Research Article

The Application of Shiau et al (2009)'s Measure on ERP Adoption to Turkish Small and Medium Enterprises

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Abstract

Purpose: The purpose of this paper is to contribute to the development of measures to assess the ERP adoption of small and medium-sized enterprises by the use of Shiau et al (2009:99)'s scale. Design/Methodology/Approach- The paper follows Shiau et al (2009: 99)'s methodology for the application of a scale that has validity and reliability. The data obtained from 263 Turkish SMEs are analyzed by preliminary analysis and EFA, CFA and SEM. **Findings:** The present study revealed that the theory of Shiau et al (2009: 99) is valid and different in the Turkish context. The managers perceive ERP adoption as beneficiary and the costs do not matter when compared to the expected results. **Research limitations/Implications:** Sample size and item numbers included in the scale should be taken into consideration in generalizing the results. **Originality/Value:** The paper applies a new scale (Shiau et al, 2009: 99) in a different context. The results can guide the academics and practitioners studying ERP adoption of SMEs.

Keywords: ERP adoption, Small and Medium Enterprises, Turkey

Introduction

Due to the increasing costs and complexity of business processes in the globalizing world economy, Small and Medium Enterprises (SMEs) need to adopt their processes into changing circumstances (Evangelista et al, 2013: 967; Raymond and Uwizeyemungu, 2007: 499). The adoption is basically done by acquisition of advanced manufacturing and information technologies (Muscatello et al, 2003: 852;

Dangayach and Deshmukh, 2005: 483). The most popular system seems to be Enterprise Resource Planning (ERP) software in the SMEs context (Li, 2011: 491). The system basically enables the users to monitor, detect, audit and react to the ongoing process according to their authorization (Saini et al, 2013: 109).

In a scale development attempt conducted by Shiau et. al. (2009:99), there has been a call for application of the new measure in

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different contexts. Following this research call, the present paper tries to measure the ERP adoption perceptions of Turkish SMEs by the use of this scale.

With this aim, initially a detailed literature review is carried out. The prior literature is examined in terms of subject, methodology and findings (Evangelista et al, 2013: 979). The research model included the application of the questionnaire to a randomly defined sample (Colin et al, 2014: 369). Then, the obtained data are analyzed by the use of some preliminary (descriptive statistics, reliability, correlations) analyses (Petroni and Rizzi, 2001: 147; Buonanno et al, 2005: 392), Exploratory Factor Analysis (EFA) (Iris and Cebeci, 2014: 261), Confirmatory Factor Analysis (CFA) (Upadhyay et al, 2011: 130) and lastly Structural Equation Modelling (SEM) (Shiau et al, 2009: 99).

The results revealed that the theory built by Shiau et al (2009: 99) is validated and confirmed in the Turkish SMEs context. Managers perceive ERP adoption as beneficiary and not costly when compared to the expected benefits.

Literature Review

In today's competitive framework, small and medium enterprises (SMEs) lack resources to compete with larger companies (Shiau et al, 2009: 100). On the other hand they have the ability to adapt their production processes faster than the larger firms (Chin et al, 2004: 234). The literature is rich in studies about ERP adoption of SMEs. Prior research is reviewed in terms of subjects, context, methodology and findings. The results revealed valuable information on design and the methodology of the present study.

Marri et al (2003: 151) conducted a research study on the implementation of computer-integrated manufacturing in small and medium enterprises. They applied a survey to 24 firms and the results of the study indicate that SMEs need to adopt technology in order to compete.

Petroni (2002: 329) investigates the critical factors of MRP implementation in the SMEs. The author indicates some factors such as ability to meet volume/product changes, better capacity planning, better cost estimation, better inventory control, better meeting of delivery promises, better product customization, better product scheduling and higher inventory rotation. These factors are also considerable in ERP adoption. On the other hand, Fu et al (2004: 234) focus on strategies for the adaptation of ERP systems. Technology, delivery system and performance criteria are presented as the main strategic fields in ERP adoption. Moreover, Li (2011: 489) searched the ERP adoption in Chinese SMEs context. The study revealed some critical factors in ERP adoption of SMEs. Buonanno et al (2005: 384) also investigated the factors affecting ERP systems. They found that complexity is not the major factor for SMEs' adoption decisions whereas they regard structural and organizational factors as more important. Besides these, Doom et al (2010: 378) investigated the critical success factors of ERP adoption in Belgian SMEs context. Furthermore, Matinidos et al (2011: 60) analyzed factors affecting ERP system effectiveness. Besides these, Upadhyay et al (2011: 130) focused on factors affecting ERP implementation in Indian context. Saini et al (2013: 103) also made a research study on identifying the factors affecting ERP adoption in the same context.

Muscatello et al (2003: 850) made a research study on the implementation of ERP in SMEs. The study adopts a multiple case study approach and the results imply that, SMEs should integrate CIM and ERP in their production processes.

Huin et al (2002: 771) investigate the internal supply chain planning determinants in SMEs. The research asserts that larger companies adopt ERP systems and have many advantages in competition. So similar systems should be used by SMEs.

Holter et al (2008: 21) made a research study on developing a framework for purchasing transport services in SMEs.

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They conclude that SMEs need ERP systems for better operational performance.

Dawn et al (2002: 139) studied the e-business readiness of SMEs. They assert that many SMEs are not adopting computer integrated manufacturing systems. However, the ones applying ERP are ready for such circumstances.

Archer et al (2008: 73) focused on the barriers to the adoption of online supply chain solutions in SMEs. They conclude that SMEs need some education on the benefits of e-business solutions. Adopting SMEs is found to be more responsive in flexibility and agility.

Petroni and Rizzi (2001: 144) investigated the antecedents of MRP adoption in SMEs. The analysis of 109 responses revealed that managers with the desire to maximize profits are more prone to adopt MRP.
Poba-Nzaou et al (2008: 530) made a research study on the adoption and risks of ERP in SMEs. The results of the study imply that in order to minimize the risk of ERP, the managers should deploy some strategies, principles and policies and act in a predefined plan.

Dangayach and Deshmukh (2005: 483) analyzed advanced manufacturing technology implementation. The analysis of 122 responses indicate that SMEs give the highest priority to quality whereas the lowest is on flexibility. Evangelista et al (2013: 967) also focused on technology adoption of SMEs.

Laukkanen et al (2007: 319) searched whether size matters in ERP adoption. The results of the study indicate that there are significant differences between the adoption criteria of the larger and smaller enterprises. The larger ones are more outward-oriented whereas the smaller ones are more prone to work on efficiency.

Raymond and Uwizeyemungu (2007: 487) researched a profile for ERP adoption of manufacturing SMEs. Analysis of 356 responses from Canadian SMEs revealed three types of SMEs (internally disposed, externally disposed and unfavorably disposed).

Esteves (2009: 25) focused on the benefits of ERP adoption in SMEs. The results imply that SMEs can benefit from ERP adoption in many ways. They can have a long-term vision besides auditing the whole system.

Shiau et al (2009: 99) developed a scale for measuring the ERP adoption of SMEs. The scale is adopted in the present study. They conclude that future research can be done by the use of their scale.

Parker and Castleman (2009: 167) focused on e-business adoption of SMEs. The results showed that many scales omit the small firm idiosyncrasy. So, it can be understood that new scales can be derived by considering these recommendations.

Xie et al (2014: 358) developed an integrated decision making system for ERP implementation in SMEs. They assert that cost increases with the implementation of ERP. At the same time the performance also increases with this adoption. They conclude that critical success factors should be predefined before the adoption of ERP.

Iris and Cebeci (2014: 261) analyzed the relationship between ERP adoption and lean manufacturing maturity in the Turkish SMEs context. They have developed some strategies for the adoption of ERP and assert that ERP can be used in leaning of the production systems.

The literature review disclosed much useful information for the present study. First of all, as Marri et al (2003: 151) suggest, SMEs need to adopt technology to compete in the modern world. It is asserted that they can have better operational performance with technology adoption (Holter et al, 2008: 21; Dangayach and Deshmukh, 2005: 483). They also should integrate their production systems with ERP (Muscatello et al, 2003: 850; Dawn et al, 2002: 139). This will lead them to overcome the barriers of ERP adoption and they can have some benefits with this integration (Archer et al, 2008: 73).

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Predefined goals will enhance the elimination of risks (Poba-Nzaou et al, 2008: 530) and they will be able to design new decision trees (Iris and Cebeci, 2014: 261; Xie et al, 2014: 358). They will have the opportunity to maximize their profits via these systems (Petroni and Rizzi, 2001: 144). It is also observed that there are differences between the sizes and adoption decisions of enterprises (Huin et al, 2002: 771; Laukkanen et al, 2007: 319). Some critical success factors, such as; capacity planning, inventory control, delivery promises, cost estimation, product scheduling and meeting volume/product changes can be utilized in the theory of the research (Petroni, 2002: 329; Fu et al, 2004: 234; Li, 2011: 489; Buonanno *et. al.*, 2005: 384; Doom et al, 2010: 378; Matinidos et al, 2011: 60; Upadhyay et al, 2011: 130; Saini et al, 2013: 103). These factors can be considered in theory building. The review also showed that many studies in different regional contexts are conducted (Doom et al, 2010: 378; Matinidos et al, 2011: 60; Upadhyay et al, 2011: 130; Saini et al, 2013: 103). These attempts allowed derivation of some typology for adopting SMEs (Raymond and Uwizeyemungu, 2007: 487). Moreover, there have been research calls for the present study (Shiau et al, 2009: 99; Parker and Castleman, 2009: 167). To sum all up, the present study is justified and the methodology and the theory are developed with the use of former literature.

Theoretical Framework

Shiau et al (2009: 99) developed a scale to measure the ERP adoption of SMEs. The theory of the present study is based on their framework. They included top management, technological skills, cost management and benefits of ERP usage as indicators of ERP adoption. Shiau et al (2009:99) proposed some hypotheses about these constructs;

H1- Possession of rich IS (ERP) knowledge by the CEO has a strong and positive relationship with ERP adoption.

H2- The perceived benefits of ERP systems have a strong and positive relationship with ERP adoption.

H3- The higher cost of ERP implementation has a strong and negative relationship with ERP adoption.

H4- The technical sophistication of modern business software has a strong and positive relationship with ERP adoption.

In order to test these hypotheses, many analyses are needed to be done. But initially these concepts are explained in detail.

CEO (top management)

The success of any project in enterprises is bound to the willingness of the top management to perform the project activities (Muscatello et al, 2003: 850; Upadhyay et al, 2011: 132). This concept is described as the extent to which executive managers of the adopting firm provide the attention, resources, and authority required for ERP implementation (Maditinos et al, 2011: 66). As the top managers have to play a leadership role which is driven by the commitment for the organization, they should get involved in activities actively and determine priority to the projects (Saini et al, 2013: 108).

Technology adoption

Rapid changes in the markets force enterprises to take new positions in production management (Evangelista et al, 2013: 967). If the state of technical infrastructure is not efficient to meet the needs of the customers, enterprises need to adopt technology (Petroni and Rizzi, 2001: 147). The concept can be defined as the acquisition of new technological devices, or adoption of new technological items into the production lines (Doom et al, 2010: 385). If enterprises deploy a predefined plan in the adoption, they prevent some obstacles such as resistance to change and complexity of the system (Buonanno et al, 2005: 390; Archer et al, 2008: 75).

Cost analysis

To date, ERP adoption requires a huge amount of investment and SMEs have financial limitations (Muscatello et.al, 2003: 850). If the expected results of the adoption are limited when compared to the investment, the managers should decide on whether adoption causes profit or not (Poba-Nzaou et al, 2008: 530; Li, 2011: 489).

Benefit analysis

This concept can be defined as the benchmarking of the pros and cons of ERP adoption (Petroni and Rizzi, 2001: 144). Not only the financial issues, but also the operational and responsiveness of the enterprise should be taken into consideration (Dangayach and Deshmukh, 2005: 489).
Empirical Study

Poba-Nzaou et al (2008: 537) report that surveys subject to ERP adoption lack testing of models in the former studies. The study of Shiau et al (2009: 99) tries to develop a scale to measure the adoption of ERP in SMEs. The present study aimed to apply this scale to the Turkish context and compare the results of Shiau et al (2009:99).

With this aim, the scale is translated into target language (Maditinos et al, 2011: 67). A pre-test is deployed to academics and practitioners (Evangelista et al, 2013: 975). According to the recommendations of the sample, necessary changes are done. The sample of the study is randomly defined by the use of The Union of Chambers and Commodity Exchanges of Turkey's database. SMEs report capacity to this union. The questionnaire is sent to the respondents with e-mails. In order to acquire a high response rate, follow-up phone calls are performed (Shiau et al, 2009: 108). As a result of these extensive attempts, the researcher was able to collect 287 forms. Hence, some of them have some missing values and seem to be randomly filled. So, they are removed from the data set.

The frequencies about age, sex and the position of the sample showed that it reflects the sector dynamics. Most of the sample (%74,9; 197) consists of males. Low level managers (%44.1; 116), middle managers (%37,3; 98) and top managers (%18,6; 49) are observed to fill in the questionnaire. Age differs from 24 to 59. This variable is grouped into lowest to 28 (%23,6;62), 29 to 34 (%27; 71), 35 to 42 (%24; 63) and lastly 43 to highest (%25,5; 67) in order to manage the data easily. The sector dynamics are met as the age of the sample suits the working age and the status of the sample is highest in low level managers and lowest in top managers.

Descriptive statistics are examined in terms of means and standard deviations with the aim of observing the distribution of the data. Kolmogorov-Smirnov test is applied and it is found that the data have normal distribution. The means and standard deviations were similar when compared to the items of the same variables (Laukkanen et al, 2007: 325).

Cronbach alpha scores of the items of the same variables are assessed in order to test the reliability of the data set. The results showed that the data are reliable as all of the items passed the acceptable thresholds (Petroni and Rizzi, 2001: 152). Table 3.1 demonstrates the number of items and Cronbah Alpha scores of each variable. The number of indicators was limited but the scale of Shiau et al (2009:99) included these variables and indicators at present.

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Table 1: Reliability Statistics

	N of Items	Cronbach's Alpha
Technology	3	0,865
CEO	4	0,907
Cost	3	0,926
Benefit	3	0,859

As the data showed normal distribution, Pearson correlation is used in order to see whether these constructs are related to each other or not. The means of the items for the same variable are calculated and correlations analysis is done. The results showed that the highest correlation is between technology and benefits. All of the correlations were significant with $p<0.01$. Table 3.2 shows the results of this analysis

Table 2: Correlations

	techmean	CEOmean	Costmean
CEOmean	,392**		
Costmean	,256**	,174**	
Benemean	,477**	,342**	,216**

CEOmean= Top management, Costmean= cost analysis, Benemean= benefit analysis, Techmean= technology

adoption.**=correlation is significant with $p<0.01$.

The demographic features are analyzed with ANOVA test and some statistically significant results are obtained. The results showed no significance in status but, ANOVA test according to gender showed that males are more control oriented than females. In the test of age groups, technology adoption willingness was statistically higher in younger groups. Also, they were more prone to benefits of adoption. The older groups were more control oriented than the younger ones. Lastly, the older groups were more cost oriented than the former ones.

The theory of Shiau et al (2009: 99) consists of multiple variables. The reliability of these items was significant and positive relationships among these variables are observed. But there is need for factor analyses in order to see whether the distribution of constructs is the same as the theory of the research (Petroni and Rizzi, 2001: 152). Initially, Exploratory Factor Analysis (EFA) is done. The results of this analysis provided valuable information about the formation of the constructs in the theory. KMO and Bartlett's test is applied and a KMO value of 0,788 is achieved (Maditinos et al, 2011: 69). This shows that the size of the sample is adequate for this analysis. Communalities showed that every variable is related to another variable. A Total Variance Explained (TVE) value of %87,012 is obtained which means that the data have construct validity. Lastly, the factors are rotated with varimax in principle components analysis method (Iris and Cebeci, 2014: 270) and the results are depicted in Table 3.

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Table 3: Rotated Component Matrix

	Component			
	1	2	3	4
Tech1				,899
Tech2				,904
Tech3				,690
CEO1	,916			
CEO2	,866			
CEO3	,781			
CEO4	,868			
Cost1		,967		
Cost2		,955		
Cost3		,969		
Bene1			,923	
Bene2			,918	
Bene3			,915	

The results showed that the theory of the research is verified. All of the items are listed with the items of the same variable. However, the relationships between these variables cannot be assessed with EFA. So, Confirmatory Factor Analysis (CFA) is needed (Upadhyay et al, 2011: 130).
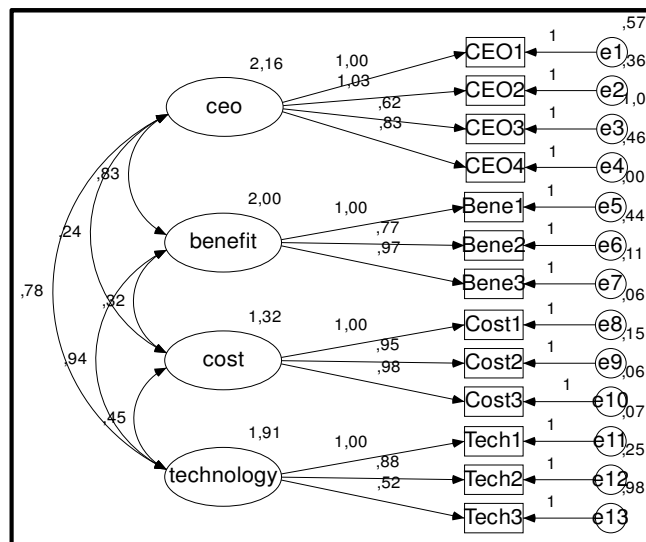
Figure 1: CFA Model

The factors of EFA are put into a CFA model and covariance lines are drawn (Maditinos et al, 2011: 69). Every indicator is added an error term and the model is tested via the use of AMOS 16.0. The model reported good fit indices as baseline comparisons were statistically higher than the acceptable thresholds (NFI=,933; RFI=,911; IFI=,947; TLI= ,929; CFI=,947; CMIN/DF=4,565; RMSEA=,117) (Upadhyay et al, 2011: 135). The covariance table depicted in Table 3.4 gave the opportunity to test the hypotheses developed by Shiau et al (2009:99).

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Table 4: Co variances

			Estimate	S.E.	C.R.	P	Label
ceo	<-->	benefit	,825	,144	5,714	***	
ceo	<-->	cost	,244	,110	2,212	,027	
ceo	<-->	technology	,782	,142	5,490	***	
benefit	<-->	cost	,323	,103	3,132	,002	
benefit	<-->	technology	,937	,136	6,901	***	
cost	<-->	technology	,455	,104	4,356	***	

The strongest relationship is between benefits analysis and technology and the lowest is between cost and benefit analysis. However, all of these relations can be considered high and statistically significant (p<0.01 and p<0.05). This shows that all of Shiau et al (2009:99)'s hypotheses are accepted in the present study. The factors are set in a Structural Equation Model (SEM) and the results showed the same situation. The model is depicted in Figure 3.2.

The hypothesis test showed that top management affects ERP adoption in a great extent. Moreover, perceived benefits of the system highly affect the adoption. The descriptive statistics proved that the sample doesn't perceive ERP adoption costly. As a result they showed an intention to adopt ERP systems. If the sample reported a negative statement to these items, the hypothesis would state the negative situation.
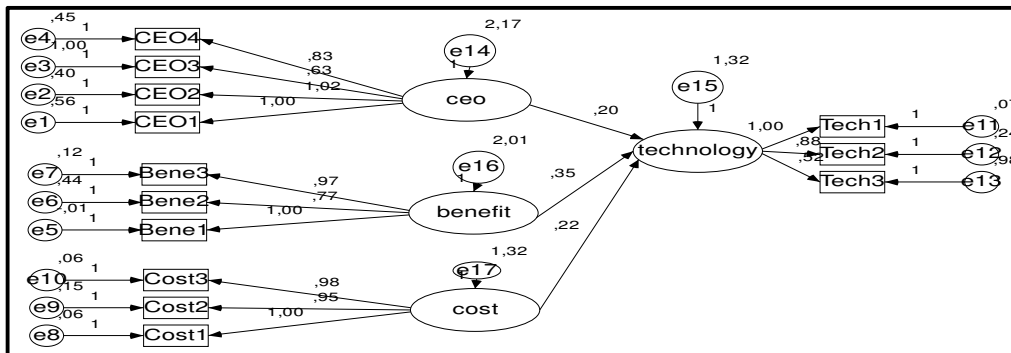
Figure 2: SEM model

As the sample perceives positively, the hypothesis can be accepted. Lastly, the sample reported a positive relationship between technical sophistication and ERP adoption. So, the last hypothesis can be accepted. The SEM reported good fit indices (NFI=,920; RFI=,899; IFI=,934; TLI= ,917; CFI=,934; CMIN/DF=5,196; RMSEA=,127) (Maditinos et al, 2011: 69). The discriminant validity (Shiau et al, 2009: 109) and composit validity (Poba-Nzaou et al, 2008: 539) of the CFA model is assessed and Table 3.6 demonstrates the results.

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Table 6: Validity Measures

	CR	AVE	MSV	ASV	cost	ceo	benefit	technology
cost	0,977	0,933	0,082	0,048	0,966			
ceo	0,909	0,717	0,158	0,109	0,144	0,847		
benefit	0,961	0,892	0,229	0,142	0,199	0,397	0,944	
technology	0,883	0,724	0,229	0,153	0,287	0,385	0,479	0,851

Average Variance Extracted (AVE) is higher than Composite Reliability (CR) and 0,5. Also the MSV and ASV of the measures are lower than AVE which means that the scale has both discriminant and composit validity (Shiau et al, 2009: 109).

To sum all up, the empirical study revealed that the hypotheses of Shiau et al (2009:99) are valid in the Turkish SMEs context. The sample perceives ERP adoption as a beneficiary and cost saving technology acquisition. Moreover, managers are in favor of adopting such decision support systems.

Conclusion, limitations and ideas for future work

This study aimed to apply the scale of Shiau et al (2009:99) in the Turkish manufacturing SMEs context. In order to do so, initially a detailed literature review is conducted. The previous literature is examined in terms of subject, methodology and findings.

The scale is translated into target language and a pre-test is performed on academics and practitioners. The necessary changes are done. Sampling is randomly done by the use of UCCET's database. The questionnaires are e-mailed to the respondents and follow up phone calls are made in order to increase the response rate. As a result, 263 usable responses are obtained.

The analysis of the data included some preliminary analyses such as descriptive statistics, reliability analysis, correlations. These analyses gave the idea that the sample reflects the sector dynamics and the data are distributed normally. Afterwards, some more specific analyses such as EFA, CFA and SEM are conducted in order to see whether the theory of the research fits with the data or not. As a result of these analyses, it is observed that the data fit into the theory significantly. By doing so, the hypotheses, derived by Shiau et al (2009:99) are also tested and validated.

As a result of all of these analyses, the sample is observed to perceive ERP adoption positively. The top managers support these kinds of acquisitions and they do not think they are costly when compared to the expected benefits.

The present study includes only a small sample. So, its findings cannot be generalized to the whole context. Future research can include a greater sample. The application of this scale in different contexts can make contribution to the literature and provide a better understanding of ERP adoption behavior of SMEs. Lastly, the items included in Shiau et al (2009:99) are limited in number. Higher response rates can be achieved with shorter questionnaires but the analysis of the data can be troublesome if the reliability of the measures is low. In conclusion, the present study showed that the ERP adoption perceptions of Turkish SMEs are different from the Taiwanese.

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