

Patterns in enterprise management software

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ABSTRACT

In this paper a study was conducted on the complex integrated software that exists on the Romanian market. This consisted in identifying and analysing the size of the enterprise, the number of users, the technical characteristics determined by the type and number of modules included in the software and other information related to the implementation, according to the supplier's specifications. The primary analysis made it possible to obtain results regarding the integrated software market in Romania in terms of customer size, field of activity, software products that include the biggest number of modules. By statistical analysis using the multivariate cluster grouping exploration technique, the degree of similarity between the software and the modules was determined, calculating the distance by means of three measurement methods: the Euclidean distance, the percentage of disagreement, and the correlation coefficient 1- Pearson-r.

Keywords: *Integrated software, Performance, Functionality, Implementation time.*

INTRODUCTION

The processes of transformation of society recorded in recent years have demonstrated that the transition to post-industrialism and the knowledge-based society is a continuous challenge in the education system towards the introduction of modern means of technology and communication. The use of technologies requires a certain degree of education and the advantages offered provide the necessary support for progress and civilization in an economy [Allen, 1994; Anghel, 2009, Šolc, 2012]. Financial education also plays an important role because it allows understanding of existing accounting information in an enterprise's financial reports (production, sales, costs, investments, debtors, liquidities, debts).

In a knowledge-based economy, global productivity, quality, and low cost challenges can be overcome by introducing complex integrated software that increases hardware and software performance as a result of implementation requirements and as a consequence of the need of specialised work force, being a real help for business management. Thus, through the implementation of an ERP system, both small and medium-sized businesses and large businesses can cope with change with more rapidity and ease, and managers can access the necessary information anywhere thanks to modern information systems (cloud-based, open source ERP or electronic business systems) [Deshmukh, 2015; Hendricks, 2007].

Any enterprise irrespective of size or field of activity, since its establishment faces the need to manage financial and accounting transactions. As business grows, the need to have more complex software that brings together the financial and accounting side and other business processes becomes more and more acute. American Production and Inventory Control Society (Educational information society for resource management research) has defined the ERP system as such: „ERP is a framework for planning all of the resources of a business, from strategic planning through execution” [APICS, 2011]. Integrating information through ERP software is considered to be an important asset for modern businesses [Park, 2007, Schulte, 2015]. ERP systems are considered complex information systems that allow information flows between different subunits of an enterprise located differently from the point of view of the area but also within the departments thus allowing for strategic and competitive advantages [Hendricks, 2007; Basoglu, 2007]. These advantages are also considered in terms of more efficient management of enterprise resources and rapidity in decision making [Davenport, 1998, Malhotra, 2010]. Depending on the characteristics of the ERP system, there may be both specific benefits: customization data as well as general benefits such as: full process integration, reduced data processing, upgrading technology, portability of other systems, adaptability and application of best practices in the field in which the enterprise operates [Saaticioglu, 2007; Ngai, 2008].

The problem that businesses are generally confronted with is to minimize costs, and choosing a software

to streamline administrative processes involves several aspects, both technical and economic. With the growth of the enterprise, this problem becomes more and more acute and lately it has been noticed that more and more companies opt for integrated software's that allow both the financial accounting and the part of production, purchasing and selling. According to a survey by Eurostat in 2015, there were 22% of companies adopting ERP technologies in Romania, compared to 19% reported in 2010 and compared to 56% of existing enterprises in Germany or compared to 50% of existing enterprises in Belgium. The average value of enterprises adopting ERP technologies at the levels of the 28 countries surveyed in Europe amounts to 36% in 2015, compared to 21% in 2010, and of these, the size of the enterprise is 30% of small enterprises, 60% of medium enterprises and 80% of large enterprises [<http://ec.europa.eu/eurostat>].

The decision to adopt and implement a business ERP solution has been widely debated by many specialists who have taken into account numerous individual factors, underlying this decision [Leem, 2004; Hwang, 2005, Malhotra, 2010]. The overall performance of a company is considered to be improved by an ERP system and by how accounting information can be obtained, taking into account several features that it considers (compatibility, complexity, efficiency, best practices, training And competitive pressure), and this can be visible after many years of ERP usage [Nicolaou, 2006; Davenport, 1998]. Specialists from the well-known Gartner group address the issue of the need to implement integrated software, when a company wants to be successful, with interconnected modules, defining enterprise resource planning (ERP): "ERP is no longer a "thing". Postmodern ERP is a technology strategy that automates and links administrative and operational business capabilities increasingly delivered as cloud or SaaS solutions, with appropriate levels of integration balancing the benefits of vendor-delivered integration against business flexibility and agility" [Montgomery, 2017].

An essential feature for gaining future benefits as a result of implementing an integrated ERP system is considered to be the degree of adaptation and involvement of management, which must realize that besides a sizeable investment, there are also a number of changes and major challenges implied [Gosain, 2004; Nwankpa, 2015]. Several researchers state that the benefits of an ERP system depend on how companies exploit data and process integration capabilities after the deployment phase [Häkkinen, 2008; Ruivo, 2012]. Among the advantages offered by the implementation we can mention: the existence of integrated modules that allow the rapid transfer of data, reduce the operational costs (the information is operated once and it is accessible to any module), saving time and resources, the existence of a unique database, decisions being based on current, consistent and easily available information, by computerization of order picking, acquisitions, inventory management, warehouse management, logistics, eliminating potential human errors due to manual processing that sometimes lead to delays in honouring requests or delivery of non-ordered goods [Rashid, 2002]. Thus, studies show that there are also firms in which they have proved to be a failure due to non-use or partial use, due to problems of internal organization or inability to assimilate new knowledge [Gattiker, 2005; Hwang, 2005]. Among the benefits found in an ERP system from the Supply-chain Management (SCM) perspective, we can list: access to specialized professional information, that the consultants of the supplying company that designed the product provide, the avoidance of personal decisions, that may sometimes be erroneous; using tested software that works in other companies, supporting decision-making by providing analysis and reporting tools needed to monitor a business [Chang, 2008]. Several studies have demonstrated the existence of a dependency between the number of modules developed by the software application and the subsequent operational performance that it can provide [Madapusi, 2012]. So many specialists say that when software applications have more than 8 modules their efficiency decreases [Gattiker, 2005; Mabert, 2001]. Other studies have shown that organizational features and organizational support have had a positive impact on usability and utility perceived by users [Lee, 2010; Ngai, 2007]. Since planning a business is a complex process, studies have shown that the complexity of the ERP system can have a negative impact on users, considering to ease of use and perceived usefulness, but the compatibility with the technical operating systems and practices is positive. [McAfee, 2002].

The purpose of this study was to identify and analyse the integrated software on the Romanian market in terms of functionality, number of users, market segment served and other useful information related to implementation. Subsequently, a statistical analysis was carried out to determine the differences or similarities that might exist between the software provided by different manufacturers on the one hand and the modules included on the other.

MATERIAL AND METHOD

This study is based on the identification of integrated software products, using several ERP modules available on the Romanian market for small, medium and large enterprises. An analysis and data processing was carried out based on the information available on the ERP community website (<http://www.comunitateaerp.ro>, accessed on 03.03.2017) where you can find selected software suppliers in Romania and information about the software products available.

Table 1 presents the soft products taken into study.

Table 1. List of software applications on the market in Romania

Code	Soft name	Code	Soft name	Code	Soft name
A	ASiS ERP	M	Microsoft Dynamics AX	AA	SAP ERP
B	ASKI SFA	N	Microsoft Dynamics CRM	AB	SENIOR ERP
C	bcManager Professional	O	Microsoft Dynamics NAV	AC	SeniorCRM
D	B-ORG ERP	P	Mobile Reporting	AD	SIVECO Applications 2011
E	Charisma Enterprise	R	NEOMANAGER	AE	SoftData
F	ClassoftSQL	S	Oracle E-Business Suite	AF	WinMENTOR
G	Entersoft Business Suite	T	PeopleSoft Enterprise	AG	WinMENTOR Enterprise
H	Entersoft Business Suite ERP	U	Pharmec	AH	WizPro
I	eParc Auto	V	Pluriva ERP	AI	WizSalary
J	EPICOR ERP	X	Primavera	AJ	WizTime
K	HERMES SFA	Y	QlikVieW	AK	XPERT@business
L	HostWare winSPA	Z	Roadnet		

The integrated software products analysed in the study include the following modules that define functionality: BI (Business Intelligence), ERP (Enterprise Resource Planning), CRM (Customer Relationship Management), SCM (Supply-chain management), TMS (Treasury Management System), HR/Sal (Human resources/Salary), SPP (Spare parts planning), BPM (Business Process Management), PPC (Production Planning and Control), SFA (Sales Force Automation), WMS (Warehouse Management System), FI/CO (Financial Accounting and Controlling), PSA (Professional services automation), PM (Plant Maintenance), DMS (Document Management System), e-B (Electronic business), e-H (Electronic health), e-C (Electronic customs), e-A (Electronic agriculture). The functionality feature, defined by the modules embedded in the software, provides useful information on existing solutions that can be exploited or developed by manufacturers (expertise, consultants, and specialists) and are useful for future clients. Any further personalization can be built on a software that already exists, has been tested and even works in a variety of businesses.

The chosen market segment is a representative one, allowing access to existing customers in different branches of the economy: production, commerce, services or transport. In the product implementation information, three variables were studied: the duration of implementation, the duration of the user training required and the average life of the product. These three durations were taken into consideration as follows: implementation time - the feature that includes information about: installation, data transfer, customizations or improvements according to customer requirements; the necessary duration of user training (information transfer, specialized assistance etc); average product lifetime - information about the time the software maker will maintain the software in a state of functionality, by providing a number of customer service (maintenance, data updates / reports, product development, training, technical support, etc.).

Subsequently, a statistical analysis was carried out using cluster-based multivariate exploration technique, using Statsoft's Statistica 8. For this, cluster analysis was chosen by means of the unique link (closest neighbour), thus calculating the distance between two clusters as well as the distance between two objects (closest neighbours) from different clusters. According to the hierarchical agglomerative algorithm, in the first step the distance between the items was calculated, in the second step the item pair was selected which is the

closest and their union was made in a class, in the third step the distance from the other classes of items was recalculated, and then resumed step two until finally one cluster is obtained. After linking two identified items because of the problem of recalculating the distances between the new cluster and the others, the single linking method was used. Three methods of distance measurement were used to find the distance between items: Euclidean distance (Eq. (1)), disagreement percentage (Eq. (2)), and 1-Pearson-r correlation coefficient (Eq. (3)).

$$\text{distance}(x,y) = \{\sum_i (x_i - y_i)^2\}^{1/2} \tag{1}$$

$$r_{12} = \sum(Y_{i1} - Y\text{-bar}_1) \times (Y_{i2} - Y\text{-bar}_2) / [\sum(Y_{i1} - Y\text{-bar}_1)^2 \times \sum(Y_{i2} - Y\text{-bar}_2)^2]^{1/2} \tag{2}$$

$$\text{distance}(x,y) = (\text{Number of } x_i \neq y_i) / i \tag{3}$$

RESULTS AND DISCUSSIONS

Analysing the integrated software products on the Romanian market according to the size of the company and the number of possible users, the distribution shown in Figure 1 was obtained.

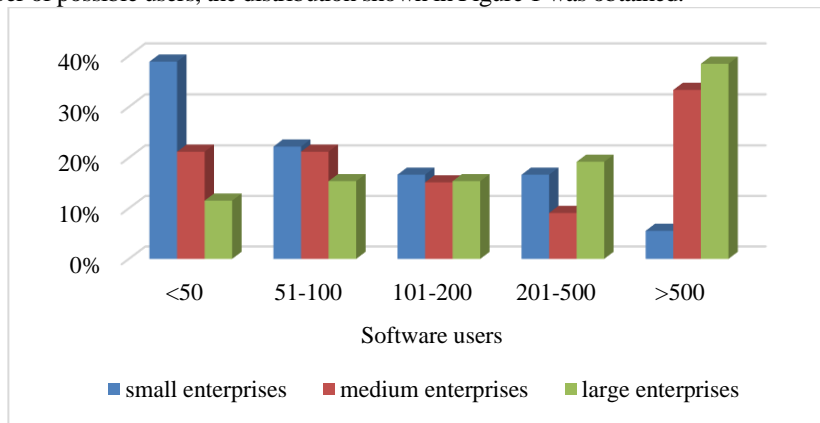


Figure 1: Distribution of software products by enterprise size and number of users.

Figure 1 shows that most software companies are targeting small business clients (21%) with a number of users up to 50 or between 51-100, to medium-sized business customers who have a number of more than 500 users (33%), followed by customers with up to 50 or between 51-100 (21%), or large business customers with the possibility of accessing over 500 users (38%), followed by clients with users ranging between 200-500 (19%).

On the Romanian market, there are software's that include one or more integrated modules having the possibility to transfer information from each other. Figure 2 shows that the most developed modules that are contained in the existing software products are: ERP (23 software out of 35 total), HR-Sal (15), FI/CO (13), WMS (12) And SCM (11), SFA (10) and CRM and PPC (9).

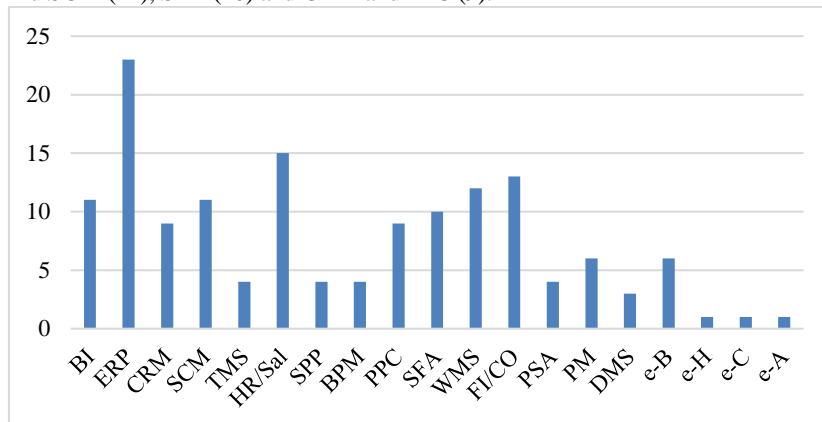


Figure 2: Distribution of existing modules in software.

Figure 3 shows the distribution of soft products according to the number of modules developed. From the analysis of Figure 3, most of the modules are incorporated into the software by: AD (SIVECO Applications 2011-19), followed by J (EPICOR ERP - 16), H (Entersoft Business Suite - 15), A (ASiS ERP - 11) and D (B- ORG ERP - 8). The first 5 software's that are characterized by the largest number of built-in modules (extended functionality on multiple activities) are: (AD) with the modules: BI, ERP, CRM, SCM, TMS, HR / PPC, SFA, WMS, FI / CO, PSA, PM, DMS, e-B, e-H, e-C, e-A; (J) with all less modules: e-H, e-C, e-A; (G) with all the less: HR / Sal, e-H, e-C, e-A; (A) with all the less: FI / CO, PSA, PM, DMS, e-B, e-H, e-C, e-A, and (D), however: BI, ERP, SCM, HR / Sal, PPC, WMS, FI / CO, e-B.

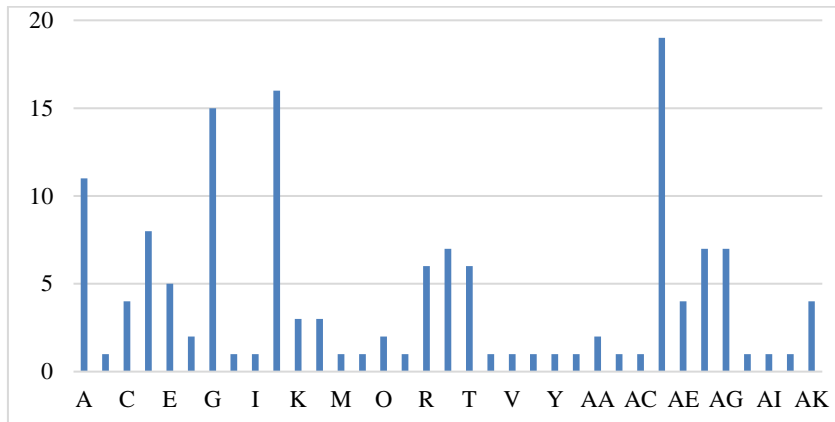


Figure 3: Distribution of software by the number of modules developed.

Analysing the first 5 software products according to the market segment (1-production, 2-commerce, 3-transport, 4-services), the customers have obtained the following: AD is the only software that addresses all market segments, followed by A and D (1,2 and 4), J (1,3), H (1,4). The first two products (AD, J) have the longest implementation time, and this can be explained by the large number of modules and the large amount of information that implementation implies. In the case of the average duration of the user training period, it is found that the fourth product and the second offer the longest training duration of over 30 days or up to 30 days. After the average life of the product, offered by producers to their customers, AD and D have the highest average life span (over 10 years), followed by J and A (5-10 years) and H (1-2 years) last. The average lifetime shows the period during which the producing company develops the product and maintains it. It was found that the first two products (AD, J) have the longest implementation time, and this can be explained by the large number of modules and the large amount of information that implementation implies. In the case of the average duration of the user training period, it is found that the fourth product (> 30 days) and the second offer the longest training (<30 days). After the average life of the product, offered by the manufacturers to their customers, AD and D have the highest average life span (over 10 years), followed by J and A (5-10 years), and on last place H (1-2 years). The average lifetime shows the period during which the producing company develops the product and maintains it. Figure 4 shows a diagram that includes the Euclidean distance for all types of software on the Romanian market (35), where we see clustering clusters and the values to which clusters have been joined. The analysis of clusters was done by comparing the similarities between groups and analysing the relationships between them. The smallest known Euclidean distance is for example between AF and AG. Other groups of software such as H, J, AD, and A vs. E have the Euclidean distance greater than 2.5, which shows us the difference that exists between the first and second category. From the analysis of Figure 5 it is observed that the best similarity is obtained at a distance of less than 0,1 and the smallest at a distance of over 0,3. According to the obtained result we can say that the modules with the least similarity are BI followed by the ERP.

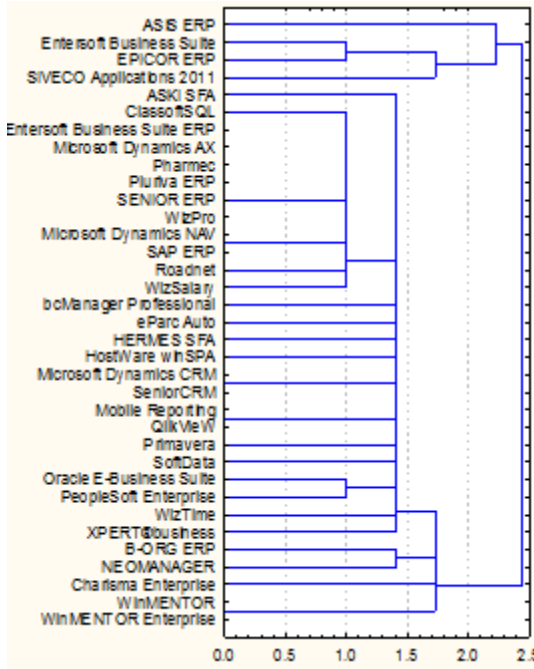


Figure 4. Euclidean distance obtained for soft products.

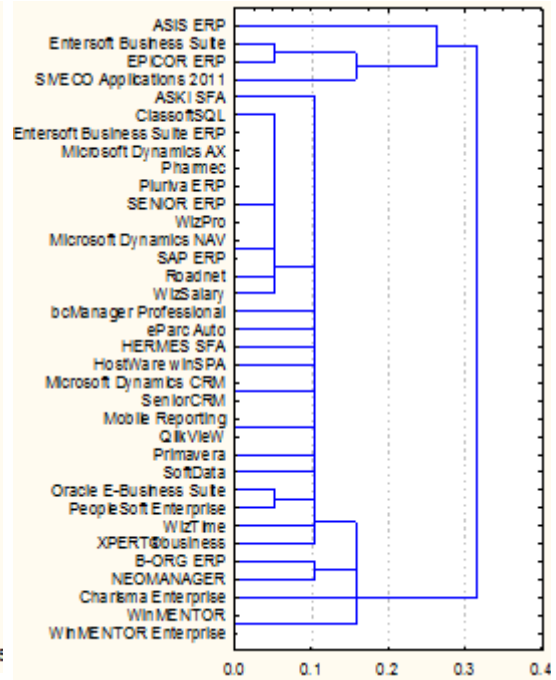


Figure 5. Discrepancy percentage for software products.

Figure 6 shows that the largest distance is given by the cluster containing all ERP modules and the ERP module, with a distance of about 3,4.

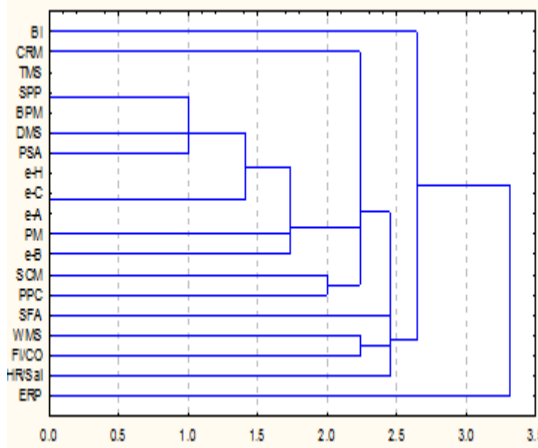


Figure 6. Euclidean distance obtained for software modules.

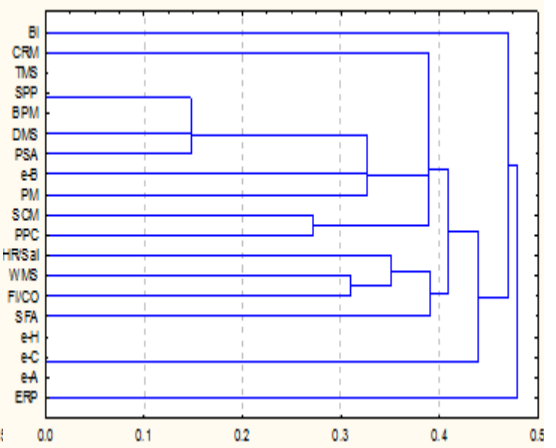


Figure 7. Pearson correlation obtained for software modules.

In Figure 7, a diagram was obtained using the Pearson correlation, showing the degree of linear association between two variables taken in the study, normally distributed.

Comparing the results obtained by measuring the distance by the three measuring methods, the Euclidean distance, the 1-Pearson-r correlation coefficient and the disagreement percentage, similar results were obtained confirming the similarity or dissimilarity of some software and modules.

In the study we have obtained useful information regarding the number of users that the existing integrated software on the Romanian market allows and it was observed that in the small enterprises, the most applications (39%) can be used for a number of to 50 users, while for medium and large enterprises of over

500 users (33% and 38% respectively). It has been noticed that on the Romanian market there are 35 software applications that have several integrated modules, sometimes different, which are characterized by different content, targeted market segment and duration of implementation. Out of the 19 modules of the software's analysed in the study, the AD software includes everything, followed by J and H. For medium and large enterprises, there are: AD, J, H, D for small businesses: the software A. The average implementation time for software is from 1 month to 12 months, the average duration of training from 1 day to 30 days, and the average life span from 1 year to over 10 years. Because the first two implementation and training times are variable depending on several features that are not accessible (to the vendor: number of specialists involved, size of the company, need for personalization, etc.) to the buyer: the data sources, the possibility of preparation for the transfer data, equipment, etc.), the study did not allow the analysis of all these variables. We consider the last variable: lifetime was more affordable to analyse, as it depends exclusively on the manufacturer. The longest average life span is provided by AD and D software over 10 years and J and A for up to 10 years, so customers can reimburse acquisition, training and implementation costs, and the provider provides improvements, service assistance and maintenance etc.

CONCLUSION

By statistical analysis it was possible to observe the similarity that exists between both software and integrated modules, namely the degree of attraction that makes the distance as small as possible. The use of integrated software to allow the correlation of accounting information with its operational needs is desirable for any firm but the implementation is hampered by the economic factor (price) and the technical factor (level of education).

Although software has appeared on the market with the possibility of using it without cost (for educational purposes), these software taken over in the study do not currently have this component. I think this would be important for both producers and users because it would allow a new vision and a practical attitude to what exists in businesses in the economic environment by helping to understand the role of technology in the progress of a society.

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