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AKADÉMIAI KIADÓ

ERP adoption of SMEs in Romania: An IT innovation step or a business transactional necessity?

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ABSTRACT

The study aims to determine the influencing factors of Enterprise Resource Planning (ERP) systems adoption in the Romanian small and medium companies (SMEs). Our research is based on a national level representative survey with 374 personal interviews of CEOs. The conceptual framework is based on a detailed literature review and adopts the main dimensions of the Technological Organisational and Environmental (TOE) model. Applying a binomial logistic regression model, the significant factors for ERP adoption are identified. The main result is that the ERP system is an operative, necessary tool of business transactions for SMEs, not a cutting edge, IT innovative implementation. The adoption of ERP is positively impacted by a wider market scope since ERP systems support the expanded business partnerships and market extension procedures. Further results of the model show that business performance indicators do not affect ERP adoption, however the managers' perception of the competitive pressure and the top management support toward IT applications increase the likelihood of adoption.

KEYWORDS

information management, information systems, ERP adoption, TOE model, Romania

JEL CLASSIFICATION INDICES

M15, M19, O33

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1. INTRODUCTION

Enterprises' highest information technology development represents the enterprise resource planning (ERP) systems usage. We consider it is true even now for small and medium (SME) companies. The ERP systems integrate all transaction data and possible business processes, in a comprehensive and interactive platform, behind which the data processing technologies make the application of multidimensional analytical tools and accounting process analysis possible.

The development of the theoretical framework started with Rogers and Marshall (2003) concept of "Diffusion of Innovation" (DOI) theory and many theoretical models have been developed to explain the adoption of IT innovations. Some of these models explain the acceptance of technology innovations of the companies, and they have been tested by many empirical researches worldwide. Few of them have been conducted in the Central and East European countries, but no research was done about Romania, which represents a fast-developing country since the protracted effects of the global economic crisis on the economy.

Our main research question is: what are those technical, organisational, and environmental factors, which influence SMEs in Romania to adopt an ERP system? The more detailed research question analyses if the IT development level or the necessity of business complexity determines the ERP adoption of the SMEs.

We based our hypotheses primarily on the Technological Organisational, and Environmental (TOE) conceptual framework, while also incorporating additional explanatory variables, as our empirical research was part of a broader SME study encompassing the financial, strategic, and partnership dimensions of the firms.

The empirical research is based on a 347 SMEs national level representative survey conducted at the end of 2018 in Romania. Our survey analyses the SMEs in the period of 2013–2018 after the financial crisis, and before the COVID when the management perceived the boom not the limits of the crisis. The effects of the global financial crisis were long-lasting, in 2013 was registered the highest number of companies struggling with financial problems (Fejér-Király et al. 2019). Since 2013 the GDP increased by 28%, GDP per capita has grown annually by 8.6% on average, and the total gross disposable income per capita increased by 8.2%.

We introduced into the model a set of commonly used indicators as CEO characteristics, organisational characteristics, IT assets, IT efficiency factors, and level of diversification of inter-organisational relationships. To construct adequate variables and for data reduction reasons we used the factor and cluster analysis methods. The research focused on SMEs with more than 10 employees, with a slightly different SME classification than the European Commission Guide (2022) definition: companies with more or equal than 10, and less than 250 employees of which the annual turnover is less than 50 million euros, and/or an annual balance sheet total not exceeding 43 million euros.

The structure of the paper is as follows: firstly, we present the most relevant literature of the SMEs ERP adoption, followed by the presentation of the conceptual model, and we draw up the research hypotheses. The next Section contains the descriptive statistics of the primary research data; the explanatory variables of the model are detailed. The fifth Section enumerates the results of the logistic regression model, and our conclusions are formulated at the end of the paper.

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2. LITERATURE REVIEW

The theories of IT adoption demark the theoretical framework for ERP implementation. Since the DOI theory of Rogers (1962), many theoretical models have been developed to explain the adoption of IT innovations: Technological Acceptance Model (TAM, Davis 1985), Technological Organisational and Environmental (TOE, Tornatzky – Fleischer 1990), an adaptation of the Theory of Planned Behaviour (TPB, Harrison et al. 1997), and the Resource-Based View (RBV – Barney 1991). The DOI, TOE and the RBV theories concern the firm level, and the others to the individual level.

The TOE model is one of the most popular in IT adoption research, Zhu et al. (2003) owing to its applicable comprehensive structure. The model includes three contextual dimensions of a firm's decision toward innovation: the technological, organisational, and environmental context. The first one includes the IT readiness and knowledge, the availability and characteristics of the technologies, while the organisational dimension contains formal and informal linking structures, communication processes and the size of the firm, and the environmental one includes mainly the market structure, industry characteristics and technology support infrastructure.

The most relevant to our research goal is to use the TOE model as conceptual framework on the basis of the works of Pan – Jang (2008), Ramdani et al. (2009), Seethamraju (2015), Awa and Ukoha (2016), Gupta et al. (2018), Catherine – Abdurachman (2018), AlBar – Hoque (2019), and Mohammad et al. (2020).

The three main dimensions predicting the ERP adoption's likelihood of the TOE model are constructed by different sets of variables in the literature.

I. The *technological dimension* includes the ICT readiness and knowledge in general, mostly represented by ICT infrastructure, ICT skills (knowledge of the employees, technical know-how), the availability and characteristics of the technologies.

The ERP system's *availability and characteristics* of the technologies were analysed by Ramdani et al. (2009) and Awa and Ukoha (2016). This compatibility means the alignment with existing resources, information processing and perceived competitive advantage. The prevalence of the cloud ERP systems, the SaaS (Software as a Service) concept, diminished the importance of this characteristic, in fact this is the foremost advantage of remote access. By Low et al. (2011) and Seethamraju (2015) the adoption decision has not influenced the firm's IT readiness, capabilities and infrastructure, due to the SaaS concept which requires less IT resources. However, as Awa and Ukoha (2016) indicate, internet network technologies as part of the companies' ICT infrastructures are important items of the TOE adoption model.

The *IT knowledge* is part of a general technical know-how in Awa and Ukoha (2016), while AlBar and Hoque (2019) also suggest the presence of "specialised or knowledgeable personnel" having a determinant role in adoption. The smaller firms lack of IT knowledge may be an obstacle in the ERP systems adoption, and the information systems knowledge is considered as a factor of cloud ERP systems adoption, as Mohammad et al. (2020) indicated.

Modern IT systems are complex socio-technical systems, technical capabilities organically complete with human *IT resources* derived from training and experience. The importance of ICT skills was proved by AlBar and Hoque (2019) and Mohammad et al. (2020), and specifically the training and education appear in Ruivo et al. (2014) and Gangwar et al. (2015). *Training* reduces employees' anxiety and stress increasing the acceptance of the ERP system implementation (Gamage 2019).

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II. The *organisational dimension* contains a set of factors, among which the most analysed are the organisational characteristics (firm size, financial resources etc.), top management support, and characteristics of the business operations (managerial structure, degree of centralization, and partnership complexity).

One of the most analysed organisational characteristics is the *size* of the company. This factor is described with the number of employees. Hsu and Lin (2016) presumed the smaller firms have limited resources in adoption, on the other hand, the cloud ERP's cost efficiency may be an opportunity for SMEs as Karunagaran et al. (2019) argued.

Firms with larger *financial resources* are more likely to adopt Enterprise Systems, as Ramdani et al. (2009) suggested. The financial factor was present in Buonanno et al. (2005) as the company's turnover, while in Pan and Jang (2008) and Soobrayen et al. (2019) as the total capital. The lack of financial resources could lead to a restrictive attitude for SMEs in the ERP systems trialability (Mohammad et al. 2020).

On the other hand, the financial perspective of cloud ERP systems differ especially for SMEs, because cost savings are the main benefit of them as Chen et al. (2015), Ali and Miller (2017), AlBar and Hoque (2019), Chang and Hsu (2019) and Mohammad et al. (2020) suggest.

However, in developing countries the SMEs' financial situation depends to a large extent on the national economic development. During boom time, a period of full confidence in growth, the SMEs more likely invest in new technologies. In this way, we examined the role of financial perspective in ERP adoption in context with economic expectations related to the near future of the firm and the sector.

Top management support for ERP adoption means involvement, resource allocation and continuous support, which lead to increase the organisational absorption capacity and motivation (Park et al. 2007). The positive effect on adoption of top management support, namely their innovative attitude is formulated in Ramdani et al. (2009), Gangwar et al. (2015), Catherine and Abdurachman (2018), Gamage (2019), Kurnia et al. (2019), Hasan et al. (2019) and Mohammad et al. (2020). In AlBar and Hoque (2019), the senior manager's role is to enthusiastically communicate the cloud ERP system's organisational benefits, formulate a strategy for its use and be determined on the goals and standards regarding them. The top management clear vision regarding the usefulness and value creation of the ERP systems is fundamental as Gamage (2019) argued.

The organisational characteristic dimension includes the *membership of an industrial group*, the presence of branch offices as it mentioned in Buonanno et al. (2005), foreign firm ownership especially in transition economies Keszey (2017).

III. *The environmental dimension* includes mainly the market structure (industry type, competitive pressure), market scope (market share, partnership), external computing support, and governmental control (regulation, information sharing).

Industry type, sector classification is also a firm characteristic was included as an environmental factor in TOE model by many researchers: Bradford and Florin (2003), Ramdani et al. (2009), Chiasson and Davidson (2005), Hsu and Lin (2016) and Hasan et al. (2019).

As determining external factors, the analysis of the *competitive pressure* is widely present in literature. Pan and Jang (2008) and more recently Catherine and Abdurachman (2018) could not find a significant effect of the perceived competitiveness among Taiwanese communication

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industry and Indonesian companies. In a competitive environment, the companies more likely adopt ERP (Ruivo et al. 2012), or cloud ERP (AlBar and Hoque 2019). Recent research analysed this effect generally on cloud computing adoption, such as Hsu and Lin (2016), Gangwar et al. (2015), Karunagaran et al. (2019) and Matias and Hernandez (2021) argue that the competition intensity is an important factor in firm's cloud services adoption. However, this effect was found negative by Bradford and Florin (2003) and Awa and Ukoha (2016), who argued that the ERP systems are not yet used to gain competitive advantage.

Competitive pressure is complemented with another market structure characteristic, the *market scope* (i.e. local, regional, national or international), see in Buonanno et al. (2005), Ramdani et al. (2009) and Mohammad et al. (2020). The market scope refers to the level of operations in the companies that are present on market, from local and regional up to the global presence. Zhang and Jin (2015) suggest that the market orientation has an important effect on international companies' performance.

Buonanno et al. (2005) argues, the international supply chains and the global market presence require complex solutions, as ERP systems, although their results indicate insignificant effect of this factor to the ERP adoption. The companies with greater market scope more likely adopt information systems as Ramdani et al. (2009) affirm, due to competitive necessity in the marketplace. His results indicate that the market scope environmental indicator is not significant.

3. CONCEPTUAL MODEL AND DATA

3.1. Conceptual framework and hypotheses

Based on the literature review and the given specificities of the empirical research we drew up in Figure 1 the conceptual model to explain the SMEs' ERP adoption.

The operationalization of these dimensions could be preceded by various ways determined by the mainstream theories of literature, the given possibilities of the empirical primary research, and last, but not the least by own research hypothesis. We derived our research questions into nine hypotheses.

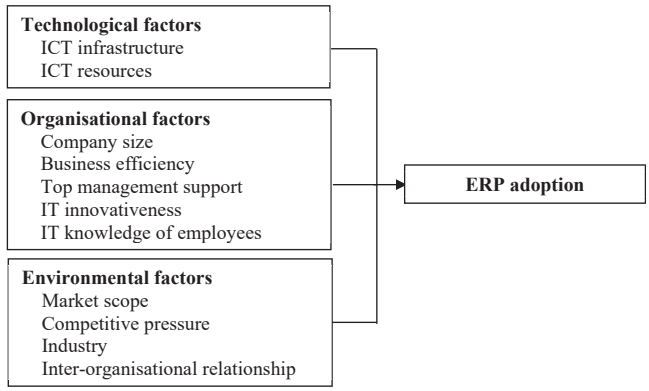

Fig. 1. The conceptual model

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H1. The size of the company has a significant, positive effect on ERP adoption.

If we take note of the higher penetration of ERP systems of the large companies compared to SMEs the difference between the medium and the small companies seems plausible. Buonanno et al. (2005) found that business size is a predictor of ERP adoption. Soja and Weistroffer (2016) and Ramdani et al. (2009) also stated that larger firms in the SME category are more likely to adopt IT and ES (Enterprise System). Later, Awa and Ukoha (2016) and Catherine and Abdurachman (2018) found a significant impact on ERP adoption.

We quantified the characteristics of the size with turnover, number of employees, and the extensive growth, which is a factor of size growth representing the number of employees and the turnover increase of the last three years.

H2. Business performance has a positive effect on ERP adoption.

Our framework for IT adoption contains financial-performance variables, such as the average return on capital and growth of business for the last three years. Buonanno et al. (2005) found that financial constraints are not important reasons for ERP non-adoption in the SME sector, Soja and Weistroffer (2016) stated that improving business performance is a more influential adoption motivator for the Polish companies than in developed countries. Ramdani et al. (2009) found that the SMEs with greater financial resources are more likely to adopt ES technology.

We operationalised the business results of an SME with the following indicators: profit, change in profit of the last three years, and the debt of equity indicator. Apart from the objective indicators, we decided to analyse the effect of CEOs' perceptions about business performance. This separation is a gap in the literature, but it could be reasonable in the case of SMEs where CEOs usually are not supported by experts.

H3. Competitive pressure has a positive effect on ERP adoption.

The analysis of this influencing factor has got wide attention in the specific literature, but many of the authors analyse the influencing effect of the competition generally on technology adoption.

Lee and Lee (2004) affirm that small businesses are not focusing on the competitive advantage of the ERP systems. Ramdani et al. (2009) embedded the competitive pressure into the environmental dimension of the TOE framework and found it insignificant to enterprise system adoption. Ruivo et al. (2012) analysed the significant factors of ERP adoption for SMEs in the case of Portuguese and Spanish firms. Catherine and Abdurachman (2018) assumed that in a competitive environment the cloud ERP adoption for SMEs has strategic importance, but the results showed an insignificant impact.

Competitive pressure could be measured by some objective indicators (e.g. industry concentration ratio), but in our research we asked the management's perception. We used three variables, which should be interpreted together: expectations regarding the future of the company, expectations regarding the future of the industry, and the perception of competitiveness on a ten-point scale.

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H4. A greater market scope has a positive effect on ERP adoption.

Based on the list of the plans for the next three years (Table 2), we had enrolled the SMEs into three clusters: those who focus on technological-infrastructure growth, those who plan a moderate growth by increasing productivity and those who want to enter into a new market, targeting an extensive growth.

This latest plan, a horizontal extension to new markets, comes from market scope definition by Zhu et al. (2003). Based on their arguments Ramdani et al. (2009) tested the market scope as a predictor affecting through the increased internal costs (more information processing and higher administrative complexity) and external costs (search costs). They rejected the hypotheses and they found that market scope is insignificant in SMEs' adoption of Enterprise Systems. In contrast Mohammad et al. (2020) found that the cloud ERP system adoption generated a greater market scope.

H5. The IT knowledge of employees has a positive effect on ERP adoption.

The importance of IT knowledge on ERP system adoption has been tested by many researchers: Pan and Jang (2008), Ramdani et al. (2009), Bernroider et al. (2011), Ruivo et al. (2012) and Kokles et al. (2015). In Ramdani et al. (2009) the IS experience as an assigned variable of IT knowledge proved to be insignificant, while in AlBar and Hoque (2019) the IT knowledge of the employees has significant impact on the Cloud ERP adoption.

We quantified this item with an ordinal scale of CEOs' perception of the IT knowledge level of the employees and the IT training level compared to competitors. Regarding the high correlation between the two variables, we computed an IT knowledge factor (80.2% of the total variance explained) for the model.

H6. Top management support to IT positively affects ERP adoption.

Many researchers analysed the effect of CEOs' attitude to IT. Waarts et al. (2002) state that the attitude toward IT innovation is significant for early adopters of the ERP and insignificant for later adopters. Ramdani et al. (2009) measured top management support to the ES adoption with multi-items variables and found it as an influencing factor. Top management support is an important pillar of the adoption framework according to Gamage (2019).

Our approximation of the CEO's support is a factor of the perceived usefulness (PU) of several different IT solutions, which is considered a fundamental determinant of technology adoption in Davis (1985).

H7. IT innovative companies are more likely to adopt ERP systems.

The companies differ from one another in degree of innovation adoption, which depends on their perceptions toward the advantage, complexity and compatibility. Rogers (1962) and Moghavvemi et al. (2012) demonstrated the impact of IT innovation on competitive advantage among SMEs, and emphasised the importance of managers' perceptions and behaviour toward IT innovation.

We examined the CEOs' perception about their firm's IT innovativeness. The two created factors (IT innovative and IT indifferent) computed from 11 variables that described the importance, penetration, and plans of IT-solutions compared to competitors (Table 3).

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H8. ICT resources and capabilities positively affect ERP adoption.

Waarts et al. (2002) tested the compatibility between the ERP adoption and the current IT infrastructure and found some positive influence of some performant hardware platform. Ramdani et al. (2009) rejected the hypothesis that the perceived compatibility of ES with current infrastructure increases the likelihood of the adoption. The higher level of the ICT infrastructure positively affects ERP adoption in AlBar and Hoque (2019), and Awa and Ukoha (2016) emphasised the role of the quality of internet connections in the cloud ERP adoption.

As a proxy of the ICT infrastructure, we analysed the perceived importance and the penetration of several IT solutions and the use of e-sales and e-purchase too. Beyond these objective indicators of the development level, we considered the managers' opinion about the level of the IT budget compared to the competitors on an ordinal scale.

H9. The more complex inter-organisational relationship has a positive effect on ERP adoption.

A complex relationship with customers and suppliers, as a component of the business complexity, requires the appropriate IT management solutions to handle the information processes. Buonanno et al. (2005) found that business complexity is insignificant on ERP adoption. We analysed the inter-organisational relationship through the number of suppliers and two characteristics of the supply chain: the ratio of those suppliers who deliver more than one product, and the ratio of those suppliers who deliver from other counties.

3.2. Descriptive statistics of the sample

Our primary research means a nation-level representative survey for Romanian SMEs at the end of the year 2018. In Romania there were 49,090 small and 8,579 medium enterprises in 2018. The targeted sample size was 400 SMEs, but after a rigorous data cleaning process, 374 cases remained. We achieved the representativeness by quota sampling and follow-up data weighting, regarding company size, industry category (6 sectors) and region (8 NUTS2 regions). We used two weights: one to assure representativeness separately for SMEs, and one for SMEs together. The computer-aided personal interviews (CAPI) ensured that the observations were independent of one another.

The topics that were included in the questionnaire: strategy, information technology, finance, investment, business relations, and company performance. According to these researched items, the interviewed persons had to be the CEO or the next person in the organisational structure. The expensiveness of the quite big, representative sample and the content comprehensiveness resulted in a disadvantage of the research; the questionnaire could not be designed only for our research goal, but it also gave the opportunity to analyse the effect of various, non-IT variables.

The empirical research data was merged with companies' performance data such as turnover, profit, mobilised and current assets, debt, all for the 2013–2018 period, data obtained from the official and public corporate balance sheets.

3.2.1. Descriptive statistics of the business environment. The analysis of the companies' IT investment decisions assumes that the business environment is taken into account as complete as possible. Between 2013 and 2018, the Romanian economy realised a significant growth, the GDP increased from 2013 to 2017 with 24%, the hourly productivity increased from 8.2 to 10.9 euro, while the employment rate has changed from 60.9% in 2013 up to 67.3% in 2017 (insse.ro).

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We classified companies into a six-category variable for industry classification, and an eight-category region variable. The modern market economy, the opportunity for entrepreneurship in Romania started in 1990, thus the firms included in our research have 15.7 years of activity on average. The number of employees on average is 40.8 employees, the average net profit is 184 thousand euros, which means 6.5% return on sales. We calculated the debt of equity indicator using the formula of debt capital/(debt capital + equity). In the case of indebtedness indicator, a 0.5 value expresses the equality between liabilities and equity. The average is 0.70. Beyond the business efficiency of a given year, investment decisions could be influenced by the results of recent years, so we take into account the results of the preceding three years.

For the reason of data reduction and to avoid multicollinearity in the model, we performed factor analysis on business performance variables: the average annual changes in the number of employees, turnover, profit and productivity variables. The resulting two factors explain 90.4% of the total variance and represent a factor of profitability growth, highly correlated with profit (0.97) and productivity (0.98) increase, and a factor of size growth representing employee number increase (0.92), and turnover increase (0.92). One might describe these factors as intensive, respectively extensive growth.

3.2.2. Management characteristics. Over the objective performance data, which we calculated for the last three years using the corporate balance sheets, the subjective, or one might say a more holistic opinion of managers about the company's business situation. Management attitudes are quantified into the model by the perception of business efficiency of the last three years, perception of own competitiveness, expectations regarding the future of the industry, expectations regarding the company's performance in the next year and the intention of investing in the next three years. Descriptive statistics are shown in Table 1.

3.2.3. Strategy and plans. We were interested in how the SMEs' management made plans and strategies. A quarter (25.7%) of Romanian SMEs have a written strategy. One question concerned the frequency of strategic analysis tools usage. We mentioned ten different analytical tools and methodologies, such as competitor analysis, customer evaluation and satisfaction

Table 1. Descriptive statistics of management characteristics

Perception of business efficiency of the last three years, %	Weakened	Stagnated	Acceptable	Exceptional
	3.0	15.5	67.3	14.2
Perception of own competitiveness	8.0 (avg. of 1–10 scale)			
Expectations about the sector's future, %	Decreasing		Stable	Growing
	4.0		63.4	32.6
Expectations regarding the company's performance in the next year	3.9 (avg. of 1–5 scale)			
Investment intention over the next three years, %	45.6			

Source: Survey data, $N = 374$.

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analysis, distribution chain analysis, analysis of the economic and technological environment and others. The clusters formed from these variables using K-means cluster analysis do not delimit according to various targeted analyses, but represent the frequency of the use of all the analytical tools used: occasionally (8.1%), more often (31.4%), using all tools regularly (60.6%).

Another important bunch of questions are presented in Table 2, concerned with the plans for the next three years (respondents could select only 3).

Using cluster analysis for dimension reduction we have defined three well-differentiated clusters of SMEs based on plans: those who focus on a technological-infrastructure growth (27.3%), those who plan a moderate growth by increasing productivity (51.4%) and those who want to enter into a new market, targeting an extensive growth (21.3%).

3.2.4. The level of diversification of inter-organisational relationships. The complexity of partnerships is also an expected explanatory factor of ERP adoption. Over the number of suppliers two more ratio scale variables characterise the complexity of connections with suppliers. The percent of suppliers who deliver more than one product has an average of 54.3%, and a median of 50%. The relevance of the physical distance is considered by another variable, it expresses the ratio of those domestic suppliers who have their headquarters in the same county. (It is exhaustive, complementing the ratio of those suppliers who have their headquarters in the same locality, and the ratio of suppliers outside of the county).

3.2.5. Characteristics of the IT capabilities. The first topic was the CEO's opinion about the situation of IT adaptation and its position compared to competitors, covered by 11 questions. We searched the determinative latent dimensions using factor analysis, according to the KMO[1] test (0.94). Based on the eigenvalue above one criterion, the two factors explain 71.1% of the total variance. The factor coefficients adjusted with Varimax rotation are displayed in Table 3.

Table 2. Plans for the next three years, %

Increasing productivity	34.9
Introducing new technologies	17.5
Increasing the financial stability	59.0
Maintaining the market share	31.0
Moderate growth	39.9
Aggressive growth	8.2
Infrastructure development	11.8
Change of outdated infrastructure	7.9
Entering new markets	25.3
Attracting funds through projects	7.8

[1]The Kaiser–Meyer–Olkin (KMO) test is a statistical measure to determine how suited the data is for factor analysis.

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Table 3. Managers' perception of the importance, penetration and plans of IT solutions

	IT innovative	IT indifferent
In our sector, we are the leaders in IT innovation	**0.843**	0.218
In our sector, we are precursors in the development of new IT initiatives, even if not all of these efforts prove to be profitable	**0.819**	0.249
We provide quick answers to early signs of favourable IT opportunities	**0.885**	0.120
We analyse IT innovations in detail before they are adopted	**0.734**	0.182
We do not have long-term IT-related objectives	0.117	**0.884**
Our company does not have a consistent pattern of IT-related behaviour	0.185	**0.792**
In our sector, the rhythm of technological change is fast	**0.761**	0.305
In our sector, competitors have an innovative use of IT benefits	**0.838**	0.123
We do not have a formalised/conceived IT strategy	0.346	**0.753**
In our sector, we are leaders in acquiring new knowledge (through R&D)	**0.779**	0.338
We are leaders in turning our knowledge into a competitive advantage	**0.757**	0.289

Source: Survey data, $N = 374$.
Note: Bold values indicate factor loading higher than 0.70.

The high scores of the first factor are typical of those innovative companies, who have consciously grounded IT strategy, not only responds to technological challenges of the sector but also tries to be a leader, while the second factor correlates with the lack of IT strategy and inconsistent IT adaptation. We denominated the first factor as IT innovative and the second as IT indifferent which suggest only to a modest extent that these factors – by default – do not correlate.

The next item focused on the perceived importance and penetration of the IT applications and solutions in the companies. The most used systems are the CRM[2] (37%), ERP (25.5%) and DDS[3] applications (21.7%), and their perceived importance does not differ significantly. The applications of CRM and DSS are introduced into the model as explanatory variables.

[2]Customer Relationship Management.

[3]Intelligent Digital Solutions.

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The CEO's opinion about the importance of these IT applications does not differ significantly and correlate largely, the smallest correlation coefficient is 0.54. This fact forces us to build these variables into the model as a factor of the perceived importance of IT solutions.

The IT expenditures of the company compared to competitors' expenditure is expressed by an ordinal scale variable.

ERP systems can functionally integrate online relations with customers and suppliers. Almost a third (31.4%) of the SMEs managers confirmed to use online sales, and on average 15.8% of the turnover comes from online sales. Regarding the online purchase, 28.9% of companies use it only for ancillary activities (e.g. transportation) and 14% purchase online.

4. RESULTS AND DISCUSSION

4.1. Logistic regression model

To identify the main factors influencing the ERP adoption in Romanian SMEs, we build the set of explanatory variables (Table 4) into a binomial logistic regression and an ordinary least square model.

The goodness of fit of the binomial logistic regression indicated by the Cox & Snell R square is 0.42 and the Nagelkerke R Square 0.64. The overall percentage of correct prediction regarding the classification table is 0.90 with a percentage of the "No" prediction of 0.95, as well as 0.72 of "Yes".

Despite the use of data reduction techniques (cluster and principal component analysis), the number of explanatory variables introduced into the model does not meet the thumb rule of ten events per variable. Based on Vittinghoff and McCulloch's (2007) work, we preferred a model with higher explanatory power instead of the exclusion of variables and got a 7.6 event per variable (EPV) indicator.

4.2. The results confirm our hypotheses

H1. The size of the company. This influencing factor - mentioned by so many in the literature - has no significant effect on the probability of ERP adoption. For SMEs, neither the turnover nor the number of employees, nor the size dynamics of the last three years affect the presence of ERP. We remind that in our research the SME means small and medium enterprises, not including the micro-companies.

Regarding simple descriptive statistics, 21.3% of the SMEs use ERP systems, 19.2% of the small and 31.3% of medium companies. The difference between the two mean values is not explained by size, as measured by the number of employees or turnover, but rather by other technological, organisational, or environmental characteristics.

H2. Business performance does not affect ERP adoption. Objective indicators of economic efficiency: profit, change in profit of the last three years, and indebtedness have no significant effect. In contrast to the management perception of the corporate performance of the last three years, it has a significant positive impact on the dependent variable. That is, as long as objective business results of the company are not affected by the management's perception of the effectiveness, it positively influences the probability of ERP adoption.

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Table 4. The results of the binomial logistic regression model

		Binomial logistic	
		Coeff. (B)	Sig.
D1	Regions (Base: North–West)		0.949
D2	Sector (Base: Agriculture)		0.679
D3	Age of the company	−0.040	0.384
D4	Nr. of the domestic establishment	0.142	0.208
D5	Foreign majority ownership	−1.312	0.151
H1.1	Turnover	0.000	0.320
H1.2	Employees number	0.007	0.289
H2.1	Profit	0.000	0.322
H2.2	Intensive growth factor	−0.111	0.933
H2.3	Extensive growth factor	−0.089	0.731
H2.4	Indebtedness	−1.763	0.100
H2.5	Perception of business efficiency of the last three year	1.549	0.009
H3.1	Expectations regarding the future of the industry	−2.252	0.002
H3.2	Expectations regarding the company's performance in the next year	1.123	0.014
H3.3	Perception of own competitiveness	−0.471	0.091
H4.1	Existence of written strategy	0.214	0.532
H4.2	Use of strategic analytical tools	0.095	0.86
H4.3	Clusters of plans in the next three years (base: technological–infrastructure growth)		0.06
H4.4	Moderate growth by increasing productivity	0.045	0.947
H4.5	Entry into a new market	1.638	0.049
H5	IT knowledge factor	0.571	0.235
H6.1	Importance of IT solutions factor	0.313	0.477
H6.2	IT expenditure	0.740	0.091
H7.1	IT innovative factor	−0.621	0.152
H7.2	IT indifferent factor	0.519	0.154
H8.1	Nr. of applied IT solutions	−0.215	0.427
H8.2	Applied CRM system	1.812	0.004

(continued)

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Table 4. Continued

		Binomial logistic	
		Coeff. (B)	Sig.
H8.3	Applied DSS system	−0.076	0.917
H8.4	e-sales	1.212	0.105
H8.5	e-purchase	−0.440	0.489
H9.1	Number of suppliers	0.848	0.044
H9.2	The ratio of suppliers who delivers more than one product countries	0.025	0.02
H9.3	The ratio of suppliers who deliver from other countries	0.008	0.42
	Constant	−10.64	0.012

H3. Competitive pressure has a positive effect on ERP adoption. Expectations regarding the future of the company and industry should be interpreted together with the perception of competitiveness. The expectations for the industry have a negative, while the company's expectations for the coming year have a positive impact on the dependent variable. (The Pearson correlation is 0.43 between these two variables.) More pessimistic industry expectations - with the same level of the company expected performance, - thus increase the probability of owning an ERP. This is in line with the assessment of the company's industrial competitiveness on a ten-point ordinal scale, which also has a significant negative coefficient in the model. SMEs with lower perceived competitiveness are more likely to adopt an ERP system, highlighting the impact of competitive pressure.

H4. A greater market scope has a positive effect on ERP adoption. The direction of the strategy for the next three years significantly affects ERP adoption. Of the three categories of the created cluster, technological-infrastructural growth represents the basis, and relative to this, increasing productivity is not significant, but planning to enter into a new market is. According to this, ERP systems aim to serve the increased business relationships and processes of the market extension.

H5. The IT knowledge level of employees has a positive effect on ERP adoption. The opinion of the CEOs about the IT knowledge of employees positively influences ERP adoption. The factor representing expenditures on IT training, the IT knowledge level of the employees and the adoption level of the IT assets in comparison to industry average exposes a positive effect on the ERP adoption.

H6. Top management support to IT positively affects ERP adoption. ERP adoption requires managerial openness and financial capacity. The perceived importance of IT solutions, assessed through questions about the significance of various IT tools and applications, along with IT expenditure, has a positive effect, albeit at a significance level of less than 10%.

H7. IT innovative companies are more likely to adopt ERP systems.

None of the two factors of managers' perception about IT competitiveness have a significant coefficient. Those SMEs who are self-considering leaders in IT innovation and respond to

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technological challenges of the sector are less likely to be the ERP adopters. A major result of our model is that ERP systems are an operative, necessary tool of business transactions for SMEs, not an IT innovative implementation.

H8. The IT capabilities positively affect ERP adoption. This previous explanation is supported by other explanatory variables of IT development. The perception of the ERP as a management tool is also confirmed by the fact that the adapted CRM tool has a positive effect, but the DSS has no significant effect on the dependent variable. The ERP system is a transactional-operational tool for SMEs, not an analytical tool. The number of implemented IT tools has no significant effect, as well as the existence of online sales and purchases which confirms that IT development among Romanian SMEs differentiates functionally, and does not follow a general linear evolution.

H9. The more complex inter-organisational relationship has a positive effect on ERP adoption. This hypothesis is supported by the significant positive effect of the number of suppliers, and the ratio of suppliers who deliver more than one product. The effect of the ratio of those suppliers who deliver from other counties is insignificant. The positive effect of the more complex supplier chain confirms the perceived transactional character of the ERP systems for the Romanian SMEs.

5. CONCLUSIONS

Our detailed questionnaire and the considerable sample size made a profound model specification possible with numerous previously untested explanatory variables, and resulted in a binomial logit model with a high explanatory power. Although our definition of SMEs excluded micro-companies, the sample still includes a sufficient range of sizes to analyze the impact of company size on ERP adoption. A surprising result is that none of the variables of the company size characteristics, the number of employees, the turnover had a significant effect, but other technological, organisational or even environmental characteristics should explain the difference between the ERP penetration of SMEs.

An important finding is that ERP systems are affordable not only for well-performing companies; they are not "luxury tools" exclusive to successful SMEs. Business efficiency indicators such as profit, profit changes over the past three years, and indebtedness have no significant effect. However, management's perception of business performance does matter, with performance over the past three years having a positive effect. Another contribution to this research area methodology is the extension of the measurement tools, which complement the mainstream set of indicators.

There is a consensus in the literature regarding the positive effect of company size on ERP adoption or generally on IT innovation. In our results the difference between the penetration of medium (31.3%) and small companies (19.2%) supports this assumption: larger firms more likely adopt ERP systems.

Another important result is the insignificance of the IT innovative factor. We could summarise that the ERP systems for the Romanian SMEs are a necessary tool for operation-level business transactions and not a cutting-edge IT innovation. However, a certain level of IT capabilities is required for ERP adoption. Among the indicators included in our research—CRM and DSS systems adoption, e-sales, and e-purchase—only the use of a CRM system had a significant effect

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on ERP adoption. This finding aligns with the previously discussed market orientation of Romanian SMEs, rather than an IT-innovative attitude.

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