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Using fuzzy c-means clustering algorithm in financial health scoring

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Abstract

Classification of firms according to their financial health is currently one of the major problems in the literature. To our knowledge, as a first attempt, we suggest using fuzzy c-means clustering algorithm to produce single and sensitive financial health scores especially for short-term investment decisions by using recently announced accounting numbers. Accordingly, we show the calculation of fuzzy financial health scores step by step by benefit from Piotroski's criteria of liquidity/solvency, operating efficiency and profitability for the firms taken as a sample. The results of correlation analysis indicate that calculated scores are coherent with short-term price formations in terms of investors' behavior and so fuzzy c-means clustering algorithm could be used to sort firm in a more sensitive perspective.

Keywords: *Accounting numbers, financial analysis, financial classification, Fuzzy c-means (FCM) clustering algorithm*

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Introduction

Investors' decisions represent the expectations derived from cumulative beliefs that include past experiences and formation of recent reasonable differences in prior beliefs (Ball and Brown, 1968; Morris 1996; Fama, 1998; Core et al., 2003; Cajueiro and Tabak, 2004; Brimble and Hodgson, 2007). In this sense, announced accounting numbers as quantized signals play an important role on changes in beliefs and can cause rapid stock price fluctuations mostly in weak efficient or inefficient markets where investors must actively manage their portfolios in order to expect a proper return in the frame of speculative investment behavior (Fama et al., 1969; Malkiel and Fama, 1970; Harrison and Kreps, 1978; D'Ambrosio, 1980; Harvey, 1993; Urrutia, 1995; Aitken, 1998; Grieb and Reyes, 1999). In other words, especially in short-term, investors buy or sell stocks based on changes in financial health of firms which become clear by recently announced accounting numbers (Core et al., 2003). Therefore investors need summarized indicators to make investment decisions in post-announcement short-term.

Financial classification is useful tool for market participants to compare differentiation in financial situations. Although there are lots of general accepted scores, summarizing the large amount of valuable data is currently one of the major problems in the literature. For instance, F-Score is widely accepted benchmark developed by Piotroski (2000) to show financial performance of the firms as single summarized indicator and provides many useful insights to identify financially healthier firms. However, the numerical characteristic makes F-Scoring (between '0': the lowest and '9': the highest qualification) insensitive to sort and classify firms especially to explain the price formations ans short-term investors' decisions.

In the literature, there are various studies which utilize a clustering algorithm for classification problem. On the other hand, while most part of these studies have tried to integrate clustering techniques into portfolio management (Pattarin et al., 2004; Tola et al., 2008; Nanda et al., 2010 etc.), there are limited number of studies that concentrate on classifying the firms based on their announced accounting numbers.

Wang and Lee (2008) suggest a clustering method based on a fuzzy relation to classify the financial ratios of different companies and they stated that the clustering method can be applied in conditions where the cluster number is not determined. On the other side, their study does not mention the benefit of using this kind of clustering.

The main contribution of this study is to suggest a systematic alternative to sort firms sensitively according to changes in their financial health based on recently announced accounting numbers. In other words, we show how Fuzzy c-means (FCM) clustering algorithm could be used in order to produce single and more sensitive numerical indicator, hereupon called 'fuzzy financial health score (F-FHS: between '0' and '1')', that show the changes in financial health compared to previous year. To our knowledge, our study is first to provide a methodological perspective under this point of view.

We present this methodological perspective through an implementation on selected sample. Since the reaction level of markets with low efficiency on recently announced accounting numbers is high, we select the data of 166 active firms listed and traded on National Market of Istanbul Stock Exchange[1] as a sample in model implementation. We use delta determinants of F-Score to calculate F-FHSs of selected firms: ΔROA (change in return on assets), ΔCFO (change in cash flow from operations), ΔLEV (change in leverage), ΔCR (change in current ratio), ΔMARGIN (change in gross margin) and ΔTURN (change in asset turnover).

2013 and 2014 annual announced accounting numbers were used because in that period Turkey initialized its position against IMF and ranked as the sixth biggest economy in Europe and the sixteenth in the world. Therefore, these years can more clearly reflect firm specific performance under smooth economic conditions.

In order to see if F-FHSs are meaningful summarized single indicators or not, correlation analysis is executed between calculated scores and realized returns of firms for given short period. Ten trading days (n) are used as pre and post terms of announcement time of financial statements and three different indicators are used as return inputs, 'rA', 'rB' and 'rC'.

'r_A' denotes the price changes of stock in percentages by using 'P_{t+n}' and 'P_{t-1}', indicate the stock prices at

[1] Studies in the literature such as Balaban (1995), Kawakatsu and Morey (1999), Buguk and Brorsen (2003) etc. found that Turkish market is weak form efficient.

the end of post announcement term and the one trading day before from 't' respectively, while 't' indicates the announcement date of financial statements.

$$r_A = \frac{P_{t+n} - P_{t-1}}{P_{t+n}} \quad (1)$$

In order to make return input more explanatory from the view of investors' active behavior, trading volumes are taking into account for pre and post terms via calculating their weights '$w_{t\mp i}$' and 'r_B' that denotes the weighted average price changes of stock in percentages is added into analysis as second return input.

$$r_B = \frac{\left[\frac{\sum_{i=1}^{n} w_{t+i} P_{t+i}}{\sum_{i=1}^{n} w_{t+i}}\right] - \left[\frac{\sum_{i=1}^{n} w_{t-i} P_{t-i}}{\sum_{i=1}^{n} w_{t+i}}\right]}{\frac{\sum_{i=1}^{n} w_{t+i} P_{t+i}}{\sum_{i=1}^{n} w_{t+i}}} \quad (2)$$

More return or less loses results compared to market's return also perceived as win situation by investors. In this sense, 'r_C' is added as another return input via calculating the spread between 'r_B' and market return (r_M) which indicates percentage change in market index value (IV) between the post n[th] trading day and announcement date.

$$r_C = r_B - \frac{IV_{t+n} - IV_t}{IV_{t+n}} \quad (3)$$

The structure of the paper is as follows. In the next section, a brief overview of the FCM algorithm is provided. In section 2, data sources are mentioned, calculation of F-FHSs is shown step by step and the results of correlation analysis are given. In Section 3, conclusions are mentioned.

1. FCM Clustering Algorithm

Clustering algorithms based on its structure are generally divided into two types: fuzzy and nonfuzzy (crisp) clustering. Crisp clustering algorithms give better results if the structure of the data set is well distributed. However, when the boundaries between clusters in data set are ill defined, the concept of fuzzy clustering becomes meaningful (Nefti and Oussalah, 2004). Fuzzy methods allow partial belongings (membership) of each observation to the clusters, so they are effective and useful tool to reveal the overlapping structure of clusters (Zhang, 1996). Fuzzy c-means (FCM) clustering algorithm is one of the most widely used method among fuzzy associated models (Bezdek and Pal, 1992).

Fuzzy clustering methods are used for calculating the membership function that determines to which degree the objects belong to clusters and used for detecting overlapping clusters in the data set. FCM clustering algorithm, one of the commonly used clustering method, is initially proposed by Dunn (1973) and developed by Bezdek (1981).

Let $X = \{\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n\}$ denote a set of n objects and each i object ($i = 1, 2, \dots, n$) is represented with d dimensional vector $\mathbf{x}_i = \left[x_{1,i}\ x_{2,i}\ \dots\ x_{d,i}\right]^T \in \Re^d$. So, $n \times d$ dimensional data matrix, composed of a set of n vectors is

$$\mathrm{X} = \begin{bmatrix} x_{1,1} & x_{1,2} & \cdots & x_{1,d} \\ x_{2,1} & x_{2,2} & \cdots & x_{2,d} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n,1} & x_{n,2} & \cdots & x_{n,d} \end{bmatrix}. \quad (4)$$

A fuzzy clustering algorithm separates data matrix, X into c overlapping clusters in accordance with the design of a fuzzy partition matrix, U. Fuzzy partition matrix, U is composed of the degrees of memberships of objects, $\mathbf{x}_i$ ($i = 1, 2, \dots, n$) in every cluster k ($k = 1, 2, \dots, c$). The degree of membership of i. vector in cluster k is represented by $\mu_{k,i} \in \mathrm{U}$. Accordingly, the partition matrix is given by

$$\mathrm{U} = \begin{bmatrix} \mu_{1,1} & \mu_{2,1} & \cdots & \mu_{c,1} \\ \mu_{1,2} & \mu_{2,2} & \cdots & \mu_{c,2} \\ \vdots & \vdots & \ddots & \vdots \\ \mu_{1,n} & \mu_{2,n} & \cdots & \mu_{c,n} \end{bmatrix}. \quad (5)$$

In fuzzy clustering method, each cluster is represented with a vector of cluster centers which is usually identified as the centroids of d objects, e.g., average of all the datum of the corresponding cluster (Celikyilmaz and Turksen, 2009). The algorithm calculates c number of cluster center vectors $V = \{\mathbf{v}_1, \mathbf{v}_2, \dots, \mathbf{v}_c\} \in \mathcal{R}^{c \times d}$ where each cluster center is denoted as $\mathbf{v}_k \in \Re^d$, $k = 1, 2, \dots, c$.

FCM clustering algorithm is a simple and convenient method. In this method, the number of clusters, c is assumed to be known or at least fixed. Because this assumption is considered to be unrealistic in many data analysis problems, the method for determining the number of clusters such as Cluster Validity Index (CVI) analysis has been developed in FCM clustering algorithm (Pal and Bezdek, 1995; Kim and Ramakrishna, 2005; Celikyilmaz and Turksen, 2008).

FCM clustering method is based on a constrained optimization problem reaching the optimum solution with the minimum of the objective function. The mathematical model of this optimization problem with two prior information such as number of cluster, c and fuzziness parameter, m is identified as:

$$\begin{aligned} &\min J(\mathrm{X};\mathrm{U},\mathrm{V}) = \sum_{k=1}^{c}\sum_{i=1}^{n}\left(\mu_{k,i}\right)^{m} d^2(\mathbf{x}_i,\mathbf{v}_k) \\ &0 \le \mu_{k,i} \le 1\,,\forall i,k \\ &\sum_{k=1}^{c}\mu_{k,i} = 1\,,\forall i > 0 \\ &0 < \sum_{i=1}^{n}\mu_{k,i} < n\,,\forall k > 0, \end{aligned} \tag{6}$$

where each cluster is represented by a prototype, $\mathbf{v}_i$ (Bezdek, 1981). The value of $m \in (1,\infty)$ in objective function is expressed as the degree of fuzziness or fuzzifier, and it determines the degree of overlapping of clusters. The situation of "$m = 1$" which means that the clusters are not overlapping represents the crisp clustering structure (Hammah and Curran, 1998). Here, $d^2(\mathbf{x}_i,\mathbf{v}_k)$ is the measure of distance between i. object and k. cluster center. FCM clustering algorithm specifically uses Euclidean distance. Quadratic distance ensures that the objective function is not negative definite, > 0 .

Optimum membership values and cluster centers derived from the solution of optimization problem in (6) with the method of Lagrange multipliers are calculated as,

$$\mu_{k,i}^{(t)} = \left[\sum_{l=1}^{c}\left(\frac{d\left(\mathbf{x}_i,\mathbf{v}_k^{(t-1)}\right)}{d\left(\mathbf{x}_i,\mathbf{v}_l^{(t-1)}\right)}\right)^{\frac{2}{m-1}}\right]^{-1} \tag{7}$$

$$v_k^{(t)} = \frac{\sum_{i=1}^{n}\left(\mu_{k,i}^{(t)}\right)^{m}\mathbf{x}_i}{\sum_{i=1}^{n}\left(\mu_{k,i}^{(t)}\right)^{m}}\,,\ \forall k = 1,2,\ldots,c \tag{8}$$

In eq. (7), $\mathbf{v}_k^{(t-1)}$ denotes cluster center vector for cluster i obtained in $(t-1)$th iteration. $\mu_{k,i}^{(t)}$ in eqs. (7) and (8) denotes optimum membership values obtained at t. iteration. According to this operation, the membership values and cluster centers seem to be dependent on each other. Therefore, Bezdek (1981) proposed an iterative formula for determining membership values and cluster centers. Accordingly, at each iteration t, objective function $J^{(t)}$ is determined by

$$J^{(t)} = \sum_{k=1}^{c}\sum_{i=1}^{n}\left(\mu_{k,i}^{(t)}\right)^{m} d^2\left(\mathbf{x}_i,\mathbf{v}_k^{(t)}\right) > 0 \tag{9}$$

FCM algorithm is ended at the end of a particular iteration or according to a termination rule defined as $\left|v_k^{(t)} - v_k^{(t-1)}\right| \le \varepsilon$ (Celikyilmaz and Turksen, 2009).

2. The data and empirical implementation

2.1. Data

166 active firms listed and traded on National Market of Istanbul Stock Exchange (BIST-Borsa Istanbul) were selected as a sample for empirical implementation. Selected sample does not include financial service firms and the companies with lack of data. Annual accounting numbers of 2013 and 2014 are obtained from Public Disclosure Platform of BIST (KAP). BIST100 index is used for '$\mathrm{r_M}$' calculation. Historical stock prices, trading volumes and index values are obtained from 'Matriks' which is the one of formal data distributor of BIST. The dates for post and pre nth trading days are shown in **Table 1** according to announcement dates of financial statements for each firm.

Table 1. 't', pre nth and post nth days of each selected firms

Firm Codes *(Date notation: day/month/year)*	Post 10th Trading Day	Announcement ← Date (t) →	Pre 10th Trading Day
ARCLK	13.02.2015	30.01.2015	16.01.2015
TOASO	16.02.2015	02.02.2015	19.01.2015
ARENA	17.02.2015	03.02.2015	20.01.2015
AFYON, TTKOM	19.02.2015	05.02.2015	22.01.2015
HEKTS	20.02.2015	06.02.2015	23.01.2015
MAALT	23.02.2015	09.02.2015	26.01.2015
IZOCM	24.02.2015	10.02.2015	27.01.2015
CEMTS, EREGL	25.02.2015	11.02.2015	28.01.2015

Firm Codes *(Date notation: day/month/year)*	Post 10th Trading Day	Announcement ← Date (t) →	Pre 10th Trading Day
EGGUB, ERBOS, TCELL, VESBE	26.02.2015	12.02.2015	29.01.2015
OTKAR, PKART	27.02.2015	13.02.2015	30.01.2015
USAK	27.02.2015	14.02.2015	02.02.2015
LOGO, TKNSA, VERUS	02.03.2015	16.02.2015	02.02.2015
BOLUC, MRDIN	03.03.2015	17.02.2015	03.02.2015
FROTO	04.03.2015	18.02.2015	04.02.2015
TAVHL	05.03.2015	19.02.2015	05.02.2015
AKENR, AKSA, TATGD	06.03.2015	20.02.2015	06.02.2015
CRFSA, KARTN, KONYA	09.03.2015	23.02.2015	09.02.2015
AKCNS, COMDO, CIMSA, NETAS, PIMAS, VESTL	10.03.2015	24.02.2015	10.02.2015
ASUZU, BAGFS, BOYNR, THYAO, TTRAK	11.03.2015	25.02.2015	11.02.2015
BIZIM, BRISA, BUCIM, KOZAL	12.03.2015	26.02.2015	12.02.2015
ALCAR, ALKA, DITAS, DOAS, EGSER, GOODY, INTEM, KORDS, KRSTL, OLMIP, SANKO, SASA, SODA, TRKCM, TUKAS, YUNSA	13.03.2015	27.02.2015	13.02.2015
ADEL, AKSUE, AKPAZ, ALKIM, ANACM, AYGAZ, BAKAB, BSOKE, BOSSA, BURVA, DMSAS, DENCM, DERIM, DYOBY, ENKAI, IHEVA, IHGZT, KAREL, KENT, KLMSN, KNFRT, KUTPO, LINK, OZBAL, PRKME, PETUN, PINSU, PNSUT, TEKTU, TUPRS, UYUM, VKING, YATAS	16.03.2015	02.03.2015	16.02.2015
BIMAS, KCHOL, PARSN, SELEC	17.03.2015	03.03.2015	17.02.2015
AKFEN, BRSAN, IHYAY, IZMDC, MNDRS, PGSUS, ULKER	18.03.2015	04.03.2015	18.02.2015
AEFES, CCOLA, KERVT, NUHCM, TKFEN	19.03.2015	05.03.2015	19.02.2015
AKSEN, ASELS, BMEKS, CMBTN, CMENT, ZOREN	20.03.2015	06.03.2015	20.02.2015
HURGZ, PETKM	20.03.2015	07.03.2015	23.02.2015
ALARK, ALCTL, ALYAG, AYEN, BANVT, EDIP, IHLAS, INDES, ULUSE	23.03.2015	09.03.2015	23.02.2015
CLEBI, DEVA, DOHOL, GENTS, POLHO, ROYAL, SARKY, TRCAS, VAKKO	24.03.2015	10.03.2015	24.02.2015
ANELE, ARSAN, BTCIM, BURCE, CEMAS, DGKLB, ECILC, EMKEL, ESCOM, GEREL, GLYHO, GOLTS, GUBRF, IPEKE, ITTFH, KARSN, KILER, KOZAA, MRSHL, MGROS, TIRE, NTHOL, PENGD, SKTAS, TMSN, TBORG, YAZIC	25.03.2015	11.03.2015	25.02.2015
NTTUR	26.03.2015	12.03.2015	26.02.2015
ODAS	08.06.2015	25.05.2015	11.05.2015
MARTI	23.06.2015	09.06.2015	26.05.2015

Source: Developed by authors.

2.2. Empirical Implementation: Producing Fuzzy Financial Health Scores

In order to calculate F-FHSs for selected firms, the steps outlined below are performed.

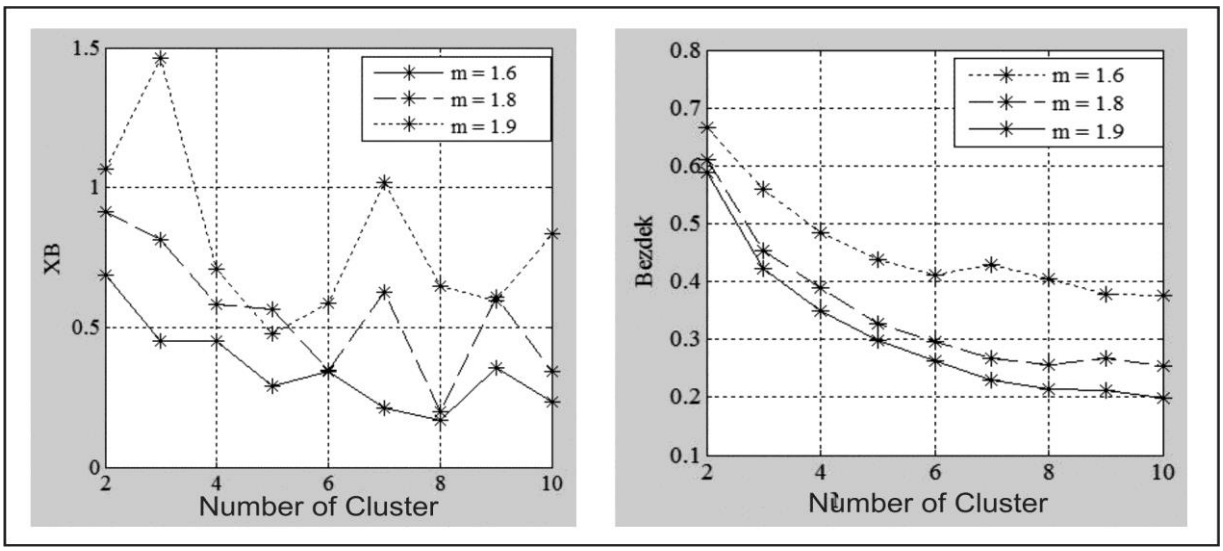
Step 1. Due to the existing heterogeneity in measurement units of variables, it is necessary to perform a homogenization process. By utilizing the normalization of the variables, weighting variables more or less is prevented. The normalization process is performed with the following relation:

$$X_{new} = \frac{X_i - X_{min}}{X_{max} - X_{min}} \quad (10)$$

where X_{min} is the minimum value and X_{max} is the maximum value of corresponding variable. All variables with normalization is scaled to the range $[0, 1]$.

Step 2, Optimum value of the number of cluster (c) and degree of fuzziness (m) are determined by utilizing CVI analysis.

Figure 1. The change in cluster validity indices according to the number of cluster, (left) XB index, (right) Bezdek's partition coefficient



Source: Developed by authors

In Figure 1, the results of two validity indexes, Xie – Beni (XB) Index (Xie and Beni, 1991) and Bezdek's partition coefficient (Pal and Bezdek, 1995), are displayed. The proper value of the number of cluster and degree of fuzziness that satisfies the minimization of XB index and maximization of Bezdek's partition coefficient are determined as $c = 5$ and $m = 1.6$, respectively.

Step 3. Cluster center vectors and partition matrix are determined by applying FCM clustering algorithm with the prior information, c and m, obtained at previous step.

For $c = 5$ and $m = 1.6$ by applying FCM clustering method, cluster center vectors, $V = \{\mathbf{v}_1, \mathbf{v}_2, \dots, \mathbf{v}_c\} \in \mathcal{R}^{c \times d}$ are determined as,

$$V = \begin{bmatrix} 0.348 & 0.271 & 0.212 & 0.409 & 0.508 & 0.539 \\ 0.573 & 0.285 & 0.219 & 0.493 & 0.716 & 0.593 \\ 0.508 & 0.276 & 0.217 & 0.470 & 0.621 & 0.637 \\ 0.684 & 0.279 & 0.223 & 0.493 & 0.720 & 0.531 \\ 0.499 & 0.281 & 0.213 & 0.478 & 0.626 & 0.526 \end{bmatrix} \quad (11)$$

Step 4. Euclidean norm is calculated for each cluster center vector.

In this implementation, it is claimed that the norm values allow an assessment of the general level of financial health for each cluster. Thus, while the value of the calculated norm for each cluster increases, the level of financial health rises in accordance with defined determinants, and while the norm value becomes smaller, the level of financial health of cluster will be reduced similarly. As a result, calculated Euclidean norms for center vectors of five clusters are given in Table 2.

Table 2. Euclidean norms calculated for the cluster center vectors

Cluster Number	Norm (h_i)
1	0.978
2	1.251
3	1.181
4	1.281
5	1.127

Source: Developed by authors.

Step 5. The advantage of FCM clustering algorithm is to produce the degree of membership of each country to c cluster. Let the degree of memberships of i. firm to c number of cluster is denoted as $\boldsymbol{\mu}_i = [\mu_{1,1}, \mu_{2,1}, \dots, \mu_{c,1}]$ and the vector consisting of the norms of cluster center vectors is represented by $\boldsymbol{h}$. Accordingly, the F-FHS for each firm is determined with the following formula,

$$\lambda_i = \boldsymbol{\mu}_i \boldsymbol{h} \quad (12)$$

Step 6. F-FHSs of each firm are presented in Table 3 and F-FHS, $i = 1, 2, \dots, n$ is calculated with the following relation,

$$\mathrm{F-FHS}_i = \frac{\lambda_i - \lambda_{min}}{\lambda_{max} - \lambda_{min}}, i = 1, 2, \dots, n \quad (13)$$

Table 3. F-FHS of each firm

Firm Codes	F-FHS	Firm Codes	F-FHS	Firm Codes	F-FHS	Firm Codes	F-FHS	Firm Codes	F-FHS
ADEL	0.34	BRSAN	0.61	FROTO	0.57	LINK	0.30	SKTAS	0.73
AFYON	0.88	BOSSA	0.68	GENTS	0.49	LOGO	0.87	TATGD	0.84
AKCNS	0.92	BOYNR	0.66	GEREL	1.00	MRDIN	0.91	TAVHL	0.89
AKENR	0.45	BRISA	0.80	GLYHO	0.29	MAALT	0.74	TEKTU	0.78
AKFEN	0.42	BURCE	0.83	GOODY	0.67	MRSHL	0.59	TKFEN	0.86
AKSA	0.67	BURVA	0.83	GOLTS	0.63	MARTI	0.57	TKNSA	0.59
AKSEN	0.77	BUCIM	0.92	GUBRF	0.77	MNDRS	0.60	TOASO	0.63
AKSUE	0.49	CRFSA	0.98	HEKTS	0.59	MGROS	0.81	TRKCM	0.74
AKPAZ	0.61	CCOLA	0.66	HURGZ	0.33	TIRE	0.90	TUKAS	0.40
ALCAR	0.65	COMDO	0.68	IHEVA	0.77	NTHOL	0.52	TRCAS	0.60
ALARK	0.39	CLEBI	0.72	IHGZT	0.94	NTTUR	0.64	TCELL	0.53
ALCTL	0.87	CEMAS	0.25	IHLAS	0.78	NETAS	0.70	TMSN	0.05
ALKIM	0.83	CEMTS	0.62	IHYAY	0.92	NUHCM	0.92	TUPRS	0.57
ALKA	0.64	CMBTN	0.54	INDES	0.58	ODAS	0.81	THYAO	0.70
ALYAG	0.00	CMENT	0.93	INTEM	0.71	OLMIP	0.68	TTKOM	0.72
ANACM	0.68	CIMSA	0.63	IPEKE	0.50	OTKAR	0.69	TTRAK	0.12
AEFES	0.41	DMSAS	0.89	ITTFH	0.52	OZBAL	0.66	TBORG	0.54
ASUZU	0.37	DENCM	0.90	IZMDC	0.77	PRKME	0.31	ULUSE	0.50
ANELE	0.68	DERIM	0.43	IZOCM	0.92	PARSN	0.91	USAK	0.70
ARCLK	0.68	DEVA	0.56	KAREL	0.60	PGSUS	0.68	UYUM	0.70
ARENA	0.53	DITAS	0.86	KARSN	0.44	PENGD	0.90	ULKER	0.67
ARSAN	0.93	DOHOL	0.56	KARTN	0.39	PETKM	0.51	VAKKO	0.68
ASELS	0.57	DGKLB	0.61	KENT	0.87	PETUN	0.68	VERUS	0.69
AYEN	0.91	DOAS	0.65	KERVT	0.67	PINSU	0.85	VESBE	0.93
AYGAZ	0.68	DYOBY	0.66	KILER	0.65	PNSUT	0.62	VESTL	0.82
BAGFS	0.80	EDIP	0.93	KLMSN	0.58	PIMAS	0.39	VKING	0.94
BAKAB	0.69	EGGUB	0.95	KCHOL	0.65	PKART	0.48	YATAS	0.81
BANVT	0.76	EGSER	0.92	KNFRT	0.75	POLHO	0.52	YAZIC	0.35
BTCIM	0.92	ECILC	0.53	KONYA	0.91	ROYAL	0.57	YUNSA	0.82
BSOKE	0.87	EMKEL	0.82	KORDS	0.92	SANKO	0.69	ZOREN	0.85
BIMAS	0.65	ENKAI	0.65	KOZAL	0.68	SARKY	0.69		
BMEKS	0.68	ERBOS	0.93	KOZAA	0.51	SASA	0.91		
BIZIM	0.54	EREGL	0.66	KRSTL	0.36	SELEC	0.69		
BOLUC	0.82	ESCOM	0.15	KUTPO	0.99	SODA	0.85		

Source: Developed by authors.

Step 7. Correlation analysis is executed in order to see if F-FHSs work or not. The results of significance test are given in Table 4 and there is a statistically significant relationship between F-FHSs and r_B, r_C respectively. That means F-FHSs are coherent with short-term price formations and so, the scores could be used as summarized single indicators to sort firms according to changes in their financial health in a more sensitive way.

Table 4. The relation between F-FHS and r_A, r_B, r_C

Return Inputs	F-FHS	
	Corr. Coeff.	Sig. Level (p)
r_A	0,138	0,794
r_B	0.652	0,000*
r_C	0,529	0,000*

*$p < 0{,}05$,
Source: Developed by authors.

Conclusion

The paper suggests a methodological perspective for the first time on how Fuzzy c-means (FCM) clustering algorithm could be used in order to sort firms according to changes in their financial health compared to previous year. Accordingly, to show this methodology, we applied FCM clustering algorithm and produced fuzzy financial health scores (F-FHSs) of selected 166 active firms listed and traded on National Market of Istanbul Stock Exchange by benefit from F-Score's delta determinants calculated via using the accounting numbers of 2013 and 2014. This implementation enables us to classify firms in a more sensitive way based on single numerical indicator.

A correlation analysis was executed between calculated scores and realized returns for a given short term in order to investigate the employability of F-FHSs. The results indicate that FCM clustering algorithm is beneficial tool to sort firms according to their financial health level and can provide a sensitive and single summarized indicator for investment decisions based on recently announced accounting numbers especially for markets with low efficiency.

In this paper, we tried to show this methodological perspective through empirical implementation by using F-Score's delta determinants. On the other hand, this is not the only option. Also, the best-fit mix of determinants to produce most efficient F-FHSs can be investigated which is also closely related with the subject of value or behavioral relevance of accounting numbers.

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The perceived suitability of management accounting information:

a contingency based investigation

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Abstract

The current paper aims at testing the existence and the strength of the relationship between selected variables and the managers' assessment of the information provided by the management accounting system (MAS), based on a contingency approach. In order to achieve the objective of the paper, we employed the correlation analysis with the purpose of investigating the strength of the relationship between the assessments made by managers with respect to the suitability of the management accounting information and certain variables (the company profile, the manager profile and the operations of the management accounting department). In this context, we used the data collected from randomly selected managers active in companies located in two Central and Eastern European countries, i.e. Poland and Romania. We found moderate relationships to the assessed suitability of the MAS information only for two of the three variables: the manager profile – mainly with respect to the managed department, and the operations of the management accounting department – mainly with respect to the frequency of the meetings between the manager and the management accountant.

Keywords: *Managers' perception, management accounting, contingency factors, correlations*

JEL Classification: *M10, M49*

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Introduction

Though the managers' perception is widely debated in literature, whenever it comes to the usefulness of the information provided by the management accounting system (MAS), the topic still arouses interest. The review of the specific literature reveals a wide range of studies in this direction (Chenhall and Morris, 1986; Mendoza and Bescos, 2001; Pierce and O'Dea, 2003; Cheffi and Beldi, 2012). Yet, these studies highlight mainly the differences between the perception of information providers and that of information users, called forth by fundamentally different motivations and attitudes. What is not often encountered in the context, though it should, is a debate on the internal and external factors influencing the manner in which managers, as information users, assess the information delivered by the management accounting system.

Research in management accounting is often focused on issues like organizational systems and processes, information use, the behaviour of accountants and other users (Gupta and Govindarajan, 1991). Management accounting practices are analyzed at micro - and macro level (Granlund and Lukka, 1998), whereas the two levels refer to the scope and comprehensiveness of management accounting issues. The macro-level consists of concepts, ideas, techniques, system designs and the purpose of using MA information, while the micro-level refers to behavioural patterns and styles of the information use (Ahrenes, 1996), tasks, operations and actors of the management accounting system, i.e. management accountants as providers of management accounting information, and managers as users of management accounting (Granlund and Lukka, 1998).

There is a significant amount of research built on a contingency-based approach, examining factors like the external environment (Gordon and Miller, 1976; Merchant, 1990; Hartman, 2000; Haldma and Laats, 2002; Otley, 2016), the national culture (Hofstede, 1984; O'Connor, 1995), the technology (Otley, 2016; Haldma and Laats, 2002), the size of the company (Dropulic, 2013; Merchant, 1985; Sharma, 2002; Chenhall, 2007; Cadez and Guilding, 2008), or its strategy (Gupta and Govindarajan, 1984; Simons, 1987; Chenhall and Morris, 1986). All these analyses were performed in different contexts; still, there are few studies on contingency factors in developing countries and these mainly approach the influence of such factors on management accounting practices (Albu and Albu, 2012; Hopper *et al.*, 2009; Jaruga and Ho, 2002; Haldma and Laats, 2002; Anderson and Lanen, 1999). The relationship between these variables and the managers' perception on the usefulness of information for the decision-making process hasn't been debated at all, to the best of our knowledge. In this context, the present paper expands the analysis and fills the literature gap by performing a vast study of the interdependence between several variables and the relevance of the information provided to managers by management accounting.

Starting from these premises, the objective of the current paper is to test the strength of the relationship between selected variables and the managers' assessment of the information provided by the management accounting system, based on a contingency approach. For this purpose, we relied on data collected from randomly selected companies located in Poland and Romania. More, the study includes a comparative analysis of the determining factors identified in the two countries.

Central and Eastern European countries are a proper field for testing managers' perception on the matter of interest, out of two reasons. First, the development of management accounting in this area started after completing the long period of a centrally planned economy. The 90s were characterised by significant political and economic changes, with a major impact on the accounting system and further on the perception of the provided information. It is a consequence of the fact that, after a time in which decisions were made on a central level, the new economical background compelled companies to act independently and employ tools supporting an efficient business administration. Secondly, the interest of the managers for management accounting increased gradually as a consequence of the incentives provided first by the academia and then by the business environment itself. The academics included management accounting in their research concerns (Szychta, 2002; Haldma and Laats, 2002; Albu and Albu, 2012), and launched joint projects with the business environment. In the meantime, the local branches of multinational companies in former communist countries raised the awareness of managers with regard to the role played by management accounting information in decision-making.

Both Poland and Romania are CEE countries that belong to the above-described context, yet exhibit relevant differences in the development of management accounting, with Poland being one step ahead. First of all, right after 1990, the accounting systems of the two countries were confronted with two different influences, coming from abroad: the influence of the German accounting system in Poland, respectively the influence of the French accounting system in Romania. Secondly, concerns over management accounting were raised much earlier in Poland, due to the involvement of the academia in this area even prior to the fall of communism. Thirdly, the Romanian accounting regulations created confusion among practitioners, by displacing their interest towards the delivery of information for external reporting (provided by financial accounting), to the detriment of information for decision-making (provided by management accounting).

In order to achieve the objective of the paper, we employed the correlation analysis to test the existence of relationships between several contingency factors and the assessed suitability of the information and reporting provided by the management accounting system, as well as the strength of such relationships.

The contribution of the present study to the body of related research is bidirectional. Firstly, the paper identifies some of the factors that influence the manner in which managers assess the usefulness of the information provided by management accounting; this may help both practitioners and academics to understand why management accounting is less developed in these countries than in other countries (particularly, the Western ones). Secondly, it explains the similarities and differences in the managers' perception on the management accounting usefulness within the two countries, in the light of several contingency factors; given the fact that management accounting should provide useful information for the decision-making process, such an investigation (from management perspective) brings to light some features of the management accounting systems within each of the two countries.

The remainder of the paper is organized as follows. The first section provides a brief review of the existing related literature and is followed, in the second section, by the description of the research design employed. The third section surveys the identified relationships between three considered variables (the company profile, the manager profile and the operations of the management accounting department), and the managers' perception on the information provided by management accounting. The final section points to the conclusions of the study, the limits of the research, as well as the future research directions.

1. Literature review

As a basis for our research, we reviewed prior studies, aiming firstly to assess the extent to which the contingency theory has been employed so far in the context of management accounting, and secondly to identify the independent variables most often related to accounting information.

1.1. A contingency approach to management accounting

Starting from a debate initiated by Zimmerman (2001), Malmi and Granlund (2009) wonder what is "the purpose and role of theory in management accounting research" and, provided an answer is found, whether current theories, originating in economics, sociology, psychology, or the organization theory, fulfil this purpose. Pointing to Luft and Shields (2002), who indicate that the management accounting theory focuses on explaining its causes and effects, they believe that the definitive reason for academics to understand the "causes, effects and functioning of management accounting" is to use this understanding in creating better management accounting practices.

The theoretical background of management accounting in its historical evolution is examined by Waveru (2010), who points to four distinct stages, each marked by a specific theory: the conventional wisdom up to 1960', the agency theory between 1960'-1970', the contingency theory between 1980'-1990' and the strategic management accounting from 1990' to date.

The contingency theory has been developed starting with the 60s (Burns and Stalker, 1967; Lawrence and Lorsch, 1967), evolving from sociological studies on organizational structure (Chenhall, 2003; Woods, 2009). One of the earliest approaches of contingency in relation with management accounting belongs to Hofstede (1967), who showed the significant impact of economic, technological and sociological factors on the functioning of budgetary systems. The influence of cultural factors was subsequently added (Hofstede, 1983; Brownell,

1982; Brownell and Hirst, 1986). Hopwood (1972) and Otley (1978) pointed to the fact that every company operates in a specific environment, under the influence of different factors.

Contingency is placed by Hambrick and Lei (1985: 764) and Fisher (1995) between two extreme approaches, i.e. the situation-specific and the universalistic approach of the control systems. In the situation-specific rationale, the factors that affect each control system decision are unique, so there are no general rules and models that could be applied. The situation-specific model can practically be seen as a contingency approach with an extremely large number of contingent factors so that the identification of broad classes of factors is seen as futile. Research based on the situation-specific model usually takes the form of case studies. Contrariwise, the universalistic approach starts from the premise that "optimal control system design holds, to some degree, in all settings and firms" and can be analogously represented as a contingency with only one contingency setting.

Amid the two, the contingency theory starts from the premise that "universal solutions to problems in organizational control generally do not exist" (Otley, 2016). In this view, no single type of structure is appropriate for all organizations; rather the design and functioning of the organization are influenced by contingent factors. Eventually, the organizational effectiveness depends on the fit between the information system and contingent factors like the type of technology, the environmental volatility, or the size of the organization (Islam and Hu, 2012).

In the context of management accounting, the contingency theory shows that there is no accounting system that can be considered universally appropriate to all organizations, in all circumstances (Emmanuel *et al*., 1990), but rather the specific features of a system will depend on the specific circumstances of the organization, while the effectiveness of an accounting system depends on its capacity to adapt to changes in external and internal factors. Research on contingency relies on the existence of a link between the nature of the management accounting system and the enhanced performance.

However, research hasn't identified so far any key contingencies that would allow the development of prescriptions to suit different sets of circumstances; occasionally, different studies recommended conflicting solutions. Therefore, it is unlikely that research will manage to define a general contingency model, for an optimal control in all combinations of circumstances (Otley, 2016).

In the same line, Chenhall (2007) stresses that no single contingency theory exists, but rather "a variety of theories", continuing the reasoning of Otley (1980, p.413) who highlighted the need to associate the "specific aspects" of the accounting system that need to be explained with the "certain defined circumstances" and demonstrate the "appropriate matching" between the two. Islam and Hu (2012) highlight three types of questions addressed by the research on contingency in management accounting, regarding "the fit between organizational control and structure", "the impact of such fits on performance" and "the investigation of multiple contingencies and their impact on organizational design".

The next sub-section takes stock of independent variables frequently related by prior studies to accounting (including management accounting) information systems.

1.2. The contingency variables

In an early study, Gordon and Miller (1976) point to the environment, the organizational characteristics and the decision-making style as main classes of contingent variables for the design of accounting information systems. Currently, Otley (2016) points to the environmental uncertainty, expressed as perceived environmental uncertainty, as the one which attracted the widest attention on the part of the researchers.

In the four decades lying in between, numerous interrelations have been examined in the literature. We find external contingent factors related to the external environment (Khandwalla, 1977; Merchant, 1990; Chapmann, 1997; Hartmann, 2000), and the national culture (Hofstede, 1984; Harrison, 1992; O'Connor, 1995), with researchers most often emphasizing the environmental uncertainty and hostility. In equal measure, we find internal factors like the size of the organization (Khandwalla, 1972; Bruns and Waterhouse, 1975; Merchant 1981; Merchant, 1985), the technology (Khandwalla, 1977; Merchant, 1984; Dunk, 1992) and the strategy of the company (Miles and Snow, 1978, Gupta and Govindarajan, 1984; Simons, 1987; Chenhall and Morris, 1986). In the latter category, the appropriateness of the accounting data for the

performance evaluation of business units (Fisher, 1995; Hartmann, 2000; Chenhall, 2003) can also be included.

Fisher (1995) classifies the contingent variables addressed in literature up to the moment of his contribution in five distinct categories: external environment; competitive strategy and mission; technology; unit, firm and industry variables; knowledge and observability factors. He stresses however that the variables listed under the five categories should not be considered exhaustive or independent and recommends that future research addresses "the causality and correlations among the contingent control variables".

A further classification was later performed by Merchant (1998), who defined three categories of variables: the first one included variables referring to people and organizations, the second one listed variables related to mission and strategy, and the last one included environmental and technological variables. Mockler (2002) identified three classes of variables, i.e. external variables, competition-related variables and company-specific variables. In the same line, Nita (2009) divided contingency variables into internal, i.e. strategic and organisational variables, and external, i.e. sector and macroeconomic variables.

In a recent literature review on the topic of interest, Otley (2016) takes stock of and summarizes the independent variables most often used in contingency-based research, classifying them in major external and major internal variables. As such, the major external variables include the technology, the market competition or hostility, the environmental uncertainty and the national culture, while the major internal independent variables are the size and structure of the organization, its strategy and compensation and information systems, as well as psychological variables (like the tolerance for ambiguity), the employees' participation in the control systems, the position on the market, the product life-cycle stage, and systems change. Complementary, the dependent variables explained on a contingent basis, as identified in the literature by Otley (2016) are the performance and its measures, the budgeting behaviour, the management control system design and the use of it, the effectiveness, the job satisfaction, the change in practices, and the product innovation.

In the same context, Klassen (2014) points to a variable which is logically prior to strategy, i.e. the value logic, understood as the basic business model adopted by the organization. The effect of culture on the design of information systems is further widely investigated in literature, whereas many contributions rely on Hofstede's works (Hofstede, 1980; Hofstede *et al.*, 2010). In an early stage, Hofstede (1980) identified four dimensions on which to characterize national cultures, i.e., individualism, masculinity and uncertainty avoidance that were subsequently completed by short-term vs. long-term emphasis, respectively by pragmatism and indulgence (Hofstede *et al.*, 2010).

One of the major faults of the contingency-based research, as pointed to by Fisher (1995) is the "piecemeal way" of its performance, meaning that most often merely one contingent factor and one control attribute are examined at a time, despite the fact that the effectiveness of the control system design is determined by interactions between multiple contingent and control factors.

As specific illustrations, Gordon and Narayanan (1984) examined the relationship between the structure of the organization and the characteristics of information, finding that decision-makers perceive as important those characteristics of information that are related to the perceived environmental uncertainty.

The perceived usefulness of MAS information was examined by Chenhall and Morris (1986), who found that information perceived as useful by managers is broad in scope and timeliness. The link between the perceived usefulness of MAS information and the business performance was in effect extensively investigated in literature, in the following decade (Gul, 1991; Gul and Chia, 1994; Fisher, 1996). A significant gap in the adequacy of MAS information was ascertained in the manufacturing industry by Subramaniam (1993), whose analysis considered the perceived usefulness of MAS information by managers and the availability of this information.

The required characteristics of the MAS information were linked to the specific strategy of the firm, whereas Abernathy and Guthrie (1994) reported that companies with an orientation to continuous product-development and innovation employ effective broad-scope information systems, unlike companies with a narrow product-market. Chong (1996) focused on the usefulness of broad-scope MAS information in connection with the uncertainty of the management tasks, finding that broad-scope MAS information increases the effectiveness of managerial decisions and performance only under circumstances of high task uncertainty, otherwise implying a mere information overload.

More recently, Cadez and Guilding (2008) considered the company size, its strategy and market orientation as

contingent variables, concluding that both the company's size and its strategic choices had a significant influence on the application of strategic management accounting. Aver and Cadez (2009) linked the participation of management accountants in the decision-making process rather to sociological developments.

With specific reference to the Eastern Europe, Haldma and Laats (2002) investigate the contingencies influencing the management accounting system, in the case of Estonia, as an example of transitional economy, pointing to the small number of studies on the development of management accounting in Eastern European countries. The research on accounting systems in this geographical area focuses on the financial accounting, proving that management accounting was here in the initial stage of development. More, the published research consists mainly of state-of-the-art type studies, without any theoretical framework, while research on management accounting practices in transition economies had been published, up to that moment, only with reference to India (Anderson and Lanen, 1999) and South Africa (Luther and Longden, 2001). On this particular case, Haldma and Laats (2002) find that the environmental contingency can be analysed distinctly, at the general business environment and the legal accounting environmental level. As for Estonia, the two authors argue that "within the Soviet accounting framework, management accounting existed in a very narrow sense" and it later developed on the background of an extant competition between the habits of the centrally planned economy on the one hand, and the need to solve daily management issues, on the other hand. The research confirms the influence of contingencies that had been pointed to by previous studies, like the tightening competition and the organization size, and introduces possible new factors, specific for transitional economies, like the legal accounting environment and the shortage of qualified accountants.

2. Research design

2.1. Research methodology

As indicated by Nita (2013), the contingency-based research on management accounting should include four components, i.e. the set of situational variables studied, the research questions relating to the methods of management accounting, the type of accounting theory employed (normative or positive) and the corresponding research methods. The present research focused on the positive theory of accounting, aiming to identify the strength of the relationship between specific variables and the assessment of managers in matters of usefulness of the management accounting information.

The empirical research was performed between May 2015 – March 2016, by means of a questionnaire-based online survey addressing randomly selected companies operating in Poland and Romania, in various industries, with different origin-based capital profiles.

The questionnaire was structured in four different sections: the first two provided a brief characterisation of the company, respectively of the respondent, the third section referred to the organisation of the management accounting system within the company, while the fourth section was meant to capture the managers' perception on the suitability of the information delivered by management accounting systems. The four sections consisted of a total of 26 half-open and closed questions, whereas the latter included single- and multiple-choice, span and matrix questions. They were selected and enunciated as a result of a thorough literature review, including studies on the purpose for which information is used (Baiman, 1982; Burns and McKinnon, 1992a; Burns and McKinnon, 1992b; Burns and McKinnon, 1993; Mendoza and Bescos, 2001), the information suitability (Burns and McKinnon, 1992a; Burns and McKinnon, 1992b; Burns and McKinnon, 1993; Mendoza and Bescos, 2001), as well as its qualitative features (Chenhall and Morris, 1986; Johnson and Kaplan, 1987; Pierce and O`Dea, 2003).

The survey resulted in 154 completed questionnaires, out of which 116 originated from Poland and 38 from Romania. One questionnaire corresponded to one respondent participating in the study, whereas there were also cases in which different questionnaires were completed by different managers from the same company.

The responses were analysed by means of the interdependence theory, meant to reveal correlations between variables. For this purpose, Czuprow's T coefficient – T_c, Pearson's C coefficient – C_P and Cramer's V coefficient – V_c were applied to all variables under analysis, as standard coefficients used in descriptive statistics for searching correlations in collected data (Yule, 1912; Keller, 2012; Bergsma, 2013). All indicated coefficients have a value within the range of [0,1]. The closer the coefficients are to zero, the weaker the correlation between the variables, whereas the closer they are to 1, the stronger the correlation between the analysed elements (Sobczyk, 2000).

As previously mentioned, subject of the statistical analysis are the factors (variables) identified based on the reviewed literature (e.g. Blum, 2006; Budde, 2009). The factors were divided into 3 categories: (1) factors related to the company profile (type, size, origin of capital); (2) factors related to the manager profile (education, experience, and managed department); (3) factors related to the operations of the management accounting department (organisation, frequency of reporting and frequency of meetings between managers and management accountants).

As a brief overview of the first category of factors, the companies under analysis were divided into three size classes, based on their number of employees: small entities (with less than 10 employees), medium entities (with 10 to 200 employees) and large entities (with more than 200 employees). Considering their business area, these were classified into manufacturing and nonmanufacturing companies, whereas based on the origin of their capital, the sample included companies with foreign, domestic or shared capital.

The second category of factors defined the profile of the responding managers, considering their education (bachelor, master, post-graduate, doctoral studies), the management experience (short – under 6 years, average – 6 to 10 years, long – over 10 years) and the managed department. Four different areas of operations were taken into account: (a) support departments, like HR, IT, finance; (b) sales and marketing; (c) purchases, logistics and production, and (d) other.

Considering the organisation of the management accounting department, within the third category, two distinct options were considered: (a) management accounting is performed by a distinct department of the company; (b) management accounting is performed within other departments or processes. The reporting frequency was classified into three classes: high (daily and upon managers' request), average (once a week) and low (once a month). The same three frequency classes were employed with regard to the frequency of meetings between management accountants and managers, a fourth option was however considered here, i.e. no meetings with management accountants.

2.2. Sample profile

The empirical research covered companies from different sectors, of a different size and with various sources of capital, operating in Poland and Romania (see **Table no. 1**).

Table no. 1. Profile of the companies participating in the survey

Company profile	ROM		POL	
	Number	%	Number	%
Type of company				
Manufacturer	23	61%	60	52%
Service	11	29%	42	36%
Trade	4	11%	14	12%
Origin of capital				
100% domestic	11	29%	34	29%
100% foreign	16	42%	66	57%
share of foreign	11	29%	16	14%
Number of employees				
< 10	2	5%	12	10%
11-50	4	11%	12	10%
51-250	9	24%	20	17%
>250	23	61%	72	62%
Annual turnover in 000 000 EUR				
< 2	5	13%	16	14%
2-10	8	21%	22	19%
11-50	13	34%	8	7%
51-200	5	13%	12	10%
> 200	7	18%	58	50%

Source: Authors' own processing

Both the Polish and the Romanian sample are dominated by manufacturing companies, large entities in terms of number of employees, mainly with foreign capital. The best represented sectors in the Romanian sample are the automotive, the food and beverages, the IT & new technologies, the telecom and the clothing & textiles industry, while in Poland most of the surveyed companies belong to the consumer goods, the building and construction, the IT & new technologies, the consulting and the healthcare sector.

Table no. 2 summarizes the profile of the responding managers, in respect of their professional experience.

Table no. 2. The experience of the surveyed managers

Experience	ROM		POL	
	Number	%	Number	%
< 1	1	3%	10	9%
1-5	8	21%	28	24%
6-10	18	47%	44	38%
11-15	7	18%	14	12%
> 15	4	11%	20	17%
TOTAL	**38**	**100%**	**116**	**100%**

Source: Authors' own processing

We observe that, in both countries, the best-represented experience classes are 6 to 10 years, followed by 1 to 5 years.

Table no. 3 illustrates the educational profile of the responding managers, where we observe that most respondents in both samples hold a Master's degree, yet the MBA and the PhD are more frequently encountered among Polish managers.

Table no. 3. Education of the surveyed managers

Education background	ROM		POL	
	Number	%	Number	%
High school degree	2	5%	0	0%
Bachelor degree	10	26%	2	2%
Master's degree	26	68%	114	98%
Post graduate studies	0	0%	6	5%
MBA	5	13%	46	40%
PhD	2	5%	10	9%

Source: Authors' own processing

The surveyed managers come both from operations departments like production, logistics, purchasing or sales (53% of the Romanian and 50% of the Polish managers) and from support departments like HR, IT or finance (41% of the Romanian and 39% of the Polish managers).

In most of the examined entities (80% of the Polish, respectively 62% of the Romanian companies), management accounting is performed within an independent department. Yet, there are companies that prefer to integrate management accountants with employees from different departments.

3. Results and discussions

According to the research objective, Czuprow's T coefficient - T_c, Pearson's C coefficient - C_P and Cramer's V coefficient - V_c were employed in order to

investigate the strength of the relationship between the company profile, the manager profile and the operations of the management accounting department, on the one hand, and:

1. The managers' assessment of the extent to which the information provided by the management accounting is used in performing management tasks;
2. The managers' assessment of the suitability of certain types of information provided by the management accounting system, in the context of the management process;
3. The managers' assessment of specific quality characteristics of internal reports, prepared by management accountants;
4. The managers' assessment of specific communication channels for the information delivered by the management accounting system.

According to the Merchant's (1998) classification, the contingency variables considered by our study refer to people and organizations. They are mainly organizational variables, similar to Cadez and Guilding (2008) Gordon and Narayanan (1984), treated as internal factors in the context of management accounting. Among these, the size of the company and the origin of the capital are seen as most important in literature (Nita, 2009).

3.1. Factors determining the assessment of the extent to which the information provided by the management accounting system is employed as a support of the management process

In order to determine the factors related to the assessment of the extent to which the information provided by the management accounting system is employed in performing management tasks, we examined the interdependence between this assessment and the following variables:

- the company profile (type of company, size, origin of capital);
- the manager profile (professional experience, education, managed department);
- the operations of the management accounting department (organisation, frequency of reporting, frequency of meetings between managers and management accountants).

The initial testing of the data showed that the company profile is a variable with no significant influence on managers' assessments (see **Table no. 4**).

Table no. 4. The relationship between the *company profile* and the assessed suitability of the information provided by the MAS

Company profile	Type of the company						Size of the company						Origin of the capital					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
Long term planning	0.19	0.24	0.23	0.15	0.18	0.18	0.22	0.26	0.35	0.15	0.25	0.18	0.13	0.16	0.22	0.17	0.20	0.28
Implementing the strategy	0.11	0.13	0.13	0.13	0.16	0.16	0.21	0.25	0.34	0.17	0.21	0.28	0.16	0.19	0.26	0.13	0.13	0.18
Preparing budgets	0.24	0.29	0.28	0.24	0.29	0.28	0.32	0.38	**0.47**	0.14	0.16	0.22	0.27	0.32	**0.41**	0.25	0.30	0.39
Performance measurement	0.15	0.18	0.18	0.12	0.15	0.15	0.15	0.18	0.25	0.14	0.16	0.22	0.08	0.10	0.14	0.18	0.21	0.28
Increasing profitability	0.17	0.21	0.20	0.24	0.28	0.27	0.17	0.21	0.28	0.19	0.22	0.30	0.14	0.16	0.23	0.15	0.18	0.25
Managing own department	0.16	0.19	0.18	0.32	0.38	0.36	0.05	0.07	0.09	0.22	0.26	0.35	0.22	0.26	0.34	0.24	0.29	0.38
Make or buy/ outsourcing decision-making	0.20	0.23	0.23	0.22	0.26	0.25	0.21	0.25	0.34	0.08	0.10	0.13	0.15	0.18	0.24	0.19	0.23	0.30
Making investment decisions	0.19	0.23	0.23	0.20	0.24	0.24	0.09	0.11	0.16	0.16	0.19	0.26	0.13	0.15	0.21	0.16	0.19	0.26
Making decisions regarding R&D	0.10	0.12	0.12	**0.47**	**0.56**	**0.49**	0.11	0.13	0.18	0.27	0.32	**0.41**	0.17	0.20	0.27	**0.40**	**0.47**	**0.56**
Cost reduction	0.08	0.09	0.09	0.27	0.32	0.31	0.14	0.17	0.23	0.18	0.22	0.29	0.11	0.13	0.18	0.14	0.23	0.17
Cost control	0.03	0.04	0.04	0.25	0.30	0.29	0.20	0.24	0.32	0.11	0.13	0.18	0.14	0.17	0.23	0.18	0.22	0.29
Assessing internal projects	0.07	0.08	0.08	0.27	0.32	0.31	0.14	0.17	0.23	0.14	0.17	0.23	0.21	0.25	0.33	0.11	0.14	0.19

Source: Authors' own processing

Table no. 4 shows a weak or very weak relationship between the company profile and the suitability assessment of management accounting information. These results are quite puzzling as, according to previous contributions to literature, the company size and type should have a significant impact on the development of management accounting (Otley, 2016; Cadez and Guilding, 2008).

Only a moderate relationship is noticed between the size of the company and the origin of its capital, on the one hand, and the suitability assessment of the information for the budget preparation, on the other hand, in case of Polish managers. A moderate relationship can also be observed between the type of company, the origin of the capital and the size of the enterprise (to a lesser extent) on the one hand, and the suitability assessment of the information for R&D decision making, on the other hand, in case of Romanian managers.

Based on the preliminary variable analysis, neither the manager profile has a strong influence on managers' assessments (see Table no. 5).

Table no. 5. The relationship between the *manager profile* and the assessed suitability of the information provided by the MAS

Manager profile	Professional exeprience						Education						Managed department					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P
Long term planning	0.11	0.13	0.18	0.22	0.26	0.35	0.08	0.10	0.10	0.16	0.19	0.19	0.15	0.22	0.29	0.18	0.27	0.35
Implementing the strategy	023	0.27	0.36	0.13	0.16	0.22	0.02	0.02	0.02	0.12	0.15	0.14	0.20	0.29	0.38	0.14	0.21	0.29
Preparing budgets	0.19	0.23	0.31	0.14	0.17	0.24	0.08	0.10	0.10	0.13	0.16	0.16	0.37	**0.54**	***0.61***	0.25	0.36	**0.46**
Performance measurement	0.19	0.23	0.31	0.14	0.17	0.24	0.32	0.38	0.35	0.13	0.16	0.16	0.18	0.26	0.35	0.17	0.25	0.34
Increasing profitability	0.14	0.17	0.23	0.24	0.28	0.37	0.11	0.13	0.12	0.17	0.20	0.20	0.14	0.21	0.29	0.19	0.28	0.37
Managing own department	0.13	0.15	0.21	0.15	0.18	0.25	0.24	0.29	0.28	0.19	0.23	0.22	0.13	0.20	**0.27**	**0.27**	**0.39**	**0.48**
Make or buy/ outsourcing decision-making	0.14	0.16	0.23	0.24	0.29	0.38	0.12	0.14	0.14	0.16	0.19	0.19	0.16	0.23	0.31	0.17	0.24	0.32
Making investment decisions	0.11	0.14	0.19	0.16	0.19	0.26	0.11	0.13	0.13	0.10	0.11	0.12	0.21	0.31	**0.40**	0.15	0.22	0.29
Making decisions regarding R&D	0.20	0.24	0.32	0.17	0.20	0.28	0.22	0.26	0.25	0.06	0.07	0.07	0.14	0.20	0.28	0.28	**0.45**	**0.54**
Cost reduction	0.07	0.09	0.12	0.15	0.18	0.25	0.06	0.07	0.07	0.12	0.14	0.14	0.19	0.27	0.36	0.19	0.28	0.37
Cost control	0.12	0.15	0.20	0.22	0.26	0.34	0.07	0.09	0.09	0.11	0.13	0.13	0.11	0.16	0.22	0.23	0.33	**0.43**
Assessing internal projects	0.16	0.19	0.26	0.08	0.10	0.14	0.23	0.28	0.27	0.13	0.15	0.15	0.14	0.28	0.20	0.22	0.32	0.41

Source: Authors' own processing

The results show a weak or very weak relationship between the education and the professional experience of the managers on the one hand, and the suitability assessment of management accounting information, on the other hand.

Moderate relationships can be identified between the managed department and the assessed suitability of the information. In the case of Polish managers, the moderate interdependence refers to the assessed suitability of the information for budget preparation and investment decision, while in the case of Romanian managers, it refers to budget preparation, internal projects, cost reduction and control and R&D decisions. What should be noted is that, in Polish companies, the relationship between the managed department and the use of the information provided by the accounting system for the purpose of preparing budgets and supporting management decisions is slightly stronger (C_P=0.61). The results confirm that the type of the managed department exerts influence on the use of the information by the manager.

The third variable considered regards the organisation and operations of the management accounting department (see Table no. 6).

Table no. 6. The relationship between the *operations of the MA department* and the assessed suitability of the information provided by the MAS

Operations of the MA department	Organisation of MA						Frequency of reporting						Frequency of meetings					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
Long term planning	0.12	0.14	0.14	0.17	0.20	0.20	0.20	0.23	0.31	0.32	0.38	**0.47**	0.11	0.13	0.19	0.22	0.25	0.34
Implementing the strategy	0.10	0.12	0.12	0.15	0.18	0.17	0.18	0.22	0.29	0.21	0.25	0.33	0.28	0.34	**0.43**	0.28	0.33	**0.42**
Preparing budgets	0.30	0.36	0.34	0.12	0.15	0.15	0.13	0.16	0.22	0.22	0.26	0.35	0.27	0.32	**0.41**	0.19	0.22	0.30
Performance measurement	0.16	0.19	0.19	0.29	0.34	0.32	0.04	0.05	0.06	0.23	0.28	0.36	0.32	0.38	**0.48**	0.27	0.32	**0.41**
Increasing profitability	0.13	0.16	0.15	0.31	0.37	0.37	0.17	0.20	0.28	0.20	0.24	0.32	0.22	0.26	0.35	0.21	0.25	0.34
Managing own department	0.13	0.15	0.15	0.07	0.09	0.09	0.23	0.27	0.36	0.12	0.14	0.20	0.12	0.15	0.20	0.17	0.20	0.27
Make or buy/ outsourcing decision-making	0.26	0.31	0.30	0.17	0.20	0.20	0.18	0.21	0.29	0.24	0.29	0.38	0.34	**0.40**	**0.49**	0.19	0.23	0.31
Making investment decisions	0.13	0.16	0.16	0.14	0.16	0.16	0.26	0.31	**0.40**	0.20	0.24	0.32	0.20	0.24	0.32	0.25	0.30	0.39
Making decisions regarding R&D	0.09	0.11	0.11	0.06	0.07	0.07	0.12	0.15	0.20	0.19	0.23	0.31	0.15	0.17	0.24	0.19	0.23	0.31
Cost reduction	0.13	0.15	0.15	0.25	0.30	0.29	0.11	0.13	0.18	0.09	0.11	0.16	0.12	0.14	0.20	0.16	0.19	0.26
Cost control	0.14	0.16	0.16	0.17	0.26	0.26	0.16	0.19	0.26	0.31	0.37	0.46	0.11	0.13	0.19	0.22	0.26	0.35
Assessing internal projects	0.14	0.17	0.17	0.08	0.11	0.11	0.17	0.21	0.28	0.06	0.07	0.10	0.17	0.20	0.28	0.23	0.28	0.37

Source: Authors' own processing

The results show a generally weak or very weak relationship between the organisation of the accounting department on the one hand, and the suitability assessment of management accounting information, on the other hand. However, we notice a moderate interdependence between the reporting frequency and the use of information to support investment decisions in companies in Poland, respectively between reporting frequency and long-term planning and cost control, in business organisations from Romania.

What is interesting to note is that the frequency of meetings with the employees of the management accounting department determines to a moderate extent the use of information derived from this department for a relatively large amount of activities supporting the work of managers. It includes, among others, the implementation of strategies and performance measurement in the examined companies from Poland and Romania, and also in the case of Polish managers, preparing budgets and making short-term decisions.

The results show that, although the organisational issues around the management accountant (department, position, function) or the internal reporting frequency are not essential in determining the suitability of the specific information. Staff meetings with the employees of the accounting department are deemed relevant by the surveyed managers, while their frequency determines the use of the information as a management support to a higher extent than the other examined factors.

3.2. Factors determining the assessed suitability of selected information provided by the management accounting system

The assessed suitability of selected information provided by the management accounting system, as a support of the management process, was correlated with the same three variables: the company profile, the manager profile, the operations of the management accounting department.

The preliminary testing of the data showed that the company profile is not a variable with a strong influence on the assessment of selected types of information (**Table no. 7**).

Table no. 7. The relationship between the *company profile* and the assessed suitability of selected information provided by the MAS

Company profile	Type of the company						Size of the company						Origin of the capital					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
Costs	0.21	0.25	0.24	0.21	0.21	0.21	0.16	0.20	0.27	0.08	0.13	0.13	0.23	0.27	0.36	0.20	0.24	0.32
Revenues	0.11	0.13	0.13	0.11	0.14	0.14	0.15	0.18	0.25	0.05	0.18	0.25	0.20	0.24	0.32	0.20	0.24	0.33
Financial results	0.10	0.12	0.12	0.10	0.19	0.20	0.18	0.22	0.29	0.21	0.25	0.33	0.21	0.24	0.33	0.33	0.39	**0.49**
Financial indicators	0.10	0.12	0.12	0.10	0.15	0.14	0.20	0.24	0.32	0.16	0.21	0.28	0.26	0.30	**0.40**	**0.45**	**0.53**	***0.60***
Variance analysis	0.06	0.07	0.07	0.06	0.18	0.18	0.20	0.24	0.32	0.23	0.28	0.37	0.20	0.23	0.31	0.29	0.35	**0.44**
Actual financial data	0.20	0.24	0.23	0.20	0.22	0.22	0.30	0.35	**0.45**	0.27	0.32	**0.41**	0.16	0.19	0.26	0.21	0.25	0.33
Planned financial data	0.10	0.12	0.12	0.10	0.10	0.10	0.12	0.15	0.20	0.23	0.27	0.36	0.20	0.24	0.33	0.14	0.17	0.23
Non-financial indicators	0.14	0.16	0.16	0.14	0.12	0.12	0.29	0.34	**0.43**	0.15	0.18	0.25	0.12	0.14	0.19	0.31	0.37	**0.46**

Source: Authors' own processing

Table no. 7 shows a weak or very weak relationship between the type of the company and the use of information for management purposes. Further, we observe a moderate relationship between the size of the company and the use of actual financial data in both countries, as well as between the size of the company and the use of non-financial ratios in Poland. The origin of the capital and the use of financial indicators exhibit as well a moderate interdependence in both countries, with a slightly higher coefficient in the case of Romania (C_P=0.6). Romanian companies also display a moderate relationship between the origin of the capital and the use of information on financial results, variance analysis and non-financial ratios. The figures actually indicate that although managers are basically provided with information on costs, revenues and financial results, managers of mainly larger companies, or companies with foreign capital located in Romania also employ other types of information, delivered by management accounting, as a support of the management process. A plausible explanation of this state of the art may be that transnational corporate headquarters imposing standard solutions on their branch offices have a significant influence on the type of information used as a management support.

The second variable considered in the analysis, i.e. the manager profile, was proven not to have a strong influence on the considered assessments (see Table no. 8).

Table no. 8. The relationship between the *manager profile* and the assessed suitability of selected information provided by the MAS

Manager profile	Professional experience						Education						Managed department					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
Costs	0.14	0.16	0.22	0.11	0.18	0.19	0.01	0.01	0.01	0.07	0.09	0.09	0.14	0.20	0.27	0.22	0.33	**0.42**
Revenues	0.26	0.31	**0.40**	0.25	0.29	0.38	0.25	0.30	0.29	0.13	0.16	0.17	0.15	0.22	0.30	0.19	0.23	0.37
Financial results	0.15	0.17	0.24	0.23	0.27	0.36	0.07	0.08	0.08	0.08	0.10	0.10	0.11	0.15	0.21	0.22	0.26	**0.41**
Financial indicators	0.17	0.20	0.27	0.27	0.32	**0.42**	0.05	0.06	0.06	0.10	0.12	0.13	0.12	0.17	0.24	0.23	0.27	**0.43**
Variance analysis	0.25	0.29	0.38	0.29	0.34	**0.44**	0.11	0.13	0.13	0.13	0.15	0.15	0.17	0.25	0.33	0.20	0.24	0.39
Actual financial data	0.18	0.21	0.28	0.13	0.16	0.22	0.06	0.08	0.08	0.29	0.35	0.33	0.16	0.23	0.31	**0.43**	**0.51**	***0.67***
Planned financial data	0.13	0.16	0.22	0.23	0.28	0.36	0.18	0.22	0.21	0.21	0.25	0.24	0.15	0.21	0.29	0.28	0.33	**0.50**
Non-financial indicators	0.16	0.19	0.26	0.22	0.26	0.35	0.09	0.11	0.11	0.09	0.10	0.10	0.18	0.26	0.35	0.18	0.21	0.34

Source: Authors' own processing

The results point to a weak or very weak relationship between the education of the surveyed managers and the use of selected types of information. In turn, we observe a moderate relationship between the work experience of the managers and the employment of information on revenues in Poland, while in Romania moderate dependencies are proven between work experience and the use of information on financial indicators and variations, as well as between the type of the managed department and the use of information on costs, financial results, financial indicators and planned financial data. Romania also exhibits a stronger relationship between the type of the managed department and the application of actual financial data (Cp=0.67), while in Poland, the relationship between the type of department and the type of information used in each of the examined cases is weak or very weak.

The last variable examined in this area regards the operations of the management accounting department (see **Table no. 9**), which proved to be a rather weak determinant of the specific assessments.

Table no. 9. The relationship between the *operations of the MA department* and the assessed sustability of selected information provided by the MAS

Operations of the MA department	Organisation of MA						Frequency of reporting						Frequency of meetings					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P
Costs	0.16	0.19	0.19	0.12	0.14	0.14	0.15	0.18	0.25	0.28	**0.45**	**0.43**	0.13	0.15	0.21	0.21	0.25	0.34
Revenues	0.08	0.10	0.10	0.09	0.11	0.11	0.12	0.14	0.19	0.14	0.13	0.23	0.34	**0.41**	**0.50**	0.23	0.27	0.36
Financial results	0.10	0.12	0.12	0.13	0.16	0.16	0.11	0.13	0.19	0.18	0.21	0.28	0.12	0.14	0.19	0.28	0.33	**0.42**
Financial indicators	0.12	0.14	0.14	0.15	0.18	0.18	0.17	0.20	0.27	0.17	0.20	0.27	0.30	0.36	**0.45**	0.33	0.39	**0.49**
Variance analysis	0.39	**0.46**	**0.42**	0.20	0.23	0.23	0.16	0.19	0.25	0.23	0.27	0.36	0.38	**0.45**	**0.54**	0.31	0.38	**0.47**
Actual financial data	0.22	0.26	0.25	0.19	0.22	0.22	0.14	0.17	0.23	0.19	0.23	0.31	0.12	0.14	0.20	0.21	0.25	0.33
Planned financial data	0.11	0.13	0.13	0.11	0.13	0.13	0.17	0.20	0.27	0.21	0.24	0.33	0.19	0.23	0.30	0.34	**0.41**	**0.50**
Non-financial indicators	0.24	0.28	0.27	0.16	0.19	0.18	0.20	0.24	0.32	0.26	0.31	0.41	0.21	0.25	0.33	0.18	0.21	0.29

Source: Authors' own processing

The collected results of the statistical analysis substantiate a weak or very weak relationship between the organisation of management accounting in the examined companies and the information employed as a management support. The only moderate dependence is observed in Polish companies with regard to the variance analysis. Neither the frequency of reporting is strongly connected with the suitability of selected information as a management support in Polish organisations. Yet, the case of Romania exhibits a moderate relationship between the frequency of reporting and the suitability of information on costs and non-financial ratios. The frequency of the meetings with management accountants is, however, a factor with a significant impact on the assessments of the surveyed managers. Relationships between the frequency of meetings and the suitability of information on variations and financial indicators are observed both in Poland and in Romania. More, the frequency of meetings is further linked in Romania to the information on financial results and planned financial data, and in Poland to information on the revenues. Hence, it can be stated that the meetings between managers and management accountants play a leading part in the context of the assessed suitability of information on costs, revenues, current or planned financial data.

3.3. Factors determining the assessment of the quality characteristics of management accounting reports

The same three variables considered so far (the company profile, the managers' profile and the operations of the management accounting department) were employed in analysing the assessment of the quality characteristics of management accounting reports. In this context, the company profile showed a weak or very weak influence on the specific assessments (see **Table no. 10**).

Table no. 10. The relationship between the *company profile* and the assessment of the quality characteristics of MA reports

Company profile	Type of the company						Size of the company						Origin of the capital					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
Comprehensibility	0.22	0.26	0.25	0.12	0.15	0.14	0.24	0.28	0.37	0.09	0.11	0.15	0.08	0.10	0.14	0.19	0.23	0.31
Completeness (content)	0.17	0.20	0.19	0.12	0.15	0.15	0.21	0.25	0.33	0.17	0.20	0.27	0.16	0.19	0.26	0.15	0.18	0.25
Clarity	0.18	0.21	0.21	0.26	0.31	0.29	0.24	0.28	0.37	0.16	0.19	0.26	0.12	0.15	0.20	0.24	0.29	0.38
Time available	0.25	0.30	0.28	0.14	0.17	0.17	0.19	0.23	0.31	0.13	0.16	0.22	0.15	0.18	0.24	0.13	0.15	0.21
Level of detail	0.17	0.20	0.20	0.12	0.15	0.15	0.18	0.22	0.30	0.17	0.20	0.27	0.13	0.15	0.21	0.28	0.34	**.043**
Comparability (standardization)	0.10	0.12	0.12	0.26	0.31	0.29	0.15	0.18	0.24	0.17	0.20	0.28	0.13	0.15	0.21	0.21	0.25	0.33
Graphical representation	0.28	0.34	0.32	0.20	0.24	0.24	0.14	0.17	0.23	0.17	0.21	0.28	0.14	0.16	0.22	0.14	0.17	0.23
Relevance	0.31	0.36	0.34	0.13	0.15	0.15	0.22	0.26	0.35	0.14	0.16	0.22	0.31	0.37	**0.46**	0.21	0.25	0.33
Comments on the content	0.21	0.25	0.24	0.14	0.17	0.16	0.14	0.17	0.24	0.32	0.39	**0.48**	0.13	0.16	0.22	0.21	0.25	0.33
IT support	0.28	0.33	0.31	0.27	0.33	0.31	0.28	0.33	**0.43**	0.12	0.14	0.19	0.18	0.22	0.29	0.16	0.19	0.26
Reference to future	0.10	0.12	0.12	0.12	0.15	0.14	0.15	0.17	0.24	0.10	0.12	0.16	0.13	0.16	0.22	0.18	0.21	0.29

Source: Authors' own processing

The results indicate a weak or very weak link between the assessment of the quality characteristics of management accounting reports and the company profile, in both countries. A moderate dependence can be identified in few cases, such as the relationship between the relevance of the report and the origin of the capital, or the IT support and the company size in Poland, respectively between the report comments and the company size, or the degree of detail and the origin of the capital in Romania.

The manager profile proved to determine managers' assessment of the management accounting reports to a weak or very weak extent (see **Table no. 11**).

Table no. 11. The relationship between the *manager profile* and the assessment of the quality characteristics of MA reports

Manager profile	Professional exeprience						Education						Managed department					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P	Tc	V_c	C_P
Comprehensibility	0.11	0.14	0.19	0.22	0.27	0.35	0.20	0.23	0.23	0.11	0.13	0.13	0.18	0.26	0.35	0.20	0.29	0.38
Completeness (content)	0.15	0.17	0.24	0.22	0.26	0.34	0.15	0.17	0.17	0.34	0.38	**0.41**	0.19	0.28	0.37	0.15	0.21	0.29
Clarity	0.08	0.10	0.14	0.30	0.36	**0.46**	0.16	0.20	0.19	0.11	0.13	0.13	0.17	0.24	0.32	0.14	0.21	0.28
Time available	0.16	0.19	0.26	0.13	0.16	0.26	0.15	0.18	0.17	0.09	0.10	0.10	0.16	0.23	0.31	0.12	0.18	0.25
Level of detail	0.09	0.10	0.14	0.15	0.17	0.24	0.20	0.23	0.23	0.18	0.21	0.21	0.13	0.19	0.26	0.20	0.29	0.37
Comparability (standardization)	0.12	0.14	0.19	0.25	0.30	0.32	0.04	0.04	0.04	**0.42**	**0.50**	**0.48**	0.16	0.23	0.31	0.14	0.23	0.31
Graphical representation	0.12	0.14	0.20	0.05	0.07	0.09	0.30	0.35	0.33	0.32	0.38	0.36	0.14	0.20	0.27	0.22	0.31	0.41
Relevance	0.08	0.09	0.13	0.14	0.17	0.24	0.12	0.15	0.15	0.13	0.16	0.16	0.19	0.27	0.36	0.17	0.25	0.33
Comments on the content	0.18	0.21	0.28	0.24	0.29	0.38	0.11	0.13	0.13	0.15	0.18	0.17	0.14	0.20	0.27	0.18	0.27	0.35
IT support	0.12	0.15	0.20	0.12	0.14	0.20	0.16	0.19	0.18	0.28	0.34	0.32	0.16	0.24	0.32	0.30	**0.43**	**0.52**
Reference to future	0.26	0.31	**0.40**	0.18	0.21	0.29	0.15	0.17	0.17	0.07	0.09	0.09	0.18	0.26	0.34	0.11	0.16	0.22

Source: Authors' own processing

The work experience of the managers is linked in Poland to the assessment concerning the reference to future of the information provided in the reports, and in Romania to the assessment of the report clarity. Moderate relationships are further observed in Romania between the education of the managers and the assessment of the report completeness and comparability, as well as between the managed department and the IT support and graphical presentation.

As for the operations of the management accounting department, as the third examined variable, it proved to determine the specific assessments to a weak or very weak extent (see **Table no. 12**).

Table no. 12. The relationship between the *operations of the MA department* and the assessment of the quality characteristics of MA reports

Operations of the MA department	Organisation of MA						Frequency of reporting						Frequency of meetings					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
Comprehensibility	0.12	0.15	0.14	0.12	0.14	0.14	0.20	0.23	0.31	0.17	0.21	0.28	0.15	0.18	0.24	0.28	0.33	**0.43**
Completeness (content)	0.08	0.10	0.10	0.19	0.22	0.22	0.19	0.23	0.31	0.14	0.17	0.23	0.16	0.20	0.27	0.20	0.24	0.33
Clarity	0.22	0.26	0.25	0.12	0.14	0.14	0.23	0.28	0.37	0.17	0.20	0.27	0.19	0.23	0.31	0.26	0.31	**0.40**
Time available	0.13	0.15	0.15	0.25	0.29	0.28	0.13	0.15	0.21	0.16	0.20	0.27	0.17	0.20	0.27	0.21	0.25	0.34
Level of detail	0.20	0.24	0.23	0.12	0.14	0.14	0.13	0.15	0.21	0.14	0.17	0.23	0.16	0.18	0.25	0.27	0.32	**0.41**
Comparability (standardization)	0.21	0.25	0.24	0.24	0.29	0.28	0.13	0.15	0.21	0.08	0.10	0.16	0.13	0.16	0.22	0.16	0.19	0.25
Graphical representation	0.05	0.06	0.06	0.24	0.29	0.28	0.18	0.21	0.29	0.20	0.24	0.32	0.16	0.19	0.26	0.13	0.16	0.22
Relevance	0.14	0.16	0.16	0.12	0.15	0.15	0.13	0.15	0.21	0.23	0.28	0.36	0.16	0.19	0.26	0.24	0.29	0.38
Comments on the content	0.10	0.11	0.11	0.26	0.31	0.29	0.16	0.19	0.26	0.23	0.27	0.36	0.18	0.22	0.29	0.25	0.30	0.39
IT support	0.14	0.17	0.16	0.21	0.25	0.24	0.28	0.34	**0.43**	0.18	0.22	0.30	0.17	0.20	0.28	0.23	0.28	0.36
Reference to future	0.25	0.29	0.28	0.29	0.34	0.32	0.17	0.20	0.27	0.15	0.17	0.24	0.16	0.19	0.26	0.30	0.35	**0.45**

Source: Authors' own processing

Neither the organisation of the management accounting department nor the reporting frequency are linked to the assessment of the quality characteristics of internal reports, except for a moderate relationship between the latter and the reporting IT support, in the case of Poland. In Romania, the frequency of meetings between managers and management accountants is, however, a relevant factor for the quality assessment of internal reports, based on the moderate relationship between the considered variable, and the assessment of the clarity, comprehensibility, degree of detail and reference to future.

3.4. Factors determining the managers' assessment of the communication channel of the information provided by the management accounting department

In order to identify the factors determining the assessment of different communication channels of the information provided by the management accounting department, we relied on the correlation between this specific assessment and the same three variables employed in the prior analyses: the company profile, the manager profile and the operations of the management accounting department.

Out of these, the company profile doesn't interact significantly with the assessment of the considered communication channels (see **Table no. 13**).

Table no. 13. The relationship between the *company profile* and the assessment of the communication channel of the information provided by the MA department

Company profile	Type of the company						Size of the company						Origin of the capital					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
PDF files	0.07	0.09	0.09	0.13	0.14	0.15	0.18	0.22	0.29	0.15	0.18	0.25	0.09	0.10	0.15	0.18	0.22	0.29
Printed version reports	0.12	0.14	0.14	0.18	0.21	0.20	0.15	0.18	0.25	0.32	0.39	**0.48**	0.18	0.21	0.29	0.20	0.24	0.32
Excel data transfer	0.27	0.32	0.31	0.12	0.15	0.14	0.18	0.21	0.29	0.08	0.13	0.13	0.13	0.16	0.22	0.12	0.20	0.19
Online via Frontend	0.22	0.26	0.25	0.07	0.09	0.08	0.21	0.25	0.34	0.33	**0.49**	**0.40**	0.23	0.27	0.36	0.30	**0.45**	**0.35**
Mobile reporting	0.07	0.08	0.08	0.15	0.18	0.18	0.23	0.28	0.37	0.29	0.35	**0.44**	0.13	0.16	0.22	0.21	0.25	0.34

Source: Authors' own processing

The few moderate relationships that can be observed originate exclusively from Romania, where the company size is linked to the delivery of specific information through mobile reporting or online data – whereas both communication channels are employed rather by large companies, as well as through printed reports – frequently used by smaller companies. A third moderate relationship is exhibited between the origin of the capital and the online communication of the data – a common channel in companies with foreign capital, due to the high geographic spread of the companies within a group.

In the same line, only a very weak relationship can be observed between the manager profile and the assessment of the communication channel (see **Table no. 14**).

Table no. 14. The relationship between the *manager profile* and the assessment of the communication channel of the information provided by the MA department

Manager profile	Professional exeprience						Education						Managed department					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
PDF files	0.17	0.20	0.28	0.18	0.21	0.29	0.15	0.17	0.17	0.08	0.09	0.09	0.17	0.24	0.32	0.19	0.27	0.36
Printed version reports	0.24	0.29	0.38	0.27	0.32	**0.42**	0.30	0.36	0.34	0.17	0.20	0.21	0.16	0.23	0.30	0.22	0.32	**0.41**
Excel data transfer	0.21	0.25	0.34	0.11	0.19	0.18	0.01	0.02	0.02	0.07	0.09	0.09	0.15	0.22	0.30	0.10	0.21	0.20
Online via Frontend	0.07	0.08	0.12	0.18	0.21	0.28	0.11	0.13	0.13	0.15	0.18	0.17	0.17	0.24	0.33	0.14	0.21	0.28
Mobile reporting	0.10	0.12	0.17	0.17	0.20	0.27	0.17	0.20	0.20	0.09	0.10	0.10	0.13	0.19	0.26	0.19	0.28	0.37

Source: Authors' own processing

Merely two moderate relationships can be identified at this point, both originating from Romania and involving the employment of printed reports, in connection with the work experience of the manager, respectively with the managed department.

The last examined factor, i.e. the operations of the management accounting department, is proven to determine the specific assessments to a very weak extent (see **Table no. 15**)

The only moderate relationship is observed between the frequency of reporting and the employment of mobile reporting in the case of Romania. This is a justified relationship as the large share of branch offices in Romania requires the use of advanced IT solutions, like mobile reporting. In all the other examined instances, the relationships are very weak or weak and thus are not subject to further interpretation.

Table no. 15. The relationship between the *operations of the MA department* and the assessment of the communication channel of the provided information

Operations of the MA department	Organisation of MA						Frequency of reporting						Frequency of meetings					
Country	POL			ROM			POL			ROM			POL			ROM		
Coefficient	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P	T_c	V_c	C_P
PDF files	0.23	0.28	0.27	0.12	0.14	0.14	0.11	0.13	0.19	0.20	0.23	0.31	0.22	0.26	0.35	0.23	0.27	0.36
Printed version reports	**0.32**	0.38	0.35	0.23	0.27	0.26	0.08	0.10	0.14	0.19	0.23	0.30	0.19	0.23	0.31	0.24	0.29	0.38
Excel data transfer	0.14	0.17	0.17	0.12	0.14	0.14	0.15	0.18	0.25	0.12	0.21	0.20	0.16	0.19	0.26	0.20	0.34	0.32
Online via Frontend	0.23	0.27	0.26	0.14	0.16	0.16	0.11	0.13	0.18	0.23	0.28	0.37	0.11	0.13	0.18	0.16	0.19	0.26
Mobile reporting	0.17	0.21	0.20	0.22	0.26	0.25	0.18	0.22	0.29	**0.28**	**0.33**	**0.43**	0.15	0.18	0.25	0.23	0.27	0.36

Source: Authors' own processing

Conclusions

There is a global homogenization tendency in matters of management accounting practices, though research often points to particularities of American, Western European and Japanese management accounting practices (Chow et al., 1994; Granlund and Lukka, 1998, Horvath, 2011), as well as to specific features of management accounting practices in Central and Eastern European countries, with a similar historical background (Szychta, 2008).

In this context, the objective of the present paper was to test the strength of the relationship between selected variables and the managers' assessment of the information provided by the management accounting system. For this purpose, we employed the correlation analysis based on Czuprow's T coefficient - T_c, Pearson's C coefficient - C_P and Cramer's V coefficient - V_c, applied to data collected from randomly selected companies located in Poland and Romania.

The correlation coefficients employed in the study revealed, in case of both Poland and Romania, a rather weak relationship between the three selected organizational variables – the company profile, the manager profile and the operations of the management accounting department – on the one hand, and the assessed suitability of management accounting information and reporting, on the other hand (see Appendix).

The *company profile* is a factor with a weak to moderate influence on the assessed suitability of the information derived from the management accounting system by Polish and Romanian managers. Regardless of the type of company, its size and the origin of the capital, the managers' assessments are mainly similar. There are few exceptions to this matter, like the moderate relationship between the company type and the assessed suitability of the information for R&D decisions in Romania. The importance of the company profile, mainly of the origin of the capital, has also been emphasized in literature (Gordon and Miller, 1976; Waterhouse and Tiessen, 1978; Macintosh and Draft, 1987).

The *manager profile* proves to be weakly and moderately connected to the assessed suitability of the information derived from the management accounting system, whereas most moderate relationships are observed around the managed department of the respondent, especially in the case of Romania.

In respect of the third factor – *the operations of the management accounting department* - the strongest relationships were observed between the frequency of the meetings between managers and management accountants, on the one hand, and the assessed suitability of the information provided by management accounting, on the other hand.

The study contributes to the body of related research in two senses: it identifies influencing factors of the manner in which managers assess the usefulness of the information provided by management accounting, and it provides a comparison in the matter of interest between two Eastern European countries where, to the best of our knowledge, no similar study has been conducted.

As limits of the research, we should first point to the unbalanced distribution of the responses received in Poland and Romania, leading to the fact that the

comparison can't be generalised. Second, the managers' perception was examined only based on questionnaires. The results need be further substantiated based on interviews performed among the same respondents.

Starting from the results of the present study, we can identify two future research directions: (a) a macro-level analysis of cultural factors that might influence the managers' perceptions on the suitability of the information provided by the MAS for the managerial process and (b) a comparative analysis based on contingency variables, with a similar scope, between the managers' perceptions within the CEE countries and other countries, particularly the Western ones.

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Appendix - Summary of the results of the research on determining the impact of the examined factors on the assessments made by managers

Analysed variables		Assessment of extent to which the information provided by the MA department is used in performing management tasks		Assessment of the suitability of certain types of information provided by the MAS, in the context of the management process		Assessment of specific quality characteristics of internal reports, prepared by management accountants		Assessment of specific communication channels for the information delivered by the MAS	
Country		POL	ROM	POL	ROM	POL	ROM	POL	ROM
Company profile	***Type of the company***	weak or very weak relationship	moderate relationship only for R&D decisions	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship
	Size of the company	moderate relationship only for budget preparation	moderate relationship only for R&D decisions	moderate relationship for: actual financial data, non-financial indicators	moderate relationship only for actual financial data	moderate relationship only for IT support	moderate relationship only for: comments in reports	weak or very weak relationship	moderate relationship for: printed version of reports, mobile applications, online reporting
	Origin of the capital	moderate relationship only for budget preparation	moderate relationship only for R&D decisions	moderate relationship only for financial indicators	moderate relationship for: financial results and indicators (stronger relationship), variance analysis, non-financial indicators	moderate relationship only for relevance	moderate relationship only for degree of detail	weak or very weak relationship	moderate relationship only for online reporting
Manager profile	***Professional experience***	weak or very weak relationship	weak or very weak relationship	moderate relationship only for revenues	moderate relationship for: financial indicators, variance analysis	moderate relationship only for reference to the future	moderate relationship only for clarity	weak or very weak relationship	moderate relationship only for printed version of reports
	Education	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	moderate relationship for: completeness, comparability	weak or very weak relationship	weak or very weak relationship
	Managed department	moderate relationship for: budget preparation (stronger relationship), investment decisions	moderate relationship for: budget preparation, department management, R&D decisions,	weak or very weak relationship	moderate relationship for: costs, results, financial indicators, actual financial data (stronger relationship),	weak or very weak relationship	moderate relationship for: graphical presentation, IT support	weak or very weak relationship	moderate relationship only for printed version of reports

Analysed variables		Assessment of extent to which the information provided by the MA department is used in performing management tasks		Assessment of the suitability of certain types of information provided by the MAS, in the context of the management process		Assessment of specific quality characteristics of internal reports, prepared by management accountants		Assessment of specific communication channels for the information delivered by the MAS	
Country		POL	ROM	POL	ROM	POL	ROM	POL	ROM
			cost control and assessment of internal projects		planned financial data				
Operations of the MA department	***Organisation of MA department***	weak or very weak relationship	weak or relationship	moderate relationship only for variations analysis	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship	weak or very weak relationship
	Frequency of reporting	moderate relationship only for investment decisions	moderate relationship for: long-term planning, cost control	weak or very weak relationship	moderate relationship only for costs	moderate relationship only for IT support	weak or very weak relationship	weak or very weak relationship	moderate relationship only for mobile reporting
	Frequency of meetings between managers and management accountants	moderate relationship for: strategy implementation, budget preparation, performance measurement, making short-term decisions	moderate relationship for: strategy implementation, performance measurement	moderate relationship for: revenues, financial indicators, variance analysis	moderate relationship for: financial results and indicators, variance analysis, planned financial data	weak or very weak relationship	moderate relationship only for: clarity, comprehensibility, degree of detail and references to the future	weak or very weak relationship	weak or very weak relationship

Source: Authors' own elaboration

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Bankruptcy risk prediction models based on artificial neural networks

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Abstract

The purpose of this research is to study the ability of artificial neural networks to forecast the companies' risk of financial distress. We predicted the bankruptcy risk using the associated financial ratios (overall liquidity ratio and the overall solvency ratio) and two artificial neural network models based on the backpropagation algorithm. The proposed models were implemented and tested using the PyBrain software and have been applied to 55 companies listed on the Bucharest Stock Exchange during 2010-2014. After a total of 19,944 iterations for the learning stage, the two algorithms converged and the errors obtained during the tests reached the fixed target. The empirical results showed that the artificial neural network models are efficient and reliable in detecting the risk of bankruptcy. The artificial neural networks are very useful in economic analysis when the complexity of data makes it difficult to implement functions that proper describe the link between economic variables. The use of the neural networks method for predicting the risk of bankruptcy is less common in Romania. This study intends to fill this gap in the literature and we believe it could be of interest not only for the companies listed on the stock exchange, but also for investors, shareholders and banks.

Keywords: *Artificial Neural Networks; backpropagation; bankruptcy risk; overall liquidity ratio; overall solvency ratio*

JEL Classification: *M41, C53, G33*

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Introduction

For enterprises' competitiveness in the fast changing economic environment of the international market, the accurate prediction of the financial risk is one of the key factors. The globalization of the financial markets shortened the time that policy makers should respond and take decisions (Aydin and Cavdar, 2015). Meanwhile, the interconnections between the financial institutions magnify the consequences of the economic crises (Glasserman and Young, 2013). As a result, there is a high request for accurate forecasting of the firms' financial distress and bankruptcy risk. The accurate predicting models help the policy makers to take the right decisions and to reduce the trading risk (Airinei and Berta, 2012). The recent financial crisis emphasized the weakness of the traditional statistical models. If there is a significant difference between the predicted and the audited profits, the companies would lose their credibility to investors and all stakeholders (Bunget et al., 2014). The data analysis can be performed using diverse techniques such as descriptive statistics, regression analysis, data mining, fuzzy logic algorithms or neural networks models.

1. Literature review on applying artificial neural networks to business

In a healthy economy there is a high request for a proper distribution of resources in the financial markets. Nowadays firms are complex systems, the economic environment is changing very fast and the managerial functions can no longer be performed by a single person. Managers have shorter time for taking decisions and evaluation of the companies became a very difficult issue, requesting a good qualitative and risk oriented analysis. Accurate results require suitable accounting data (Bunget, 2009), including qualitative variables, such as political and environmental indicators, calendar anomalies and business cycles (Tjung et al., 2012) as well as the use of proper statistical methods (Vallini et al., 2009). The research papers showed that ANNs can forecast the companies' financial performance with a high accuracy.

Salama and Omar (2014) developed and tested a backpropagation ANN model that could detect and predict fraudulent financial reporting. Shang et al. (2015) studied the financial risk forewarning of the Growth Enterprises Market (GEM) companies belonging to the Chinese Strategic Emerging Industries (SEI). They used the stepwise regression model and backpropagation neural network (BPNN) model. The empirical results showed that BPNN can better predict the financial risk than the regression model. They found that the accuracy of NN and other Artificial Intelligence (AI) methods is superior to that of traditional statistical methods. Compared to other models of predicting stock prices, the empirical studies showed that ANNs have the best performance (Ardebili et al., 2015).

Trying to discover complex patterns in data by using multiple discriminant analysis (MDA) and ANN, Coats and Fant (1993) found that NN approach is more accurate and effective than MDA. Yildiz and Yezegel (2010) performed a fundamental analysis trading strategy on a sample of firms traded in the New York (NYSE), American (AMEX) and NASDAQ stock exchanges. They showed that the neural networks have the ability to predict future returns in NYSE/AMEX/NASDAQ securities for the period 1990-2005.

Traditional statistical models are valid only under some restrictive assumptions such as linearity, the normal distribution of data and the independence of predictor variables (Alborzi et al., 2013; Yildiz and Yezegel, 2010). As a result, they do not accurately reflect the economic processes and environment. They cannot inductively learn from new data dynamically, thus greatly affecting the forecasting accuracy (Khademolqorani and Farimah, 2015).

Using linear regression and ANN methods, Ahangar et al. (2015) estimated the stock price of the companies listed on Tehran Stock Exchange. Comparing the performance of the two algorithms, the empirical results showed that ANNs are more efficient than the linear regression model. Hu et al. (2012) used a sample of daily oil prices from Brent, West Texas Intermediate (WTI), Dubai, and International Petroleum Exchange (IPE) between 1990 and 2005 and tested the prediction accuracy of ANNs for the prices of crude oil futures. During the empirical tests they used Elman recurrent neural

network (ERNN), recurrent fuzzy neural network (RFNN), and Multilayer Perceptron (MLP). The results showed that the RFNN has the best predictive power and the MLP has the worst one. They also found that the predictive power of the ANNs is better when the training time increases.

2. Backpropagation neural networks

The human brain is endowed at birth with the ability to process information and perform complex activities such as motion control, pattern recognition, interaction with the environment and the ability to learn from experience. It is made of neurons which transform the inputs into outputs. Artificial Intelligence (AI) stores knowledge, being able to use it to solve problems and it acquires new knowledge from experience. For this purpose, it uses a language made of symbols that helps to seek solutions and solve the given problems. The semantic expressions used in AI are complex, syntactic and rule-based, being similar to the natural language.

As part of the Artificial Intelligence, the neural networks are systems that use approximation methods based on the learning process. Neural computing is a discipline that attempts to simulate the functioning of the human brain using computer systems (Aydin, 2015), algorithms, and combining knowledge from different disciplines such as biology, chemistry, physics, mathematics, and economics. An important feature of these networks is that they are capable of self-organization and therefore, to solve the problems, they do not require the implementation of some programs with powerful algorithms. Instead, they need a training phase for building knowledge using some specific data sets.

After storing the knowledge, through a process of "thinking" that mimics human reasoning, they are able to solve very complex problems. Thus, starting from a training set containing a lot of examples that are given as input values, the neural networks create a specific model based on the given problem. Other approaches are the neuro-fuzzy systems and the hybrid models based on genetic, fuzzy or neural networks (Pradhan et al., 2015). They are based on the fuzzification - defuzzification process applied to the inputs and outputs of the neural network, bringing the artificial reasoning closer to the human one.

Due to their universality, the application fields of neural networks are very diverse, from the natural sciences, industry, agriculture, arts, and entertainment. With the help of neural networks, the analyses and predictions for the management of companies and the capital markets can be performed with high accuracy. Among the most frequently used applications include natural language processing, image processing, pattern recognition, handwriting interpretation, robotics and modeling in economy and finance.

During the business activities, highly difficult problems can be solved by experts, namely professionals who have extensive experience. The Artificial Neural Networks (ANN) can also gain experience after performing some iterative learning processes. They are able to solve the highly complex problems of the economic environment, without resorting to the knowledge of specialists.

3. Basic principles of neural computation

The neural computations are based on mathematical models taken from neurobiology, having three main components:

- Computation units;
- Layers made of computation units;
- Rules for changing the intensities of connections between the computation units.

The neural computing concept was launched in 1943 in "A Logical Calculus of Ideas Immanent in Nervous Activity" published by teachers McCulloch and. In 1969, Minsky and Papert presented the neural model made of layers of neurons that transmit information from input to output through connections similar to the synaptic connections. The most important step in the developing of the neuronal networks is the implementation of learning by the backpropagation method, discovered by Werbos in 1974, which has been still used. Depending on how the neurons are connected, there are three types of networks: directly connected, backpropagation (BP) or recurrent. BP networks are common in many applications. They

use a multilayer neural architecture that have at least one hidden layer of neurons and apply algorithms to minimize the function error. The activation function of the hidden layers is a logistic function of the following form (Enăchescu, 2009):

$$f(x) = 1 / (1 + e \wedge (- x))$$

The number of nodes in the hidden layer can be determined using the trial and error method or by the formula method. The most used formulas are (Shang et al., 2015):

$$m = \sqrt{nl}$$

$$m = \log_2 n$$

$$m = \sqrt{n+1} + a \,;\, a = constant, a \in [0,1]$$

Where:

- *m* = number of nodes in the hidden layer
- *n* = number of nodes in the input layer
- *l* = number of nodes in the output layer

The neural networks can be used for prediction, classification, conceptualization, data filtering and association. To perform the evaluation of the model, the data set is usually split into three sets: training set, validation set and test set (Badea, 2013). The accuracy of ANNs forecasts depends on some factors with significant impact on their performance, including the selection of input variables, the network architecture, and the quantity of data used for the training step (Walczak, 2001). Despite other programming methods, the artificial neural network has the ability to learn. Learning in a neural system is based on two steps. The first step is designed to train and to accumulate the knowledge. In the next step they perform functional modifications to the neural network nodes that modify the internal structure. A neuron or node has several input signals and produce a single output signal, each of the entries having assigned a specific synaptic weight.

During the learning process, the neurons change the weights of the input variables, depending on the errors between the target output and the predicted output of the network. Based on the weights of the neural connections, the algorithm synthesizes a specific model to solve the problem. Through this mechanism, the neural networks can perform complex tasks, for which the implementation of classical algorithms for processing would be very difficult.

In the typical structure of a backpropagation (BP) network type, the neurons are connected in multiple layers. The first layer receives the input values, the last layer network provides the output, and between these two layers there could be one or more hidden layers. Each computing element of a neural network is assigned a combination of inputs that is turned into an output value, based on the previously stored knowledge. During the training-learning process, the network receives a large number of input values and adjusts the weights using the BP algorithm. Based on the inputs, the network of artificial neurons identifies certain patterns and connections and gets an output that will be compared with some known values, called target values. The errors computed as the difference between the outputs of the network and target values flows back through the hidden layers of the network. The process repeats until the difference between the output value of the network and the target one reaches a minimum set a priori.

One drawback of these systems is the time interval required to load and store knowledge. Another problem is the large amount of input information necessary for the learning process (Kaastra and Boyd, 1996). In order to provide a proper solution, the system should receive complete details of the task. As the large amount of input data needed to be processed is time and resource consuming, the researchers are currently seeking to develop new training systems that can operate efficiently with a smaller amount of initial knowledge.

4. Empirical study using neural networks to predict bankruptcy risk

The paper proposes two supervised ANNs model based on the backpropagation method for predicting the risk of bankruptcy using the associated financial ratios. The learning process is supervised, based on a sample of inputs and outputs. The supervised learning includes error-correction process, reinforcement learning, stochastic learning and error-convergence (Salama and Omar, 2014). The error convergence concept means that the differences between the target

and the computed output values must be minimized. For this purpose, the algorithm changes the weights and creates the appropriate model. The neural network models predict the risk of bankruptcy based on the analysis of past events of the corporate activity (Prodan-Palade, 2016).

Romania is an emerging country that has a dynamic market and presents numerous opportunities for the international economic environment, along with more risks than other developed markets. In the last 26 years our country has experienced many transformations, transitioning from a centralized to a market economy. Regarding the dynamic business environment, according to the National Trade Registry Office, on 31 December 2015 in Romania there were a number of 773,781 active legal entities. During the same year, a total of 10,269 entities have involved into insolvency proceedings, representing a rate of 1.33% of active entities, down from the previous period with 50.38%, while 2.29%, respectively a number of 17,698 entities had suspended their activity, meaning an increase by 12.10% compared to 2014.

Many of the entities listed on the Bucharest Stock Exchange (BSE) are in their first stage of development and require much investment, the bank loans being among the most important sources of funding for the Romanian companies. The problems of liquidity and debt repayment capacity are essential in analyzing their financial balance. Therefore, we consider necessary the building of a base knowledge and the formalization of prediction models for liquidity and solvency of the entities, based on the concept of neural networks.

Our research proposes two prediction models, one designed for prediction the overall liquidity ratio and the other designed for prediction the overall solvency ratio. The two indicators are considered to be the main ones in analyzing the financial stability of an entity. The overall liquidity ratio is expressed by the fixed assets ratio, the global financial autonomy ratio, acid test ratio, the cash ratio and the profit ratio. The overall solvency ratio is expressed by the fixed assets ratio, the global financial autonomy ratio and the overall liquidity ratio (Prodan-Palade, 2016).

The sample consists of 55 entities listed on BSE during 2010-2014 from the manufacturing industry. The accounting information used for determining the financial indicators was extracted from the companies' annual reports published on the website of the stock exchange.

The application has three working stages for training, testing and prediction. During the training stage the network is learning, based on the information provided at the input and identifies a particular model. For the first stage we used the accounting input data corresponding to the financial exercises between 2010 and 2013. The predicting and testing the accuracy of the algorithm were performed using accounting data for the year 2014.

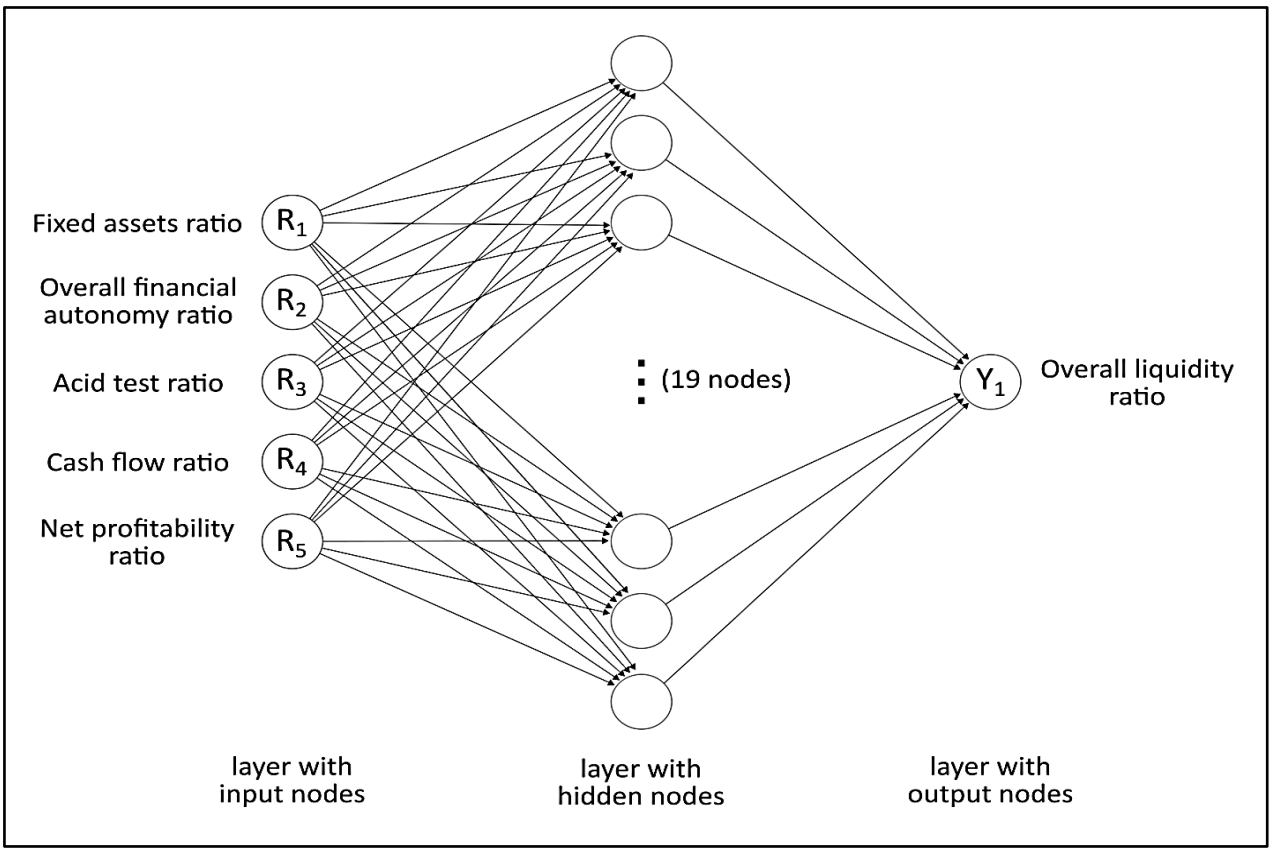
4.1. Building a neural network model for the prediction of overall liquidity ratio

The concept of liquidity expresses the company's ability to pay its short-term debt obligations. It is the coverage level of short-term debts by current assets. The acceptable values for this ratio vary from one industry to another. The literature recommends a general value more than 1. On the other hand, there are certain cases where a too high overall liquidity ratio (current ratio), for example much more than 2, may signify the presence of inventories and receivables that consume significant financial resources and therefore being a negative sign for the company. Hence, in the prediction model of overall liquidity ratio we considered useful to include the acid test ratio that takes into account the inventory levels of the entity.

The architecture of this ANN is shown in **Figure no. 1**. The proposed model consists of:

- 5 neurons in the layer 1 (the input layer);
- 19 neurons in the layer 2 (the hidden layer);
- 1 neuron in the layer 3 (the output layer).

Figure no. 1. The neural network model to predict the overall liquidity ratio



Source: own processing

Where:

- R1 (Fixed assets ratio) = fixed assets/total assets
- R2 (Overall financial autonomy ratio) = shareholders' equity/total passive
- R3 (Acid test ratio or Quick ratio = (current assets – inventory)/current liabilities
- R4 (Cash flow ratio) = net cash flow/current liabilities
- R5 (Net profitability ratio) = after-tax profit/net turnover
- Y1 (Overall liquidity ratio or Current ratio) = current assets/current liabilities

Considering:

- R_i ; $i = \overline{1,5}$, the input neurons;
- H_j; $j = \overline{1,19}$, the hidden neurons;
- Y_1, the output neuron;
- W_{ji}^k; $i = \overline{1,5}$; $j = \overline{1,19}$, $k = \overline{2,3}$, the weights of connections between the neuron *i* placed in layer number *k-1* and neuron *j* placed in layer *k*;
- f_k; $k = \overline{2,3}$, the activation function corresponding to the layer k, $k = \overline{2,3}$,the neural network is working in the following way:

For the layer 1(input), the input vector is R = (R_1, R_2, R_3, R_4, R_5)

For the layer 2 (hidden): $H_j = f\left(\sum_{i=1}^{5} R_i\, w_{ji}^2\right)$; $j = \overline{1,19}$

For the layer 3 (output): $Y_1 = f\left(\sum_{j=1}^{19} H_j\, w_{1j}^3\right)$

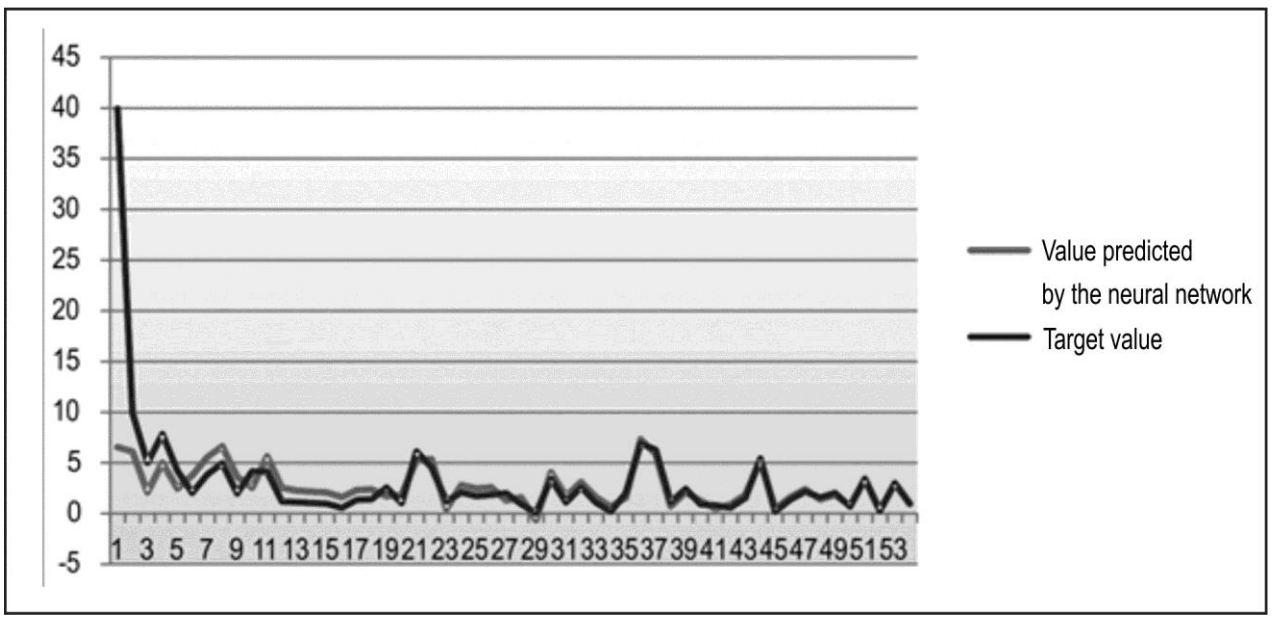
The number of hidden nodes is determined by the model's complexity. As it is showed in **Figure no. 1**, entries in the system include ratios R1, R2, R3, R4 and R5 which, after the model building process, are given different weights. Every ratio has assigned one node in

the network. Each of the 19 nodes of the hidden layer is connected to all input and output nodes. The output layer contains a single node (Y1), which is the overall liquidity ratio.

The first step for building the model is the training period, which is the learning process when the weights are given the optimal values. Our model uses a supervised learning process because it is based on a pair of training data consisting of an input vector (R1, R2, R3, R4, R5) and a desired output Y_1. The learning method used in the model is backpropagation. The goal of the algorithm is to find the proper function that can give the right output, based on the input vector. The network's training period tries to gather knowledge about the studied model. During the training period, the algorithms determine the weight of each node and the type of relationship - direct or reverse - between them. During the storage of knowledge, the network tries to minimize the errors determined by the difference between the values provided by the model and the target values, changing the weights. Taken together, the sets of input values that consist of the five financial indicators values for the years 2010, 2011, 2012 and 2013 is the information that is used by the neural network to change its structure.

The result of the test (see **Figure no. 2**) confirms the accuracy and predictive power of the designed model.

Figure no. 2. General liquidity ratio, comparison between the value predicted by the neural model and the target value



Source: own processing in Excel and PyBrain

To implement the proposed model, we used the open source application PyBrain (Tom et al, 2010) built in the Python programming language. The training error value is set to 0.0001, with a learning rate of 0.05, using a total of 19,944 iterations for the learning stage. Following the stored knowledge, we tested the model using the appropriate database comparing forecast values for the year 2014 with target values for the neural network. The process is repeated using the neurons from theal hidden layers. It was found that the algorithm gave an accurate model which can be used in the prediction analysis.

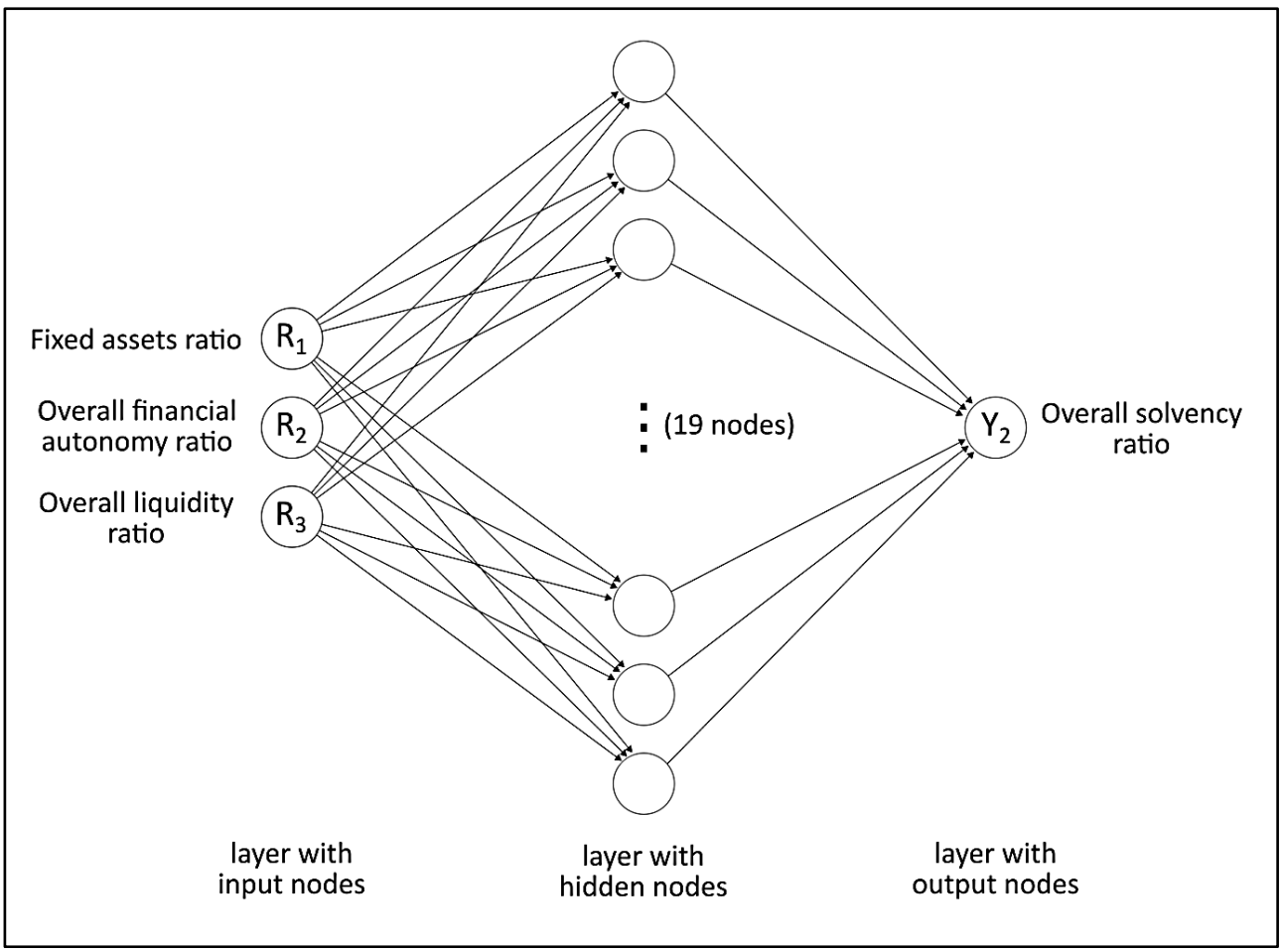
4.2. Building a neural network model for predicting the overall solvency ratio

The solvency or the patrimonial solidity of an entity is its ability to pay on the due dates its long-term debts and interests. In our application, we built a neural network to predict the overall solvency ratio (see **Figure no. 3**).

Where:

- R1 (Fixed assets ratio) = fixed assets/total assets
- R2 (Overall financial autonomy ratio) = shareholders' equity/total liabilities
- R3 (Overall liquidity ratio) = current assets/current liabilities
- Y2 (Overall solvency ratio) = total assets/total liabilities

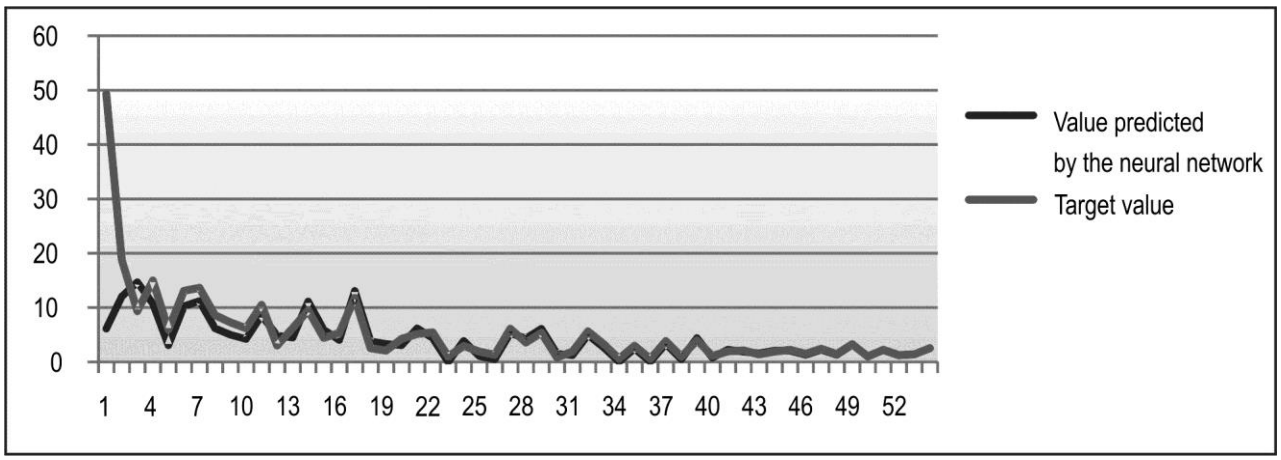
Figure no. 3. The neural network model to predict the overall solvency ratio



Source: own projection

As shown in **Figure no. 4**, there are 23 nodes, three input nodes, one output corresponding to the general solvency ratio Y1, and 19 hidden nodes (Prodan-Palade, 2016). The inputs in the system include ratios R1, R2, R3. For each of them there is one node in the network. During the model building process, they receive different weights.

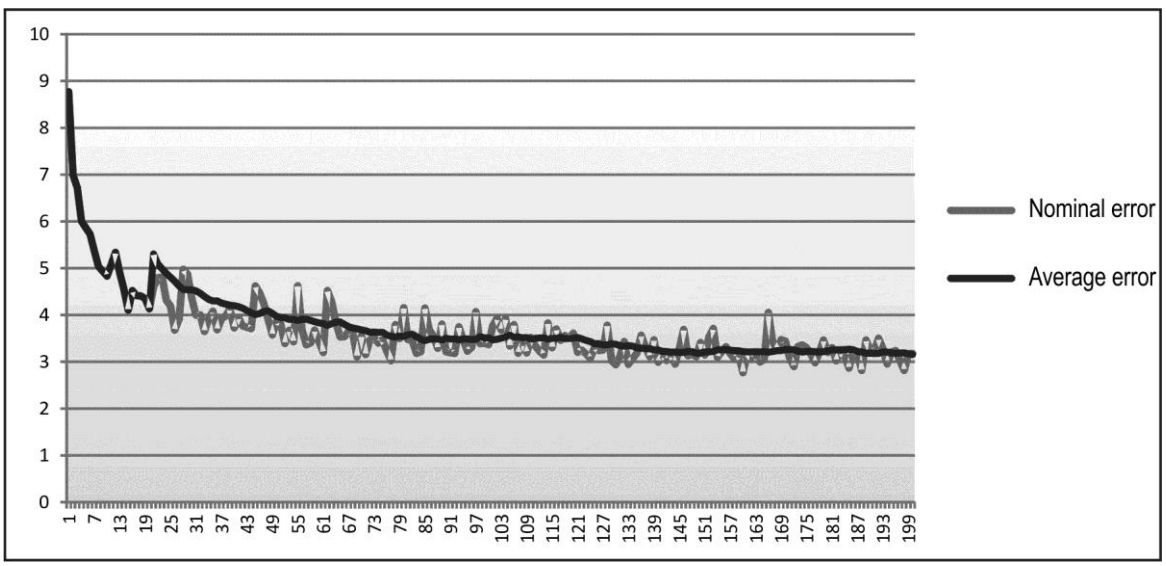
Figure no. 4. The solvency ratio, general comparison of the value predicted by the neural model and the target



Source: own processing in Excel and PyBrain

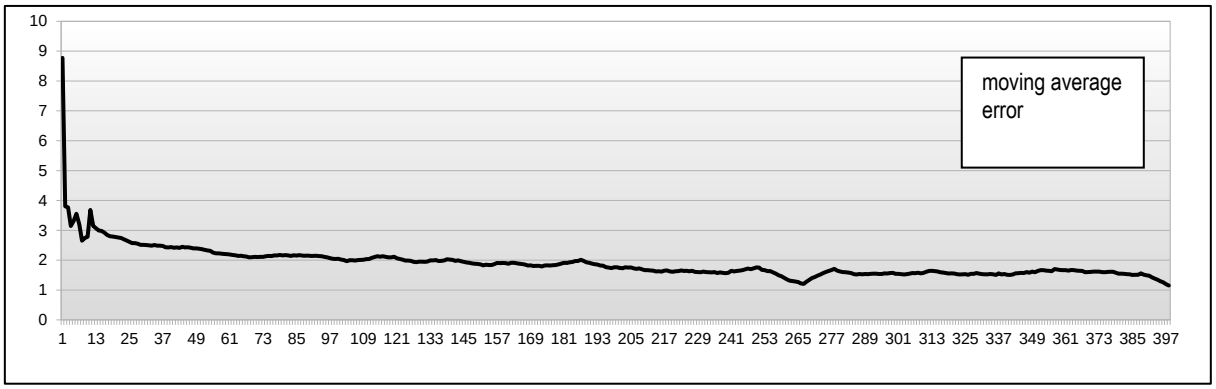
An important aspect of neural networks is the convergence error that means minimizing the differences between the model output vector obtained by learning and the target vector containing the set of a priori given values. When the inputs values cannot explain the output target values, namely there is no correlation between them, the network cannot build the neural model and the recorded errors don't converge. Our network is convergent and the errors reach a local minimum (see **Figures no. 5 and 6**).

Figure no. 5. The evolution of errors recorded during the 19,944 training steps



Source: own processing in Excel and PyBrain

Figure no. 6. The evolution of moving average errors during the 19,944 training steps



Source: own processing in Excel and PyBrain

Conclusions and perspectives on the use of neural networks in economy

The purpose of our research was to develop two neural networks of backpropagation type, a widely used technique, to predict the overall liquidity and solvency ratios of the entity. We tested each model's accuracy by comparing the output of the predicted model with a set of target values taken from the audited financial statements of entities listed on BSE. The novelty of the research is that we used a sample of Romanian entities and for our investigation we used the recent available financial accounting information for the years from 2010 to 2014. With the mentioned tools, we built the neural networks using a combination of financial indicators which were chosen based on the specialized literature and own reasoning. The research is justified by the ever increasing request for implementation of performance algorithms that can make a correct prediction of the firms' evolution on the rapidly growing contemporary markets. The accuracy of the predictions is impressive, proving once again that information technologies in symbiosis with financial information produce value for the entities and constitute basic elements of modern management.

Due to a broad spectrum of factors that influence a firm's activity, the prediction of its evolution is a difficult process. To obtain reliable results, the analysts must use complex models and a large amount of data. If the forecasted results differ significantly from the values recorded in annual reports, they represent an impediment to the management process. The risks are magnified and the entity loses its credibility for the investors. Therefore, the analysis and prediction activity play a very important role, influencing the company's relationship with its stakeholders. All these elements justify the need to develop modern and efficient methodologies of analysis and prediction of the risk of bankruptcy.

In the research works, the financial risk is defined by several indicators, depending on the context of the investigation. For banks, it can suggest the entity's inability to pay debts at maturity, while for the stock exchanges companies that register losses or negative equity for three consecutive financial exercises have high financial risk (Shang, 2015). At the same time, the suppliers take decisions based on the solvency, liquidity and going concern ratios of the entity, usually pursuing a less time horizon compared to the financial creditors. From the corporate governance's point of view, risk reduction involves increasing the liquidity and solvency and making the best decisions to ensure a financial autonomy and a competitive favorable position on the market. Therefore, we consider appropriate the prediction of these indicators, namely the overall liquidity and solvency ratios. For a proper risk assessment, we need to analyze and interpret the significant aspects of the entity's business activity and the ability to predict any unforeseen future events that may occur. An example is the financing activity, which is an important part of the investment and development process. It is an essential part of the economic policy for a company. Financing

decisions must be based on the information provided by economic and financial analysis. If an entity has provided more alternatives for financing, the manager will have to choose the best option that fits the business needs, according to its specific activity and long-term strategies. Since long-term financial resources are part of the permanent capital of the entity, being in direct connection with the entity's financial mechanisms in the long term, the selection of the most efficient variant is made by following a detailed review process.

Conventional techniques for risk prediction have some drawbacks. For example, in the case of the Z score function, there is no theoretical basis of strict linear dependence of the variables used in the regression model. The application of fuzzy logic, which works with logical values in the range zero and one, show more accuracy in prediction algorithms, but requires advanced knowledge and experience from the practitioners. The neural networks learn by themselves, but they need experience based on the examples provided at the input, without specifying certain modeling functions and without resorting to specialist knowledge.

Research papers published in the field show that a well-trained neural network can predict the financial risk with great accuracy, recording higher performance than the multivariate linear regression algorithms (Coats and Fant, 1993; Shang et al., 2015). They can be properly approximated by non-linear functions, using neurons placed in the hidden layers and weighting the links between nodes. Neural networks offer valuable solutions to various complex issues of corporates activities and they are very useful tools for stock exchanges, investors, managers and financiers.

As future research, we plan to use neural networks to detect fraud in financial reporting. The model that we recommend for further work should use values of certain financial ratios predicted by the neural network, which can be compared with the target values taken from annual and audited reports. Significant discrepancies may be a signal of fraudulent reporting activity and the auditors can enhance their control over these items. The backpropagation method which is used in this paper can be replaced by other methods (Enăchescu, 2009). At the same time, for predicting bankruptcy risk we have to consider other financial and non-financial variables related to the governance of an entity.

We should mention some research limitations: the sample was composed of only 55 entities which were analyzed over a short time period. The efficiency of neural networks increases proportionally to the amount of input data. It could be interesting to study all the Romanian entities, including those which are not listed on the Bucharest Stock Exchange. To provide an overview of the Romanian companies, we mention that on 31 December 2015 there were 773,781 active firms registered in Romania. A comprehensive study, taking a sample of all these entities may be of particular interest for the economic environment of our country.

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Performance audit in public institutions in the Czech Republic

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Abstract

Public economics examine the influence of the state on economic equality and efficiency, and on conduction of business entities in connection with the various tax systems and individual behavior in private consumption. Long-term sustainability of public finances is in the interests of society as a whole and therefore is interesing for scientific research worldwide. From a budgetary perspective, the public economy in the Czech Republic is characterized mainly by the state budget, 6,249 municipal budgets and 14 budgets of local government units. These all units are together subject to annual statutory audit, which mainly represents the analysis of the system of the audit informative and monitoring indicators. Analyzed data and indicators were obtained from sources of Czech Statistical Institute and Czech Ministry of Finance with the follow use of absolute and relative indicators applied for each size group of public budget entity. On this basis the paper suggests possible changes and consolidation of municipal and local government budgets in the Czech Republic.

Keywords: *Audit, municipality, local government unit, public budget, debt, deficit.*

JEL Classification: *H60, H63*

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Introduction

The public sector is part of the national economy, whose main area of interest is to carry out a public service, which is funded from public funds as well as are managed and administered in public administration. Budgeting for the public sector is fundamentally different from budgeting in the private sector. They differ in their purpose, their processes, and their accounting methods.

Decisions within public sector are made on public option and are subject to public control (Volek, 2005). Because public sector budgets invite a certain level of public participation, they are usually a lot more transparent than private sector budgets. From a financial 's standpoint, this means there is need to justify the amount of spending on each item so everyone will understand and agree that such an expenditure was necessary. So the issue of control of public administration is completely different than controlling the business sector of the national economy, and moreover, is subject to the principles of publicity, the principles associated with the obligation to give public entities the requesting information (Becker, Murphy and Werning, 2005). Public sector represents one of the hallmarks of public administration and its name is derived from the fact that it is implemented in the public interest (Barro, 2014).

Financial management in the public sector and private sector differ significantly. Those who have experience in one of these areas may not necessarily be ready for financial management in the other sector due to some of these differences. The main differences are in accounting, profit, context and decisions.

Government agencies of public budgets are not necessarily profit-driven in the same way that private businesses and corporations tend to be. They may be task-oriented or driven by some other motivating force endemic to the specific type of work the organization is focused on daily. Another fundamental difference between public and private financial managers is the context in which they operate. The public budgets manager may be subject to legislative and regulatory constraints that prevent autonomous action. The political framework of the public sector may pit bureaucratic financial managers against elected officials on occasion, causing significant limitations to getting the job done. The differences in the decision-making process between public and private sector financial managers are closely related to the context of operation. Public sector financial managers often have to work with political constituencies and navigate between competing interest groups. Important financial decisions are often rendered by creating coalitions and support. Decisions cannot typically be handed down and passed off to the next in command without some type of public sanction or approval (Gruber, 2015).

In terms of administration, management and performance of public finances it is overall a very difficult and complex issue for every national finances at all levels. The article will focus on analyzing the structure of public budgets in the Czech Republic, especially budgets of municipalities and local government units (LGU) with special focus on long-term sustainability of budgets and subsequent performance audit of these entities within the country. This article aims to evaluate the performance of municipalities and LGU and on base of the evaluation of performance audit suggest the main principles of public budgets reform leading to their better condition, economy and efficiency.

Smith and Thomas (2004) describe public budgeting through four perspectives. The politician sees the budget process as a political event conducted in the political arena for political advantage (Krugman and Eggertsson, 2012). There are three main roles of government in the economy: allocation of resources, distribution of goods and services, and economy stabilization (Musgrave, 2007). Rubin (1997) suggested that budgetary decision making is largely political, rather than based on economic conditions. Public budgeting of municipalities and LGU is in financing an enterprise or local government during a definite period, which is prepared and submitted by a responsible executive to a representative body (or other duly constituted agent) whose approval and authorization are necessary before the plan may be executed (Merchant and Stede, 2003). Shick (1986) outlined the three functions of budgeting: Strategic planning and deciding on the goals and objectives of an public organization; Management control and management's process of assuring effective and efficient accomplishment of goals and objectives laid out via strategic planning and Operational control and audit focused on proper execution of specific tasks that provide the most efficient and effective means of meeting the goals and objectives. Developed country governments in EU desperately need more long-term and predicTable no. aid, given through their budgets, to

finance the expansion of health care, education, and other vital social services (Bokkering, 2008). All the mentioned objectives and functions of budgets are achievable due to budgetary audit control. Budget audit control is the process of determining and analyzing the deviations of effective values of indicators from the predetermined values (Anthony and Govindarjan, 2003).

In the Czech Republic there is a total of 6,249 municipalities and 14 LGU by the end of 2015. The task of each municipality in the Czech Republic is to allocate sufficient funds to finance the activities that the municipality has in its scope and activities, as well as those which are transmitted by the state (Rektorik and Selesovsky, 1999). Municipalities and LGU seek comprehensive development of its territory and ensure the needs of its citizens through public goods and services.

On July 1st 2004 came into effect law No. 420/2004 Call., on the Act on the audit of municipalities and LGU, where articles 1-9 of § 4 oblige the rule to provide (till 30th June of current year) the audit management for the past year. The audit shall be conducted in accordance with law No. 93/2009 Coll., on Auditors and the International Auditing Standards and related application clauses of the Czech Chamber of Auditors.

1. Objectives and methods

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks that the financial statements contain material misstatements due to fraud or error. When assessing these risks, the auditor considers internal control relevant to the preparation and fair presentation of the financial statements. The aim of the assessment of internal controls is to propose appropriate auditing procedures, not to comment on the effectiveness of internal controls. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management as well as evaluating the overall financial statement presentation.

For the preparation and fair presentation of financial statements in accordance with accounting standards of the entity, there are data sources obtained from the Czech Statistical Institute and the Czech Ministry of Finance. Analyzed data indicators in this paper are municipality profile, balance sheet and municipality budget, while these data were analyzed using both the absolute and relative methods of managerial accounting. Using these data the paper counts debt service ratio (DSR) for the calculation of different size group of municipalities and LGU. Finally is calculated Audit system of informative and monitoring indicators (ASIMI) for all municipalities and contributory organizations established by them and evaluate the results of the calculation. Based on these data and analysis results the main objective of the paper is to evaluate the main results of audit of municipalities and LGU in the Czech Republic and determine possible directions of future reform of its budget system.

2. Basic principles and scope of the audit

The auditor shall, in accordance with these regulations, to comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement (Lucas and Moll, 2014). Part of this responsibility is designing, implementing and maintaining internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error, selecting and applying
appropriate accounting policies and making reasonable accounting estimates (Pospisil, 2013).

The role of the auditor is to issue the audit opinion on the financial statements.

Data review on the annual management of municipalities and LGU, which forms part of the final account are based on law No. 420/2004 Call, § 2, article 1-2:

a) the income and expenditure of the budget, including cash transactions relating to budget funds,
b) financial transactions related to the creation and use of monetary funds,
c) the costs and benefits of business,
d) cash transactions related to pooled funds expended under an agreement between two or more municipalities or LGU or under contract with other legal entities or individuals,

e) financial transactions related to foreign sources within the meaning of the legislation on accounting,
f) management and disposal of funds provided from the National Fund and other funds from abroad provided under international treaties,
g) the billing and settlement of financial transactions to the state budget, the municipality and LGU budgets other budgets, state funds and of other persons.

The further audit and examination include:

a) the trading and management of property owned by territorial unit,
b) the trading and management of state assets under the management of a territorial unit,
c) placing and execution of public contracts,
d) the status of obligations and claims and their trading,
e) liability for the obligations of individuals and legal entities,
f) pledging of movable and immovable assets in favor of third parties,
g) the establishment of easements on the property of a territorial unit,
h) accounting of municipalities and LGU.

Subject of the review referred to in § 2 are audited in terms of:

a) the compliance with obligations under special regulations, especially regulations on financial management of municipalities and LGU on the management of their assets, accounting and on remuneration,
b) the compliance of the management of funds in comparison with the budget,
c) the compliance with the purpose of a received grant or a refundable financial assistance and the conditions of their use,
d) substantive and formal correctness of documents examined transactions.

Financial management in the context of this paper is characterized by basic financial indicators and the relationships between them as the following (including the types of financial documents where the indicators can be found). Table no. 1 shows the list of used and analyzed indicators of municipal and LGU budgets in the Czech Republic at present.

Table no. 1. Analyzed indicators of municipalities and LGU

Municipality profile	Balance sheet	Budget
Identification number	Fixed assets	Tax revenues
Number of inhabitants	Current assets	Non-tax revenues
Performs state administration or not	Total assets	Capital revenues
	Total current accounts	Accepted transfers
	Own sources	Total revenues
	External sources	Current expenditures
	Total liabilities	Capital expenditures
		Total expenditures
		Annual budget balance

Source: own processing

For analyzing the financial management of municipalities, auditors use basic financial analysis ratios, such as the following balance sheet indicators:

- Fixed assets / Total assets;
- Current assets / Total assets;
- Own sources / Total liabilities;
- External sources / Total liabilities;
- Total current accounts / Total liabilities.

In additing to the indicators mentioned above, beginning from July 2004 Czech government approved municipal debt regulation through the debt service ratio (DSR). The actual formula for the calculation is:

$$DSR = \frac{\text{Debt serice}}{\text{Debt base}}\ x\ 100 = \frac{\text{Interest + Principal and bond instalment +Leasing instalment}}{\text{Tax revenues +Nontax revenues +Received transfers}} \quad (1)$$

3. Results

The Ministry of Finance of the Czech Republic calculates the debt service ratio for each municipality and in case the ratio overruns 30% than the minister of finance sends a letter to the municipality. The debt service ratio was first calculated in April 2004 from the 2003 data. **Table no. 2** shows current indebtedness of municipalities in the Czech Republic in 2015 divided in different size group.

Table no. 2. Indebtedness of municipalities in 2015

Size group	Number of municipalities	Distribution of debt to assets ratio (%)			Distribution of debt to income ratio (%)		
		Median	75th percentile	95th percentile	Median	75th percentile	95th percentile
< 200	1456	1	4	19	7	22	110
201-500	1998	3	8	27	14	45	130
501-1000	1361	4	10	30	25	57	149
1001-5000	1161	6	10	24	32	61	134
5001-10000	141	6	11	21	35	52	104
>10000	132	7	11	17	41	57	96

Source: own processing

The municipality is required to explain within three months the reasons for this overrun and suggest measures to improve the situation (Maaytova et al., 2015). At the same time the municipality submits the audit report and the multi-annual budget outlook. Then the ministry evaluates these documents together with the total debt, debt per capita, tax revenues per capita, debt in the past years, size of the municipality and its overall financial situation (Barro, 2013). In case of overrun of the debt service ratio in the next year the Ministry of Finance will put the municipality on a list, which will be passed on to the grant providers (ministries or state funds). The grant providers should consider this list when providing new grants. There is no absolute prohibition of grant provision to these municipalities, but it may be a factor of grant rejection.

The described procedure is effective only for a short time, however several problems arose (Lucas, 2003). The debt service ratio does not say much about the total indebtedness and about the ability to pay off the debt (Summers, 2000). The ministry did not inform the municipalities sufficiently about the whole procedure and its goals. In our understanding the procedure should have alert both the Ministry of Finance and the particular municipality, that the debt is too high and that some measures should by applied. However many municipalities, which regularly pay off their debt, felt unfairly accused. At the same time the "debt service ratio" is not very concrete and is therefore often confused with "indebtedness."

Audit system of informative and monitoring indicators (ASIMI)

The Ministry of Finance of the Czech Republic, on the basis of Government Resolution dated November 12, 2008 no. 1395 on audit of the management of municipalities and repealing Government Resolution of 14 April 2004 no. 346 on the regulation of indebtedness of municipalities and counties through the debt service, annually performs ASIMI for all municipalities and contributory organizations established by them and evaluate the results of the calculation, building always on data 31.12. relevant year (after final enrollment). ASIMI indicators are divided into two separated parts and are audited and evaluated all together:

1. Informative indicators:
   a) Population of the municipality;
   b) Total income (after consolidation);
   c) Interest;

d) Payment of installments for bond and borrowed funds;
e) Total debt service;
f) Debt service indicator (%);
g) Total assets;
h) Liabilities;
i) Balance at bank accounts in total;
j) Loans and municipal bonds;
k) Received repayable financial assistance and other debts;
l) Total debt;
m) The debt to foreign sources (%);
n) 8-year balance;
o) Current assets;
p) Current liabilities.

2. Monitoring indicators:

a) Share of foreign sources to total assets (%);
b) Total current liquidity;
c) 5-year development if indebtedness;
d) Annual change of indebtedness.

The Ministry of Finance of the Czech Republic performs annually - from the submitted financial and accounting statements - calculation of ASIMI for all municipalities and evaluates the results of the calculation. Municipalities whose indicator of overall liquidity will be by 31.12. of the current year in interval <0; 1>, while the share of foreign sources to total assets will be greater than 25%, will receive a letter from the Minister of Finance and asked for an explanation of this state and the opinion of the council of the municipality. The Ministry of Finance will, upon receipt of the municipalities concerned, inform the government of the Czech Republic on results of monitoring of municipal finances for the current year.

The Ministry of Finance also evaluates the operations of other municipalities (including their subordinate governmental organizations), with the indicator of the overall liquidity in the interval <0; 1> using the above indicators, paying attention especially to municipalities that are in this interval occurred repeatedly. Municipalities who were identified with serious problems with their solvency, will be offered assistance focused on analyzing problems arising with the draft recommendations on possible solutions. Auditing of municipal management does not require additional administrative or financial demands on budgets and run municipalities. Municipalities are required to currently send to the Ministry of Finance of the Czech Republic completed ASIMI table.

The time table of ASIMI audit is:

a) Calculation of Audit system of informative and monitoring indicators (March);
b) Distribution of letters of Ministry of Finance of the Czech Republic (April);
c) Justification unsatisfactory status (June);
d) Information for members of the government (3rd. Quarter).

In 2016 Audit of ASIMI included all 6,249 municipalities and 14 LGU. By the 31. 12. 2015 there were 176 municipalities with the indicator of the overall liquidity in the interval <0; 1> and also 226 municipalities with the share of foreign sources to total assets higher than 25%. These two indicators all together exceeded the 28 municipalities. It is an annual fall of 2 municipalities, while 12 municipalities had exceeded those values in some previous years. The resulting values of the indicators are only indicative of the potential risk of economic problems, but it does not necessarily mean that the municipality is in a difficult financial situation. This can be assessed only after a thorough audit of the financial and accounting reports, and especially the additional documents provided by the municipalities themselves.

Based on the provided analysis, it is possible to state that:

- From the point of terms of solvency the most vulnerable municipalities are those, which were mandated contribution for breach of budgetary discipline and municipalities and those, that have made the wrong investment decisions (Rogoff and Reinhart, 2012);
- The greatest risks to the economic situation of municipalities is seen in non-compliance with the conditions of grant projects supported by EU funds and also from national programs. These risks arise both from errors in the preparatory and implementation phases;
- Most municipalities with exceeding the given values of ASIMI, should not get into serious trouble with

their solvency, because these identified risk proved only temporary;

- High insolvency risk was identified just in 2 municipalities of 6,249 total: Prameny and Turovice.

Municipalities (including their subordinate governmental organizations) reported at the end of 2015 the total debt of EUR 3,10 billion. Compared to the previous year with a decrease of 2.3%, in absolute terms, the debt declined by EUR 71,4 million. The total volume of municipal debt includes bank loans from financial institutions, issued municipal bonds, repayable financial assistance received and other debts, incl. loans from state funds. **Table no. 3** shows summary data on indebtedness of municipalities in the Czech Republic in 2010-2015.

Table no. 3. Summary indebtedness of municipalities in the Czech Republic (billion EUR)

Variable/Year	2010	2011	2012	2013	2014	2015
Loans	2.14	2.18	2.44	2.46	2.42	2.36
Municipal bonds	0.56	0.50	0.49	0.54	0.42	0.38
Received repayable financial assistance and other debt	0.27	0.27	0.28	0.30	0.34	0.36
Total	2.97	2.95	3.21	3.30	3.18	3.10

Source: Czech Statistical Office; own processing

In the structure of the debt of municipalities have the greatest weight the long term loans, whose share during 2015 decreased by 0,1 percentage points to 76,1%, the share of municipal bonds issued decreased by 1,0 percentage points to 12,3% and the remaining part of the debt of municipalities (11,6%) were consisted of repayable financial assistance and other debts. Total debt of municipalities in 2015 contributed 4 largest city of the Czech Republic by 50,4%, the value of their debt amounted to EUR 1,55 billion.

Loans that municipalities have adopted from financial institutions, similarly to previous years, chiefly aimed at reconstruction and construction of technical infrastructure for pre-investment projects co-financed from EU funds and the regeneration and construction of housing (Reinhart and Rogoff, 2010). Municipalities also used these funds for reconstruction, insulation and expansion of educational facilities, sports arenas and other public facilities (Stiglitz, 2015; Stiglitz, 2016). These loans are characterized by relatively low interest rate and very long maturities. Debt itself cannot be evaluated negatively. Without a loan or credit, many municipalities cannot fund its development (gasification, local roads, sewers, water mains, sewage, preschool and school facilities, etc.). So it depends on what municipalities can borrow, whether the loans are repaid seamlessly and how well the project is ready.

Indebtedness in 2015 was showed in 3,255 municipalities out of a total of 6,249 municipalities (52,1%). Number of municipalities that have shown indebtedness in recent years remains broadly stabilized, although in the last year there has been a slight increase (by 20 municipalities).

According to the applicable laws governing budgetary responsibility meets the 92% of municipalities the rule on budgetary responsibility for municipalities and LGU (ie. debt to average income in last 4 years shall not exceed 60%). According to the monitoring of municipal management for the year 2015 - which among other things monitors the level of debt and liquidity municipalities - operate with a higher degree of risk only 28 municipalities.

LGU (counties) including contributory organizations established by them, reported at the end of 2015 total debt EUR 0,943 billion. From 2014 to 2015 the value of debt fell by EUR 42 million (4,4%). On the line of credit was recorded decrease debt by EUR 20 million. The share of loans in total debt reached up to 92,0%. LGU did not issued any bonds in 2015. **Table no. 4** shows summary data on indebtedness of LGU in the Czech Republic in 2010-2015.

Some LGU continued drawdown of loans granted by the European Investment Bank, which pre-finance and co-finance massive investments in regional infrastructure. These loans are generally disbursed in several tranches with different maturities, typically in excess of 10 years. Other LGUs have taken loans mainly from the biggest Czech banks like Czech Savings Bank, Inc., which

belongs to Erste Group, or Commercial Bank, Inc., which belongs to Societe Generale Group for the purpose of pre-investment of projects for the repair of roads or flood damage.

Table no. 4. Summary indebtedness of LGU in the Czech Republic (million EUR)

Variable/Year	2010	2011	2012	2013	2014	2015
Loans	593	700	793	839	871	868
LGU bonds	9	14	7	26	24	5
Received repayable financial assistance and other debt	80	82	75	91	90	70
Total	682	796	875	956	985	943

Source: Czech Statistical Office; own processing

Conclusion

Municipalities in the Czech Republic are independent, self-governing entities whose powers and responsibilities are granted by laws of the national parliament. Basic municipal rights are to own property, to act on own behalf and to manage responsibilities on behalf of the national government.

Municipal and LGU regional budgets in aggregate by the end of 2015 showed indebtedness of EUR 4,043 billion, which is by 3,0% (EUR 122 million) more than in the previous year. The total volume of loans taken by the territorial budgets was increasing in 2015 as well (non governmental organizations) amounted to EUR 3,228 billion.(increase of 1,9% over the previous year).

In the institutional area of public finance, the Czech Republic has been criticized for a weak budgetary framework for several years although it has always met its obligations in terms of general government sector performance over the last years. Since the termination of the excessive deficit procedure with the Czech Republic in June 2014, the medium-term budgetary objective has been met every year. A set of proposals for regulations on budgetary responsibility (a draft constitutional law on fiscal responsibility, a draft law on rules for fiscal responsibility and a draft law amending certain laws in connection with adoption of fiscal responsibility regulations) was approved by the Czech government already in February 2015, and after then it was under consideration in the Chamber of Deputies of the Parliament of the Czech Republic until October 2016. These proposals are base of planned future reform of public budgetary system in the Czech Republic.

The ongoing reform of public administration and financial management of municipalities and LGU in the Czech Republic contribute to stronger and more efficient fiscal decentralization or to more efficient redistribution within the system of public budgets. Within finance system of municipalities is important area methodology of redistributed yields of shared taxes from the state budget into the municipal and LGU budgets. The current financing of municipalities is focused mainly for calculating the share of 21,4% of the shared taxes and the share of 8,4% for LGU in the current methodology. Shares of the revenues are redistributed to municipalities and LGU on the basis of strictly selected criteria. In order an effective redistribution, it is necessary to have another criteria that reflect the characteristics of individual municipalities and LGU. The adjustment would help secure additional funding to municipalities. One possible criterion is the number of inhabitants over 65 years, which reflects the expenditure on social services and activities in social security per inhabitant. This criterion is implemented to Slovakia in its system of financing municipalities.

The Government aims to ensure such changes in the tax system, which will not hinder economic growth and contribute to a more balanced tax burden and adequate public budgets revenue and at the same time to an efficient and transparent management of state expenditures, which includes, inter alia, providing full information to the public. Partial improvement of the current condition of public budgets in the Czech Republic can be realized also through the improvement of revenue estimation which would include careful usage of revenues forecasts provided by local authority governments, usage of new revenue forecasting

techniques and interconnection of the annual budgetary process with multiannual budget outlook.

Change of rules connected with fiscal flows between different levels of public administration (financing of transferred competency, change of budgetary allocation of taxes, change of requisitions concerning investments' grants). Financing of transferred competency is among unsolved problems in the Czech Republic and there is argue between state and municipalities that correctly complain that state does not pay enough for the municipalities mandatory expenses.

Finally the Czech Republic's fiscal policy is transparent and produces good results. The macroeconomic outlook of the Ministry of Finance is always compared with the outlooks of municipalities and LGU and is discussed with them. But for now, the legislative process of approving draft government legislation in the field of fiscal responsibility still remains unfinished. This legislation should result in further strengthening of the national fiscal framework and in the implementation of the EU Directive on requirements for budgetary frameworks of the Member States.

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Data

1. Act No. 420/2004 Coll., on the Act on the audit of municipalities and LGU.
2. Act No. 93/2009 Coll., on Auditors and the International Auditing Standards.

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The evolution of the internal auditing function in the context of corporate transparency

Abstract

The study presents relevant aspects concerning the evolution of internal auditing, after the economic recession. The reasons that persuaded the authors to tackle the evolution of the internal auditing function are the timeliness actuality and importance given to internal auditing in the post-economic crisis period. Therefore, at the level of published literature, a series of studies concerning the evolution of internal auditing and its role were analysed. Following the conceptual delimitation and the presentation of the study concerning the published literature, the authors undertook a qualitative study, which covered the perspectives of the internal auditing function. The result of this analysis indicates that even though a series of changes have been undertaken concerning the function of internal auditing, in the recent period, the role and the importance of this function inside the entities will change.

Keywords: *Internal audit, IIA, governance, evolution.*

JEL Classification: *M42*

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Introduction

According to Arthur Hald (1994), "no large business can escape internal auditing. If the large organisations haven't adopted it until now, they will do it so sooner or later, and, if events develop as they did until now, they will have to have it sooner".

The events linked to the crisis drew attention mainly to the internal control systems and risk management. While previous attempts to reform the corporate governance system have been focused on the composition of the administrative council or on problems linked to remuneration, the financial crisis put risk aspects in the foreground.

Internal auditing takes place in different legislative and cultural environments: within organisations that differ from the point of view of their scope, size, complexity and structure; by people from inside or outside of the organisation. Although differences that can influence the practice of internal auditing can exist in every environment, it is essential to respect the International Standards for the Professional Practice of Internal Auditing set by IIA (Standards for Internal Auditing) to fulfil the responsibilities of internal auditors and the activity of internal auditing. If the legislation or regulations do not allow internal auditors or the activity of internal auditing to respect certain sections of the Standards, it is necessary to respect all the other sections of the Standard and to declare the existing non-conformity (International Standards for the Professional Practice of Internal Auditing, 2012 Institute of Internal Audit, p.4).

Internal auditing is an activity of strategic importance in what concerns the control and management processes at the level of the economic entities. Using different procedures and working instruments, internal auditing offers an analysis and a complete image of the pursued activities, through the working methods used in the company, the method of organising the entity and the operations undertaken. In this sense, it is considered that internal auditing brings a plus value and offers assurance on the internal control system of the entity, also viewed in the light of the principles of corporate governance.

According to the Institute of Internal Auditors, "internal auditing is an independent, objective assurance and consulting activity designed to add value and improve an organisation's operations. It helps an organisation accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control and, governance processes" (Mermod and Sungun, 2013: 65).

Today, the function of internal audit plays a major role in improving companies' performance. The main reasons behind this role are the increasing rate of transformation of the economy, the swiftness of decision-making and the necessity of entrepreneurs to collect all the possible resources in order to gain a competitive advantage in relation to the competition. Of all the functions of an organisation, the internal audit function is the only one that plays this role in a natural way since it has "a unique responsibility to document, explain and evaluate activities linked to risk, control and governance". The function of internal audit has the capacity to increase the performance of companies by its own nature, as it leads to the daily obtainment of information through data collection.

Simultaneously, internal auditing represents a key element of organisations' corporate governance risk management and the structure of internal control. Creating an effective audit function represents a challenge for the organisations. The competitive advantages that can be obtained, fully reward the efforts (resources) invested and they include: improvement of risk management processes, of control environments, strengthening of relationships with regulatory authorities, a greater effectiveness during governance, a greater effectiveness in managing risks and controlling activities.

For a long period, internal auditing was considered an aid for external auditing through verification of the internal control process within the entity. Today, without omitting this aspect, the internal auditing activity has the role of supporting the external audit as well as to verify and evaluate the internal control, but nevertheless the function of internal audit starts to play a considerably more important role in assisting the management in what concerns the risk to which the entity is subject. In this context, it becomes clearer the fact that the professional profile of the internal auditor will suffer some changes generated not only by the modifications occurred in the role which they fulfil but also due to the challenges they have to face in the business world: risk management, more sophisticated information technologies, data mining etc. (Chersan, 2016).

1. Scientific research methodology

The article proposes to highlight the importance of the connection between the area of accounting and audit. In order to benefit of timely results and conclusions in research activity of the economic domain, we need to analyse facts, economic events, numbers and statistical data. The viable analysis of a domain or of an economic activity shows the necessity for the existence of a methodology and a specific research model. In what concerns the accounting domain, the fact that it represents an important source of information for economic decision-making and, especially, managerial decision making is widely acknowledged. The lack of economic facts provided by accounting can represent a major disadvantage for a manager.

Recently, from the point of view of importance within the entity, internal auditing gains more and more ground, thus representing an attractive and of interest research domain. The scope of this study is to identify and highlight the perspectives of the internal audit function and the ways in which this function will develop.

The conducted research is of qualitative type. The followed objectives are the identification of the evolution of internal auditing functions. The research entailed covering the published literature which harnesses the researches in the domain of internal auditing, analysing the norms and regulations in force, as well as analysing the studies concerning the evolution of internal auditing, carried out worldwide by prestigious international bodies.

In the research, our scientific approach is based on a deductive approach from the general to the particular. Therefore, we began from the actual stage of knowledge by defining the key concepts regarding internal auditing.

We subscribe to the idea according to which the completion of a scientific endeavour is the beginning of further development or of new approaches in the research domain. Thereby we end this research with a series of conclusions.

2. Conceptual approaches regarding internal auditing

The activity of internal auditing emerged and developed due to its utility to the beneficiaries and due to its capacity of satisfying certain needs of its users. The activity of internal auditing is of strategic importance, because managers, as well as the Board of Directors of the entity, know that as long as there is a suitable internal control system, any mistakes and failures will be investigated and alleviated in a timely manner. The Board of Directors perceives internal auditing as an action for improving the activity, as well as an action of searching for and discovering errors and misdemeanours (Țingău,2007).

Thus, the clarification of the internal auditing notion, and more than that, the clarification of the role that internal auditing plays today, is imperative. A number of researchers from the field have analysed the evolution of internal auditing at the international and national level (Möller and Witt, 1999; Anderson, 2003; Ramamoorti, 2003; Ratliff and Reding, 2002; Flemming Ruud, 2003; Moeller, 2005; Boța-Avram and Popa, 2011; Precob and Rusu-Buruiana, 2015; Chersan, 2016).

Starting with the definition retrieved from the explanatory dictionary, the audit term comes from Latin, from the word *audit-auditing*, which has the meaning of "to listen".

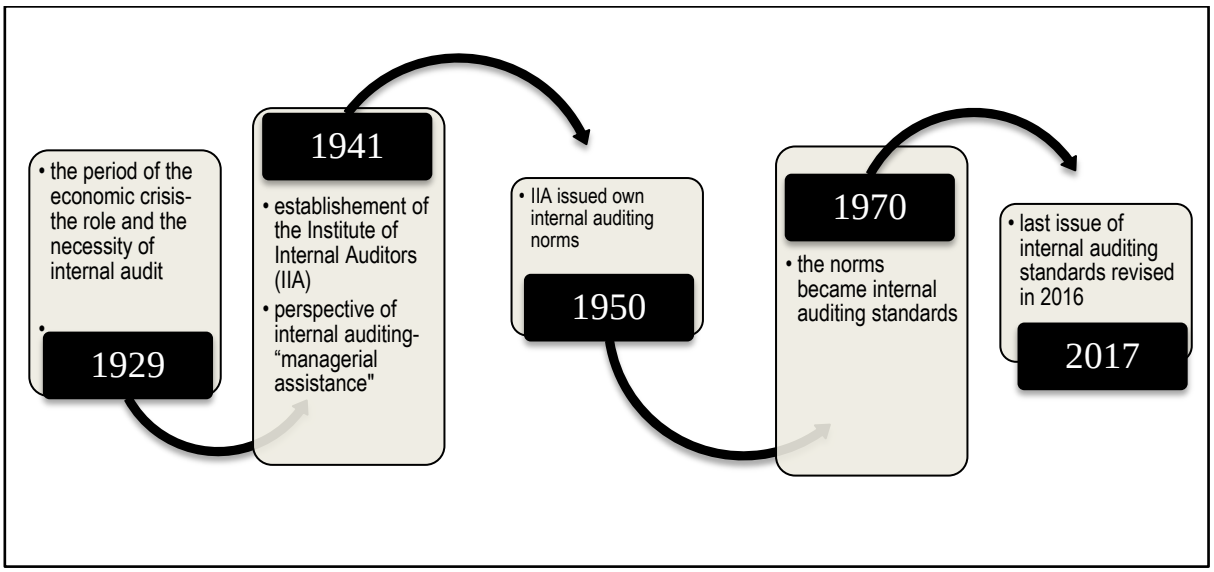
A more intense usage of the term audit is found in the period of the economic crisis from 1929, since then the role and necessity of internal auditing continuously increased, a fact which led to the organisation and standardisation of internal auditing practices through the establishment in 1941 in Orlando, Florida, SUA, of the Institute of Internal Auditors (IIA), to which, at the moment, more than 120 countries are related.

The internal audit had an important role within corporate governance already since 1940 (Möller, 2004) and it became even more important as the years passed. Since 1940, many changes have occurred regarding internal auditing which was regulated through different norms and corporate governance codes. Hermanson and Rittenberg (2003) consider that among the basic activities of internal auditing are listed the evaluation of risk, ensuring control inside the entity and ensuring compliance.

In 1942, J.B. Thurston, the first president of the International Institute of Internal Auditors, declared with an astonishing forecast that the most brilliant perspective of internal auditing will be the "managerial assistance". In 1991, Joseph J. Mossis – president of the Institute of Internal Auditors from Great Britain, resumes the same remark, but in more precise terms: "it

is clear for those that work within the Internal Auditing function that this plays a vital role, helping the management to hold the reins of internal control" (Ghiță et al, 2005).

Figure no. 1. Evolution of internal auditing



Source: Own projection

Starting with 1950, IIA issued own internal auditing norms, different from those of external auditing. With time, these generalised and from 1970 they became internal auditing standards, which are subject to permanent changes due to the entities that are constantly struggling with new challenges.

A first definition of internal auditing was given by Brink Victor, director of IIA Research Foundation in the year 1958. "Internal auditing thus emergence as a special segment of the broad field of accounting, utilizing the basic techniques and method of accounting. The fact that the public accountant and the internal auditor use many of the same techniques often leads to a mistaken assumption that there is little difference in the work or in ultimate objectives. The internal auditor, like any auditor, is concerned with the investigation of the validity of representations, but in his case the representations with which he is concerned cover a much wider range and have to do with many matters where the relationship to the accounts is often somewhat remote. In addition, the internal auditor, being a company man, is quite naturally more deeply interested in helping to make those operations as profitable as possible." (Brink and Cashin, 1958).

Internal auditing is defined in the Professional Norms issued by the Institute of Audit and Internal Control as being "an objective and independent activity that confers to an organisation an insurance regarding the level of control concerning operations, it guides the organisation in order to improve its operations and it contributes to adding a plus value". Furthermore, it has to be mentioned that internal auditing helps the organisation to reach its objectives as it evaluates the management process, the control and governance process, but also the risk to which the organisation is exposed; more than that, internal auditing offers solutions to enhancing the efficiency of these processes, or to cover deficiencies (Chițu and Ioanaş, 2005).

The internal auditing activity, as we have mentioned before, appreciates and guides the corporate governance process, in order to accomplish specific objectives related to ethics, responsibility and efficiency in administration. In this sense, for monitoring and ensuring the conformity with the applicable corporate governance code, we consider that it is imperative to define the concept of corporate governance. Corporate governance, according to OECD, represents all the procedures and processes according to which an

organisation is directed and controlled. The Chartered Institute of Internal Auditors from Great Britain, according to the Cadbury report (Cadbury, 1992), adds certain key aspects of the corporate governance system to this definition: governance accomplishes the distribution of rights and obligations between the Board of Directors, managers, shareholders and stakeholders, in order to ensure the coordination of the activities and the attainment of the company objectives. The Preda report (Preda, 1999) regarding the Code of Conduct of the companies listed at the stock exchange considers that corporate governance is the result of certain norms, traditions and behavioural models developed by each legislative system. IIA published in July 2006 "Organisational Governance: Guidance for Internal Auditors", a guide which strengthens the relationship between internal auditing and its advisory role in specific aspects of corporate governance (Tiron-Tudor, 2007).

Internal auditing has a more important role since the apparition of the Sarbanes Oxley Law (2002). Even though the Sarbanes Oxley Law does not specifically address the role of the internal auditing within corporate governance, there are corporate governance requirements for the auditing committees, external auditors as well as suggestions regarding the importance of internal auditing.

Boța-Avram (2009) captures the evolution of internal auditing: orientation towards increasing the efficiency of risk management, increasing stakeholder's level of satisfaction, development of the abilities that internal auditors must possess, increasing concern in measuring and evaluating the performance of internal auditing, increasing the level of technology in the work of internal auditing (Boța-Avram, 2009: 22). Lately, internal auditors have engaged more and more in operational auditing, risk management, internal controls, governance and IT concepts (Mermod and Sungun, 2013: 65). It is very important to observe which direction the function of internal auditing will take in the future.

3. The role of internal auditing

If the *Standards* are used together with other standards issued by other regulatory bodies, the internal auditing reports can, as well, mention the use of other standards, by case. In such a situation, if there are disparities between the *IIA Standards* and the other standards, the internal auditors and the internal auditing activity have to respect the *IIA Standards* and can apply also the other standards if these are more restrictive.

The scope of the *Standards* is:

1. To outline the basic principles regarding the practice of internal auditing.
2. To supply a general framework for developing a wide range of internal auditing missions capable of generating a plus value.
3. To establish the reference framework for evaluating the results of internal auditing.
4. To boost the improvement of the organisation's processes and operations.

The standards represent mandatory requirements, based on principles, including:

- *Statements* regarding basic requirements for the professional practice of internal auditing and for evaluating its effectiveness that are applied at international, organisational and individual level.
- *Interpretations*, which clarify terms or concepts from the *Statements* (International Standards for the Professional Practice of Internal Auditing, 2012 Institute of Internal Auditors, p. 4)

The scope of internal auditing has to be the achievement of the activity objectives of the entity, through (Țingău, 2007: 62-66):

a) The protection of the entity's assets – to ensure a faithful image of the patrimony;
b) Ensuring the faithfulness and accuracy of accounting information – an obligation for the administrator of the patrimony;
c) The way in which accounting is organised;
d) The organisation and execution of the stocktaking;
e) The way of drawing up the Balance Sheet;
f) The verification of the way in which the accounting activity is carried out.

The *insurance missions* involve the objective evaluation of the evidences by the internal auditor in order to express an independent opinion or conclusions regarding an entity, an operation, a function, a process, a system or other aspects. The type and the coverage sphere of the insurance missions are set by the internal auditor. Generally, three participants are involved in the insurance missions:

(1) the person or group directly involved in the entity, operation, function, process, system or any other aspect being audited – *responsible for the process*,

(2) the person or group that organises the evaluation – the *internal auditor*, and

(3) the person or group that uses the evaluation – the *beneficiary of the mission* (International Standards for the Professional Practice of Internal Auditing, 2012 Institute of Internal Auditors, p.5).

The counselling missions have an advisory character and they take place, generally, at the formal request of the beneficiary of the mission. The type and the coverage sphere of the counselling activities are set in common agreement with the beneficiary of the mission. Generally, two participants are involved in counselling missions: (1) the person or group that supplies the counselling – the *internal auditor* and (2) the person or group, that requests and benefits from counselling – the *beneficiary of the mission*. When carrying out counselling missions, the internal auditor has to be objective and he cannot assume managerial responsibilities (International Standards for the Professional Practice of Internal Auditing, 2012 Institute of Internal Auditors, p.5).

4. Evaluation of the priorities within the function of internal auditing

The frequent changes inside the entities are at the base of the new challenges that the internal auditing function is facing. It is not enough for the internal auditing departments to understand the new developments at the level of the organisations, these also have to examine in a systematic and rigorous the moving targets like possible risks, the existing processes that are continuously evolving and the new processes that appear as a result of the external changes. Additionally, the regulatory system and the compliance requirements lead to the increase of the scope and insurance responsibilities in internal auditing (Protiviti, 2013).

Therefore, today's internal auditors focus on some basic questions such as:

- How can a new entrant, medium sized company make sure that the local teams do not yield to the corruption practices?
- How can a multinational company be sure that the data provided by their clients is well protected, even when it is in the hands of the employees that travel all around the world?
- How can the audit committee of an enterprise in full development know, that their data centre is protected from persons that illegally try to take over the control of the security system?

Such questions can easily occur to the executive directors of audit and their team. The evolutionary nature of the technology regarding the social networks inside companies outlines the ultrafast changes (accompanied by uncertainties) on which today's internal auditors have to concentrate (Protiviti, 2013).

Protiviti conducted a study in 2013, which had as a major subject the way in which internal auditing handles uncertainty, the manner in which it reacts to the frequent and fast changes of the processes of the economic entities, and the improvement of the collaboration with the other departments of the entity. Over 1.000 respondents have participated at the study, being included also the executive directors of audit, directors of internal auditing, managers and their teams. These professionals have evaluated in excess of 150 areas of competence and knowledge of internal auditing, in three standard categories of the study: general technical knowledge, knowledge regarding the auditing process and competences and abilities linked to the personnel. The participants practically represent all the industrial sectors. The key results of this study target (Protiviti, 2013):

- The social networks remain a priority. Understanding the way in which the social networks function and develop is critical for the internal auditors in the future. These reflect the usage frequency of the social networks inside the company, as well as the inherent risks that accompany these networks. It is important to be mentioned that, the same risks and problems appear within other developing technologies that the economic entities are starting to use;
- The changes from within the regulatory and drafting bodies attract attention. The future modifications as "Updated internal control COSO – Integrated framework" and the recent audit standard decrees of the Institute of Internal Auditors (IIA) – Standards 1110, 2010.A1, 2010.A2, and 2450 – provoke the

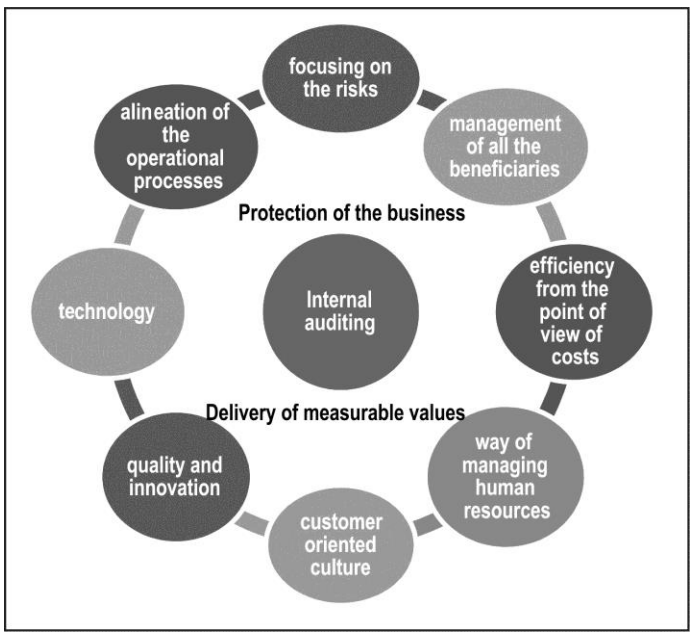
internal auditors to keep up with the new requirements and the changes resulted in the audit practices and processes.;

- The nature of fraud is changing – like the way in which the internal auditors relate to it. Since organisations rely more and more on the so-called "big data" (generated both internally and externally) in the decision making process, new forms of fraud target these specifics. The internal auditors are aware of the existence of these new risks of fraud and try to apply new top techniques (for example, the continuous analysis and monitoring of the data) as a part of preventing, screening and attenuation of frauds.
- There is a constant interest for technology-based audit. As in previous studies, the executive directors of audit and other professionals of internal auditing consider that data analysis instruments, computer assisted audit instruments, continuous auditing and monitoring approaches are essential for improvement of the missions.
- Internal auditors target a more strategic way of thinking and a more efficient collaboration. The need for enhancing strategic thinking reflects the increase in the regularity with which internal auditing is requested in understanding and analysing the risks before making the decisions. Persuasion, negotiation and administration of confrontations must be improved and it demonstrates a better understanding, by the internal auditors, of the need to work closer with their colleagues from the organisation in order to diminish the risks within the more complex processes of the work environment.

5. Perspectives of internal auditing

Internal auditing is becoming one of the bodies that can easily influence the added value of the entity. The basic function of internal auditing is to offer the necessary information to the Board of Directors. As we could previously observe, the Institute of Internal Auditors defines the main function of internal auditing as being the one of responsible executive managing and suitable insurance regarding risk and control management. A secondary function of internal auditing is the consolidation and improvement of risk management and of suitable controlling, through the promulgation of accounting principles, as well as those of corporate governance.

Figure no. 2. Key attributes of the function of auditing



Source: Own projection

The majority of the internal auditors admit the fact that they cannot hold their current status if they continue to stay in their comfort zone and supply the auditing committee information and points of view based on the traditional approach of internal auditing. The challenge of internal auditing consists in obtaining a unanimous consent regarding the necessity of enlarging the current role of internal auditing, simultaneous with the maintenance of an adequate level of performance. In order to enlarge the current role and to improve the work methods, the **"auditors of the future"** owe to develop their capabilities and actual processes.

In the study "State of the internal auditor profession – 2010" conducted by PWC (2010) in the journal "Maximization of the internal auditing function", a concept which supports the need for eight key attributes of an efficient internal auditing function, is presented.

According to a study conducted by KPMG (2016) regarding the top 10 risks to which auditors should pay attention is:

1. increased requirements in the regulatory plan;
2. culture and leadership method;
3. reporting (according to the regulations);
4. stress tests;
5. cyber security;
6. relationship management with the service suppliers (as a result of outsourcing of certain activities and of the IT system maintenance);
7. continuous evaluation of risks
8. usage of data analysis/continuous auditing;
9. recruitment and retention of the auditors with experience;

Therefore, we can observe from the papers by Protiviti, 2014 and 2016, that there is an increasing interest in IT technology. Thus, the internal auditor has to be an expert in not only the auditing activity, but also in the IT field. The auditor, through the work he executes, can appeal to the following IT elements (Stanciu, 2016):

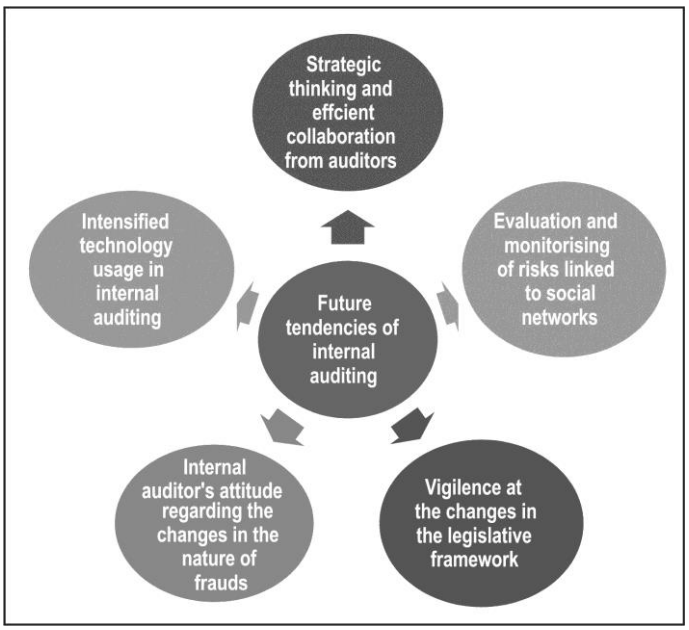
- electronic worksheets;
- instruments for the management of the collected information;
- data analysis instruments;
- data mining instruments;
- continuous auditing instruments;
- mission planning instruments;
- instruments for tracking the implementation of the recommendations;
- Software applications for risk evaluation etc.

Regarding the future orientations in the area of internal auditing, the following can be observed (Protiviti, 2013):

- social networks remain a priority (the organisational social networks continuously grow and develop, the evaluation and monitoring of the risks of social networks are or soon will be key elements within the auditing plans, the precise nature of the risk of organisational social networks are changing in a rapid rhythm); the changes within the regulatory and elaboration bodies of the norms draw attention (the function of the internal auditing recognises recently decreed auditing standards as being top priorities); the nature of the frauds is changing, as well as the way in which internal auditors perceive them (notable priorities include the prevention and detection of frauds, and the method of approaching risks linked to "cloud computing");
- There is a constant interest for technology based auditing (the usage of data analysis technologies represents a key priority, data analysis instruments and computer assisted auditing instruments continue to represent key area which need improvement); internal auditors target a more strategic thinking and a more efficient collaboration (internal auditing is looking to become a collaboration, proactive and strategic function for the organisations).

The collaboration within the companies results in the increase of work productivity, a more efficient use of the resources, innovation and a decrease of the risk profile. Thus, pressure builds on internal auditing in order to increase collaboration and coordination with the other departments. Unfortunately, this enhancement of collaboration cannot be achieved immediately. It is important to remember that it is not enough for the effort to come from only one direction (from the internal auditing function), it is necessary that the other departments are proactive and strategic involved as well. A few of the benefits of intensifying collaboration observed by the directors of the internal auditing departments are a more rigorous evaluation of risks, a piercing visibility over key risks, trust among employees, orientation and efficiency.

Figure no. 3. Perspectives of the internal auditing function



Source: Protiviti (2013), Internal Audit Capabilities and Needs Survey Report – Assessing the Top Priorities for Internal Audit Functions

The independence of internal auditing represents a delicate subject in the internal auditing department's directors' vision, due to the close relationship that exists between independence and collaboration. Even though the internal auditing function is traditionally an independent function, some of the interview respondents consider that the independence can be overstated to the extent that it makes them feel as strangers inside the companies they work for. Regarding the collaboration with the other departments, they say that they have to make compromises linked to independence for the benefit of the whole organisation. The internal auditors are employees of the companies and they have to act in the interest of the company so they cannot be independent. The others state that the independence of the internal auditing function is not compromised by the regular collaboration with the other departments, the real challenge being exactly in the collaboration.

The road, which the internal auditing function is taking, is pretty clear. Surprises can appear, obstacles that would affect the visibility, however the saving key element consists in the cooperation and coordination of internal auditing with the rest of the members and processes from the company. In conclusion, the development, the efficiency and the effectiveness of internal auditing will influence the future performances obtained by the organisations.

Conclusion

The global economic environment is continuously changing. The organisations are interested in increasing their performance, a desire that is not possible if their internal auditing department is not keeping up the pace with the fast rhythm of development of the economic entities. What does it mean to keep up the pace? It means to identify the potential risks, the evolution of the processes and the results of the changes from the external environment. There is a direct relation between the company's performance and the internal auditing function, the performance being the effect and the internal auditing function being one of the causes.

In the last decades, important changes took place in what concerns the attention given to the evaluation of the benefits, effectiveness and performance of internal auditing. Therefore, internal auditing registers a continuous evolution, determined by the dynamic environment in which it operates.

The expectations of the management and of the investors have become higher, therefore practical requirements from the auditors are further important, the managers expecting auditors to provide more than only credible assurance and efficient auditing missions, because they want to be able to turn to the internal auditing for strategic initiatives. The quality of good practices is determined by the level in which the internal auditors correctly anticipate the evolution of the risks and requirements of the auditing committee and of the management, concentrating their attention on the areas that are the most exposed to risk, and offering recommendations for improving the processes and attaining the strategic objectives.

The priority of the internal auditors remains the risk evaluation and the internal control. Additionally, the internal auditor has to collaborate with the auditing committees and the external audit for identifying the risks. Moreover, in the last period, more emphasis is put on advanced IT knowledge, which involves a rigorous approach regarding IT risks, through integrating them with the business risks.

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The Excel Data Mining Add-in. Applications in Audit and Financial Reports

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Abstract

Performance reasons in decision making based on business data usually requires a good management of multiple data formats and also processing speed, flexibility, portability, automation, power of suggestion and ease of use. The paper comes with theoretical ideas and practical examples in favor of using the Excel Data Mining Add-in's for the aforementioned reasons. Most of the examples include figures linked to video scenarios constructed by the authors and part of an interactive on-line list with eighteen pieces. Together they contribute to understanding most of the requirements to fulfill in order to have valid examples and useful results.

Keywords: *business and financial data, spreadsheets, Data Mining (DM), examples*

JEL Classification*: C61, D81, D83, M42*

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Introduction

This paper starts from some techniques used by most Data Mining tools when dealing with large data from databases and presents the advantages of using spreadsheets as client applications (msdn.microsoft.com/...dn282385.aspx). The last ones are so familiar to the end users and have an interface that integrates programming or scripting languages for office applications such as VBA meaning Visual Basic for Applications for Microsoft Excel (msdn.microsoft.com/.../ee814737.aspx), and Google Apps Script for Google Sheets (developers.google.com/.../sheets), many functions and advanced facilities for processing, analysis, representation and simulation all based on the interactivity and dynamics principles with great impact on users' ability to perceive, interpret, understand and manage complex information in different cases.

The concept of Data Mining essentially means the supervised identification of undiscovered patterns and hidden relationships in huge data sets (searchsqlserver.techtarget.com). Inmon which is a well-known guru in data warehousing (computerweekly.com) gave one of the most concise definitions of a Data Mining (Inmon and Linstedt, 2014) namely analysis of large quantities of data to find patterns such as groups of records, unusual records and dependencies. The Data Mining initiatives usually come from marketing and retail sales departments and are suited for organizations having very large databases (Airinei, 2002).

This concept is closely related to that of data oriented Decision Support Systems (DSS) and Business Intelligence (BI) – especially the one for strategic purposes (dssresources.com/…id=174) that requires huge amounts of data (bi-insider.com). Although the BI term is known as a set of concepts and methods for improving decision-making emerging in the 90's (Howard Dresner from the Gartner Group - dssresources.com/…/dsshistory.html), the evidences from the specialty literature indicate approaches from 15 years earlier (Cleland and King, 1975; Pearce, 1976) containing clear references to BI, business planners and managers and decision making.

As concluded by Dan Power (dssresources.com/…id=199), Data Mining tools include: case-based reasoning, data visualization (mostly graphs, trees, and clusters), fuzzy queries and analyzes, genetic algorithms, and neural networks.

Starting a few years ago we are witnessing implementations of this concept and related models not only in applications dedicated to database and data warehouse management systems, but in modules of spreadsheet applications that are working with these above as suggested even from this paper's title. This seems obvious when thinking that such dedicated products allowed the construction of DM structures and models starting simply from one table (usually as aggregation of many others from a database).

The applicability of the theoretical and practical elements of this article in auditing, especially the one of performance (Fraser, 1998) and financial reports is justified starting from a specific need to valorize the existing data structures (often data records in tables and tables in databases) and get rapidly and at minimum cost reports able to present clear information on causality related to effectiveness (actual / estimated results compared to those proposed) and efficiency (consumed resources compared to achieved / estimated results).

The concrete examples in this article support certain conclusions drawn from the literature review, namely: the utility of approaching the audit engagements by using data mining techniques (Vintilescu Belciug et al., 2010) as a complement to traditional methods of risk analysis and intervention on site, the consecration of existence of possible areas of integration between data mining and audit processes grouped by stages (Sirikulvadhana, 2002) such as: planning, execution, documentation and completion) or by specific examples (Wang and Yang, 2009) as neural networks for: risk assessment, finding errors and fraud, determining the going concern of a company, evaluating financial distress, and making bankruptcy predictions and decision trees for: analysis of bankruptcy, bank failure, and credit risk), the advance of the latest software tools that implement data mining algorithms and the fact that many users considered them until recently being not very friendly (Chersan et al., 2013) and requiring technical skills advanced enough.

The paper also aims to eliminate some confusions on using time stamp values (e.g. calendar dates, parts of it or replacement values) when operating on time series containing business data (e.g. sales amount recognized as a factor of direct influence for the level of certain financial indicators such as the operating income).

1. The research methodology

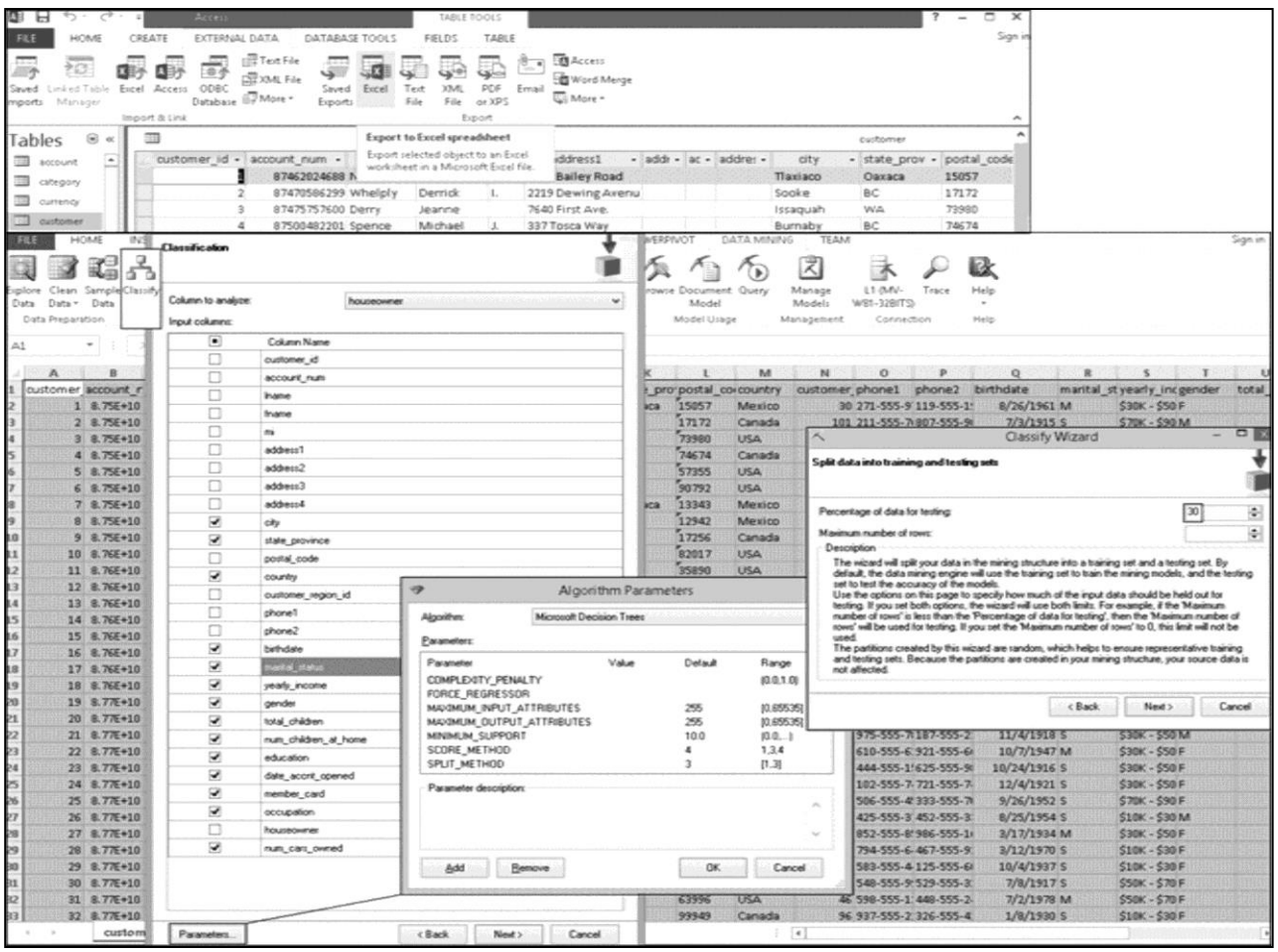
The source data for the examples presented in this paper come from two Microsoft samples databases. The first set of examples was created starting from an Access database file called foodmart (sites.google.com/.../supp4excel2datamining) originally available on the

installation CD of a previous version of Microsoft (MS) SQL Server. The second one is from a MS SQL Server sample database called „AdventureWorksDW2012_Data.mdf" already installed and prepared for use inside a Windows 8.1 32 bits virtual machine (y2u.be/Xs2SWtBqdzI) that we have used for this article. This machine benefited from the Microsoft Imagine / formerly Dream Spark educational software license for all applications installed inside and it was optimized for Oracle Virtual Box. In fact SQL Server 2012 (or 2008) is a prerequisite for the installation of the Excel Data Mining add-in which is detailed in the second video tutorial (playlist mentioned below). Although they serve for building the examples and related video support materials (tutorials – the playlist created by the authors and available at goo.gl/JDDtFp), such data only have a guide purpose in this research with high applicative nature, the similarities to reality being merely coincidental.

2. From intuitive patterns to deep analysis starting from simple sources of data as tables

The first example we have chosen was meant to classify by generating a decision tree where the estimated variable was a categorical one with two possible values (house_owner: Yes or No – Y or N) depending on some other fields (see **Figure no. 1**) containing information about customers (an export to Excel from the *customer* table in the *foodmart* database).

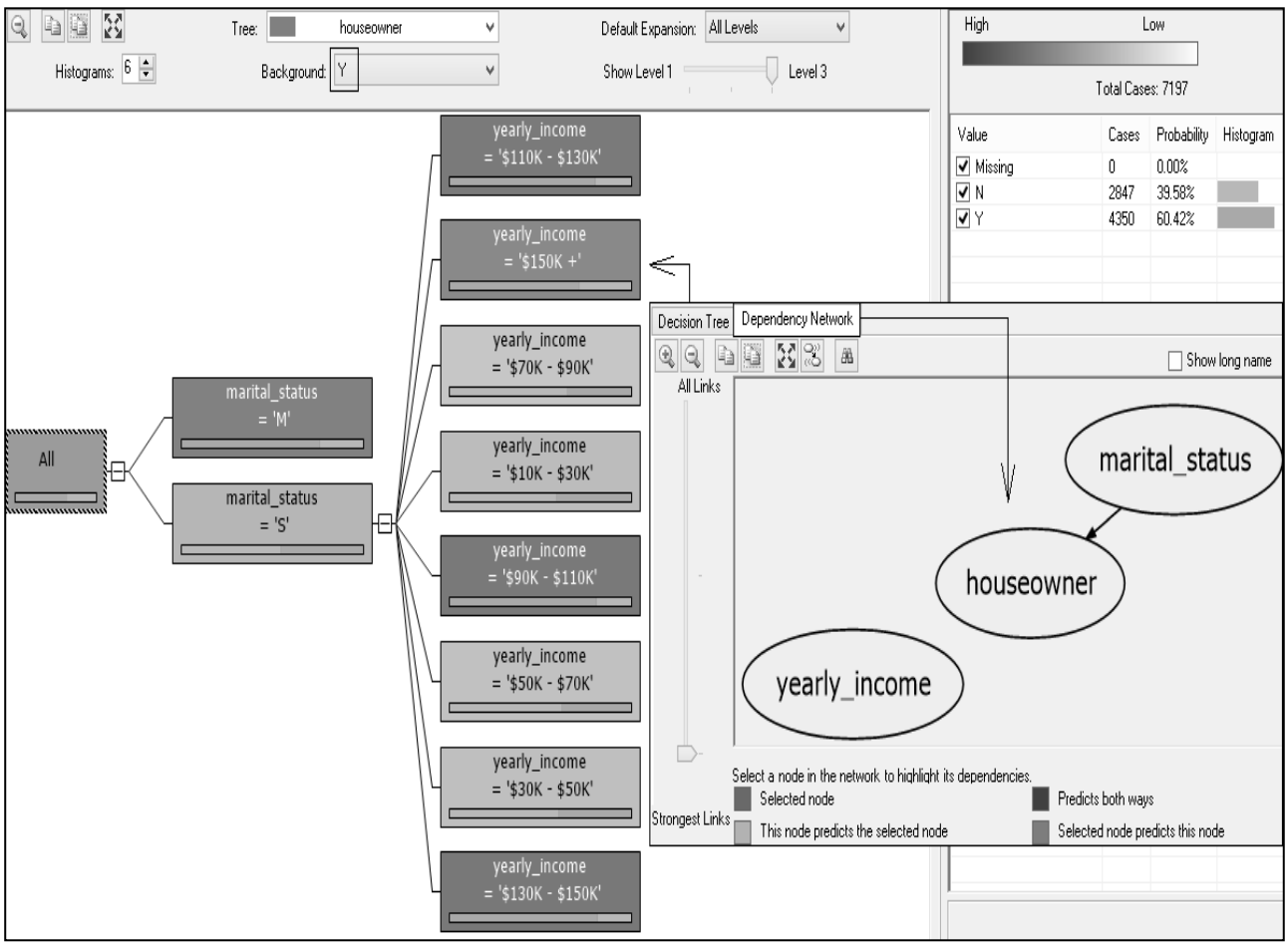
Figure no. 1. Example of export followed by the use of classification option of the Excel Data Mining add-in and the configuration of the input fields



Source: The video tutorial created by the authors: y2u.be/Nx9xqCX1DjY

The results (**Figure no. 2**) of this classification above by using default settings (Microsoft Decision Trees algorithm and 30 percent of data for testing) consist in: (1) a decision tree and (2) a dependency network that indicate the most important variables that influence the houseowner value, namely marital_status (married or single – M or S) and yearly_income (eight thresholds: '$10K - $30K', '$30K - $50K', '$50K - $70K', '$70K - $90K', '$90K - $110K', '$110K - $130K', '$1300K - $150K', '$150K +'), in this order of importance.

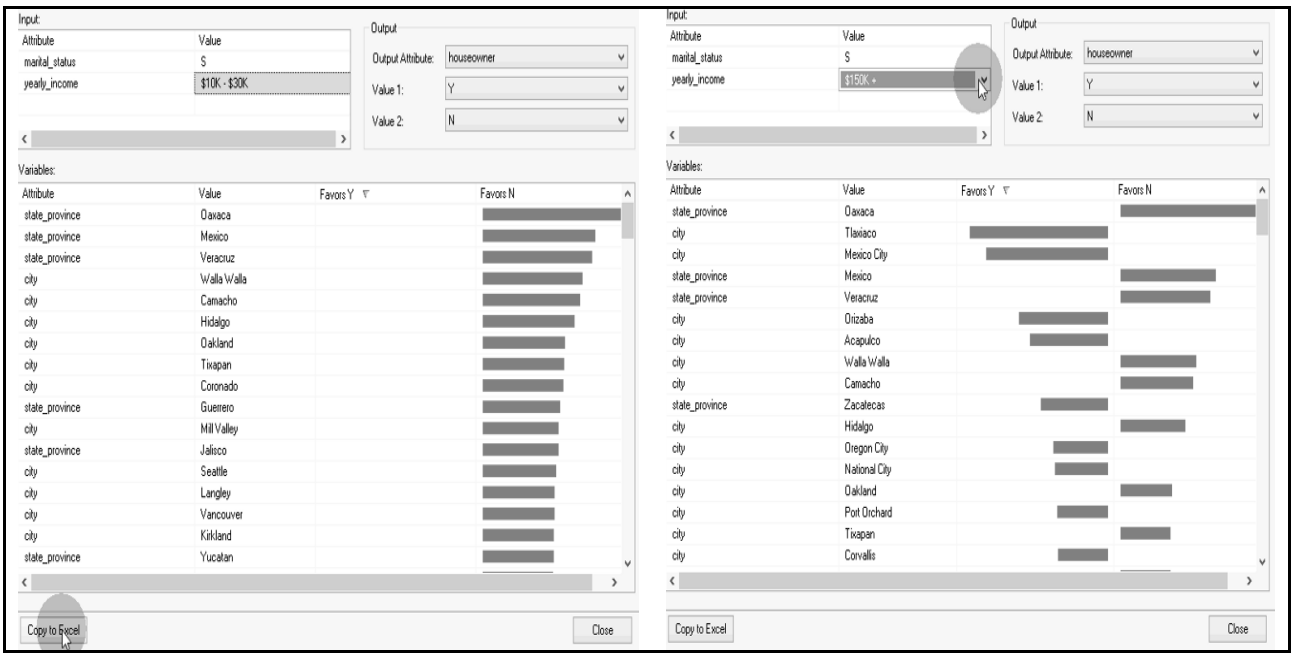
Figure no. 2. Example of result of classification starting from data in a table with customers and made by using the Microsoft Decision Trees algorithm



Source: The video tutorial created by the authors: y2u.be/Nx9xqCX1DjY

As seen above (left side of Figure no. 2) the branches that indicate a higher probability for Yes (Y – houseowner) are darker, the rest of them being colored with a lighter shade. We can also observe that the houseowner as a variable depends essentially on the marital_status (right side of Figure no. 2 – the slide bar on Strongest Links) and then on the yearly_income (the slide bar on All Links). And that can also be deduced directly from the decision tree in which the node closest to the root expresses a test (inf.ucv.ro) corresponding to the marital_status attribute. When clicking on marital_status='M' (terminal node) we have got a probability more than 74% in all ten tests we have done in the same configuration (input columns, column to analyze, algorithm, percentage of data for testing).

Figure no. 3. Examples of discriminative analysis after applying the logistic regression (profs.info.uaic.ro) for the same conditions above and specifying those two already identified major impact input variables and some of their values



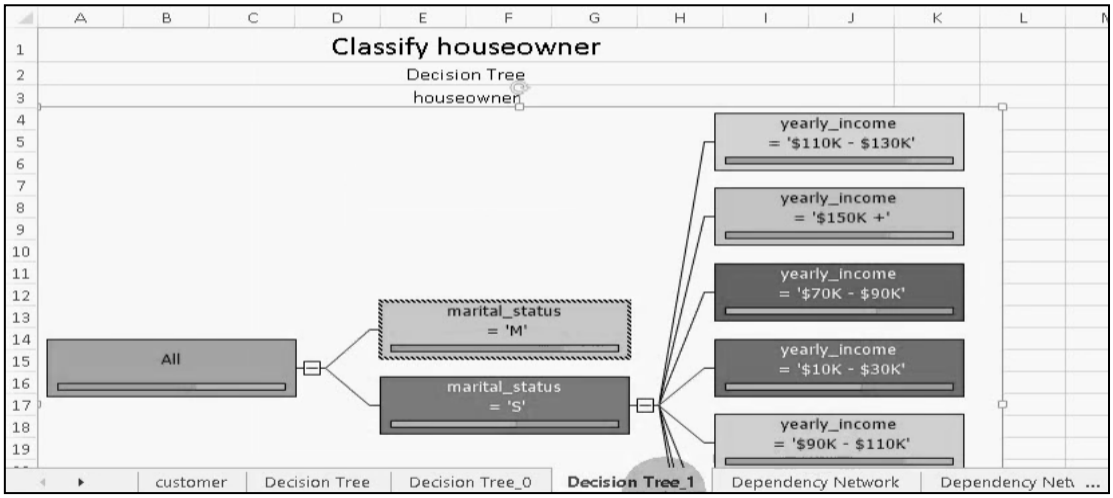
Source: The video tutorial created by the authors: y2u.be/-6jzQuyTjlo

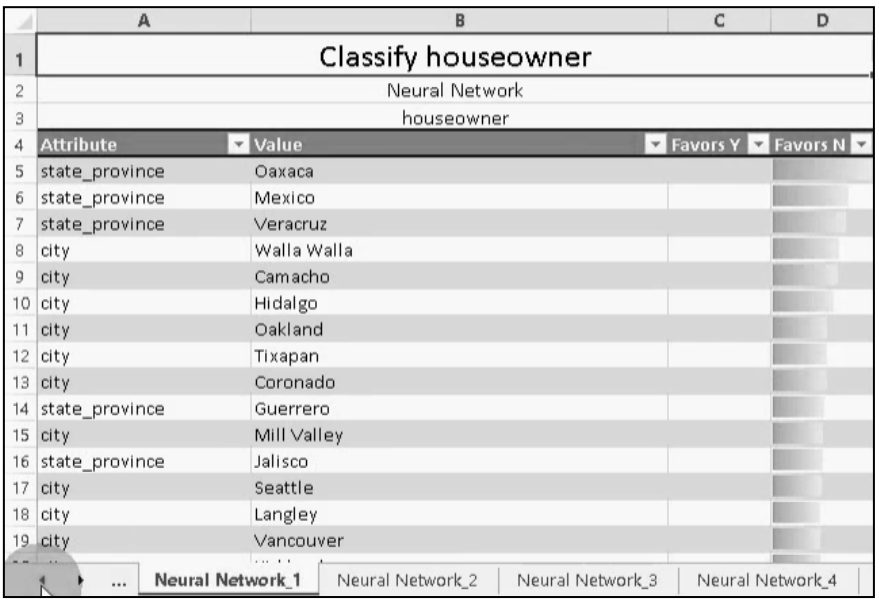
In the previous images (**Figure no. 3**) we tried to show how we have predicted probabilities that the customers fall into those two categories of the binary response (onlinecourses.science.psu.edu): house owner or not, depending on some explanatory variables and their values. We have done the discriminative analysis partially captured above (**Figure no. 3**) starting from another algorithm, namely Logistic Regression implemented by Microsoft using a variation of the Neural Network algorithm (msdn.microsoft.com/.../ms174828.aspx) which is easier to train.

The "Copy to Excel" functionality helped us to send the results back to Excel as new sheets containing screen shots (left side of **Figure no. 4** for decision trees) or most importantly data sets with visual effects usually involving conditional formatting done automatically (e.g. discriminative analysis based on logistic regression - right side of **Figure no. 4**).

Based on the results described above (**Figures no. 1-4**) on can develop similar examples to address also the problem of customer classification (corresponding to the acceptance / maintaining phase of the audit approach) into one of two categories: acceptable / unacceptable, starting from a validated log of such decisions, in tabular format and including many other descriptive attributes (geography, industry, average number of employees, turnover, evolutions of certain indicators, amount of fee, etc.).

Figure no. 4. Example of results of the "Copy to Excel" functionality





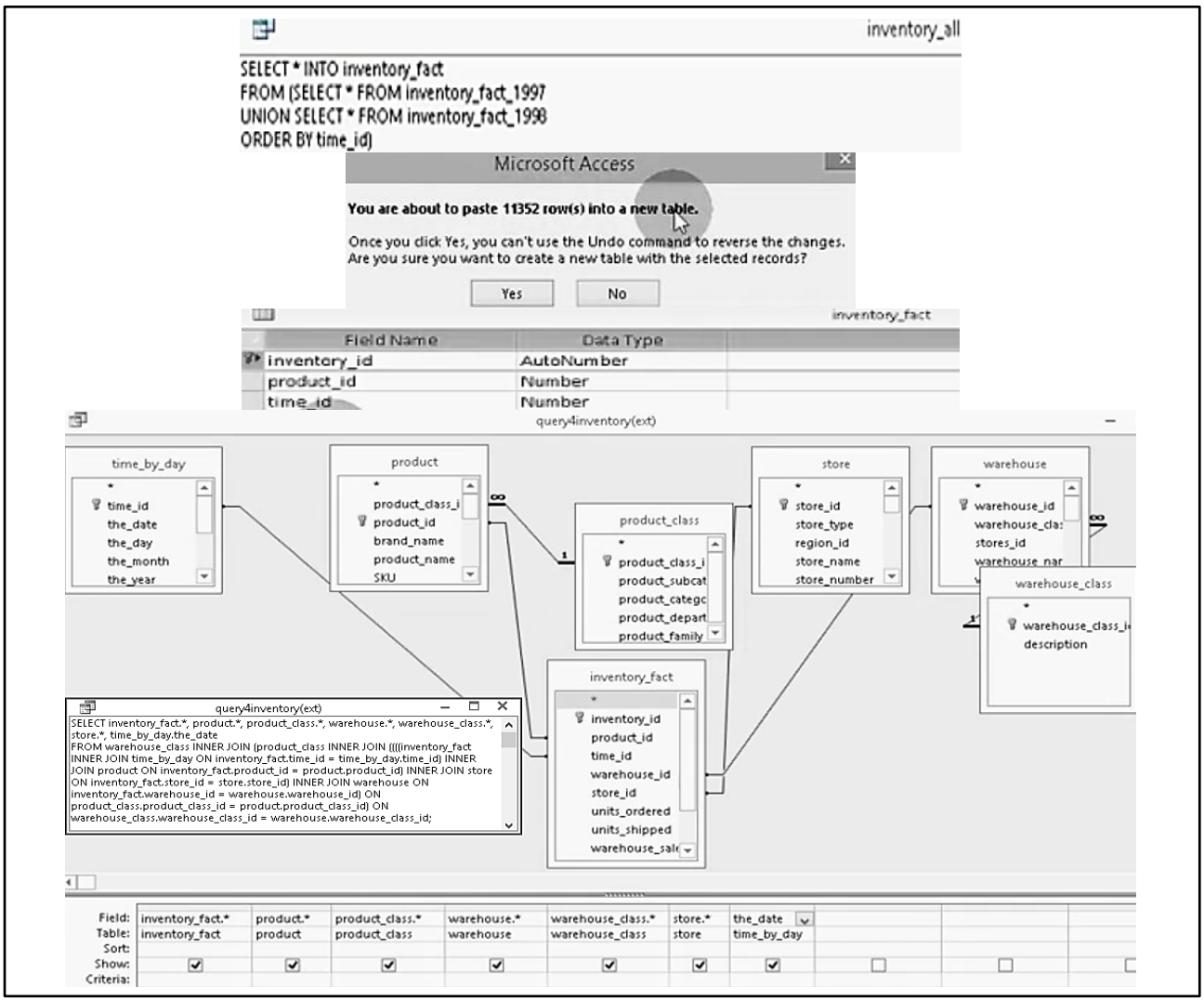
Source: The video tutorials created by the authors: y2u.be/Nx9xqCX1DjY and y2u.be/-6jzQuyTjlo

3. Cumulating historical data and using descriptive fields from many tables of a database

The dynamic and interactive reports responding to many information needs that we are so familiar with as well as the older static ones as snapshots of information at precise moments and generating more questions than answers (Rasmussen et al., 2002) may use both current and historical data. The 1st category is represented by data from Transaction Processing Systems (TPS) and commonly referring to the current year while the second essentially means data involving a larger period as time reference. The proportion of using those two categories essentially depends on decisional needs (at operational, tactical or strategic level). For minimizing the redundancy and dependency of data or because of storage space and write speed needs (deshpande.mit.edu) the schema of a traditional

relational data source is usually thought as many tables obtained by applying the principles of normalization (w3schools.in). Moreover, because of further performance reasons (read, respectively write speed needs) historical data must be separated from current data. Both categories essentially include records from transaction tables (e.g. expenses, sales, exams, etc.) the difference being made by the value of the time stamp. That explains why those tables loaded only with historical data are being renamed with a time indication, archived and separated from the rest of the transactional system in order to improve its operational (current) performance. When needing large amounts of historical data for analyzes based on ad-hoc queries the systems must do vice versa by aggregating into a single table (source for a fact table in a data warehouse) all the records from the historical archives of the transaction tables (of the same type as the resulting one). In most cases, that generates the advantage of an increased potential to identify patterns. But it also comes with difficulties related to putting data together in a common and consistent format especially when the applications and the structure of the data source have also changed in time.

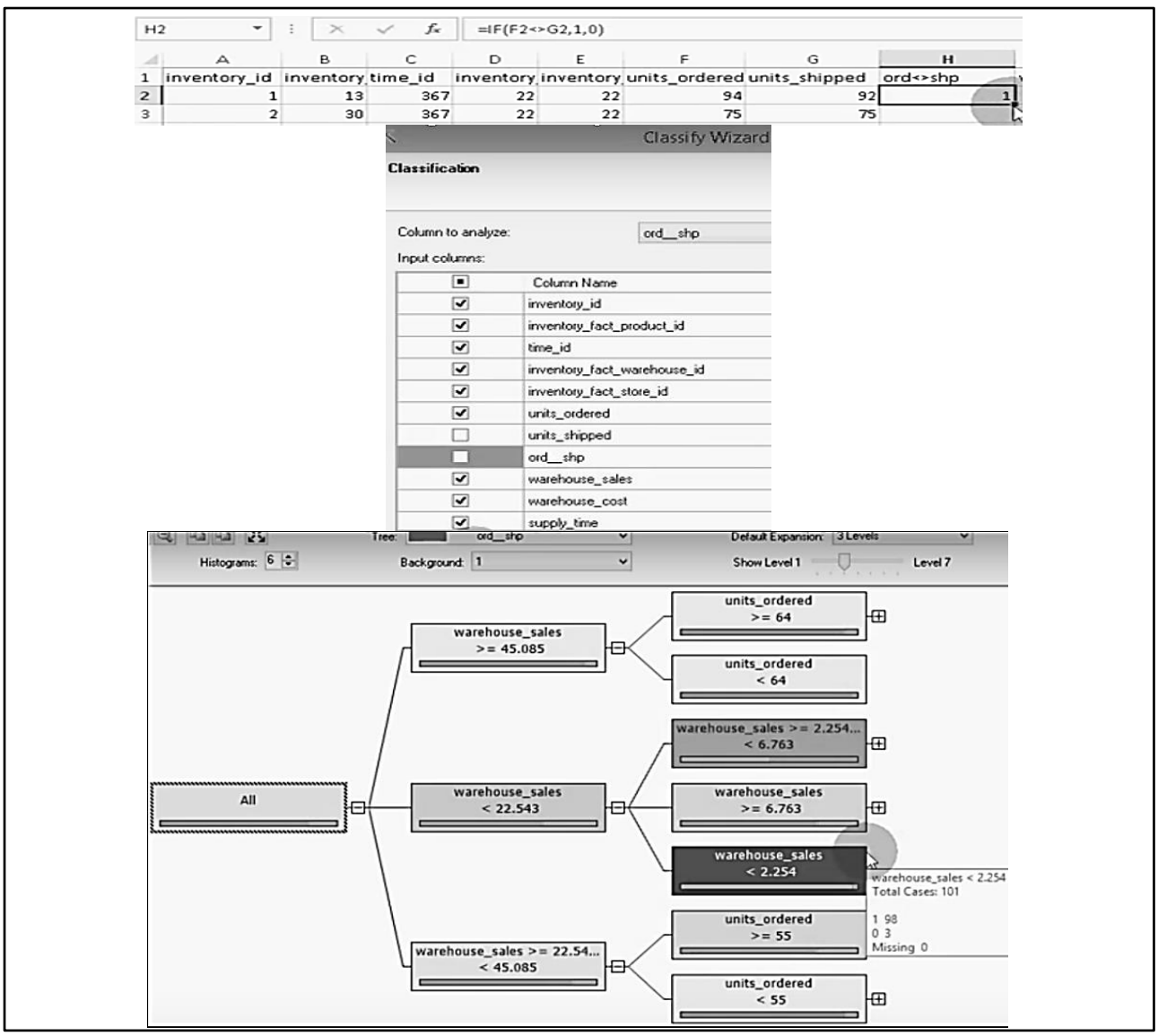
Figure no. 5. Gathering both transactional and descriptive data by using two MS Access SQL queries in cascade

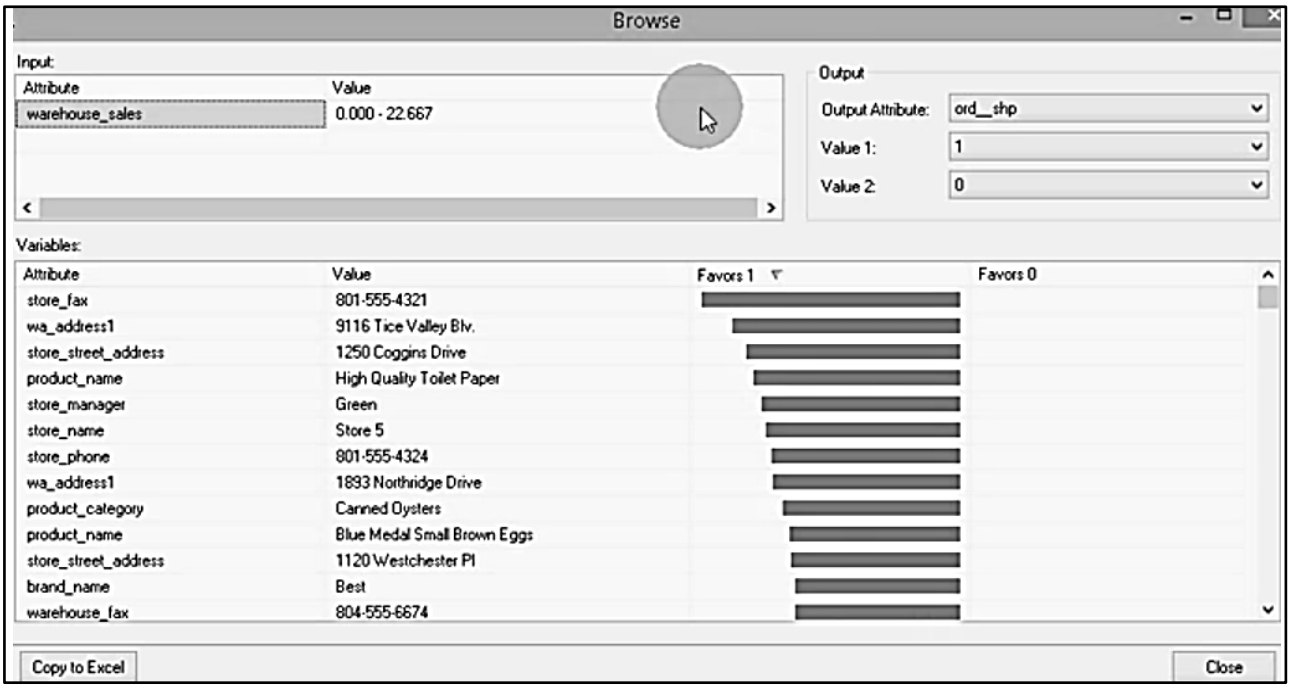


Source: The video tutorial created by the authors: y2u.be/kTuYLuav3Eo

The **Figure no. 5** is presenting an example of inventory data gathering (applications including freight audit) in two major steps corresponding to two SQL queries in Microsoft Access: 1st - based on cumulating (UNION clause) the records from two transaction tables of the same type and corresponding to just two years (1997 and 1998) and adding an necessary id column (inventory_id with values generated automatically – AutoNumber type) in the resulting persistent table (INTO clause); 2nd - based on temporarily retrieving values of descriptive fields from all the tables related or suitable for a relation (**Figure no. 5** – INNER JOIN clause) with the one resulting from the 1st query above, namely *inventory_fact*. In this case the resulting tabular data consisting in the second set of just 11352 records won't get into a persistent table of the database (a kind of de-normalization - searchoracle.techtarget.com) otherwise needed to save time at the expense of storage space and it will serve for external export (Excel) just after executing / running the query itself.

Figure no. 6. Results of consecutively using 2 Data Mining models - derived target field with only 2 values





Source: The video tutorials created by the authors: y2u.be/4nOMMRoC2BU and y2u.be/wce_aoTTsbw

Moreover, for speed of design reasons we have chosen all source fields without selecting them explicitly but indicating that by using the most flexible wildcard character, asterisk / "*", after the table name (**Figure no. 5**), both SQL and design mode (techrepublic.com). For the same reasons above the new derived column needed for analysis (**Figure no. 6** - output attribute for both models: classification-top and logistic regression-bottom) was then defined directly in Excel by using the IF function (top of **Figure no. 6**, ord<>shp as 1 or 0 meaning that units ordered and units shipped are different compared to each other or equal).

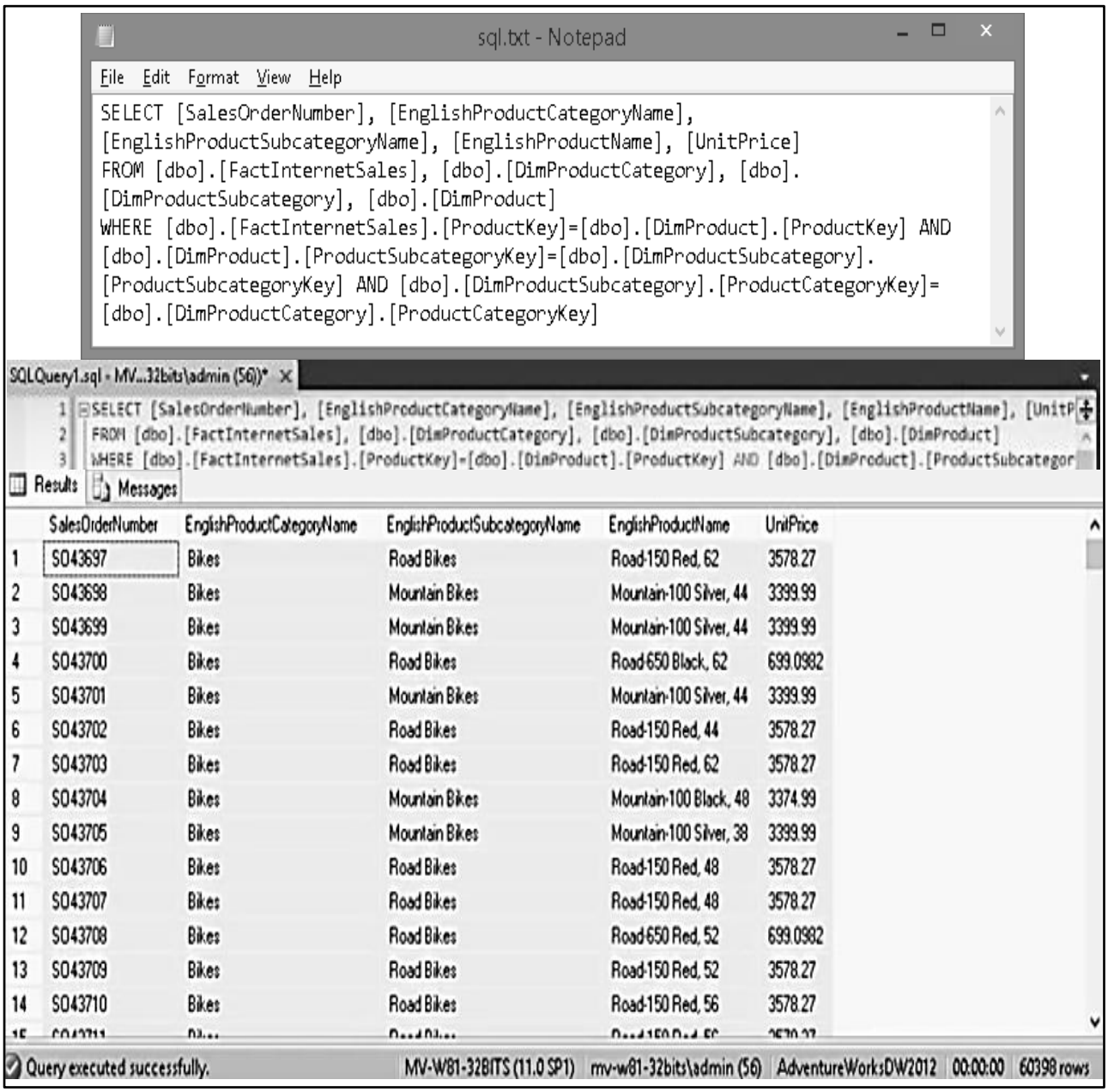
4. Association rules for identifying behavioral patterns

In the theory and practice of data warehouses and multidimensional modeling the examples below reminds of the "snowflake" schema meaning that the source for a dimension (perspective of analysis based on descriptive columns organized in hierarchies) is not represented by just a single table but many related ones (in one-to-many relations: e.g. product category, product subcategory, and product – **Figure no. 7**) able to support the analysis with more than just one descriptive field per dimension. In order to be able to apply the association rules algorithm in this case below we have also needed repetitive values for the *SalesOrderNumber* field to be associated to different product categories / subcategories / names.

The main reason for gathering those descriptive data residing in multiple tables from the database in the example above (**Figure no. 7**) is to determine association rules type "If I buy the product X, I will buy the product Y too." in the purchasing behavior (FactInternetSales source table) and the most important dependencies (**Figure no. 8**).

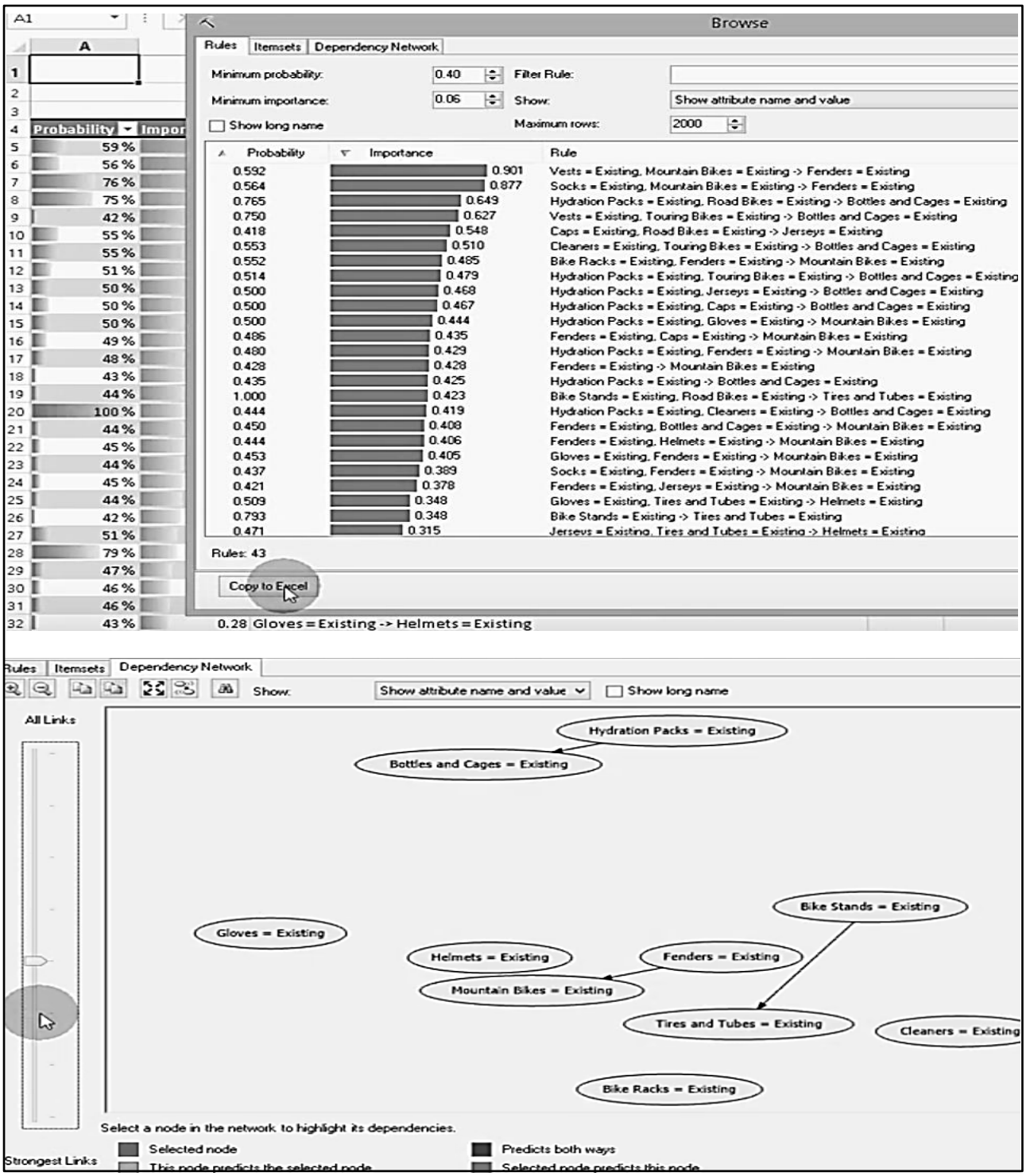
From the results **in Figures no. 7** and **8** we can understand why the applications of the algorithms able to identify association rules can contribute to audit and fraud detection and prevention. As example, if the set of inputs would have attributes such as: Claim identificator, Insurance type, Name of the insurance product, Name of the insured person, Insurer, Name of the examiner agent and Solution (total or partial loss and reject) and the algorithm would identify "IF Casco insurance, Insured person X and Examiner agent Y THEN total loss" as association with high probability and importance, it would not necessarily mean a fraud alarm but it would worth at least the effort to investigate further.

Figure no. 7. Gathering both types of data: transactional about sales and descriptive about products by using a single MS SQL Server query



Source: The video tutorial created by the authors: y2u.be/2rW2wK77HD8

Figure no. 8. Results of applying the Microsoft Association Rules algorithms (the associate option of the add-in)

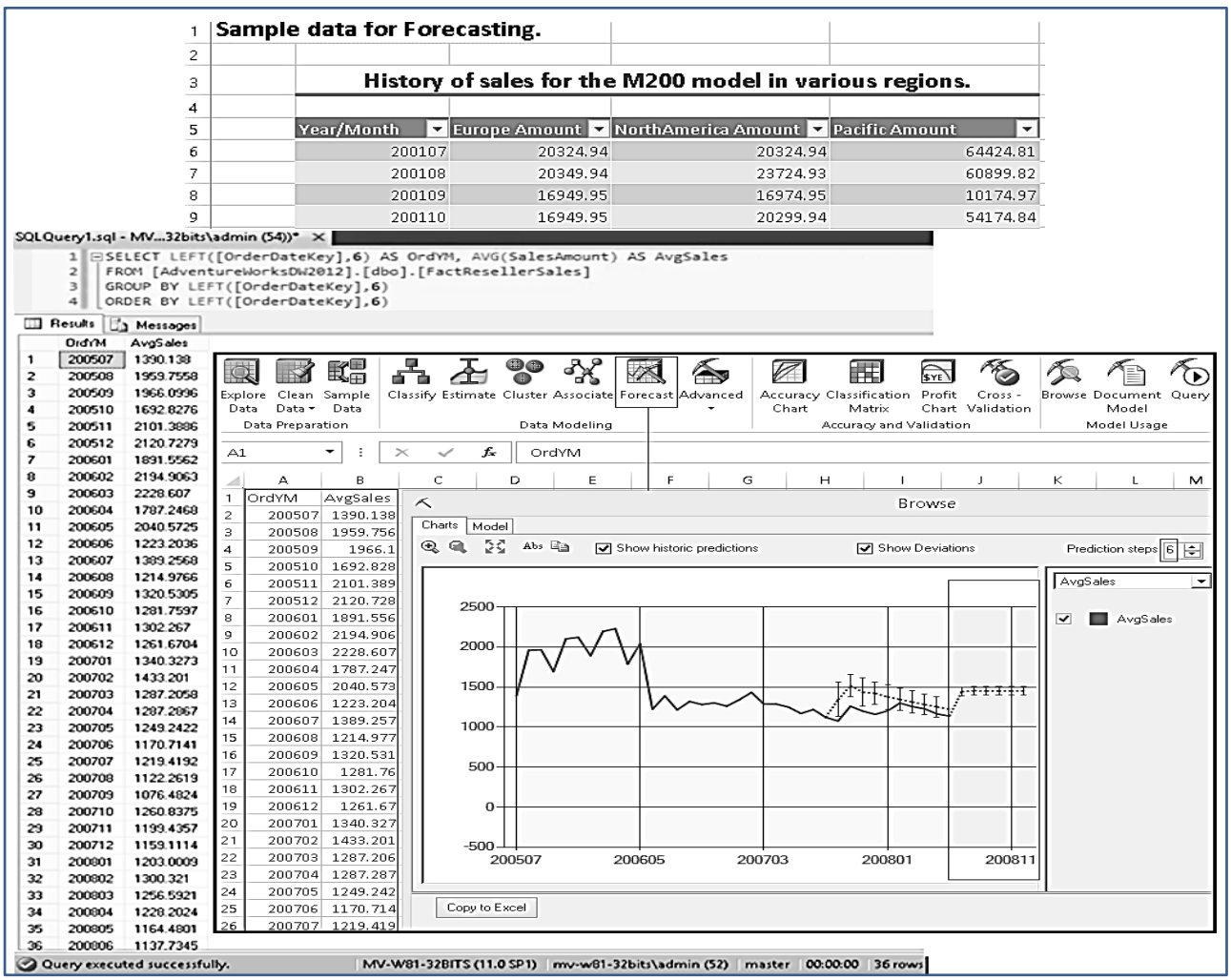


Source: The video tutorial created by the authors: y2u.be/3_8E01hnSD0

5. Forecasting starting from aggregated historical data

For more historical data than in the previous example (**Figure no. 5**) we have considered to create a special forecasting scenario closer to reality. We have started from scratch with a new example involving data on 36 months in four calendar years, this time by using a simple SQL query on a single table but with ORDER BY and GROUP BY clauses for sorted results and aggregations meaning computing aggregated values as: sums, averages, total counts, counts for a specified condition and so on. In our case those were averages on every month of an year combined into a single numerical field derived / composed by passing from left to right in the specific order: years to months corresponding to larger to smaller units (**Figure no. 9** - just like in Microsoft's data sample which is provided when installing the Data Mining add-in).

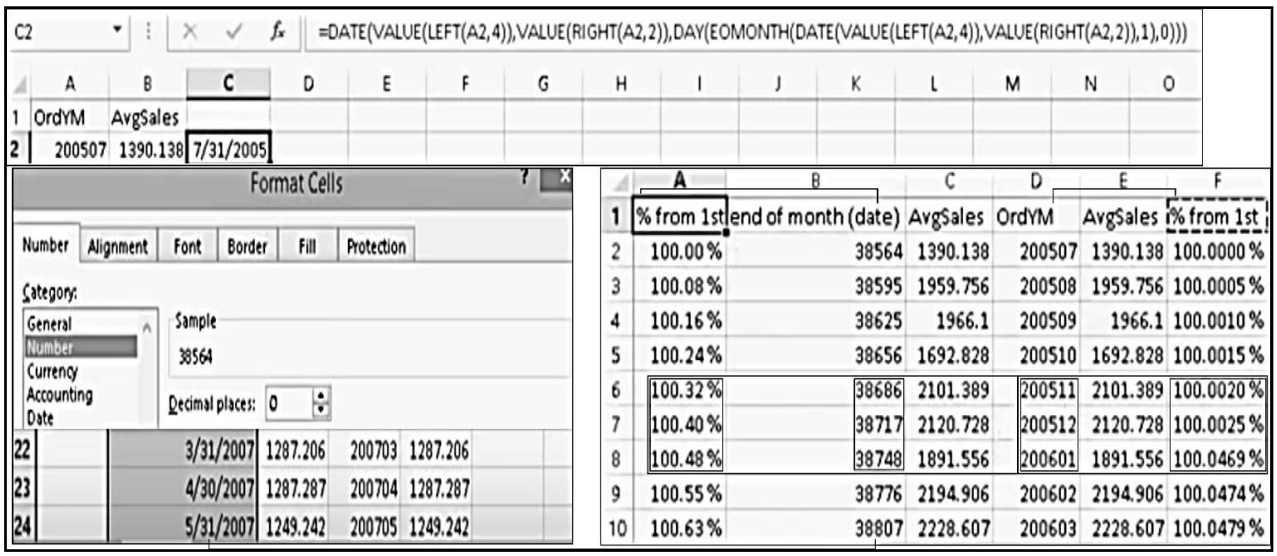
Figure no. 9. Historical data aggregation (time stamp style from the Microsoft's sample) using a SQL Server query (GROUP BY clause) followed by simply copying results to use them in forecasting (Excel's Data Mining add-in)



Source: The video tutorials created by the authors: y2u.be/RjTwGROD0TI and y2u.be/qHJ3Zm3JBT4

After the steps described above (**Figure no. 9**) and several other processing operations (Figure no. 10) we will get to a set of data suitable for forecasting implemented by using the Microsoft Time Series algorithms as a combination of ARIMA (Auto-Regressive Integrated Moving Average - optimized for improving accuracy in long-term predictions) and ARTXP (Auto-Regression Trees with Cross-Prediction - optimized for predicting the next likely value in a time series - msdn.microsoft.com/.../bb677216.aspx) algorithms.

Figure no. 10. Deriving and explaining the correct time stamps as full dates internally stored (Excel) as numbers in right format data sources as support for undistorted forecasting



Source: The video tutorial created by the authors: y2u.be/e0SkDwG9mNY

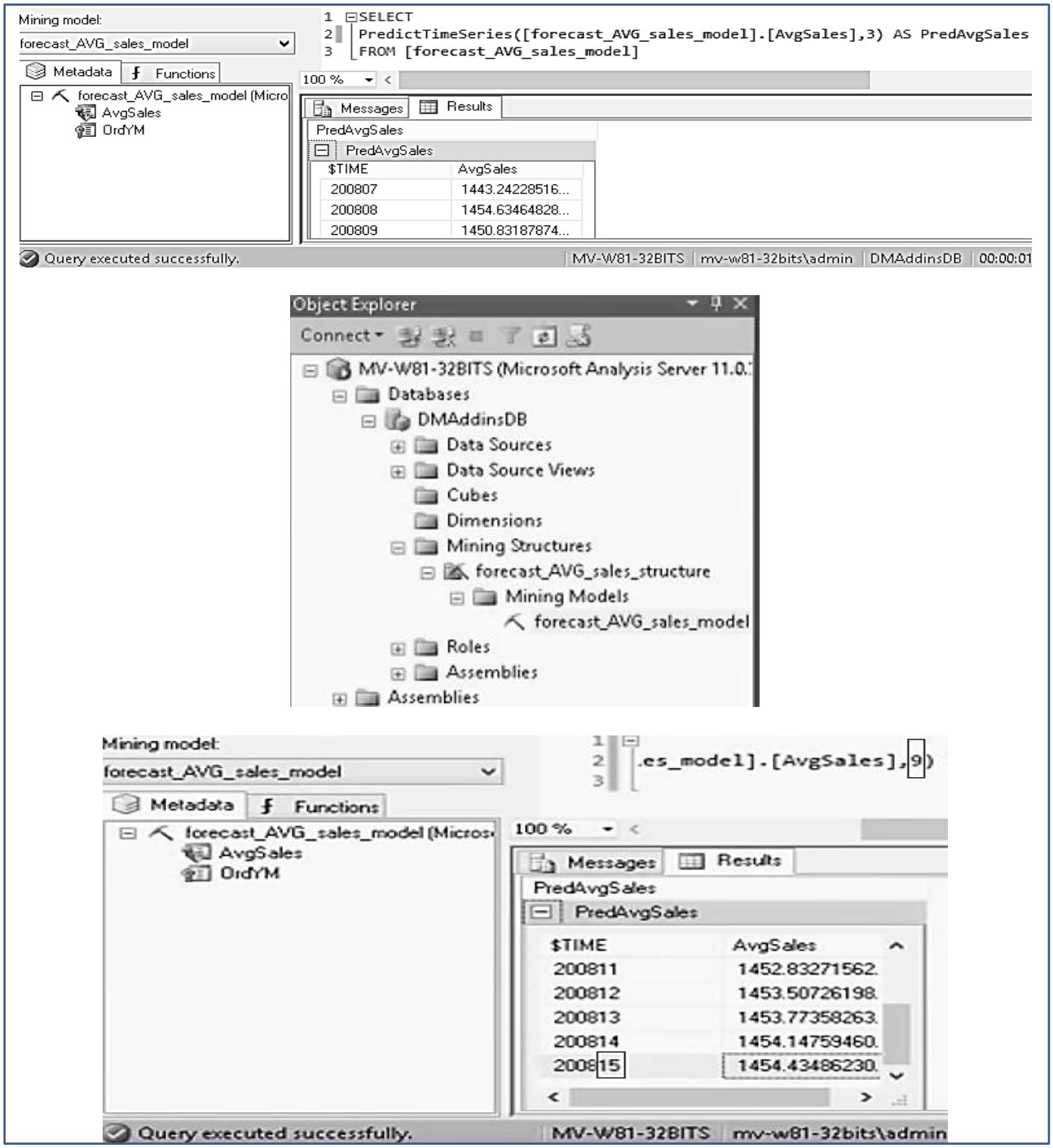
We have also thought at automatically deriving the correct (the MM/DD/YYYY format translated into an integer number - **Figure no. 10**) time stamp labels and we presented more details about their comparative behavior when getting trend line functions and forecasting results with this Excel Data Mining add-in (last three tutorials in the aforementioned playlist).

6. Support for querying persistent Data Mining models

First of all, persistent in this context refers to a model defined the way it will be deployed and stored on the server (SQL Server Analysis Services – a module other than the Database Engine) and available for querying (**Figure no. 11**).

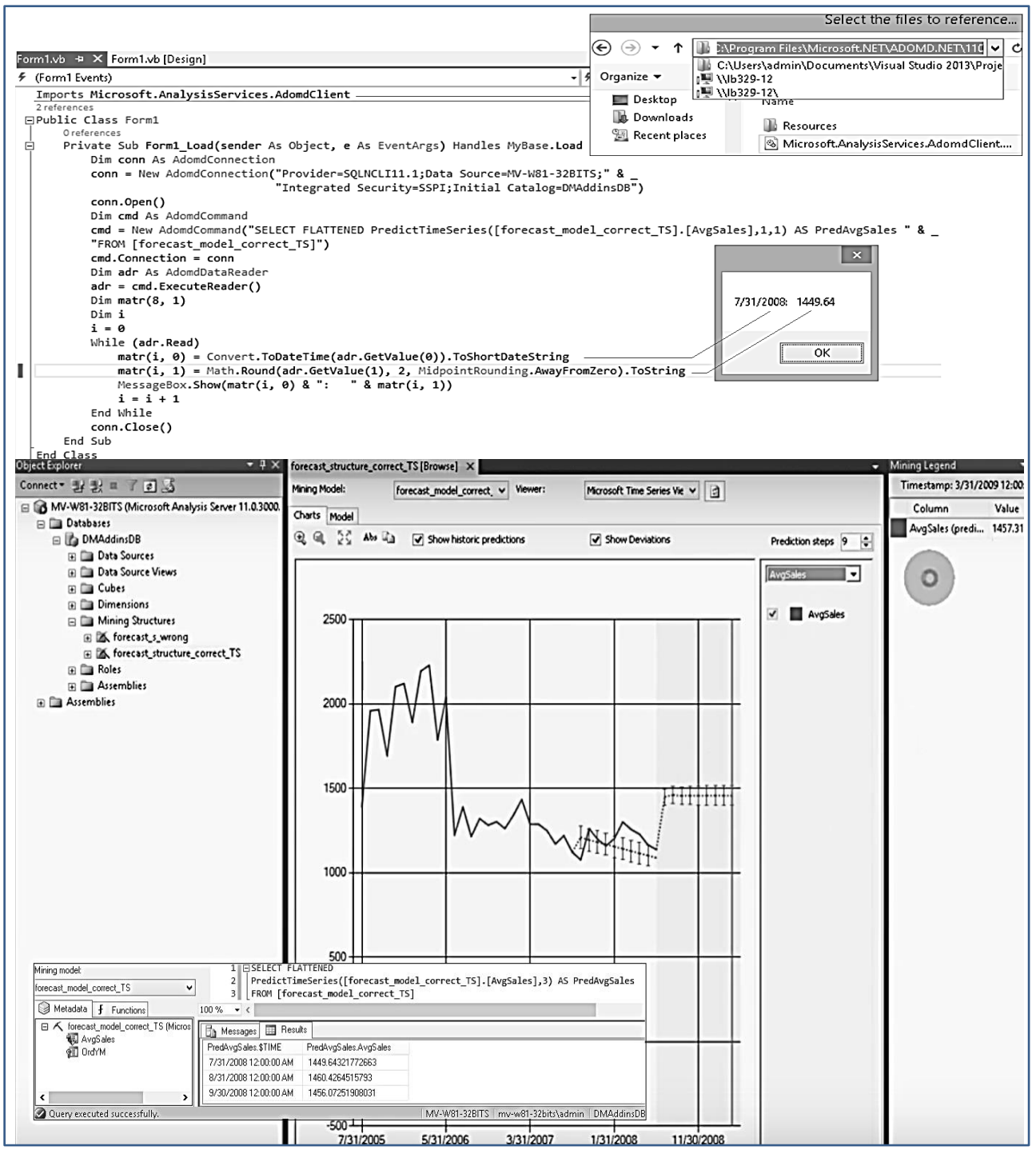
The *Data Mining* add-in available in Excel offers many advantages over the direct use of *SQL Server Analysis Service*. Among others, on can mention here: speed of use of Excel's tabular environment and formula language, possibility of many exports / imports as / from spreadsheets starting from different database formats and to indirectly involve multiple source tables by using the Structured Query Language (SQL), the possibilities of exploiting the resulting structures and models directly (the "copy to Excel" option), by using queries (SQL DMX extension - **Figures no. 12** and **13**) or programmatically (**Figure no. 12**). Last two are conditioned by activating persistency when defining models (*use temporary model* option unchecked - **Figure no. 13** vs. **Figures no. 1** and **2**).

Figure no. 11. Data Mining eXtensions (DMX) sales prediction query examples (SQL Server Analysis Services) based on a DM time series model from a wrong format data source (text time stamp: 200815 /15th month in 2008)



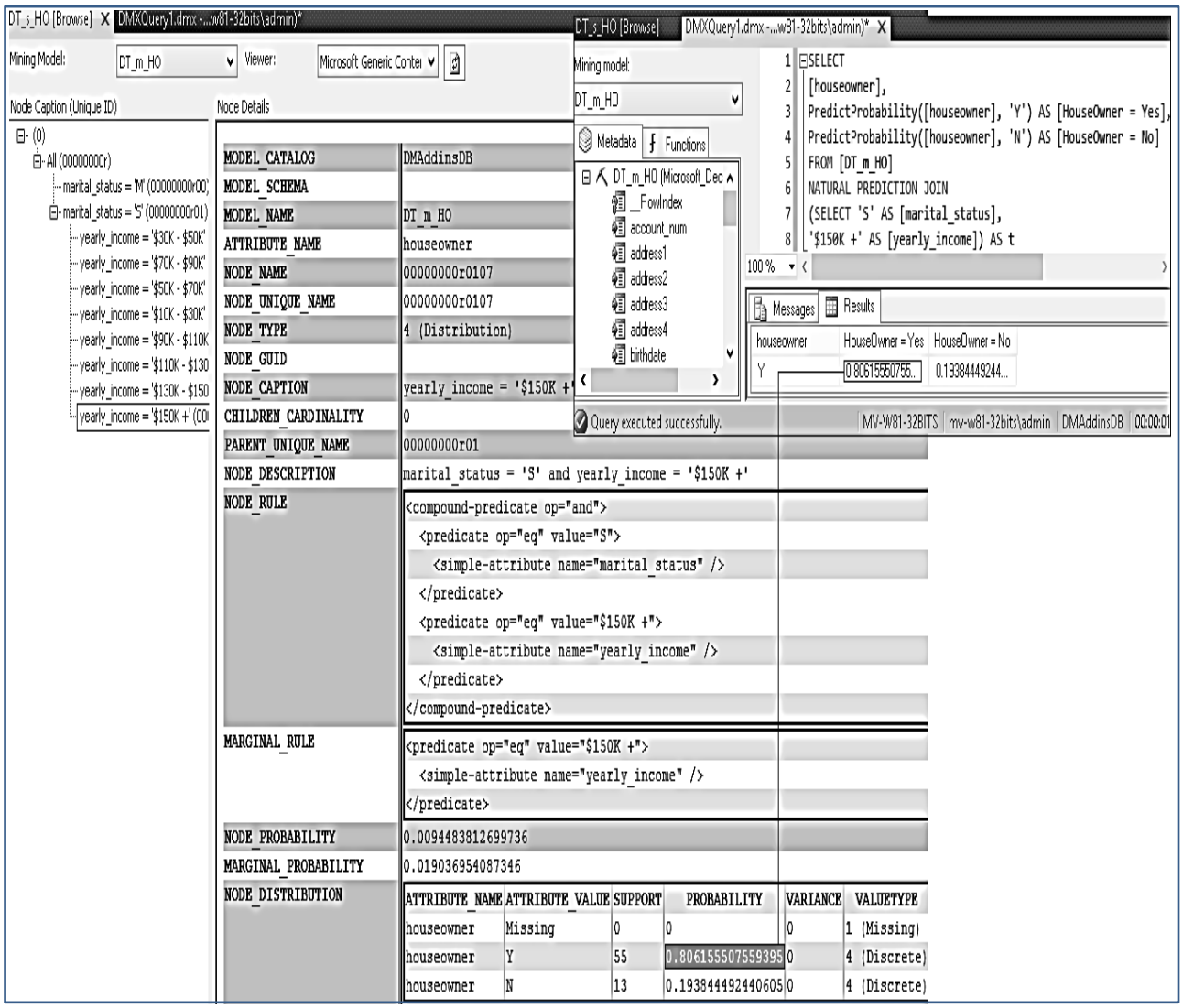
Source: The video tutorial created by the authors: http://y2u.be/qHJ3Zm3JBT4

Figure no. 12. Rough example of how to programmatically query a well-defined Data Mining model by using a DMX query in Visual Basic (VB).NET preceded by testing most of it on SQL Server Analysis Services



Source: The authors' projection resulting after development attempts with VB and SQL Server

Figure no. 13. DMX prediction query example (houseowner) based on a persistent decision trees classification model (generic content view in background)



Source: The authors' projection resulting from development attempts with SQL Server

This last advantage reminds us that the programmatic generation (Airinei and Homocianu, 2009) of Excel dashboards and scorecards by using suggestive representations, warning indicators and dynamic formatting with support for BI has been simplified a lot since the 2007 version of the Microsoft Office suite. Combining that with the ability to programmatically determine behavioral patterns and generate predicted values starting from high performance and easy to use tools such as this Data Mining add-in available for Office 2010, 2013 and 2016 promises much in terms of productivity. All these advances were defined after many years of using dedicated and now well-known technologies (e.g. SQL Server tested by authors since early 2000).

When it comes to spreadsheet products (dssresources.com/.../sshistory.html) such as: VisiCalc, Lotus 1-2-3, Microsoft Excel, Microsoft Works Spreadsheet, Sun Open Office Spreadsheets, Polaris Office Sheet, and Google Sheets the average

experience of final users is up to decades. Furthermore the easiness of using these applications even just as interface instruments to connect to data from databases and data warehouses and display it was an objective reason to continue with testing the Data Mining component that led to making this article.

By using a way of reporting which identifies itself with a sequence of steps which borrow their names from those eighteen support tutorials and also some techniques previously defined namely: E2P4CAFR (Homocianu, 2015), ACCORD / CADRE (Homocianu and Airinei, September 2014) and S-DOT (Homocianu and Airinei, August 2014) on can reach in stages, but with a minimal number of steps to follow some representations that are dynamic, interactive, suggestive, based on causality and rooted in the current reality and in the history defined by data stored in the organization's data sources.

Conclusions

We can conclude that the possibilities of the Excel Data Mining add-in component are above the expectations of a business analyst, offering the advantage of integrating identified classification patterns, association rules and predictions with the support for connectivity to various data formats, data validations, advanced graphical representations, geographical referencing, automatic conditional formatting and key performance indicators (KPI), pivot and power pivot tables and charts, automatic solving of optimization problems (solver) and the DAX (Data Analysis eXpressions) language together with the traditional formula language thereby increasing the chances of defining dashboards based on simulations, analyzes and Data Mining models truly useful for audit staff interested in performance monitoring.

We hope we have identified many real motivations to choose this Microsoft add-in for the Office suite as a near real time Data Mining tool, beyond many other recommendations available in the specialized literature and practice.

Beyond effective examples of working with well-known software applications available for a considerable range of users and providing advanced methods for analysis, query and representation of current and historical data particular to support tools for Data Mining and Business Intelligence, the paper also provides a brief theoretical description necessary in order to understand a rapid way of generating complex dynamic reports as dashboards based on analyzes and Data Mining models starting especially from sales and financial data.

The video tutorials developed by the authors, integrated in a playlist, and successively referenced in the paper prove the attempts to enrich the aforementioned way of reporting and to ensure the minimization of the number of steps required when trying to implement similar examples.

Overall, the article is trying and we hope that it succeeds to convey by clear examples some desirable traits as speed, simplicity, capacity of synthesis, transparency, flexibility and availability in reporting with support in Data Mining, as key elements of performance in preparing financial statements and supporting audit activities.

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19. http://inf.ucv.ro/documents/rstoean/5.%20Arbori%20de%20decizie.pdf
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Required conditionalities in applying public choice theory in the field of public utility services

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Abstract

Adapting public policies on public utilities to collective expectations of the population has always been a challenge for both central and local public authorities in Romania. The present article aims to highlight issues of applicability limits of the theory of public choice. The general objective of this research is to prove that the practicability of public choice requires conditionality of financial affordability. In this regard we use a theoretical analysis on the possibility and conditions of use of the theory of public choice in practice and an empirical analysis based on statistical data which illustrates an up to date comparison of the payment capacity of the sanitation services, adapted to European standards, of the population of the four counties of the Western Region of Romania, Timis, Arad, Caras-Severin and Hunedoara. We considered relevant to our study official statistics on the age structure of the population, employment, unemployment, social assisted individuals, students and pensioners and the average income of all these categories. The analysis results indicate that there are major discrepancies of the payment capacity and financial endurance between the population of the four counties and that the substantiation of charging public services using the principles of public choice would be unsustainable financially for a large part of the population. After clarifying these issues, the main conclusion of the study is that public choice theory application using the majority's autonomy is possible only through an association of financial affordability barriers. The relevance of the study is to address and propose solutions to the difficult context crossed by Romanian public authorities to find integrated solutions, so as to develop community services at European level, but at the same time to remain in the sphere of needs and payment possibilities of citizens.

Keywords: *Public choice theory, development associations, Western region, public policy, policymakers.*

JEL Classification*: H72, H76.*

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Introduction

Public choice options are a barometer of the population's options, so its understanding and application by the policy makers can develop the results and effects of public policies implemented. The current context of Romania, of increasing the quality and covering the services of public utilities regarding them require a special attention and a thorough analysis of how policymakers intend to resolve these challenges.

The general objective of this research is to prove that the effective application of the principles of public choice requires conditionality of financial affordability when addressing services or public goods, involving costs for the population. Imposing a pecuniary conditionality, as a dimension in grounding options, offers a real and practical image of the choices resulted.

The novelty and relevance of the chosen theme are conferred as it addresses a current problem faced by public policymakers in Romania. The article deals with a need for adaptability with double valence: European standards and expectations of the population. Thus, the present study may represent a guide for policymakers in the field of public utilities.

Research methodology is based on a statistical analysis comparing statistical data essential for shaping an image on revenues of a wide range of people and their ability to pay.

The present study consists of three parts. The first part comprises the contextualization of the public choice theory and shows the limits of its application, considering the major deficiencies of its practical application, illustrated by the scientific community and providing a solution to them. The empirical analysis is presented in the second part of the paper, treating a topical issue arising due to the joining of Romania at the European Union and the need to develop community services at European standards. In this view, it will be analysed the particular case of considering the establishment of tariff limits to the sanitation service in the counties of the Western Region. In the final part of the paper, we present the study findings and propose settlement of the problems encountered.

1. Literature review

The present research complements a rich literature on public choice theory, with multiple and very different opinions. A basic element of public choice is represented by the seek to the aggregation of collective options in order to shape collective and social preferences, generally applied to all voters. This paper proposes a different approach, which takes into account the disaggregation of public policy in several directions so as to meet the distinct preferences of the groups of voters and even the shaping of a legal framework to protect those who represent social cases. We start our research efforts by the contextualization of public choice theory.

Boadway and Wildasin (1984) defined the public choice as a way in which ideals and expectations of individuals regarding public goods and services get to be integrated into public policies developed by policymakers, considering a degree of empathy and adaptability of them to some collective will. Moreover, Lobonţ and Moldovan (2014) show that the rights and freedoms of citizens to participate in public decisions are clearly stipulated in the documents of international importance: Universal Declaration of Human Rights proclaimed by the United Nations General Assembly in 1948, the European Charter of Human Rights, The Protection Convention of Human Rights and Fundamental Freedoms of 1998. However, we consider important the distinction between public choice theory and an adapted form of it, which can be applied in practice. In this regard, we consider that the interventionist role of the state is important in adapting policy according to financial criteria in order to protect the population with reduced payment possibilities for some public services involving fees or prices. We support this role even if in this way it exceeds the framework of collective majority choice because individual preferences of citizens are not made in the spirit of collective empathy, but are a subjective result of its own analysis.

Our society is characterised by a pluralism of values, ideals and needs. Thus, it is impossible to get unanimous collective decisions. However, public goods and services involve an important distinction regarding the existence or inexistence of associated monetary components. We can identify goods and services that citizens can enjoy freely and public goods and services that they can benefit on charge. Needs, wishes and preferences of people evolve with time. Romania's quality of EU member state, globalisation and the trend of increasing the quality of life offered Romanians other

meanings and other expectations in respect of public goods and services. However, the financial contribution contributes to the issue of preferences, considering that the level and quality of services and goods is directly proportional with fees and charges associated. In these circumstances we believe that a real application of public choice process should be made as often as possible, partly for each important decision, to be adopted at central and local public administration level. Still, such a process would hamper the effective implementation of public policies, but would always have the representativeness of collective choice. To give real scope to this proposal, it may condition its application only to special cases. An example of such a situation would be cases involving the basic services that impose charging for the population.

Identifying a collective decision is an almost impossible task. Arrow (1951) and Black (1948) have started two opposite analysis, one concerning the possibility of aggregating individual decisions in a collective decision and the other of disaggregating the outcome of a vote. Both authors have discovered the phenomenon of "majority cycle", also known as the Condorcet paradox, meaning Candidate 1 is stronger than Candidate 2, Candidate 2 is stronger than Candidate 3 and Candidate 3 is stronger than Candidate 1. The Condorcet paradox occurs when each candidate is defeated by at least one of his opponents competing, thus being unable to determine the winner of a unique series of individual comparisons. Arrow (1951) studied whether it is possible to outline a general order, a 'social' one of preferences, which should be the result of aggregating individual preferences order of citizens. The conclusion, not surprising at all, was that it is impossible to result in a universally accepted order of each individual without imposing restrictions and conditionalities. Conditionalities proposed by Arrow (1951) were strictly related to the correctness of proper administration of choice, the choice of rationality and trying aggregation. An essential condition which should be included when elections are based on a proposed payment component is the voters' ability to pay and their affordability limit. Phenomena subject to a vote, to the ordering of collective preferences involving financial stake of the voters, deserves more attention. Black (1948) found that if preferences are arranged along a single dimension, every order of preference having a single point of maximum utility or ataraxy, would not lead to the appearance of the phenomenon of Majority cycle. This discovery of Black (1948) is called the median voter theorem. Basically, it argues that any system of public election will result in the median voter position. It had to be pointed out that the prerequisites adopted by Black (1948) are difficult to obtain in practice. The condition of ordering preferences in line with one dimension is restrictive for most public election. Any decision or preference is based on several explanatory variables and reducing any analysis based on a single variable would lead to inconclusive results.

Buchanan (1954a, 1954b), following the work of Arrow (1951) and Black (1948), launches an opposite approach to the two authors. If the latter looked for ways to sanitise the phenomenon of Majority cycle, Buchanan (1954a, 1954b), encourages it. The principle behind this encouragement is very simple: cyclical collective choices allow periodically that the minority to become part of the majority, which offers a very good representation of all voters periodically, cyclically. In full agreement with Buchanan (1954 a, 1954 b) in terms of representativeness, it is nevertheless to be pointed out that such an incentive can produce an overall instability and can create the prerequisites to the failure of any public program because of frequent changes of opinion and direction.

Having identified some shortcomings in the voting system, the Swedish economist Wicksell (1896) proposed the alternative of unanimously vote. Such a vote option comes in direct contradiction with one of the principles supported by Arrow (1951) in the impossibility theorem; the lack of dictator can influence the outcome of the vote by their own option. The model proposed by Wicksell (1896) requires that any voter can change the outcome of the ballot by a vote "against". This possibility was later identified by Wicksell (1896) himself, who then proposed a vote option requiring 5/6 of voters to be valid. However, in the economic and social reality in which we live, it is unlikely to emerge 5/6 majority opinion of all voters. Groups or trends of opinion and implicitly order of preference are a consequence of economic, social, cultural, ethnic and political components. People who have the similar economic, social, cultural developments tend to form a group of a similar opinion.

One of the basic premises of the application of public choice is that people make choices in terms of rationality. Another accepted condition is that policymakers act in light of the collective interest, not to

promote their own interests. However, the question could arise if voters, electors, have the necessary probity, the experience and knowledge to manifest some choices. Also, we wonder how we ensure that policymakers will always watch over the common good and not become biased in exercising functions and dignity. We propose a solution to two questions into one answer of compromise: *public policies to be the result of a joint decision of civil society and policymakers in different ways, depending on the nature of the problems analysed*. In light of what has been mentioned before, the foregoing analysis of the projects' or programs 'feasibility and sustainability proposed by political factors must be supported by an opinion of the beneficiaries and their hierarchy. In some situations, a view of the civil society can help decision makers to adapt public programs so as to satisfy a greater share of beneficiaries.

Ross (2009) examines public administration in terms of inputs and outputs for compliance with the principles of economy, efficiency and effectiveness arguing that management representatives in local government should carry out administrative tasks so as to ensure better use of local resources (human, material, financial), towards achieving the objectives. Analysing the premises proposed by Ross, we added that higher attention deserve the outcomes, the actual results of the implementation of projects. It requires a thorough analysis of the response of beneficiaries, represented by the public and businesses, to certain outputs. These reactions can be estimated by applying the theory of public choice. No matter how great the inputs, or how complex the outputs can be, a set of good outcomes is obtained by consulting beneficiaries.

An important point in the analysis of public choice must be the way in which individuals make their wishes known. An ideal system of application of public choice must continually monitor the collective desires. Becker (1983) shows that individuals become part of groups based on training, age, occupation, income, geographic area, and then is created a competition between these groups "of pressure" and the extent to which they influence political decisions thus creating a sort of balance. As shown by Arrow (1951), it is impossible for a collective decision to be obtained by aggregating multiple individual decisions. In addition, membership in a group can create subjective, biased individual decisions. Thus, developing Arrow's (1951) logic, each group can become a "dictator" influencing the outcome of the vote. The formation and operation of a group involve identifying in time of a leader. The leader, who theoretically is placed in a common area of ideals with all members of the group could skid from this area and represent unfair, unjust group interests. Keep in mind the above; we consider it appropriate that the division of voters into groups should not occur. Each newly formed group, which launches one vote, one allocation of preferences, represents a setback for the relevance of functioning of the public choice theory and for election objectivity.

Sen (1999) proposes an interesting approach to development, through the freedoms offered to people. Of the freedoms proposed by Sen (1999), we can mention the freedom of opportunity and economic protection against poverty. Political factors should consider this theory in applying public choice theory. Public elections should be made especially in situations when expressing a vote regarding a phenomenon involving taxes or charges. In a system of charging the population, public decision makers bending public opinion should be at the maximum. Otherwise, it can lead to downtime phenomenon by the lack of tax collection. We appreciate that the taxation of services or public goods, especially those mandatory, should be made according to the affordability of the population, namely, the degree of affordability of individuals, and households with the lowest income.

An interesting approach to the way people make the choices is conferred by Boyle (2013). He asserts that people need not only information or data when they make choices, they also need a good interpretation of them. In full agreement with Boyle (2013), we believe it is the duty of the responsible authorities to help citizens give the right meaning to information and understand the public strategies. Moreover, the Office of Fair Trading (2010) argues that only motivated people or people with various interests will be involved in the process of public choice. Given that our work studies the prestige of public choice considering a financial dimension involved, we consider that the number of those interested is very high.

2. Method and data

By virtue of a framework for comparison between the counties of the Western region, we use the statistical

analysis to determine the payment capacities of the people from the considered counties: Timis, Arad, Hunedoara and Caras-Severin. In this respect, we consider the analysis of several socio-professional and age categories together with their contribution capacities.

Political factors cannot know the wishes of all citizens or a desire universally valid but must know the capabilities of individuals to support certain taxes or charges of public services. This is necessary, especially in the case of mandatory services. A practical example in this way is the sanitation service of the localities. Law No.101/2006 of the sanitation service of the localities shows that it is mandatory that every citizen to be subscribed to the sanitation service, and if he refuses, then to sign a contractual agreement with the operator of the service, delegated by the authority, the latter to establish a special health fee to apply to service beneficiaries who have not signed a contract with the operator delegated. Of all services of public utilities, the sanitation service has a unique place conferred by the compelling character of the government.

In order to manage the health service were set up Intercomunitary Development Association (IDA), which is an associative form of all administrative and territorial units in each county: all local councils and the County Council. The need of Romanian community services to adapt to European standards in the field by respecting the specific Directives was achieved via support for European funding to provide as a condition for setting up such urgent need of financing the Development Associations, hereinafter IDA's. IDA's by their nature involve integrated management of services that they manage, ensuring a uniform level of quality of service delivery at the county level and require unitarian charging at the county level, making a single distinction between urban and rural areas.

The mandatory nature of the sanitation service is a perfect reason for IDA, as authority for the implementation and management of the service, to verify and analyse public option linked to the two dimensions of service provision: quality and quantity. It is pointed out that both dimensions proposed are directly proportionated to the service charge. We consider the quality of service as the number of fractions collection, e.g. wet, dry, glass, polyethylene, aluminium, etc. and the quantity as the collection frequency: once every two weeks, once a week, twice a week, etc. We will verify if the public choice method is the most suitable method to determine the nearest option of performing and charging the service linked to the ideals of the population, analysing the particular case of the four counties in Western Region: Timis, Arad, Hunedoara and Caras-Severin. We will correlate next the order of preferences of the voters and their payment possibilities, and we assume that they vote in terms of rationality, knowing their ability to pay and considering a limit of affordability agreed to 2% of the revenue of every voter allocated for the sanitation service. This limit is the recommendation of the Managing Authority of the Ministry of European Funds and ANRSC for the charges applied for the sanitation service. If we assess the public choice's level of quality and quantity without payment conditioning of the service, surely most respondents would opt for high levels of quality and quantity of service provision, which ensures public health and environmental protection. Where payment capabilities are correlated with the vote, the results are different.

The present article contains an analysis conducted at the level of the year 2016, the year in which most of IDA's from the area of analysis began to produce management effects and to outline regulations for the operation of the sanitation service. Data regarding population structure are the results of the latest Census by the National Institute of Statistics, and revenues are also correlated at the level of 2016. Data about the total population of the counties and structure-activity correlated with the level of income earned by each category are relevant for our study.

Observing the data from **Table no. 1**, we notice great differences in wage income, up to 40% of the four counties counted. Also, the number of employees in the active population is very different from one county to another, with differences of up to 17%. Consequently, we try to determine, using public choice theory, an agreed level of service quality-quantity, according to the rates allowed by the population of each county.

Table no. 1. Situation on Countie

Country	Population	Population age 0-14	Population age > 60	Active population	Employees	Unemloyed	Average salary	Average pension	Social assisted
Arad	454,073	65,445	96,372	208,500	111,434	7,241	1,726	716	3,520
Caraş-Severin	318,616	44,963	68,611	119,300	50,375	6,739	1,516	775	2,259
Hunedoara	457,932	62,014	97,338	187,300	106,870	11,155	1,597	949	3,379
Timiş	679,848	95,344	131,089	331,400	195,913	6,280	2,136	785	1,656

Source: centralization made by the author based on the National Institute of Statistics data

Table no. 2 indicates the percentage of each presented category of individuals reported to the total number of residents from each county.

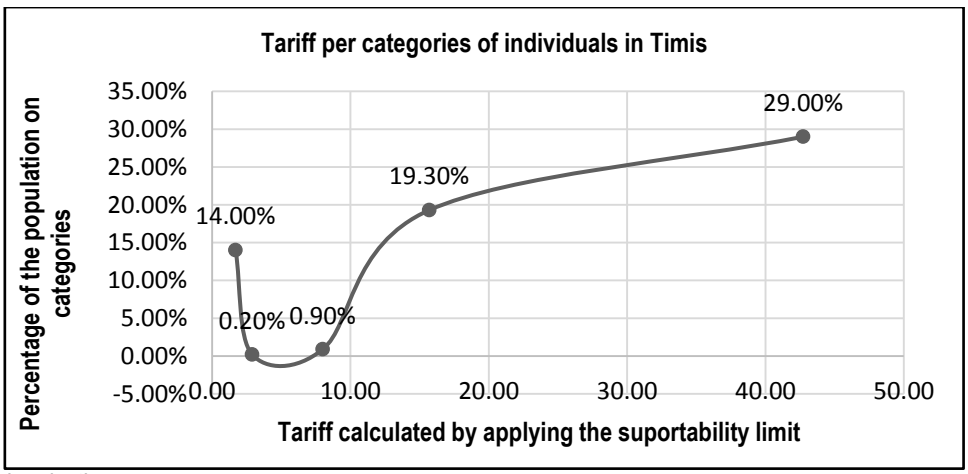
Table no. 2. Percentage of categories of individuals

	Percentage of total population				
County	Population age 0-14	Population age >60	Employees	Unemployed	Social assisted
Arad	14.50%	21.20%	24.50%	1.50%	0.80%
Caraş-Severin	14.10%	21.50%	15.80%	2.10%	0.70%
Hunedoara	13.50%	21.30%	23.00%	2.40%	0.70%
Timiş	14.00%	19.30%	29.00%	0.90%	0.20%

Source: centralization made by the author based on the National Institute of Statistics data

Next we will determine the value of affordability up to the limit of 2% for the sanitation service for each category contained in **Table no. 2**, taking into account the average wage and average pension income from each county, as well as students' income, the unemployed and social assisted persons' incomes, that are identical nationwide. By this, we mean student income allowance, unemployment benefits and social assistance.

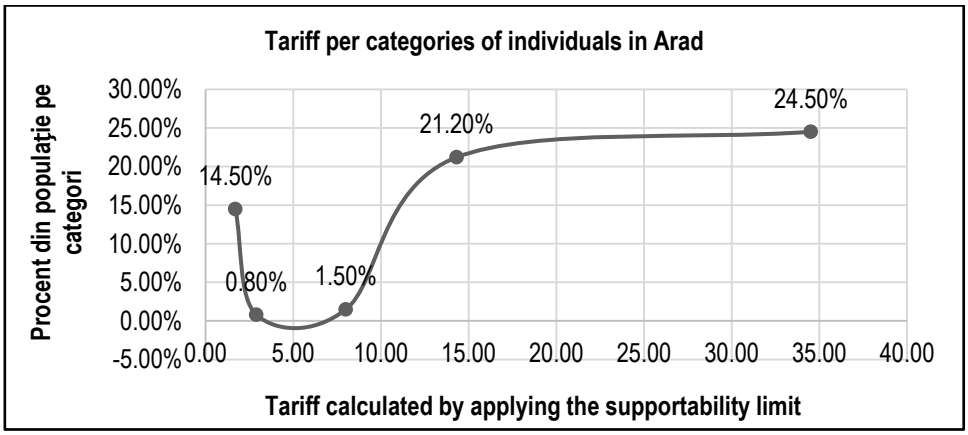
Graphic no. 1. Evolution of supportability limits per categories in the Timiş County



Source: personal projection

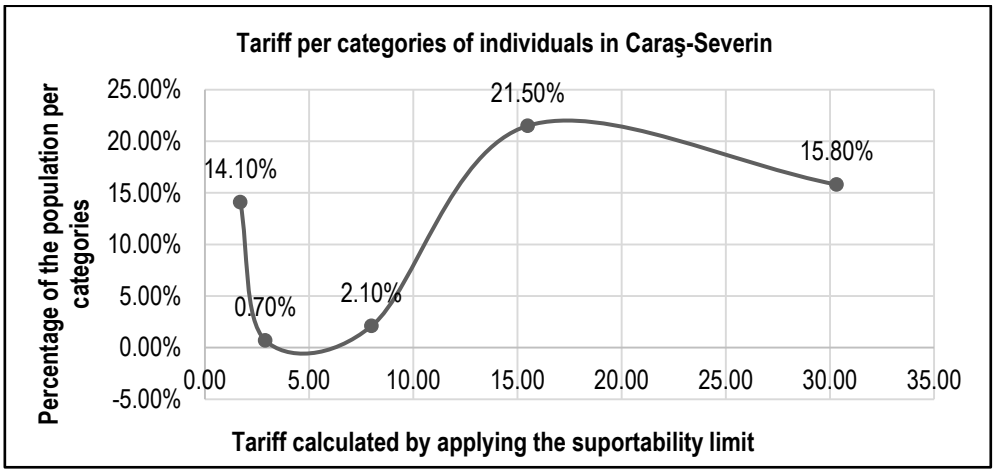
Graphic no. 1 indicates that there is no population majority of over 50% to have the same limit of affordability. However, it can be shaped a majority of the population that can support a tariff level of 15 lei/person/month, given that 29% of the population can pay 42.72 lei/person/month and 19.3% may pay 15.7 lei/person/month. Moreover, a weighted average affordability limit for the categories of people on income indicates a charge of 24.96 lei/person/month. This rate would exceed the limits of affordability of more than 35% of the county population, which would violate the recommendations of Sen (1999) of respecting the freedoms and avoiding poverty. In this way, by the power of example, a socially assisted person with a monthly income of 145 lei and must pay 24.96 lei for the sanitation service, allocates around 17% of its revenues for this service. Also, analysing **Graphic no. 1**, we can observe that the median voter theory of Black (1948, 1958) has no practical applicability, in this case, there is no middle point towards which to strive other options. This is due to large differences in income between the categories included in the analysis and the disproportionate nature of the number of persons in each category analysed.

Graphic no. 2. Evolution of supportability limits per categories in the Arad County



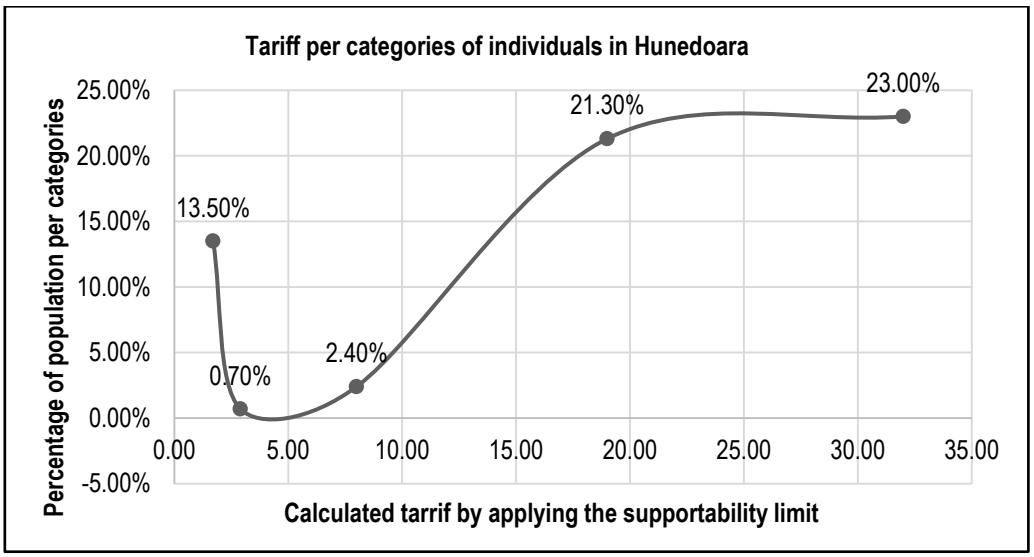
Source: personal projection

Graphic no. 3. Evolution of supportability limits per categories in the Caraş-Severin County



Source: personal projection

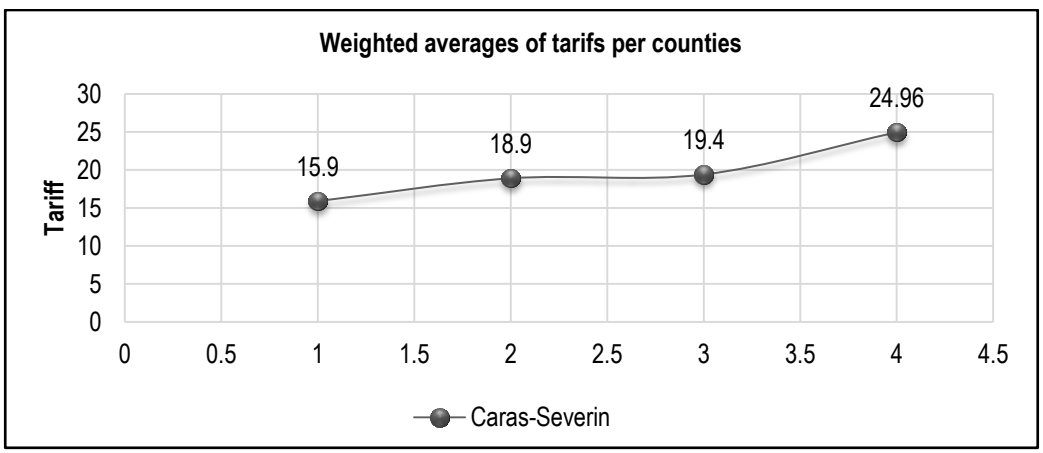
Graphic no. 4. Evolution of supportability limits per categories in the Hunedoara County



Source: personal projection

Further analysing affordability limits of categories included in our analysis and for the other counties in Western Region, Arad, Caraş-Severin and Hunedoara, we see the same inability to aggregate individual options in a single group option.

Graphic nr. 5. Weighted averages of the four counties in the region



Source: personal projection

3. Results and discussions

The analysis of affordability limits and of weighted averages on the counties in the region shows large differences in affordability, of up to 57% between Caraş-Severin (15.9 lei/person/month) and Timis (24.96 lei/person/month). Thus, a region-wide charge would be harder to establish, so as not to affect the broad categories of the population. A solution of setting a fair price for the case in question must be

primarily an analysis of regional disparities, not by region. Differences in income, population structure and limits of endurance between the four counties analysed did not include an integrated analysis of them. Instead of charging at individual counties level allows adaptation to the socio-economic county specific. Focusing on a fair charging in each county, we suggest for the situation we have analysed, a mandatory service, creation of facilities so that the categories of people with the lowest incomes as pupils, students, unemployed, socially assisted, to benefit from a quality service according to the European Directives in the field and remain within their affordability limits. We firmly believe that in this critical situation, IDA can create a pricing system that satisfies all the categories mentioned, which would be consistent with the vision of Wicksell (1896) of unanimous votes. Thus, it can be created an opportunity for each service user to choose his limit in terms of quality and quantity of the service provided, with the amendment that each one should receive the minimum necessary quality required by law and directives. IDA should impose a charging limit that service operators to practice in accordance with the above limits in our example and even to create the possibility of subsidising the service by local authorities for social assisted people and those without an income.

Conclusions

Compliance outlining a majority is an attribute of the democratic society in which we live. However, some situations such as the present one, accept exceptions to the rule. The sanitation service is not a luxury, but is essential for any person, regardless of the income. Its binding nature requires the protection of those with lower incomes. ADI establishment and operation at the level of each county from the western region and from Romania supports the idea of charging at the county level and not regional or national one, the differences in household incomes between counties being very high.

It is obvious that public choice theory cannot aggregate individual preferences. In some situations, such as the present one, nor can it identify a majority of preferences without adding multiple groups. Nevertheless, it remains an important landmark for political factors that, in situations like the one analysed, of the sanitation service, should identify pricing methods differentiated so as to be bearable for each socio-professional category and age.

Using as benchmark collective desires, financial protection of users and specific adaptation to the socio-economic structure and specificity of each county, decision makers can create public service to be performing and at the same time sustainable and appreciated by the population.

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