

Development and Validation of Novel Constructs to Measure the Effectiveness of Human Resource Information Systems

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Abstract

The primary objective of this study is to develop a statistically validated set of constructs based on constructs derived from the existing literature. This new set of constructs is validated through empirical research that may further be used to assess the effectiveness of a human resource information system (HRIS) used in various IT companies. This study incorporates data collected only from the information technology (IT) companies operating in India. The research is mainly exploratory and descriptive. Data were collected from employees of IT companies registered with The National Association of Software and Services Companies (NASSCOM), India, on a simple random basis. Exploratory factor analysis (EFA) of data brought the initial count of eight identified dimensions to four. Further, a confirmatory factor analysis (CFA) using the structural equation modeling (SEM) approach proposed by the authors resulted in an excellent fit, reflecting the accuracy and usability of the derived constructs in the model. Thus, four new constructs are now available to measure HRIS effectiveness. Although the scale developed was empirically measuring an HRIS's effectiveness well, it may, however, require further improvements or modifications to suit specific research conditions outside the Indian IT industry. Organizations now need not involve numerous aspects of HRIS effectiveness measurement. They may now use this model and the included scale to evaluate the extent to which their HRIS is effective and assess the kind of impact it has on different aspects of human resource management at their workplace. This study has brought down the size of the scale of IS effectiveness measurement, without compromising much with the previously published constructs by scholars and experts.

Keywords: *Confirmatory factor analysis (CFA), Exploratory factor analysis (EFA), Human resource information system (HRIS), Indian IT industry.*

1. Introduction

Human resource information systems (HRIS) have gained several definitions—a computerized database meant to collect, store, manage, deliver manipulated data about the human resources [1]; a system for collecting, storing, maintaining, retrieving, and validating human resources data [2]; and a system used for the acquisition, storage, analysis, and communication of retrieved data [3]. Recent definitions of HRIS see it more as a computerized HR management tool. Previous studies have shown that smaller organizations won't incline towards HRIS much [4], [5]. But with the increasing workforce size, HR management would become a tedious task. Therefore, not surprisingly, by the end of the 20th century, almost 60% of the Fortune 500 companies had already introduced HRIS to support HR management process [4]. In the recent past, larger organizations, in particular, have adopted HRIS to facilitate HR management [6]. In the 21st century, the role of HR management has shifted from the administration of human resources to a more strategic position of performance improvement of the organization [7]–[9]. The benefits of computerization in business processes such as accuracy, timeliness, saving operational cost [2], [10], and information dissemination across geographical boundaries are well known. It is also known to improve organizational competitiveness, reporting standards, reengineering the entire HR function of the company, and its ability to shift focus from transactional support to strategic support [11]. An HRIS will improve not only the

administrative HR functions of an organization [2], [12] but also its strategic decision-making potential [11], [13]. The need for a highly effective HRIS is therefore quite imminent. Business houses invest heavily in the procurement and implementation of HRIS. This investment will turn into a disaster if their HRIS fails to deliver the intended benefits to the organization. Therefore, a precise assessment of HRIS effectiveness is desirable. Studies conducted in the past have revealed different perspectives of measuring IS effectiveness [14], resulting in a wide range of dimensions that have been regularly used in similar studies. Delone and McLean (1992) pressed researchers to combine individual aspects of IS effectiveness and derive a comprehensive measurement instrument.

The primary objective of this study was to use the existing set of dimensions of HRIS effectiveness measurement and obtain a new scale with an empirically-validated set of constructs. This research comes forward with a concise, yet instrumental tool to assess the effectiveness of an HRIS in any organization with promising reliability and accuracy.

2. Literature Review

Evolution of HRIS Effectiveness Measurement Models

It is crucial to determine the effectiveness of an information system to justify hefty investments in procurement and implementation of information systems, improving managerial decisions, and adding value to the organization [15]. Although the assessment of IS effectiveness is deemed critical, there is a lack of consensus about its definition and its operationalization [16]. Delone and Mclean conducted exhaustive research in the area of IS effectiveness and had proposed a D&M IS Success Model [17]. In this model, they outlined six different constructs, viz., system quality, information quality, use, user satisfaction, individual impact, and organizational impact. They argued that these six dimensions are interrelated, indicating a causality flow in the direction of the information process. This model met several constructive criticisms, especially related to the constructs and the relationships among them. They reviewed those reservations and improved the model to come up with an updated model in the year 2003 that comprised of a set of six dimensions, viz., information quality, system quality, service quality, intention to use, user satisfaction, and net benefits [15]. Among these parameters, system quality, information quality, and system success are believed to be vital for any organization to gain competitive advantage and thereby making it essential to continue research to identify new scales and measures of organizational effectiveness [14]. Other dimensions, such as '*usage*' [18]–[20], '*user satisfaction*' [21]–[24], '*cost*' [25], '*system quality*' [26] have also been used in numerous studies on IS effectiveness. Studies to assess the benefits of HRIS are available. Few noteworthy studies are related to the role of HRIS for cost advantage and other transformational goals [27], faster and efficient operational, administrative support, as well as strategic and transformational efficiency [6], [28], [29].

HRIS in India: A Review

A study conducted in the National Aluminium Company (NALCO) Limited revealed that HRIS is primarily used for administrative support. Despite a need for the reengineering of the system, it has improved the rate of execution of HR functions and facilitated better competency [30]. NALCO could further save the cost of HRIS by opting to develop an in-house software module, but the decision proved to be time-consuming [31]. HRIS packages being used by the organizations in India can potentially serve as a decision support system (DSS) to administrative as well as strategic purposes [32]. Despite the adoption and implementation of HRIS by companies operating in India, it still fails to cater to all the business levels and needs reengineering to become relevant and purposeful [33]. Although HRIS is used extensively in India, and it contributes significantly in the areas of human resource administration, compensation management, organizational development, and human resource planning, its utility and returns realized are still below par when compared to that with companies in the developed

economies [34]. One of the studies identified that most of the companies operating in India (80.77%) had implemented HRIS only in the last ten to fifteen years, and those HRIS modules are mostly purchased from third-party proprietary HRIS vendors [35]. Out of those many different modules available in the HRIS packages used by the Indian companies, it was found that they use it mostly for technical and strategic purposes, and also for performance and reward management [36]. Yet, not all companies could capitalize fully on their HRIS's potential, and not all the possible benefits from it could be realized [31]. It was observed that nearly all the IT companies in India are using HRIS, and it delivers a positive impact on their HR management efforts [37].

Most of the previous studies have relied heavily on the IS Effectiveness Model of DeLone and McLean, and the preidentified constructs to measure IS effectiveness were used without any significant deviations. The authors, therefore, see some scope to explore and propose a few new dimensions to measure the same and contribute to the existing literature of HRIS effectiveness models.

3. Scale Development and Validation

The efforts towards the scale development started with the identification of select constructs derived from the literature. Operational HRM, Functional HRM, and Strategic HRM are the three essential constructs that can be used for measuring the effectiveness of e-HRM [6]. Taking cues from previous studies, the authors used eight initial constructs to proceed with: system quality, information quality, user satisfaction, savings, system utility, operational HR management, functional HR management, and strategic management.

Item Generation and Scale Construction

The authors developed a 50-items, self-administered, close-ended, 5-point Likert scale questionnaire in agreement scale (from 1 = strongly disagree to 5 = strongly agree) for data collection. The items were derived from the studies discussed in the previous section, and few of them were modified to suit the research requirements.

Content Validation

Fifteen copies of the questionnaire were distributed to the Professors in the North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh, India) as the subject matter experts for its content validity. Experts were provided with the questionnaire, along with the definitions of constructs for content validation.

Table 1. Definitions of the Eight Constructs of HRIS Effectiveness

Constructs	Definition
System Quality	This dimension focuses on the overall performance of the system under study.
Information Quality	This parameter refers to the quality of output produced by the HRIS, value addition, general utility, and importance attributed to it by the users.
User Satisfaction	This construct includes the assessment of different benefits derived by the HRIS's stakeholders, both inside and outside the organization.
Savings	This dimension reflects the range of savings HRIS users can make in the form of financial cost, time, and labor.
System Use	This construct identifies the extent to which the HRIS is used and whether its full functionality is used as intended or not.
Operational HRM	This dimension represents the role of HRIS in discouraging the daily administrative challenges such as data entry, record keeping, attendance & absenteeism, leave management,

	payroll, compensations, pensions, etc.
Functional HRM	This construct includes measures to assess the technical roles executed by managers such as staffing, training needs assessment, performance appraisal, compensation management, health & safety, employment equity, etc.
Strategic HRM	This parameter represents strategic roles such as career development, turnover analysis, human resource planning, competitive advantage, and adding value to the organization.

The theoretical descriptions of the constructs are put forward in Table 1. Items having an agreement of more than 90% were selected for further application in the study. Out of the original 50 questions, 36 were retained, and the rest 14 items were dropped. The final eight constructs with their variables are presented in Table 2.

Table 2. HRIS Effectiveness Items After Content Validity

Constructs/Items
<p>System quality</p> <ol style="list-style-type: none"> *HRIS has increased the data security-related threats for my company. Extensive training is not required to get used to our current HRIS hardware and software. I have 24x7 access to the HRIS from a range of platforms. Our HRIS software is bug-free and hence requires minimum tech-support. Access to the HRIS is granted to the employees through their respective user IDs and passcodes only. The server hosting my company's HRIS is protected by a robust & updated firewall. <p>Information quality</p> <ol style="list-style-type: none"> The information generated by the HRIS is concise and free from personal biases. The information generated by the HRIS is of high quality and precise. *Information generated by the HRIS is not so accurate and hence not much reliable. The information generated by the HRIS is relevant & as per the user requirements. <p>User satisfaction</p> <ol style="list-style-type: none"> *I feel dissatisfied with the HRIS because it has a sophisticated user interface and is challenging to work. I am satisfied with the accuracy, preciseness, and timeliness of the reports generated by HRIS. There is a strong sense of user satisfaction for HRIS due to a range of useful outputs derived from it. <p>Savings</p> <ol style="list-style-type: none"> HRIS has minimized paperwork in my office. Our recruitment costs have come down due to HRIS. Our training expenses have come down due to HRIS. HRIS has reduced data input, data maintenance, and other overall management expenses. HRIS has facilitated time savings in communicating information with our stakeholders. <p>System use</p> <ol style="list-style-type: none"> The built-in features of our HRIS package are a close match to the actual management requirements.

2. All the modules in the HRIS package are being used to the best possible extent in my company.
3. *There are a few unused modules of HR management in our HRIS package.

Operational HRM

1. HR managers can manage employee data related to their attendance, leaves, payrolls, pensions, etc. more efficiently by using HRIS.
2. Data input and record-keeping can be taken care of more efficiently through HRIS.
3. HRIS has led to the complete automation of our HRM activities.
4. Employees in my office may view and edit their primary personal employment data themselves.

Functional HRM

1. HRIS has improved the recruitment and selection process.
2. There has been a drop in the employee turnover rate after the implementation of HRIS.
3. *HRIS hasn't helped in employee-management conflict resolution.
4. HRIS has improved our training and development process.
5. HRIS has contributed to improving the performance appraisal system of my organization.

Strategic HRM

1. HRIS is proving to be more of a decision support system (DSS) rather than just an automation tool.
2. HRIS has added the desired value to our organization and enhanced its competitive advantage.
3. HR managers now focus on employee career development with the help of HRIS in our organization.
4. The strategic decision-making ability of our HR department has improved by the inputs from HRIS.
5. HRIS can assess our current employment situation and facilitate forecasting of future workforce requirements.
6. The organization's mission and business objectives can now be achieved effectively using HRIS.

Data Collection and Cleansing

Next, an online questionnaire on 'Google Forms' platform was framed and e-mailed to professionals (executives and managers) working with the IT and ITeS companies operating in India. Companies registered with the National Association of Software and Services Companies (NASSCOM), India, were chosen in the sampling unit. The questionnaire set was e-mailed to 554 prospective respondents working at various levels in the IT companies, and a total of 427 responses were received.

Monotones are those non-valuable responses that simply have no variance and should be dropped before further analysis [38]. After transferring the dataset to an excel sheet, the check for variations was conducted. All the response sets were found to have some variance, and therefore, no monotones were identified. Missing values are incomplete responses. The possibility of missing values was eliminated while preparing for the online questionnaire itself. All the items were marked as compulsory, thereby preventing incomplete form submission.

The common method bias (CMB) may lead to questionable inferences drawn out of the statistical analysis and thus posing the threat of invalid conclusions [39], [40]. The CMB can be attributed by the respondents (e.g., consistency motif and social desirability), item characteristics (e.g., complex and ambiguous items), context (e.g., context-induced mood), and measurement context (e.g., time and location of measurement, universal medium to obtain measurement) [39]. The occurrence of CMB in this study was averted by

introducing procedural measures such as ensuring respondent anonymity and minimizing evaluation apprehension, counterbalancing question order by shuffling and improving scale items by using negatively scored items. Harman’s single factor test, the statistical measure to test CMB, was also conducted on the IBM SPSS software platform. After loading all the variables into the unrotated factor analysis and restricting the number of factors to one, it was found that the percentage of variance accounted for the first component is 43.046%, which is less than 50%. This means that the instrument used for this study is statistically free from any significant common method bias.

4. Exploratory Factor Analysis (EFA)

Factor analysis is needed to measure the latent (unobserved) variables that are reflected by their corresponding observed variables. A reliable questionnaire (scale) is the one that reproduces the same/similar results repeatedly. Internal consistency is an important measurement property for questionnaires that intend to measure a single underlying construct by using multiple items [41], and the Cronbach’s alpha (α) is the most common measure of scale reliability [42]. Literature suggests a minimum alpha (α) cut-off value at 0.5 [43], [44] and a more stringent suggested value at 0.7 [45]. The observed Cronbach’s alpha (α) value for the instrument used in this study obtained from SPSS is 0.954, signifying a good internal consistency. Principle components analysis (PCA) method with varimax rotation was used in this study. In order to determine the factorability of an inter-correlation matrix, the Keiser-Meyer-Olkin (KMO) test and Bartlett’s test of sphericity was conducted on the data set. A KMO score of 0.6 or higher is considered adequate and 0.8 or higher is considered good for factorization [46]. KMO value of 0.7 and above would mean that PCA can be carried out without facing sample size issues. The KMO score for the instrument used in this study was found to be 0.887, which is comfortably beyond the acceptable range, thus, confirming the factorability of the dataset. At the same time the Bartlett’s test of sphericity (ρ) is a statistical measure used to test the null hypothesis that correlation matrix derived in the study is an identity matrix. Ideally, the ρ -value is desired to be insignificant, i.e., the value should ideally be ≤ 0.05 . The closer the value to 0, the better the factor analysis is expected to be. The ρ -value in this study was found to be 0.000. As $\rho < 0.05$, the null hypothesis is rejected and would mean that the correlation matrix is not an identity matrix and further analysis can be carried out.

After all the prerequisites for a deficiency-free factor analysis were taken care of, EFA was conducted on SPSS, and four distinct factors were identified. After an orthogonal rotation, seven items were dropped by SPSS for low factor loadings (< 0.5), and another four items were dropped because there were less than three items loaded to the factors. As a result, only first four components loaded with nine, eight, five, and three questions respectively were retained, and only those select four factors were used to measure the effectiveness of HRIS in the Indian IT industry. The outcomes of EFA resulted in 25 items grouped with four new dimensions/constructs. The new groups were renamed to create new constructs, as summarized in Table 3.

Table 3. Summary of EFA findings

Constructs/Items	Factor loadings
Informed Business Process	
1. The information generated by the HRIS is relevant and as per the user requirements.	.856
2. The information generated by the HRIS is concise and free from personal biases.	.842
3. The information generated by the HRIS is of high quality and precise.	.776
4. I am satisfied with the accuracy, preciseness, and timeliness of the reports generated by HRIS.	.760
5. There is a strong sense of user satisfaction for HRIS due to a range of useful	

outputs derived from it.	.696
6. The built-in features of our HRIS package are a close match to the actual management requirements.	.681
7. HRIS has improved our training and development process.	
8. The organization's mission and business objectives can now be achieved effectively using HRIS.	.654 .597
9. HRIS has contributed to improving the performance appraisal system of my organization.	.565
Strategic Value	
1. Our training expenses have come down due to HRIS.	
2. Our HRIS software is bug-free and hence requires minimum tech-support.	.743
3. HRIS has minimized paperwork in my office.	.664
4. HRIS is proving to be more of a decision support system (DSS) rather than just an automation tool.	.651 .625
5. HRIS has reduced data input, data maintenance, and other overall management expenses.	.612
6. HRIS has added the desired value to our organization and enhanced its competitive advantage.	.589
7. The strategic decision-making ability of our HR department has improved by the inputs from HRIS.	.579
8. Our recruitment costs have come down due to HRIS.	
IT Infrastructure and Data Security	
1. Access to the HRIS is granted to the employees through their respective user IDs and passcodes only.	.552 .783
2. I have 24x7 access to the HRIS from a range of platforms.	
3. The information generated by the HRIS is not so accurate and hence not much reliable.	.729 .572
4. HR managers can manage employee data related to their attendance, leaves, payrolls, pensions, etc. more efficiently by using HRIS.	.510
5. The server hosting my company's HRIS is protected by a robust and updated firewall.	.505
Module Usage Benefits	
1. All the modules in the HRIS package are being used to the best possible extent in my company.	.640
2. There has been a drop in the employee turnover rate after the implementation of HRIS.	.640
3. HRIS has led to the complete automation of our HRM activities.	.606

5. Confirmatory Factor Analysis

Once the four new factors were identified after the EFA stage, it was now required to test the hypothesis that a relationship between the observed variables and their underlying latent constructs exists. By doing this, it can be established that these four new constructs would adequately measure the effectiveness of HRIS or not. Whereas, in the EFA, the factor structure (how the variables relate, and group based on inter-variable correlations) is explored; in the CFA, the factor structure extracted in the EFA is confirmed.

The authors believe that there is a close relationship among the constructs and propose a model to be tested using CFA on the IBM AMOS platform (Figure 1).

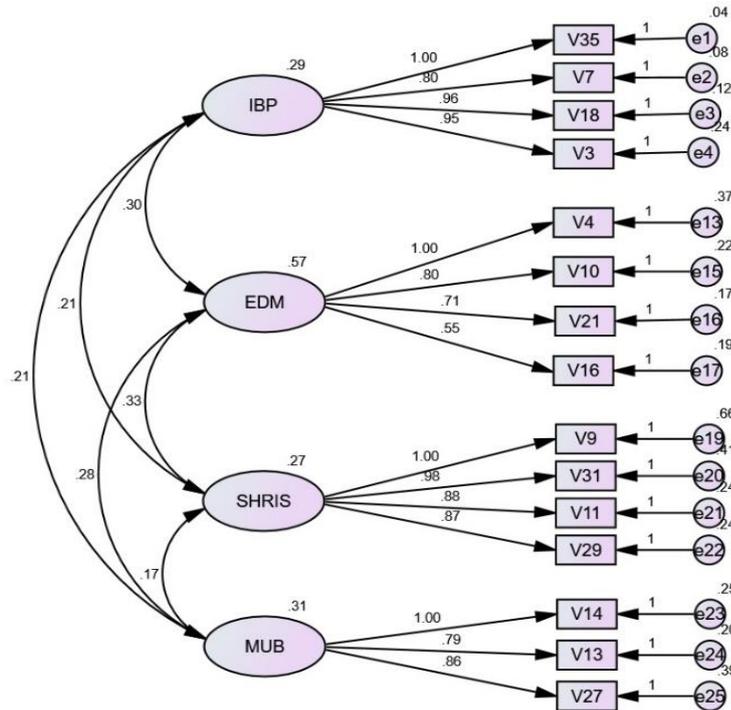


Figure 1. CFA Model

The constructs were code-named as IBP (informed business process), EDM (economic decision making), SHRIS (secured HRIS infrastructure), and MUB (module usage benefits). Initially, all the items were loaded in the model for CFA. But the simulation yielded poor model-fit indices. The authors then had to introduce several modifications to improve the statistics and arrive at an acceptable model that has a reduced number of items loaded to the constructs (as depicted in Figure 1). The description of the v with their respective variable names used in the model is given in Table 4. The model-fit indices variables derived from the model from the simulation are given in Table 5.

Table 4. The New Constructs and Measuring Variables

Construct	Items	Variable Code
Informed Business Process (IBP)	It makes all the relevant information readily available on demand.	V35
	It processes concise information that is free from biases.	V7
	It generates high-quality information.	V18
	It delivers precisely the information that was sought.	V3
Economic Decision Making (EDM)	It contributes to the company as a decision support system.	V4
	It delivers value addition and surges in the competitive advantage of the company.	V10
	It improves the strategic decision-making abilities of the HR department.	V21
	It causes a downfall in the recruitment costs for the company.	V16
Secured HRIS	It grants me a seamless 24x7 access on a	V9

Infrastructure (SHRIS)	variety of platforms.	
	It runs on a secured IT infrastructure capable of delivering accurate and reliable information.	V31
	It confirms secured data access and information management.	V11
	It is protected by robust cyber-security measures like firewalls and antivirus programs.	V29
Module Usage Benefits (MUB)	All the built-in modules of the HRIS package are used in the company.	V14
	It has reduced the employee turnover rate from the company.	V13
	It has resulted in 100% automation of the human resource management process.	V27

Table 5. Model-fit Indices

Test Index	Cut-off limit	Measured value
p-value	> 0.05	0.112
SRMR	< 0.08	0.0567
GFI	> 0.90	0.885
TLI	> 0.95	0.971
CFI	> 0.90	0.977
RMSEA	< 0.08	0.045

6. Discussion and Conclusion

The confirmatory factor analysis of the derived constructs from the exploratory factor analysis yielded some highly encouraging indices. The EFA stage started with eight initial constructs to measure HRIS effectiveness. These constructs were derived from the existing literature. The authors in this study reduced this number to four, using the principal component analysis (PCA) technique during the EFA. These four new constructs were then renamed according to the items loaded on them. These constructs were meant to measure HRIS effectiveness with similar accuracy. The idea behind this study was to come forward with a concise set of constructs and items measuring them.

Subsequently, the four new constructs, viz., informed business process, economic decision making, secured HRIS infrastructure, and module usage benefits were made to pass through a confirmatory factor test on IBM AMOS. The results reflect that the four constructs are related closely enough to assess HRIS effectiveness, even with a reduced number of items loaded for measurement. This study adds to the existing literature on HRIS effectiveness measurement. Studies on similar aspects may now make use of this smaller item-set. It will facilitate faster analysis and lesser complexities, without compromising on the quality of outcomes.

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