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## Business Intelligence during times of crisis: Adoption and usage of ERP systems by SMEs

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### Abstract

Adoption of Enterprise Resource Planning (ERP) systems is considered to be one of the most important technological and organizational innovation in modern enterprises and SMEs, that promote knowledge diffusion, and sound business decision making processes. Notwithstanding the importance of information and knowledge management, especially during periods of crisis, most small and medium-sized enterprises (SMEs) still underestimate the application and the dynamics of Business Intelligence in their decision-making processes when adopting and implementing ERP systems and their marketing oriented subsystems such as Customer Relationship Management (CRM). In this paper ERP systems adoption and implementation by SMEs in the region of Western Macedonia is examined. Special attention is given to the critical factors affecting adoption of ERPs by SMEs and the business intelligence potential of implementing and using ERP during a period of crisis. The factors identified are related with the economic and organizational characteristics of the SMEs surveyed. Our results indicate that although SMEs recognize the advantages and benefits gained by the application of these systems, especially in managing and summarizing heterogeneous data, still the business intelligence capabilities of ERP systems are underutilized, as managers do not take advantage of the knowledge and experience gained from using them. The paper concludes with proposals for further research on the implementation of ERP systems and the expansion of business intelligence usage by SMEs.

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## **1. Introduction**

Enterprise resource planning (ERP) became a key strategic tool, for all firms operating in nowadays competitive and globalized economy (Sakas et al, 2014; Marinagi et al., 2014). ERP applications and their Business Intelligence capabilities have been transforming the way organizations conduct business and operations, by dramatically improving financial transparency, marketing and customer services, supply chain and operations management, human resources management, by integrating all resources and information in a single platform. Business Intelligence tools provide the techniques and solutions that help managers to fully analyze and understand complex business situations, and simplify decision making processes that is of crucial importance in periods of financial and economic crisis as the one SMEs are currently in (Dekoulou & Trivellas, 2014; Trivellas & Santouridis, 2013; 2013a).

Notwithstanding the importance of these systems, SMEs are still struggling to implement and fully leverage the advantages stemming from the use of these systems. In this paper the perceptions and attitudes of managers and users of ERP systems towards the factors affecting the successful adoption, and usage of ERP systems and their business intelligence capabilities are examined, in the region of Western Macedonia in Greece. The basic research questions addressed concern the crucial factors affecting the successful adoption and implementation of ERP systems, the advantages derived from their usage, and the importance of the Business Intelligence capabilities that are embodied in an ERP system.

The remainder of the paper is organized as follows. Section 2 offers the definitions of ERP and Business Intelligence systems and briefly revises relevant literature concerning the success factors for implementing and using these systems. Section 3 discusses the data used in the study and the methodology used. In section 4 the results are presented, and finally section 5 concludes the paper discussing the results, and offering suggestions for further study.

## **2. ERP and Business Intelligence in SMEs**

ERP is a software-driven business management system that integrates all aspects of every-day business and operations, including marketing and sales with the usage of CRM subsystems, manufacturing, inventory management, planning, financial accounting and human resource management, helping firms run their business more efficiently, raising the levels of customer service and satisfaction, while increasing productivity and lowering costs and inventories at the same time.

Business Intelligence is defined as systems that collect, transform, and present structured data from multiple sources (Negash, 2004) reducing the needed time to obtain relevant business information and enable their efficient use in management decision making process (Den Hamer, 2004), allowing dynamic enterprise data search, retrieval, analysis, and explanation of the needs of managerial decisions (Nofal et al., 2013). Pirttimäki (2007) describes Business Intelligence as a process that includes a series of systematic activities, being driven by the specific information needs of decision makers and the objective of achieving competitive advantage. According to Tyson (1986), Business Intelligence focuses on collecting, process and present data concerning customers, competitors, the markets, technology, product and the environment.

The advantages generated by the implementation of the ERP and Business intelligence system come from the integration between the modules in order to achieve operational and organisational goals such as improved productivity, lower costs, reliable performance, reductions in paperwork, saving time etc. (Dekoulou & Trivellas, 2014; Zuyderduyn, 2014; Trivellas & Santouridis, 2013;2013a). Said et al (2003) issues that are of critical importance for all firms especially for SMEs that operate in very competitive environments. ERP and Business intelligence systems are more successful on the ability to maintain agreements with customers with respect to the full delivery and in a timely manner (Zuyderduyn, 2014), and can communicate more effectively with customers on the progress an order (Marinagi et al., 2014). These goals can be of critical importance in periods of crisis where both firms and customers become more cost conscious and efficient utilisation of resources may become an issue of surviving or not. Understanding and fully utilizing Business Intelligence capabilities can be a daunting task for

SMEs' managers, due to the organisational characteristics and the limited resources they have at their disposal, as even large companies managers have limited understanding of those systems (Hwang, 2009).

The majority of the research focused on investigating ERP and BI but only a few attempts to integrate them (Nofal et al., 2013), a trend also highlighted by Fitriana (2011). There are three approaches in the use of Business Intelligence in the literature (Rouhani et al., 2012) depending on the goal of usage BI and the required focus, namely, the managerial approach, focusing on improving management decision making, the technical approach, and the enabling approach that focuses on value added capabilities.

In this paper the managerial approach is used to measure perceptions of managers and ERP systems users towards the advantages and implementation factors affecting the usage of ERP and Business Intelligence system. The perceived usefulness of a Business Intelligence systems and its learnability are determinants for end-user acceptance and are measures of a successful implementation (Sangar et al., 2013). High levels of the perceived advantages of using ERP systems should be positively correlated with Business Intelligence capabilities, and therefore to higher usage of these capabilities from SMEs. A longer period of time using these systems should also result in more effective usage of Business Intelligence capabilities and higher level of the perceived advantages derived from the utilization of ERP systems, due to economies of knowledge, and the need to reduce costs in crisis periods.

### 3. Research Methodology

The core objective of the present paper is to investigate the attitudes and perceptions of SMEs in the region of Western Macedonia, that use ERP systems and business intelligence to their everyday operation. Our main goals are to identify the main advantages that an SME can derive from the implementation and usage of an ERP system, and the business intelligence capabilities offered by ERP systems.

In order to measure the above mentioned, 37 firms of the region of Western Macedonia were examined, during April and May 2014. The majority of the firms (56.10%) are commercial firms, with 31.71% coming from the manufacturing sector, 7.32% are services firms and only 4.88% from the tourism sector. More than one out of two firms (58.54%) employ more than 20 employees, and the vast majority of the firms (80.00%) had more than 1.5 million € turnover. It is also important to note that almost all firms of the sample use ERP systems provided by Greek software firms (such as SoftOne, Singular Logic, Entersoft, etc.), and that all firms have implemented an ERP system during the last 10 years.

Managers and users of ERP systems were personally interviewed, with the use of a structured questionnaire divided in 5 sections, concerning the implementation, adoption and usage of Business intelligence capabilities of the ERP system used by the firm. All questions were taken from relevant literature hypotheses, and were presented using the Likert scale from 1 (totally disagree) to 5 (totally agree). In order to identify the relationship between the advantages yielded by the usage of ERP systems, business intelligence features and firms' characteristics, various statistical tests were employed as the non parametric test of Kruskal-Wallis, the Spearman correlation coefficient and the Kolmogorov-Smirnov non parametric test.

### 4. Results

SMEs have only recently began adopting ERP systems in their daily operations. The firms in the sample examined has been using ERP systems for an average of approximately 6 years with a standard deviation of 3.09 years. The main advantages identified by the respondents relate to data integration (50.00%), controlling activities (37.50%) and flexible decision making (32.50%) which are all related to business intelligence features of ERP systems. However, it is worth reporting that contribution to cost reduction (10%) was considered as the less important advantage of implementing the ERP system in the company, despite the fact that during crisis periods, reducing cost is of essence for SMEs. On the other hands the main disadvantages and deterrents for adopting ERP systems were cost of initial setup and support (36.80%) and most importantly the cost and time required for training

the personnel to handle the new system (44.70%). Good quality training makes the user comfortable with the system and it increases their expertise and knowledge (Sangar et al., 2013)

In Table 1 the factors affecting the successful adoption of ERP systems are presented. The reliability of respondents' answers has been tested, using Cronbach's alpha reliability test, for all sections of the questionnaire with values higher than 0.7, reaching 0.948 for the questions of whole the questionnaire. Specifically for the questions of Table 1 the value of Cronbach a indicator is 0.763, and the Kolmogorov-Smirnov test shows that answers do not follow the normal distribution.

Table 1. Factors affecting the successful adoption of ERP systems.

	Average	Median	S.D.	Range	D (sig.p.)
1. Communication / cooperation between the involved departments of the enterprise	4,55	5	0,833	2	D(37)=0,465, p=0,00
2. Project group skills involved in implementing of the ERP system	3,76	4	0,867	3	D(37)=0,277, p=0,00
3. Process of surveillance and evaluation of implementing ERP	3,91	4	1,01	4	D(37)=0,263, p=0,00
4. Software training/education	4,33	5	0,924	3	D(37)=0,340, p=0,00
5. Needs assessments of enterprise - system's specifications	4,21	4	0,820	3	D(37)=0,277, p=0,00
6. Clarity of objectives by the implementation of ERP	3,85	4	0,939	3	D(37)=0,291, p=0,00
7. Appropriate parameterization of software	4,55	5	0,754	2	D(37)=0,424, p=0,00
8. Suitability-sufficiency in technological infrastructure of the enterprise	4,06	4	0,827	3	D(37)=0,289, p=0,00
9. Support from the software provider	4,67	5	0,595	2	D(37)=0,440, p=0,00
10. Capability of management and personnel concerned	4,24	4	0,502	2	D(37)=0,413, p=0,00
11. Enterprise's available financial and human resources	4,06	4	0,788	2	D(37)=0,217, p=0,00
12. Personnel's training due to ERP system implementation	4,39	5	0,827	2	D(37)=0,374, p=0,00
13. Level of trust between people involved in ERP system implementation.	3,91	4	1,01	3	D(37)=0,223, p=0,00
14. Level of quality service in external technical support for the ERP implementation.	4,24	4	0,902	3	D(37)=0,284, p=0,00
<b>Total Average:</b>	<b>4,18</b>		<b>1,50</b>		

According to the results of the above Table, participants overall agree on the importance of the crucial factors affecting the successful implementation of an ERP system as they were reported in the relevant literature. The most important factors identified are the support of the software provider (4.67), the configuration/customization of the ERP system (4.55), and the ability of communication and cooperation between all the involved departments of the firm (4.55). Respectively the least important factor concern the composition and the skills of the group assigned to implement the project with 3.76.

The advantages of implementing and using ERP systems were thoroughly examined by 14 questions in section B of the questionnaire. Cronbach a value for the questions of Table 2 is 0.846. The overall average value for all questions is 4.10 with a standard deviation of 0.47, while answers are not normally distributed.

The advantages that are most favoured by respondents are the integration of data and information from different departments (4.68), the reliability of information assembled (4.43), and saving time (4.40). However saving

operational resources (3.60), cultivating a culture of responsibility (3.68) are valued as less important contribution of ERP systems, and effective intra-enterprise solution (3,78), raising questions concerning the strategic and organisational integration of ERP systems in the participating SMEs.

Table 2. Respondents' perceptions of advantages of implementing ERP Systems.

	Average	Median	S.D.	Range	D (sig.p.)
1. Reliable information	4,43	4	0,636	2	D(37)=0,317, p=0,00
2. Data and information integration	4,68	5	0,572	2	D(37)=0,440, p=0,00
3. Productivity increase	4,15	4	0,736	2	D(37)=0,231, p=0,00
4. Improvement in quality of decisions	3,95	4	0,783	3	D(37)=0,300, p=0,00
5. Time - saving	4,40	5	0,871	3	D(37)=0,354, p=0,00
6. Cultivate Responsibility	3,68	4	0,764	3	D(37)=0,415, p=0,00
7. More effective solutions in an intra-enterprise level found	3,78	4	0,620	2	D(37)=0,317, p=0,00
8. More effective use of information sources and enterprise's data	4,25	4	0,776	2	D(37)=0,283, 2=0,00
9. Operational functions facility	4,15	4	0,622	2	D(37)=0,320, p=0,00
10. Operational resources saving	3,60	4	1,128	4	D(37)=0,203, p=0,00
11. Improvement in customers services	4,23	4	0,660	2	D(37)=0,283, p=0,00
12. Better suppliers evaluation	3,90	4	1,033	4	D(37)=0,207, p=0,00
13. Optimal inventory management and procurement (supply chain)	4,23	5	1	3	D(37)=0,331, p=0,00
14. Optimal management of human resources (personnel, payroll, etc.)	4,08	4	0,997	4	D(37)=0,245, p=0,00
<b>Total Average:</b>	<b>4,10</b>		<b>0,47</b>		

The relationship between the characteristics of firms and the perceptions of benefits derived by ERP implementation is tested using the non parametric test of Kruskal-Wallis as the responses are not normally distributed. The variable used is the mean value of all the responses, while the independent variables are the: a) the sector in which the firm operates, b) the number of employed personnel, and c) the sales turnover. The results are shown in Table 3.

Table 3. Results of perceptions of managers concerning advantages of ERP systems.

	Kruskal-Wallis $\chi^2$	Df	Significance
a) Sector of activity	8,72	4	0.033**
b) Number employed personnel	0,16	5	0.983
c) Sales Turnover	6,93	4	0.074

\*\* significant for 0.05

According to the results of the test the perceived advantages of ERP implementation differ only across sectors with as the value of the test is  $\chi^2(3, N=37) = 8,717, p = 0,033 < 0.05$  probability. Figure 2 depicts that the firms of the sample in the service and manufacturing sector responded more uniformly, while commercial firms' perceptions of advantages of ERP implementation differ significantly.

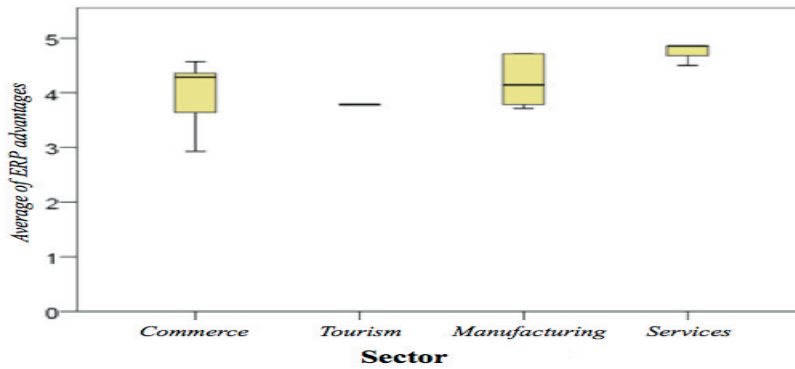


Fig. 1. ERP advantages and SMEs sectors.

Business Intelligence is the focus of the 4<sup>th</sup> section of the questionnaire examining 23 business intelligence capabilities of ERP systems. The average value for the total of the 23 variables is 3.99 with a standard deviation of 0.508. Notably 11 out of 23 variables take scores less than indicating that SMEs do not take full advantage of the business intelligence capabilities of ERP systems. Cronbach a value for the questions of Table 4 is 0.903 and the Kolmogorov-Smirnov test shows that answers do not follow normal distribution.

Table 4. Results of perceptions of managers concerning Business Intelligence capabilities, of ERP systems.

Possibility of Business Intelligence	Average	Median	S.D.	Range	D (sig.p.)*
1. Group services and tools (groupware)	3,97	4	0,706	2	D(37)=0,260, p=0,00
2. Possibilities of collaborative decision making	3,68	4	0,541	2	D(37)=0,370, p=0,00
3. Clustering of problems	4,03	4	0,875	3	D(37)=0,220, p=0,00
4. Optimization techniques	4,45	5	0,768	3	D(37)=0,343, p=0,00
5. Import/Export data from/to other systems	4,48	5	0,769	2	D(37)=0,394, p=0,00
6. Simulation models	3,55	3	0,810	3	D(37)=0,267, p=0,00
7. Simulation / risk assessment	3,74	4	1,094	4	D(37)=0,238, p=0,00
8. Treasury management tools (capital, producers, loans)	3,90	4	1,044	4	D(37)=0,247, p=0,00
9. Economic management tools (Financial Accounting)	4,42	4	0,620	2	D(37)=0,309, p=0,00
10. Investment Management Tools	3,39	4	1,174	4	D(37)=0,215, p=0,00
11. Cost-audit tools (profitability analysis, profit accounting centers)	4,19	5	1,138	4	D(37)=0,309, p=0,00
12. Property management tools	3,35	3	1,082	4	D(37)=0,215, p=0,00
13. Graphic representations	3,90	4	1,012	4	D(37)=0,309, p=0,00
14. OLAP Possibilities (Multi dimensional analysis)	4,39	5	0,715	2	D(37)=0,210, p=0,00
15. Aggregated results tools	4,68	5	0,702	2	D(37)=0,377, p=0,00
16. Entrepreneurial references (enterprise reporting)	4,42	5	0,848	3	D(37)=0,320, p=0,00
17. Data Extraction (data mining)	4,19	4	0,873	4	D(37)=0,484, p=0,00
18. Dynamic user interface (Dashboard)	4,03	4	0,836	2	D(37)=0,334, p=0,00

19. Decision making methods, using fuzzy logic	3,74	4	1,032	4	D(37)=0,283, p=0,00
20. Decision making analysis with multi-criteria	3,87	4	1,056	4	D(37)=0,231, p=0,00
21. Datawarehouses	4,13	4	0,846	3	D(37)=0,212, p=0,00
22. Applications on mobiles (mobile application), tablets	4,03	4	0,912	3	D(37)=0,247, p=0,00
23. Cloud applications systems (Web-based)	3,61	4	0,989	4	D(37)=0,278, p=0,00
<b>Total Average:</b>	<b>3,99</b>		<b>0,508</b>		

Business intelligence capabilities that are considered the most important are the aggregated results tools (4.68), importing/exporting data (4.48) and economic management/accounting tools (4.42), while property management tools (3.35) and investment analysis tools (3.39) are considered less important.

The link between the advantages of implementing an ERP system and the Business Intelligence capabilities in SMEs is examined in Table 5. Furthermore the correlations between ERP system implementation and their Business Intelligence capabilities, with the years of ERP usage are also investigated, using the Spearman coefficient. The more years a firm uses an ERP the more conscious should be on the advantages and capabilities it offers, due to experience and economies of knowledge.

Table 5. Results of perceptions of managers concerning Business Intelligence capabilities, of ERP systems.

Correlations	Spearman Coefficient	Significance p.
Total Average Table 2 answers vs Total Average Table 4 answers	0,738	0.000***
Total Average Table 2 answers vs Years of ERP usage	-0,022	0,892
Total Average responses Table 4 vs Years of ERP usage	-0,021	0,901

\*\*\* significant for 0.01

The values of the Spearman coefficient indicate that years of usage have no correlation with the perceived advantages of implementing and using an ERP system nor with the Business intelligence capabilities of the ERP system. That result may indicate the lack of economies of knowledge, and the underutilisation of the capabilities of the ERP system, resulting to poor ROI, and less efficient management and marketing decisions, that are critical in times of crisis. However, as expected the perceptions of the advantages emanating from the implementation of ERP systems are highly and positively correlated with the perceptions of business intelligence capabilities that the system delivers.

## 5. Conclusions

The present research aimed at investigating the perceptions and attitudes of firms using ERP systems and their Business Intelligence capability in the region of Western Macedonia in Greece. The integration of ERP systems is important for SMEs from a strategic point of view, especially due to the competition, they face in a globalised business and economic environment, where focus on cost reduction and customer needs is of utmost importance.

The sample consisted of 37 firms and respondents found more important the advantages derived from reliable data collection and consolidation, as well as saving time by automating procedures, but not saving operational resources, and cost. These results are in line with relevant findings of (Kanellou & Spathis, 2013), but are in contrast with the findings of (Said et al., 2003), (Forslund, 2010) and (HassabElnaby et al., 2012) who argued that the main benefit from adopting and implementing an ERP system is cost reduction. Similarly the Business Intelligence capabilities that are considered more important are data related, important for business reporting and date importing and exporting capabilities, about profit and non-profit organizations analysis (Nasiopoulos, Sakas, Vlachos, 2014).



Our findings raise important questions regarding the strategic intent and the reasons of adopting, implementing and finally using an ERP system by SMEs. ERP systems and their Business intelligence capabilities are not incorporated in SMEs in order to fully exploit the benefits deriving from their usage. Organizational and operational factors such as culture (Trivellas et al., 2006; 2007), strategy (Konstantopoulos et al., 2007; Reklitis et al., 2007), leadership (Trivellas & Drimoussis, 2013; Trivellas & Reklitis, 2014), learning (Dekoulou & Trivellas, 2014) and quality management (Trivellas & Santouridis, 2009), as well as strategic orientation of a firm (Reklitis & Trivellas, 2002; Trivellas, 2012) are significantly affecting the implementation and integration of sophisticated business intelligence systems (Nasiopoulos, Sakas, Vlachos, 2014). SMEs especially in times of crisis divert resources from “expensive” tasks as training and integration of new software and its capabilities divesting themselves from potential competitive advantages and losing the chance to gain core competences (Dekoulou & Trivellas, 2014). In addition, a lot of work needs to be done regarding linking ERP systems to outsourcing partners of an SME (Kutsikos & Sakas, 2014).

The results of this study can be used in the implementation of ERP systems and the usage of business intelligence features by SMEs, but also for the formulation of marketing strategies for ERP software companies focusing on SMEs. An important limitation of the study is the small sample used, that is unfortunately a common problem in conducting questionnaire research with SMEs. However, further research should focus deeper on the organisational structures of SMEs, facilitating the implementation of ERP systems, as the underutilisation of the new capabilities of these systems deprives them from well needed future growth. Moreover, scholars should examine the role of education (Santouridis et al., 2014) and HR practices in order to enhance work outcomes (Trivellas, 2011; Trivellas et al., 2013; 2013a; Kakkos & Trivellas, 2011) and cultivate the necessary behavioral and emotional competencies (Trivellas & Drimoussis, 2013; Trivellas & Reklitis, 2014) for the full and every-day application of ERP systems in a safe work environment (Metallidou et al., 2014).

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