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ЦЕНТЪР ЗА ПРОФЕСИОНАЛНО ОБУЧЕНИЕ „ЗНАНИЕ И БИЗНЕС“

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Dear readers, we are pleased to inform you that on the initiative of the Editorial Board of "Knowledge and Business" Ltd., "Knowledge and Business" is a licensed publisher of the scientific journal "Economics and Computer Science.".

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Sincerely: Prof. Dr. Sc. Petko Iliev

Measuring the problem use of internet – internal structures and dependences

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Abstract. The purpose of this article is to find some of the most important dimensions of the term "problem use of internet". A questionnaire based survey among 579 students at secondary schools in Varna is conducted. The main examined dimensions are: time spent in internet, individual and emotional life, social life, home and school obligations. This paper raises the question of whether the students can be grouped based upon their internet experience. A clustering procedure is completed with variables of frequency of eight internet activities. Several cycles of hierarchal clustering are applied using the method of between-groups linkage with applied metrics for Squared Euclidian Distance. The F-test from the ANOVA table shows that the three most important indicators for the results of the clustering are: the frequency of game play; the frequency of socializing with other people online; and the frequency of shopping on the internet. Six clusters of people are defined.

Key words: internet addiction, internet dependency, hierarchal clustering.

1. Introduction

Focusing attention on the problems connected with the use of internet is influenced by two foundational tendencies:

- Internet has become an inseparable part of people's daily lives (Statistics 2015);
- Several studies (Valsamidis et al. 2012, Young 1999, Zhang & Xin 2013, Tsai & Lin 2001, Saville et al. 2010, Lopez-Fernandez et al. 2013, Azadi et al. 2014) have proven that it is an actual problem and has a harmful influence on people's lives, especially the under-aged.

The article uses the concept „problem use of internet“. It means: condition, which lead to damaging use of internet (extended time on the internet; withdrawing from other activities connected to the life of an individual such as work, educational, social or family responsibilities; focusing on internet based activities), which on their part lead to negative personal consequences (Kehayova-Stoycheva et al. 2017). The current research is a part of a research project, financed by the Program of the Ministry of Education for supporting research in higher education institutions (NP-155/2015). This research is its empirical phase.

The aim of this article is to identify models of internet use of school age children through an empirical way and through a system of assessment and judgment indicators of online behaviour in order to discover internal structures and dependencies.

The subject of the study is school age children. The focus on school age children has been dictated by the personal understanding of the authors that the future behaviour of children as active members of society and in social groups is of great importance.

The object of the research is the understanding and judgments of the students associated with their daily behaviour when using internet.

2. Methodological frame of the study

The psychometric approach is used to measure the problem use of internet. In combination with various statistical methods, the psychometric approach provides a good foundation for assessing the differences between the young people's self-evaluation of their internet use and its influence upon different aspects of their lives.

The applied research instrument contains 28 indicators, directly connected with determining the problem use of internet, as well as one multi-point indicator for determining activities completed on the internet and 3 basic demographic characteristics. The research instrument is tested for reliability and validity (overall validity; content, competitive and convergent validity) (Kehayova-Stoycheva et al. 2017). The fundamental indicators, included in the research instrument, are based upon four basic dimensions of observed phenomenon: time spent on the internet; individual and emotional life; social life; and home and school obligations (table 1).

Table 1.

Content of basic dimensions of problem use of internet measurement

Dimension (code)	Number of indicators in dimension	Indicator's code
Time spent in internet (T)	5	T1 ÷ T5
Individual and emotional life (IEL)	8	IEL1 ÷ IEL8
Social life (SL)	9	SL1 ÷ SL9
Home and school obligations (HSCO)	6	HSCO1 ÷ HSCO6
Total number of indicators for identification of problem use of internet (PUI)	28	

Almost all the (26) indicators are measured using an ordinal scale, two of which are with intervals. Two types of ordinal scales are used in order to achieve greater accuracy in assessing actual behaviour when gathering the initial data (table 2). All the scales have seven degrees.

Table 2.

Indicator's measurement scales – basic characteristics

Scale type	Range of Values	Number of degrees	Indicators measured by the scale
Interval	From "More than 10 days" to "0 days"	7	T1
Interval	From "0 Times" to "More than 10 times a day"	7	T2
Interval	From "0 Hours Daily" to "More than 10 Hours Daily"	7	T3
Ordinal	From "Never" to "Always"	7	T4, IEL1 ÷ IEL5; SL1÷SL6
Ordinal	From "Categorically Yes" to Categorically "No"	7	IEL 6 ÷ 8; SL7, SL8; HSCO4÷6

For the purpose of obtaining an overall final result from the whole sample, as well as intermediate results from the initial dimensions of the problem use of internet, all answers by variables are interpreted through the interval "Existence of a problem when using internet – The absence of a problem when using internet", categorized into 7 degrees. In this way, the necessary conditions are created for the application of analysis techniques for more exact categorization of internal structures and dependencies between the dimensions and measures of the problem use of internet.

Table 3.

Transformational Meanings of the Scales

Scale type	Range of Values	Transformed meaning of the scale	Number of degrees	Indicators measured by the scale
Interval	From "More than 10 days" to "0 days"	From "Absence of a problem" to "Existence of a problem"	7	T1
Interval	From "0 Times" to "More than 10 times a day"		7	T2
Interval	From "0 Hours Daily" to "More than 10 Hours Daily"		7	T3
Ordinal	From "Never" to "Always"		7	T4, IEL1÷ IEL5; SL1÷SL6
Ordinal	From "Categorically Yes" to "Categorically No"		7	IEL 6 ÷ 8; SL7, SL8; HSCO4÷ 6

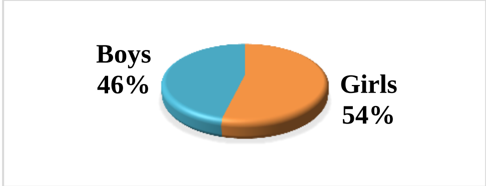
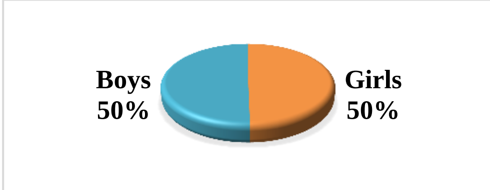
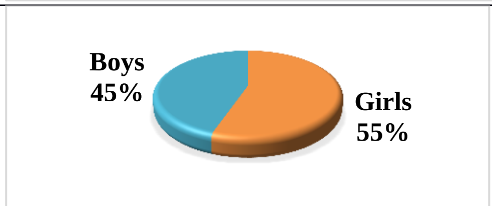
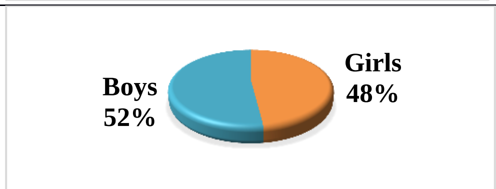
The primary data is gathered in educational institutions using group surveys. 579 eighth grade students to eleventh grade students from Varna, Bulgaria took part in the study. Twelfth graders are excluded from the observation because the period of data-gathering took place from the end of April to the middle of June in 2016.

The basic structures of the respondents and their experience using internet

The age of those observed is between 14 and 18 years old. The age of respondents is not registered directly. Instead of direct observation, the observed person’s grade is registered. The other basic demographic characteristic observed is the person’s sex (table 4).

Table 4.

Distribution of Respondents by Grade and Sex

Grade	Distribution of Students by Sex
Eighth 26,4% of the Respondents	
Ninth 29,9% of the Respondents	
Tenth 21,4% of the Respondents	
Eleventh 22,3% of the Respondents	

Source: Own calculations

Concerning the diversity of students included in the survey, it can be said that there are present from both criteria – sex and grade. Therefore, the research can be used to formulate some theoretical hypotheses, which can be the foundation for future quantitative research projects.

Internet experience is observed by measuring the frequency of doing some (altogether 8) primary activities: playing games; listening to music, watching films and programs; searching for information not related to school; searching for school-related information; using email; interacting with others online; shopping; and online training. The frequency is measured on a 7-point scale from “1 – never does this activity” to “7 – always does this activity”. Two criteria are applied, in order to categorize the respondents, to understand whether the participants meet the required experience with internet. The first criterion is that the subject did more than a 5 of the various activities on internet. The second criterion is that the subject did at least half of these activities often. Concerning the first criteria, 95.4% of the studied students indicated that they have done at least 6 of the 8 activities. In connection with the second criteria, an index is calculated for the frequency of total experience of the number of activities carried out on internet and the number of activities frequently performed. The index values range between 0 and 1. The closer the value came to 1 meant that the internet activity of the respondent is more frequent. The limit of the value for the frequency of internet activity, which would meet the conditions of the second criterion, is 0.5. Only 41.6% of the students are doing more than 4 of the activities which met this condition. Also included in the category frequent internet use are respondents, who have an index less than 0.5, but who have acknowledged that they have spent more than 3 hours daily on the internet (Liu & Kuo 2007). This condition is accepted as normal, because a person might not do many of the observed internet activities but instead only does one activity often and thus spends much time on internet. The share of those meeting the second criteria for frequency of internet activity was 89.9%.

As a result of the completed categorization procedure, three levels of activity were identified through the above-mentioned criteria (fig. 1).

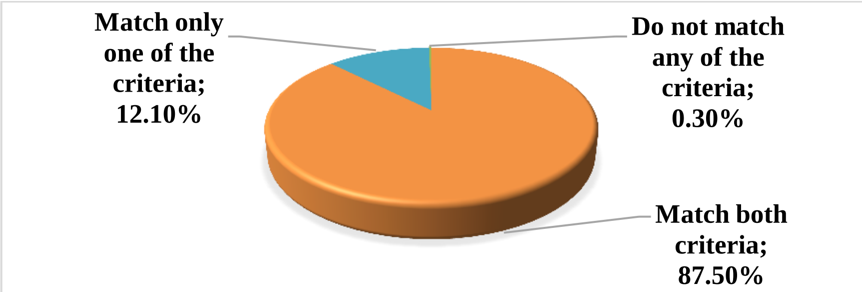


Figure 1. Structure of respondents according to whether they fall within/without the criteria for internet experience

Source: Own calculation

From the group of respondents that only met one of the purposed criteria of categorization of internet activity, 88.4% of them only met the criteria for various internet activities, and the other 11.6% – the criteria for frequency of internet activity. The data indicates that internet experience can be categorized in 3 groups: (1) great experience (students who do many activities and frequently); (2) little experience (students, who do many activities but rarely and students who do few activities but often) and (3) lack of experience (students, who do little activity and rarely).

The research raises the question of whether the students can be grouped based upon their internet experience. Such a grouping provides the opportunity to gain richer pictures of the students' internet activity. For this purpose, a clustering procedure is completed with variables of frequency of eight internet activities. Initially, several cycles of hierarchal clustering are applied using the method of between-groups linkage with applied metrics for Squared Euclidian Distance. Initially, between 2 and 10 clusters are set. Because of the large number of cases, it is difficult to use the agglomeration table and dendrogram. The analysis of the frequencies of the cluster affiliations (Appendix 1) clearly shows that in every situation between 85% and 99% of the cases are classified in one of the cluster groups. This aggregation is much too large, which forced the creation of a greater number of clusters in order to verify whether subgroups exist within the identified clusters of the previous cycle. A second clustering procedure is done with the same characteristics, which can only be differentiated from the first by the initial number of possible clusters – between 2 and 30. The analysis of the frequencies shows that in clusters 26 to 30 are formed 6 groups with more than 20 cases, 4 groups with between 10 and 19 cases and several independent clusters. No other researches on the issue are identified to further validation of the decision on the possible number of clusters. A reasonable number of clusters (based upon the number of captured values and the expected clarity of the profile of the clusters) is 6. Another clustering procedure is applied used the K-means method. The F-test from the ANOVA table (Appendix 2) shows that the three most important indicators for the results of the clustering are: the frequency of game play; the frequency of socializing with other people online; and the frequency of shopping on the internet (table 5).

Table 5.

Profile of cluster groups according to frequency of completion of observed internet activity (6 clusters)

Cluster Groups	Profile of people	Size of the cluster
Cluster 1	Play games **from time to time; often** enjoy music, films and programs; **very often** search for non-school related information; **from time to time** search for school-related information; **from time to time** use email; **from time to time** interact with others online; **very rarely** shop online; **rarely** study online	11,7%
Cluster 2	Play games **from time to time; often** enjoy music, films and programs; **often** search for non-school related information; **often** search for school-related information; **from time to time** use email; **always** interact with others online; **rarely** shop online; **very rarely** study online	20,2%

Cluster 3	Play games **from time to time; often** enjoy music, films and programs; **very often** search for non-school related information; **rarely** search for school-related information; **rarely** use email; **very often** interact with others online; **very rarely** shop online; **very rarely** study online	22,8%
Cluster 4	Play games **often; very often** enjoy music, films and programs; **very often** search for non-school related information; **often** search for school-related information; **often** use email; **always** interact with others online; **from time to time** shop online; **from time to time** study online	11,9%
Cluster 5	Play games **from time to time; often** enjoy music, films and programs; **often** search for non-school related information; **rarely** search for school-related information; **very rarely** use email; **very often** interact with others online; **often** shop online; **rarely** study online	16,5%
Cluster 6	Play games **rarely; from time to time** enjoy music, films and programs; **rarely** search for non-school related information; **rarely** search for school-related information; **very rarely** use email; **often** interact with others online; **very rarely** shop online; **very rarely** study online	16,9%

Source: Own calculation

It is difficult to tell whether it is possible to get a clear enough profile (clear inner similarity and a clear external difference) with only 6 clusters. One possible explanation is that almost all of the observed students did more than 6 of the observed internet activities. Despite that it is can be said that:

• in cluster 1 are students, who very often search for non-related school information and who enjoy music, films and programs – “seekers of general information and entertainment”;

• in cluster 2 – when they are on internet, they are always interacting with others online, enjoying films, music and programs, and searching for other information (school related and non-school related) – “chatters and searchers of entertainment and information”;

• in cluster 3 – quite often interact with other people online, search for non-school related information, and often enjoy music, films and programs – “communicators and searchers for general information and entertainment”;

• in cluster 4 are grouped students, whose activity is of a high frequency, but whose most distinctive feature is that this cluster is the only one, whose members often use email and play games – “Postal workers and gamers”;

• cluster 5 also contains students, whose activity is of a high frequency, but their only distinctive feature is that they are a grouping of people, who often shop online – “shoppers”;

• in cluster 6 are grouped students, whose activity is infrequent. The only activity which they do often is interacting with others online – “communicators”.

It can be quite reasonable to assume that it is possible to search and find not more than 6 clusters (in the group of students) according to the internet activities. We recommend conducting a quantitative study to see if the profile is "cleared" to a greater extent by reducing the number of cluster groups to 5, 4 or 3.

Intellectual curiosity raises the questions of whether the profile of the identified groups would be clearer, if there is observed a difference in behaviour while using internet? In order to identify types of behaviour on internet some of the indicators for time in the research instrument may be used: how many times a day internet is accessed; how many hours daily are spent on internet; and how many days could one go without internet. Several cluster procedures are completed upon the observed subjects using these three indicators. This grouping is done individually without combining it with the indicators of frequency of activity, so that “watered-down” profiles are not produced. The same steps are taken, such as initially completing a hierarchal cluster using the between-groups linkage method applying the metric of Squared Euclidian Distance, which initially produced between 2 and 10 clusters. The analysis of the frequencies of cluster affiliations of the respondents showed that big enough groups can be obtained with 2, 3, 4 and 5 clusters. The application of the K-means method revealed an interesting differentiation from the view of the evaluation of time that one could “go without” the internet and because of that 4 cluster groups will be examined here from that point of view of internet behaviour (table 6).

Table 6.

Profile of Cluster Groups by the type of internet behaviour (4 clusters)

Cluster Groups	Profile	Size of the cluster
Cluster 1 “Spend an inordinately long time and are consciously attached to internet”	Access internet more than 10 times day and spend 5 to 6 hours online; they claim that they cannot go a day without internet.	24,2%
Cluster 2 “Spend an inordinate amount of time, but admit that they can go without internet”	Access the internet more than 10 times a day and spend 5 to 6 hours online; they claim that they can go 9-10 days without internet.	39,4%
Cluster 3 “Spend a moderate amount of time on internet and realize they are consciously attached to internet”	Access the internet 3-4 times a day and spend 3 to 4 hours online; they claim that they cannot go a day without internet.	17,7%
Cluster 4 “Spend much time, but admit that they can go without internet”	Access internet 3-4 times a day and spend 5 to 6 hours online; they claim that they can go 9-10 days without internet.	18,7%

Source: Own calculation

It can clearly be seen according to the frequency of accessing internet and time spent on it that two main groups can be observed. It is interesting that both of these groups can be further divided into two sub-groups – one contains respondents who cannot go without internet for a day and the other, those who can go without internet for several day. This result is interesting for the consequent findings that can be taken from the data for problem internet use. Almost all authors of the examined articles on this topic are categorical that when problematic behaviour exists, there is a propensity of those affected to ignore the problem and deny its existence. In the current study, it is not possible to categorically state whether the same situation exists here. The clustering results, however, can serve in forming problem areas, which can be studied more in depth through modification and inclusion of additional research instruments and methods.

A cross-cluster analysis is done across the members of the cluster groups based upon the types of internet behaviour in order to enrich the profile of the 6 identified groups of persons according to the frequency of different internet activities (table 7).

Table 7.

Distribution of cluster affiliations based upon the frequency of different internet activities and according to the type of internet behaviour

Cluster affiliations based upon the frequency of different internet activities	Cluster affiliations according to the type of internet behavior			
	“Spend an inordinately long time and realization of consciously attached to internet”	“Spend an inordinate amount of time, but admit that they can go without internet”	“Spend a moderate amount of time on the internet and realize they are consciously attached to internet”	“Spend much time, but admit that they can go without the internet”
“Seekers of general information and entertainment”	25.0%	17.2%	34.4%	23.4%
“Chatters and seekers of entertainment and information”	24.5%	39.1%	16.4%	20.0%
“Communicators and seekers of general information and entertainment”	23.1%	47.1%	14.9%	14.9%
“E-mailers and gamers”	28.1%	50.0%	10.9%	10.9%
“Shoppers”	22.5%	49.4%	7.9%	20.2%
“Communicators”	22.5%	27.0%	27.0%	23.6%

Note: a statistically significant relationship is identified at a level of significance of 0.01.

Source: Own calculation

Several problems can be formed from the distribution, but they need to be verified through quantitative research projects:

• The majority of the group “Seekers of general information and entertainment” spent 3 to 6 hours daily on the net. Half of them know that they could “go without” the internet for several days.

• The groups “Chatters and seekers of entertainment and information”, “Communicators and seekers of general information and entertainment”, “E-mailers and gamers”, and “Shoppers” spend quite a lot of time on internet (more than 10 hours daily – according to the respondents). More than half of them, however, admit that they can go without internet for more than 10 days.

Internal structures and dependencies found in the measurements of problem internet use

In the course of testing and validation of the research instrument (Kehayova-Stoycheva et al. 2017) several tests are executed in search of other internal factor structures of variables, that would form measurable differences from the conceptually defined ones (table 1). From this view point, the results of the applied exploratory factor analysis (EFA) do not give any satisfactory results. For this reason, the first task at this study is to verify again the conceptually defined structure of dimensions of problem use of internet. For that purpose, a confirmatory factor analysis (CFA) is applied using IBM SPSS AMOS 18.0 (fig. 2).

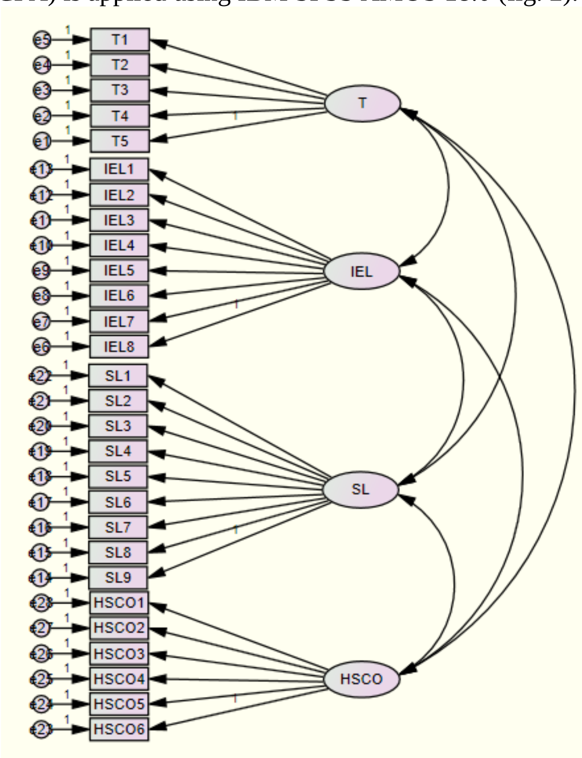


Figure 2. Path diagram for conducting a confirmatory factor analysis of the conceptual defined dimensions of problem use of internet (28 unique factors)
Source: Screenshot in AMOS

Conceptual factors structure did not produce an identifiable model in AMOS. An analysis of the data for multi-variant normal distribution of variables (completed automatically, because one of the important conditions of completing a confirmatory factor analysis is for observable variables to be distributed normally (Albright 2008; Ahmad 2005)) shows that 6 of the variables do not meet the conditions for asymmetry and excess (see Appendix 3).

Table 8.

Variables that do not meet the conditions for normal distribution

Code and Name of the Variables	**Affiliation with the conceptual dimension of problem use of internet**	**Mo and Mean for 7 point scale (1-absence of a problem – 7 – presence of a problem**	**Share of the total of Mo (%)**
SL3 – How often would you prefer to spend time on internet instead of with your favorite girl/boy?	Social Life	1 1.82	67.5
SL5 – Do you happen to prefer contact with your internet friends instead of contacting with your real friends?		1 1.92	61.2
SL8 – Do you think that internet relationships are more valuable and fulfilling in comparison with your real-life relationships?		1 1.59	78.0
SL9 – Do you perceive the internet as a "friend" that can take the place of your real friends?		1 1.77	79.4
IEL7 – Do you think that the real world is not as exciting as the activities that you take part in on the internet?	Intellectual and Emotional Life	1 1.45	68.1
IEL 8 – Do you think that internet gives you an emotional experience that you cannot find in real life?		1 1.37	61.8

Source: Own calculations

All of the indicated variables are connected to important human values – love, friendship, life and way of life. Thus, they are connected with some very important beliefs. Beliefs, which are widely held and disseminated to all levels of society especially to the level of reference group of respondents. It is possible to observe a "damaged authenticity" in the way that the students have consciously answered these questions. It is difficult to expect that a person (even one of school-age) to consciously say that they often ignore their love, because of their activities in internet. The same is true of the remaining variables in this group. Results from other studies (Children International 2006; Azadi et al. 2014; Balkan & Adalıer 2012; Jahanian & Seifury 2013) indicate that few people consciously admit a problem with their internet behaviour. Using the current research methodology, applied to this situation, however, it is impossible to prove whether the question has been consciously answered "correctly", and if yes, to understand for which of the study subjects it is true.

It is important to clarify that between 0.9% and 5.3% of the respondents have categorically shared that: the real world is not as exciting as the activities that they take part in internet; internet provides them with emotional experiences, which they cannot find in real life; quite often they prefer internet to their loved one, boy/girl; they prefer their internet friends to their real friends; their relationships on internet are more valuable in comparison to their relationships in real life and that they accept internet as a "friend", which can take the place of their real friends. Since this current research is not representative, no more generalizations can be made. It is necessary to track this group of students or other groups of students through other quantitative research projects in order to determine the real size of the group of people with "problem use of internet". However, the fact remains that such a group exists.

The aforementioned 6 variables, from the tests conducted to this point concerning the content of the measurement of problem use of internet, generate noise which interferes with extracting additional internal structures. At this point, the decision is made to repeat the confirmatory factor analysis but excluding the variables from table 8.

The second attempt is successful because of the identifiability of the proposed structure (see fig. 3). Aside from that, however, the conceptual defining dimensions did not "fit" well with the empirical data, which can be seen from the data of the initial indicators for the adequacy of the model in table 9.

Table 9.

Initial indicators for the model's adequacy (Albright 2008; Hafiz et al. 2013)

Indicators	Reference Values	Value of the Model	Conclusion
χ^2 (CMIN) – chi squared	The closer to 0 the better	1689,934	
df – degree of freedom	-	203	
P - probability	≥ 0,05	,000	Not covered
χ^2/df	≤ 2 - 5	8,325	Not covered
GFI (Goodness of fit index) – Index of matching data	≥ 0,90	0,786	Close, but not satisfactory
AGFI (Adjusted goodness of fit index) – Adjusted index of matching data	≥ 0,90	0,734	Close, but not satisfactory
CFI (Comparative fit index) – Comparable Match Index	≥ 0,95	0,631	Not covered
RMSEA (Root mean squared error of approximation) – Mean root square of covariant remnants	≤ 0,08	0,113	Not covered

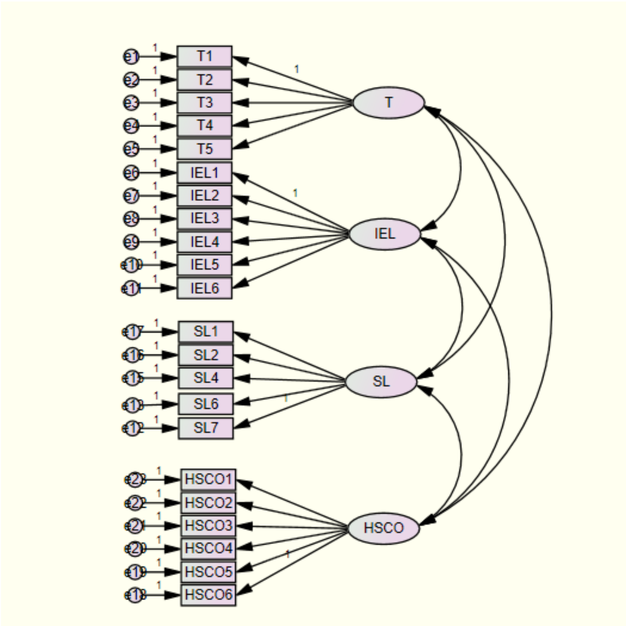


Figure 3. Path diagram for conducting a confirmatory factor analysis of the conceptual defined dimensions of problem use of internet (22 unique factors)
Source: Screenshot in AMOS

At this point in the study, it is necessary to accept an alternative hypothesis that the applied covariant matrix is not equivalent to the observed one. Practically, that means that the conceptual defining factor groups (T – Time spent on the internet; IEL – Individual and Emotional Life; SL – Social Life; and HSCO – Home and School Obligations) can have different content of the observed variables. In order to test this, an exploratory factor analysis (EFA) is conducted with 22 variables (KMO = 0.865; Bartlett's Test of Sphericity = 3351.931). 5 factors are initially extracted using the method of principal components and Varimax rotation (see all the initial data from the factor analysis with 5 factors in Appendix 4). A quick overview of the rotated component matrix shows that two indicators are found in the fifth factor. As a fact that is not an actual problem, but the results still need to be checked using the previously used four factors (see all the initial data from the factor analysis with 4 factors in Appendix 5). Comparison of the internal consistency of the newly produced factor groups (Table 10) shows that all of the groups have acceptable results (executable and close to the admissible value of 0.700) of the Cronbach α coefficient. Determining the number and contents of the factor groups is decided by the next run of the Confirmatory Factor Analysis (CFA).

Table 10.

Comparison of results from internal consistency test of factor groups with the 4th and 5th factor

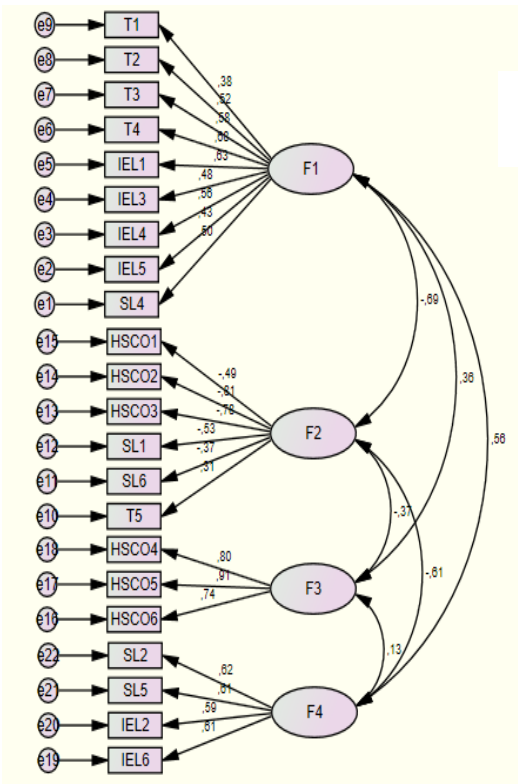
Factor and included variables	**Value of Cronbach's α**
Factor 1: T2, T3, T4, IEL1, IEL4, IEL5, SL4	0,758
Factor 2: Sl1, SL6, IEL2, IEL3, SL1, SL6	0,774
Factor 3: HSCO4, HSCO5, HSCO6	0,863
Factor 4: SL2, SL7, IEL6	0,558
Factor 5: T1, T5	0,513

Factor and included variables	**Value of Cronbach's α**
Factor 1: T1, T2, T3, T4, IEl1, IEL3, IEL4, IEL5, SL4	0,667
Factor 2: T5, SL1, SL6, HSCO1, HSCO2, HSCO3	0,536
Factor 3: HSCO4, HSCO5, HSCO6	0,863
Factor 4: SL2, SL7, IEL2, IEL6	0,690

Source: Own calculations

The factor structure of the extracted five factors obtained from the running of the Confirmatory Factor Analysis does not provide an identifiable model. In contrast, the four factor structure not only provides an identifiable model, but also most of the initial adequate indicators approach referential values (fig. 4). From this data a decision can be made that the four-factor structure is the most appropriate for the variables with which the current study is working.

All standardized regression coefficients fulfilled the requirement to be equal or greater than 0.4 (Joreskog & Sorbom 1996). Factor 1 combines nine variables, which the standardized regression coefficients move within the range of between 0.68 and 0.38 (see Appendix 6). Between 15-47% is the explainable variation of variables of this factor (see the data for R2 in Appendix 6). Looking at content relationships, the grouped variables refer to time spent on internet; frequency of getting on internet; hours of activity during the day; preference of internet to other interesting activities; "getting trapped" on internet (staying up late; longer than expected; getting on the internet while with friends); online advice from friends more often than getting advice from friends "live"; assessment of ability to go without internet; emotional condition of the subject when internet activity is interrupted (fig.4).



Basic indicators showing the adequacy of the model

χ^2 (CMIN) – 1106,960
df – 203
χ^2/df – 5,453
GFI – 0,872
AGFI – 0,840
CFI – 0,775
RMSEA – 0,088

Figure 4. Path diagram with the results of a confirmatory factor analysis with four factor structures (22 unique factors)

Source: Screenshot in AMOS

From this point of view, these factors are called "Time, Involvement, and Attachment". Involvement here means, when a person so obsessed in his internet activity that he does not meet his primary needs (sleep and longer time spent on internet that initially planned). Attachment, because the internet active person, in important situations (meetings with friends, consulting on important questions), gets online, and when it comes to important decisions, he prefers to consult others online. The most often indicated answer (Mo) based upon the measured indicators "time, involvement, and attachment" from the level of the respondents are presented in table 11.

Table 11.
Mo by indicators of the dimension "Time, Involvement, and Attachment" for the whole sample, according to sex and grade

Question	***For the whole sample***	***Sex***		***Grade***			
		Boys	***Girls***	***8th***	***9th***	***10th***	***11th***
T1.Do you spend more time than expected on internet?	Often	From time to time	Often	Often	Often	Very Often	From time to time
IEL1.Do you happen to stay up late on the internet instead of going to bed?	Very Often	From time to time	Often	From time to time	Very Often	Often	Very Often
T3.How hours a day do you usually spend on internet?	3-4	3-4	3-4	3-4	3-4	3-4	3-4
IEL4.Do you happen to get on internet even when you have other interesting activities you could be doing?	Very rarely	Very rarely	Very rarely	Very rarely	Very rarely	Very rarely	Very rarely
T2.How many times a day do you usually get on internet?	More than 10 times	More than 10 times	More than 10 times	More than 10 times	More than 10 times	More than 10 times	More than 10 times
SL4.Do you happen to get on internet while you are with friends?	From time to time	From time to time	From time to time	Often	From time to time	From time to time	From time to time
IEL3.Do you happen to be annoyed, angered, or feel some other such emotion, if for some reason your internet activities are interrupted?	Very rarely	Very rarely	Very rarely	Very rarely	Very rarely	From time to time	Very rarely
IEL5.When you are making an important decision, do you seek counsel from online friends?	Very rarely	Very rarely	From time to time	Very rarely	Never	Very rarely	Very rarely
T1. How many days can you go without the internet?	0	0	0	0	0	9 - 10	0

Source: Own calculations

The data shows that differences (according to the sex and grade they are in) in students' attitude concerning the indicators in the first dimension may be found in 3 of the indicators: whether they spend more time on internet than expected; staying up late on the computer rather than sleeping; and consulting primarily with online friends about important decisions. The other 6 indicators in this dimension mostly develop in the same way no matter whether they are girls or boys and it also did not depend on the grade the child is in.

Another comparison is completed on the indicators of the dimension. An index of problematic behaviour is calculated – indicator PBI (table 12), which reflects a ratio between the proportion of individuals with problematic behaviour and the proportion of individuals without problematic behaviour in the respective indicator. Values of an indicator < 1 show that a larger part of the researched individuals have problematic behaviour for that indicator, and values of an indicator > 1 – the opposite.

Table 12.

Values of the Problem Behavior Index according to the indicators measured for "Time, Involvement, and Attachment"

Indicator	T4	IEL1	T3	IEL4	T2	SL4	IEL3	IEL5	T1
Value of the PBI	0,27	0,53	2,66	2,69	0,17	1,02	1,31	2,6	1,19

Problem behavior at the aggregate level is observed with the indicators for: staying on internet longer than originally planned; frequency of getting on internet during the day and staying on internet until late at night instead of sleeping. For three of the indicators (whether they get on the internet while with friends; how many days they can go without the internet and do they have a negative emotional attitude, if something interrupts their internet activities), the aggregates, showing problem behavior and those that do not, are almost equal (index values are around 1).

Six indicators are grouped in factor 2. All the absolute values fulfill to a satisfactory degree the requirement to be around 0.4 (they are found in the area between 0.31 and 0.81 – Appendix 6). Almost all values have a negative impact on the factor. Between 9-61% is the accepted variation of the variables for this factor (Appendix 6). In terms of content, here are grouped indicators, which refer to ignoring various tasks or delaying to do these tasks in order to stay on the internet, as well as the assessment of the ability to reduce the use of the Internet. For this reason, this factor is called "neglecting activities and refusal to take part in other activities and readiness to decrease use of the internet". Among the respondents, no differences in student behavior can be found with regard to the dimension composite indicators (table 13).

Table 13.

Mo by indicators of the dimension "neglecting activities and refusal to take part in other activities and readiness to decrease use of the internet" for the whole sample according to sex and grade

Question	***For the whole sample***	***Sex***		***Grade***			
		Boys	***Girls***	***8th***	***9th***	***10th***	***11th***
HSCO2. Have you ever put off other engagements because of internet?	From time to time	Often	From time to time	Very rarely	From time to time	From time to time	Often
HSCO3. Have you ever completely ignored other engagements because of internet?	Never	Never	Never	Never	Never	Never	Never
SL1. Have you ever ignored members of your family?	Never	Never	Very rarely	Never	Very rarely	Very rarely	Very rarely
HSCO1. When you go home, is the first thing to do to turn on your computer?	Very rarely	Never	Very rarely	Very rarely	Very rarely	Very rarely	Very rarely
SL6. Would you refuse to go interesting school events because you prefer to stay on the net?	Never	Never	Never	Never	Never	Never	Never
T5. Do you think that if you decide to decrease your internet use, you would be able to do it?	Categorically No	Categorically No	Categorically No	Categorically No	Categorically No	Categorically No	Categorically No

Source: Own calculation

The only variable which has a low index of problem behaviour (0.48) is the variable connected to the will to decrease internet use. 32.4% of the students are categorical that they cannot achieve a decrease in their internet activities, even if they decide that they need to. Concerning the variable that students procrastinate in fulfilling their home and school commitments because of the internet, there is almost an equal proportion of students with problematic behaviour and those without. Concerning the rest of the variables in the factor group, a greater proportion of the students are without problem behaviour (table 14).

Table 14.

Values of the Problem Behavior Index of the dimension “neglecting activities and refusal to take part in other activities and readiness to decrease use of internet”

Indicator	HSCO2	HSCO3	SL1	HSCO1	SL6	T5
Value of the PBI	0,93	2,84	7,43	1,51	5,33	0,48

Source: Own calculations

Factor 3 has a clear and clean content. And the three variables grouped here are related to school commitments. It is called “school performance” (Appendix 6). And the three indicators have a very high value of the regression coefficients. All the regression coefficients are positive. The proportion of the explained variation of variables of the factor is within 55 – 83%. Independent of the student’s sex or grade in which they study, the structure of the answers for the indicators is identical. According to this assessment, the students are almost equally divided about whether internet interferes with their studies or not. The value of the index of problem behaviour according to the indicator (PBI_{HSCOS}) is 1.25. The fact that 19.2% of the respondents are categorical that internet interfered with their studies should not be ignored. Almost more than half of the students do not share the opinion that internet does not cause a lack of concentration in school (PBI_{HSCOS} = 1.65). A great number of students do not share the opinion that internet has a negative impact on their grades in school (PBI_{HSCOS}=1.89). The number of students who are categorical that internet has a negative impact are almost 15%.

The last factor, factor 4, combines the four variables, which are related to a preference for being on the internet instead of meeting with friends or eating, with the belief that internet provides a better place for getting acquainted with people than in “real” life, and with a feeling of greater comfort with the virtual world in comparison with the real world. This factor is called “Social Comfort”. All the values for the regression coefficients exceed 0.4 and the portion of explainable variation of variables of this factor is within the range of 13-39% (Appendix 6). Also with this factor no difference is registered in the structure of the behaviour concerning sex or the grade in which they study. And the four variables, which constitute the dimension of “Social Comfort”, have values in the index of problem behaviour (PBI) greater than 5.

Confirmatory Factor Analysis (CFA) shows interdependencies between the four configured dimensions (factors) (table 15).

Table 15.

Interdependencies between the dimensions for Problem Internet Use (Correlation coefficients)

Dimensions	“Time, Involvement, and Attachment”	“Neglecting activities and refusal to take part in other activities and readiness to decrease use of the internet”	“School Results”	“Social Comfort”
“Time, Involvement, and Attachment”	-	-0,698	0,356	0,623
“Neglecting activities and refusal to take part in other activities and readiness to decrease use of the internet”	-0,698	-	-0,373	-0,692
“School Results”	0,356	-0,373	-	0,148
“Social Comfort”	0,623	-0,692	0,148	-

The dimension “Time, Involvement, and Attachment” and “Neglect and Withdrawal from other activities and readiness to decrease internet use” have a moderately high and inverse proportionality, just as with the dimension “Neglect and Withdrawal from other activities and readiness to decrease internet use” and “Social Comfort”. Moderately high, but direct proportionality also exists between “Time, Involvement, and Attachment” and “Social Comfort”.

The research instrument is verified to see whether it “catches” problem behaviour on an individual level. For this purpose, five additional variables are calculated for each respondent:

• F1, which represents a total sum of the responses of the dimension indicators “Time, Involvement, and Attachment”;

• F2 – a total sum of the responses of the indicators in dimension “Neglect and withdrawal from other activities and readiness to decrease internet use”;

- F3 – a total sum of the responses of the indicators in dimension “School performance”;
- F4 – a total sum of the responses of the indicators in dimension “Social comfort”;
- PUI –total sum of the responses for all 22 variables used to measure problem use of internet.

The results of each of the new variables allow each individual to be categorized according to each variable into three categories: lack of a problem with respective variable; likelihood of problem behaviour with the respective variable; existence of a problem with the respective variable (table 16).

Table 16.

Range of intervals for categorizing the respondents based on the variables for assessing problem internet behaviour

Variables / ***Categories of respondents***	***F1*** ***9 ÷ 63***	***F2*** ***6 ÷ 42***	***F3*** ***3 ÷21***	***F4*** ***4 ÷ 28***	***PUI*** ***22÷ 154***
Lack of a problem with this variable	9 ÷ 26	6 ÷ 17	3 ÷ 9	4 ÷ 11	22 ÷ 65
More likely to exhibit problem behavior with this variable	27 ÷ 44	18 ÷ 30	10 ÷ 16	12 ÷ 20	66 ÷ 109
Existence of a problem with this variable	45 ÷ 63	31 ÷ 42	17 ÷ 21	21 ÷ 28	110 ÷ 154

Source: Own calculations

The proportion of students categorized with problem behaviour according to the variables of the dimension “Time, Involvement, and Attachment” is 15%. According to the dimension of “Neglect and Withdrawal from other activities and readiness to decrease internet use” – 4.5%; according to “School Performance” – 19.4%; according to “Social Comfort: – 1.4%. The aggregate variable for problematic internet use “catches” 2.4% of students categorizing them with problem behaviour for all the indicators used in this research instrument.

3. Conclusion

Some of the main dimensions of the term “problem use of internet” are defined. Using hierarchical clustering six clusters with people are defined.

Cluster 1 – seekers of general information and entertainment.

Cluster 2 – chatters and searchers of entertainment and information.

Cluster 3 – communicators and searchers for general information and entertainment.

Cluster 4 – postal workers and gamers.

Cluster 5 – shoppers.

Cluster 6 – communicators.

It is necessary to track other groups of students through other quantitative research projects in order to determine the real size of the group of people with “problem use of internet”.

An index of problematic behaviour (PBI) is calculated. It reflects a ratio between the proportion of individuals with problematic behaviour and the proportion of individuals without problematic behaviour in the respective indicator. The values of the PBI are calculated in the following dimensions: (1) time, involvement, and attachment, (2) neglecting activities and refusal to take part in other activities and readiness to decrease use of the internet, (3) school performance and (4) social comfort.

Four additional variables are calculated – the total sum of responses for each dimension. PUI is calculated – the total sum of the responses for all 22 variables used to measure problem use of internet. The results of each of the new variables allow each individual to be categorized according to each variable into three categories: lack of a problem with respective variable; likelihood of problem behaviour with the respective variable; existence of a problem with the respective variable. The aggregate variable for problematic internet use “catches” 2.4% of students categorizing them with problem behaviour for all the indicators used in this research instrument.

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Appendixes

Appendix 1

One-dimensional distribution of the cluster affiliation of the respondents based on the frequency of observed activities with 2 to 10 cluster groups

Average Linkage (Between Groups) – 10 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	463	80.0	85.0	85.0
	2	19	3.3	3.5	88.4
	3	24	4.1	4.4	92.8
	4	5	.9	.9	93.8
	5	5	.9	.9	94.7
	6	21	3.6	3.9	98.5
	7	1	.2	.2	98.7
	8	5	.9	.9	99.6
	9	1	.2	.2	99.8
	10	1	.2	.2	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

Average Linkage (Between Groups) – 9 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	482	83.2	88.4	88.4
	2	24	4.1	4.4	92.8
	3	5	.9	.9	93.8
	4	5	.9	.9	94.7
	5	21	3.6	3.9	98.5
	6	1	.2	.2	98.7
	7	5	.9	.9	99.6
	8	1	.2	.2	99.8
	9	1	.2	.2	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

Average Linkage (Between Groups) – 7 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	487	84.1	89.4	89.4
	2	25	4.3	4.6	93.9
	3	5	.9	.9	94.9
	4	5	.9	.9	95.8
	5	21	3.6	3.9	99.6
	6	1	.2	.2	99.8
	7	1	.2	.2	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

Average Linkage (Between Groups) – 6 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	512	88.4	93.9	93.9
	2	5	.9	.9	94.9
	3	5	.9	.9	95.8
	4	21	3.6	3.9	99.6
	5	1	.2	.2	99.8
	6	1	.2	.2	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

Average Linkage (Between Groups) – 5 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	517	89.3	94.9	94.9
	2	5	.9	.9	95.8
	3	21	3.6	3.9	99.6
	4	1	.2	.2	99.8
	5	1	.2	.2	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

Average Linkage (Between Groups) – 4 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	538	92.9	98.7	98.7
	2	5	.9	.9	99.6
	3	1	.2	.2	99.8
	4	1	.2	.2	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

Average Linkage (Between Groups) – 3 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	539	93.1	98.9	98.9
	2	5	.9	.9	99.8
	3	1	.2	.2	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

Average Linkage (Between Groups) – 2 cluster groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	540	93.3	99.1	99.1
	2	5	.9	.9	100.0
	Total	545	94.1	100.0	
Missing	System	34	5.9		
Total		579	100.0		

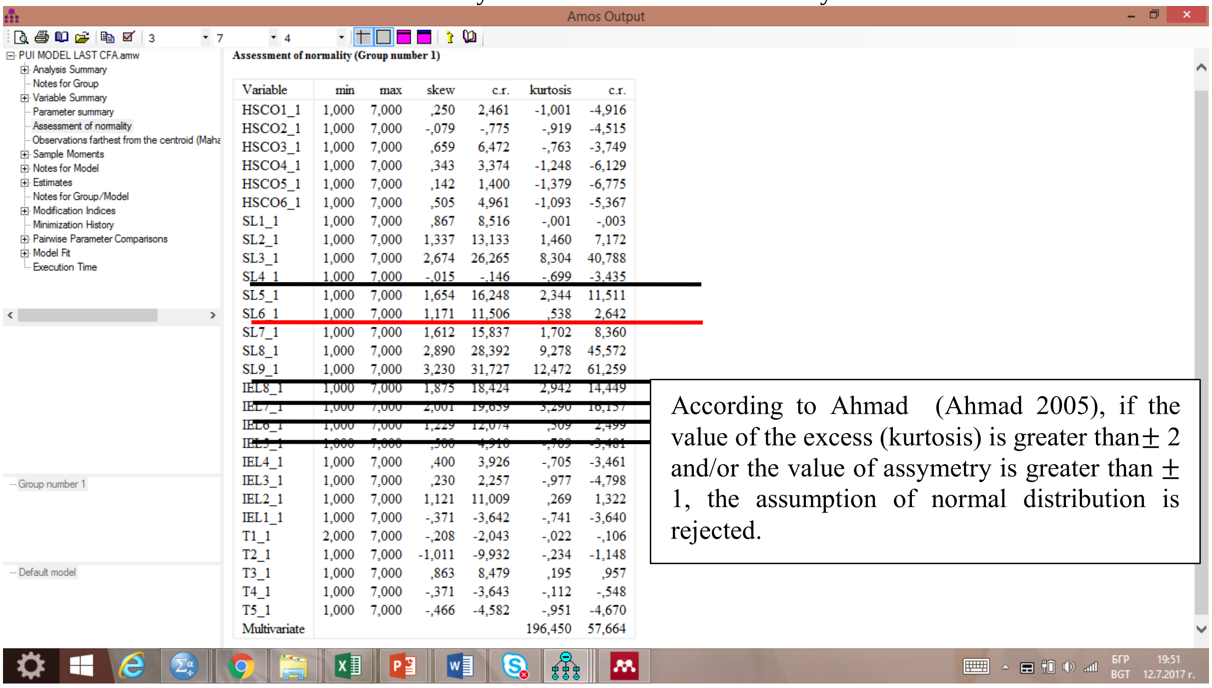
Appendix 2

ANOVA table of conducted clustering of variables for the frequency of completed internet activities using the K-mean method with 6 clusters

Question	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
A6.1. How often do you play games?	36.044	5	.221	539	162.743	.000
A6.2.How often do you download music, films, games and programs from the internet?	59.330	5	1.480	539	40.083	.000
A6.3.How often do you search for non-school related information on the internet?	109.531	5	1.276	539	85.860	.000
A6.4.How often do you search for school-related information on the Internet?	72.015	5	1.613	539	44.659	.000
A6.5.How often do you use email?	103.989	5	1.422	539	73.114	.000
A6.6.How often do you socialize with others online?	106.239	5	1.064	539	99.891	.000
A6.7.How often do you shop on the Internet?	122.268	5	1.296	539	94.311	.000
A6.8.How often do use the Internet to help you study (courses, tests, etc.)?	79.549	5	1.596	539	49.828	.000

Appendix 3

Screenshot of the results from the analysis of the multivariant normality of observed variables in AMOS



Assessment of normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
HSCO1_1	1,000	7,000	,250	2,461	-1,001	-4,916
HSCO2_1	1,000	7,000	-,079	-,775	-,919	-4,515
HSCO3_1	1,000	7,000	,659	6,472	-,763	-3,749
HSCO4_1	1,000	7,000	,343	3,374	-1,248	-6,129
HSCO5_1	1,000	7,000	,142	1,400	-1,379	-6,775
HSCO6_1	1,000	7,000	,505	4,961	-1,093	-5,367
SL1_1	1,000	7,000	,867	8,516	-,001	-,003
SL2_1	1,000	7,000	1,337	13,133	1,460	7,172
SL3_1	1,000	7,000	2,674	26,265	8,304	40,788
SL4_1	1,000	7,000	-,015	-,146	-,699	-3,435
SL5_1	1,000	7,000	1,654	16,248	2,344	11,511
SL6_1	1,000	7,000	1,171	11,506	,538	2,642
SL7_1	1,000	7,000	1,612	15,837	1,702	8,360
SL8_1	1,000	7,000	2,890	28,392	9,278	45,572
SL9_1	1,000	7,000	3,230	31,727	12,472	61,259
IEL8_1	1,000	7,000	1,875	18,424	2,942	14,449
IEL7_1	1,000	7,000	2,001	19,659	3,290	16,157
IEL6_1	1,000	7,000	1,229	12,074	,509	2,499
IEL5_1	1,000	7,000	,500	4,910	-,709	-3,481
IEL4_1	1,000	7,000	,400	3,926	-,705	-3,461
IEL3_1	1,000	7,000	,230	2,257	-,977	-4,798
IEL2_1	1,000	7,000	1,121	11,009	,269	1,322
IEL1_1	1,000	7,000	-,371	-3,642	-,741	-3,640
T1_1	2,000	7,000	-,208	-2,043	-,022	-,106
T2_1	1,000	7,000	-1,011	-9,932	-,234	-1,148
T3_1	1,000	7,000	,863	8,479	,195	,957
T4_1	1,000	7,000	-,371	-3,643	-,112	-,548
T5_1	1,000	7,000	-,466	-4,582	-,951	-4,670
Multivariate					196,450	57,664

According to Ahmad (Ahmad 2005), if the value of the excess (kurtosis) is greater than ± 2 and/or the value of assymetry is greater than ± 1, the assumption of normal distribution is rejected.

Appendix 4

Initial results of the completed exploratory factor analysis – 22 variables – 5 extracted factors

KMO and Bartlett‘s Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.865
Bartlett‘s Test of Sphericity	Approx. Chi-Square	3351.931
	df	231
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.716	25.982	25.982	5.716	25.982	25.982	2.942	13.372	13.372
2	2.316	10.526	36.508	2.316	10.526	36.508	2.847	12.943	26.314
3	1.614	7.335	43.843	1.614	7.335	43.843	2.495	11.341	37.655
4	1.174	5.338	49.181	1.174	5.338	49.181	1.985	9.024	46.679
5	1.054	4.792	53.973	1.054	4.792	53.973	1.605	7.294	53.973
6	.979	4.448	58.421						
7	.892	4.057	62.478						
8	.865	3.931	66.409						
9	.765	3.476	69.885						
10	.752	3.417	73.302						
11	.687	3.124	76.426						
12	.641	2.914	79.340						
13	.632	2.874	82.215						
14	.599	2.721	84.936						
15	.559	2.539	87.475						
16	.523	2.377	89.852						
17	.483	2.195	92.047						

18	.460	2.089	94.136						
19	.422	1.917	96.052						
20	.370	1.682	97.735						
21	.274	1.247	98.982						
22	.224	1.018	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

Question	Component				
	1	2	3	4	5
IEL4.Do you ever get on internet even when there are other interesting activities?	.641	.252	.079	-.006	.032
IEL5.Do you mainly seek advice from your online friends when you are making an important decision about your life and future?	.627	-.142	.209	.225	.010
T2.How often do you usually get on internet no matter the reason why?	.563	.038	.065	-.050	.348
SL4.Do you ever get on internet while you are with friends?	.552	.220	.000	.113	-.012
T4.Do you stay on the net longer than you had planned?	.549	.296	.171	.028	.257
T3.How many hours a day do you usually spend on the Internet daily?	.492	.126	.004	.188	.394
IEL1.Do you ever to go to bed late and stay on internet instead of going to sleep?	.491	.313	.159	.162	.260
HSCO2.Do you ever put off doing your chores or homework because you are surfing the net?	.170	.750	.252	.066	.168
HSCO3.Do you ever completely ignore your chores or homework because you are surfing the net?	.224	.727	.234	.000	.126
SL1.Do you ever ignore members of your family for the sake of your internet activities?	.342	.516	.040	.277	.032
IEL3.Do you ever get irritated, angry or react sharply, if your internet activities are interrupted for some reason?	.452	.513	-.049	.017	-.131
SL6.Would you refuse to take part in an interesting school event because you preferred to stay on the net?	-.146	.495	-.102	.389	.187
IEL2.Do you ever miss a meal so that you don’t interrupt what you are doing on internet?	.336	.453	.098	.350	.017
HSCO1. When you go home, is the first thing to do to turn on your computer?	.115	.453	-.015	.331	.247
HSCO5.Does the time you spend on internet distract you from studying?	.151	.154	.878	-.026	.051
HSCO4.Does the time you spend on internet interfere with your concentration at school?	.165	.003	.866	.003	.016
HSCO6.Does the time you spend on internet have a negative impact on your grades in school?	.011	.135	.843	.022	-.038
SL7.Do you think that you can get to know a person better on internet than through personal contact?	.053	-.064	.041	.734	.000
IEL6.Do you feel more comfortable in the virtual world than in the real world?	.184	.224	.029	.683	-.071
SL2.Do you often prefer to stay at home surfing the Internet rather than going out with friends?	.090	.329	-.085	.579	.149
T5.Do you think that if you decide to use the internet less and for shorter periods of time that you will be able to do it?	-.006	-.167	-.033	-.168	-.761
T1.How many days do you think that you would be able to go without internet?	-.296	-.061	.036	.149	-.651

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Appendix 5

Initial results of the completed exploratory factor analysis – 22 variables – 4 factors

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.865
Bartlett's Test of Sphericity	Approx. Chi-Square	3351.931
	df	231
	Sig.	.000

Rotated Component Matrix[a]

Question	Component			
	1	2	3	4
T2.How many times a day do you get on the internet no matter the reason why?	.641	.108	.037	-.109
IEL4.Do you ever get on the Internet even when there are other interesting activities?	.631	.106	.130	.110
T4.Do you stay on the net longer than you had planned?	.609	.278	.185	.043
IEL5.Do you mainly seek advice from your online friends when you are making an important decision about your life and future?	.598	-.214	.190	.235
T3.How many hours a day do you usually spend on the Internet?	.586	.236	-.035	.094
IEL1.Do you ever to go to bed late and stay on the internet instead of going to sleep?	.553	.314	.164	.157
SL4.Do you ever get on the Internet while you are with friends?	.531	.083	.044	.218
T1.How many days do you think that you would be able to go without the Internet?IEL3.Do you ever get irritated, angry or react sharply, if your internet activities are interrupted for some reason?	-.473	-.330	.108	.342
IEL3.Do you ever get irritated, angry or react sharply, if your internet activities are interrupted for some reason?	.411	.274	.058	.231
HSCO2.Do you ever put off doing your chores or homework because you are surfing the net?	.234	.677	.324	.157
HSCO3.Do you ever completely ignore your chores or homework because you are surfing the net?	.273	.621	.316	.118
SL6.Would you refuse to take part in an interesting school event because you preferred to stay on the net?	-.077	.565	-.092	.356
T5.Do you think that if you decide to use the internet less and for shorter periods of time that you will be able to do it?	-.227	-.551	.075	.123
HSCO1. When you go home, is the first thing to do to turn on your computer?	.191	.508	-.009	.301
SL1.Do you ever ignore members of your family for the sake of your internet activities?	.349	.400	.098	.378
HSCO5.Does the time you spend on the Internet distract you from studying?	.170	.108	.876	-.027
HSCO4.Does the time you spend on internet interfere with your concentration at school?	.168	-.036	.849	-.016
HSCO6.Does the time you spend on internet have a negative impact on your grades in school?	.009	.074	.846	.032
IEL6.Do you feel more comfortable in the virtual world than in the real world?	.156	.163	.032	.699
SL7.Do you think that you can get to know a person better on the Internet than through personal contact?	.042	-.011	-.015	.640
SL2.Do you often prefer to stay at home surfing the Internet rather than going out with friends?	.132	.378	-.096	.534
IEL2.Do you ever miss a meal so that you don't interrupt what you are doing on internet?	.337	.345	.143	.433

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Appendix 6

Standardized regression coefficients and coefficients of determination (R^2) according to factor groups

Code	Content of the Indicator	Standardized regression coefficient	Coefficient of determination (R^2)
Factor 1: Time, Involvement and Attachment			
T4	Do you stay on the net longer than you had planned?	0,68	0,47
IEL1	Do you ever to go to bed late and stay on the internet instead of going to sleep?	0,63	0,39
T3	How many hours a day do you usually spend on the Internet daily?	0,58	0,34
IEL4	Do you ever get on the Internet even when there are other interesting activities?	0,56	0,31
T2	How often do you usually get on the Internet?	0,52	0,27
SL4	Do you ever get on the Internet while you are with friends?	0,50	0,25
IEL3	Do you ever get irritated, angry or react sharply, if your internet activities are interrupted for some reason?	0,48	0,18
IEL5	Do you get advice mainly from online friends when you are making an important decision?	0,43	0,22
T1	How long do you think you can go without internet?	0,38	0,15
Factor 2: Neglecting activities and refusal to take part in other activities and readiness to decrease use of the internet			
HSCO2	Do you put off other commitments because of the internet	- 0,81	0,65
HSCO3	Do you ever ignore completely your commitments because of the Internet	- 0,78	0,61
SL1	Do you ever ignore member of your family	- 0,53	0,28
HSCO1	When you go home, is the first thing to do to turn on your computer	- 0,49	0,24
SL6	Would you refuse to take part in an interesting school event because you preferred to stay on the net	- 0,37	0,14
T5	Do you think that you can decrease your internet usage if you decide to	0,31	0,09
Factor 3: School Results			
HSCO5	Time spent on the Internet distracts you from your studies	0,91	0,83
HSCO4	Time spent on the internet interferes with good concentration at school	0,80	0,64
HSCO6	Time spent on the internet has a negative impact on your school grades	0,74	0,55
Factor 4: Social Comfort on the Internet			
SL2	Surfing the internet versus opportunities to go out with friends	0,64	0,39
IEL6	Feel more comfortable on the internet than in real life	0,61	0,37
IEL2	Miss meals because of the Internet	0,59	0,35
SL7	People online can be known better than those in real life	0,36	0,13

Мисли за недоказани хипотези

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Резюме. Цел на настоящата статия е представяне на една философска гледна точка за счетоводството. Използван е философският подход както на класици във философията, така и съвременна гледна точка. Счетоводните проблеми са пречупени през призмата на философския поглед. Дискутира се емпиричното изследване в счетоводството чрез наблюдение и обобщение. Дадени са някои философски виждания за връзки на математиката с икономиката, математиката и иконометрията.

Ключови думи: счетоводство, философски подход.

1. Формулировка на проблема

Озаглавих тази статия така по следните съображения: първо, счетоводството днес е изправено пред нови предизвикателства; второ, промените в икономическата наука се отразяват по своеобразен начин върху него; трето, извършва се пробив в стари стереотипи и канони, превъзмогват се заблуди, възникват нови теории и хипотези; четвърто, появяват се нови разработки, оспорващи значимостта и пълнотата на доминиращата теория; пето, старото се руши, новото е в зародиш, все още не е кристализирало като същност и форма. Това налага да се обърнем с лице към някои нерешени въпроси в счетоводството, някои да поставим на вниманието на читателя.

Авторът, от гледище на теорията и методологията на икономическата наука, има за цел да постави някои нерешени въпроси пред счетоводната мисъл. Някои могат да звучат по странен начин, по тия причини в заглавието е сложен текст „Мисли за недоказани хипотези”. Може би това ще привлече вниманието на научната общност.

2. Изходни предпоставки и анализ на проблема

Не претендираме на бъдем специалисти в теорията на счетоводството и затова не можем да вникнем в нейните тънкости и детайли. Това, че не сме специалисти, не значи че не бива да се докосваме до нея. Теорията не може да бъде дело само на специалисти, работещи в това направление. За съжаление това продължава и днес. Нашите предци имаха по-друг подход, проследим ли историята, Кант, Хегел,

О. Конт, К. Маркс, И. Пригожин и пр. разглеждаха нещата на по-широк фронт. И това има своя логика. Всеки, който се занимава с частни въпроси, не може да отмине общите. Той на всяка крачка се сблъсква с тях. Теорията на икономиката представлява едно цяло. За да я изучим, ние изкуствено я разделяме на отделни части. Нямаш ли усет за цялото, нямаш усет за частта. Частта не е цялото, въпреки че в диалектически снет вид го съдържа. В последно време сме свидетели на друг подход. Частта се затваря и капсулира в себе си, не се открива за други системи, откъсва се от цялото, попадаме в тясна специализация, от рода на тази: лекарят се специализира за едното ухо, а друг за другото, като че ли този афоризъм не е лишен от съдържание.

Може да звучи парадоксално, към счетоводството все още не се прилага философски подход. В наши дни, ние сме свидетели на пробив в тази посока. Школата на Соколов дава пример в това отношение. Вече се появиха и първите публикации. У нас по едни или други причини отсъстват такива. Предимство се дава на чисто счетоводни проблеми от рода: кои приходи и разходи към коя сметка следва да се отнесат. Не отричам този подход, но теорията на счетоводството не бива да се свежда само към това, нейн недостатък е, че се затваря в рамките на своя предмет, не се отваря към други дисциплини и системи.

Теорията трябва да се оценява от различни гледни точки. Тя не бива да се разглежда единствено от гледище на нейните постулати.

Но животът е многолик. Той не търпи схеми и шаблони. Има многолинейност на икономическата динамика, което се отнася не само за икономическата наука, но и за естествените. Теоретична система съдържа две сили: центростремителна и центробежна. Първата се стреми да запази целостта на системата, ядро и защитен пояс. Втората, елементите да излизат извън пределите на тази система, да придобият статус на самостоятелно функциониране.

Днес съществуват нови теоретични системи: комбинация, коалиция, интеграция, съжителство на теории от различен род, проникване на системи една в друга, отпор и възмущение на системи, социална алергия, недопускане на системата да прониква в други системи. Това важи и за счетоводството. Като вид система то не може да остане извън други теоретични системи, не бива да пренебрегва философския подход в своя анализ и да се свежда само до практическа приложимост на знанията, да се превръща в своего рода занаят. Теоретичните системи са отражение на реални икономически процеси. Една система може да бъде безупречна от гледище на самите постулати, които я съставляват, но сравнена с друг ранг системи да не бъде дотам плодотворна и научно издържана. Да посочим някои примери: Евклидовата геометрия е безупречна от гледище на своята същност - две успоредни прави не се пресичат, но сравнена с неевклидовата геометрия, тази на Лобачевски, това не е така. Двете линии в далечината се пресичат, тъй като има изкривяване, усукване на пространството.

Припомням тези неща по следните съображения: първо проблемите на счетоводството са проблеми не само на него, но и на други теории; второ, то не може да се обясни с една единствена теория, заложена още от времето на Л. Пачоли (1494 г.); трето, теоретичното познание да се опира на по-широка основа; четвърто, да бъде дело на синтез от теории. А това налага преоценка на доминиращата теория, остаряла ли е тя, или в стадия на информационното общество стеснява своя обхват, губи предназначение или придобива друго изражение. Този въпрос няма еднозначен отговор. Той се нуждае от по- голяма обстоятелственост.

3. Теоретично и емпирично познание и неговата значимост в анализа на счетоводните проблеми

Този въпрос днес придобива злободневен характер. Ако преди теорията е била на почит и уважение, сега е на заден план, дори може би - забрава. Внушава ни се, че емпиричното познание трябва да бъде приоритетно, то като че ли е непосредствената практика. Много дисертации, хабилитационни трудове, научни изследвания следват пътя на описанието: цифри, таблици, взети в готов вид от разни статистически сборници. Теорията се губи, доколкото е налице, има обзорен, обобщаващ характер, разпиляна е, липсва стройност на изложението, не съдържа нови неща, изпъстрена е със стари клишета и банални истини. Преподаването също има такъв характер.

Това не трябва да бъде път на научното изследване и на самото преподаване. Без да влизам в спор и в тънки детайли на проблема, ще посоча само някои изходни положения. Всяка научна разработка, както и преподаването на икономически знания трябва да почива на три „кита” (стълба): философия, теория и методология, практическа приложимост. Тези неща, като че ли, ги няма, връх взима емпириката. Тя обаче не може да обхване и разкрие същността, а само описва външната, повърхностна страна на явленията. Емпиричното познание е частично знание, необходимо, но не достатъчно да разкрие същността. То не изчерпва знанията в неговата цялост. Икономическата наука, както и счетоводството, не е само емпирична наука, каквито твърдения се срещат. Те обхващат: теоретическо знание, емпирично познание, парадигматично, инструментално познание, опитно познание, дедуктивно познание. Сложната съвкупност на счетоводството не може да се представи и изучи само от едно познание - емпиричното.

Теорията и емпириката са степени на човешкото познание и като такива са в единство и противоречие. Теоретичната наука не е емпирична наука, но не е и априорна. Истината не може да се разкрие само чрез логически априорен път. Логическата строгост и вътрешната непротиворечивост не ни предпазва от грешки и правилни теоретични конструкции. Правилно построени силогизми могат да имат резултати, противоречащи на действителността. Всяко наше знание започва благодарение на сетивата ни, преминава после към разсъдъка и завършва след това в разума. Първата степен на познание е сетивното, чувственото, след това - логическото, абстрактното. Двете страни на познанието трябва да вървят ръка за ръка „всички обекти, които представляват субстрат на човешкото усещане, възприятие и наблюдение, преминават и през сетивата на животните. Но само човекът може да преобразува сетивните стимули в наблюдение и опит и отново само той може да подрежда различните наблюдения и опит в съгласувана система (Л. фон Мизес 2015).

Теоретичното познание в счетоводството разкрива същността на явлението посредством наблюдение и обобщение. Емпиричното познание, обаче не обхваща всички степени на познание. От тази гледна точка, недооценката на икономическата методология и теория на познанието у нас не е оправдана. Интересът към тях спада. Счетоводството трябва да очертае своето проблемно поле и методология, да види дали „ядрото” и „защитния пояс” дали не са застрашени. А това налага да навлезем в по-широк кръг на икономическо изследване.

Така че схващането за приоритет на емпиричното познание и преподаване е лишен от всяко основание. То затваря пътя на по- модерни методи на познание - не е предимство, а недостатък на самата теория и на преподаването. За да бъде преодоляно противоречието, би могло да се отива към някакво “споразумение”, съглашение (конвенционализъм) между различните теоретически школи.

Икономиката преминава от едно състояние в друго, от хаос към порядък и обратното, от порядък към хаос (И. Пригожин, И. Стенгерс 2001). Тогава може ли проблемите на счетоводството да се обяснят с една единствена теория. В живота, както казах, съществува и нелинеен път на развитие, а той не се побира в рамките на доминиращата парадигма в счетоводството. В хода на човешкия прогрес, на цивилизацията, науката се освобождава самоочиства от ония теории и грешки, които пречат на този прогрес и на тази цивилизация. Доминиращата теория не може да се приеме за вечна и универсална за всички времена.

4. Счетоводната наука в контекста на парадигмата на Т. Кун

Тук, може да се възрази – парадигмата на Кун се отнася най-вече до естествените науки и по-специално до класическата физика и астрономия. Това не се отрича, но не означава, че трябва да се отхвърли нейната методология спрямо икономическата наука. За да се види, доколко е приложима, нека видим нейната концептуална същност. Отчасти за това стана дума, сега ще разгледаме проблема от друг ъгъл на зрение. Т. Кун изхожда от следните обстоятелства (Т. Кун 1996):

1. Науката, в случая счетоводната се развива в съответствие някои модели

2. Група учени откриват други модели и теории, други закономерности, т.е. по-ефективни методи на научно познание. И на тази основа търсят, дали твърденията подлежат на емпирична проверка, ако не, коригират своите принципи.

3.Парадигмата търси начини по новому да се обяснят факти, събития, които влизат в теорията и преподаването на учебни дисциплини и невъзможността те да се осветлят с предишни теории.

Основните положения на тази парадигма, изразена в неговата книга „Структурата на научните революции” се свежда до това: науката се развива в съответствие с някои теории и модели, т. нар. допарадигмен период, съществуват различни конкуриращи теории, но нито една не е доминираща; парадигма, доминираща сред останалите школи, всички признават нейната ръководна роля; нормално развитие на науката; кризисен стадий; поява на нова парадигма; промени в структурата на научната революция, утвърждаване на нова парадигма в структурата на научното познание; възвръщане към стадия на нормалната наука.

Вписват ли се тези изисквания към счетоводната наука?

В определен смисъл да, но аз не ги разглеждам.

Тук възниква въпроса, дали фактите и събитията в счетоводството могат да се обяснят с доминиращата теория, заложена още от Лука Пачоли. Ако не - настъпва криза в научната революция. Старата теория или се отхвърля или стеснява своя обхват. Старите знания се фалшифицират, опровергават и се дава път на знания, обусловени от новата парадигма.

Теорията на счетоводството, според нас не може да предложи за сега по-конструктивни програми, от тези които са в момента. Вероятно ще се възрази, че има други парадигми в счетоводната отчетност: Първо, антропологическа (счетоводната практика определя теорията; второ конюнктурна (пазара формира теорията); трето, събитийна (прогностична функция) четвърто, процесуална (процес на вземане на решения); пето, идеологизирана; шесто, информационна (оценка на информацията за фактите на стопанския живот) седма, биховерстична (изучаване поведението на лицата, приемащи решения). Тези парадигми в комбиниран, съдържателен план могат да се ппредставят по-следния начин: униграфическа, диаграфическа, камерална (Е. И. Зуга 2012, Н.В. Генералова, Н.А. Соколова 2012).

Това, според нас, не са парадигми в строгия философски смисъл на това понятие, приложени към икономическия анализ, те повече наподобяват на икономически подходи, но не и на парадигми. Фактът, че счетоводството има допирни точки с правно-административни актове и с институциите, не го превръща в правна и институциална наука. Доминиращата теория на счетоводството страда от един съществен методологически порок. Тази теория се представя за универсална, присъща на всички стадии на обществото. Всяка теория е ограничена от времето, при което възниква. Няма теория за всички времена. Ако теорията не се потвърждава от основните факти, поставя се под съмнение нейната общовалидност.

Провъзгласила се за непоклатима и универсална, системата на двойното счетоводство се опълчва срещу теории, които засягат нейната концептуална същност. Какво значи универсалност? Това е неизменност на реда. Всичко, което противоречи на него се отрича. Теориите не се разглеждат в тяхната цялост, като степени на човешкото познание. Тази методологическа слабост съзря и Имре Лакатош. "Ако разгледаме най-значимите последователности на теориите, имащи място в историята на науката, то видно е, че се характеризират с непрекъснатост, свързващ техните елементи в едно цяло" (И. Лакатош 1995).

Счетоводството не бива да се обвързва само с една единствена теория. В тази връзка не е излишно да припомним словата на Имре Лакатош: "За Попър, пише той, изменението на науката е рационална или поне се поддава на рационална конструкция и попада в сферата на откритието. За Кун изменението на науката - от една парадигма към друга - е мистично обръщение в друга вяра, което не се ръководи и не може да се ръководи от правилата на разума, и което изцяло попада в сферата на (социалната) психология на о т к р и т и е т о. Изменението на науката има религиозен характер" (И. Лакатош 1995).

Този подход, приложен към теорията на счетоводството я обрича на застой. Моите възражения срещу него се свеждат до следното: първо, преходът на икономическата наука от една парадигма към друга, е плод не на мистиката, а резултат на икономическите промени на действителността; второ, "правилата на разума" не са умозрителни заключения, а отражение на реални обективни икономически процеси; трето, логическите форми на мисленето, на разума могат да имат самостоятелно битие, но те не могат и не бива да се откъсват от своята обективна основа; четвърто, разумът освободен от съдържанието (реалността) е спекулативна измислица, граничеща с мистиката, откриваща път на идеализма.

Да се признае непоклатимостта на дадена теория и свързани с нея категории, това значи да се отрича историческия характер на икономическата наука и свързаните с нея категории. Това значи, че са конструирани по естествен начин, че развитието им следва този път, а другите по изкуствен начин. Това твърде много напомня "Краят на историята" на Фукояма, която обрича самата история на застой. Без критика на старото, не може да се утвърди настоящето. Старото обаче не следва да се отрича изцяло, а да се вгражда в настоящето и бъдещето, от гледище на целите на движението.

Науката е низ от теории, съединени в едно цяло. Критика към доминиращата теория трябва да има не само по време на криза, но и в зачатие и възход от нейното развитие. Критика преди към марксизма нямаше. Той се възхваляваше и абсолютизираше, пригаждаше се към една или друга политическа групировка (номенклатура). Всяко отклонение се смяташе за ерес, проява на буржоазна идеология. Нещата в действителност стоят много по-различно. Дори да приемем, че дадена теория е в своя апогей, резултатите, дори и емпирично потвърдени, не винаги издържат на проверовъчния тест на времето, което не означава, че критиката трябва да отслабва. Нашето познание се развива и усъвършенства. Това, което вчера е било истина, днес престава да е. Учените днес например оспорват валидността на Дарвиновата теория, теорията на относителността на Айнщайн и пр. И. Лакатош се позовава на теорията на Нютон. "Когато тя възникна, първо около нея бе океан от "аномалии" (ако е угодно "контрапримери") и тя встъпи в противоречие с теориите утвърждаващи тези аномалии. Но, проявилите изобретателност и блестящо остроумие нютоновци превърнаха един контра- пример в друг подкрепящ пример. И това те направиха главно за сметка на неопровержението на тези изходни "наблюдателни" теории, на основанието на които се установили тези "опровергаващи" данни. Те всяка нова трудност превърнаха в нова победа на своята програма" (И. Лакатош 1995).

Това се отнася, както за счетоводството, така и за неокласическата теория, всяка трудност превръща ли се в победа на тяхната програма? Да вземем за пример свободния пазар. Неговите принципи не могат да придадат социална насоченост на пазара. Прекомерната им свобода доведе и до днешната криза. Тя е криза не само на икономиката, но и на теориите, които я осветляват и обясняват, в алтернативите на нейното разрешаване.

Раждането или смъртта на теорията зависи от фактите. Може ли те да се изразят и обяснят с парадигма, носеща теоретичните белези на 1494 год.? Научната теория винаги отхвърля ония идеи, които не съвпадат с талвега на историята и оправдава ония от тях, които спомагат за неизбежните промени. Трябва да се отрича старото, което пречи на утвърждаването на новото, да се насърчават идеите на промяната. Такава е диалектиката на новото. Научното знание трябва да се основава на строгата обективност на фактите, логически да ги обобщава и извежда закономерностите, да представя в логическа форма историческия процес от простото към сложното, от нисшето към висшето, да включва пред идещето като необходима предпоставка но недостатъчно за обяснение на специфичното съдържание на знанието от по-висш ранг, т.е. да поставя нещата, идеите, науката и пр., в определена йерархия, както се изразява Огюст Конт.

Слабото звено в теорията и преподаването на счетоводството е, че те не се основават на солидна философска основа. То не се разглежда като философия, методологията отсъства, преобладава схоластика и емпиризъм. Теорията не е в състояние да обясни преходните процеси, обусловени от информационното общество. Налице са два подхода: първият, несъответствието на теорията на фактите трябва да се търси не в научното познание, а в самите факти, ако то не отговаря на тях “толкова по-зле за самите факти”.

Научното знание се извежда от непротиворечивостта на логическите форми. В много случаи те се откъсват от своята обективна основа, свеждат се до начин за построяване на нашите мисли по някакви граматически правила. Тази теза е неприемлива. Наистина логическите форми могат да имат самостоятелно битие, отделени обаче от съдържанието си, те откриват пътя на мистиката и спекулацията, превръщат се в игра на думи. “Противоречието е критерий за истината, отсъствието на противоречие - критерий за заблуждение” (Хегел).

Ние трудно се разделяме с установилото се и мъчно свикване със ставащото. Нашето съзнание някак си е приковано към бива- щото (към определен вид знание), приобщени оставаме, като че ли слепи и неми към други теории и системи. Претенцията за истинност обаче може да се превърне в оръжие на неистинност чрез обстоятелствата, които я опровергават. Истината не бива да се затваря в себе си, в своята черупка, а да се отваря към други системи и теории, да търси опора в реалния свят на икономиката. Това като че ли в по-малка степен важи за неокласическата теория. Тя се затваря в себе си, брани концептуалната си същност с всички средства, опълчва се срещу ония, които посягат на нейното “твърдо ядро” и “защитен пояс”.

Теорията се проверява чрез грешките си. Ако те застрашават “твърдото ядро” и защитния слой около него бе отслабен, устойчивостта се нарушава, научността на теорията губи своята сила, тъй като постулатите върху които тя се гради не издържат проверка на времето. Не бива да се забравя и това, че обективността на счетоводната парадигма, както и на всяка друга теория, не е абсолютна, а относително обективна.

Има опознати и неопознати неща. Познатите неща в зависимост от степента на научното познание могат да бъдат отхвърлени и опровергани. В живота възникват нови факти, нови наблюдавани явления, старите факти губят своята достоверност, теорията основана върху тях губи своята научност. Дали всякога това е така?

Науката открива факти и закономерности в рамките на определено време. Но ако след това се открият нови, които противоречат на постулатите на теорията, учения би следвало да суспендира старите схващания и да представи нови, обусловени от времето. Изправени сме пред две дилеми: първата да снеме проблема, втората, да намери начин за неговото разрешаване.

Наличието на несъответствие на факти и на теория още не е критерий изцяло да се отхвърли една или друга теория. Тук възникват нови обстоятелства: първо, не всички неща от сложната съвкупност могат да се проверят, има неща които не могат да се проверят, което крие опасност за несъответствие на теория и факти; второ, верността, или неверността на една теория се проверява или опровергава от достатъчен брой факти. Ако ги има добре, но ако не са налице, как следва да се процедира?

Проблемът може да се реши чрез логическата непротиворечивост на теоретичната система. Ако не се наруши, теорията запазва своята научност, тя обаче може да отключи плурализмът и конкуренцията на нови теории. В рамките на нея (конкуренцията), тя (старата) трябва да докаже своята научност, не стане ли това, има два варианта: да слезе от историческата сцена или да се превърне в частен случай на други теории, които по-добре обясняват света на икономиката.

5. Наука ли е счетоводството?

Този проблем е колкото стар, толкова и нов. Стар, защото възниква в самата зора на счетоводството, и нов, защото днес има нови измерения. В САЩ счетоводството не се разглежда като наука, а като регистрация на факти и събития, изразени в счетоводна форма. Но в Русия то се разглежда като наука. У нас този въпрос все още не е на почит.

Изказани са две противоречиви мнения. Първото, счетоводството е практика, приложни знания, регистрация на факти. От тази гледна точка то не е наука. Но може ли практиката да се развива без наука? Постулатите, принципите на счетоводството се предопределят от самата практика, за тях са нужни теоретични обяснения. Практиката се онаучовява, нейното развитие предполага това така да бъде. Счетоводството не може без научни методи. В рамките на рационалното едно знание може да се окаже по-предпочитано пред друго. Счетоводството без да разкрива нови закони се оказва, че е наука. Науката има три функции: познавателна (теоретична), практическа и прогностична. При счетоводството, както и в другите науки, те са неотделими и съществуват като цяло. Не може да развиваш теорията без да се основаваш на практиката. И обратно.

Спорът за счетоводството дали е наука или не, е повече схоластичен и измислен. Има и нещо друго, което затруднява проблема: няма точна дефиниция за науката, всяко определение е ограничено, границата е условна и подвижна. Ако изхождаме от определението за науката, дадено от Йозеф Шумпетер (’’История на икономическия анализ”): науката е всеки вид знание, което е обект на съзнателно усъвършенстване; тя е всяка област на знание, разработваща специална техника в търсенето и интерпретацията на факти. Ако проблемът се разглежда в тази светлина ще видим, че счетоводството напълно попада под обхвата на трактовката на Шумпетер. То е не само наука, но и философия. У нас обаче не се обръща внимание на този пункт. Счетоводството е и е политическа икономия, а счетоводителят - истински икономист (П. Ж. Прудон).

6. Математика и икономика

Този проблем придобива особена важност. Той е тема не само на вчерашния, но и на утрешния ден, вероятно и занапред ще бъде такъв. Увлечението по математика е толкова силно, че ни изправя пред дилемата: икономиката клон на математиката ли е, или математиката - клон на икономиката. Големите икономисти А. Маршал, Дж. Кейнс и др. ни предпазваха от такова увлечение. По образование бяха математици, но те не се изкушиха да спекулират с математиката. Днес това като че ли се забравя. Неокласиката превърна математиката в сърцевина и ядро на икономикса, която стана самоцел, а не средство за по-добро разбиране на икономиката. Понякога прости неща се обличат в сложна математическа одежда. Това засенчва предмета на икономическата теория. Студентът може да решава задачи без да знае теорията на проблема (И. Пригожен, И. Стенгерс), вследствие на което подготовката на кадри се осакатява. Това важи не само за студентите, но и за преподавателите. Много от тях преподават икономика, без да са специалисти – инженери, математици, особено това се случва в техническите училища, където има открити факултети по икономика. Прекомерната детайлизация на математическия апарат се смята за висша степен на научност, а владението на теорията – ненаучност. Воля за преодоляването на този проблем, като че ли няма.

Икономиксът все повече придобива вид на математическа икономия, икономическата наука се заменя с иконометрия – „наука за единния принцип на човешкото поведение”. Реалните икономически процеси не могат да се изразят само с помощта на тази иконометрия. Математическите методи, вън от контекста на качествения анализ, не могат да придадат научност на икономическата теория. Те дават верни резултати, ако се основават на правилни теоретични принципи. Ако заложеният теоретичен модел е неправилен, то и количествените зависимости, изразени чрез математическите модели, ще бъдат погрешни. Математическата формализация, макар и да създава външно впечатление, че стои в основата на построяването на единна теоретична система на икономическата теория, в крайна сметка тя не може да бъде съдържателен елемент на тази теория, а има спомагателно значение.

Икономическата литература, според М. Алле (виден френски икономист), в течение на четири десетилетия се развиваше в погрешно направление: в посока на съвършени изкуствени и откъснати от живота математически модели и преобладаване на математическия формализъм, което от само себе си е голяма крачка назад. Той смята, че повечето съвременни икономически теории грешат в три посоки: първо, злоупотреба с математиката; второ, логическа несъстоятелност; трето, пренебрежение към явленията на реалната действителност. Математиката е средство, инструмент в анализа, главното е критическият анализ на аксиомите и съпоставянията им със следствията от опита (THESIS 2001). Прекомерната математизация се превръща в самоцел, достига висока степен на абстрактност, която може да се откъсне от своята обективна основа.

В икономическата теория и в преподаването най-напред трябва да присъства качественият логически анализ, а след това количествения или математическия. Качественият анализ определя степента на приложение на математиката в икономиката, а не обратното. Математическото знание е едно от средствата за опознаване на икономиката, а не всеобщ принцип на това познание. Така че към приложението на математиката в икономиката трябва да бъдем предпазливия.

Thoughts of unproven hypotheses

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Abstract. The purpose of this article is to present a philosophical point of view for accounting. The philosophical approach of both the classics in philosophy and the modern point of view has been used. The accounting problems are described through the prism of the philosophical view point. Empirical research in accounting is discussed through observation and summary. There are some philosophical views on mathematical links with economics, mathematics and econometrics.

Key words: accounting, philosophical approach.

Предприемаческо управление в малките и средни фирми в Р България (на примера на предприятията за производство на пластмаси)

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Резюме. В доклада е изследвана актуалността на съвременна управленска концепция - предприемаческото управление. Изведени са насоки за приложението на тази управленска технология в малките и средни предприятия, както и са доказани твърдения относно ролята на предприемаческите и управленските функции за реализиране на процесите на предприемаческото управление в предприятията за производство на пластмаси. Данните и информацията са верифицирани чрез проведено анкетно проучване проведено **през** 2016 година посредством структуриран въпросник., обхващащо двадесет ръководители на предприятия на територията на Североизточен район за планиране . Практическата значимост на разглежданата проблематика се отчита с посочването на конкретен подход във внедряването на иновативни решения в управленската практика и модернизирането на използваните управленски технологии. Резултатите от проведеното емпирично изследване по косвен път свидетелстват за изключителния фокус на ръководителите върху резултатите от предприемаческото управление: иновативност, растеж и развитие. Човешкият фактор, казано най-общо, пряко свързан с резултатите на предприемаческото управление, има допълващо и обслужващо тези резултати значение.

Ключови думи: предприемачество, предприемаческо управление, технологично предприемачество, пластмаси.

Въведение

В условията на глобална икономика и засилената в резултат на това, конкуренция, всяко едно предприятие в нашата страна следва да прилага иновативни модели на управление и на развитие. По този път, бизнес предястията биха могли да се противопоставят на неблагоприятното влияние на някои фактори на средата и да постигнат по-добри икономически, но и социални резултати. С постигането на резултати, предприятията биха могли да поддържат добър имидж пред своите акционери, клиенти и кредитори.

В това отношение, в настоящата статия се прави изследване и анализ на приложението на съвременната управленска концепция, наречена предприемаческото управление в малките и средни предприятия в нашата страна. Изведени са насоки за адаптирането и усъвършенстването на тази управленска технология на примера на предприятията за производство на пластмаси, както и са доказани твърдения относно ролята на предприемаческите и управленските функции за реализиране на процесите на предприемаческото управление вътре в тях. В допълнение, в статията се проучват и възможностите и ограниченията на предприятията за създаване на благоприятна среда за иновации, като се отчита внедряването на иновативни решения в управленската практика и модернизирането на използваните управленски технологии.

Настоящият анализ, в съдържателно отношение, представлява част от работата по проект: „Разработване на система за оценка на компетенциите на работната сила по браншове и по региони”. В статията са приложени статистически данни, анализи и материали от различни източници като например, Национален статистически институт (НСИ), Евростат, европейски и национални разработки (стратегии, планове за действия, нормативна документи), които засягат сектор „Химия" и по-конкретно подсектор „Производство на пластмаси и изделия от пластмаси". Данните и информацията са верифицирани чрез проведено анкетно проучване, обхващащо двадесет ръководители на предприятия за производство на пластмаси и изделия от пластмаси на територията на Североизточен район за планиране. Анкетното проучване е проведено посредством структуриран въпросник в периода януари 2016 – март 2016 година.

1. Постановка на проблема

От осемдесетте години на миналия век въпросите за предприемаческото управление придобиват особена популярност, пракитико-приложна, както и научна значимост**.** Принос за все по-нарастващата роля на темата за предприемаческото управление в бизнес публикациите, в продължение на вече няколко десетилетия, имат бележити български учени като К. Тодоров, Й. Коев, М. Харизанова, М. Мирчев, както и значимото творчество на П. Дракър и Р. Ланглойс, Р. Киро, Кр. Стеарт, И. Търенсън и др. (Todorov, K., 2001; Koev, et.al., 2014; Harizanova, M., M. Mirchev, H. Mironova, 2006; Draker, P. 2010; Langlois, R. 2014; Kyrö, P., 2015; Thuresson, J. 2010).

Причините за интересът към предприемаческото управление имат основания да се проучат *в широк и в тесен аспект*. В по-общ план, сред открояващите се предпоставки са новата „роля" на човека, неговият творчески и образователен потенциал - ключ за развитие на икономиките и обществата. В този именно контекст, появата и развитието на съвременните управленски технологии са резултат и следствие на дълбоки социални, демографски, културни и глобални, обществени промени. В по-тесен аспект, нарастващата потребност от приложение на предприемаческото управление и кореспондира с факторите на съвременната бизнес среда – бързото развитие на технологиите, ускоряването на технологичните, вътрешноорганизационните промени, многообразието от предлаганите продукти и услуги, съкращаването на жизнения цикъл на стоките, появата на много и конкурентни организации, новите знания и пр. Не на последно място, причините за появата и развитието на предприемаческия мениджмънт следва да се търсят в критичните точки на традиционната мениджърска практика и някои от нейните негативни ефекти върху организационното развитие.Така посочените предпоставки, поставят като императив пред организациите да ползват подходите и механизмите на предприемаческото управление като алтернатива за посрещане на съвременните бизнес предизвикателства.

По въпросите за предприемаческото управление се установява, че въпреки критичната маса изследвания по темата, теоретичната наука е в дълг към изследване на интересуващата ни категория през призмата **на малките и средни предприятия** – основен двигател на икономическото, социалното и технологичното развитие в едно общество. Приоритетно, предприемаческото управление „се преписва" на големите компании, а така се недооценява огромния иновационен потенциал на малките и средни предприятия. Пренебрегват се редица възможности, които приложението на съвременните управленски практики могат да разкрият пред тези предприятия, с оглед на нарастващите промени на съвременната бизнес среда и значимата им роля за икономиките и обществата.

Преобладаващите малки и средни предприятия в структурата на предприятията в страната ни, следва да осъществяват процеси на преструктуриране в синхрон с добрите европейски практики. Осъществяването на тези процеси в не малка степен трябва да се основава на приложение на най-съвременни управленски технологии, с акцент върху производителността, растежа, развитието, иновационната активност и не на последно място по важност - участието на служителите в тях.

В резултат на посоченото по-горе, **целта** на настоящото изследване е да установи *проявлението на предприемаческото управление* в малки и средни фирми на територията на Р. България. По-конкретно обект на емпиричното проучване са двадесет предприятия, специализирани в производството на пластмаси и изделия от пластмаси. Изпълнението на посочената цел ще допринесе до решаването на важни теоретични и особено приложни дискусионни въпроси, като например: има ли основание предприемаческото управление да се асоциира единствено с малкия и среден бизнес и как тази съвременна управленска технология би спомогнала за решаването на важни секторни проблеми на предприятията относно тяхното по-ефективно функциониране, растеж и развитие.

Химическата индустрия има огромно значение за почти всички сектори на икономиката в една страна. Нейното състояние е анализирано въз основа на показателите в следните сектори и подсектори по КИД-2008:20., а именно: „Производство на химични продукти", 1920 „Производство на рафинирани нефтопродукти", 22.1. „Производство на изделия от каучук" и 22.2 „Производство на изделия от пластмаси". Според данни на Евростат за 2010 година, приносът на подсектори 22.2 „Производство на изделия от пластмаси" и 1920 „Производство на рафинирани нефтопродукти" в Европейския съюз е близък до този на сектор 20 „Производство на химични продукти", макар и да остава малко по-нисък

(Световна банка, Постигане на интелигентен растеж: как иновациите и научните изследвания да работят за България, Доклад No. 66263- BG, 2012).

Според данните на европейската статистика, нефтохимическите продукти и пластмасовите изделия и тези от синтетичен каучук са с дял по 24%, а химичните продукти – с 26% за 2010 година. В своята класификация на продажбите на отделните групи продукти за 2010 година статистиката посочва, че приносът на нефтопродуктите е 16,4%, на основните неорганични продукти, торовете и специалните химикали – 26.5 %, а на полимерите (включващи пластмаси, синтетичен каучук и изкуствени влакна) и изделията от пластмаси и каучук заедно – 30,4% (http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database; http://www.mee.government.bg/ind/doc_invest/Bg.econ02.07.2010.pdf).

В нашата страна химическата индустрия, според националната статистика и представителни секторни проучвания, се характеризира с редица специфични и нерактерни за европейското икономически пространство проблеми, като например:

- намаляване на асортимента на произвежданите продукти и изделия в Р България;
- недостатъчно разработване и внедряване на иновационни чисти или т. нар. „зелени” технологии;
- недостатъчно внедрени безотпадъчни високи технологии, за разлика от европейските практики;
- липса на висока професионална квалификация на кадри с интердисциплинарна подготовка;
- липса на специалисти с фундаментални познания относно теоретичните основи на технологичните процеси;
- недостатъчното финансиране на научно-приложните разработки;
- липса на високотехнологични иновации;
- липса на социални иновации и предприемачество;
- недостатъчно участие на жените в предприемачеството;
- европейските политики се прилагат с помощта на силно бюрократизирани процедури в страната ни и др.

Установените по-горе проблеми намаляват конкурентоспособността на производствата за пластмаси, като тяхното мултиплициране в страната ни предопределя ограничените възможности за тяхното развитие в перспектива. Поради това, приложението на предприемаческото управление като технология за насърчаване на различни по вид иновации е особено необходимо с цел усъвършенстване и растеж на предприятията от сектора в нашата страна и постигането на конкурентоспособност, съизмерима с стойностите на предприятията от Европейския съюз .

2. Емпирично изследване на предприятията за производство на пластмаси в Североизточен район за планиране

За постигането на изследователската цел следва да се представи **идентификационен профил** на изследваните предприятия, с оглед на тяхното прецизно определяне и анализ. В идентификационния профил се представят данни, които пряко кореспондират с изследователските проблеми относно приложението на предприемаческото управление в предприятията за преработка на пластмаси.

Съобразно **формата на своята регистрация** – показател с важно значение при разпределението на собствеността, от попадналите в изследователската извадка предприятия, най-голям е относителният дял на дружествата с ограничена отговорност (40%), следвани от еднoличните дружества с ограничена отговорност (35%), еднoличните търговци (15%) и акционерните дружества (10%).

Таблица 1.

Форма на регистрация на предприятията

	Брой отговорили	Процент	Валиден процент	Кумулативен процент
ЕТ	3	15,0	15,0	15,0
ООД	8	40,0	40,0	55,0
ЕООД	7	35,0	35,0	90,0
АД	2	10,0	10,0	100,0
Общо	20	100,0	100,0	

Източник: собствени проучвания на авторите

Следващият идентификационен показател с отношение към изследваната проблематика е **годината на основаване на предприятието**. Резултатите показват нееднозначно, че преобладаващата част от анкетираните заявяват опит в бизнеса повече от десет години. Този факт е показателен, основно за това, че въпреки трудния икономически преход и процесите на преструктуриране на индустрията като цяло, изследваните предприятия са се приспособили към динамично променящата се среда, както и са доказали растеж и развитие. Както установява изследването, сред открояващите се причини за това са фокусът на предприемачите основно върху иновации - продукти, технологии и нови пазари.

Важен показател на изследването е **преценката на предприемачите за успех или неуспех** в бизнес начинанията. Доминиращо задоволство от постигнатите резултати се установява при 75% от изследваните респонденти. Едва 25% от анкетираните не могат еднозначно да отговорят на поставения въпрос. Демонтираното самочувствие в преобладаващия брой случаи, е заявка за бъдещи успехи на предприемачите и на техните предприятия.

Таблица 2.

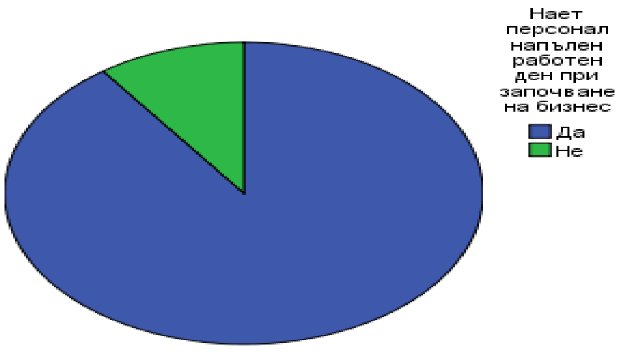
Смятате ли се успял човек в бизнеса?

Преценка на предприемача	**Брой отговорили**	**Процент**	**Валиден процент**	**Кумулативен процент**
Да	15	75,0	75,0	75,0
Не мога да преценя	5	25,0	25,0	100,0
Общо	20	100,0	100,0	

Източник: собствени проучвания на авторите

Следващият показател с отношение както към предприемаческото управление е **персоналът на предприятието при започване на бизнес**. Резултатите сочат, че 90 на сто от изследваните предприятия са имали нает персонал при започване на бизнеса (Фигура 1.). Посоченото тук предопределя извеждането на две твърдения, а именно:

- наличие на бизнес опит, предхождащ старта на настоящия бизнес (това твърдение кореспондира с показател, изследван по-рано: „година на основаване на фирмата”);
- значимостта на фактора „персонал на предприятието при започване на бизнес” за успеха на предприемаческото начинание.



Фиг. 1. Нает персонал на ОТД при започване на бизнес
Източник: собствени проучвания на авторите

Съобразно изведените в изследването ограничения, в целевата извадка не попадат т. нар. микро предприятия по смисъла на ЗМСП. В унисон с поставеното ограничение, най-голям е броят на изследваните предприятия с персонал от 11 до 50 човека - 11 предприятия, следвани от тези с персонал от 50 до 250 човека – 7 организации, и две предприятия с персонал над 250 души. Въпреки, че обект на изследване са малките и средни фирми, неслучайно в извадката попадат и две фирми с персонал над 250 човека. Целта тук е да се установи вероятностна хипотеза относно големината на предприятието и разпределението на собствеността. Посоченото твърдение има важно значение за резултатите на цялостното изследване.

Таблица 3.

Общ брой на работещите във фирмата

Работещи в предприятието	**Процент**	**Валиден процент**	**Кумулативен процент**
От 11 до 50 човека	55,0	55,0	55,0
От 51 до 250 човека	35,0	35,0	90,0
Над 250 човека	10,0	10,0	100,0
Общо	100,0	100,0	

Източник: собствени проучвания на авторите

Идентифицирането на предприемаческото управление в малките и средни фирми обхваща показателите: ръст на персонала спрямо предходната година, оборот и ръст на оборота, риск и иновационна активност. Ето защо, именно тези показатели са проучени по-детайлно.

Един от най-характерните индикатори за предприемаческо управление в изследваните организации е **нарастването или намалението на персонала спрямо предходна година.** Резултатите от проведеното анкетно проучване сочат, че 80% от фирмите през 2016 година бележат ръст на нарастване на персонала, намаление отчитат само две организации.

Таблица 4.

Ръст на нарастване на персонала спрямо предходната година

Промяна	**Брой отговорили**	**Процент**	**Валиден процент**	**Кумулативен процент**
0-5%	8	40,0	40,0	40,0
5-10%	4	20,0	26,7	66,7
10-50%	4	15,0	20,0	86,7
Над 100%	1	5,0	6,7	93,3
Без промяна	1	5,0	6,7	100,0
Общо **Липсващи случаи**	18 2	80,0	100,0	
Общо	20	100		

Източник: собствени проучвания на авторите

Следващият показател на предприемаческото управление е **иновационната фирмена активност**. За целта се изследват съвкупност от подпоказатели, като например: разходи за НИРД, за технологично оборудване, приходи от иновации и пр. Съобразно резултатите от проведеното през 2016 г. изследване, близо 90% от предприятията са направили разходи за НИРД, а от тях половината заявяват своето участие в рамките на 5-10% в структурата на разходите на предприятията.

Далеч по-голям е процентът на предприятията, които правят разходи за технологично обновление. От една страна, високите разходи за технологично обновление са свързани с технологиите като рисково звено в процесите на преструктуриране на сектора, особено що се касае до малките фирми. Същевременно, този показател е пряко свързан и с високите разходи за въвеждане на системи за контрол, като надежден инструмент на т. нар. високотехнологично предприемачество в изследваните предприятия за производство на пластмаси в нашата страна

Получаването на награди за иновационната активност не е приоритет на управлението. Едва две от изследваните организации имат получени награди за иновации – златни медали от Пловдивски панаир. Причините, според проведеното изследване за това са свързани с комплексни причини, като например: липсата на директна връзка между получени награди и пазарното присъствие на организацията; акцентът върху други процеси и аспекти на развитие; недооценяване на значимостта на наградите, недостатъчната медийна подкрепа в тази насока и пр. В резултат на посочените аргументи, се установява, че основно приходите от иновации са своеобразни награди за ръководителите предприемачи.

Таблица 5.

Награди за иновации

		Брой отговорили	Процент	Валиден процент	Кумулативен процент
Валидни случаи	**Да**	2	10,0	10,5	10,5
	Не	17	85,0	89,5	100,0
	Общо	19	95,0	100,0	
Липсващи случаи		1	5,0		
Общо		20	100		

Източник: собствени проучвания на авторите

Въведените системи за контрол на качеството и условия на труд, новите продукти, новите пазари и технологичното развитие са доминиращи направления на иновационен растеж на предприятията, специалилизирани в производствата на пластмаси. Според резултатите от анкетното проучване над половината от анкетираните собственици инвестират в **подобряване на цялостния мениджмънт** като следващо приоритетно направление на фирменото развитие. Този факт е своеобразна предпоставка и важно условие за приложението и предприемаческия мениджмънт в изследваните предприятия.

Таблица 6.

Реализирани иновации през последните три години

Промяна в мениджмънта на предприятието	Валидни случаи	Брой отговорили	Процент	Валиден процент	Кумулативен процент
	Да	11	55,0	78,6	78,6
	Не	3	15,0	21,4	100,0
	Общо	14	70,0	100,0	
	Липсващи случаи	6	30,0		
Общо		20			

Източник: собствени проучвания на авторите

По отношение на следващия показател – **ръст на оборота**, всички изследвани 20 структури отчитат ръст на оборота спрямо предходна година. Над половината от респондентите отчитат ръст в рамките до 10%, значителен такъв в рамките на 10-50% отбелязват приблизително същия процент предприятия. Настоящият показател, редом с ръста на нарастване на персонала имат **основно, определящо значение** при идентифициране на предприемаческото управление в малките и средни предприятия, специализирани в производството на пластмаси.

Таблица 7.

Нарастване на оборота спрямо предходната година в %

Валидни случаи	Брой отговорили	Процент	Валиден процент	Кумулативен процент
0-5%	7	35,0	35,0	35,0
5-10%	4	20,0	20,0	55,0
10-50%	8	40,0	40,0	95,0
50-100%	1	5,0	5,0	100,0
Общо	20	100	100	

Източник: собствени проучвания на автора

По повод на последния, но не по значимост показател, близо 70% от ръководителите считат ***риска*** за неотделим от успеха. Около половината респонденти са привърженици на т. нар. умерен риск, а почти същият е относителният дял на привържениците на високия бизнес риск. В сравнителен план, изследването установи, че предприемачите – собственици в проучваните от нас големи и средните фирми са по-склонни да рискуват в сравнение с ръководителите от т. нар. малки фирми. Една от основните причини за това е по-големият финансов, кредитен ресурс, с които разполагат големите и средни фирми от този сектор.

Таблица 8.

Как възприемате риска?

		Брой отговорили	**Процент**	**Валиден процент**	**Кумулативен процент**
Валидни случаи	**Положително**	5	25,0	26,3	26,3
	По-скоро положително	9	45,0	47,4	73,7
	По-скоро отрицателно	4	20,0	21,1	94,7
	Несъгласен	1	5,0	5,3	100,0
	Общо	19	95,0	100,0	
Липсващи случаи		1	5,0		
Общо		20	100		

3. Изводи и обобщения от емпиричното изследване на предприятията за производство на пластмаси в Североизточен район за планиране

В резултат на извършеното проучване относно идентифициране на предприемаческото управление в малките и средни фирми, на примера на предприятията за производство на пластмаси, могат да се направят изводите:

Изследваните предприятия на територията на Североизточен район за планиране са иноватори. Те са ориентирани към иновативни конкурентни предимства като технологии, продукти, пазари, системи за контрол на качеството. Посочените конкурентни предимства са взаимосвързани и показват силно изразената пазарна ориентация на предприятията в бранша.

Проучваните предприятия са склонни към поемане на бизнес риск, който неминуемо съпътства протичащите процеси на преструктуриране в сектора и динамично променящите се условия страната;

Високата иновационна активност, кореспондираща с показателя „бизнес риск”, предопределят и резултатите на предприятията: ръст на наетите и ръст на оборота.

Обобщаващият сравнителен анализ на факторите „отговорни” за формирането и развитието на предприемаческото управление, показва: поставяне на тежестта върху иновациите, пазарите, клиентите, технологиите. Посоченото тук е израз на най-значимите конкретни предимства на изследваните предприятия и силно изразената пазарна ориентация на малките и средни предприятия, специализирани в производството на пластмаси и изделия от пластмаси. Резултатите от проведеното емпирично изследване по косвен път свидетелстват за изключителния фокус на ръководителите върху резултатите от предприемаческото управление: иновативност, растеж и развитие. Човешкият фактор, казано най-общо, пряко свързан с резултатите на предприемаческото управление, има допълващо и обслужващо тези резултати, значение.

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Entrepreneurial management in small and medium-sized enterprises in Bulgaria (on the example of the plastics processing enterprises)

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Absrtact. The report examines the relevance of a modern management concept - entrepreneurial management. Guidelines for the application of this management technology to small and medium-sized enterprises are presented, as well as claims on the role of entrepreneurial and managerial functions in implementing entrepreneurial management processes in plastics processing plants. The data and information were verified through a survey conducted in 2016 through a structured questionnaire, comprising twenty heads of enterprises across the North East Region of Planning in Bulgaria. The practical significance of the researched problem is taken into account by indicating an approach in the implementation of innovative solutions in management practice and the modernization of the used management technologies. The results of the conducted empirical study indirectly testify to the outstanding focus of the managers on the results of entrepreneurial management: innovation, growth and development. The human factor, in general, directly related to the results of entrepreneurial management, has complementary, service-oriented results and significance.

Key words: entrepreneurship, entrepreneurial management, technological entrepreneurship, plastics

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Analysis of financial opportunities

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Abstract: We will start with an analysis structure that defines the key areas in which long-term funding sources will be analyzed and attracted. We will then look at the techniques for calculating the impact on the company's financial performance caused by the introduction of new capital from each of the major sources. We will turn to the often used form of graphing, EBIT (break before interest and tax) break-even chart to demonstrate the dynamic impact of financial choices, which changes the company's situation. Once we touch the leases as a special source, we will list the key issues involved in the stock options.

Keywords: analysis structure, company's financial, dynamic impact

We will focus on analyzing the opportunities available in long-term funding, distinguished from the partial operational funds that are used fairly often by companies in line with the customs of an industry or service. The focus is on this because the nature and nature of long-term funding sources are complexly related to the types of investments made and is critical to the growth, stability or decline of operations. The management must finance its strategic project with a suitable mix of capital sources that will contribute to achieving the desired growth in shareholder value.

This article will deal with the main considerations in assessing key funding opportunities open to management. Although the choice between debt, preference and total capital is blurred by the vast array of modifications and specialized tools in each category, we will focus only on the main features of the three major securities. As long as the emphasis falls on quantitative analysis, you have to understand that many other meanings go into these choices. For example, the specific types of business and industry in which it operates will affect in the long run the capital structure chosen at different stages of the development of a company, as well as the preferences and experience of top management and that of the board of directors. These aspects, however, can not be adequately covered within this article.

We will start with an analysis structure that defines the key areas in which long-term funding sources will be analyzed and attracted. We will then look at the techniques for calculating the impact on the company's financial performance caused by the introduction of new capital from each of the major sources. We will turn to the often-used form of graphing, EBIT (break before interest and tax) break-even chart to demonstrate the dynamic impact of financial choices, which changes the company's situation. Once we touch the lease as a special source, we will list the key issues involved in stock options.

Analysis structure

Several key elements need to be considered and touched. when a company faces the rising additional long-term funds. We will examine in detail five of these elements: price, exposure, flexibility, synchronization and control. The analyst can use this structure as a conceptual list to ensure that the most important considerations are covered.

Cost of additional funds

One of the main criteria for choosing from additional sources of additional long-term capital is the price included for the acquisition and maintenance of the funds.

As a general rule we assume that the increased means through various forms of debt in part are cheaper under certain conditions because the interest paid by the borrowing company is tax deductible according to the laws. The real interest rate charged on the growing loan will, of course, depend on the credit rating of the company and the degree of change in the capital structure of the new debt. In other words, specific costs will be affected not only by the current market conditions for all long-term debt instruments but also by the company-specific risk assumed by investors and insurers. Other costs in increasing long-term debt are indirect, including legal and insurance costs at the time of issue, as well as the nature and severity of any limitation imposed by creditors.

The reported costs of preferred shares are usually higher than the loan, partly because the paid preference dividends do not deduct the tax, and partly because the preferred shares occupy to some extent a weaker risk / profit hierarchy so that the holders of those shares expect and more reward. The comparative specific expense of the preferred shares is relatively easy to calculate. The level of dividend is clearly defined, legal and insurance costs arise at the time of issue and are reflected in the company's net income. However, a variety of specific reserves may cause indirect coststo the company.

Even if loans or preferred shares are used as a source of long-term funding, current shareholders may be affected indirectly because restrictive provisions and agreements are necessary to obtain a financial link, or because concessions are made to protect the rights of more senior privileged shareholders. Property ownership is an important issue in closely related corporations, especially in new risky endeavors. In certain situations, the founders of the company or the majority shareholders can exercise full effective control over the company. Issuance of new shares will be diluted both as control over the management of the company and the ability of key shareholders to enjoy a greater share of the appreciation of economic value upon successful performance. The dilution of revenue and the possible slowdown in share earnings growth caused by dilution of total equity ownership is not limited, of course, only to closely related companies. Rather, this is a common phenomenon.

Dilution of control and profit is a major factor in convertibility, the common feature we find in certain bonds and preferred shares. This provision allows conversion of security into ordinary shares under certain time and cost conditions. Indeed, these instruments are hybrid securities as they represent the delayed issue of ordinary shares at a price higher than the market value of the ordinary shares at the time the convertible bond or preferred share is issued.

Control becomes a major problem in convertible-funded operations because the possible conversion of bonds or preference shares will add new ordinary shares to the capital structure and thus lead to dilution. The effect is just like direct issuance of ordinary shares.

The choice

Any solution for alternative sources of long-term financing can not be based on value alone, although there are future stock flows and investment models with the pattern of successive funding rounds that will support them. Having future funds limited to one option because of current commitments is an additional problem. Changing financial market conditions for different types of securities can make this single option less attractive and even impossible when the funds are crucial.

Choosing the right time

The fourth element in choosing long-term funding is the time of the deal. Time is very important in terms of price and yield movements in the securities markets. The changing conditions in these markets reflect the specific costs that the firm will incur with each option in terms of interest rates or the amount of the preferred dividend transferred from the new debt or preferred shares and receive the proceeds from each of the alternatives. Therefore, the emission time will affect the spread of costs between several funding alternatives. From time to time, market conditions may in fact either exclude or clearly prefer specific choices.

For example, at low stock prices, bonds may be the most appropriate alternative, both in terms of costs and market demand. Since the proceeds of any of the issues depend on the success of the investment - whether public or private - of the securities, the conditions of the stock markets or bonds at the time may seriously influence the choice. Due to the uncertainty of the financial markets, maintaining a certain degree of flexibility in the capital structure is advisable.

Control

Finally, in terms of funding, the degree of company control exercised by shareholders is an important factor. As it is known, when new ordinary shares are issued to other people, the effect is a dilution of the profit from the shares and the ownership share of the existing shareholders.

Determining the price of ordinary shares turns out to be a relatively complex task. It involves building a theoretical framework in which to assess the risk / gain expectations of shareholders. Direct earnings have deficiencies as a measure of the specific cost of ordinary shares because they do not address the relative risk of the firm reflected in the value of ordinary shares. For this reason, we had to use a more complex structure that includes some substitutes and approximate sums to arrive at a practical result based on the theoretical model.

The approximate cost of ordinary equity based on the CAPM approach can be directly compared to specific debt charges and preferred shares, it can also be used to reach the weighted total cost of the company's capital structure. The increase of the basic own funds in the capital structure by issuance of new shares includes additional considerations. The net earnings per share of the additional shares requires additional and even increasing dividends for payment and also changes the proportions of the capital structure.

Exposure to risk

Using volatility in earnings as a working definition of risk, we find that the risk of the company is affected by the specific spending pledges - such as interest on loans or dividends on preferred shares - that every funding source is connected. These engagements bring the leverage's financial effect into company revenue productivity or raise any financial leverage that already exists. The use of tools related to long-term financial costs will widen the revenue flow as a change in economic and operating conditions.

Being responsible for providing holders of ordinary shares increasing economic value, management must devote a lot of time and effort in determining the appropriate mix of debt capital and equity capital structure of their company. This balance includes the provision of a loan with relatively low costs increase the return to shareholders, but not too many loans that threaten the generation of value to shareholders during periods with low incomes.

The main risk, of course, is that the company may not be able to meet its debt repayment obligations. The portion of the debt in the capital structure as well as the portion of the preferred shares reflects the degree of risk of partial or total default. The analysis of risk exposure is based on the creation of a historical model of profitability variability and cash flows that are expected to be future. Account must be taken of the extent to which the company's strategy changes. Any change in the exposure of the business cycle displaces the competitive pressure and the potential inefficiency in operation.

Obviously, the company's specific risk (profitability variability) and the ability of the company to service its debt burden are closely related to the business or business specifics of the company. Moreover, they are affected by general economic conditions - in addition to the ability of management to generate satisfactory operational performance. Therefore, the degree of financial leverage would be advisable and reasonable to differ significantly across industries and services, and will also depend on the relative competitive position and maturity of the firm. A business that has just started business leads to a completely different exposure to the lender than a proven industry leader.

Flexibility

The third area to be taken into account is the flexibility defined as the scope of other future funding opportunities as soon as a specific alternative is chosen. When any increase in funding is completed, the choices between future alternatives should be more limited in the next round. For example, if long-term debt securities are selected as a source of funding, restrictive clauses, asset weights and other constraints that impose minimum financial ratios, the company may only use ordinary shares as a future source of capital for a known time.

Flexibility essentially involves planning for the future. Strategic planning and coinciding corporate financial policies need to be addressed. Potential acquisitions, expansion and diversification are all affected by the degree of flexibility of management in the choice of appropriate funding and the outflow of debt resulting from the debt service commitment. As far as possible, management should combine value planning, which is a very important factor and should be analyzed at an earlier stage in the decision-making process. Unfortunately, there are no precise and clear rules that make it clear and clear how to make the final decision, as the choice is not so dependent on the circumstances prevailing in the company and in the securities markets at the time. The best approach is to look carefully at the five elements we examined and explore the pros and cons of each of them in terms of their contribution to the solution. Needless to say, the effect of each source of funding on the company's future results is very important. In the next section we will explore the methods for calculating this effect.

Calculation techniques

To get a clearer picture, we will use the main accounts of a hypothetical company - ABC. The company is drawing on alternative ways to raise $ 10 million to support the introduction of a new product. After analyzing the current performance of the corporation, we will consistently look at the impact of productivity caused by the introduction of long-term debt, preferred shares and total capital in equal installments of $ 10 million each.

Table 1.

ABC Accounting Balance ($ million)

Assets		**Liabilities and net worth**	
Current assets	15$	Current liabilities	7$
Fixed assets (net)	29$	Common stock	10$
Other assets	1$	Retainet earnings	28$
Total assets	45$	Total liabilities and net worth	45$

ABC abbreviated balance is shown in Table 1. At present, the company has 1 million ordinary shares issued with a face value of $ 10 per share. From the company's operating report, we learned that ABC has earned $ 9 million before taxes on sales worth $ 115 million over the past year. Income taxes are paid at $ 3.06 million and the effective rate is 34%.

Current performance

We will start by evaluating ABC current performance by calculating the net EPS per share of ordinary shares. We will use this format to calculate EPS and related measures. This type of step-by-step approach analyzes the impact on the income of each type of long-term capital. First of all, we declare profit before interest and taxes (EBIT). From this table you have to deduct different fees for the various long-term financing instruments. The first of these is accrued interest on a long-term loan. Short-term interest rates can usually be disregarded (unless there are significant amounts) because we assume that because of the temporary nature of short-term liabilities arising from current operations, the related interest charges have been correctly deducted from earnings prior to EBIT calculation.

Table 2.

ABC earnings per share - calculation ($, thousands, excluding share amount)

Earnings before interest and taxes (EBIT)	9,000
Less: Interest charges on long-term debt	-0-
Earnings before income taxes	9,000
Less: Federal income taxes at 34%	3,060
Earnings after income taxes	5,940
Less: Privileged dividends	-0-
Earnings available for common stock	5,940

Estimates of earnings per share are shown in Table 2. Provisions are made for both long-term interest and preferred dividends. No amounts have yet been shown for them, as our hypothetical firm at this point has neither long-term debt not preferred shares. The result of the earnings calculation is available for ordinary shares at $ 5.94 per share. Of this amount, $ 2.5 is deducted as it represents a cash dividend voted by the board of directors. We assume that this dividend payout (between 40% and 50% of earnings) is maintained for many years. We also assume that revenue steadily increases by about 4% on average over the last decade.

Shares are widespread and are being traded and the market price is currently around $ 38 to $ 47, which means it is traded for about seven to eight times revenue. The latest security analyst report estimates b = 0.9 and the risk-free rate of return is estimated at 6.5% and the average expected return is S & P 500 and is expected to be 14.0%.

Table 3.

Long-term liabilities in the capital structure

Common shares outstanding (number)	1 million
Earnings per share (EPS)	5.94
Less: Common dividend per share	2.50
Retained earnings per share	3.44
Retained earnings in total	3,440

When the liability arises in that structure, the financial position and productivity of ABC profits are significantly affected. In order to raise the $ 10 million needed to finance the new product, management has found that one of the alternatives is to issue bonds. The bonds are not backed by any specific assets of the company; instead they are issued to cover the company's total credit rating. These bonds, at current market conditions, bear an interest rate of 11.5%, which becomes due 20 years from the date of issue, resulting in a provision for a repayment fund of $ 400,000 per year starting in the fifth year. The remaining balance at the end of 20 years will be refunded as a payment of $ 4 million. The company expects to collect the full $ 10 million of bond issues after all the insurance costs and as a result will receive the face value. Once the new product has been successfully funded, the company assumes that revenue will grow by at least $ 2.0 million before tax. A small risk of obsolescence of products or major competitive attacks is expected by the management for the next 5 to 10 years because the company has developed a unique process protected by careful patent coverage.

We can now track the impact of the long-term loan on the company's performance, respecting both the change in earnings and dividends and the specific value of the newly created debt. We will analyze two opposite situations, (1) the immediate impact of $ 10 million of debt without compensation from the new product, and (2) the improved conditions expected after the investment has begun to function and the new product has begun generating revenue probably after one year).

Table 4.

ABC earnings per share - calculation with new bond issue ($, thousands, excluding share amount)

	Before the new product	With new product
Earnings before interest and taxes (EBIT)	9000	11000
Less: Interest charges on long-term debt	1150	1150
Earnings before income taxes	7850	9850
Less: Federal income taxes at 34%	2669	3349
Earnings after income taxes	5181	6501
Less: Privileged dividends	-0-	-0-
Earnings available for common stock	5181	6501
Common shares outstanding (number)	1 million	1 million
Earnings per share (EPS)	5.18	6.50
Less: Common dividend per share	2.50	2.50
Retained earnings per share	2.68	4.00
Retained earnings in total	2681	4001
Original EPS (Table 2)	5.94	5.94
Change in EPS	-0.76	+0.56
Percent change in EPS	-12.8%	+9.4%

The result of two calculations is shown in Table 3. The immediate effect of the addition of the debt is the decrease in revenue available for ordinary shares. This is due to a set interest rate of 11.5% to $ 10 million on bonds or $ 1150,000 before taxes. Profit after interest and taxes falls to $ 759,000 compared to the initial conditions in Table 2. This decrease represents post-tax interest costs for the bonds or $ 1 150,000 times (1 - 0.34). As a result, earnings per share are reduced to $ 5.18, falling by 76 cents, or a 12.8% dilution from the previous level. This change is purely due to the increased interest costs, which, based on one share of the same 76 cents, is the post-tax rate of $ 759,000 divided into 1 million shares.

Assuming that the effective tax rate is 34% in our case, the ABC debt should be 7.59%. Specific annual debt expenditures were found by referring the reported annual costs to the actual receipts received. If this revenue differs from the nominal value of the debt instrument, the specific annual debt price will of course be higher or lower than the specified rate. In the case of ABC, we have assumed that net cash flows are practically nominal and therefore the specific value of a new loan for ABC is also 7.59%, a table that will be compared to the specific value of the other alternatives for raising capital . As for the second column of Table 3, we find that the alleged successful introduction of the new product will compensate ABC for the impact on earnings on interest payments on bonds. In other words, the investment project has earned more than the specific value of the loan drawn to fund it. Revenue increased to $ 6,501,000 after tax, net increase of $ 561,000 compared to initial $ 5,940,000 in Table 2. As a result, net profit per share increased by 56 cents over the initial $ 5.94, an increase of almost 10%.

The total value for post-tax borrowers is 759,000, and the new investment is expected to raise earnings from ordinary shares. Additional revenue of $ 1,320,000 ($ 2,000,000 pre-tax revenue, less tax at 34%) significantly exceeds service costs of $ 759,000. Consequently, the investment - if ABC assumptions of revenue prove realistic - it means that it has made it possible to increase the economic value. In the end, the financial leverage introduced with the debt alternative is positive. Still, a few questions can be asked. For example, suppose the investment has earned only $ 759,000 after taxes, just to cover debt costs and maintain the position of shareholders, just as before in terms of net earnings per share. Would the investment be justified? Does this mean that the investment is made without cost to the shareholders?

At first glance, we can believe in this, but a number of issues need to be addressed here. First of all, there is no mention of the liabilities to the depreciation fund that will last for five years in this way, and that they represent cash costs of $ 400,000 per year. Such principal payments are not deducted from taxes and must be paid out of post-tax cash flows generated by the company. In this way, debt servicing (coverage of the burden) will require 40 cents per share, which exceeds the cost of the interest rate of 76 cents per share, making a total of $ 1.16 per share. $ 400,000 will no longer be available for dividends or other corporate purposes because it is already a commitment to repay the principal. Assuming that the return on the investment is exactly equal to the debt interest expense, how would the company repay the principal?

There is an obvious delusion in this line of thought. This is due to the use of accounting revenue to represent the benefits of the project and to compare it with the after tax cost of the borrowed capital used to finance it. This is not a proper economic comparison. Only a time-adjusted cash flow analysis can determine the economic costs / benefits of the exchange. We could say that the project is just about getting the specific value of the debt-related capital only if the net present value of the project was exactly zero when we reduced the additional annual cash flow to 7.59%.

This result would then represent an internal rate of return of 7.59%, the level of economic performance that would hardly be acceptable for management. But even under this condition, project cash flows (as opposed to accounting profit in the activity report) should be higher than $ 759,000, since only the interest on the bonds should be paid out of tax revenue. This must be because, within the present value of the investment analysis, the additional cash flows associated with the project must be sufficient not only to ensure a certain return but also to depreciate the investment itself.

Let's now go back to the purpose of the framework we use here. The purpose of the analysis is not to judge, the attractiveness of the investment - we assume that this has already been adequately done by the management. Instead, we are only interested in what alternative form of financing is best for the company under the circumstances. In this context, the impact of each of the alternatives on the company's profit is only one aspect of the decision on new financing.

In the case of a loan that is an alternative, under normal conditions, at the lowest price, the effect of financial leverage is expected in favor of the shareholder. When a project is selected, it has to meet a Standard Return based on approximately the cost of capital - a return that far exceeds the cost of borrowed capital.

The introduction of debt immediately trivializes the profit of the share, but this is followed by a jump in earnings per share, as described, the project's accounting revenue exceeds the interest rate reflected in the company's income statement. The company must be able to make future payments on the amortization fund in terms of monetary planning because, starting in the fifth year, 40 cents per share of the company's cash flows will be disbursed on an annual basis to repay the principal.

In principle, it is useful to look at the consequences of these facts under different conditions, ie. the risk of revenue fluctuations, both in the core business and in the contribution of the single profits of the new product, which is considered to be successful at all times. But we will consider these changes later.

Preferred Shares and Capital Structure

ABC may also meet its long-term financial needs with the alternative issue of $ 10 million preferred shares, at a price of $ 100 per share, which holds a constant dividend rate of 12.5%. For simplicity, we will assume again that the net revenue of the company will be equal to the nominal price of $ 100, after the legal and insurance costs incurred. Table 4 analyzes the conditions before and after the introduction of the new product design.

Table 5.

ABC earnings per share calculation with a new issue of preferred shares ($, thousands, excluding share amount)

	Before the new product	**With new product**
Earnings before interest and taxes (EBIT)	9000	11000
Less: Interest charges on long-term debt	-0-	-0-
Earnings before income taxes	9000	11000
Less: Federal income taxes at 34%	3060	3740
Earnings after income taxes	5940	7260
Less: Privileged dividends	1250	1250
Earnings available for common stock	4690	6010
Common shares outstanding (number)	1 million	1 million
Earnings per share (EPS)	4.69	6.01
Less: Common dividend per share	2.50	2.50
Retained earnings per share	2. T9	3.51
Retained earnings in total	2190	3510
Original EPS (Table 2)	5.94	5.94
Change in EPS	-1.25	+0.07
Percent change in EPS	-21.0%	+1.2%

This time, there is a stronger initial drop in profits from available ordinary shares, due to the impact of preferred dividends of \$ 1.25 million a year. Not only fixed costs (as well as the specific cost, given that net returns are at par value) of the preferred shares are higher than a full percentage of the 11.5% of the declared bonds, but also the dividend payments preference shares are not deducted from taxes under current law. In fact, we are dealing with an alternative that costs, under comparable conditions, 12.5% after tax, compared to bonds that are 7.59% after taxes.

Therefore, the immediate dilution of preferential emission earnings is \$ 1.25 per share or 21% compared to the original state. Over time, as revenue from the new product has been achieved, it is possible to see a possible increase in net profit per share of only 7 cents, a slight improvement of 1.2%. The \$ 1.25 million annual post-tax debt obligation leaves little room for any net profit in the income statement generated by the investment - which we know is estimated to be \$ 2.0 million before tax and \$ 1320,000 after tax .

In this situation, under the assumed conditions, we allow for a very limited financial leverage. Only slightly more than 1% growth in earnings per share has been achieved since the beginning of the year, as fixed financial costs after tax have almost doubled compared to the bond alternative. Earnings per share will be unchanged if the product is realized at a minimum profit that represents the preferential dividend price before tax:

$$\frac{\$\,1\;25000}{(1 - .34)} = \$\,1\;894\;000$$

At this point, the increased revenue from the new product will only compensate for the increased financing costs - a break-even situation. Bearing in mind that the requirement for a significant profit of nearly \$ 1.9 million is two-thirds more than \$ 1,100,000 before interest-rate taxes on the bond alternative.

Ordinary shares and capital structure

When ABC considers the new issue of ordinary shares as the third option to raise the \$ 10 million needed, the impact on their earnings is even worse. Suppose ABC will issue 275,000 new shares at a net price of \$ 36.36 after legal and insurance costs. Such a reduction of the current market price, which is \$ 40, must ensure successful emissions trading. The number of shares traded in this way will increase by 27.5% for the current 1 million shares.

Table 6.

ABC earnings per share with new common stock issue (\$, thousands, except per share figures)

	Before	After
Earnings before interest and taxes (EBIT)	9000	11000
Less: Interest charges on long-term debt	-0-	-0-
Earnings before income taxes	9000	11000
Less: Federal income taxes at 34%	3060	3740
Earnings after income taxes	5940	7260
Less: Privileged dividends	-0-	-0-
Earnings available for common stock	5940	7260
Common shares outstanding (number) in millions	1.275	1.275
Earnings per share (EPS)	4.69	5,69
Less: Common dividend per share	2.50	2.50
Retained earnings per share	2.19	3.19
Retained earnings in total	2752	4072
Original EPS (Figur 2)	5.94	5.94
Change in EPS	-1.28	-0.25
Percent change in EPS	-21.5%	-4.2%

Table 5 shows the impact on revenue in the same way it shows it for the other two alternatives.

We see that immediate dilution is \$ 1.28 per share, which is a drop of 21.5%, which in turn has the strongest impact from the three analyzed alternatives. Ordinary shares in terms of this comparison are the most expensive form of capital - even if only because they lead to immediate dilution of the current shareholders' profits. In addition, there will be an annual cash outflow of at least \$ 687,500 of post-tax revenue generated by

215,000 new shares if the current $ 2.50 annual dividend associated with ordinary shares is maintained.

In addition, we can predict that this money drain can grow at a rate of growth of 4% per year. This assumption will be made if directors continue with their policy of declaring regular cash dividends with a constant rate of disbursement from future earnings, which in turn continued to grow.

So far, pretax revenue is required to cover the dividend of $ 2.50 per share

$$\$2.50\text{x}275\ 000 \text{ shares } = \$687\ 500 \text{ (after taxes)}$$

$$\frac{\$687\ 500}{(1\ -\ .34)} = \$1\ 042\ 000 \text{ (before taxes)}$$

We can directly compare these earnings requirements of about $ 1.0 million with the $ 1,350 billion bond requirements and the $ 1,894 million preferred stock requirements. Both in terms of earnings and money planning, these amounts are very significant.

The effect of immediate income dilution is only part of the remuneration. There will also be a secondary effect of continuing dilution because, unlike the other two types of capital, newly created ordinary shares represent a current requirement for corporate profits to be on a par with those of existing shares. In this way, with our experience so far, the growth rates of earnings per share will slow down and in the future most of the shares will be outstanding - unless the income derived from the investment is at a better level of the potential growth of the existing profit rate. Turning to the second column of table 5 it is clear that, despite the extra revenue from the new product, net dividend dilution of 25 cents (4.2%) will actually continue. The contribution of the new product to the reported earnings is not sufficient to meet the demands of the new shareholders and maintain the level of the old value of the share. The impact on the incomes of an alternative to ordinary shares is greater than the revenue generated by borrowed capital.

So far, we have looked at the impact of ordinary shares on income financing. In order to find roughly the approximate sum of the specific value of the alternative, we can establish as a minimum condition the maintenance of the level of the old earnings per share. The current EPS, which is $ 5.94 (Table 2) and $ 36.36 in revenue, results in a price of about 16%.

$$\frac{\$5.94}{\$36.36} = 16.34\% \text{ (after taxes)}$$

We know that the revenue approach to measuring the price of ordinary shares is, for many reasons, quite limited, even if it is assumed in the formula for the expected revenue growth. If we use the dividend approach to find the specific price of an ordinary share, we must match the current dividend per share to the net result and add the future dividend growth. We know that the company has an approximately constant revenue growth of 4% a year and we assume that with a constant payout rate, the ordinary dividend will continue to grow at the same rate. The result is about 11%:

$$\frac{\$2.50}{36.36} + 4.0\ =\ 10{,}9\%$$

We will use the data from a while ago to test the specific cost of capital from ABC's ordinary shares with the CAPM approach.

The value of the ordinary shares, *Ke*, is approximately 13.25% when placed in a CAPM formula without risky return, *Rf* is 6.5%, β is 0.9%, the expected average return *Rm* represented by the S & P 500 is approximately 14%:

$$\text{Ke}\ =\ Rf\ +\ \beta(Rm - Rf)\ =\ 6.5\ +\ 0.9(14.0 - 6.5)\ =\ 13.25\%$$

This result is one of the most reliable for judging the specific price of ordinary shares. It can be compared with the specific value of the bonds (7.56%) and the specific value of the preferred shares (12.5%).

Obviously, the alternative to ordinary shares is the most expensive source of funding, and just as we have already found that the dilution effect is very serious. In addition, the cash flow requirements for paying the current dividend of $ 2.50 per share, plus any possible future increases in the total dividend, should be planned. Because it is difficult to maintain all these quantitative aspects visible in our debates, let's now turn to graphical representation of the various incomes and dilutions to compare the relative state of the three alternatives.

Ebit break-even chart

We have affected several times the changes in companies' profits and the different influence of the three major financial alternatives under changing conditions. The static form of analysis we have used so far does not allow us to readily explore the range of opportunities such as profit change or to visualize the sensitivity of alternative sources of funding related to these changes. It would be difficult to calculate earnings per share and other data for a large part of the different profit levels. Instead, we can use the linear relationships that exist between the quantified factors analyzed.

The graphical approach break-even "analysis can be used to compare alternative sources of funding. This part will show you how such a model that corresponds to fluctuations in EBIT (earnings before interest and taxes) and to have resulted in levels of EPS (earnings per share), can be used to illustrate the most important for us and quantitative aspects relative attractiveness of possible options. As we will see, "break-even" model allows us to easily expose a variety of analytical tests.

To begin with, we have summarized the ABC data in Table 6. Variations of this data can be plotted in a simple "break-even" graphic that shows EPS of the vertical axis and EBIT of the horizontal axis. This EBIT graph allows us to draw straight lines for all EPS alternatives under the influence of changing conditions and to find BEP ("break even") between them. every straight line with the horizontal axis, which is exactly the point where EPS is 0. These points can easily be found by performing EPS calculations on the back starting with the assumption that EPS = 0 and finding the corresponding EBIT under this condition. Calculation is shown in Table 7 for Initial th position for each of the three alternatives. Calculations of Tables 6 and 7 give us enough points through which to draw a linear function of the EPS and EBIT for a variety of alternatives (Table 8).

We can quickly note that the conclusion about the impact of profits from the alternatives we drew at the two EBIT levels already analyzed, $ 9 million and $ 11 million, retains the relatively wide variety of profits shown; any shown alternative causes a significant reduction in EPS relative to the original conditions.

Table 7.

ABC Summary of new product EPS analysis ($ thousand, except for figures per share)

	Oridginal	**Debt**	**Preferred**	**Common**
EBIT	$9,000	$11,000	$11,000	$11,000
Less: interest	-0-	1,150	-0-	-0-
Earnings before taxes	9,000	9,850	11,000	11,000
Less: Taxes at 34%	3,060	4349	3,740	3,740
Earnings after taxes	5,940	6,1501	7,260	7,260
Less: Preferred dividends	-0-	-o-\	1,250	-0-
Earnings available for common stock	$5,940	$6,501	$6,010	$7,260
Common shares outstanding (number)	1 million	1 million	1 million	1.275 million
EPS	$5.94	$6.50	$6.01	$5.69
Less: Common dividends	2.50	2.50	2.50	2.50
Retained earnings	$3.44	$4.00	$3.51	$3.19
Retained earnings in total	$3,440	$4,001	$3,510	$4,072
Oridginal EPS change		-12.8%	-21.0%	-21.5%
Final EPS change		+9.4%	+1.2%	-4.2%
Specific cost		7.59%	12.5%	13.25%

Table 8.

ABC Calculations at EPS = 0 ($ thousands, except for figures per share)

	Oridginal	**Debt**	**Preferred**	**Common**
EPS	-0-	-0-	-0-	-0-
Common share	1 million	1 million	1 million	1.275 million
Earning to common	-0-	-0-	-0-	-0-
Preferred dividends	-0-	-0-	$1,250	-0-
Earnings after taxes	-0-	-0-	1,250	-0-
Taxes at 34%	-0-	-0-	644	-0-
Earnings before taxes	-0-	-0-	1,894	-0-
Interest	-0-	$1,150	-0-	-0-
EBIT or EPS=0	-0-	$1,150	$1,894	-0-

With the usual alternatives available, the slope of EPS is different. In fact, the rights of ordinary shares intersect debt and preferential shares. Then the two lines are parallel to each other, but also with EPS in the original condition (it is on the left of them). The smaller slope of ordinary shares rights is easily explained. Introducing new shares in ordinary shares results in a proportional dilution of earnings per share at all levels of EBIT. The consequence is that additional shares cause a slower increase in earnings per share with growth in EBIT.

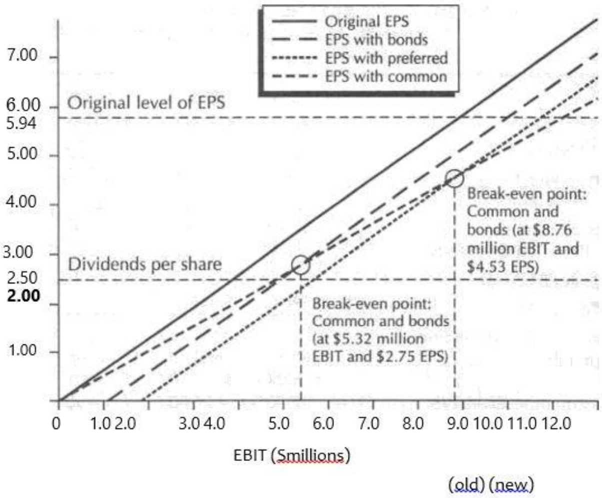

Figure 1. ABC Range of EBIT and EPS Chart

By contrast, the parallel shift of the debit and preferred shares to the right of the original rights is caused by the introduction of fixed interest or dividend charges, while the number of ordinary shares remains constant at the levels of EBIT surveyed.

The importance of intersections must now become obvious. These are BER where, for certain levels of EBIT, EPS for ordinary alternative shares and one of the other two alternatives are the same. Note that the BEP of ordinary shares with the bonds is at $ 5.3 million EBIT, while the BEP of ordinary shares with the privileged is at $ 8.8 million EBIT.

Under $ 5.0 million EBIT, therefore, ordinary alternative shares cause the least EBIT dilution, while more than $ 9 million EBIT causes the worst dilution in EPS. We recall that ABC's current EBIT is $ 9.0 million and is expected to be at least $ 11 million after the new product has contributed fully to its planned profits. Both BERs thus lie below the probable future EBIT, making ordinary alternative shares the most expensive in terms of dilution of profits.

Considering that the relative profitability of the three alternatives is different in the variety of EBIT presented, it is not possible to evaluate the three alternatives without defining a "normal" EBIT range for the company's expected performance. If future EBIT provide for fairly good movement within both BEP, ordinary shares appear more attractive than preferred shares in terms of EPS dilution but worse than debt. If EBIT is expected to grow and move relatively to the right of the second BEP, as is almost certainly the case with ABC, the new ordinary shares are not only more attractive in terms of EPS dilution but they will remain so.

Considering all of these basic considerations, of course, there are assumptions about the conditions under which the three forms of private capital would be emitted. If we can expect a significant change in all of these conditions (for example, the bid price of ordinary shares or bonds), a completely new chart needs to be mapped out, or we should at least reflect any possible cost disruption or proportion of alternatives such as change in EBIT levels.

The crossing between the EPS, which represent EBIT crossing points for alternative ordinary shares with the two other options, can easily be calculated. For this purpose, we formulate simple equations for the conditions in which all pairs of lines intersect. EPS are set equal for both alternatives, and the equations are determined for the specific EBIT level for which this condition is valid. To illustrate, let's first establish the following definitions:

E = EBIT level for each BEP with ordinary alternative shares
i = Annual bond interest in dollars (before taxes)
t = Tax rate applicable to the company
d = Annual preferred dividends in dollars
s = Number of outstanding common shares

The equation for each of the EPS can be easily found by replacing the known things in the summary:

$$\text{EPS} = \frac{(\text{E} - \text{i})(\text{i} - \text{t}) - \text{d}}{\text{s}}$$

Now we can find the break-even EBIT levels for bonds and ordinary shares in terms of EPS. For this purpose we will fill in the data in both expressions and we will receive:

Bonds *Common*

$$\frac{(E - \$1{,}150{,}000).66 - 0}{1{,}000{,}000} = \frac{(\text{E} - 0).66 - 0}{1{,}275{,}000}$$

When we decide for E, we will get the following result:

$$0.66\text{E} - \$759{,}000 = \frac{0.66\text{E}}{1.275}$$

0.842E - $967,725= 0.66E

E = $5,317,200

This break-even level of $ 5.32 million can be easily checked graphically in Table 8.

When the same approach applies to preferred and ordinary alternative shares, the following result arises:

Preferred *Common*

$$\frac{(\text{E} - 0).66 - \$1{,}250{,}000}{1{,}000{,}000} = \frac{(\text{E} - 0).66 - 0}{1{,}275{,}000}$$

$$0.66\text{E} - \$1{,}250{,}000 = \frac{0.66\text{E}}{1.275}$$

0.842E-$1,593,750=0.66E

E=$8,756,900

The chart can again be used to confirm a break-even of $ 8.76 million.

We can also use the graph to show the impact of any ordinary dividend on the three alternatives. Horizontal rights at $ 2.50 in the chart represent the current annual total dividend. Where those rights cross the alternative EPS lines, we can read a minimum EBIT corresponding to that dividend. Similarly, the chart may reflect the amortization fund requirements or other regular repayment provisions. In fact, such annual provisions involve some of the future profits for that purpose.

We can improve the effect under these conditions by transferring the

calculations one step ahead. So we will reach the so-called. UEPS (*uncommitted earnings per share)* for each option after the provisions for all repayments. We can simply deduct the cost per share of such repayments (which require dollar tax) from the corresponding EPS of the alternatives so affected, and redraw the ones on the chart. The result will be a parallel shift to the right of the affected rights from the previous position.

For example, the amortization fund's $ 400,000 depreciation requirements per year for bond selection would be 40 cents per share, and the new bond rights would move to the right of that amount over its entire range. Similarly, the crossing at point 0 of EPS, currently $ 1,150,000 EBIT, would move to the right to zero UEPS at $ 1,756,060. This shift reflects the depreciation fund's requirements for $ 400,000 per year, which turns out to be somewhat pre-taxed by $ 400,000 + (1-0.34) or $ 606,060. As it becomes clear in this case, the UEPS dividend rights would move very close to the EPS rights for preferred shares in Table 8. So far, the usefulness of this framework for dynamic analysis of the various financial alternatives has to be obvious. The reader is invited to think carefully about the consequences of the variety of tests that can be applied. For example, we can determine a minimum of EBIT below any alternative that would cover the current total dividend of $ 2.5 per share while we accept a variety of different payout ratios of 50% or 40%. This means that with 50% pay, EPS should be $ 5.00. Horizontal rights would be drawn at the $ 5.00 EPS level, and would represent minimum EBIT for the $ 2.50 dividend. The analyst should assess the possibility of lowering EBIT to this level and assess whether this would jeopardize the current dividend payment.

Certainly, other tests can also be applied, depending on the company's specific circumstances. This structure can also be used to monetize each of these results by converting corresponding EBIT into an equivalent cash flow from operations. This additional step would require determining the effect of the cash shield on depreciation. Spreadsheet analytics can be used to make the required multiple calculations.

Again, it should be stressed that each specific EBIT schedule is only valid for fixed assumptions about earnings and fixed interest and certain preferential dividends. If there is any reason to believe that any of these key assumptions may change, the positions of the EPS EPS on the graph will need to be adjusted.

Obviously, any change in the relative price in the varied alternatives will also have its effect. If the distance between the two alternatives increases, for example, the differences in the impact of the profit will expand and the distance between the parallel lines will increase. It simply reflects that the imposition of high fixed bonds suppresses EPS.

The increase in the amount of issued capital also has an effect because the slant of rights is determined by the sum of the existing leverage existing capital structure. In other words, if there is already some debt and privileged shares in the capital structure, the core EPS would increase and decrease much more sharply with changes in EBIT. Any rises in fixed funding prices would simply increase this leverage. At the same time, the EPS sloping of the total share of ordinary shares is determined by the relative number of issued shares, which in turn are related to the rate of dilution of profit as in the example shown.

Financial planning templates and spreadsheets can be used to enhance the basic analysis that is demonstrated here. What is important and must be remembered is that the analysis essentially quantifies the relative impact of alternatives on reported earnings. This effect is just one of the many factors that need to be considered when choosing funding. As we have already mentioned, the conceptual and practical context for a possible solution is far more comprehensive than this graphical expression of the proposed break-even conditions. Strategic plan for the future, risk expectations, market factors, specific criteria and current conditions of the company - all involved in the final decision.

Specific forms of funding

Our previous discussion focused on the basic choice between debt, preferred shares and ordinary shares, ignoring the many variations that are often encountered in these instruments as well as other specialized forms of financing. We will now briefly cover a few more specialized areas of the financial choices, namely convertible bonds and preferred shares, human contributions, court orders and leases.

Convertible Securities

As we started earlier, convertible into ordinary shares is a feature that is sometimes added to bond issues or preferred shares for merchantability and sync. The essence of convertibility is the issuance of the company's ability to sell ordinary shares at prices higher than those of bonds or preference shares issued at that time. This is due to the fact that the conversion price for the ordinary shares it represents is at certain expected future levels, based on the company's experience and expectations.

The conversion price is under conversion, determined for issued bonds and preferred shares. For example, new $ 100 convertible privileged may have a convertible 3, ie each share of the privileged is convertible into three shares of ordinary shares. This represents a conversion price of $ 33.33 per ordinary share, while the company's shares can currently trade in the range of $ 25.00- $ 27.00. The difference between current prices and the conversion price is called premium conversion. The same approach can apply to bonds that are usually denominated in thousands of dollars.

Given the expectation that ordinary shares of the company will exceed the conversion price, bonds or preference shares will be traded at values that represent ordinary interest or dividend yields and the value of a sale itself. The initially stated yield will prevail, but when ordinary stock prices start to outweigh the conversion price, the price of the bonds or preferred shares will be an amplifier to reflect the current market value or the underlying ordinary shares. This is the moment when conversion becomes extremely attractive to the investor. If stock prices remain below the conversion price, the cost of conversion will always be the lowest value for bonds and preferred, whereas the actual price will depend on the yield that is secured at a certain interest rate or a privileged dividend.

In view of the potential attraction of the convertible to the investor, the issuing company typically pays somewhat lower interest or privileged dividends through these instruments. In order to limit the period over which these securities are outstanding, the company may typically accelerate conversion after the market price of ordinary shares reaches the conversion price by exercising a provision (the company's right to accelerate all or part of the issue) -convertible emissions. This is usually based on a predetermined price close to the conversion price.

Convertibility adds a number of considerations to the main election, because successful convertible issues ultimately result in a rise in ordinary shares, a delayed impact on control, earnings per share, and the amount of future ordinary dividends to be taken into account in the analysis. The graph we have already used can be applied by showing this situation in two steps: (1) convertible bonds or privileged bonds or privileged, and (2) additional ordinary shares of the final conversion. While significant convertible issues remain unpaid, companies are required to calculate full net earnings per share.

Offering rights

The so-called offering of rights is a form of financing ordinary shares by minimizing the dilution of the proportional holdings of existing shareholders. They are also called a privileged subscription, since offering each existing shareholder the right to buy a certain number of ordinary shares from the company at a special price for a certain period of time after which the rights expire. The number of issued rights is usually equal to the number of outstanding shares in the stock. The specific number of rights is needed to buy each share of the new stock. Rights are issued as special certificates and are often traded on stock exchanges or at counters in banks.

Let's illustrate. If the XYZ company has 1,000,000 outstanding ordinary shares and wants to sell 250,000 new shares, 1,000,000 rights will be issued to existing shareholders with the clause that four rights are required to buy a new share of the stock at the subscription price. If the subscription price is $ 30, while the current market price is $ 40, the shareholder has to relinquish four rights and $ 30 to the company for another share, currently worth $ 40.

For the company, attracting such a course of action in addition to diminishing the dilution potential of control is a direct appeal for the funds to a group of investors who are already familiar with the company's prospects and history. If shareholders are willing, they will exercise their rights by directly buying from the company their fixed number of shares in the rights at a special subscription price. If shareholders are not interested, the rights may be sold as such because they will reflect the differential value between the shares offered and their market price.

The consequences of this alternative for the analysis are quite similar to those in the public offering that we have accepted for the case earlier. The subscription price may differ somewhat from the price that insurers provide in the public offering, but otherwise the analysis will be parallel to the alternative ordinary shares we have already explore.

Court orders

Court orders are a form of corporate security that authorizes the holder to buy a certain number of ordinary shares at a fixed exercise price for a certain period of time. Some court orders do not even have a shelf life. They are issued as an additional incentive for investors to buy a new public bond or bond or private placement of loans and bonds. Sometimes court orders are even issued as part of the offering of ordinary shares. The proportion of issued court orders to new offers varies depending on the price exercised and the degree of willingness to move the new debt issue into the hands of investors. Court orders are attached to these new securities as part of the offering, but in most cases they can be detached from the holders and sold separately if necessary. Numerous court orders are traded at any time in the securities markets.

As a result, the court order gives the option holder to buy an ordinary share if it has an advantage to do so (for example, if the exercise price is below the market price). Just as in the case of rights, with a court order, the funds go directly to the company. Since court orders, in contrast to rights, have been valid for a relatively long period of time, there is no potential to dilute the profits of past court orders. Companies with a significant number of outstanding court orders must calculate net earnings per share, just as in the case of outstanding convertible issues.

The consequences of analyzing a new proposed debt with attached court orders are primarily to recognize the potential of financial inflows from new shares such as court orders being exercised and the dilution of profits from those shares. Our graphical analysis needs to be modified to illustrate the combination of these effects.

Leasing

We have already mentioned the lease several times. This is a specific form of financing that gives the company access to a whole range of assets, from buildings to cars without the need to directly acquire them. The Lessee pays a periodic negotiated fee that covers the costs of landlord's ownership, financing, and tax costs by providing economic returns. The lessee can use the assets for a certain period of time, assuming there is no risk of ownership or technical aging, and can fix or replace the assets. The lessor, on the other hand, is supposed to have the old assets. The latter provision is especially attractive in the case of computers or technical equipment. The charterer will only bear periodic tax deduction of costs.

Long-term lease agreements, especially for buildings, can be extended for many years, thus becoming part of the company's financial structure. This accounting practice requires the disclosure of the lease obligations in the company's published financial statements if such leases are a material liability. While leases are usually not included as liabilities in the balance sheet (they are called behind balance sheet items), the notes below the balance sheet must disclose the amount of the periodic payments and forecast the capitalized value of those lease commitments.

Such disclosure recognizes the fact that the lease obligations represent a financial burden to be maintained, as is any other form of financing. Any company that hires a significant portion of its assets is less flexible in its financial choices. The effect is the same as that of the long outstanding long-term debt. Fixed lease fees add leverage to the company's operations, which is quite similar to leverage resulting from other sources.

There are many implications when choosing a lease against the property. We will not deal with the techniques of analysis and the consequences of the cash flow of the types of leases because they are too specialized and complex to look at. However, we must emphasize that there is a cost-effective lease, because the lessor has to be compensated for what it provides, financed, serviced, and replacing the assets. By definition, the lease fees must be high enough to make the lease attractive to the lessor. At the same time, the landlord is often able to use economies of scale that can have a beneficial effect on the cost of leasing, as in the case of the main equipment of leasing companies, for example.

Benchmarking needs to make the final choice between leasing and ownership, and should take into account indicators such as the tenant's cost, technological advantages, service, the flexibility of not ownership, and the impact of the company's financial position. As in all financial analyzes, the choice is based on quantitative data and the judgment of the management. In some industries, leasing is part of the normal way of doing business. For example, wholesale and storage are mainly leased, not purchased, while the transport industry, leasing of rolling stock, trucks and airplanes are predominant. In other areas, the choice of leasing is widely open and depends on what financial alternatives are considered favorable at this time.

Key questions

Here is a summary of the key issues raised directly or indirectly in this article. These are listed to help the reader use the analysis techniques discussed in the context of financial theory and business practice:

0. The choice among the different types of long-term financing is indissolubly linked to the business strategy of the company. The choice must match the risk / reward inherent in strategy and funding.

1. The cost of the different types of capital is only one element on which the new financing decision is based. While debt is generally the lowest alternative cost and ordinary shares are the highest, the need to build and maintain an appropriate balance in the capital structure often replaces the final price.

2. Non-price elements (such as risk, flexibility, synchronization, control of shareholders) and management preferences should be pursued in connection with changing market conditions and the company's future policy.

3. Sometimes new funding may represent a significant share in the existing capital structure. The way these funds have grown can cause a shift away from the desired ideal corporate capital structure. Because a block of one form of long-term capital was chosen at one point, the management may be limited in the next round of funding. To compensate for the lack of balance, it may be necessary to use a compromise mix of funds.

4. Specific provisions on new issues of a securities are broadly based on the situation. Investment bankers, insurers and management cooperate to agree on the design and cost of financial instruments, reflecting market conditions, credit rating of the company and reputation, risk assessment, company strategic plans and current financial practices.

5. When changing the company's capital structure, the cost of capital is also changed. However, the temporary shifts received from supplemented blocks of new capital should not have an effect on returns based on the cost of capital unless there is a deliberate and constant change in the company's policies.

6. New ordinary shares have a long-term effect on dilution of ownership and earnings per share. This is true whether the new shares are directly issued or are triggered by the conversion of other securities or through the exercise of court orders. The decision whether to issue new shares should be closely related to the expected results of a strategic plan. This also involves drawing the benefits of introducing new permanent equity into the capital structure.

7. Leasing as a form of financing is based on a series of compromises that need to be pursued in relation to the company's capital structure and business direction.

Summary

This article looked at the decision-making framework and some techniques used to analyze the different types of long-term funds. We focused on the three main alternatives open to management (long-term debt, preferred shares and ordinary shares).

We understood that the choice of financial alternatives is a complex of analysis and judgment. Several areas of reflection were highlighted. We looked at the cost to the company, the relative risk and the issues of flexibility, synchronization and control over different sources of funding. We understand that many aspects of the choice of types of capital include more than quantitative data.

We also focused on the impact of every financial alternative on the company's reported profit, and then we perfected the break-even chart linking EPS and EBIT, which allows us to visually test the impact of the profits of alternatives over the entire dynamic range of potential profit levels. This simple model offers the potential use of wider financial models or spreadsheets to simulate more accurately the impact of the alternative financial package or the changing conditions. Lastly, we briefly reviewed the key aspects of some more specialized forms of financing (convertible securities, rights, court orders and leasing) and suggested some analytical considerations that apply to these modified conditions.

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Objective - oriented financial analysis introduction

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Abstract: The practice of financial analysis has been immeasurably strengthened in recent years thanks to the ongoing evolution of computerized approaches in the form of spreadsheets and computer-based financial models of different types. These devices not only relieved the analyst's computing task, but also opened up a wide range of analyzes and research into alternative sensitivity, which so far has not been possible. The main potential for object-oriented financial analysis consists in enormously expanding the analyst's capabilities through an online knowledge and information interface that has not yet been achieved through existing methods and software packages.

Keywords: financial analysis, computer-based financial models, software packages

The practice of financial analysis has been immeasurably strengthened in recent years thanks to the ongoing evolution of computerized approaches in the form of spreadsheets and computer-based financial models of different types. These devices not only relieved the analyst's computing task but also opened up a wide range of analyzes and research into alternative sensitivity, which so far has not been possible.

At the same time, however, with the help of a computer, the financial analysis in its current form remains essentially a passive, powerful, processing tool that leaves much of the formatting, data selection, link specification, and computational instructions to the analyst - that is, she relies on the individual's professional knowledge to control the whole process. In addition, significant changes in a large number of variables can become so severe for the tracking analyst that creating a completely new analysis may be preferable but at the cost of denying valuable continuity.

The emergence of cost-effective PCs and workstations with massive improved computing speeds and internal memory has made it possible to develop entirely new approaches to computer financial analysis, support and decision-making. One of the most promising is the system of object-oriented financial analysis. Managing and supporting decision-making is being developed by Modem soft, Inc. The framework of software that is used is called Financial Workbench ™ (FWb ™), which embodies interactive, knowledge-based, object-oriented design concepts.

Once the financial sites have been created and classified, the FWB ™ system allows the analyst to perform, in an interactive way, consistent financial analyzes of this "model" with several constraints, all during the construction and maintenance of the interconnected database underlying of the situation. So FWb ™ extends beyond the simple. Computerization is an active exchange of knowledge and experience between the analyst and the system. Its basis is the concept of using financial items as permanent carriers of the relevant financial or other knowledge, which is the basis of information that is expandable to any amount of detailed wishes.

Financial objects and their inherent knowledge can support a significant part of the analyst's active analytical activity. Not only is the knowledge base of the individual interactively integrated with the database already included in the financial software but this combined knowledge base used to solve the problem remains freely available at any time as the analysis progresses. The various active financial assets are active parts of interrelated financial systems models that can be viewed, accessed and analyzed as a living entity that responds to the moment and is consistent in its assumptions about any changes in data. This interactive capability is especially important in very complex analytical situations where tracking links within existing spreadsheet constraints will prove to be inappropriate. Testing results of object-oriented financial analysis enable analysts to perform far more comprehensive, innovative, and in-depth analytical tasks than they did before.

Financial projects - main concept

Because financial objects and their classes are the main feature of this analytical approach, it would be useful to illustrate the nature of financial objects on the basis of a simple example. Most real-world situations are so complex that complete financial analysis is not practical, as the number of interacting elements is often enormous. It is possible, however, to abstractly illustrate the basic elements and their interactions and thus to model the basic situation by gradually adding the complexity necessary for significant results. For illustration purposes, a highly simplistic reconciliation analysis has been selected to focus on the essence of financial objects. It turned out that this is a matter of much more complex and complex situations.

PotCo manufactures and sells pots at a cost of $ 10 per unit. Each pot requires $ 5 direct production costs. All other PotCo costs are $ 100,000 per year. The PotCo president wants to know how many pots to sell annually to break the break-even point. A possible collection of objects that can be used to model this exemplary situation is shown in Figure-1.

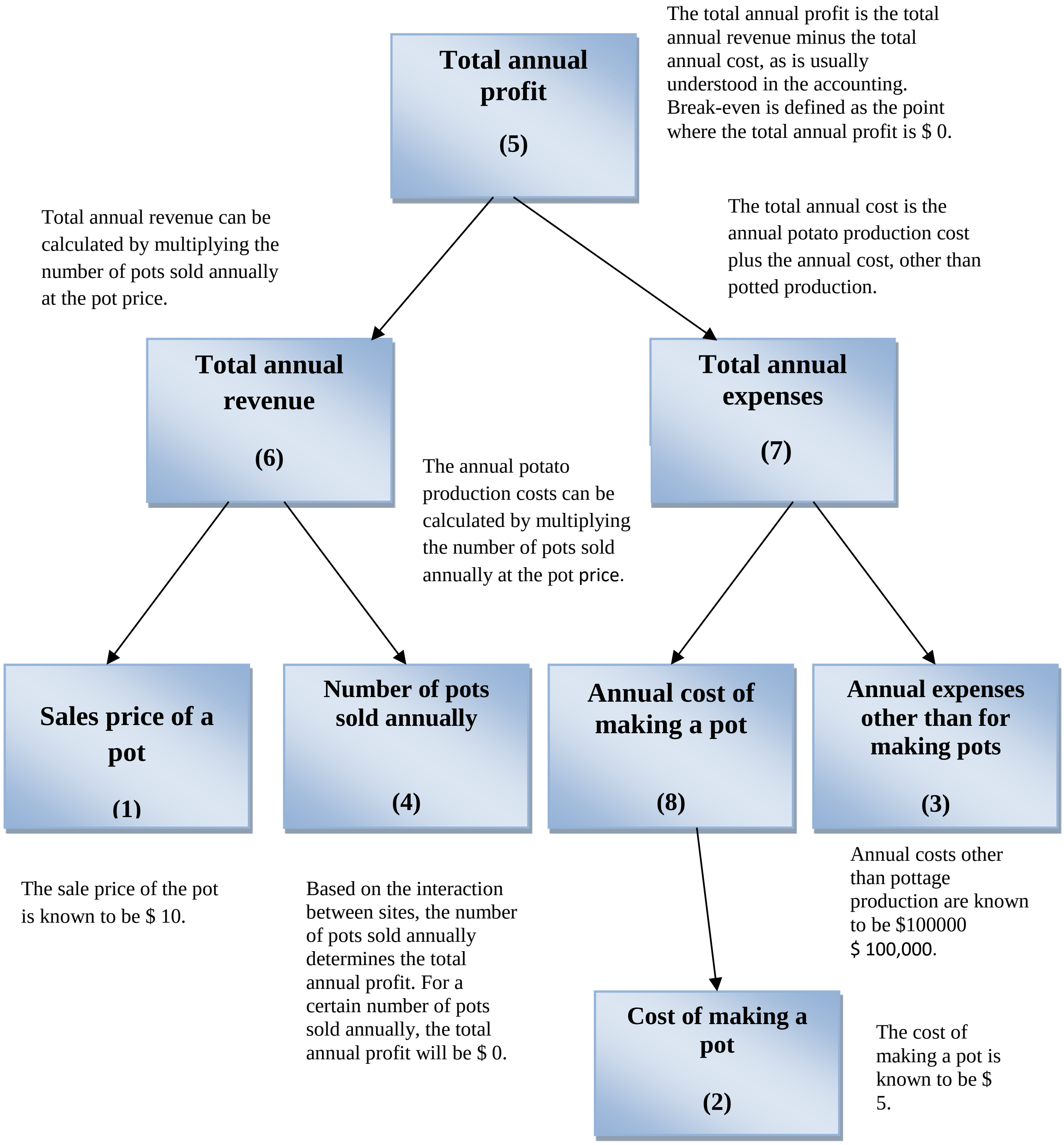

Figure1. Basic Objects for Break-Even Analysis

Once with this basic set of objects, the interaction between individual objects can be shown as follows in Figure -2. Different relationships, of course, are not limited to zero profitability, the analysis itself, and the analyst can use this, the created knowledge base for other analytical tasks. Once relationships have been established, they become readily available and proven within the system, but they can also be modified for any purpose.

The simple model presented here can be used to calculate the annual equalization volume, with an annual profit of $ 0 when the analytical study and the analyst change the key variables that know the sensitivity of the results of the different assumptions.

FWb provides for the creation of any number of objects with properties corresponding to the accounting point of view (for example, revenue, assets, liability) and physical objects (e.g., product unit, bank credit) arising in the broad spectrum of real financial situations. This is possible in order to provide knowledge and data to support the different types of financial solutions that describe each situation from the point of view of the respective group of objects, to create the different interactions between these objects, and with the help of a wide range of analytical techniques built into the system to manipulate them.

Total annual profit

Although the objects created in the FWb may be quite common, all objects should have an aspect that is financial in nature. This is necessary because FWb uses the financial knowledge to organize and understand the reason for this and to construct user-created objects. It is known that now strictly financially can be added to the sites to provide additional dimensions, which can be carried out analyzes and engineering. Because all objects have at least one financial dimension, the objects used in the FWb are usually referred to as financial objects.

With the help of a set of specific classes provided by FWb, building blocks for analysis, the user continues to choose the right classes for each financial site. Once an object has been classified, it automatically inherits a number of properties that are embedded in its class as the existing database in the system. Special training contained in one class allows the system to recognize an object. For revenue for financial purposes, the individual revenue subcategories and the preferred sequence and companion require aggregation of individual earnings appropriate for specific reports. Thus, by the individual knowledge and experience, the analyst is based on the choice in the class and remains included in each financial site and stays there for use from now on for any purpose, together with any additional aspects identified by the analyst.

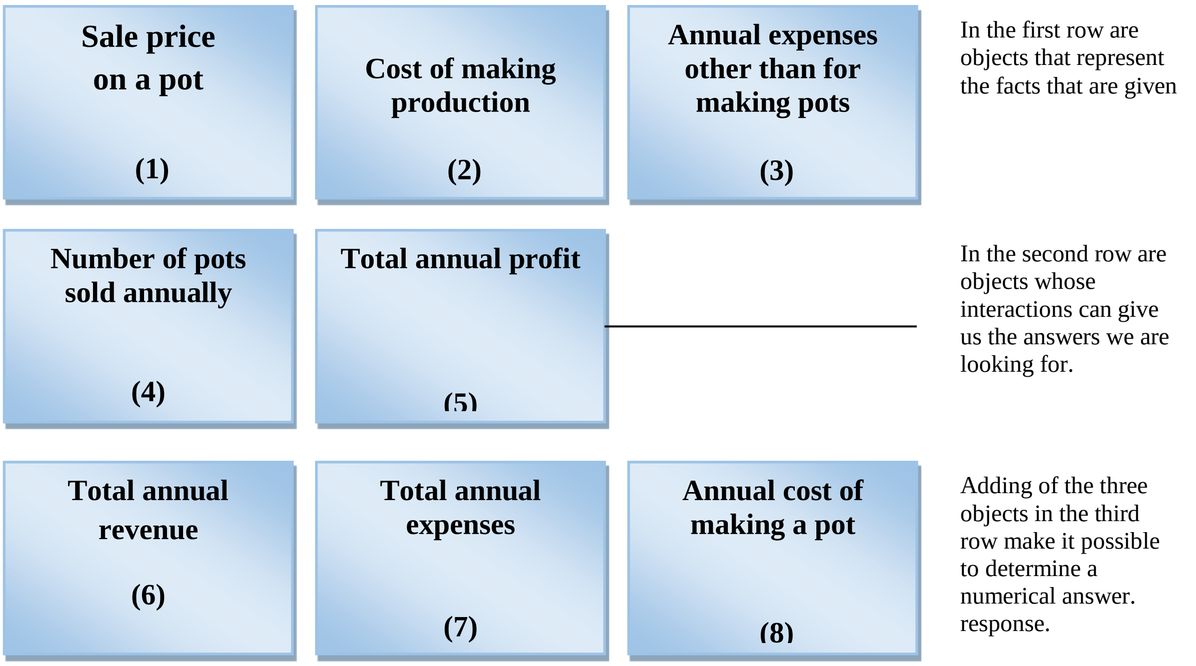

Figure 2. Interaction between objects

Each of these objects interacts directly with one or more other objects. Note that object 4 is physical, namely the number of pots that are sold for one year, while all other objects are abstract financial concepts.

As the user works by analysis, FWb automatically generates a significant amount of information about the financial state, which then remains available to both the analyst and the system as part of the database. In many cases, this new knowledge will be automatically applied by calculations or checks according to the progress of the analysis, thus enabling the analyst to complete the tasks that he has started, more efficiently and with greater in-house consistency.

The main potential for object-oriented financial analysis consists in enormously expanding the analyst's capabilities through an online knowledge and information interface that has not been achieved so far only through existing methods and software packages. This methodology releases the analyst from repetitive input actions, instruction formulation and attempts to track the assumptions and results of a set of analyzes. In a broader sense, object-oriented financial analysis brings about the realization of live financial modeling - freed from massive internal system development tasks, usually related to everything else, but is elementary based on spreadsheet techniques. The scope of financial concepts and techniques will thus be used to create analysts in a way that major efforts can concentrate on carefully structuring decision-making on issues and points of view from which they need to be resolved - which is Validating the key message for guidance on financial analysis.

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Conceptual model for concessioning in the Water Supply and Sanitation sector in Bulgaria

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Abstract. The purpose of this article is to create a new conceptual model for sustainable development of the water sector in Bulgaria on the basis of concessions by statistical regions according to the NUTS-2 classification of the European Union. The essence of the proposed model includes an approach for consolidating the existing 66 WSS operators in three WSS operators – concessionaires. The approach is applied to provide WSS services for drinking and household needs of the population. WSS services for the sectors – Industry, Services, Agriculture, Forestry and Fisheries remain outside the scope of the study. The proposed model is based on statistical analyses of the effectiveness of the WSS operators working by statistical regions and the state of the technical infrastructure they use. Such concessioning by combining one region from the North and South Bulgaria should help to overcome the existing disproportions in the social and economical development and its harmonization in the regions of Northern and Southern Bulgaria. Its implementation should create new opportunities for introducing foreign direct investment which will contribute to the sustainable development of the water sector in the country. The practical significance of the proposed model for overall concessioning of the WSS sector is for Bulgaria as well as for other countries with low and middle incomes. The model is a part of a comprehensive study of a scientific project, according to the Ordinance No.9 of the Ministry of Education and Science of 08.08.2013, with No.NPI-130/2014, on the topic: „The concession as a factor for development of the Water Supply and Sanitation sector in the Republic of Bulgaria“.

Key words: water sector, water and sanitation, water concession.

1. Introduction

There are two main types of public-private partnerships in the European water sector (Lanjekar, 2010, pp. 168-169):

- *the first one* is the English type of complete privatization in which governance and ownership are personal;

- *the second one* is the French type in which the governance is delegated (for example, through leasing and concession contracts) and combines public and private governance, but the ownership is public.

The World Bank prefers to fund a public-private partnership of the French type that is widely used and acknowledged by already developed and developing countries in various forms.

Some authors (Ameyaw *et al.*, 2017, p. 37) try to find some factors affecting the attractiveness of the water supply sector for concessions. Public-private partnerships are widely discussed as an appropriate form of investments in water supply infrastructure. The research findings of (Ameyaw *et al.*, 2017, p. 60) provide an insight into a number of important issues to enable greater private participation in water supply projects, most of which aim at reminding governments of some key areas that need reform and enabling greater commitment among them to undertake such reforms. Datasets about concessions in the water sector provide huge amounts of data. They have to be stored in data warehouses , which allow the creation of reports in different dimensions (Vasilev and et al., 2017b, pp. 54-57) by sorting, filtering, grouping and aggregating data. Furthermore business intelligence techniques (Vasilev and et al., 2017a, pp. 63-77) may be used to find an appropriate model for financing and organizing the water supply sector.

In Bulgaria, the process of decentralization in the 1990s led to the creation of companies that are too small to achieve economies of scale and perhaps even too small to effectively manage modern WSS systems (Bocheva, 2013). So far, *Sofiyska Voda PLC* has been the only WSS company operating since 2000 under a 25-year concession (Sofiyska voda, 2017). According to the contract, Sofia Municipality assigned to the company the operation and maintenance of the WSS system in Sofia. The share capital is distributed between Sofia

Municipality – 22.9% and the French company *Veolia Voda SA.* – 77.1%. *Sofiyska Voda* is not the owner, but the concessionaire of the WSS assets, which are public municipal property. All newly constructed facilities with the company's investments also belong to the municipality.

There are different problems and challenges in the water sector in the country, which can only be solved through a complete reform of the sector and reorganization of WSS companies based on concessioning.

The purpose of this article is to analyze the effectiveness of the existing WSS operators in the statistical areas and the state of their technical infrastructure, to propose **a new conceptual model for the sustainable development of the water sector in the country**.

This statement is part of a full study of a scientific project under Ordinance No.9 of the Ministry of Science and Education from 08.08.2013, with No.NPI-130/2014, titled: „The Concession as a Factor for Development in Water Supply and Sanitation sector in the Republic of Bulgaria“.

2. Reasons for concessioning of the water sector in Bulgaria

The conducted survey of the dynamics of the water sector development in the period 2003-2015 and the comparative analysis of the indicators that take into account the efficiency of the WSS operators in the statistical areas give grounds to make the following important *conclusions* regarding the development of the WSS sector in the country.

During the period under review, *total water losses in all statistical regions are high* and amounted to 68.9% on average per year. The largest is their share in the Northeast region – 68.3%. In the Southeastern region they are 60.7%, in the Northwest region 59.5%, in the North Central – 58.0%, in the South Central Region – 57.4% and the lowest in the Southwest region – 56.3% (see Figure 1).

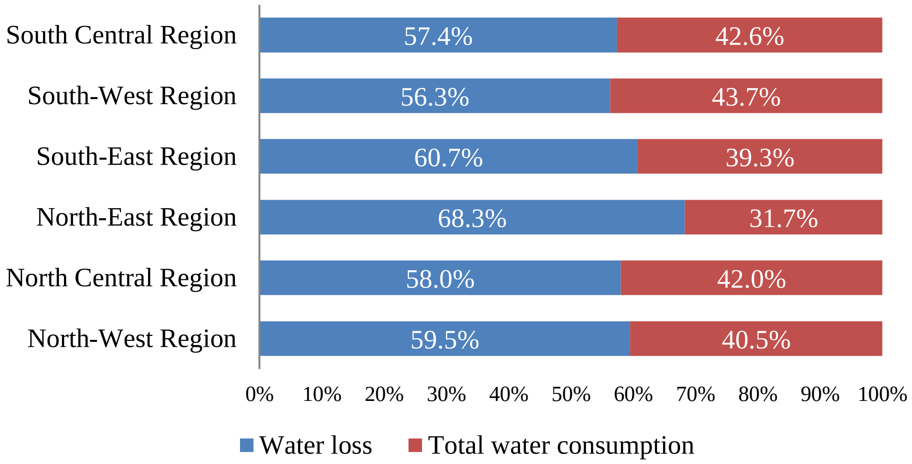

Figure 1. Relative share of total water consumption and water loss

Source: NSI data and author's own calculations.

The level of coverage of sewerage services is low and stands at 64.2% on average per year. It is the lowest for WSS PLC(AD), town of Lovech – 35.6%, WSS Ltd (OOD), town of Sliven – 37.4%, WSS Ltd (OOD), town of Kardzhali – 41.1%, WSS Ltd (EOOD), town of Vidin – 47.6%, WSS Ltd (OOD), town of Silistra – 50.5%, WSS Ltd (EOOD), town of Pazardzhic – 52.8% and WSS Ltd (EOOD), town of Pleven – 53.2% (see Table 1).

During the period 2010-2015 the ratio of operating costs to the revenues from the activity of the water and sewerage companies exceeds 100%, which is an indicator of low efficiency. For the North-East and South Central region these values are the highest. For WSS Ltd (OOD), town of Kardzhali the indicator is 104.6%, for WSS Ltd (EOOD), town of Plovdiv – 104.2%, WSS Ltd (EOOD), town of Dobrich – 103.9%, WSS Ltd (EOOD), town of Blagoevgrad – 102.2%, WSS Ltd (OOD), town of Shumen – 101.5%, WSS-Yovkovtsi Ltd (OOD), town of Veliko Tarnovo – 100,6% and WSS Ltd (OOD), town of Varna with 100.5%, or for the period the expenses exceeded the revenues by 0.5%.

The indicator measuring the cost-to-activity ratio of the invoiced water quantities has a drastically significant negative impact on the North-East region, including the individual WSS operators in it.

The total metric for the region is 2.17 BGN/m^3. For WSS Ltd, town of Dobrich this indicator is 2.59 BGN/m^3, for WSS Ltd, town of Shumen – 2.29 BGN/m^3, for WSS Ltd, town of Targovishte – 2.01 BGN/m^3.

The next indicator, showing the ratio between *uncollected revenues and operating income*, shows its uneven distribution by statistical regions. On the first place by uncollected revenues is Northeastern region with 28.5%.

This average annual value is exceeded by WSS operators in Pernik – 44.7% and Kyustendil – 33.8%.

Table 1.

Financial and economic indicators and quality indicators of the services provided of main WSS companies by statistical regions in 2010-2015

Region/ WSS operators	**Level of coverage of sanitation services (%)**	**Activity costs/ Operating incomes (%)**	**Activity costs/ Invoiced water quantities (BGN/ m^3)**	**Uncollected incomes / Operating incomes (%)**	**Costs for wages/ Activity costs (%)**	**Number of staff providing water supply services Total number of consumers (1:10000)**	**Number of staff providing water supply services / Total number of BPD (1:10000)**	**Number of staff providing sanitation services / Total number of BSD (1:10000)**
North-West	50.3	99.1	1.471	20.3	39.3	0.0033	0.0052	0.0036
Vidin	47.6	99.7	1.734	5.9	47.6	0.0023	0.0074	0.0040
Lovech	35.6	95.2	1.570	29.2	41.0	0.0031	0.0040	0.0057
Montana	-	95.8	1.197	30.3	33.9	0.0025	0.0036	0.0000
Pleven	53.2	96.8	1.674	20.6	37.8	0.0034	0.0065	0.0085
North Central	44.4	96.5	1.748	19.3	39.2	0.0037	0.0069	0.0063
V. Tarnovo	60.0	100.6	1.550	24.4	50.6	0.0034	0.0070	0.0150
Razgrad	51.1	80.2	1.506	10.2	34.3	0.0044	0.0073	0.0043
Ruse	61.2	93.9	1.662	4.1	34.6	0.0035	0.0074	0.0039
Silistra	50.5	99.2	1.896	15.8	44.8	0.0017	0.0075	0.0012
North-East	60.3	100.7	2.173	18.2	34.9	0.0038	0.0670	0.0078
Varna	73.9	100.5	1.796	16.5	42.6	0.0033	0.0940	0.0210
Dobrich	54.3	103.9	2.592	27.1	23.8	0.0029	0.1580	0.0040
Targovishte	52.6	97.0	2.010	12.8	40.0	0.0050	0.0080	0.0010
Shumen	60.5	101.5	2.293	16.3	33.0	0.0040	0.0079	0.0053
South-East	61.7	96.4	1.743	27.6	36.9	0.0035	0.0064	0.0043
Burgas	75.5	91.9	1.474	6.8	35.5	0.0041	0.0065	0.0046
Sliven	37.4	98.9	1.891	59.2	36.9	0.0039	0.0060	0.0050
Stara Zagora	74.1	96.9	1.957	15.2	36.3	0.0036	0.0060	0.0060
South-West	77.9	90.4	1.189	28.5	40.0	0.0030	0.0066	0.0027
Blagoevgrad	73.0	102.2	1.347	16.9	51.5	0.0034	0.0132	0.0023
Pernik	74.4	100.1	1.384	44.7	30.2	0.0032	0.0060	0.0020
Sofiyska voda PLC	96.1	61.7	0.644	29.3	20.2	0.0011	0.0056	0.0034
South Central	64.2	100.2	1.406	19.7	42.7	0.0039	0.0086	0.0023
Kardzhali	41.1	104.6	1.348	18.7	55.7	0.0039	0.0133	0.0016
Pazardzhik	52.8	93.3	1.094	22.3	37.1	0.0027	0.0040	0.0010
Plovdiv	73.2	104.2	1.391	24.5	31.8	0.0025	0.0049	0.0025

Smolyan	74.0	97.7	1.186	6.4	48.6	0.0063	0.0122	0.0029
Haskovo	64.6	99.0	1.963	30.3	34.5	0.0045	0.0070	0.0010

Source: according to Energy and Water Regulation commission data and author's own calculations.

The collection of revenue is also very poor by WSS Ltd, town of Sliven – 59.2%, followed by WSS Ltd, town of Montana and WSS Ltd, town of Haskovo each 30.3%. For the concessioner *Sofiyska voda PLC, town of Sofia the uncollectibility of revenue is the lowest – 29.3%.*

There are too large differences between the values of the *indicators related to the staff*. For example, for *Sofiyska voda PLC, town of Sofia* the relative share of the wage costs to operating costs are 20.2%, and for WSS Ltd, town of Kardzhali they are 2.5 times bigger – 55.7%. The relative share of the number of staff providing water supply services to the total number of consumers for Sofiyska voda PLC is 11 people, servicing 10000 consumers, and for Silistra it is 17 people for 10000, for Targovishte it is 50 people for 10000 consumers, and for Smolyan this share is 63 people for 10000.

The Human Resource *Efficiency Index*, which determines the ratio of the *average annual number of employees providing water services to the total number of BWD, is large*, for the South Central Region it is 86:10000. For WSS Ltd, town of Kardzhali and WSS Ltd, town of Smolyan it is respectively 133:10000 and 122:10000. For Northeastern region this ratio is the highest and amounts to 670:10000, and for WSS Ltd, town of Dobrich and WSS-Varna Ltd, town of Varna is respectively 1580:10000 and 940:10000.

The ratio of the average annual number of employees providing sanitation services to the total number of BSD is the biggest for Northeastern region **–** it is 78:10000**,** followed by the North Central region – 63:10000. For WSS – Varna Ltd, town of Varna it is 210:10000, and for WSS-Yovkovtsi Ltd, town of Veliko Tarnovo it is 150:10000 (see Table 1).

In the Strategy for Development and Management of Water Supply and Sanitation in the Republic of Bulgaria for the period 2014-2023 *the vision for the WSS sector is aimed at creating a „... financially, technically and environmentally sustainable WSS sector, that provides WSS services with high quality socially affordable".* (Ministry of Regional Development and Public Works, 2014b, p. 48). The implementation of this 10-year objective for the water sector implies *generating significant funds for investment in the full range of services available by 2023.* Funding from European funds as well as national co-financing from government capital grants to loans from financial institutions and mainly accumulated funds from WSS companies during this period are expected. The preliminary estimates for the 25-year period 2014-2038 show that investments are necessary in the water sector amounting to 24 207.8 million BGN (see Table 2).

Table 2.

Estimated total investment in the WSS sector for the period 2014-2038
according to the adopted strategy (in million BGN)

Source of granting, million BGN	**2014-2023**	**2024-2028**	**2029-2038**	**TOTAL**	**Share of total**
Project co-financed by EU – Grant	3 684.1	-	-	**3 684.1**	15.2%
Project co-financed by EU – national co-financing	2 247.2	-	-	**2 247.2**	9.3%
State subsidies	390.7	163.9	70.3	**624.9**	2.6%
WSS operators – internally generated resources	4 141.0	3 731.8	8 195.5	**16 068.3**	66.4%
WSS operators – loans	1 271.1	262.2	50.0	**1 583.3**	6.5%
TOTAL	**11 734.1**	**4 157.9**	**8 315.8**	**24 207.8**	**100.0%**

Source: Comparative analysis of the WSS sector in the Republic of Bulgaria for the period 2009-2014. „Prices and Business Plans - WSS Services" Directorate, WSS Services Directorate General, Version 07, p. 9 (EWRC, 2015)

In our opinion, the details in Table **2 internally generated funds from the WSS operators are too ambitious, inflated and do not match their real possibilities**. This conclusion follows from the results of the analysis of the development of the Water Supply and Sanitation sector in Bulgaria in the period 2003-2015 (see Table 3).

The analysis shows that the average value of the total annual profit of WSS operators is only BGN 17.13 million and the average annual growth rate is 13.42%. This growth rate is good but applied to the very low average annual profit base in the water sector is not enough to accumulate the necessary financial resources for investment activity, for the rehabilitation, modernization and renovation of the highly depreciated WSS infrastructure.

The results of the analysis of the financial and economic indicators and the quality indicators of the services provided by the WSS companies during the period 2010-2015 show that the following *problems* exist:

- all public operators provide water services with significant losses of drinking water;
- the technical infrastructure used is heavily;

Table 3.

Financial and economic indices of WSS companies in the country for the period 2003-2015 (in million BGN)

Index	Mini-mum	Maxi-mum	Average value	Average annual growth	Average annual growth rate (%)	Average annual increase rate (%)
1. Operating income	383.38	672.38	550.17	23.37	104.60	+4.60
2. Activity costs	376.65	641.35	529.80	20.56	104.14	+4.14
3. Final financial result (profit/loss) from the activity	-6.38	37.94	17.13	1.88	113.42	+13.42

Source: according to data provided by NSI and own calculations by the author.

- the rate of uncollectability of revenue is very high;
- employed personnel are used inefficiently;
- the relative share of remuneration relative to operating costs is high;
- the possibilities for the accumulation of investment funds are limited.

In general, the low-performing business of WSS companies *is not able to ensure sustainable development of WSS sector.* An exception is made only by the concessionaire Sofiyska Voda PLC, Sofia, which in most cases has *much better indicators than those of the other WSS operators in the country* (see Table 1). In our opinion, this is due to the chosen model of cooperation of the local authority with a foreign private partner in the form of concessioning for the provision of water services to the population and its more efficient strategy for the development of WSS services in Sofia Municipality.

3. Essence of the proposed concessioning model for the water sector

The concessioning model proposed by us has been developed on the basis of the *status of the WSS operators* by statistical regions and districts as well as on the basis of the *multiparametric analysis of the factors* determining the effective development of the water sector in the country. These include:

- factors determining the dynamics of the development of water resources;
- factors determining the dynamics of the development of water economy infrastructure;
- factors determining the dynamics of the development of provided water services;
- factors determining the quality of WSS services;
- factors determining the financial and economic development of WSS operators.

The conceptual model of concessioning is built according to the classification NUTS-2 of the European Union. In order to maximize the impact of improving the management and production structure and optimal use of the personnel of WSS operators, we propose the creation of *3 water concessions.* They cover the next statistical regions (see Figure 2):

- **Concession 1** for North-West and South-West regions;
- **Concession 2** for North central and South central regions;
- **Concession 3** for North-East and South-East regions.

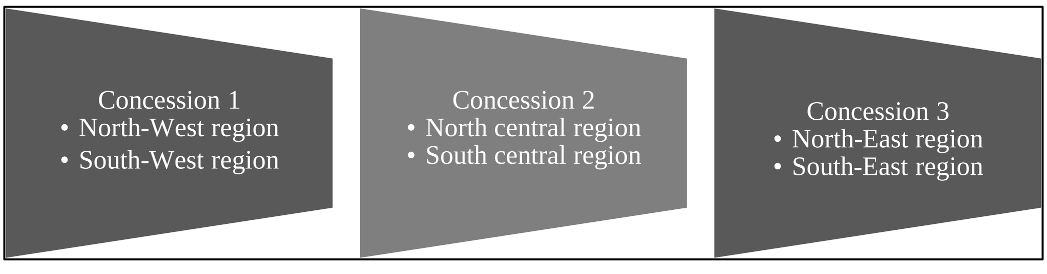

Figure 2. Optimal version of concessioning of water services provision to the population in the country

The considered optimal option for concessioning by grouping the statistical regions in the way described will contribute to the *concentration of financial, investment, technological and human resources. The consolidation of the territorial scope of the WSS operators* will give them new tactical opportunities and strategic prospects. Serving a larger number of users gives **significant benefits**, for example:

- making *bigger economies from the scale*;
- eliminating the imbalance in the pricing of water services damaging small settlements and those with predominantly pumping water supply;
- *creating more flexible organizational structures;*
- *imposing on the territory of the whole country greater sector expertise, managerial potential and international experience;*
- *accumulation of a significantly larger volume of investment for a relatively short period of time;*
- *better use of staff, working time, vehicles and machinery;*
- *taking loans on preferential terms;*
- *better opportunities for coordination, monitoring and control between water and sewerage operators (concessionaires), public authorities and control bodies.*

For a more accurate assessment of the status of WSS companies entering a statistical area, an open quantitative assessment system may be used with the introduction of relative weights only for the groups or for each individual indicator expressing the degree of importance to the rest of the item public authority or a purely expert one. This evaluation system should be adaptable to the changes in the water sector, as well as to the requirements of the EWRC, in case of changes in the country's legislation and the European Union, etc. Adjustments to the relative importance levels of indexes, as well as the inclusion / exclusion of indexes, are possible.

The model includes also the creation of **3 Regional WSS associations.** We recommend that the status and design of existing WSS associations be retained as entities in the system, but **territorially integrated - from the administrative district level to the level of the statistical area**. In the initial stage Regional WSS associations will be needed to provide a grant from the European funds in the medium term and – if the water services provided in a given area are not declared to be a concession or there are no real candidates, they will continue to work with the WSS operators operating in both regions.

We propose **that the administration of the individual Regional WSS associations** be determined in accordance with the current provision of the Ministry of Regional Development and Public (MRDPW, 2014a). Art. 3, para. 2, according to which *„If the detached territory is located in the territory of more than one district, its management address is located in the building of the district administration of the area where the majority of the consumers served by the WSS operator of the respective territory".*

Figure 3 presents the proposed conceptual model for concessions in the water sector by statistical regions of the country.

4. Interaction of public institutions with concessionaires

In the Bulgarian WSS sector, as in other countries, there are many interested parties in complex legal relationships. The *Water Act* (MC, 2017) sets out in detail the status and responsibilities of the institutions and authorities involved in the management and operation of water WSS systems, making reference to the specific legislation regarding the status and functions of the EWRC and WSS operators. In the model shown in Figure 3 are the four main types of relationships (subordination, interaction, control and monitoring of activity, consultancy and civil control) between the concessionaire companies in the WSS sector and the other institutional and potential participants, revealing the nature of their relationship.

The Ministry of Environment and Water (MEW), and in particular its Minister, is responsible for:

- environmental protection, water management at national level;
- the preparation of a National Strategy for the water sector that can provide a common framework for the management and development of the water sector; as well as
- the implementation of the relevant program providing European funding for environmental protection under which WSS infrastructure can be co-financed in accordance with its terms.

The MEW also coordinates and controls administrative structures such as Regional Inspectorates for Environment and Water and state administrations such as the Basin Directorates. They, in turn, through monitoring and control links can actively influence the work of concessionaires to make better use of water and to improve and maintain the quality of water services provided to consumers.

The Ministry of Regional Development and Public Works (MRDPW), and in particular its Minister, implements the state policy in the Water Supply and Sanitation sector at national level, such as:

- develops and proposes to the Council of Ministers a Strategy for development and management of water supply and sanitation in the Republic of Bulgaria and carries out coordination and control over its implementation;
- draws up the legislative framework for the management and development of the WSS sector;
- establishes and maintains a Unified Information System and Register of Regional WSS associations and concessionaires (WSS operators) and exercises control in the cases provided by the law.

MRDPW implements subordination relationships with the companies-water concessionaires. It also coordinates the management of WSS systems at national level as well as the activities of Regional WSS associations and provides methodological guidance for the preparation of the regional water and sanitation master plans.

The Ministry of Health (MH) controls the water quality for drinking and household needs and the health and hygiene condition of the water supply facilities. Its territorial structures – regional health inspections play animportant role in identifying priority issues and the necessary measures, which should be directed to the appropriate financial means for their prompt and effective resolution within the time limits allowed by EU law.

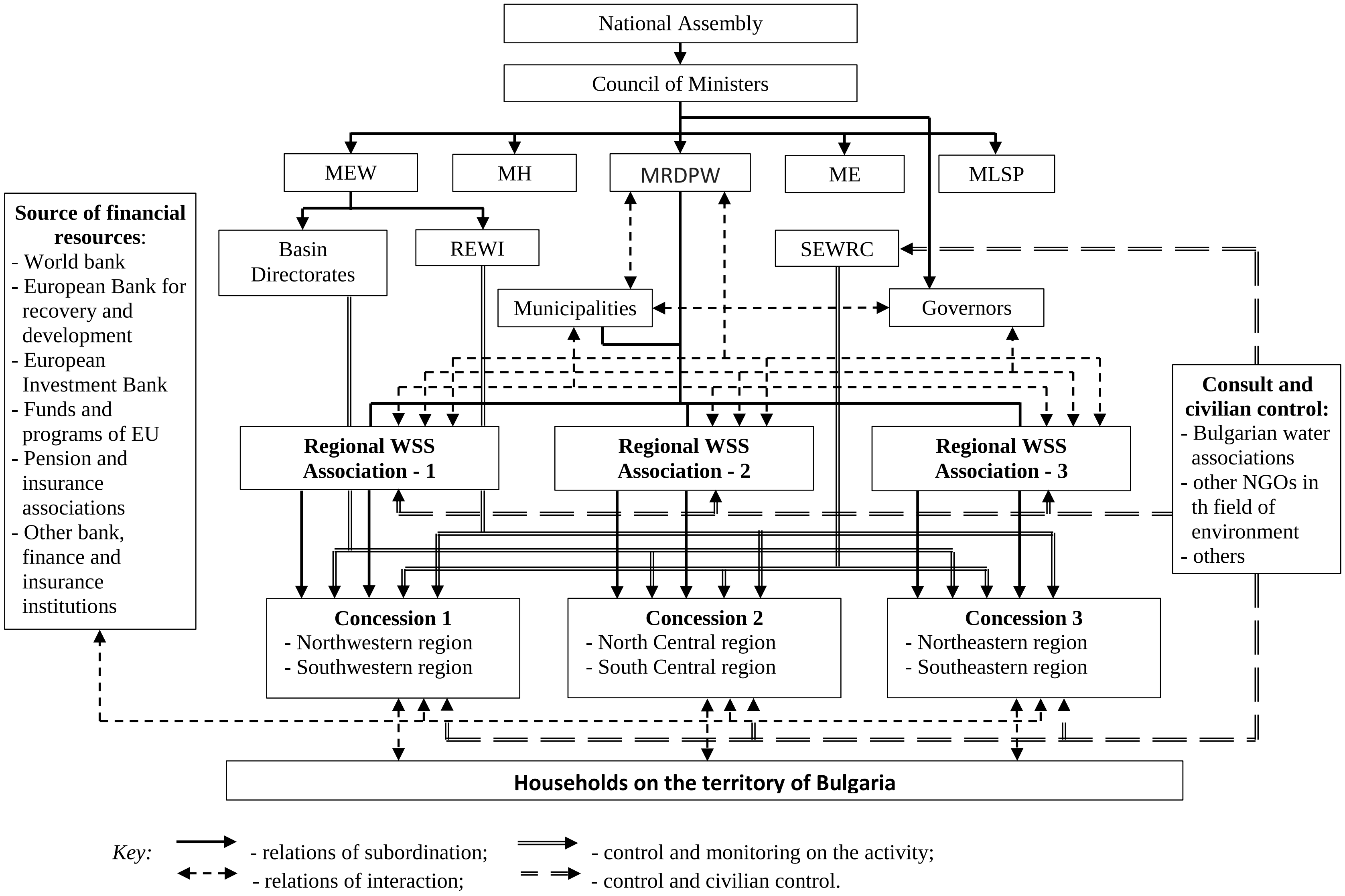

Figure 3. Conceptual model for concessioning in Water Supply and Sanitation sector by statistical regions of Bulgaria

The municipalities are responsible for managing only the WSS systems that are wholly owned by them. Their elective bodies:

- adopt general and detailed development plans necessary for the development of the WSS infrastructure in the municipality in accordance with the regional master plans for WSS and the general plans for agglomerations with over 10 000 inhabitants;
- coordinate as the direct beneficiaries the preparation and implementation of projects related to WSS infrastructure, which are financed under operational programs with EU Cohesion and Structural Funds;
- express views on the business plans developed by the concessionaire and monitor their implementation;
- represent the municipality in the concession authorities with municipal participation, in the capital and in the relevant Regional WSS association;
- exercise control in the cases provided for by the law.

The municipalities, which own WSS assets, undertake ties of subordination with the benefiting company-water concessionaire.

The Regional Water Supply and Sanitation Associations are legal entities that manage the WSS systems within the separate territories – statistical regions. They interact with the municipalities and regional governors in the territorial scope of the respective statistical regions as well as with MRDPW and fulfill the following functions:

- decide on concluding a contract with the concessionaire (WSS operator) for outsourcing of WSS services;
- prepare and approve the investment programs and the general WSS plan in accordance with the Regional Master Plan for Agglomerations with over 10,000 inhabitants;
- cohere the business plan of the concessionaire (WSS operator).

The Energy and Water Regulatory Commission (EWRC) is an independent specialized state body. Its powers include:

- preparation of projects of regulations for the water sector;
- carrying out preliminary control during the preparation of the concession and other types of contracts for management of the WSS systems and gives an opinion on their compliance with the Water Supply and Sanitation Services Regulation Act (WSSSRA) and other related normative acts;
- approval of business plans for concessionaires (WSS companies);
- exercising control and imposing penalties in the cases provided in WSSSRA;
- valuation of the prices of the water supply and sanitation services in response to the applications submitted by the concessionaires (WSS companies);
- control to achieve the target values of service level indicators from Concessionaires (WSS operators);
- dealing with consumer complaints and others.

Concessionaires, in their role as water supply and sanitation infrastructure operators, are commercial entities (irrespective of the structure of capital ownership – state, municipal or a combination of them. They provide the following WSS services:

- purification and supply of potable water and water for industrial and other needs;
- removal and purification of sewage and rainwater from urbanized territories;
- construction, maintenance and operation of WSS systems, including treatment and other facilities.

As WSS operators, the concessionaires are also responsible for fulfilling the waste water discharge requirements under the provisions of the Water Act.

The main stakeholders are the users of WSS services, covering the categories of household, commercial, industrial and other business users. Their interests are represented by consumer associations and other related structures of civil society. So far, consumer organizations have not been particularly active in the field of WSS services.

Other key stakeholders include *employees, specialists, consultants, suppliers and contractors* in the WSS sector, their trade unions and associations. An important representative is the *Bulgarian Water Association*, which expresses in general the interests of the stakeholders in the sector (Bulgarian Water Association, 2012). In the model we offer, it has the responsible role of a professional consultant and a guarantor of timely civil control, both in terms of the concessionaires' activities, as well as on the institutional decisions and public policies pursued.

5. Conclusion

In this article there is a presentation of a new conceptual model for concessioning the WSS sector in Bulgaria, which consolidates the existing 66 WSS operators in three WSS operators – concessioners. The consolidation was dome in statistical regions according to NUTS-2 classification of the European Union.

As a result of the presented concessioning model the following main conclusions can be drawn:

1. The use of concessions in the water sector will contribute to attracting new investments in it, to the expansion of private initiative and the unfolding of completion.
2. The concessions will contribute to the faster and deeper implementation of system- based and/or process-oriented benchmarking by concessionaires in order to identify and implement „good practices“ from competitors on the sector, including in an international plan.
3. A similar concessioning by the combination of one region from northern and from southern Bulgaria, should help to overcome the existing disproportions in the social and economic development and its harmonization in the regions of North and South Bulgaria. Its application should create new opportunities for introducing foreign direct investment, which will contribute to the stable development of the water sector in the country.
4. The service in the water sector by statistical regions will contribute to increasing the efficiency of the WSS services, as well as to the reduction of the administrative and managerial staff.
5. A very important advantage in giving water concessions to whole areas is the minimization of the number of operators active, which will contribute to better coordination and control between them and the public authorities
6. The reorganization of the WSS sector presented by us will have an impact on pricing – concessionaires will have much smaller, system increases in the cost of 1m3 of water to accumulate significant financial resources for significant investment activity with their business plans.
7. Concessioning of WSS services by statistical regions of foreign investors will help to overcome the political dependence and political pressure on the managers of the consolidated WSS companies.

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Модели за оптимално натоварване на производствени мощности във фармацевтичното предприятие

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Резюме. Цел на настоящата статия е изследване на някои възможности за оптимизиране натоварването на производствени мощности в съвременното фармацевтично предприятие с използване методите на линейното оптимиране. Авторът конструира математически модели за оптимална организация на производствената програма между работните центрове в предприятието, които са взаимозаменяеми (взаимонезаменяеми). Критериите за оптималност, заложени в моделите, са: максимизиране на печалбата, минимизиране на разходите, минимизиране на времето за работа на наличното технологично оборудване. Практическата значимост на конструираните линейни модели е свързана с повишаване на коефициента на натоварване на мощностите, откриване на излишни фондове време за работа и подобряване на някои технико-икономически показатели.

Ключови думи: оптимизация, математическо моделиране, технологично оборудване, фармацевтично предприятие.

1. Въведение

Важна задача на мениджмънта на всяко предприятие е разкриването на организационните резерви, т.е. на потенциалните, неизползвани при конкретните производствени условия възможности за развитие на производството. Едно от основните направления, в което се търсят такива организационни резерви, е по-пълното използване на оръдията на труда, които включват възможност за по-пълно натоварване на производствените мощности, съкращаване на времето за пребиваване на оборудването в ремонт и др. (Blagoeva, 2010).

Производствените мощности са основа за определяне на производствените възможности на предприятието и неговите производствени звена (работни центрове, цехове, бази). Производствената програма и плановете за натоварване на производствените мощности са тясно свързани помежду си (Blagoev *et al.*, 2010, p. 239; Yordanova, 2013), тъй като показателите на мощностите често се използват при решаването на задачи по оптимизация на производствената програма.

Възможността за увеличаване на обема на произведените продукти се определя преди всичко от мощността на съществуващото технологично оборудване в производствените звена, но и от степента на неговото използване. От друга страна, показателите на използване на производствените мощности зависят от обема на процесите, които трябва да бъдат извършени съгласно производствената програма на предприятието.

Въз основа на моделите за оптимално натоварване на производствените мощности се определя оптимален вариант за разпределение изпълнението на производствената програма между наличните оборудвания в производствените звена на предприятието. Посредством тези модели обикновено се намират оптималните обеми процеси, които могат да се извършат с наличния ефективен фонд време за работа на технологичното оборудване. Като критерии за оптималност в тях най-често се използват (Atanasov and Lukov, 1991; Atanasov, Nikolaev and Miryanov, 2012, pp. 108–110; Konchits, 2013):

- максимизиране натоварването на производствените мощности;
- минимизиране на общата себестойност на извършваните процеси;
- максимизиране на общата печалба за предприятието.

Целта на настоящата статия е да се предложат възможности за оптимално натоварване на производствени мощности във фармацевтичното предприятие със средствата на линейното оптимиране Във връзка с така поставената цел се решават следните задачи:

- конструиране на икономико-математически модели, приложими в случаите, в които работните центрове, функциониращи в предприятието, са взаимозаменяеми (взаимонезаменяеми) помежду си;
- залагане на различни критерии за оптималност в конструираните линейни модели.

2. Модели за оптимално натоварване на производствени мощности във взаимозаменяеми работни центрове

Задачите за натоварване на производствени мощности във взаимозаменяеми фармацевтични цехове (работни центрове) възникват често в икономическата практика, тъй като от гледна точка на фармацевтичните предприятия е от особена важност да се гарантира нормалното и непрекъснато протичане на процесите, свързани с производството на лекарствени продукти, чрез осигуряването на възможност те да могат да се осъществяват в повече от едно производствено звено. По този начин технологичните оборудвания в някои работни центрове се оказват взаимозаменяеми в определена степен по отношение на извършването на някои производствени процеси.

Важно е да се отбележи, че между взаимозаменяемите оборудвания съществуват различия във връзка с производителността, която зависи както от степента на износване, конструктивните особености, квалификацията на обслужващите работници, така и от редица други фактори. Това, от своя страна, обуславя съществуването на различия в разходите на време за извършването на един и същи процес от еднотипните оборудвания. Различия съществуват и в производствените разходи, а оттам и в печалбата, която получава фармацевтичното предприятие от единица процес, осъществен в различните работни центрове.

За да се построи моделът на задачата за оптимално използване на оборудването във взаимозаменяемите производствени звена, е необходимо:

1. Да се определят групите мощности във фармацевтичното предприятие. Това може да се осъществи по различни начини, като в случая ще групираме оборудванията според работния център, в който функционират.
2. Да се изчисли общият ефективен фонд време за разглеждания планов период за всеки от работните центрове в предприятието и, въз основа на наблюдения или отчетни документи, да се определи средният разход на време за извършването на единица процес от всеки вид с помощта на наличното технологично оборудване.

Разглеждаме следната постановка на икономическата задача.

За даден планов период в няколко взаимозаменяеми работни центрове (цехове) на фармацевтичното предприятие трябва да се извършат определен обем производствени процеси от различните видове. Известни са още:

- ефективните фондове време за работа на оборудването във всеки от работните центрове;
- разходните норми време за извършването на единица процес от всеки вид;
- някои характеристики на икономическия ефект от извършването на единица процес от всеки вид за различните работни центрове.

Трябва да се определи какви обеми от процесите и в кой работен център трябва да се извършат, за да се постигне максимален икономически ефект (напр. печалба, себестойност) от производствената дейност на фармацевтичното предприятие в зависимост от конкретните му цели за разглеждания планов период.

За да съставим икономико-математическия модел на задачата, въвеждаме следните означения:

m – брой на взаимозаменяемите работни центрове;

n – брой на процесите;

p – брой на произвежданите продукти;

i – номер на работен център;

j – номер на процес;

s – номер на продукт;

$a_{ij}^{(s)}$ – разход на време на технологичното оборудване в i -ти работен център $(i=\overline{1,m})$ за извършване на единица процес от j -ти вид $(j=\overline{1,n})$ във връзка с производството на s -ти вид фармацевтичен продукт $(s=\overline{1,p})$;

a_i – наличен ефективен фонд време за работа на технологичното оборудване в i -ти работен център $(i=\overline{1,m})$ за разглеждания планов период;

$b_j^{(s)}$ – обем от j -ти процес $(j=\overline{1,n})$ за производството на s -ти продукт $(s=\overline{1,p})$, който съгласно плановото задание трябва да се извърши от фармацевтичното предприятие;

$c_{ij}^{(s)}$ – печалба, която предприятието реализира от извършването на единица процес от j -ти вид за производството на s -ти вид продукт в i -ти работен център $(i=\overline{1,m},\ j=\overline{1,n},\ s=\overline{1,p})$;

$p_{ij}^{(s)}$ – себестойност на единица процес от j -ти вид за производството на s -ти продукт, извършен от i -ти център $(i=\overline{1,m},\ j=\overline{1,n},\ s=\overline{1,p})$.

Необходимо е да се определи какви обеми от процесите за производство на различните видове фармацевтични продукти следва да се извършват в отделните взаимозаменяеми работни центрове на предприятието.

В тази връзка, нека да означим с:

$x_{ij}^{(s)}$ – обем процес от j -ти вид за производството на s -ти вид продукт, който трябва да се извърши от оборудването в i -ти работен център $(i=\overline{1,m},\ j=\overline{1,n},\ s=\overline{1,p})$.

При съставянето на икономико-математическия модел трябва се отчетат следните ограничения:

1. Общият разход на време за всяка от групите технологични оборудвания не може да надвиши съответния наличен фонд работно време:

$$\sum_{j=1}^{n}\sum_{s=1}^{p} a_{ij}^{(s)} x_{ij}^{(s)} \le a_i\ ,\ i=\overline{1,m}\,.$$

2. Необходимо е да се осигури изпълнението на плановото задание по обем и номенклатура на различните видове производствени процеси, т.е.:

$$\sum_{i=1}^{m} x_{ij}^{(s)} \ge b_j^{(s)}\ ,\ j=\overline{1,n}\ ,\ s=\overline{1,p}\,.$$

3. Неизвестните трябва да приемат неотрицателни стойности поради техния реален смисъл:

$$x_{ij}^{(s)} \ge 0\ ,\ i=\overline{1,m}\ ,\ j=\overline{1,n}\ ,\ s=\overline{1,p}\,.$$

В случай, че фармацевтичното предприятие се стреми да максимизира общата печалба, икономико-математическият модел има следния вид:

$$\max : Z=\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} c_{ij}^{(s)} x_{ij}^{(s)} \qquad (1)$$

при условия

$$\sum_{j=1}^{n}\sum_{s=1}^{p} a_{ij}^{(s)} x_{ij}^{(s)} \le a_i\ ,\ i=\overline{1,m}\,; \qquad (2)$$

$$\sum_{i=1}^{m} x_{ij}^{(s)} \ge b_j^{(s)}\ ,\ j=\overline{1,n}\ ,\ s=\overline{1,p}\,; \qquad (3)$$

$$x_{ij}^{(s)} \ge 0\ ,\ i=\overline{1,m}\ ,\ j=\overline{1,n}\ ,\ s=\overline{1,p}\,. \qquad (4)$$

В конструираната оптимизационна задача може да бъде добавено и условие за целочисленост на променливите $x_{ij}^{(s)}$ ($i=\overline{1,m}$, $j=\overline{1,n}$, $s=\overline{1,p}$), като това зависи от натуралните измерители, свързани с обема на извършваните във фармацевтичното предприятие производствени процеси.

Вместо критерия за оптималност (1) в модела можем да поставим

$$\min : Z=\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} p_{ij}^{(s)} x_{ij}^{(s)}\ , \qquad (5)$$

ако целта на предприятието е минимизиране на общата себестойност, или

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$$\min: Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} a_{ij}^{(s)} x_{ij}^{(s)} \tag{6}$$

при критерий минимален общ разход на време за осъществяване на производствените процеси от технологичните оборудвания в центровете на предприятието.

В разглеждания модел въвеждаме променливите

$$y_{ij}^{(s)} = a_{ij}^{(s)} x_{ij}^{(s)} \ \ (i=\overline{1,m},\ \ j=\overline{1,n},\ s=\overline{1,p}),$$

представляващи единиците време, в течение на което технологичното оборудване в i -ти работен център на фармацевтичното предприятие следва да извършва процес от j -ти вид за производството на s -ти вид продукт.

При така въведените променливи целевата функция (1) и левите страни на ограничителните условия (2) и (3) се записват по следния начин:

$$Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} c_{ij}^{(s)} x_{ij}^{(s)} = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} \frac{c_{ij}^{(s)}}{a_{ij}^{(s)}} y_{ij}^{(s)} \ ;$$

$$\sum_{j=1}^{n}\sum_{s=1}^{p} a_{ij}^{(s)} x_{ij}^{(s)} = \sum_{j=1}^{n}\sum_{s=1}^{p} y_{ij}^{(s)}\ ,\ i=\overline{1,m}\,;$$

$$\sum_{i=1}^{m} x_{ij}^{(s)} = \sum_{i=1}^{m} \frac{y_{ij}^{(s)}}{a_{ij}^{(s)}}\ ,\ j=\overline{1,n}\,,\ s=\overline{1,p}\,.$$

Тогава икономико-математическият модел при критерий максимална обща печалба ще приеме следния вид:

$$\max: Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} \overline{c_{ij}^{(s)}}\, y_{ij}^{(s)} \tag{7}$$

при ограничения

$$\sum_{j=1}^{n}\sum_{s=1}^{p} y_{ij}^{(s)} \le a_i\ ,\ i=\overline{1,m}\,; \tag{8}$$

$$\sum_{i=1}^{m} l_{ij}^{(s)} y_{ij}^{(s)} \ge b_j^{(s)}\ ,\ j=\overline{1,n}\,,\ s=\overline{1,p}\,; \tag{9}$$

$$y_{ij}^{(s)} \ge 0\,,\ i=\overline{1,m}\,,\ j=\overline{1,n}\,,\ s=\overline{1,p}\,, \tag{10}$$

където:

$\overline{c_{ij}^{(s)}} = \dfrac{c_{ij}^{(s)}}{a_{ij}^{(s)}}$ $(i=\overline{1,m},\ \ j=\overline{1,n}\,, s=\overline{1,p}\,)$ – печалба от j -ти вид процес за производството на s -ти вид продукт, извършван в i -ти работен център за единица време;

$l_{ij}^{(s)} = \dfrac{1}{a_{ij}^{(s)}}$ $(i=\overline{1,m},\ \ j=\overline{1,n}\,, s=\overline{1,p}\,)$ – производителност на технологичното оборудване в i -ти работен център на предприятието, когато извършва j -ти процес за производството на s -ти вид фармацевтичен продукт.

При критерий минимални общи производствени разходи критерият за оптималност (7) се заменя с

$$\min: Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} \overline{p_{ij}^{(s)}}\, y_{ij}^{(s)}\ , \tag{11}$$

където с $\overline{p_{ij}^{(s)}} = \dfrac{p_{ij}^{(s)}}{a_{ij}^{(s)}}$ $(i=\overline{1,m},\ \ j=\overline{1,n}\,, s=\overline{1,p}\,)$ е означена себестойността на единица процес от j -ти вид за производството на s -ти вид фармацевтичен продукт, извършен в i -ти работен център за единица време.

Ако предприятието се стреми да минимизира не общите производствени разходи, а общия разход на време, то целевата функция е следната:

$$\min : Z = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{s=1}^{p} y_{ij}^{(s)} \quad . \tag{12}$$

Необходимо е да отбележим, че моделите (1) – (4) и (7) – (10) могат да се модифицират в зависимост от начина на дефиниране на производствените процеси в конкретното фармацевтично предприятие. Например, ако всеки процес се свързва с производството на определен вид продукт, то наличието на индекса s в моделите е излишно.

Конструираните модели за оптимално натоварване на производствени мощности във взаимозаменяеми звена се отнасят към разпределителната задача на линейното оптимиране. Оптималното решение на такива задачи може да се намери, например, чрез симплекс метода или чрез някои от специалните методи за решаването им (Gale, 2007; Miller, 2007; Atanasov and Milkova, 2011, pp. 289–295; Sira, 2013).

3. Модели за оптимално натоварване на производствени мощности във взаимонезаменяеми работни центрове

Нека сега разгледаме случай, в който производствените звена във фармацевтичното предприятие не са взаимозаменяеми по отношение на технологичното оборудване, с което разполагат. Постановката на задачата е следната.

Да допуснем, че в предприятието функционират m на брой работни центрове ($i=\overline{1,m}$), в които се извършват n на брой производствени процеси $(j=\overline{1,n})$, всеки от които е свързан с конкретен вид фармацевтичен продукт. Освен това е известно, че в хода на производството се използват k_j технологии за извършването на j-тия процес ($k=\overline{1,k_j}$). Нека величините $a_{ij}^{(k)}$ представляват разхода на време за извършването на единица производствен процес от j-ти вид $(j=\overline{1,n})$ от технологичното оборудване в i-ти работен център ($i=\overline{1,m}$) на фармацевтичното предприятие съгласно k-та технология ($k=\overline{1,k_j}$). Обикновено стойностите на тези величини могат да се определят на базата на съществуващите технологични норми и реалните разходи на време за изпълнение на даден вид процес в определено производствено звено, като при това се вземат предвид иновациите и интензификацията на труда, т.е.:

$$a_{ij}^{(k)} = f_{ij}^{(k)}\gamma_i\beta \;\; (i=\overline{1,m},\, j=\overline{1,n},\, k=\overline{1,k_j}),$$

където:

$f_{ij}^{(k)}$ – технологична норма време за извършване на единица производствен процес от j-ти вид в i-ти работен център съгласно k-ти технологичен начин;

γ_i – планов коефициент на изпълнение на нормите в i-ти работен център;

β – коефициент на привеждане на нормите към по-високо ниво, отчитащ иновациите и интензификацията на труда.

Докато стойностите на технологичната норма и плановия коефициент се получават на базата на непосредствени наблюдения и анализ на производствената дейност на предприятието, то стойността на β се определя от нормативни документи или посредством експертна оценка.

Въвеждаме означенията:

b_j – обем процес от j-ти вид ($j=\overline{1,n}$), който трябва да се изпълни от фармацевтичното предприятие съгласно плана за разглеждания период;

a_i – наличен фонд време за работа на оборудването в i-ти работен център $(i=\overline{1,m})$.

Полезността на извършената работа може да се измерва по различни начини, в зависимост от условията на реалната икономическа задача. Нека приемем като мярка за ефективност числата

$$c_j^{(k)} \;\; (j=\overline{1,n},\, k=\overline{1,k_j}),$$

представляващи печалбата, която предприятието получава при реализацията на единица процес от j-ти вид, извършен в съответствие с k-та технология.

Необходимо е да се определят обемите процеси от всеки вид, които трябва да се извършат по съответните технологични начини, т.е. числата:

$x_j^{(k)}$ – обем процес от j -ти вид ($j=\overline{1,n}$), който трябва да се извърши по k -ти технологичен начин ($k=\overline{1,k_j}$).

При така въведените означения общата печалба за фармацевтичното предприятие от извършването на различните производствени процеси се задава посредством функцията

$$Z=\sum_{j=1}^{n}\sum_{k=1}^{k_j}c_j^{(k)}x_j^{(k)} .$$

При съставяне на модела трябва да се вземат предвид следните ограничения:

1. Разходът на време за извършването на производствените процеси не може да надвишава наличния фонд време за работа на технологичното оборудване в съответния работен център, т.е.:

$$\sum_{j=1}^{n}\sum_{k=1}^{k_j}a_{ij}^{(k)}x_j^{(k)}\le a_i\ ,\ i=\overline{1,m} .$$

2. Необходимо да се осигури изпълнението на плановото задание по обем и номенклатура на различните производствени процеси:

$$\sum_{k=1}^{k_j}x_j^{(k)}\ge b_j\ ,\ j=\overline{1,n} .$$

3. Реалният смисъл на променливите налага необходимостта те да бъдат неотрицателни числа, т.е.:

$$x_j^{(k)}\ge 0\ ,\ j=\overline{1,n}\ ,\ k=\overline{1,k_j} .$$

В задачата могат да се добавят и условия за целочисленост на променливите $x_j^{(k)}$ $(j=\overline{1,n}, k=\overline{1,k_j})$, ако натуралните измерители по отношение на обема на извършваните производствени процеси го изискват.

В резултат на това икономико-математическият модел има следния вид:

$$\max: Z=\sum_{j=1}^{n}\sum_{k=1}^{k_j}c_j^{(k)}x_j^{(k)} \qquad (13)$$

при ограничения:

$$\sum_{j=1}^{n}\sum_{k=1}^{k_j}a_{ij}^{(k)}x_j^{(k)}\le a_i\ ,\ i=\overline{1,m}\ ; \qquad (14)$$

$$\sum_{k=1}^{k_j}x_j^{(k)}\ge b_j\ ,\ j=\overline{1,n}\ ; \qquad (15)$$

$$x_j^{(k)}\ge 0\ ,\ j=\overline{1,n}\ ,\ k=\overline{1,k_j} . \qquad (16)$$

Като критерий за оптималност в модела може да се приеме и постигането на оптимален ефект от гледна точка на сумарната себестойност на извършваните процеси във фармацевтичното предприятие. В такъв случай е необходимо целевата функция (13) да се замени с:

$$\min: Z=\sum_{j=1}^{n}\sum_{k=1}^{k_j}p_j^{(k)}x_j^{(k)}\ , \qquad (17)$$

където $p_j^{(k)}$ – себестойност на единица процес от j -ти вид ($j=\overline{1,n}$), извършен в съответствие с k -та технология ($k=\overline{1,k_j}$).

Постановката на задачата по критерий максимална печалба (минимална себестойност) е целесъобразно да се разглежда в тези случаи, при които извършваните процеси имат икономически обоснована цена (себестойност). Считаме, че е удачно да разгледаме задачата за изпълнение на плановото задание по производствени процеси и в друг аспект, като за критерий за оптималност ще приемем минималното изразходвано време от наличното технологично оборудване във всички работни центрове на фармацевтичното предприятие.

Нека да въведем в ограничителните условия (14) допълнителните променливи y_i ($i=\overline{1,m}$), чийто реален смисъл е неизползваното време от оборудването в i -ти работен център на предприятието. Очевидно, колкото по-голяма е стойността на i -тата допълнителна променлива ($i=\overline{1,m}$), толкова по-малко време се изразходва в съответното производствено звено за изпълнение на плановото задание. При това, добавянето на y_i ($i=\overline{1,m}$) към левите страни на ограничения (14) означава, че е необходимо тези условия да се запишат във вид на равенства, т.е.:

$$\sum_{j=1}^{n}\sum_{k=1}^{k_j} a_{ij}^{(k)} x_j^{(k)} + y_i = a_i \,,\ i=\overline{1,m}\,.$$

С направените допълнения и изменения моделът на задачата приема следния вид:

$$\max: Z = \sum_{i=1}^{m} y_i \tag{18}$$

при условия

$$\sum_{j=1}^{n}\sum_{k=1}^{k_j} a_{ij}^{(k)} x_j^{(k)} + y_i = a_i \,, i=\overline{1,m}\,; \tag{19}$$

$$\sum_{k=1}^{k_j} x_j^{(k)} \geq b_j \,,\ j=\overline{1,n}\,; \tag{20}$$

$$y_i \geq 0 \,,\ x_j^{(k)} \geq 0 \,,\ i=\overline{1,m}\,,\ j=\overline{1,n}\,,\ k=\overline{1,k_j}\,. \tag{21}$$

Моделите за оптимално натоварване на оборудването в звена, които не са взаимозаменяеми помежду си, също представляват задачи на линейното оптимиране. Оптималното решение на всеки един от тях може да бъде намерено със симплекс метода, негови модификации или други известни методи (Atanasov, Iliev and Nikolaev, 2010; Ivanova, 2014).

4. Заключение

Конструираните в настоящата разработка оптимизационни модели дават възможност да се определят оптимални варианти за разпределение изпълнението на производствената програма между наличното технологично оборудване в работните центрове на фармацевтичното предприятие. Прилагането им способства за повишаването на коефициента на натоварване на мощностите в производствените звена и за откриването на излишните фондове време. По този начин значително могат да се подобрят технико-икономическите показатели за работата на фармацевтичното предприятие.

Усилията на автора в бъдещи разработки ще бъдат насочени към доразвиване на изследваната проблематика чрез апробация на конструираните оптимизационни модели с реални данни.

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Models for optimal capacity utilization in the pharmaceutical enterprise

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Abstract. The aim of this paper is to examine some opportunities for optimizing the capacity utilization in the modern pharmaceutical enterprise using the methods of linear programming. The author constructs mathematical models for optimal organization of the production program among the working centers in the enterprise, which are interchangeable (not interchangeable). The optimality criteria set in the models are: maximizing profit, minimizing costs, minimizing the working time of available technological equipment. The practical significance of the constructed linear models is related to the increase of the capacity utilization rate, detection of redundant working time and improvement of some techno-economic indicators.

Key words: optimization, mathematical modeling, technological equipment, pharmaceutical enterprise.