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ANALYSIS OF THE INFLUENCE OF ERP ON THE PERFORMANCE OF MOROCCAN COMPANIES: VALIDITY OF THE MEASUREMENT MODEL

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A B S T R A C T

This paper focuses on the study of ERP (Enterprise Resource Planning) impact on the performance of Moroccan companies, while highlighting the causal relationships between the contributions of ERP and the measurement criteria of various aspects of performance, including economic, organizational, and human aspects.
Our primary objective is to test the reliability and validity of the measurement model for the impact of ERP on the performance of Moroccan companies.
To achieve this, we conducted a quantitative study using a questionnaire administered to Moroccan companies that use ERP systems. The collected data were then subjected to confirmatory factor analysis through structural equation modeling, particularly using the PLS (Partial Least Squares) approach.
The results of this study demonstrated that the assessment of the impact of ERP systems on the performance of Moroccan companies can be conducted using a questionnaire tailored to professionals.

1. INTRODUCTION

In a globalized digital environment, every functional or operational manager faces the challenge of decision-making and ensuring information quality. This challenge can be effectively addressed through the implementation of an Enterprise Resource Planning (ERP) system, which serves as an integrated management solution, enabling companies to standardize their IT systems to control and automate core processes.

Today, ERPs have become essential tools for supporting companies' globalization efforts by establishing a global information-sharing framework. These software solutions are configurable, modular, and designed for integration, allowing them to connect all data related to a company's functions through a unified database. Additionally, they consolidate the entire IT infrastructure into a single software suite. Through this integration, ERP systems can retrieve information automatically and almost instantly at all levels of the company hierarchy. This capability makes ERP systems a top choice for most companies (Marciniak, 1996).

The adoption of ERP systems within a company can yield general administrative productivity gains as well as specific operational advantages (Deixonne, 2001). Marciniak (2001) summarizes the expected benefits of ERP implementation in Table 1.

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Table 1. Expected Benefits of an ERP (Marciniak et al., 2001)

Reliability of Information	• Unified data entry, vocabulary and information • Common tool for a large number of individuals • Cross- checks and controls • Reduction in information volume • Traceability and visibility of information
Productivity	• Elimination of duplicate data entry • Automated reconciliations • Information enrichment throughout the process • Reduced paper usage • Availability of aggregated information
Responsiveness	• Instantaneous updates • Multi-criteria query tools
Cost and ownership optimization	• Ability to evaluate based on the organization's needs • Reduction in application and technical infrastructure landscape

In this context, this work aims to explore the connection between the implementation of ERP systems and the enhancement of performance in Moroccan companies.

The concept of performance has been the subject of various definitions, measurement approaches, and evaluation models. In French dictionaries, performance is defined as an official assessment that records an accomplishment at a specific moment, in reference to a context, an objective, and an expected result, regardless of the field of activity (Notat, 2007).

Recognizing that performance encompasses multiple facets, likely converging but deserving a more comprehensive approach than merely assessing profitability for the company or shareholders (Marmuse, 1997), one of the primary discussions in economic sector strategy revolves around the determining factors of organizational performance. Researchers from different fields have dedicated themselves to explaining performance and identifying sources of various performance levels.

By focusing on performance measurement indicators, it was important to establish a link between the contributions of ERP implementation and these indicators.

2. RESEARCH METHODOLOGY

To achieve our objective, we chose a quantitative approach as a relevant methodological choice, using a valid and reliable questionnaire for data collection. The targeted population consisted of ERP users in Morocco, from companies of all sizes and sectors.

To measure the intensity of our variables, we employed 5-point Likert-type attitude scales. The dependent latent variables, namely "economic performance," "organizational performance," and "human performance," were measured successively using 7, 6, and 4 items, while the independent latent variables, namely "economic contributions," "organizational contributions," and "human contributions," were measured successively using 7, 5, and 3 items.

For the independent latent variables, we have selected the measures presented in Table 2, 3 and 4. For the independent latent variables, we have selected the measures presented in Table 5, 6 and 7.

Table 2. The selected measures of the independent variables (Economic Contribution)

	Codes	Items	Formulation
Eco. Cont.	AE1	Time savings	The ERP has enabled time savings.
	AE2	Savings in material resources	The ERP has enabled material minimization.
	AE3	Savings in human resources	The ERP has allowed for a reduction in personnel expenses.
	AE4	Improvement in service/product quality	The ERP has improved the quality of the company's services and products.
	AE5	Enhancement of customer satisfaction	The ERP has made customers very satisfied.
	AE6	Increase in revenue	The ERP has increased sales.
	AE7	Expansion of market share	The ERP has allowed for a better position in the market.

Table 3. The selected measures of the independent variables (Organisational Contribution)

	Codes	Items	Formulation
Orga. Cont.	AO1	Facilitates access to information	The ERP has facilitated access to information.
	AO2	Enhances the reliability of provided information	The ERP has improved the reliability of communicated information.
	AO3	Simplifies control tasks	The ERP has streamlined control tasks.
	AO4	Improves coordination within the company	The ERP has enhanced coordination within the company.
	AO5	Contributes to decision decentralization	The ERP has contributed to decision decentralization.

Table 4. The selected measures of the independent variables (Human Contribution)

	Codes	Items	Formulation
Hum. Cont.	AH1	Increase employee productivity	The ERP has increased employee productivity.
	AH2	Enhance the knowledge and skills of the staff	The ERP has improved the knowledge and skills of the staff.
	AH3	Improve employee satisfaction	The ERP has enhanced employee satisfaction.

Table 5. The selected measures of the independent variables (Economic Performance)

	Codes	Items	Formulation
Eco. Perf.	PE1	Time Savings	Time savings is an indicator of economic performance.
	PE2	Material Resource Efficiency	Material resource efficiency is an indicator of economic performance.
	PE3	Human Resource Efficiency	Human resource efficiency is an indicator of economic performance.
	PE4	Quality of Services/Products	The quality of services/products is an indicator of economic performance.
	PE5	Customer Satisfaction	Customer satisfaction is an indicator of economic performance.
	PE6	Revenue	Revenue is an indicator of economic performance.
	PE7	Market Share	Market share is an indicator of economic performance.

Table 6. The selected measures of the independent variables (Organisational Performance)

	Codes	Items	Formulation
Orga. Perf.	PO1	Information Flow Quality	Information Flow Quality is an indicator of organizational performance.
	PO2	Reliability of Communicated Information	Reliability of Communicated Information is an indicator of organizational performance.
	PO3	Degree of Control	Degree of Control is an indicator of organizational performance.
	PO4	Coordination	Coordination is an indicator of organizational performance.
	PO5	Decentralization	Decentralization is an indicator of organizational performance.
	PO6	Speed of Decision Making	Speed of Decision Making is an indicator of organizational performance.

Table 7. The selected measures of the independent variables (Human Performance)

	Codes	Items	Formulation
Hum. Perf.	PH1	Employee Productivity	Employee Productivity is an indicator of human performance.
	PH2	Knowledge and Skills of Personnel	Knowledge and Skills of Personnel is an indicator of human performance.
	PH3	Employee Satisfaction	Employee Satisfaction is an indicator of human performance.
	PH4	Training	Training is an indicator of human performance.

The chosen method for analyzing the collected data is the Structural Equation Modeling (SEM) method using the SmartPLS4 software. This choice can be justified for three main reasons:

-It allows us to model latent variables, which is crucial for studying abstract and unobservable concepts.

-It enables us to ensure the reliability and validity of the measurement model, ensuring that the measures used are consistent and accurate in assessing latent variables.

-It allows us to investigate the direct, indirect, and total effects among multiple variables, providing a comprehensive understanding of relationships within the model.

To assess the reliability and validity of the measurement model, we relied on the measurement instruments presented in Table 8.

Table 8. Measurement Instruments for Reliability and Validity Evaluation

Reliability	Rhô of Jöreskog	The value considered to indicate a good level of reliability is 0.7 (Tenenhaus et al. 2005).
Convergent Validity	Factor Loeding	-A correlation exceeding 0.7 implies that there is more shared variance between the construct and its measurement than error variance. -A Correlations ranging from 0.7 to 0.5 call for caution (low reliability). -A correlation below 0.5 indicates that the variable is inadequate for measuring the latent variable.
	Average Variance Extracted (AVE)	AVE > 0.50 for each factor (Fornell and Larcker, 1981).
Discriminant Validity	Cross-loading	It allows verifying that the items of a latent variable do not strongly contribute to neighboring constructs (Lacroux, 2009).
	Criterion of Fornell and Larcker	The square of the AVE (Average Variance Extracted) of each construct should be greater than the squared correlation between the construct and the other constructs in the model (Chin, 2010).

3. RESULTS

3.1 Description of the study population

The distribution of the questionnaire to Moroccan business leaders resulted in 115 responses, of which only 62 companies have an ERP system (Figure 1).

According to the descriptive analysis of the distribution of responses by sector of activity, industrial companies show the highest interest in ERP systems at 29%, followed by commercial and service companies, both at 22.6% each.

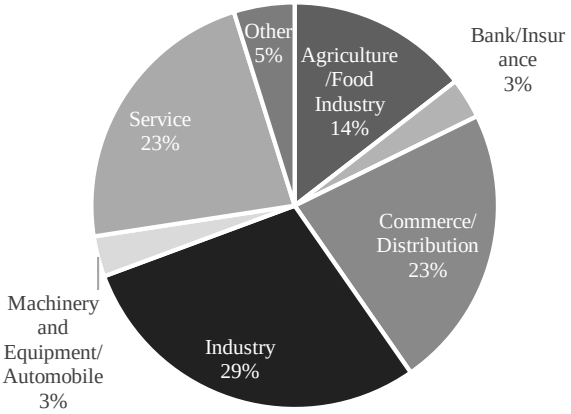

Figure 1. The sector of activity of the surveyed companies

During our survey, we used four-year intervals ranging from 2005 to 2019. The results of the distribution of responses based on this characteristic are presented in the Figure 2.

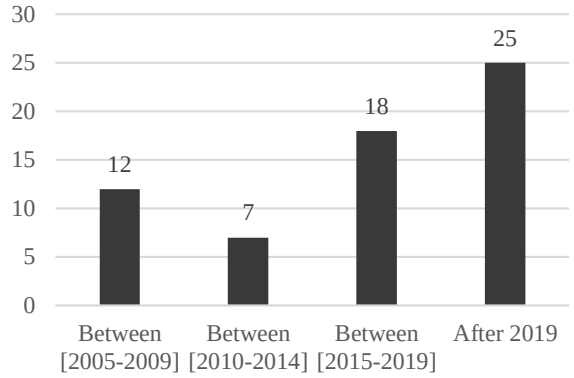

Figure 2. Distribution of responses by year of integration

3.2 Convergent Validity of the Measurement Model

Convergent validity of the measurement model includes composite reliability to assess internal consistency, reliability of individual indicators (loadings), and Average Variance Extracted (AVE).

According to the results obtained from the SmartPLS software (Table 9), we observe that almost all items have a factor loading greater than 0.70, indicating that they significantly contribute to the measurement of their respective constructs.

Furthermore, the composite reliability of each construct is above 0.70, which means there is internal consistency among the questions posed for each construct. We also note that the average variance extracted from the constructs is above 0.50, indicating that convergent validity has been achieved.

Table 9. Reliability and Convergent Validity of Constructs

Constructs	Items	Convergent Validity		Reliability of Constructs
		Individual Item Reliability Loadings)	Average Variance Extracted (AVE)	Composite Reliability (CR)
Eco. Cont.	AE1	0.898	0.669	0.934
	AE2	0.850		
	AE3	0.874		
	AE4	0.802		
	AE5	0.803		
	AE6	0.752		
	AE7	0.735		
Orga. Cont.	AO1	0.923	0.885	0.975
	AO2	0.960		
	AO3	0.972		
	AO4	0.966		
	AO5	0.878		
Hum. Cont.	AH1	0.911	0.849	0.944
	AH2	0.941		
	AH3	0.912		
Eco. Perf.	PE1	0.818	0.599	0.912
	PE2	0.805		
	PE3	0.835		
	PE4	0.891		
	PE5	0.695		
	PE6	0.720		
	PE7	0.620		

Orga. Perf.	PO1	0.837	0.802	0.960
	PO2	0.931		
	PO3	0.855		
	PO4	0.934		
	PO5	0.905		
	PO6	0.906		
Hum. Perf.	PH1	0.852	0.766	0.929
	PH2	0.913		
	PH3	0.940		
	PH4	0.788		

3.3 Convergent Validity of the Measurement Model

Discriminant validity tests whether the items unintentionally measure something other than the intended constructs. Two commonly used measures of discriminant validity are cross-loading and the Fornell and Larcker (1981) criterion (Table 10).

Cross-loading is achieved by correlating the scores of each latent variable's components with all the other items. The table above displays results that adhere to the aforementioned rule. The items of each variable contribute more to explaining their own construct than explaining a neighboring variable in the same model.

Table 10. Cross-loading

	Eco. Cont.	Orga. Cont.	Hum. Cont.	Eco. Perf.	Orga. Perf.	Hum. Perf.
AE1	**0.898**	0.795	0.791	0.408	0.376	0.392
AE2	**0.850**	0.627	0.549	0.246	0.277	0.217
AE3	**0.874**	0.677	0.740	0.300	0.258	0.321
AE4	**0.802**	0.533	0.662	0.119	0.047	0.100
AE5	**0.803**	0.445	0.588	0.114	0.027	0.052
AE6	**0.752**	0.435	0.641	0.171	0.115	0.186
AE7	**0.735**	0.387	0.562	0.121	0.048	0.113
AO1	0.685	**0.923**	0.675	0.392	0.498	0.412
AO2	0.736	**0.960**	0.772	0.285	0.445	0.346
AO3	0.732	**0.972**	0.760	0.378	0.566	0.451
AO4	0.697	**0.966**	0.733	0.337	0.557	0.442
AO5	0.655	**0.878**	0.722	0.277	0.490	0.365
AH1	0.809	0.679	**0.911**	0.453	0.364	0.349
AH2	0.740	0.780	**0.941**	0.282	0.323	0.266
AH3	0.680	0.703	**0.912**	0.358	0.424	0.350
PE1	0.301	0.463	0.402	**0.818**	0.690	0.644
PE2	0.230	0.188	0.363	**0.805**	0.486	0.536
PE3	0.293	0.269	0.340	**0.835**	0.524	0.533
PE4	0.328	0.412	0.396	**0.891**	0.588	0.653
PE5	0.200	0.147	0.133	**0.695**	0.267	0.451
PE6	0.257	0.242	0.297	**0.720**	0.401	0.567
PE7	0.036	0.090	0.161	**0.620**	0.289	0.536
PO1	0.345	0.521	0.447	0.523	**0.837**	0.603
PO2	0.254	0.529	0.400	0.619	**0.931**	0.697
PO3	0.192	0.468	0.308	0.591	**0.855**	0.777
PO4	0.240	0.500	0.367	0.523	**0.934**	0.723
PO5	0.224	0.460	0.321	0.518	**0.905**	0.685
PO6	0.239	0.463	0.344	0.571	**0.906**	0.794
PH1	0.270	0.380	0.274	0.616	0.605	**0.852**
PH2	0.311	0.406	0.353	0.701	0.733	**0.913**
PH3	0.241	0.381	0.307	0.692	0.742	**0.940**
PH4	0.253	0.345	0.304	0.521	0.706	**0.788**

The application of the Fornell-Larcker criterion (1981) requires that a latent variable shares more variance with its assigned indicators than with any other latent variable. In other words, the square root of the AVE of each construct should exceed the correlations with other latent constructs (Hair et al., 2014).

According to the Fornell and Larcker (1981) criterion, the results presented in Table 11 below are consistent. Therefore, following the examination of the two aforementioned criteria, the discriminant validity of the measurement scales is confirmed.

Table 11. Fornell-Larcker criterion (1981)

	Eco. Cont.	Orga. Cont.	Hum. Cont.	Eco. Perf.	Orga. Perf.	Hum. Perf.
Eco. Cont.	**0.818**					
Orga. Cont.	0.745	**0.941**				
Hum. Cont.	0.808	0.778	**0.922**			
Eco. Perf.	0.319	0.404	0.358	**0.774**		
Orga. Perf.	0.277	0.407	0.547	0.624	**0.896**	
Hum. Perf.	0.307	0.355	0.432	0.726	0.798	**0.875**

4. DISCUSSION

The integration of ERP systems in Moroccan companies is relatively recent, with a noticeable increase in adoption rates since 2014. This increase can be attributed to the launch of the national strategy for information society and the digital economy known as "Maroc Numeric 2030." Initially, Morocco initiated a digital Moroccan project (2013 version) aimed at adopting an "E-Morocco" strategy, which would advance the country's international positioning and make it a major IT platform in all sectors.

Indeed, in response to the economic, social, and financial changes driven by the rapid diffusion of new digital technologies, Moroccan companies are compelled to modernize and improve their work systems, especially their information systems, in order to renew their business management systems. ERP systems can serve as a strategic means in this regard, as they enable companies to modernize and make their information systems more responsive.

However, there are few studies that assess their impact on business performance, as observed in the existing research. Therefore, our work can be considered the first study conducted to validate the reliability and validity of a questionnaire on the impact of ERP systems on the performance of Moroccan companies.

The purpose of assessing the reliability of a questionnaire was to propose a measurement scale for assessing the impact of ERP systems on the performance of Moroccan companies that is reliable and exhibits valid and satisfactory psychometric qualities. Such an instrument can assist managers in measuring this impact effectively.

The implementation of an ERP system can generate benefits related to administrative productivity (Deixonne, 2001), such as optimizing the cost of ownership and eliminating tasks related to reconciliation, corrections, and information consolidation (Marciniak, 1996). For this reason, ERP is a major tool for enhancing the overall operation of the company and strengthening its performance (Deixonne, 2001). According to our study, 30% of the surveyed companies have adopted ERP systems to improve their performance.

Overall, the statistical analysis indicates that the questionnaire on the impact of ERP systems on company performance meets several validity criteria. In our study, the internal reliability of the questionnaire was high, with a Jöreskog's rho coefficient exceeding 0.70. Convergent validity was achieved with an average variance extracted exceeding 0.50 and factor loadings greater than 0.70.

Discriminant validity was also confirmed following the examination of the two aforementioned criteria: cross-loading and the Fornell and Larcker (1981) criterion.

Based on the significant and satisfactory results obtained during the measurement model evaluation, future studies should assess the structural model to ensure that the relationships between latent variables are accurately described and to test our various hypotheses.

5. CONCLUSION

In conclusion, the integration of ERP systems in Moroccan companies, driven by the national "Maroc Numeric 2030" strategy, serves as a critical lever for modernization and competitiveness in an evolving economic environment. Although few studies have examined their impact on business performance, our research represents an initial step toward validating a reliable measurement tool to assess this impact. The results of the statistical analysis confirm the validity and reliability of our questionnaire, providing a robust psychometric instrument for managers seeking to measure ERP effectiveness. In the future, evaluating the structural model will allow for a deeper understanding of the relationships between latent variables and enable testing of the proposed hypotheses, thus enriching knowledge on the impact of ERP systems on the performance of Moroccan companies.

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