotional papers that were only promoting a specific system or technology and that did not have the structure or the essentials of a scientific work.

Selection of Sources

In step three, the terms "Human Resources Information System" and "HR Information System" were selected as the key strings for retrieval. In the case of the Web of Science database, the retrieval was restricted to the occurrence of these strings in the "Topic", "Title", "Abstract" and "Author Keywords" fields, and the occurrence in the Scopus database was searched in the "Title", "Abstract" and "Keywords" fields. The reason for giving priority to retrieval only in the selected fields over the full-text retrieval was the effort to filter out the papers that only marginally deal with HRIS. For the same reason, the subject-area based filtration was used in the Scopus database where only papers from the "Business", "Social Science" and "Computer Science" subject areas were retrieved.

As of 20 December 2020, there were 52 papers meeting the predefined criteria in the Web of Science database and 103 papers in the Scopus database. Having excluded the duplicate records appearing in both databases, there were 110 records left in the selection.

Those which were published by the specialised literature publishers, namely, Elsevier and Springer Publishing Company or those publicly available (e.g. in Open access), were subsequently selected from these records. There were 58 records altogether.

Selection of Particular Papers

The selected papers were subsequently assessed on an individual basis, whereas further research only involved those which were primarily focused on HRIS, as defined in sub-chapter 2.1. All papers dealing with the public service information systems were, therefore, excluded from selection. Similarly, the papers that primarily dealt with other issues and marginally mentioned the human resources systems were eliminated from the selection as well. Based on the assessment of the content, 43 papers were selected for further study.

Twenty-six out of the selected papers were articles in journals (whereas in three cases, it was a special conference edition). The other works were entries in the conference proceedings. As far as the frequency of the papers in the specific journals or proceedings is concerned, there was no identified source where the HRIS related papers would accumulate, and that, as a result, might be regarded as essential to the general discussion about this topic. The highest number of papers (3) dealing with HRIS were published in *Journal of Physics: Conference Series*, two papers in *Cogent Business & Management*. The other papers were coming from different sources, and the specialisation of the sources was rather broad, coming from journals with a relatively broad specialisation in business economics (e.g. *Journal of Business Economics* or *International Journal of Entrepreneurship*) or information systems and technologies (e.g. *Asian Journal of Information Technology*, or *Journal of Management Information and Decision Sciences*) to journals with very specific focus (e.g. *African Journal of Hospitality, Tourism and Leisure* or *Annals of Applied Sport Science*).

Classification of Papers

In this step, the selected papers were sorted by the basic topic they deal with. Five basic topics were identified that the researched papers deal with – HRIS implementation and acceptance, exploring the effect of HRIS on a certain variable or process in the company, draft model for creating new HRIS for specific purposes, HRIS-related security and HR analytics, as well as using advance technologies for human resources data analysis. Forty-one out of the papers researched were dealing with one of these basic topics. The content of the two other papers was more essayistic in nature where one presented HRIS history, and the other involved consideration of the future thereof.

Detailed Analysis of Classification

In step six, the basic classification was further developed in order to obtain a more comprehensive idea of the current state of the academic discussion about HRIS. The papers researched were then grouped by the year of publication and country of the authors' operation. The five basic topics identified in the previous step were further divided into more specific sub-topics which characterise the focus of the individual papers more precisely. The last question tackled by the analysis was to what extent the papers researched reflected the issue of the "fourth industrial revolution". The results of this analysis are summarised in the next chapter.

Results and Discussion

Classification of Papers by Year of Publication

Distribution of papers by the year of publication is shown in Table 1.

Table 1: Distribution of papers by the year of publication

Year of publication	Number of papers
2015	3
2016	9
2017	10
2018	5
2019	10
2020	6

Source: own research, 2020

Table 1 indicates that the frequency of the HRIS related papers has not shown any developmental trend in the past five years. There have only been several academic papers primarily dealing with this subject per year. For the sake of completeness, it is worth mentioning that the review was conducted at the end of 2020, and for this reason, some papers of that year might not be contained in the databases by that time. The number of papers for 2020 should not, therefore, be considered final.

Classification of Papers by Country of the Author

The structuring of the individual papers by the country of the author's origin is shown in Table 2. The criterion applied to the classification was the working place of the corresponding author of the paper, or the first author in case the corresponding author was not explicitly stated.

Table 2: Distribution of papers by the country of the corresponding/first author

Country	Number of papers
Indonesia	13
Republic of South Africa	4
USA	2
Germany	2
Malaysia	2
Philippines	2
United Arab Emirates	2
Bangladesh	2
United Kingdom	2
Central African Republic	1
Slovakia	1
Thailand	1
Croatia	1
Iran	1
Ghana	1
Spain	1

Iraq	1
Saudi Arabia	1
Fiji	1
Algeria	1
South Korea	1

Source: own research, 2020

Table 2 indicates that the HRIS subject has been intensively discussed mainly in so-called developing countries in the past five years. A significant factor to observe is mainly the representation of authors from South East Asia, constituting 20 out of 43 researched papers. There is also a relatively high proportion of authors operating at the African universities (strictly speaking, seven papers). On the other hand, Europe and North America appear to currently pay rather small attention to the HRIS subject in the academic sphere, as there were only seven and two papers, respectively, originating from these regions.

Such predominance of the less developed countries in the HRIS discussions is undoubtedly one of the suggestions for further analysis. The authors of this paper offer, as a possible explanation, the fact that the developing countries only go through

certain steps of the economy digitalisation process that have already been successfully completed in the developed countries. One such step is the massive implementation and expansion of the functionalities of the corporate information systems. The subject of HRIS, as one such system, is more topical in these countries compared to the developed countries where the HR information systems have been used routinely for a longer period of time. However, this is only a hypothesis. Proving or disproving this would require additional targeted research.

Classification of Papers with Thematic Focus

The thematic focus of the papers is shown in Table 3.

Table 3: Thematic focus of papers researched

Basic topic	Specific sub-topic of paper under the basic topic	Number of papers	Total number of papers
HRIS implementation and acceptance in the company	Factors affecting successful implementation and acceptance	10	18
	Opinion of actual or potential users on particular HRIS	3	
	Factors affecting decision-making of the management concerning HRIS implementation	1	
	Draft research framework for assessment of HRIS implementation and acceptance	1	
	Selection of specific HRIS	1	
	Rate of HRIS utilisation in the company or in the industry	1	
	Effect of users' character traits on stress resulting from use of HRIS (technologies)	1	
	Fluctuation	3	14

Effect of HRIS on a specific variable or process in the company	Personnel planning and mapping	3	
	Recruitment	2	
	General HR performance, efficiency of HR processes, ability of HR department to fulfil company objectives	2	
	Innovation activity and creativity of employees	1	
	Reduction of human errors	1	
	Effect of HR on strategic decision-making in the company	1	
	CRM	1	
Draft model of new HRIS	Draft HRIS structures using some of the modelling tools, e.g. UML or TOGAF framework	4	4
Security related to use of HRIS	Effect of HRIS on security of access to information, use of specific security technologies	3	3
HR analytics	Potential and questions of use of HR analytics	2	2
General reflections on HRIS	HRIS history and development	1	2
	Opinions of HR managers on digital transformation	1	

Source: own research, 2020

Table 3 indicates that the most frequently occurring basic topic in the papers researched was the HRIS implementation and acceptance, i.e. the subject of HRIS implementation in the company and its subsequent acceptance and routine use by employees. In the terms of this topic, the biggest interest was given to whether **it was possible to identify factors that were the main determinants of success of the HRIS implementation and acceptance**, thus supporting the success of the implementation process using proper control of these factors. This sub-topic was the subject of 10 papers altogether.

The authors tried to identify the key factors mainly using structural models (for instance, see the papers by Noutsu et al., 2017; Quaasar et al., 2018; Viridiananto et al.; 2016, Rahman et al., 2016 or Imron et al., 2019) that depict the individual entities with a potential to affect the process of implementation and subsequent acceptance of an information system. Based on the assumed relations between these entities, hypotheses were construed afterwards. The data required for the statistical testing of the hypotheses were obtained in the form of

questionnaires. Although the particular formulation of the results of the individual authors differ depending on the construction of the models and hypotheses applied, the basic conclusions were consistent across the individual studies, when the elementary precursors identified for the successful implementation of HRIS or its acceptance by employees were the ability of the system to perform the tasks that the employees are assigned to do there, intuitiveness and promptness of the system, as well as the social pressure (in particular, in the form of pressure exerted by the management) on the utilisation of the system.

Another frequently occurring basic topic is the effect of the HRIS use on the functioning of a specific process in the company or on the development of a certain variable. As indicated in Table 3, the research focused mostly on the issue of the **benefits of HRIS for the human resources management through the studies analysing the effect of HRIS on hiring and maintaining the sufficient number of qualified and motivated personnel**. Shahreki et al. (2020), Ekawati (2019) and Pouransari et

al. (2016) were dealing with the effect of HRIS on reducing fluctuation, when the former paper again used the above-discussed combination of the structural model and questionnaire, whereas in the other two papers, the data were obtained by a literature review. Ambarwati and Tirtoadisurja (2016), Trisnawati (2019) and Nurasiah (2019) researched the significance of the use of HRIS for personnel planning, which was confirmed by the questionnaire surveys conducted in the papers by Trisnawati (2019) and Nurasiah (2019). Haddadi et al. (2017) and Laumer et al. (2015) were concerned with the use of the information systems to support the recruitment of new employees. For these purposes, Haddadi et al. (2017) suggest using the public education portal from which the company might obtain contact details of potential employees with the required profile, whereas Laumer et al. (2015) conducted a questionnaire survey that confirmed (including but not limited to) a positive effect of the use of HRIS on the filing of job candidates records and on the work with them. The papers by Shiyaa (2019) and Siregar and Dachyar (2018) evaluate the effect of HRIS on the performance of the corporate HR as a whole, while the paper by Shiyaa (2019) also analyses the effect on the general performance of the company. Moussa and Arbi (2020) were exploring the relation between the use of HRIS in the company and the innovative activity and creativity of employees. The research was conducted in the form of a questionnaire, and it confirmed the positive relationship between the variables researched. However, its validity is rather limited by the low number of observations (only 42 questionnaires).

There were 11 papers researched dealing with the sub-topics and exploring the benefits of HRIS for the human resources management. This group of sub-topics can therefore be regarded as another significant subject of interest in the current academic discussions about HRIS.

Beside the effect of HRIS on the human resources management, several studies were also dealing with the impact on other

variables, e.g. CRM (Keshtidar et al., 2017), ensuring compliance with legislation and reduction of human errors (Aghimien et al., 2019) or on increasing the importance attached to HR in the process of strategic planning and decision-making in the company (Marler and Parry, 2016). The hypotheses concerning the positive effect of HRIS on the variables researched were also confirmed in these studies.

The rest of the basic topics identified were dealt with in significantly lower number of papers. In four papers, the authors introduced their own model design that should be used as an inspiration for designing HRIS for specific purposes. The papers by Baswardono et al. (2019) and Wibawa et al. (2018) model the HRIS design suitable for micro-, small and medium-sized companies. Luciano (2020) presents a specific HRIS design for the university environment that was developed into a prototype stage and tested successfully. HRIS for universities is also the subject of the papers by Sofyana and Putera (2019), using the TOGAF framework procedures for the analysis and design.

Three papers examined the security of HRIS. The paper by Phudphad et al. (2017) explores the effect of the proportion of the individual organisational factors on HRIS security and its subsequent impact on the general climate and openness in the company by applying the analytical hierarchic process. Based on a questionnaire survey, the authors identified the "management" factor to be fundamental for the HRIS security, introducing mainly the security policies and system controlling. Madyatmadja et al. (2020) introduce the risk analysis of HRIS use in pharmaceutical industry, conducted with the use of COBIT 5 framework. The paper presented by Sapuay et al. (2019) then contains the proposal of multi-factor user authentication that would improve the HRIS security.

A topic that is related to the fourth industrial revolution, but that appeared rather sporadically in the papers researched, is "HR analytics" or the use of big data and advance analyses for the purposes of the human resources

management. Zeidan and Itani (2020) introduce the results of the review conducted in the EBSCO database, which included retrieval of papers containing the terms “HR analytics” or “Workforce analytics” from the period of 2005–2020. The paper by Angrave et al. (2016) was rather reflective in character. According to the authors, the present use of the advance analyses in HR is basically misguided. Therefore, the analyses conducted do not have sufficient benefits. According to Angrave, it is necessary to create new analytical tools and procedures, the outcome of which will be more relevant for the company management.

Occurrence of the Fourth Industrial Revolution Technologies in the Papers Researched

The last question explored in the process of the review was to what extent the current specialised papers dealing with HRIS reflect the “fourth industrial revolution”, or the technologies associated with this term. The palette of the technologies associated with the “Industry 4.0” is rather broad. It is based upon “9 pillars of Industry 4.0” (Vaidya et al., 2018) that, however, various authors add other technologies to, usually depending on their specialisation.

With respect to the substance of HRIS defined in Chapter 2.1, it could be assumed that those technologies of the fourth industrial revolution that are software-based and are connected with managing data or with the architecture and operation of information systems (e.g. web- and cloud-based technologies, big data, etc.) would be considered relevant. On the other hand, the production related technologies (e.g. in the form of simulation software, additive production or autonomous robots) and HRIS do not have any direct contact points, and the occurrence thereof in the papers researched was therefore not expected.

The analysis of the selected papers confirmed these assumptions. In the papers researched, the present trend of HRIS based on web technologies that can be operated in

cloud environment was the most frequently mentioned (in nine papers). Three papers dealt with big data – in two cases, it was about the use thereof in HR analytics. The other papers (Ekawati, 2019) were dealing with their potential for predicting the personnel fluctuation. The last of the fourth industrial revolution technologies mentioned was the artificial intelligence that is stated by Shiyaa (2019) as one of the factors affecting the quality of the HRIS output.

Conclusion

The systematic review of the papers specialised in the “Human Resources Information Systems”, conducted with the use of the citation databases (Web of Science and Scopus and with the use of sources published by the Elsevier, Springer Publishing, Company publishers and public materials), indicates that the number of specialised papers published in the past five years on this subject has been stable. It does not indicate either an increasing or decreasing trend. In regional terms, the topic explored is current mainly in developing countries, whereas the biggest accumulation of the papers was identified in the South East Asia region. On the other hand, only few papers meeting the review criteria were dealing with this subject in Europe and North America.

In terms of content, the biggest attention was paid to the HRIS implementation and acceptance, in particular, of the identification of the specific factors determining the successful implementation of the system. Another frequently occurring topic was the effect of the HRIS application on the human resources management in the company.

As far as the fourth industrial revolution technologies are concerned, the current trend of web-based solutions operated in cloud was mainly reflected in the papers researched. In several cases, they also discussed the use of the big data analysis in HRIS. The other Industry 4.0 technologies (except for one reference to artificial intelligence) were not mentioned in the papers researched. Their eventual interconnection with the human resources

information systems can therefore be a suitable subject for further research.

Note: A complete list of all papers researched is available from the authors of this paper upon request.

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