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ORIGINAL ARTICLE

Human Resource Management Systems and Firm Innovation: A Meta-Analytic Study

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Abstract

Building on the resource-based view, this paper examines the meta-analytic relationships between Human Resource Management (HRM) systems and different types of firm innovation (innovation in products or services, innovation in processes, and innovation in people and organizations) and the moderating role of sampled industries and sampled cultural clusters in these relationships. With 119 records from 57 unique papers published between 2000 and 2020, this study found that HRM systems positively contribute to innovation in products or services, innovation in processes, and innovation in people and organizations. Sampled industries and cultural clusters significantly moderate the relationships between HRM systems and innovation in products or services. These results may be biased because most empirical researchers focused on innovation in products or services instead of innovation in processes or innovation in people and organizations. Despite the dynamism of HRM systems, researchers are most like to include compensation, training, and performance appraisal while studying HRM systems and firm innovation.

Keywords: Human Resource Management systems, Firm innovation, Country culture clusters, Industry, Meta-analysis

JEL classification: L2, M10, M54

Introduction

When explaining how Human Resource Management (HRM) systems contribute to firm performance, processes, strategies, and culture, researchers came up with two main explanations. Both explanations are driven by the resource-based view. In the systematic explanation, HRM systems demonstrate their effect through the configuration or aggregation of practices on firm human resources. In the strategic explanation, HRM systems adjust, influence, and develop the needed human resources to achieve results (Bowen & Ostroff, 2004). Firm innovation has been studied at the firm performance level, the firm process level, the firm strategy level, and firm culture level. To explore relationships between HRM systems and firm innovation, we applied the resource-based view and integrated the firm innovation literature.

There are different classifications of firm innovation; we selected the results of Knight (1967). This classification of firm innovation aligned tightly with different types of firm resources in the resource-based view. Barney (1991) suggested that firm survival and success depended on three types of resources: physical capital resources, human capital resources, and organizational capital resources. Knight (1967) listed the following types of firm innovation: product or service innovation, production-process innovation, and organizational-structure and people innovation. Both physical capital resources and product or service innovation focus on firm outputs. Both human capital resources and production-process innovation focus on firm processes. Both organizational capital resources and organizational-structure and people innovation focus on firm culture and strategies.

Empirical studies of HRM systems and firm innovation have inconsistent results. To resolve this problem, we clarified different types of firm innovation, conducted a meta-analysis based on existing empirical

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studies, and tested the moderating effect of sampled industries and sampled cultural clusters.

Overall, this paper aims to make three theoretical contributions: 1) it enhances the practicality and legitimacy of the resource-based view when examining relationships between HRM systems and different types of firm innovation; 2) it proves the positive effect that HRM systems have on different types of firm innovation; and 3) it examines the moderating effects of sampled industries and sampled cultural clusters on the relationship between HRM systems and different types of firm innovation.

1 Theoretical background and hypotheses

According to the resource-based view, firms are resource bundles (Barney, 1991; Penrose & Penrose, 2009). HRM influences firm performance through influencing firm resources. This view provides fundamental support to explain why and how HRM influences firm performance. HRM includes all policies and practices to acquire, train, appraise, and reward past, current, and future employees (Dessler, 2000). In the literature on HRM, researchers have developed increasing interest in studying HRM systems instead of individual HRM practices (Monks et al., 2013; Nishii & Paluch, 2018; Velikorossov et al., 2020). One of the main reasons is that the effect of one HRM practice depends on other HRM practices (Boon et al., 2019). Similarly, Guest and Conway (2011) found that the effect of a combination of HRM practices (HRM systems) is stronger than the effect of individual HRM practices. Ferraris et al. (2019) explored the influence of HRM systems on ambidextrous work in smart city projects. Chadwick et al. (2015) examined how HRM systems influence firm performance.

Lepak et al. (2006) defined HRM systems as collections of individual HRM practices to achieve overarching goals. Many researchers named their HRM systems based on intended goals. For example, Tang et al. (2015) defined the strategic HRM system as "a combination of strategy-oriented practices such as staffing, training and development" (p. 167). Zhang et al. (2016) defined the capability-based HRM system as "a set of people management strategies and activities that enable employees to develop their skills and knowledge and ultimately contribute to competitive advantages" (p. 133). Soo et al. (2017) defined intellectual capital-enhancing HRM systems as "HRM practices that not only develop human capital but build social relationships and interactions (and the associated social capital that emerges from these exchanges) as well as the technology, systems, routines, and databases for knowledge capture and sharing—that organizations build the crucial learning capabilities necessary for innovation and performance" (p. 433). Ceylan (2013) defined commitment-based HRM systems as practices that "provide career development and long-term growth opportunities, and to increase group motivation and social interactions" (p. 211). Zhou et al. (2013) defined collaborative HRM systems as the HRM practices of "internal human capital to develop teamwork and cross-functional teamwork skills" (p. 267). Al-Tal and Emeagwali (2019) defined a knowledge-based HRM system as HRM practices "designed to improve organization's knowledge process" (p. 8). Many researchers also refer to HRM systems as high-performance work systems (Armstrong et al., 2010; Fu et al., 2015; Gürlek, 2021; Messersmith & Guthrie, 2010) and high-involvement work systems (Boxall & Macky, 2009; Gollan, 2005; Rehman et al., 2019). Following this trend, this paper only focuses on HRM systems instead of individual HRM practices.

Firm innovation is a type of firm performance. Researchers have widely applied the resource-based view to explain the relationship between HRM systems and firm innovation (Donate et al., 2016; Lopez-Cabrales et al., 2009; Messersmith & Guthrie, 2010; Oke et al., 2012). Many empirical studies have found positive relationships between HRM systems and firm innovation. However, other studies have found negative or non-significant relationships between HRM systems and firm innovation (Beugelsdijk, 2008; Jimenez-Jimenez & Sanz-Valle, 2005; Liu et al., 2017). One explanation of the inconsistency is sampling bias or selection bias, which represents a deviation between samples and the population. A meta-analytic study can reduce the bias effect and examine the "true" relationships between HRM systems and firm innovation at the population level. Unlike an empirical paper, a meta-analysis aims to find construct relationships at the population level after correcting the influence of sampling errors, measurement errors, range restrictions, etc. Meta-analysis collects data from existing (published and unpublished) studies. When the number of independent studies is small and/or when the sample sizes of these studies are small, it is possible that the meta-analytic results are biased.

According to the resource-based view, firms can achieve sustainable competitive advantages and long-term success through three types of resources: physical capital resources, human capital resources, and organizational capital resources. Physical capital resources include a firm's technology, plants, and equipment. Human capital resources include experience, judgement, intelligence, and insight of individual managers and workers in a firm. Organizational capital resources include a firm's formal and informal planning, controlling, and coordinating system, as well as informal relations among groups within the firm (Barney, 1991). Although Barney's examples mainly applied to manufacturing fields rather than service fields, he suggested different levels of resources. The physical capital resources focus on the outcome or result aspect of firm performance. The human capital resources focus on the formalized procedures aspect of firm performance. The organizational capital resources emphasize the dynamic and communicational aspect of firm performance. The three levels of resources align well with different types of firm innovation that Knight (1967) suggested: product or service innovation, production-process innovation, organizational-structure and people innovation. This alignment provides support to test the relationships between HRM systems and different types of firm innovation.

Therefore, we hypothesize that:

H1. *At the population level, HRM systems enhance firm (a) innovation in products or services, (b) innovation in processes, and (c) innovation in people and organizations.*

While examining relationships between HRM systems and firm innovation, researchers generally believe that sampled industries play a critical role in these relationships. Some researchers have suggested to conduct industry-specific studies (Bhatnagar, 2012; Li et al., 2015; Lu et al., 2015; Sung & Choi, 2018; Thai Hoang et al., 2006). For example, Fındıklı et al. (2015) found that strategic HRM systems enhanced firm knowledge management capacity and innovation (exploration and exploitation). They believed that more context-specific future research was needed. Ceylan (2013) found that commitment-based HRM systems enhanced firm product, process, organizational, and marketing innovation activities. She suggested researchers collect data from specific industries.

Many other researchers recommended conducting research in diverse industries (Leticia Santos-Vijande et al., 2013; Mahmood et al., 2017; Natalicchio et al., 2018). For example, Do et al. (2018) found that innovation-led HR policies enhanced firm innovation. They recommended future researchers to test this finding in various research settings and multiple industry contexts. Patel et al. (2013) found that high-performance work systems enhanced organizational ambidexterity (exploration and exploitation). They suggested that future researchers use large samples from a broad cross-section of industries to enhance generalizability. Perdomo-Ortiz et al. (2009) found that total quality management-based HRM systems enhanced both technological innovation and non-technological innovation in a firm. They believed that future research could benefit from collecting data from multiple industries. Similarly, Lepak et al. (2007) encouraged future research to study the industry pressures on firm HRM systems and practices.

Despite different approaches to study the influence of industry or industries, it is clear that sampled industries influence the effect that HRM systems have on firm innovation. Therefore, we hypothesize that:

H2. *At the population level, sampled industries moderate relationships between HRM systems and firm (a) innovation in products or services, (b) innovation in processes, and (c) innovation in people and organizations.*

In addition to sampled industries, country, culture, and cultural clusters are broadly mentioned as potential moderators of the relationship between HRM systems and firm innovation. For example, de Araújo Burcharth et al. (2014), Fellnhofer (2017), and Wei and Atuahene-Gima (2009) recommended future research to examine how HRM systems influence firm innovation in different countries. Cooke and Saini (2010), Hohenberg and Homburg (2016), and Soto-Acosta et al. (2014) encouraged future HRM researchers to fully consider the influence of national culture. Ma et al. (2019) and Naqshbandi et al. (2019) thought that future research can benefit from collecting data from different countries and cultural settings.

Although used interchangeably, country and culture are different constructs. Country refers to the land of a person's birth, residence, or citizenship. It also refers to the political state, nation, or territory (Merriam-Webster, n.d.). Although country sometimes represents culture, it is a poor proxy for culture (Taras et al., 2016). According to Taras et al. (2009), culture is relatively stable, includes values, beliefs, norms, and traditions, is shared within a population. For HRM researchers, it is more benefitable to study the influence of culture instead of the influence of country.

While exploring national culture, researchers found that cultural clusters are more relevant than culture per se in innovation studies, organizational studies, and international business studies (Beugelsdijk et al., 2018, 2017; Lorenzen & Frederiksen, 2008; Ronen & Shenkar, 2013). Similarly, Soto-Acosta et al. (2016) suggested future researchers to combine firms from different cultures while examining the relationships between HRM systems and firm innovation. Do et al. (2016), Lau and Ngo (2004), and Tang et al. (2015) recommend future researchers to draw samples from different nations and regions. Therefore, we hypothesize that:

H3. *At the population level, sampled cultural clusters moderate relationships between HRM systems and firm (a) innovation in products or services, (b) innovation in processes, and (c) innovation in people and organizations.*

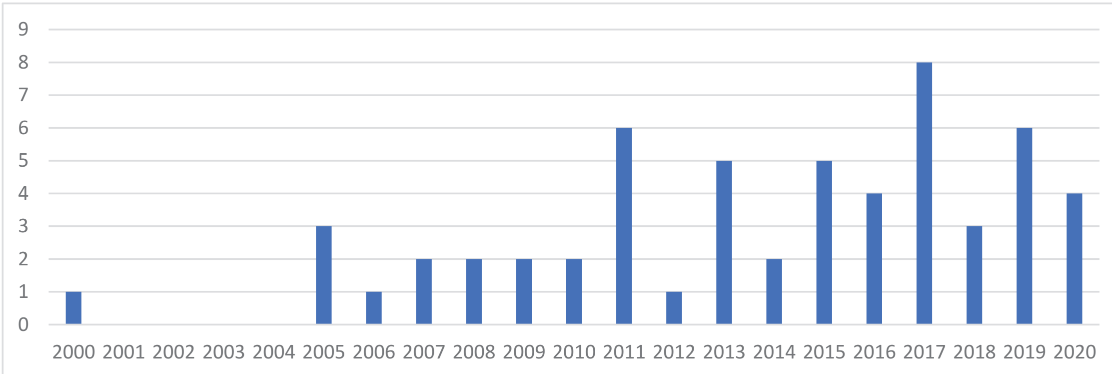

Fig. 1. Trend of quantitative publications in firm innovation and HRM systems.

2 Scope of search and keywords

Based on available data or individual studies, meta-analytic researchers aim to generate the best estimation of the true relationship between studied constructs. The best estimation is called the effect size, which should have the statistical errors and sampling bias corrected (Schmidt & Hunter, 2015). Unlike empirical studies, meta-analytic studies use archived data, which generally come from the correlation matrix of empirical studies. Thus, to be included in this meta-analytic study, a paper must have included correlation value(s) between variables of interest. In rare situations, a paper included empirical data without disclosing correlation values. In such a case, we contacted the paper authors for details and clarifications.

We conducted a thorough search in the following databases: CORE, Directory of Open Access Journals, EBSCO, Emerald Insight, Google Scholar, JSTOR, ProQuest, SAGE, Science Direct, Social Science and Research Network, Springer Link, Taylor & Francis Online, Wiley, and Web of Science. The search keywords included "innovation," "innovativeness," "innovate," "human resource," "HR," "high performance work system," and "high commitment work system." To make this study more comprehensive, we also searched for keywords about individual HRM practices ("training," "compensation," "reward," "performance management," "appraisal," "promotion," "employee participation," "teamwork," "hiring," "staffing," "employee empowerment," "recruitment," and "selection"), since researchers might not be consistent about naming their constructs empirically. The paper searching was finalized at the beginning of 2021.

With the list of potential papers, we read and evaluated how HRM systems were measured in these papers. After consulting HRM experts and scholars, we believed that an HRM system needed to include at least 3 individual HRM practices. This was done because the focus of this study was to quantify relationships between HRM systems and different types of firm innovation. We are grateful for the support from University of Texas at El Paso faculty and research assistants.

3 Preliminary data analysis

After searching in published papers, we looked at relevant professional reports, called for unpublished or in-progress studies, and considered governmental statistics, ultimately finding 57 unique papers published between 2000 and 2020: 51 journal publications, 3 dissertations, 2 theses, and 1 research report. Fig. 1 shows the publications of quantitative papers in the field of firm innovation and HRM systems. Based on the current selection criteria, the first paper was published in 2000. However, up until 2005, more and more empirical works were devoted to exploring the relationship between firm innovation and HRM systems. Among these 57 papers, 26 papers included data from manufacturing industries; 7 papers included data from service industries; and 24 papers included data from both manufacturing and service industries. As shown in Table 1, most of the selected papers surveyed companies in the Anglo, Confucian Asia, and Western Europe cultural clusters (House et al., 2004).

Some of these papers included more than one type of HRM system and/or firm innovation. In total, these

Table 1. Sampled cultural clusters of selected papers.

Cultural cluster list	No. of selected papers	Percentage
Africa and Middle East	3	5.26%
Anglo	15	26.32%
Confucian Asia	18	31.58%
Southern Asia	3	5.26%
Western Europe	18	31.58%

Table 2. Selected papers by different types of firm innovation.

Innovation in products or services

Adebanjo et al. (2020); Armstrong et al. (2010); Boehm et al. (2014); Botelho (2020); Ceylan (2013); Chang et al. (2013); Chen et al. (2018, 2019); Collins (2000); Collins and Smith (2006); Do (2017); Donate and Guadamillas (2011, 2015); Donate et al. (2016); Fu et al. (2015); Gahan et al. (2021); Gürlek (2021); Jimenez-Jimenez and Sanz-Valle (2008); Kang (2015); Kianto et al. (2017); Lepak et al. (2007); Li et al. (2019); Liu (2011); Lopez-Cabrales et al. (2009); Mavondo et al. (2005); Messersmith (2008); Messersmith and Guthrie (2010); Nasution et al. (2011); Nieves and Osorio (2017); Nieves et al. (2016); Olander et al. (2015); Papa et al. (2018); Patel et al. (2013); Sheehan (2014); Smith et al. (2012); Soo et al. (2017); Soto-Acosta et al. (2016, 2017); Stock and Zacharias (2011); Tang et al. (2015); Wang and Chen (2013); Wei et al. (2011); Zhang et al. (2016); Zhou et al. (2019, 2013)

Innovation in processes

Al-Tal and Emeagwali (2019); Ceylan (2013); Chang et al. (2019); Jimenez-Jimenez and Sanz-Valle (2007, 2008); Mavondo et al. (2005); Messersmith (2008); Messersmith and Guthrie (2010); Nieves et al. (2016); Smith et al. (2012)

Innovation in people and organizations

Ceylan (2013); Chang and Huang (2005); Collins (2000); Fu et al. (2015); Jimenez-Jimenez and Sanz-Valle (2005); Kang (2015); Ko and Ma (2019); Liu et al. (2017); Messersmith and Guthrie (2010); Para-González et al. (2018); Patel et al. (2013); Rasheed et al. (2017); Razouk (2011); Song et al. (2019); Stock and Zacharias (2011); Zhang and Li (2009)

Table 3. Components of HRM systems and different types of firm innovation.

	Innovation in products or services	Innovation in processes	Innovation in people and organizations
Compensation and benefits	60	11	20
Job and work design	57	10	17
Training and development	66	14	20
Recruiting and selection	50	12	17
Employee relations	31	8	9
Communication	45	10	8
Performance management and appraisal	53	11	19
Promotions	27	9	12
Turnover, retention, and exit management	4	2	0
Other	5	0	1

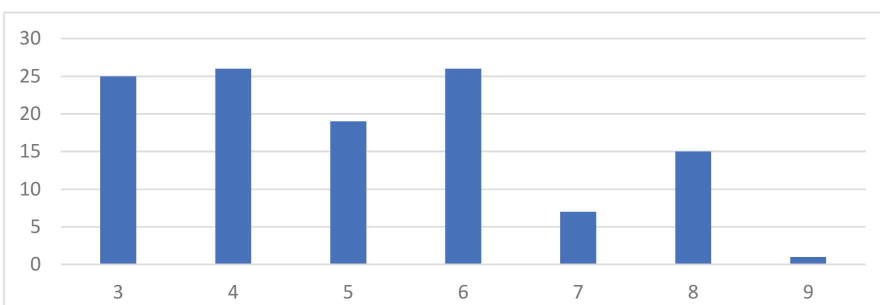

Fig. 2. The number of individual HRM practices within HRM systems.

papers contributed 119 records to this meta-analytic study. For the 119 records, 80 records were in the category of innovation in products or services, 15 records were in the category of innovation in processes, and 24 records were in the category of innovation in people and organizations (see Table 2 for details). For the present study, an HRM system should include at least three individual HRM practices. Fig. 2 presents the number of individual HRM practices in the HRM systems of the selected records. About half of the selected HRM systems included three or four individual HRM practices. The most complicated HRM system included nine individual HRM practices. The average number of individual HRM practices within HRM systems was five. Table 3 shows different types of HRM practices in the HRM systems among the selected 119 meta-analytic records. One can observe that when exploring overall firm innovation by HRM systems, training and development and compensation and benefits were the most frequent HRM practices within the HRM systems studied. The same pattern can be found for innovation in products or services. When examining innovation in processes, performance management and appraisal showed up more frequently in the HRM systems than when explaining other types of firm innovation. The same pattern of innovation in processes was also found in innovation in people and organizations.

Studies were matched to the country from which the data were obtained. Then, a modified version of the prior categorizations of country clusters (Hofstede, 2001; House et al., 2004; Ronen & Shenkar, 2013) was used to place each study into a parsimonious listing of country culture clusters. The culture clusters and the countries therein were as follows: Middle East: Turkey, Jordan; Anglo: Australia, United States, Ireland, United Kingdom; Confucian Asia: China, Vietnam, South Korea; Southern Asia: India, Malaysia, Indonesia, Pakistan; and Western Europe: Spain, Germany, Finland, Italy, Portugal, France. When looking at the different cultural clusters and industries, we realized that most of selected records came from Anglo, Confucian Asian, and Western European researchers. Manufacturing companies were more welcomed by HRM researchers in their studies of firm innovation than were service companies in most of the cultural clusters, except for Africa and the Middle East (see Table 4). The popularity of manufacturing companies also showed in the different types of firm innovation. In the field of human resource management systems and firm innovation, researchers were less likely to carry out their empirical studies purely based on service companies. Innovation in products or services have received more researchers' attention than innovation in processes or innovation in people and organizations have (see Table 5). Table 6 presents the HRM components within HRM systems that explained firm innovation in different industries. If a study collected data from manufacturing companies, it was very likely to include compensation and benefits, training and development, and performance management and appraisal in its HRM systems. However, if a study collected data from service companies, it was very likely to include compensation and benefits, training and development, and recruitment and selection in its HRM systems. It is worth noting that turnover, retention, and exit management are the individual HRM practices least likely to be included within an HRM system in studies that explore firm innovation.

When analyzing the different types of firm innovation by cultural clusters, we realized that innovation in products or services played a dominant role in the field of HRM systems and firm innovation regardless of the sampled cultural cluster. We also found that researchers had no strong preference for

Table 4. Sampled cultural clusters and sampled industries.

	Sampled industries		
Cultural clusters	Manufacturing	Service	Manufacturing and service
Africa and Middle East	0	1	6
Anglo	31	5	9
Confucian Asia	13	1	12
Southern Asia	2	1	0
Western Europe	19	3	16

Table 5. Different types of firm innovation and sampled industries.

	Sampled industries		
Types of firm innovation	Manufacturing	Service	Manufacturing and service
Innovation in products or services	47	7	26
Innovation in processes	3	3	9
Innovation in organizations and people	15	1	8

Table 6. Components of HRM systems and sampled industries.

	Sampled industries		
Components of HRM systems	Manufacturing	Service	Manufacturing and service
Compensation and benefits	48	11	32
Job and work design	44	7	33
Training and development	50	9	41
Recruiting and selection	39	9	31
Employee relations	27	7	14
Communication	39	7	17
Performance management and appraisal	49	5	29
Promotions	24	3	21
Turnover, retention, and exit management	2	3	1
Other	4	1	1

Table 7. Different types of firm innovation and sampled cultural clusters.

	Sampled cultural clusters				
Types of innovation	Africa and Middle East	Anglo	Confucian Asia	Southern Asia	Western Europe
Innovation in products or services	3	28	18	2	29
Innovation in processes	2	8	1	0	4
Innovation in organizations and people	2	9	7	1	5

Table 8. Components of HRM systems and sampled cultural clusters.

	Sampled cultural clusters				
Components of HRM systems	Africa and Middle East	Anglo	Confucian Asia	Southern Asia	Western Europe
Compensation and benefits	7	32	19	3	30
Job and work design	0	30	22	3	29
Training and development	7	41	22	3	27
Recruiting and selection	7	36	17	2	17
Employee relations	0	29	5	2	12
Communication	0	26	18	2	17
Performance management and appraisal	2	38	16	2	25
Promotions	0	25	7	1	15
Turnover, retention, and exit management	0	4	1	0	1
Other	0	3	3	0	0

cultural clusters when studying innovation in processes and innovation in people and organizations (see Table 7). Performance management and appraisal, job and work design, compensation and benefits, and training and development were the most popular individual HRM practices within HRM systems that explained firm innovation in different cultural clusters (see Table 8).

4 Meta-analytic results and hypotheses testing

In the literature on meta-analysis, researchers design their statistical software based on either a fixed-effects model or a random-effects model. Fixed-effects models assume that exactly the same value underlies all studies in the meta-analysis, while random-effects models allow the possibility that population parameters vary from study to study. The random-effects model is generally used more often. Fixed-effects models are a specific case of random-effects models in which the standard deviation equals zero. Rosenthal-Rubin's meta-analysis approach is based on a fixed-effects model. Hedges and Olkin's or Hedges and Vevea's meta-analyses approaches with random-effects models are rarely used in the literature (Schmidt & Hunter, 2014). Schmidt and Hunter's (2014) meta-analysis approach is widely used in the literature and is based on a random-effects model. Field (2001) found that the three approaches performed similarly when effect sizes were homogeneous, but the Schmidt & Hunter approach had the best performance when effect sizes were heterogeneous. Therefore, this meta-analysis study uses the approach and software from Schmidt and Hunter.

Range restriction can be considered a selection bias; it reflects the deviation between a sample and its population. Researchers categorize range restriction into direct range restriction and indirect range restriction. They generally believe that indirect range restriction is commonly found in empirical studies (Hunter et al., 2006; Le et al., 2016; Schmidt et al., 2006). Given the intrinsic difficulties of social science, Dahlke and Wiernik (2019) suggested that researchers should adjust range restriction, especially indirect range restriction, by using a comprehensive meta-analysis as the population value and then calculating the range restriction ratio by the reliability differences. In the Schmidt & Hunter meta-analysis approach, range restriction is on the independent variable side rather than the dependent variable side (Schmidt & Hunter, 2014). However, based on the intrinsic dynamism of HRM systems and their components, it is very challenging to identify a convincing population level parameter for range adjustment. Therefore, no range restriction is adjusted in this meta-analytic study.

Before conducting any meta-analytic procedures, researchers need to assess the degree of publication bias in their data. Publication bias refers to the systematically representative differences between published studies and unpublished studies (Rothstein et al., 2005). Kepes et al. (2012) provided an insightful review of the different approaches to assessing publication bias: failsafe n, subgroup analyses, funnel plot, trim and fill, cumulative meta-analysis, correlation- and regression-based methods, and selection models. Among these seven approaches, Kepes et al. (2012) recommended the selection models and cumulative meta-analysis approaches to assess publication bias when researchers conduct meta-analyses with heterogeneous assumptions. Selection models are widely used in the Hedges meta-analysis methods; the cumulative meta-analysis approach is broadly applied in the Schmidt & Hunter meta-analysis methods (Kepes et al., 2012). In this paper, we used the Schmidt & Hunter meta-analysis software and therefore applied the cumulative meta-analysis approach to detect the extent of any publication bias in our dataset. For a cumulative meta-analysis, if the mean corrected correlation increases in size as small sample studies are added, this indicates the possibility of publication bias in the low-sample-size studies (Schmidt & Hunter, 2015). In this paper, the range of mean corrected correlation ranged from .288 to .424. The results suggest that concern for publication bias is low in our dataset.

This meta-analysis included 57 unique papers that contributed 119 records to the topic of HRM systems and different types of firm innovation. According to Valentine et al. (2010), researchers only need two studies to conduct a meta-analysis. The bias of meta-analytic results mainly comes from the sample representativeness of included papers, not the number of included papers. Similarly, Schmidt and Hunter (2014) recommended conducting a meta-analysis with three independent studies. Following suggestions from Schmidt and Hunter (2014), we conducted a meta-analytic study for a group with at least three records.

Hypothesis 1 suggested that, at the population level, HRM systems enhance firm (a) innovation in products or services, (b) innovation in processes, and (c) innovation in people and organizations. Table 9 shows the relationships between HRM systems and types of innovation. The relationship between HRM systems and innovation in products or services includes 80 independent studies with 14,429 firm-level responses. The mean true score correlation ($\hat{p}$) is .370, which is statistically significant at 95% confidence level. Therefore, H1(a) was supported. The relationship between HRM systems and innovation in processes includes 15 independent studies with 2834 firm-level responses. The mean true score correlation ($\hat{p}$) is .362, which is statistically significant at 95% confidence level. Therefore, H1(b) was supported. The relationship between HRM systems and innovation in people and organizations includes 24 independent studies with 3973 firm-level responses. The mean true score correlation ($\hat{p}$) is .358, which is statistically significant at 95% confidence level. Therefore, H1(c) was supported.

Hypothesis 2 proposed the moderating effect of sampled industries at the population level. Following the testing approaches in other meta-analysis studies (Cooke & Sheeran, 2004; Schepers & Wetzels, 2007), we first calculated the relationship between HRM systems and different categories of firm innovation in types of different industries. See Table 10 for relationships between HRM systems and types of innovation in industries. Then, we used Fisher's Z method to compare the correlation parameters between HRM systems and different types of firm innovation. As shown in Table 11, the relationships between HRM systems and innovation in products or services are stronger in the service industries than in the manufacturing or mixed industries ($p < .001$). However, the moderating effect of sampled industries was not statistically significant for the relationships between HRM systems and innovation in processes or between HRM systems and innovation in people and organizations. Therefore, Hypothesis 2(a) was supported. Hypotheses 2(b) and 2(c) were not supported.

Hypothesis 3 proposed the moderating effect of sampled cultural clusters at the population level. Table 12 shows relationships between HRM systems and innovation in products or services in different cultural clusters. Based on Fisher's Z values in Table 13, this relationship is the strongest in the African and Middle East cultural cluster, followed by the Confucian Asian cultural cluster. The relationship strengths are not statistically significantly different in the Anglo cultural cluster and the Western European cultural cluster. Hypothesis 3(a) was partially supported. Table 14 shows the relationship between HRM systems and innovation in processes in the

Table 9. HRM systems and types of innovation.

	k	N	$\bar{r}$	SD_r	SD_{pre}	SD_{res}	$\hat{p}$	SD_p	CV_{LL}	CV_{UL}	CI_{LL}	CI_{UL}	%Var
Innovation in products or services	80	14,429	.319	.167	.070	.152	.370	.173	.148	.592	.327	.412	17.410
Innovation in processes	15	2834	.311	.257	.069	.248	.362	.285	−.002	.727	.211	.513	7.150
Innovation in people and organizations	24	3973	.301	.194	.074	.179	.358	.210	.078	.627	.266	.450	14.761

Note: k = number of independent samples; N = total sample size; $\bar{r}$ = sample-size-weighted mean observed correlation; SD_r = sample-size-weighted standard deviation of observed correlations; SD_{pre} = standard deviation of observed correlations predicted from all artifacts; SD_{res} = standard deviation of observed correlations after removal of variances due to all artifacts; $\hat{p}$ = mean true score correlation (corrected for unreliability in both variables); SD_p = true score standard deviation; CV_{LL} and CV_{UL} = lower and upper bounds, respectively, of the 80% credibility interval; CI_{LL} and CI_{UL} = lower and upper bounds, respectively, of the 95% confidence interval around the mean true score correlation; %Var = percentage of variance attributable to statistical artifacts.

Table 10. HRM systems and types of innovation in industries.

Types of innovation	Industry	k	N	$\bar{r}$	SD_r	SD_{pre}	SD_{res}	$\hat{p}$	SD_p	CV_{LL}	CV_{UL}	CI_{LL}	CI_{UL}	%Var
Innovation in products or services	Manufacturing	47	8432	.305	.131	.070	.110	.354	.126	.192	.515	.310	.397	28.850
Innovation in products or services	Service	7	1307	.538	.217	.061	.209	.623	.239	.317	.929	.436	.809	7.776
Innovation in products or services	Mixed	26	4690	.284	.163	.071	.147	.328	.169	.112	.544	.256	.401	18.668
Innovation in processes	Service	3	549	.377	.140	.068	.122	.438	.141	.258	.619	.254	.623	23.507
Innovation in processes	Mixed	9	1640	.361	.299	.068	.291	.420	.335	−.009	.848	.193	.647	5.242
Innovation in people and organizations	Manufacturing	15	2168	.309	.177	.079	.159	.367	.186	.129	.606	.261	.474	19.851
Innovation in people and organizations	Mixed	8	1685	.297	.218	.067	.207	.353	.243	.042	.664	.174	.532	9.406

Note: k = number of independent samples; N = total sample size; $\bar{r}$ = sample-size-weighted mean observed correlation; SD_r = sample-size-weighted standard deviation of observed correlations; SD_{pre} = standard deviation of observed correlations predicted from all artifacts; SD_{res} = standard deviation of observed correlations after removal of variances due to all artifacts; $\hat{p}$ = mean true score correlation (corrected for unreliability in both variables); SD_p = true score standard deviation; CV_{LL} and CV_{UL} = lower and upper bounds, respectively, of the 80% credibility interval; CI_{LL} and CI_{UL} = lower and upper bounds, respectively, of the 95% confidence interval around the mean true score correlation; %Var = percentage of variance attributable to statistical artifacts.

Table 11. Moderation effects of industries (Fisher's Z values) on HRM systems and innovation in products or services.

	$\hat{p}$	k	N	A	B
A. HRM systems and innovation in products or services in manufacturing industries	.354	47	8432		
B. HRM systems and innovation in products or services in service industries	.623	7	1307	−6.047	
C. HRM systems and innovation in products or services in mixed industries	.328	26	4690	.807	6.217

Note: $|Z| > 1.960$ is significant at two-tailed .05 level; $|Z| > 2.576$ is significant at two-tailed .01 level; $|Z| > 3.291$ is significant at two-tailed .001 level.

Table 12. HRM systems and innovation in products or services in cultural clusters.

Cultural clusters	k	N	$\bar{r}$	SD_r	SD_{pre}	SD_{res}	$\hat{p}$	SD_p	CV_{LL}	CV_{UL}	CI_{LL}	CI_{UL}	%Var
African and Middle East	3	668	.507	.137	.058	.125	.587	.142	.405	.770	.407	.767	17.727
Anglo	28	6554	.276	.105	.063	.085	.319	.097	.195	.444	.274	.365	35.260
Confucian Asian	18	2970	.345	.148	.072	.130	.400	.149	.209	.590	.320	.479	23.288
Western European	29	3747	.314	.198	.082	.180	.363	.206	.099	.627	.280	.447	17.021

Note: k = number of independent samples; N = total sample size; $\bar{r}$ = sample-size-weighted mean observed correlation; SD_r = sample-size-weighted standard deviation of observed correlations; SD_{pre} = standard deviation of observed correlations predicted from all artifacts; SD_{res} = standard deviation of observed correlations after removal of variances due to all artifacts; $\hat{p}$ = mean true score correlation (corrected for unreliability in both variables); SD_p = true score standard deviation; CV_{LL} and CV_{UL} = lower and upper bounds, respectively, of the 80% credibility interval; CI_{LL} and CI_{UL} = lower and upper bounds, respectively, of the 95% confidence interval around the mean true score correlation; %Var = percentage of variance attributable to statistical artifacts.

Table 13. Moderation effects of cultural clusters (Fisher's Z values) on HRM systems and innovation in products or services.

	$\hat{p}$	k	N	A	B	C
A. HRM systems and innovation in products or services in the African and Middle East cultural cluster	.587	3	668			
B. HRM systems and innovation in products or services in the Anglo cultural cluster	.319	28	6554	4.208		
C. HRM systems and innovation in products or services in the Confucian Asian cultural cluster	.400	18	2970	2.907	−2.104	
D. HRM systems and innovation in products or services in the Western European cultural cluster	.363	29	3747	3.478	−1.215	.881

Note: $|Z| > 1.960$ is significant at two-tailed .05 level; $|Z| > 2.576$ is significant at two-tailed .01 level; $|Z| > 3.291$ is significant at two-tailed .001 level.

African and Middle East cultural cluster and in the Western European cultural cluster. Although both groups have positive effect sizes, the moderating effect of sampled cultural clusters was not statistically significant for the relationships between HRM systems and innovation in processes. Hypothesis 3(b) was not supported. Table 15 shows the relationship between HRM systems and innovation in people and

Table 14. HRM systems and innovation in processes in cultural clusters.

Cultural clusters	k	N	$\bar{r}$	SD_r	SD_{pre}	SD_{res}	$\hat{\rho}$	SD_p	CV_{LL}	CV_{UL}	CI_{LL}	CI_{UL}	%Var
Anglo	8	1487	.225	.112	.071	.087	.262	.100	.135	.390	.172	.353	40.295
Western European	4	828	.192	.162	.068	.147	.223	.169	.007	.440	.039	.408	17.716

Note: k = number of independent samples; N = total sample size; $\bar{r}$ = sample-size-weighted mean observed correlation; SD_r = sample-size-weighted standard deviation of observed correlations; SD_{pre} = standard deviation of observed correlations predicted from all artifacts; SD_{res} = standard deviation of observed correlations after removal of variances due to all artifacts; $\hat{\rho}$ = mean true score correlation (corrected for unreliability in both variables); SD_p = true score standard deviation; CV_{LL} and CV_{UL} = lower and upper bounds, respectively, of the 80% credibility interval; CI_{LL} and CI_{UL} = lower and upper bounds, respectively, of the 95% confidence interval around the mean true score correlation; %Var = percentage of variance attributable to statistical artifacts.

Table 15. HRM systems and innovation in people and organizations in cultural clusters.

Cultural clusters	k	N	$\bar{r}$	SD_r	SD_{pre}	SD_{res}	$\hat{\rho}$	SD_p	CV_{LL}	CV_{UL}	CI_{LL}	CI_{UL}	%Var
Anglo	9	1317	.230	.057	.080	0[a]	.273	0[a]	.273[a]	.273[a]	.229	.317	100[b]
Confucian Asian	7	176	.239	.151	.075	.131	.284	.154	.088	.481	.151	.417	24.827
Western European	5	1035	.342	.237	.067	.228	.406	.268	.064	.749	.159	.653	7.855

Note: k = number of independent samples; N = total sample size; $\bar{r}$ = sample-size-weighted mean observed correlation; SD_r = sample-size-weighted standard deviation of observed correlations; SD_{pre} = standard deviation of observed correlations predicted from all artifacts; SD_{res} = standard deviation of observed correlations after removal of variances due to all artifacts; $\hat{\rho}$ = mean true score correlation (corrected for unreliability in both variables); SD_p = true score standard deviation; CV_{LL} and CV_{UL} = lower and upper bounds, respectively, of the 80% credibility interval; CI_{LL} and CI_{UL} = lower and upper bounds, respectively, of the 95% confidence interval around the mean true score correlation; %Var = percentage of variance attributable to statistical artifacts.

[a] Based on a simulation study from Brannick et al. (2019), researchers found the Hunter & Schmidt method tends to have a narrower range for credibility intervals and confidence intervals compared to other meta-analysis methods. The main reason is that the Hunter & Schmidt method selects estimators with small sampling variances. "When the number of effect sizes is small (say 5 or 10), the difference can be large enough to be consequential" (Brannick et al., 2019: 494).

[b] Percentage of variance attributable to statistical artifacts as calculated by the Hunter & Schmidt meta-analysis program was actually greater than 100%, since the Hunter & Schmidt method tends to overestimate the amount of variance due to sampling error when K and N are small (Brannick & Hall, 2001; Rabl et al., 2014).

organizations in the Anglo cultural cluster, the Confucian Asian cultural cluster, and the Western European cultural cluster. Although all groups have positive effect sizes, the moderating effect of sampled cultural clusters was not statistically significant for the relationships between HRM systems and innovation in people and organizations. Hypothesis 3(c) was not supported.

5 Discussion and future research direction

This paper has examined the meta-analytic relationships between HRM systems and different types of innovation based on existing empirical studies. It has followed the research direction suggested by Bowen and Ostroff (2004) and studied the meta-features of HRM systems. Our findings show that HRM systems enhance all three types of firm innovation. Training and job design are high-frequent practices within HRM systems used to explore firm innovation. This paper has also followed the research directions suggested by Bhatnagar (2012), Do et al. (2016), and Natalicchio et al. (2018) and examined the effects of industry and cultural clusters. We find that most empirical studies have been conducted in the Anglo, Confucian Asia, and Western Europe cultural clusters. Although researchers have realized the existence of different types of firm innovation, innovation in products or services has received more study interest than innovation in processes or than innovation in people and organizations. Based on the current sample, we find that sampled cultural clusters and industries moderate the relationship between HRM systems and innovation in products or services ($p < .05$).

Cohen (1988) suggested that .1, .3, and .5 represented small, medium, and large effect sizes. Some researchers suggested .2, .5, and .8 as the small, medium and large effect sizes (Gignac & Szodorai, 2016; Sawilowsky, 2009). Other researchers suggested that the effect size strength should vary based on sample size (Goulet-Pelletier & Cousineau, 2018). Detailed discussion of effect sizes goes beyond the scope of this paper. We would like to remind readers that, if the meta-analytic effect size ($\hat{\rho}$) is small and/or insignificant at the population level, it is still possible that the independent variable plays a significant role in the dependent variable in a niche field or sample.

We would like to remind readers to hold critical views on relations between HRM systems and firm innovation. Although this paper has examined different types of firm innovation, it is a construct mainly studied as an outcome variable. On the one hand, emphasizing innovation excessively may harm firm short-term operational performance and financial performance. On the other hand, firm innovation may have been included or studied in firm performance. Researchers found an inverted-U relationship between HRM systems and firm performance (Chi & Lin, 2011; Gu & Liu, 2022).

Finally, we would like to bring up the limitations of this paper and hope to clarify some future research directions. First, compared to innovation in products or services, innovation in processes and innovation in people and organizations have fewer empirical records. Future researchers can benefit from exploring the relationship between HRM systems and innovation in processes and innovation in people and organizations. Second, we have not found convincing population-level parameters for range restriction adjustment. Our study has not addressed the range restriction influence. Future researchers should make more effort to control or reduce the effect of range restriction in their empirical or meta-analytic studies. Third, our study has listed different types of firm innovation. Future researchers can examine relationships among these types of firm innovation in addition to HRM systems.

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