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CHILD ACQUISITION OF CZECH MODAL VERBS

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Abstract: The article presents a description of the acquisition of modal verbs and their grammatical forms in a Czech monolingual child. The author uses a corpus of transcriptions of audio recordings from age 2.8 to 3.6 which covers the phase of protomorphology and transition to morphology proper. Pragmatic function of verbs occurring in a child's speech is illustrated by examples, the occurrence of miniparadigms and gradual development of grammatical forms is documented. First the child produces only a limited number of forms – first just in repetitions, then the 3rd person singular present tense appears as a universal form. Finally the 1st person singular and plural forms appear. In parallel, the child learns to use the past tense, the future tense, conditional and passives.

Key words: Czech language acquisition, developmental psycholinguistics, child language, verbal grammatical categories, modal verbs

1 Introduction

This article will present how a child language corpus can be used to analyse first language acquisition in phases from the onset of speech to the acquisition of whole grammar paradigms. I present the description of developing grammatical categories of Czech modal verbs in a Czech monolingual boy at age 2.8 – 3.6 (years, months). Not only the formal aspects will be taken into consideration, but also the semantic and pragmatic aspects of employing modal verbs in dialogues.

2 Methodology

The article presents part of a longitudinal research of Czech language acquisition, namely verbal categories of modal verbs. The theoretical background is based on the developmental phases of pre-morphology, protomorphology and modular morphology/morphology proper (Dressler, W. U. (ed), 1997; Voeikova, M. D., Dressler, W. U. (eds), 2002; Bittner, D., Dressler, W. U., Kilani-Schoch, M. (eds), 2003; Voeikova, M. D., Stephany, U. (eds), 2009).

"In the pre-morphological stage, words are rote-learned and usually occur in their base form, with typically one form per lemma. The protomorphological stage manifests itself by the emergence of grammatical oppositions which develop into miniparadigms. Evidence of the first inflectional rules may be found. Passing into the stage of morphology proper, the children approach qualitatively, if not quantitatively, adult models" (Stephany, U., Voeikova, M. D. (eds.), 2009: 4). The development is gradual; there are transitional phases when some typical characteristics of two following stages co-exist. Although some innate capacities for language acquisition are taken into consideration, mostly external influence, e.g. input that a child receives from his environment, is seen as a source of language material for a child. The material is categorized into miniparadigms in which at least three different grammatical forms of a lemma exist; in this case it is three occurrences of different verbal person and number.

3 Data

To illustrate the development of Czech modal verb acquisition, I will quote from the corpus of a one Czech monolingual boy from the onset of usage of modal verbs till age 3 and half years, this phase illustrates the period of protomorphology and transition to morphology proper. I also present a quantitative analysis, although the child's development is still in progress and not all the verbal categories are present in his speech, e.g. 2nd person plural is not used at all. The boy has been recorded twice a month for 30 minutes at home in interaction with his mother or other adults. The audio recordings have been transcribed according to CHAT, which is a method used in the CHILDES (Child Language Data Exchange System) database (MacWhinney, Snow, 1985, http://childes.psy.cmu.edu, http://laboratorium.detskarec.sk). Also diary data which have been prepared in parallel with the audio recordings are used, as the transcripts themselves illustrate only a part of the development in the analysed phase and other relevant phenomena could be neglected. It must be stated that a child acquires Common Czech (a substandard variety of Czech language) and not the Standard, as it is present in the input which he receives from the environment; the boy lives in Prague and his parents have university education.

The analysed period covers 11 months in the child's development. The total number of utterances was 4166. The total number of utterances containing verbs is 2167. As can be illustrated in table 1, the number of utterances containing verbs starts to increase at age 3.4 which is also the period in which the frequency of modal verbs increases.

Table 1: number of utterances containing verbs

age (year, month)	2.8	2.9	2.10	2.11	3.0
number of utterances	303	386	289	268	339
utterances with verbs	151	156	141	144	140
utterances with verbs %	50 %	40 %	49 %	54 %	41 %

age (year, month)	3.1	3.2	3.3	3.4	3.5	3.6
number of utterances	302	279	422	503	560	515
utterances with verbs	155	103	206	333	311	327
utterances with verbs %	51 %	37 %	49 %	66 %	56 %	63 %

4 Results

4.1 Occurrence of lemmas and their pragmatic function

The first modal verbs occur at 2.8 but only as repetitions. If mother asks, the child answers, repeating the modal verb in the same form as in mother' utterance, suggesting that he understands the meaning but he is not yet able to produce the correct form.

*MOT:	*tak, Myslíčku, chceš malovat?*
	so, Myslíček, would you like to draw?
*MYS:	*chceš, chceš*
	(verb chtít – 2nd person singular, the same form as in mother' question).

Sporadically modal verbs occur in spontaneous speech at age 2.9 – 3.2. However, real development of modal verbs starts at 3.3, so roughly at the same time when the total verbal production increases in the child's speech, we can observe the transitional phase from protomorphology to morphology proper. The first verbs that start to occur in spontaneous speech are *moci / can, chtít / want* and *muset / must.*
The verb *moci / can* is first used at age 2.9, in situations when reading supermarket offers:

*MOT:	*tak boty, ale ty si nekoupíme*
*MOT:	so shoes, but we will not buy them
*MYS:	*koupit*
*MYS:	buy (inf)
*MOT:	*v tom bys neuměl chodit*
*MOT:	you wouldn't be able to walk in them
*MYS:	***moh, moh, moh***
*MYS:	could, could, could

The child uses a modal verb in reaction to an utterance containing another modal verb, however, its meaning is not fully appropriate. The form is probably past tense as at this age first occurrences of past tense form start to occur in lexical verbs. Similarly the verb *muset / must* is used at the same age (2.9):

*MOT: *no to jsou voříšky, ty jsem nekoupila, protože je nemůžeš jíst*
*MOT: these are nuts, I did not buy them, because you cannot eat them
*MYS: ***muset***
*MYS: must (inf)

Here the child again uses a modal verb in reaction to an utterance containing another modal verb. The infinitive most probably signals the directive function – *you must buy it*. In the following months, the verb *must / muset* is used in the directive function, signalling what his mother should do:

*MYS: *musí tam zapajkovat anto* (3.0)
*MYS: must (3rd person singular present) park the car there

Here we can see that at the age 3.0 the child understands that modal verbs combine with lexical verbs. Verb *chtít / want* is used when a child expresses his own will, its frequency increases at the age 3.3 when the child also starts to use the personal pronoun *já / I.*

*MYS: *já chcu stát* (3.3)
*MYS: I want to stand

Verbs *umět / to be able to* and *smět / to be allowed to* are acquired later, when we can observe a grammatical spurt and transition to morphology proper. Examples of age 3.6 are provided to illustrate the pragmatic function of modals.
The child talks about his own skills using the modal verb *umět / to be able to* in the 1st person singular present tense:

*MYS: *já to umim* (3.6)
*MYS: I am able to do it (complete puzzle)

Verb *smět / to be allowed to* is usually used to express directive function – prohibition:

*MYS: *máma nesmí tyhle zavíjat* (3.4)
*MYS: mum is not allowed to close this (door)

Also the verb *moci / can* is used more often, expressing possibility:

*MYS: *a je to a můžu další vyhazovat* (3.6)
*MYS: and it is done and I can throw another (the child plays on a PC)

As can be seen, modal verbs are used mostly to express the child' s own will (*chcu / I want*) or his skill (*umím / I am able to*). Verb *moci / can* expresses possibility. Verbs *muset / must* and *smět / to be allowed to* are used in the directive function. Using modals to express politeness is not observed at this stage of development.

Table 2: occurrence of modal verbs in months

lemmas	2.8	2.9	2.10	2.11	3.0	3.1
chtít	repetition		x			x
muset	repetition	x			x	
moci		x				
umět					x	
smět						

lemmas	3.2	3.3	3.4	3.5	3.6
chtít		x	x	x	x
muset	x	x	x	x	x
moci		x	x	x	x
umět		x	x	x	x
smět			x		x

4.2 Miniparadigms and grammatical forms

"A miniparadigm is a non-isolated set of minimally three phonologically unambiguous and distinct inflectional forms of the same lemma produced spontaneously in contrasting syntactic or situative contexts in the same month of recording" (Bittner, D., Dressler, W. U., Kilani-Schoch, M. (eds), 2003: XXXVIII). For the first months of modal verb occurrence it is typical that verbs occur only in one form – at the beginning in 2nd person singular, when the child repeats the adult's model, expressing a positive answer:

*MOT: *chceš hadr?* (2.8)
*MOT: do you want a duster?
*MYS: *chceš*
*MYS: you want

Later the 3rd person singular present tense appears as the most frequent verbal form in the child's production, referring not only to things in his environment but also to any interactant, including himself:

*MYS: *ten to umí* (3.0)
*MYS: he can (do) it (speaking about himself)

At age 3.2 the 1st person plural appears and the child combines modal verbs with lexical verbs:

*MYS: *musíme udělat novou (r)ybu*
*MYS: we must make a new fish (from modelling clay)

At age 3.3, finally the 1st person singular appears and its frequency rapidly increases, often in the negative form:

*MYS: *já nechcu malovat fixou* (3.3)
*MYS: I don't want to draw with a marker

We can observe a grammatical overgeneralization; the child uses *chcu* instead of *chci* to achieve regularity in the grammatical system. This is a clear example that the child has already started to build up a grammatical system and he understands the rules of how conjugation paradigms function. Real miniparadigms start to appear from the age 3.4. The child uses 1st person singular, 3rd person singular, 1st person plural and 3rd person plural in the present tense. 2nd person is not used at this stage of development.

One month later, at 3.5, future tense, past tense and conditional are added (2nd person is not used, other persons are frequently used both in singular and plural). Passive forms start to occur. Transition to morphology proper is obvious. Some more complicated forms are used, for illustration:

*MYS: *to musí bejt vyhozený* (3.5)
*MYS: it must be thrown away

This form can be interpreted as passive, although the child does not use the correct form of passive participle (*vyhozeno*) but resultative adjective (*vyhozený*). However, in his input only adjectival forms are present as his parents use Common Czech and not Standard Czech.

*MYS: *nechtěla jsem je mít nahoře* (3.5)
*MYS: I did not want to have them up there (he cannot reach plastic bags)

The child still uses the feminine ending when talking about himself as this form is more frequent in the input he receives. Past tense is formed correctly.

*MYS: *mohla by někde bejt* (3.5)
*MYS: she could be somewhere (he is looking for a sock)

Here the child correctly uses the conditional form, with correct word order and correct meaning. Such a complicated form is used only a year later after the onset of speech. This is not a typical development as the child started to talk very late and developed advanced forms very quickly, but it is not unusual either. What is important, the stages described in scientific literature are present, although the timing is a bit delayed at first and then accelerated. Lay persons (mothers) often describe this

kind of development saying: *s/he did not talk at all and then started talking in sentences.* As was illustrated in our example, this is not really true.

5 Conclusion

It can be observed that communicative competence develops gradually in the child, initially he is able to produce only limited number of forms – first just in repetitions, then 3rd person singular present tense appears as a universal form. Finally 1st person singular and plural forms appear; this sequence can be observed for lexical verbs as well. In parallel, the child learns to use tenses – past tense and future tense appear in the same month. Surprisingly, the child, who was a late talker, quickly develops elaborate forms such as passives and conditionals. One possible interpretation could be that he has received quite complicated input from his environment which took a longer time to process. At the same time, the child had problems with pronunciation so that he started to speak at a phase when he had quite a good understanding of the Czech language.

Literature:

1. Bittner, D., Dressler, W. U., Kilani-Schoch, M. (eds.): *Development of verb inflection in first language acquisition. A cross-linguistic perspective.* Berlin: Mouton-de Gruyter, 2003. ISBN 3-11-017823-0.
2. Dressler, W. (ed.): *Studies in Pre- and Protomorphology*. Wien: Verlag der Österreichischen Akademie der Wissenschaften, 1997. ISBN 3-7001-2654-9.
3. MacWhinney, B., Snow, C.: The Child language data exchange system. *Journal of Child Language*, vol. 13, 1985, 271–296.
4. Stephany, U., Voeikova, M. D. (eds.): *Development of nominal inflection in first language acquisition. A cross-linguistic perspective*. Berlin, New York: Mouton de Gruyter, 2009. ISBN 978-3-11-018840-0.
5. Voeikova, M. D., Dressler, W. U. (eds.): *Pre- and Protomorphology. Early Phases of Morphological Development in Nouns and Verbs.* München: Lincom Europa, 2002. ISBN 3-89586-468-4.
6. URL: < http://laboratorium.detskarec.sk> [cit. 2014-06-20].
7. URL: <http://childes.psy.cmu.edu/ > [cit. 2014-06-20].

Primary paper section: A

Secondary paper section: AI

WHAT DO TEACHERS THINK ABOUT SOCIAL EXCLUSION OF THEIR PUPILS?

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Podpora terciárního vzdělávání studentů se specifickými vzdělávacími potřebami na Ostravské univerzitě v Ostravě, reg. č.: OP VK CZ.1.07/2.2.00/29.0006

Abstract: This paper deals with parcial research study discussing about the opinions and attitudes of teachers of Roma pupils in primary schools and his/her competences. It presents some educational context of social exclusion of Roma pupils in the Czech Republic. The questions of social disadvantage and of educational of requirements are also mentioned.

Keywords*:* education, Roma pupil, competence of teacher, social exclusion, disadvantage, opinion, attitudes.

1 Introduction

Many authors focus on the issue of the personality of teachers or his/her pedagogical competences (such as e.g. Seberová 2006, Švec 1998, Vančová, Harčaríková 2013, and many others). An attention is paid to pedagogical competences, to communication with pupils and also to pre-graduate preparation of teachers etc. We do not address the psychological issues of the personality of a teacher (see Kaleja 2011), nor general competences of teachers. On the contrary, we want to focus on specific competences of teachers dealing with Roma pupils, who are socially excludeda from primary school system. While doing so, we base our efforts on existing long-term educational experiences with Roma pupils, with teachers (teachers and assistants of teachers), and also with Roma' parents. Our experiences are further enhanced by already performed research projects dealing with a wide spectrum of educational problems of this target group. Specific skills and competences of a teacher dealing with Roma pupils represent a set of attributes and characteristics that the teacher applies during his teaching work with the intention to make the educational process as effective as possible in relation to the target group. Attention is mostly paid to special educational needs of these pupils.

Akimjaková (2009) states that in terms of motivation of socially disadvantaged Roma children and in order for Roma pupils to actually attend school, the decisive factor is the actual personality of the teacher. She says that if pupils feel a positive personality from their teacher, they are able to achieve surprising and successful results. On the other hand, if the positive personality of the teacher is missing, not even the best teaching method will help the teacher to achieve results. Often we do not realize that the relationship of pupils who come from socially disadvantaged (and only from disadvantaged) environments, is formed at an early age. It is very difficult to persuade them to replace their behavioural patterns that they accepted from their parents with behavioural patterns presented by their teacher. Therefore, it is desirable according to Krupová (2009) to create for these pupils highly motivational and stimulative environment in school, so they have a chance to experience the joy of new knowledge and success. Roma ethnic groups view the education process in terms of axiological aspect completely differently when compared with the majority of the society. Education is usually given lower importance (see more in Kaleja 2011). However, we cannot say that educated Romas´ view education as unimportant. If we say something like that, it would be an incorrect interpretation taken out of a broader context. Krajčíriková and Oravcová (2010) state that pupils lack positive role models in their parents, who would explain to them the importance and need for education and also parents do not encourage their children to go to school so the child does not feel the need to be in school, and to belong there. Often parents urge their children to go school only to receive social benefits, etc., and ignore the need for actual self-realization of the pupils. Therefore, it is desirable that teachers of Roma pupils (and also others - such as social workers, and adults) are aware of these facts and that they take these facts into consideration during their pedagogical work.

2 Research study

In the years 2010 – 11 we implemented a research, whose aim was to focus on finding the impacts of social exclusion on the sociological level and in the level of social disadvantage of pupils seen by the pedagogical workers of selected primary schools in Ostrava. Within the researched issue the quantitative method was applied. Into the empirical survey there were deliberately chosen 6 primary schools that educate in almost absolute majority pupils from Roma minority from socially excluded localities in Ostrava. At the time of the data collection (spring 2011) 142 pedagogical workers (including the *teacher's assistants*) were employed there. In the investigation 110 of them (77,5 %) actively participated, which can be considered a relatively representative number with respect to the research set.

Teachers	
PhD degree	2
M.A./M.Ed. degree	67
B.A. degree	15
No university degree	26
Practise more than 20 years	35
Practice less than 20 years	23
Practice to 10 years	19
Practise to 5 years	33

Tab 1: *The basic characteristic of respondents*

The research instrument was a newly created questionnaire of it's own structure. It consists of 13 research areas (see RA1-13) and a few categorical areas (e.g. level of achieved education, length of teaching experience, gender, school, etc.). For the purposes of interpretation of the research findings we present all data generalized, not separately according to particular subcategories. In the research field the pedagogical workers had were allowed to choose more than one answer, thus the sum of the quantitative expression in the given subcategories (RA1-13) does not have to be 100 %.

The main research question was: ***What aspects of social exclusion and disadvantage of Roma pupils have an influence on the process of education seen by the eyes of pedagogical workers?*** and it was divided into the following research areas / sub-questions (RA1-13):

- the reasons of insufficient pre-school education (RA1),
- the conditions under which the parents choose the preparatory class of primary school (RA2),
- what differences can be seen in children who attended pre-school or the preparatory class of the primary school and those who did not attend pre-school or preparatory class of the primary school (RA3),
- the conditions under which the preparatory class of primary school would be considered beneficial (RA4),
- the reasons of language barrier in children / pupils (RA5),
- factors which can have a positive influence on overcoming the language barriers (RA6),
- teaching Roma pupils Romany language in primary school (RA7),
- the possibilities of help in overcoming the language barrier in the classroom (RA8),
- reasons for increased absence of pupils (RA9),
- causes of insufficient motivation of pupils for school work (RA10),
- the possibilities of taking into account pupils' hobbies in the classroom (RA11),
- conditions to improve the school success (RA12),
- knowledge of socially excluded areas / environments (RA13).

The orientation was directed to identify the opinions of pedagogical workers, who come into a daily contact with

socially excluded / disadvantaged pupils. By the empirical investigation we want to show **how these pedagogical workers of the schools**, who are in a daily contact with pupils, **perceive the context of social exclusion**, actually the social disadvantage of their pupils. On the basis of the findings we can be further work with the pieces of knowledge and direct them to a deeper inductive (*qualitatively oriented*) analysis. After the execution of the content analysis of relevant legislative documents, specialized sources, strategic or inspection reports etc. we place the obtained knowledge into wider social, and also educational context.

Clarification of terminology

- **Social exclusion** is rising from the concept of analysis of social exclusion, it has sociological connotations, with dual interpretation:
  1) There are defined persons with appropriate characteristic, that are socially excluded or there exists a risk towards this phenomenon. There especially belong: persons with any kind of disability, addicted people, elderly people living alone, people with low qualification, unemployed people or people employable with difficulties, etc.
  2) In the conditions of the Czech Republic mainly people living in ghettos (in socially excluded localities) are considered excluded persons. In this context those are mainly Roma people (almost 90 %).

In our text we hold the point no. 2.

- **Social disadvantage** is legislatively defined in the law and regulations dealing with education. By the concept they belong **to the category of special educational needs** (*health disability, health disadvantage and social disadvantage*). Social disadvantage involves:
  - children living in institutional and protective education,
  - children of migrants, asylum seekers, refugees,
  - children from families with low socio-economic status,
  - children whose mother tongue is different from the language of the teacher,
  - children whose parents (guardians) do not cooperate with the school.

3 Interpretation of research findings

- RA1: ***What are the reasons for insufficient pre-school preparation of socially excluded Roma pupils?***

The Roma parents come from socially excluded areas and they are significantly determined by the environment, its perspective resulting from negative deviations (*social-pathological phenomena*), which immediately accompany the social exclusion. The manifestations of social exclusion relate mainly to the low level of education, unemployment, dependence on state social support, social-pathological phenomena etc. Social exclusion is manifested in socio-economic, cultural and political dimensions. Thus the pedagogical workers suggest that the problem is in **insufficient family support of pupil's educational career** (95 %), as well as in ascribed **importance and low rating of pre-school education** of their children in the system of education (90 %). This only confirms the empirical findings related to the preparatory classes of the primary school (see Kaleja 2013, and also Analysis by company GAC).

- RA2: ***On what preconditions the parents choose the preparatory class of the primary school?***

On the basis of their own experience teachers declare, that parents' decision, whether the child will attend the preparatory class of the primary school, affects the assumption that the child will continue in the compulsory school attendance at this particular primary school (80 %). Therefore if the parents choose pre-school education for their children, **they prefer the preparatory class of the primary school.** With respect to the inclusive conception of school it can be only recommended and highlighted so as the preparatory classes of the primary school are formed exclusively with schools of the main educational stream. In **Report on the State of the Roma Minority in the Czech Republic in 2010** there is stated that if the preparatory classes of the primary schools are established in primary practical schools, there is an assumption that the child starts his / her educational career immediately outside the main educational stream, which cannot be considered an inclusive educational mechanism.

- RA3: ***In what can be seen the differences in children who attended the pre-school or the preparatory class of the primary school and in children who did not attend pre-school or the preparatory class of the primary school?***

The differences are reflected mainly in general unpreparedness for entry to the first grade of primary school of the main educational stream. It considers especially the level of **adaptability to the new environment and new order, the system of requirements, the basic knowledge of space and time** (75 %)**. The deficiency can be also seen in the basic academic knowledge and general skills** (90 %), which an ordinary child entering school has already acquired.

- RA4: ***On what conditions would be the preparatory class of the primary school considered a benefit?***

Regular attendance has a significant influence on the effectiveness of the educational process. The absence in the lessons in the preparatory classes of the primary school is excusable, because the attendance in the pre-school preparation is not obligatory (*the same as in pre-school*). In relation to the attendance we very often face long weekends, with absence, when the parents do not get up in the morning, do not walk the child to school, or they consider the attendance in the preparatory class a formal matter (25%). **The attendance in preparatory classes of the primary school could be far more effective for the child alone, provided that his / her attendance is highly regular and the parents also work with the child at home** (85 %).

- RA5: ***What are the reasons of language barriers in children / pupils?***

The parents of Roma children **themselves do not acquire the language of the majority society sufficiently.** They speak sc. Roma Czech language (see Kaleja 2011). The parents speak in ethnolect, the vocabulary is poor from the perspective of lexicology. Mother tongue of Roma pupils significantly affects their form of the Czech language, and this is very often the first cause why the majority of Roma pupils, according to the report of the European Roma Rights Centre (1999), was placed into the special education. The report stated: *"The pronunciation of a Roma child is generally different from the one of a non-Roma child and thus psychologists sometimes wrongly concluded that the Roma child is not clever only because of his / her accent."* (ERRC 1999:31) Another factor of language barrier that the pedagogical workers perceive is **unwillingness of parents to participate in learning**. Last year the Czech School Inspectorate (CSI) got involved in the issue of social disadvantage through an investigation in primary practical schools. In 2009/2010 the Czech School Inspectorate carried out an inspection of correct placement of pupils into schools out of the main education stream. It was focused on the effectiveness of the usage of diagnostic stays and the possibility of pupils to return into to the main education stream. Further the inspection monitored in what way the schools in their own evaluation of Roma pupils observe their language, culture and former experience with learning. During the inspection 171 of 398 primary practical schools were visited. From the results it is obvious that some Roma pupils were unjustifiably determined as pupils with mental disability, that not in all cases the legal requirement for their placement into special classes was fulfilled and that diagnostic stays of pupils were not always determined in accordance with the rules (CSI 2010, on-line).

According to the thematic report of the Czech School Inspectorate with the title **Summary of pieces of knowledge from the thematic inspection in former special schools** from the year 2010 there were "*…in school year 2009/2010 in these*

schools reported in statistics 17 455 pupils, the actual number at the time of inspection was 15 894 pupils. 5 052 pupils were placed there without the diagnosis of special educational needs. From the total number of pupils 68,2 % were diagnosed with mild mental disability, out of which according to the directors and school counsellors 35 % are Roma pupils with mild mental disability. The highest occurrence of these diagnoses in Roma children was in the Ústí nad Labem region (53,1 %), Karlovy Vary region (48,5 %) and Liberec region (41,8 %).” (CSI 2010, pg. 5) The report further states: “*In accordance with the Education Act in the visited schools insufficient identification and evidence of socially disadvantaged pupils were discovered, there is preserved general focus of evaluation of unsuccessfulness of pupils in ordinary education stream as mild mental disability. There is missing differentiation of needs and specific conditions of support of socially disadvantaged pupils and pupils with mild mental disability and it has a significant impact on the possibilities of Roma pupils to integrate into the main education stream according to the Frame Educational Programme of Special Needs Education.*“ (pg. 6)

- RA6: **Which factors can have positive influence on overcoming the language barrier?**

To apply **greater demands on teaching the Czech language** in lessons of Roma pupils sounds quite uneven. The Czech language is for majority of those pupils a secondary language, it belongs to a completely different language group, and moreover, the level of the language is affected by many factors, e.g. social environment, socio-economic position of the family (see also Bernstein’s theory of language codes in Kaleja, M. 2011) etc. On the other hand the teachers believe that if the parents talk to their children in standard Czech, they do not use ethnolect, their form of the Czech language would be much better (95 %). It is therefore worth considering, whether with respect to the above mentioned such argument of the teachers is really legitimate. It is not possible to determine what great demands mean and whether it is really justifiable. The presence of the teacher’s assistant (65 %) is considered a huge help by the teachers for communication with Roma pupil and their parents. They also mention relatively large shortage of the teacher’s assistants (50 %).

- RA7: ***What is the attitude of pedagogical workers towards the teaching of Romany language to Roma pupils in primary schools?***

If it should be chosen whether to introduce Romany language into the curriculum of primary education, and it means into schools were there is a predominance of Roma ethnicity, there are no objections from the teachers. They recommend the teaching of Romany language in the form of an extra-curricular lesson (30 %), not an obligatory or an optional subject (60 %). However, there are also those who argue that the teaching of Romany language is not and could not be a benefit for the educational perspective of Roma pupil (10 %).

- RA8: ***What are the possibilities of help to overcome the language barriers in the lessons?***

The language barrier can be overcome by the help of the application of an individual approach to the pupils (35 %), through tutoring concentrated on the development of communicative competence (20 %), through a proper model of speech in the person of the teacher (60 %) and through frequent repetition of thematically correct expressions and phrases (70 %).

- RA9: ***What reasons for the increased absence of the pupils do the pedagogical workers see?***

According to the pedagogical workers the reasons for the increased absence of pupils corresponds to the parents’ lack of interest in children’s education (85 %) and the lack of interest of the pupils in the school work (75 %).

- RA10: ***What are the reasons for insufficient motivation of pupils for school work?***

The parents instil to their children the insufficient prospect for further education and employment, and success on the labour market (75 %). Already according to the research of M. Kaleja (2010) it became clear that Roma parents perceive racism in the Czech Republic very intensively and they believe (38 % out of N183[1]), that in case of the ethnic Roma person the education does not play any role in order for the Roma person to be successful on the labour market. The colour of the skin is decisive according to them. Only 29 % (out of N183) claim that with the acquired education the Roma person can find the job.

- RA11: ***What are the possibilities of taking into consideration the hobbies of pupils in the lessons?***

According to some teachers taking the hobbies into account, or using them in the educational process does not take place (40 %). They argue by the fact that the curriculum is quite extensive, that there is no place to add range into the educational process (30 %). The benefit for both the theory and the practice would be to deal with this fact. **Pupil’s potential, its usage can be a great mechanism energising motivation, interest in education.** It is sad that many teachers do not pay enough attention to it. Some of them report that they partially take into account individual abilities of their pupils (35 %).

- RA12: ***What conditions can help to improve the school success of the pupils?***

Almost all schools are struggling with the lack of material conditions for school work. The pupils go to school without school necessities, in some schools the books and exercise books remain in the classroom. They do not take them home. They do not prepare for the lessons, they do not do their homework. Thus learning is significantly determined by these circumstances. Books and encyclopaedias are available only in school and they are not always optimally used in the education process. Pedagogical workers determine as a condition for the improvement of school success of a pupil parents’ interested in children’s education (90 %), and also better material facilities of the family (65 %) and professional approach of the teachers themselves (30 %).

- RA13: ***Do the teachers know what the life in socially excluded localities is like?***

Many teachers have no real conception about the issue of social exclusion. They perceive this phenomenon only generally, they are aware of socially pathological phenomena occurring in socially excluded localities (ghettos), however, they do not deal with the scope of impacts and life perspective of children (pupils) growing up in socially excluded families. Some of them are not interested in knowing and they argue by the fact that the family does not cooperate with the school (80 %), their main task is to educate, and only then to raise the children (70 %). They do not solve the consequences of this phenomenon because it is not in the scope of their competences (60 %).

The extent and impacts of social exclusion are immediately reflected in school practice, their influence is very noticeable. Pedagogical workers (*all the pedagogical workers of the school*) should have adequate knowledge relating to this issue. Those would help them better understand the problems connected with the phenomenon of social exclusion, they would in better way help them to see the importance of school success of socially excluded Roma pupils. The teachers have the key role in the process of shaping life perspective of the pupils, they have direct influence on the formation of the personality of the pupil.

The realised research is a kind of a probe that outlines the current situation. It predicts the necessity to further deal with the research area, both quantitatively and qualitatively.

4 Summarily

Pedagogical work with socially excluded Roma pupils is very demanding. It requires high level of resilience on the teacher's part. Lacková (2009) addresses moral resistance in terms of intercultural context and provides several theoretical models of resilience and also characterizes psychological concept of this

[1] N183 = sample of 183 people

phenomenon. She understands resilience as an activity (performed against all obstacles and unpleasant situations) focusing on achieving a certain goal and that is, that a man should reach a certain quality of life. However, we should remember not to focus only on pedagogical workers but also on students themselves and try to increase their resilience levels. Personality of Roma pupils´ teacher should be characterized by intercultural sensitivity, which would be presented by (see Kaleja 2011, 2013):

- willingness to work with the Roma ethnic group,
- the ability to respect the particularities of ethnic pupils
- good social skills,
- knowledge of Roma ethnicity (social differentiation, structure, existential issues, culture, tradition)
- basic knowledge of Roma language,
- willingness to provide primary knowledge about the culture of Roma ethnicity,
- strict justice to all pupils,
- prosocial sense of the solution of educational problems,
- sensitive active / activating communication with parents.

The characteristics of intercultural sensitivity correspond to the concept of teacher oriented to humanistic education (Dargová 2001). Dargová (2001) defines humanistic education as education, when teachers look at physical, mental and moral development of pupils with the accent of self-creation and self-improvement. The main representatives of this concept are Carl Rogers, Abraham Maslow, Gordon Allport. Dargová further emphasizes that the representatives of humanism in education concern every pupil as being free, original, creative and authentic, not only as being reactive.

Teachers of Roma pupils should know the local environment from which the pupils comes from, should be aware of his family environment and should also be oriented in the issues of educating ethnic pupils. Roma children coming from socially excluded environments have completely different educational dispositions, such as for example:

- parents have low education, children have different models, not only within level of education, but generally,
- parents are unemployed or unemployable, they are dependent on social benefits and lead their children to that,
- their needs, values and motivations for schooling are different, they hardly can understand the meaning of level of school education,
- their social, cultural, social-economic and politic positions are different, they are born in this, they are growing up in this, and they hardly get out of this on their own, they need some help,
- they have inconsistent experience with majority, such as prejudice, racism, physical, psychological and social attacks,
- children live two worlds in parallel (Roma people´s world and majority people´s world), many times they cannot understand the rules, style of communication, they cannot clearly understand the way of behavior of people from majority, etc.

Literature:

1. AKIMJAKOVÁ, B. Resocializačné pôsobenie v špeciálnej pedagogike z kresťanského hľadiska. in: *Dimenzie a perspektívy rozvoja osobnosti jednotlivca I. Špeciálna pedagogika. Rodina – škola – spoločnosť.* Pedagogická fakulta Katolíckej univerzity, Ružomberok, 2009. ISBN 978-80-8084-490-5, s. 8-13.
2. ČESKÁ ŠKOLNÍ INSPEKCE. *Tematická zpráva. Souhrnné poznatky z tematické kontrolní činnosti v bývalých zvláštních školách.* Praha, 2010.
3. DARGOVÁ, J. *Tvorivé kompetencie učiteľa.* Prešov : Privat Press, 2001. ISBN 80 – 968608 – 1 – X.
4. EUROPEAN ROMAN RIGHTS CENTRE. *A Special Remedy. Roma and Schools for the Mentally Handicapped in the Czech Republic.* Hungary: ERRC, 1999. ISBN 963-03-7825-6.
5. GAC, spol. s r. o. *Analýza sociálně vyloučených romských lokalit a absorpční kapacity subjektů působících v této oblasti.* Praha, 2006. Zadavatel projektu: MPSV a Rada vlády pro záležitosti ČR.
6. GAC, spol. s r. o. *Vzdělanostní dráhy a vzdělanostní šance romských žákyň a žáků základních škol v okolí vyloučených romských lokalit.* Závěrečná zpráva projektu MŠMT ČR, 2009. Sociologický výzkum zaměřený na analýzu podoby a příčin segregace dětí, žákyň, žáků a mladých lidí ze sociokulturně znevýhodňujícího prostředí.
7. HARČARÍKOVÁ, T. a kol. *Pedagogika detí s poruchami učenia, správania a autizmom raného a predškolského veku.* Bratislava: PdF UK, 2013. ISBN 978-80-89238-89-7.
8. KALEJA, M. *Determinanty hodnotových konstruktů ve vzdělávání romských žáků základních škol.* Ostrava: PdF OU, 2013. ISBN 978-80-7464-233-3.
9. KALEJA, M. *Romové a škola versus rodiče a žáci*. Ostrava: Ostravská univerzita v Ostravě, 2011. ISBN 978-8073-689438.
10. KRAJČIRÍKOVÁ, Ľ.; ORAVCOVÁ, M. Hodnotová orientácia rómskych rodín. in: Chudoba v kontexte dneška - zdravotné, psychické, sociálno-právne, filozofické, etické a etnické aspekty chudoby v súčasnosti In. Gažiová M. (red.): *Zborník referátov z IX. sociálno-vedeckej konferencie s medzinárodnou účasťou.* Verbum - vydavateľstvo Katolíckej univerzity v Ružomberku, Ružomberok 2010. ISBN 978-80-8084-566-7, s. 113-121.
11. KRUPOVÁ, I. Rozvíjanie prírodovednej gramotnosti rómskych žiakov a žiakov zo sociálne znevýhodňujúceho prostredia. In: Gažiová M. (red.). *Chudoba v kontexte dneška – zdravotné, psychické, sociálno-právne, filozofické, etické a etnické aspekty chudoby v súčasnosti*. VERBUM – Vydavateľstvo KU v Ružomberku, Ružomberok 2010. ISBN 978-80-8084-566-7, s. 122 – 132.
12. LACKOVÁ, L. *Osobnostná odolnosť v interkultúrnom kontexte.* Ostrava: PedF Ostravské univerzity v Ostravě, 2009. ISBN 978-80-7368-758-8.
13. SEBEROVÁ, A. *Výzkumná kompetence v učitelské profesi a ve vzdělávání učitelů*. Pedagogická fakulta OU, Ostrava 2006. ISBN: 80-7368-270.
14. ŠVEC, V. *Klíčové dovednosti ve vyučování a výcviku*. Brno: Pedagogická fakulta MU, 998. ISBN: 80 -210 -1937 -9.
15. VANČOVÁ, A., HARČARÍKOVÁ, T. Špeciálnopedagogické intervencie a komplexná starostlivosť o deti s postihnutiami raného a predškolského veku. Bratislava: PdF UK, 2013. ISBN 978-80-89238-84-2.
16. ZEZULKOVÁ, E. *Jazyková a komunikativní kompetence dětí s mentálním postižením.* V Ostravě: Ostravská univerzita, Pedagogická fakulta, 2011, 134 s. ISBN 978-80-7368-991-9.
17. ZEZULKOVÁ, Eva. *Rozvoj komunikační kompetence žáků s lehkým mentálním postižením.* V Ostravě: Ostravská univerzita, Pedagogická fakulta, 2013. ISBN 978-80-7368-991-9.

Primary Paper Section: A

Secondary Paper Section: AM

ANALYSIS OF SPECIFIC OPEN INNOVATION COMPONENTS BASED ON PERCEPTION AMONG SLOVAK COMPANIES

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Abstract: In modern era businesses are in a highly competitive environment where the goal is not to acquire their competitiveness through activities such as reducing costs, but through constant innovation. There exist no excellent businesses, there are only those that are able to survive and it is with the ability to reflect on the changing environment using innovation activities. This topic mainly concerns SMEs, while they have less resources to achieve high innovation performance then large companies. This research paper is specifically focused on companies in Slovakia, comparing innovation performance and its perception among micro, SMEs and large companies. The aim of the research is to analyze, compare and evaluate perception of specific components of open innovation model among Slovak companies.

Keywords: innovation, open innovation, external relations, SMEs

1 Introduction

In the current economy based on knowledge not only tangible and financial assets enter the management, but also those which are of a qualitative nature and often difficult to measure. Companies are very dependent on these intangible assets, given that they support the growth of companies and their competitiveness (Kaplan, Norton, 2004). These intangible assets can be classified under one term which is knowledge management. Knowledge management can be generally understood as “an effort to make know-how available in an organization to “those who need it, to where it is needed, at the right time and in a form in which it is needed in order to increase human and organization performance” (Papula et al, 2013). At the same time, however, the flow of knowledge is not limited throughout the organization from top management to the lowest level, but in all directions. Whether the acquisition of knowledge from the employees themselves, or even from outside the organization. Many authors thus agree that it is the proper knowledge management that is becoming increasingly important in maintaining a competitive advantage and thus enters into the process of innovation management and increasing innovation potential (Will, 2008).

1.1 Open innovation model and the differences based on size of organization

As it is important to properly manage knowledge in organizations, innovation activity also significantly contributes to its success. Capacity of organizations to continually generate innovation is regarded as one of the main factors affecting the performance of the organization, its stability and ability to form and maintain a competitive advantage (Lengnick-Hall, 1992; Porter, 1990). Research authors dealing with this subject directly indicate that the ability to generate ideas is leading to the dominant competitive position (Banbury & Mitchell, 1995; Bates & Flynn, 1995). Innovations are indeed relatively established notion among businesses, especially in terms of product and process innovation (Tidd & Bessant, 2005), but there are still gaps in the ability of effective management of innovation process. To produce the required quantity and quality of innovation activities, company must first obtain high quality ideas and to be able to manage the resources of these ideas.

Historically, companies use a model that was based on in-house management and sharing of knowledge, which led to the creation, collection and evaluation of ideas and then to innovation. For innovation, organizations used their own resources, whether human, financial or material. Closed innovation model as it is called today (Chesbrough, 2003) is still a very used approach to innovation. In reality, however, it relates more to small and medium-sized organizations, which are not operating globally and thus have less linkages to external entities.

The use of internal resources for the development and promotion of innovation is still of high importance. However, the ultra-competitive environment, which is characterized by rapid change, however, is forcing businesses to innovate more and more often. They face insufficient internal capacity, and often lack new ideas for innovation. Open innovation model (Chesbrough, 2003; Gassmann, 2004 & van de Vrande et al., 2009) therefore focuses not only on internal resources for innovation, but also external. However the flow of knowledge that lead to innovation can go inwards and also outwards from the organization (Huang & Rice, 2009). The following figure number 1 shows a comparison of closed innovation and open innovation model.

Figure 1: Comparison of closed and open innovation model[1]

Many businesses now recognize the importance of the involvement of external actors in their innovation activities precisely because what Chesbrough said, that "not all wise people work for us" (Chesbrough, 2003). However, this model is not new. In particular, large companies that maintain relations with its external partners regularly use these external resources as an incubator for ideas. In practice, however, today the need for open innovation develops into a new level, not only as gaining knowledge but also trading or lending of intellectual capital (Grönlund, Sjödin, & Frishammar 2010, p.108).

Large companies are often at an advantage in terms of innovation activities, not only in terms of the existing relations but also wider resources, and people that help the creation of ideas (Habaradas 2009; Bianchi et al., 2010). However small and medium-sized organizations due to lack of financial and human resources are more and more dependent on building relationships with external partners to achieve higher innovation activity. The following figure 2 shows the involvement of different sources for innovation. Except human resources-employees, all other entities can be summarized under the category of external sources of innovation.

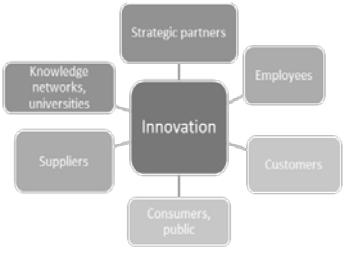

Figure 2: Sources for ideas in innovation process[2]

Thus both internal and external resources enter the creation of ideas for innovation. Practice has confirmed that the external resources (open innovation model) is not an independent approach to innovation, but complementary to the internal knowledge of the company and therefore together lead to innovative activities (Roper et al. 2008).

[1] Chesbrough, H. Open Innovation: The new imperative for creating and profiting from technology. Harvard Business School Press 2003, Boston, Massachusetts
[2] Atkearney [cit. 2014-10-01]. Available at: http://www.atkearney.com/documents/10192/760607/FG-Turbocharging-Open-Innovation-in-a-100-Day-Blitz-1.png/2b91d5f3-783e-4e0b-b6e4-c32c22e3be02?t=1361819739610

1.2 Innovation and sharing knowledge within Slovak companies

Several studies confirm that the innovation performance of small and medium-sized organizations in open model is inferior to the innovation performance of large companies. In contrast, 20% - 60% of large companies are involved in open innovation activities within the OECD countries, but only 5% -20% of SMEs involve in such activities. If we take into account Slovakia compared to other EU28 countries, Slovak SMEs are ranked 21 from EU28 countries and placed third among the V4 countries (Innovation Union Scoreboard, 2014).

By Lee et al. it is precisely the involvement of SMEs in networks with external entities that is essential for collecting ideas for innovation (Lee et al., 2010). However, the fact that the approach to open innovation in Slovakia is not among SMEs is sufficient extend is also due to the mistrust of sharing with external entities. Small and medium sized organizations consider sharing knowledge as a threat because they see it as an important transfer of knowledge and know-how to other entities rather than the possibility of jointly developing competitiveness (Papula, Volna, CAD, 2013). It is clear that continuous innovation activity and proper allocation of resources for innovation are keys to building competitiveness. The right activities related to the management of intellectual capital – hence in our case the management of relations with external entities and innovation directly affect the financial performance of organizations, according to research on a sample of Slovak organizations (Pilková et al., 2012).

2 Methodology

Research goal
The aim of the research is to find and analyze linkages between innovation and relations with external subjects. Followed by further comparison of results among micro and small-sized companies, medium-sized companies and large companies.

Sample and data collection
The sample for this research consisted of 69 Slovak companies with size from micro to large company. The main presence had medium-sized companies with the number 30, followed by 17 small-sized companies and 16 large-sized companies. Micro-sized companies had lowest share from the sample group. Companies were divided based on the number of their employees, where:

- Large-sized company – 250 and more employees
- Medium-sized company – 50 to 249 employees
- Small-sized company- 10 to 49 employees
- Micro-sized company- 0 to 9 employees

Figure 3 shows the distribution of interviewed companies by their size.

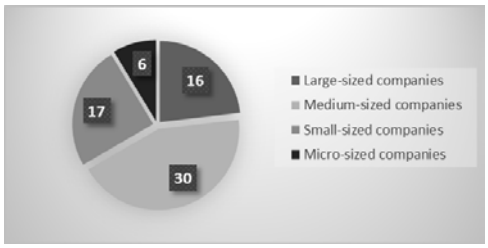

Figure 3: Division of companies researched, based on number of their employees.

Data in this research were collected from questionnaires in 2014, where interviewees were executives, top management or from controlling division. Interviewees in this research were asked to answer questions divided into topics focused on companies' objectives and their importance, their activities within these objectives, and their long term significance.

For the purpose of this paper, two specific dimensions were analyzed within these 3 questions:

1. *"In your company, in terms of achieving the objectives of the company, what significance do you attribute to:"*
   - Innovation – changes/improvements of products, processes
   - Relations with external subjects
2. *"Please, give your opinion on the following statements":*
   - In our company there is a mechanism to capture ideas and recommendations for improvement or innovation, (which come from the employees). Relations with external subjects
   - In our company, we are aware of the need for strong relationships and partnerships (with universities, professional associations, business partners) and we provide activities to build them.
3. *"Which of the following areas do you consider essential for long-term financial performance management company (long-term sustainability=the ability to meet the objectives as profit, ROA, ..)"*
   - Investing in research, development and innovation processes
   - Building and developing long-lasting relationships and strategic partnerships with business partners

To quantify these qualitative indicators, interviewees were asked to answer within a scale of 1 to 4, where the meaning was:
1 - No importance; does not apply; insignificant
2 - Small importance; sometimes applies; no very significant
3 - Medium importance; usually applies; significant
4 - High importance; always applies; very significant

Resarch data were collected with collaboration with doc. Ing. Ján Papula, Phd. & Mgr. Jana Volná, PhD.

2.1 Results

The aim of this paper is to find and analyze linkages between innovation and relations with external subjects. We focus on this topic from two dimensions. Both researched topics about innovation and relations with external partners are divided into three questions based on importance, activities and significance. Secondly we compare obtained results among three groups of companies based on their size. For the purpose of this research the sample of 69 questioned companies was divided into16 large companies, 30 medium companies and 23 small and micro companies, which were analyzed separately.

Analysis in this paper provide an overview of current situation among Slovak companies based on their view and linkages in the area of open innovation.
To understand and explain the importance of innovation in the context of objectives, activities and long term significance, we look at evaluations of three groups of companies – micro and small, medium and large. Figure number 4 shows the percentage shares of each type of answer, from the most positive 4 (meaning significant, important) to least positive 1 (insignificant, least important).

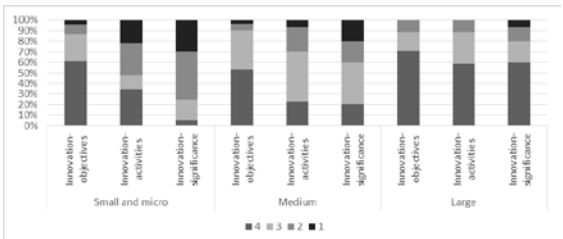

Figure 4: Analysis of innovation in context of objectives, activities and long term significance

In comparison of each type of businesses in the dimension of innovation, high evaluation achieved question regarding innovation objectives in each type of business. However figure number 4 clearly shows that activities regarding innovation and

the significance for long term sustainability are highly evaluated only by large companies. Around 60% answered with the most positive answer (number 4) for both questions. Moreover these two questions were evaluated very poorly by small and micro companies, where 22% of these companies do not do any activities towards innovation, and 26% do not consider innovation significant for their long term sustainability.

To find the linkages in the context of open innovation, we further analyze the area of relations with external partners. For the purpose of this paper we divided external subjects as resources into customers and other external subjects. This is because most companies have relations with customers in some kind of form, and to analyze the relations with other external partners, the data could be spoiled by grouping these two kinds of relations.

Figure number 5 shows the percentage by answers (1 to 4) for the area of relations with external partners. Clearly more companies from each group answered positively to each objectives, activities and significance. Positive result is that most companies realize the significance of partnerships for long term sustainability.

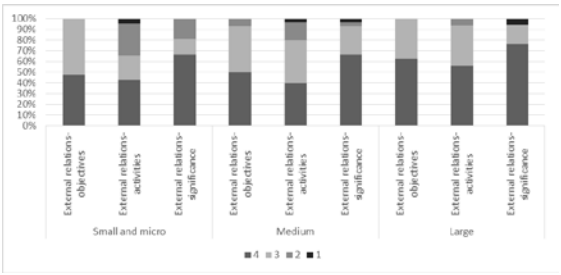

Figure 5: Analysis of external relation in context of objectives, activities and long term significance

If we use an assumption, that large companies have higher innovation performance than smaller companies, which is the basis for European commission research on innovation (2014), we can use a comparison for Slovak companies in our research.

Figure number 6 shows the average answer for each group of companies in the innovation area. With the benchmark we can see that the main differences are in the question of activities and significance, where both micro and small and medium companies rank even below average.

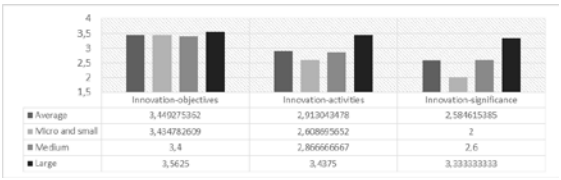

Figure 6: Comparison of average answers in innovation topic

Thus high perception of importance of innovation does not automatically influence companies activities, neither their perception of innovation in the context of long term sustainability.

Overall rating in the area of relations with external subjects was higher than in the area of innovation. However results shown in figure number 7 indicate, that lowest rating achieved question about activities within relations with external partners. Again, we can see that seeing importance of one factor does not automatically influence activities with the same strength.

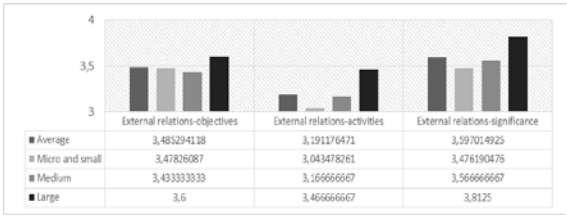

Figure 7: Comparison of average answers in external relations topic

In order to fully understand linkages within objectives, activities and significance for each topic we need to find relations among them. Next figure number X shows correlation in three important dimensions – linking objectives and activities in innovation, followed by external relations, and innovation objectives with external relations objectives.

We used Pearson's correlation to find possible relationship between these pairs of variables. Existing positive relationship, can be found only for large companies in each pair of variables. These relations are statistically significant (at the 95% confidence level with probability $p<0.05$), meaning there exist strong relations and the awareness of linkages within these variables only for large companies.

	External relations-objectives		
	Micro and small	Medium	Large
External relations-activity	0,138757849	-0,01101	**0,616316**
Innovation-objectives	0,022936745	0,057215	**0,497067**
	Innovation-objectives		
Innovation-activity	Micro and small	Medium	Large
	-0,198688023	-0,10046	**0,59604**

Table 1: Comparison of Pearson's correlation within innovation and external relations topics

Correlation of 0,497 for relation of innovation objectives and external relation objectives shown for large companies indicates that there clearly exist a link which confirms the theory of open innovation, if we assume that large companies really achieve better results in open innovation performance.

3 Discussion and conclusion

With current environment pushing organizations to innovate more frequently, the need to find sources for innovation becomes evident. The model of closed innovation, where one derives only from internal sources is not appropriate for this type of economy. Therefore the idea of open innovation overcomes the shortcomings by engaging external sources to the process of innovation. While large companies have been using this model for a while, it is essential for SMEs to widen their innovation sources. When looking on the environment of Slovak companies, researches show that Slovak SMEs rank below average, moreover at the tail of EU28 (European commission statement 2014). To investigate the problem of low innovation performance of Slovak companies (especially SMEs) we have analyzed their perception of open innovation components, focusing on innovation objectives, activities and long term significance with external relations objectives, activities and long term significance.

While companies exist in clearly dynamic environment based on knowledge economy, only large Slovak companies perceive innovation as strategically very significant for long term sustainability along with their activities. In contrary micro, small and medium-sized companies do not engage in innovation oriented activities very much. The high difference in the evaluation of innovation objectives versus its activities and significance, for companies except large-sized, can be explained as they know the concept of innovation, but do not fully understand it. Thus they consider innovation important but do not go further. Another explanation may be, that these firms do not know how to engage in innovation activities, do not have the

resources or relationships needed. The area of external relations seems more consistent in answers. Although large companies rank higher with the importance perception in each question than smaller companies. Looking at the average answer within the question of activities regarding external partners, we can see that the smaller the company is the less it engages in these activities. This is easy understandable, while large companies cooperate more with their partners, having strong long term relations. The possibility for small and medium-sized companies to engage in these activities more is through networks. Mostly knowledge networks whether with public entities such as universities or partners, competitors and other businesses. These networks may create appropriate environment to create and share ideas for innovation.

Most importantly this research examines the relations in these areas of innovation and external relations. With the assumption that large companies have better innovation performance, thus better understanding of the concept, they can be used as a benchmark for smaller companies. Examining the linkages, we found strong statistical relations between innovation objective importance and innovation activities for large companies along with strong relation between external relations objectives and activities. It indicates, that large organizations really understand the concept of innovations, because when the see the importance of innovation they also engage in innovation activities. Similarly with external partners. More interesting founding though is the significant correlation between innovation objectives and external relation activities. Large organizations thus use the concept of open innovation. The lack of correlations-relations for smaller companies indicate, that they do not deliberately use open innovation model, nor they seem to understand the linkages in order to be innovative.

When questioning the perception of the concept of open innovation there still can exist a fear of sharing among SMEs which is a great barrier to successfully engage in innovation activities as described by Papula (Papula et al., 2013). As the theory suggest, it is however essential for especially SMEs to engage in innovation activities that incorporate also external environment. Although first of all there is a need for SMEs to realize the importance of open innovation and linkages that lead to better innovation performance.

Literature:

1. Atkearney.: [cit. 2014-11-01] Available at: http://www.atkearney.com/documents/10192/760607/FG-Turb ocharging-Open-Innovation-in-a-100-Day-Blitz-1.png/2b91d 5f3-783e-4e0b-b6e4-c32c22e3be02?t=1361819739610.
2. Banbury, C.M., Mitchell, W.: *The effect of introducing important incremental innovations on market share and business survival*, Strategic Management Journal, 16, 1995, pp. 161-82.
3. Bates, K.A., Flynn, E.J.: *Innovation history and competitive advantage: a resource-based view analysis of manufacturing technology innovations*, Academy of Management Best Paper Proceedings, 1995, pp. 235-9.
4. Cherbrough, H.: *Open Innovation: The New Imperative for Creating and profiting from Technology*. Cambridge, MA: Harvard Business School Publishing. 2003.
5. European Commision.: *Innovation Union Scoreboard 2014*. 94 p.. 2014. ISBN 978-92-79-34662-0. [cit. 2014-11-01] Available at:http://ec.europa.eu/enterprise/policies/innovation/files/ius/ius-2014_en.pdf.
6. Gassmann, O., Enkel, E.: *Towards a theory of open innovation: three core process archetypes*. Proceedings of The R&D Management Conference, Lisbon, Portugal, July 6-9. 2004.
7. Grönlund, J., Sjödin, D., Frishammar, J.: *Open innovation and the stage-gate process:A revised model for new product development*. California Management Review, 52(3), 2010, 106-131.
8. Habaradas, R.: *The challenges of SME innovation and technology upgrading indeveloping economies*: Insights from Malaysia, Thailand, and the Philippines. *Journal of International Business Research, 8(* 1). 2009, 869-89.
9. Holienka, M., Pilková A. *"Impact of Intellectual Capital and its Components on Firm Performance Before and After Crisis"* The Electronic Journal of Knowledge Management Volume 12 Issue 4 (pp261-272) available online at www.ejkm.com.
10. Huang F., Rice, J.: *The role of absorptive capacity in facilitating "open innovation" outcomes: A study of Australian SMEs in the manufacturing sector*. International Journal of Innovation Management, 13 (2), 2009, 201-220.
11. Kaplan, R. S., Norton, D.: *Measuring the Strategic Readines of Intangible Assets.* Harvard Business Review, 2004.
12. Lee, S., Park, G., Yoon, B., Park, J.: *Open innovation in SMEs - An intermediated network model.* Research Policy, 2010, 39 (2), 290-300.
13. Lengnick-Hall, C.A.: *Innovation and competitive advantage: what we know and what we need to learn*, Journal of Management, 18, 1992, pp. 399-429.
14. Papula., J., Volná, J., Huľvej, J.: "*Knowledge networks as a source of knowledge initiatives and innovation activity in small and medium organizations*", Proceedings of International Conference KDIR 2013 and KMIS 2013 Algarve: Scitepress, pp. 389-396, 2013, ISBN 978-989-8565-75-4.
15. Pilková, A. Kovačičová, Z. Holienka, M. Rehák, J.: *Podnikanie na Slovensku: vysoká aktivita, nízke rozvojové ašpirácie*; Bratislava: Univerzita Komenského v Bratislave Fakulta managementu, 2012. ISBN 978-80-223-2823-4.
16. Porter, M.E.: *The Competitive Advantage of Nations*, Free Press, New York, NY. 1990.
17. Roper S., Du J., Love J. H.: *The Limits of Open Innovation: Openness and (quasi-) markets in the organization of innovation*, Research Paper 0713, Aston Business School. Birmingham. 2007.
18. Tidd, J., Bessant, J.: *Managing innovation: Integrating technological, market and organizational change.* 2005.
19. Van de Vrande, V., de Yong, J.P.J., Vanhaverbeke, W., de Rochemont, M.: *Open innovation in SMEs: Trends, motives and management challenges*. Technovation 29, 2009, 423-437.
20. Will, M.: *"Intellectual Capital Management and Strategy Development in European SME – An Integrated Approach"*, Paper prepared for the First International Doctoral Consortium on Intellectual Capital Management, Paris, May. 2008.

Primary Paper Section: A

Secondary Paper Section: AE, AH

ECONOMIC STRUCTURE AND REGIONAL LABOR PRODUCTIVITY DIFFERENTIALS IN POLAND

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Abstract: The aim of the paper was an attempt to verify the impact of the regional industry-mix on the large regional disparities observed in the levels of the regional labor productivity in Poland. The analysis was carried out using a modified shift-share analysis method. Obtained results showed that in the majority of Polish regions importance of industry mix component in shaping the diversity of labor productivity was very limited. Large regional disparities in regional levels of labor productivity may therefore resulted from internal factors affecting the competitiveness of individual regions.

Keywords: labor productivity, regional disparities, shift-share analysis.

1 INTRODUCTION

An increasing number of regional studies, including economic studies, is connected both with uneven distribution of production factors within a region and also uneven efficiency in utilization of the production factors. As a result we can observe the increase in the diversity of economic performance of regional economies. One of the aspects of this diversity is high level of regional labor productivity differentials.

Because of existing and even increasing differences in regional labor productivity in Poland the main aim of presented paper is an attempt to verify the impact of the regional industry-mix on the large regional disparities observed in the levels of the regional labor productivity across Poland. In order to verify the role of the particular industry-mix for the regional labor productivity level, a modified shift-share analysis method will be conducted. This method will allow to check if industry-mix observed in particular regions had significant impact for regional labor productivity differentials.

The rest of the paper is structured as follows: in the section 2 previous results concerning the role of industry-mix for the regional labor productivity differential will be presented. Section 3 discusses the data and the scope of regional labor productivity differentials in Poland. Section 4 describes used model and obtained results. A short conclusion will be presented in section 5.

2 PREVIOS RESULTS

The existing literature concerning determinants of regional productivity differentials, indicates that one of the potential source of observed differentials is regional industry-mix.

The study conducted by Estban [2000, p. 253-364] for chosen regions from European Union and countries such as Belgium, France, Italy, Portugal and Spain and performed for 6 sectors elucidated the extent to which existing regional inequality in labor productivities can be attributed to differences in the sectoral composition of activities, rather than to productivity gaps that are uniform across sectors. The obtained results showed that regional specialization has a very minor role and that interregional differences can be explained by uniform productivity gap only. Similar results were presented by Di Giacinto and Nuzzo [2005, p. 1-31]. They attempted to do progress in the empirical explanation of wide labor productivity differentials across Italian regions. In first step they used shift-share technique in order to assess the role of the industry mix in determining such disparities. Their findings suggest that composition effects appear to justify only about one third of the productivity gap suffered by the Italian regions and the most important drivers of labor productivity were industry-by-industry productivity disparities caused by different level of R&D investment, transport infrastructure, the efficacy of political and social institutions, agglomeration economies, financial markets development and geographical factors. Ezcurra et al. [2005, p. 679-697] in the study conducted for 197 NUTS2 regions belonging to 15 European Union Member States in the period of 1977-1999 tested for the respective roles of regional and sectoral factors in productivity convergence in the analyzed countries. An analysis based on methodology involving a combination of shift-share technique showed that the greatest contribution to overall inequality in production per worker in the European Union can be attributed mainly to the regional component, industry mix, therefore, appears to have contributed relatively little to regional dispersion in average productivity over the 23 years covered by the study.

Yang and Lahr [2008, p. 1-31] using multiregional input-output tables and disaggregated employment data, decomposed change in labor productivity growth for seven regions of China between 1987 and 1997 into five partial effects – changes in value added coefficients, direct labor requirements, aggregate production mix, interregional trade, and final demand. They found that the increase of labor productivity for regions and sectors in China mainly comes from the decreasing labor input per unit of gross output and from changes in value added share of gross output. The aggregate production mix, interregional trade, and final demand also have important but smaller effect on most of regions in China. Decker et al. [2009, p. 1-10] examined the determinants of state labor productivity in USA during the 1989 to 2000 period. They estimated their model for two sub-periods (1989 to 1995 and 1996 to 2000) in order to isolate the labor productivity boom of the late 1990s. The obtained results indicate that the determinants of labor productivity changed during the productivity boom of the late 1990s. During the period 1996 to 2000 greater industrial diversity appeared to have stimulated labor productivity, whereas in the earlier period, 1989 to 1995, specialization promoted labor productivity. The changes in industry mix as potential source of regional disparity during 1990s in China was also confirmed in a study conducted by Li and Haynes [2010, p. 1-29]. This study was performed for the three major economic sectors, agriculture, manufacturing, and services from 1995 to 2004.

3 DATA AND SOURCES

The verification of the importance of regional economic structures on the regional disparities observed in the levels of the regional labor productivity in Poland was conducted with the use of data collected from the Local Data Bank prepared by Central Statistical Office of Poland. The period of the analysis due to the lack of more recent data was constrained to the period 2006–2011. The study was conducted for 16 Polish regions in accordance with NUTS2 standard (in case of Poland regions remain corresponding to a voivodeships) and in decomposition for the three major economic sectors, agriculture, manufacturing, and services. This classification was developed by Fisher [1933] which decompose the economy into: primary sector, consisting of agriculture, secondary sector, formed by industry and the tertiary sector, incorporating all other activities that did not fit in the first two sectors. Clark [1940] began to use the term "services" to apply to all activities of the tertiary sector, treating it as a complement to other sectors. The author of the paper decided to compute the regional level of labor productivity independently. The level of regional labor productivity for each sector was calculated as the relation between regional gross value added for particular sector and employment in this sector. Thus, the mean regional labor productivity was calculated as mean of labor productivity for each sector weighted by the employment shares for each sector.

The high level of regional inequality in labor productivities in Poland in analyzed Period was confirmed by the Gini coefficient

(The Gini coefficient measures the inequality among values of a frequency distribution for example levels of income or productivity) and coefficient of variation (see Table 1 and Figure 1).

Table 1. The variation of regional labor productivity in Poland

	Gini coefficient	Coefficient of variation
2006	0,126	22,98%
2007	0,128	23,11%
2008	0,125	22,21%
2009	0,128	22,86%
2010	0,134	24,36%
2011	0,131	23,63%

Source: Own estimation, based on data from Central Statistical Office of Poland.

Figure 1. Regional labor productivity in Poland in 2011

Source: Own estimation, based on data from Central Statistical Office of Poland.

As we can see on the table 1 the value of Gini coefficient ranged in analyzed period from 0,12 to 0,13. In the countries where the level of inequalities in the regional labor productivity is the highest (for example United States, Turkey, Mexico) the value of this indicator was ca. 0,26, on the other hand in the countries with the lowest level of disparities (Denmark, Sweden) the Gini coefficient had a value of 0,04 [OECD 2008, s. 64]. The large regional differences in the level of labor productivity in Poland was also confirmed by the high value of the coefficient of variation – ca. 23% in analyzed period.

Such high inequalities come from differences in the levels of labor productivity in individual voivodships. Figure 1 presents the regional labor productivity in the comparison to the average value for Poland (Poland = 100) in 2011. The highest level of labor productivity was observed in Mazowieckie voivodship (the labor productivity amounted to 144% of the national level). The high, above the national average, levels of regional labor productivity has been observed also in voivodships such as Dolnośląskie, Pomorskie, Śląskie and Wielkopolskie. The lowest levels of labor productivity, under the 70% of the national average, was observed in voivodships such as Lubelskie, Świętokrzyskie and Podkarpackie.

4 DATA AND SOURCES

In order to verify the potential role of the industry-mix observed in particular region, for the existing differences in labor productivity levels in Polish regions the modified shift-share approach proposed by Estban [2000] was utilized. This method allows to assess the extent to which the different regional specialization (sectoral composition of activities) affects the regional labor productivity.

The shift-share analysis was originally proposed by Dunn [1960], as a forecasting technique for regional growth of employment (regional employment dynamics). The essential idea is to analyze the extent to which the difference in growth between each region and the national average is due to the region performing uniformly better than average on all industries or to the fact that the region happens to be specialized in fast growing sectors. Later Estban [1972] modified the standard two factor decomposition and extend it to the sum of three components. The first component named structural, indicates the growth share attributable to the particular industry-mix of particular region. The second one named differential, measures the part due to the region growing faster at the sectoral level (due to internal factors). Finally, the third component named allocative, measures the covariance between two previous components. This can be interpreted as the contribution to the regional growth deriving from its specialization in those activities where region is most competitive.

Even contemporary researches use the shift-share technique in order to verify sources of regional employment dynamics. You can find recent application to the Poland for example in Batóg and Batóg [2007], Kudłacz [1998] or Woźniak [2010].

As we can find in Estban [2000, p. 5] even though the shift-share analysis was originally considered as a technique to analyze the regional employment dynamics, it is quite straightforward to extend it to the decomposition of interregional aggregate productivity differences. Aggregate average productivity per worker is the weighted sum of the productivities at the sectoral level. Thus, a particular region can have an aggregate productivity per worker above the mean because of two reasons (or a combination of both). On the one hand, it can be that in all, or most, sectors this region has a productivity per worker above the mean. On the other hand, it can be the case that sectoral productivities are not different from the mean, but that this region is specialized in those sectors with higher productivity per worker. For instance, the average productivity in agriculture, in industry or in the service sector could be identical across the EU regions. Yet, the regions specialized in industry would have an aggregate productivity per worker higher than those specialized in agriculture.

The presented above assumptions can be formally written as follows. See also Estban [2000, p. 1–15], Di Giacinto and Nuzzo [2005, p. 1-31], Jiang et al. [2014, p. 1-31]. Letting p_i^j denote sector's j share of employment in region i that $\sum_j p_i^j = 1$, for all regions i, thus p^j denote the Polish mean sectors's j share observed at national level. Similarly, by denoting x_i^j and x^j as sector's j output per worker, respectively for region i and for the whole country. The aggregate labor productivity can be computed as an employment weighted average of productivity at the industry level, which for the particular region can be denote as $x_i = \sum_j p_i^j x_i^j$ and for the whole country as $x = \sum_j p^j x^j$. The differences in labor productivity between region i and the national average $(x - x_i)$ can be viewed as the sum of three different effects [Estban 2000, p. 6].

The first assumes that differences in the regional labor productivity could be caused by the industry-mix component μ_i of region i. Which measures the differential productivity accruing from region i sectoral composition, once we assume that the sectoral productivities in each Polish region is the same. Formally we have:

$$\mu_i = \sum_j (p_i^j - p_j) x^j \quad (1)$$

μ_i takes positive values if the region is specialized $(p_i^j > p_j)$ in sectors with high productivity at the national level (for example services) and despecialized $(p_i^j < p_j)$ when most of activities are focused in the sectors with low productivity (for example agriculture). The μ_i component takes value equal to 0, if the regional industry-mix would be equal to the national one.

The second, differences in regional labor productivity could be caused by the intra-industry differences π_i. This component focuses on the contribution of intra-sectoral productivity differences to the shift between regional and national average productivities. Here, it is assumed that the region's economic

structure coincides with the national average and, formally can be written as follows:

$$\pi_i = \sum_j (x_i^j - x^j) p_j \quad (2)$$

π_i takes positives values, if the particular region has bigger values of productivities in the given sector than the national average ($x_i^j > x_j$) and negative values in the opposite situation. The component is equal to 0 if the sectoral labor productivities in particular region coincides with the national average ($x_i^j = x_j$).

The third of analyzed components , potentially important in explaining differences in the regional labor productivity, is a combination of the two previous effects and measures the efficiency of each region in allocating its resources over the different industrial sectors. The allocative component can also be viewed as measuring the co-variance between sectoral specialization and productivity advantages. Formally we have:

$$\alpha_i = \sum_j (p_i^j - p_j)(x_i^j - x^j) \quad (3)$$

α_i is positive if the region is specialized, relative to the national average, in sectors whose productivity is above Polish average and negative if below.

The sum of three different effects, can be write as follows:

$$x_i - x = \mu_i + \pi_i + \alpha_i \quad (4)$$

In equation (4) the gap between regional and national average productivities is decomposed additively into the three components. Each component aggregates one source of potential regional productivity differentiation.

5 RESULTS

The results of the analysis of the source of exiting differences in regional labor productivity across Polish voivodeships was presented in Table 2. According to the presented results, it could be concluded that in the most of Polish voiewodshieps for the differences in labor productivity were responsible the intra-industry differences, described as π_i .

The only exception was Śląskie voivodeship, where the difference in labor productivity could be explained in the analyzed period by the specialization in the sectors with the higher productivity levels (manufacturing and services). In the first 2 years of analysis (i.e. 2006 and 2007) also in Dolnośląskie and Zachodniopomorskie voivodeshieps for the bigger than average labor productivity levels responsible was a specialization in the sectors with higher than average labor productivity level.

However, in subsequent years in the Dolnośląskie voivodeship there was a significant increase of the labor productivity level, which was not associated with the change in the sectoral structure of the economy. The particular industry-mix was also an important factor responsible for the level of the labor productivity below the national average in the Lubelskie, Siwętokrzyskie and Podkarpackie voivodeshieps. It was caused mainly by high share of agriculture (above 30%) in the regional industry-mix.

The results also indicate that the least important component was α_i, which describe the efficiency of each region in allocating its resources in the sectors with higher than an average labor productivity.

It can be concluded that, the most important component responsible for the inequality in the regional labor productivity in Polish regions were the intra-industry differences. These differences could be caused by the specific for each region set of characteristics affecting the level of labor productivity, i.e. internal competitiveness of the region. On the other hand, meaning of industry-mix specific for each region is very limited.

Table 2. Shift-share analysis result

	2006				2007				2008			
	xi - x	η	π	α	xi - x	η	π	α	xi - x	η	π	α
Dolnośląskie	**3,5**	3,8	0,0	-0,3	**6,1**	3,1	3,0	0,0	**8,5**	2,1	5,7	0,6
Kujawsko-pomorskie	**-4,6**	2,0	-2,7	0,2	**-3,0**	2,3	-0,6	0,1	**1,5**	2,7	4,5	0,3
Lubelskie	**30,4**	8,7	23,7	2,0	**32,0**	8,0	26,4	2,4	**30,4**	6,4	26,2	2,2
Lubuskie	**20,9**	2,1	21,4	1,7	**20,9**	1,7	21,2	1,4	**16,3**	1,8	16,7	1,3
Łódzkie	**19,7**	0,4	19,4	0,2	**22,8**	1,9	21,8	0,8	**25,7**	1,6	24,8	0,8
Małopolskie	**14,8**	1,7	13,0	0,2	**11,1**	0,5	10,6	0,0	**10,3**	0,5	-9,8	0,1
Mazowieckie	**47,3**	4,2	40,2	2,9	**44,5**	4,1	37,2	3,2	**38,0**	3,1	32,0	2,9
Opolskie	**-9,7**	1,4	-8,7	0,4	**-6,7**	1,3	-5,9	0,4	**-7,1**	0,4	-7,2	0,4
Podkarpackie	**26,4**	5,2	21,6	0,4	**27,6**	5,5	22,6	0,4	**28,1**	4,3	24,5	0,7
Podlaskie	**14,5**	6,1	11,1	2,7	**17,1**	4,8	14,3	2,0	**22,0**	5,0	19,4	2,4
Pomorskie	**16,0**	2,9	12,5	0,6	**11,3**	3,0	8,4	0,0	**7,4**	3,5	4,2	0,3
Śląskie	**6,1**	4,0	1,7	0,4	**7,7**	4,4	3,3	0,0	**9,3**	4,3	5,9	0,8
Świętokrzyskie	**24,2**	8,9	15,7	0,4	**26,3**	8,6	18,6	0,9	**24,9**	6,4	19,9	1,5
Warmińsko-mazurskie	**19,4**	0,4	19,6	0,2	**22,1**	0,3	21,8	0,7	**22,6**	0,3	22,3	0,5
Wielkopolskie	**3,6**	1,3	5,6	0,8	**6,8**	1,7	8,8	0,3	**12,9**	2,5	16,1	0,6
Zachodniopomorskie	**5,9**	4,9	3,1	2,1	**9,2**	5,2	6,9	2,9	**9,4**	4,9	7,1	2,6
	2009				**2010**				**2011**			
	xi - x	η	π	α	xi - x	η	π	α	xi - x	η	π	α
Dolnośląskie	**11,6**	2,3	8,3	1,0	**13,1**	2,8	9,4	1,0	**19,5**	2,7	15,6	1,3
Kujawsko-pomorskie	**11,4**	1,6	10,2	0,4	**10,1**	1,0	-9,2	0,1	**-8,4**	1,2	-7,4	0,3
Lubelskie	**32,5**	6,0	29,0	2,5	**33,9**	6,4	30,6	3,1	**32,8**	6,2	29,7	3,1
Lubuskie	**14,2**	2,5	14,5	2,2	**21,3**	1,9	21,2	1,9	**21,0**	1,8	20,5	2,3
Łódzkie	**24,7**	0,5	24,3	0,1	**22,6**	0,6	22,1	0,1	**23,2**	0,8	22,6	0,2
Małopolskie	**-8,8**	0,9	-7,8	0,1	**-9,3**	0,9	-8,3	0,1	**-9,6**	0,6	-8,8	0,1
Mazowieckie	**41,0**	3,5	35,3	2,2	**50,1**	3,3	44,7	2,1	**46,7**	2,9	42,0	1,8
Opolskie	**10,6**	1,1	-9,4	0,2	**10,2**	1,2	-8,7	0,3	**10,3**	1,3	-8,6	0,3
Podkarpackie	**29,3**	4,7	25,3	0,7	**28,5**	5,1	23,8	0,3	**27,6**	5,1	22,4	0,1
Podlaskie	**21,2**	5,9	18,5	3,1	**21,7**	4,4	20,3	3,0	**22,4**	4,3	20,9	2,9
Pomorskie	**12,2**	2,7	9,6	0,2	**6,2**	3,0	3,9	0,7	**9,2**	3,3	6,7	0,7
Śląskie	**6,6**	3,6	4,1	1,1	**7,2**	3,6	3,2	0,4	**1,6**	3,3	-1,6	0,2
Świętokrzyskie	**26,8**	4,9	23,5	1,6	**33,5**	5,5	29,9	1,8	**33,2**	6,4	28,4	1,7
Warmińsko-mazurskie	**22,0**	0,6	22,2	0,4	**23,1**	0,1	22,9	0,3	**19,5**	0,4	19,0	1,0
Wielkopolskie	**16,1**	3,3	20,1	0,8	**6,5**	2,4	9,3	0,3	**5,8**	1,6	7,5	0,1
Zachodniopomorskie	**1,6**	3,8	0,2	2,4	**4,5**	3,0	2,6	1,1	**6,3**	3,0	4,3	1,0

Note: The result was shown in percentage differences with respect to Poland, Poland =100.

Source: Own estimation, based on data from Central Statistical Office of Poland.

5 CONCLUSION

The aim of present study was an attempt to verify the impact of the regional industry-mix on the large regional disparities observed in the levels of the regional labor productivity across Poland. This diversity remained at a high level throughout the entire analyzed period. The conducted empirical study conducted with the use of modified shift-share technique has shown that the role of different industry mix was very limited (the exception were Śląskie, Dolnośląskie, Zachodnipomorskie, Lubelskie, Podkarpackie and Świętkorzyskie voivodeshieps). The important conclusion which can be made based of obtained results is that the state policy should be aimed at boosting the internal competitiveness of the regions. The exception are Lubelskie, Świętokrzystkie and Podkarpackie voivodeships where the change of the sectoral structure of the economy could be important for lowering of the labor productivity differentials. An important addition to the conducted studies could be boarding the research period and analysis made for a more comprehensive sectoral structure of the economy.

Literature:

1. Esteban J., (2000), *Regional convergence in Europe and the industry mix: a shift share analysis*, Regional Science and Urban Economics 30, pp. 353-364.
2. BANK DANYCH REGIONALNYCH, available at: www.stat.gov.pl, date of view: 30 august 2014 r.
3. Di giacinto, V., Nuzzo G., (2005) *Explaining labour productivity differentials on Italian regions*, Bank of Italy, Economic Research Unit, pp. 1-31.
4. Benito J., Ezcurra R., (2007) *Spatial disparities in productivity and industry mix: The case of the European regions*, Urban Studies January 1, 44, pp. 99-122.
5. Yang L., Lahr M., (2008), *Labor Productivity Differences in China 1987-1997: An Interregional Decomposition Analysis*, The Review of Regional Studies, Vol. 38, No. 3, pp. 319–341.
6. Decker CH., Thompson E., Wohar M., (2009) *Determinants of State Labor Productivity: The Changing Role of Density*, The Journal of Regional Analysis and Policy, JRAP 39(1), pp. 1-10.
7. LI H., Haynes K., (2010) *Economic structure and regional disparity in china: beyond the Kuznets transition*, George Mason University, Research Paper No. 2010-16, pp. 1–29.
8. OECD, (2008) *Regional disparities in labour productivity*, in: OECD Regions at a Glance 2007, OECD Publishing, pp. 64-70.
9. Dunn S., (1960) *A Statistical and Analytical Technique for Regional Analysis*, Papers and Proceedings of the Regional Science Association 6, pp. 97-112.
10. Batóg J., Batóg B., (2007) *Shift-share Analysis of Employment Growth Within the UE Countries in 1999-2005*, in: Competitiveness of Labour Market. Economics and Competition Policy No. 8, Scientific Editor D. Kopycińska. University of Szczecin, Microeconomics Department, Print Group, Szczecin, ss.45-54.

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INTERNAL AUDIT AS A TOOL OF FRAUD MANAGEMENT

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Abstract: Internal audit supports the process of organisation management and contributes to its increased effectiveness. One of its principal goals is detection of errors, including fraud which research shows to be a grave problem to enterprises due to both its rising numbers and value of losses it generates. Internal audit may be a protection against the risk of fraud by examining risks present in an enterprise as well as by evaluating correctness and efficiency of an internal control system. Research demonstrates it is a major source of fraud detection in enterprises analysed in respect of both global regions and company size.

Keywords: internal audit, frauds, management.

Introduction

Control mechanisms, including internal audit, are applied due to occurrence of various irregularities, both premeditated, understood as fraud, and unintended – errors, elements of operational risk in any business. Research proves they are a major issue to all businesses, therefore, internal audit may substantially contribute to improvement of the enterprise management system and effectiveness of business decisions made.

The goal of this paper is to analyse functions of internal audit as a tool of fraud detection. Consequently, the global scale of fraud in 2006-2014 is identified and evaluated and the importance of internal audit in the process of disclosure is analysed with reference to both world's regions and business size.

1. Functions and task of internal audit

The scope and functions of internal audit have evolved over the years. Table 1 illustrates the process on the basis of specialist literature.

Table1 Concept and functions of internal audit

Year	Author	Concept and functions of internal audit
1945	R.B. Milne	A complete financial and operational review as part of a given organisation.
1957	V.Z.Brink, L.B. Sawyer	Internal audit applies mainly to finance and accounting, though also to operations.
1964	R.K. Mautz	Careful selection and presentation of selected interpreted business facts for management to track these facts.
1978	Institute of Internal Auditors	Internal audit is an independent evaluation exercise to assist organisation members with effective discharge of their duties. Its objectives encompass promotion of effective control mechanisms at a reasonable cost.
1998	O.R. Whittington, K. Pany	Supply of reliable operational reports containing other than financial data.
1999	R. Moeller R., H.N. Witt	Checking of arithmetic calculations or existence of appropriate book records, that is, verification of goals achieved.
2000	W. Lück	An independent activity checking and assessing structures and actions inside an enterprise. It audits and supplies analysis, evaluations, recommendations, and information about the structures and actions checked.
2002	R.L. Ratliff, K.F. Reding	Auditors must be prepared to audit anything – operations (including control systems), performance, information and information systems, compliance with law, financial reports, fraud, reporting, environment protection and quality performance.
2003	Z. Rola	Audit is an evaluation of an internal control system and, by comparing the actual to the desirable situation, establishing whether existing procedures are effective, conforming to standards and followed, as well as indications of areas to be improved and suggestions of appropriate actions.
2003	E.J. Saunders	Professional assurance activities, an effective instrument for an organisation's authorities which evaluates effectiveness of the internal control system, risk management processes, correctness of an entity's operations and activities, their correct and standardised processing, accounting and reporting in a pro-active, independent, professional and objective way, generating value by improving quality and efficiency of work. Beside providing such an assurance, internal audit also supplies advice to an organisation.
2003	L.B. Sawyer	Internal audit systematically and objectively assesses activities of internal auditors. It concerns specific operations and control in an organisation which aim to determine whether a risk is identified and minimised, operational and financial information is accurate and true, if external regulations and internal policies are followed, to satisfactorily define operational criteria, effectively attain strategic objectives, and to use resources in a productive, effective and economical manner.
2007	K. Winiarska	Internal audit comprises an examination of activities of both an organisation and its management.
2008	Institute of Internal Auditors	Internal audit is an independent, objectively assuring and advisory exercise undertaken to add value to an organisation and to streamline its activities, support an organisation with attainment of its goals by means of a systematic and disciplined approach to evaluation and improvement of effectiveness of risk management, control and corporate supervision processes.
2012	T. Kiziukiewicz	Internal audit is an instrument that assesses effectiveness of the internal control system and risk management processes, assures effective conduct of any operations and activities, generates benefits by disclosing gaps and weaknesses and by indicating methods for improvement of work quality and productivity in an active, independent and objective way.

Source: The author's own research.

Evolution of internal audit can be divided into five generations [Herban, Stuss, Krasodomska 2009]**:**

1. First generation – before 1980; the audit focused on the internal control system and verification of process conformity with the state documented in procedures,
2. Second generation - 1980 - 1989; the financial risk and areas essential to functioning of an organisation began to be identified and internal control processes were evaluated,
3. Third generation - 1990 - 1998; risk identification was expanded from finances to operations,
4. Fourth generation - 1999 - 2008; active risk management policies, effective auditing; timely recommendations for improvements to risk management processes and internal control system,
5. Fifth generation – after 2009; internal audit as an instrument of improving institutions; control and advisory functions of internal audit; auditing covers all operations of an institution; building of a value system that would concentrate all authorities, functions and staff around it; regarding audit as a management tool with the fundamental objective of improving an institution and its constituent parts at stages of establishment and functioning in its operational and strategic dimensions.

This analysis of the development of internal audit's functions demonstrates it is currently not only a tool of goal verification but also, by evaluating principles of risk management, system of internal control and reliability of financial reporting, it contributes to more effective organisation management, whereby it may become a tool in developing its business performance. As a consequence, may affect the growth of the competitiveness of the company in the market [Wolak-Tuzimek, 2010, pp.93-100; Wolak-Tuzimek, 2006, p.61]. Prevention of broadly-defined errors, including fraud, is an important task of internal audit. It was present both at initial stages of internal audit, when it was expected to verify achieved goals, and at present, when it affects business performance of an enterprise. This is the fundamental objective of internal audit, improved in particular phases of its operation.

2. Characteristic of fraud

Measuring costs of fraud is important yet very difficult. True costs are incalculable as they comprise not only monetary but

also social dimensions (loss of jobs, loss of public trust). In many cases, losses are never disclosed in full. Not all fraud is detected and thus reported. As a result, costs of fraud are measured on the basis of estimates only.

Results of a global survey conducted by the Association of Certified Fraud Examiners (ACFE) in 2006-2014 are used here. The *g*eographical distribution of organisations experiencing losses caused by fraud is presented in Table 2.

Table 2 Geographical Location of Victim Organizations

Region	Number of Cases	Percent of Cases	Median Loss (in $)
United States	646	48.0	100 000
Sub-Saharan Africa	173	12.8	120 000
Asia-Pacific	129	9.6	240 000
Western Europe	98	7.3	200 000
Eastern Europe and Western/Central Asia	78	5.8	383 000
Canada	58	4.3	250 000
Latin America and the Caribbean	57	4.2	200 000
Southern Asia	55	4.1	56 000
Middle East and North Africa	53	3.9	248 000

Source: [ACFE 2014].

The data in Table 2 imply the maximum median loss, $ 383 000, was incurred in East Europe and Asia, a result of the specific nature of the economic systems there, as well as principles of enterprise organisation and absence of control mechanisms to monitor activities and adequately manage risks.

Distribution of losses caused by fraud is shown in Tables 3 and 4. They cannot be summarised in a single table since loss classification was changed in 2010.

Table 3 Distribution of Dollar Losses in 2006-2010 (in %)

Losses in the range ($)	2006	2008	2010
Less than 1 000	1.2	1.9	2.4
1 000 – 9 999	9.1	7.0	7.2
10 000 – 49 999	15.8	16.8	18.4
50 000 – 99 999	11.6	11.2	10.6
100 000 – 499 999	29.1	28.2	29.3
500 000 – 999 999	8.8	9.6	8.4
1 mln and up	24.4	25.3	23.7

Source: The author's own compilation on the basis of [ACFE 2006, 2008, 2010].

Table 4 Distribution of Dollar Losses in 2010-2014 (%)

Losses in the range ($)	2010	2012	2014
Less than 200 000	51.9	56.5	54.4
200 000 – 399 999	12.7	12.8	11.8
400 000 – 599 999	6.9	5.7	6.6
600 000 – 799 999	2.9	3.5	3.4
800 000 – 999 999	1.9	0.7	1.9
1 mln and up	23.7	20.8	21.9

Source: The author's own compilation on the basis of [ACFE 2010, 2012, 2014].

The figures in Tables 3 and 4 indicate losses below $ 200 000 account for more than 50% of all losses, though a more detailed analysis would be more interesting, as shown in Table 3, where losses in the range $ 10 000 – 49 999 can be seen to prevail. A significant share of losses above $ 1m, more than 20% of all losses, can be noted in the entire period under analysis, confirming that examining the risk of fraud is reasonable.
Major types of fraud and their percentage share in the overall amount of losses can be analysed on the basis of the information in Table 5.

Table 5 Occupational Frauds by Category in 2006-2014 (% cases)

Frauds category	2006	2008	2010	2012	2014
Asset Misappropriation	91.5	88.7	86.3	86.7	85.4
Corruption	30.8	26.9	32.8	33.4	36.8
Financial Statement Fraud	10.6	10.3	4.8	7.6	9.0

Source: The author's own compilation on the basis of [ACFE 2006, 2008, 2010, 2012, 2014].

Asset misappropriation is the most common, though its cost is relatively low compared to the total sum of losses. The share of this fraud was 91.5% in 2006 and diminished to 85.4% in 2014. The losses it generates are estimated at $ 135000 in 2010 and $130 000 in 2014. Fraudulent reporting is the rarest, though it causes maximum financial loses. Its relatively narrow share ranges from 10.6% in 2006 to 9% in 2010. However, the losses it generates are estimated at the sum of $ 4 100 000 in 2010 and $1 000 000 in 2014. A declining frequency of the financial statement fraud can be noted, though, between 2006 and 2010 (from above 10% to below 5%), to rise substantially after 2012 (from 7.6% to 9.0%). With regard to value of losses it causes, it can be said that financial statements forged in 2010 were fewer yet involved considerably greater sums. Both the incidence and value of losses decline afterwards, with the latter dwindling far more. In this context, corruption is of a medium incidence (around 30%) and brings distinctly lowest losses (the average estimated loss is $250 000 in 2010 and $ 200 000 in 2014).

3. International audit as a method of detecting business fraud

In accordance with International Standards for the Professional Practice of Internal Auditing, internal auditing should support a business by recognising and assessment of significant risks and contribute to improvement of risk management and control systems.
As early detection as possible is a key element of preventing fraud regardless of the latter's type. ACFE survey suggests tipping is the most common method of detection. It helps to capture fraud in more than 40% cases. Management review and internal audit come second and third as forms of fraud detection, 16% and 14.1% cases, respectively. A strong system of internal control is thus perceived as the most effective tool against fraud. Methods of fraud detection are shown in Table 6.

Table 6 Detection Method of Occupational Frauds in 2006-2014 (%)

Detection Method of Occupational Frauds	2006	2008	2010	2012	2014
Tip	34.2	46.2	40.2	42.3	42.2
Management Review	-	-	15.4	14.6	16.0
Internal Audit	20.2	19.4	13.9	14.4	14.1
By Accident	25.4	20.0	8.3	7.0	6.8
Account Reconciliation	-	-	6.1	4.8	6.6
Document Examination	-	-	5.2	4.1	4.2
External Audit	12.0	9.1	4.6	2.3	3.0
Surveillance/Monitoring	-	-	2.6	1.8	2.6
Notified by Law Enforcement	3.8	3.2	1.8	3.0	2.2
Confession	-	-	1.0	1.5	0.9
IT Controls	-	-	0.9	1.1	1.1

Source: The author's own compilation on the basis of [ACFE 2006, 2008, 2010, 2012, 2014].

These details imply internal audit is a major method of detecting economic crime, though its contribution to fraud detection declines, possibly owing to emergence of new methods (e.g. IT control, supervision), growing importance of the existing ways (e.g. tip), as well as increasing numbers and shifting structure of economic crime that contribute to rising significance of other, more adequate methods.

Rationality of applying specific fraud detection methods can be determined on the basis of values of losses discovered by means of individual methods as well as average times of detection. These are illustrated in Table 7.

Table 7 Median Loss and Median Duration by Detection Method

Detection Method of Occupational Frauds	Median Loss (in $)	Median Duration (in months)
Tip	149 000	18
Management Review	125 000	18
Internal Audit	100 000	18
By Accident	325 000	32
Account Reconciliation	75 000	11
Document Examination	220 000	21
External Audit	360 000	30
Surveillance/Monitoring	49 000	8
Notified by Law Enforcement	1 250 000	30
Confession	220 000	21
IT Controls	70 000	11

Source: [ACFE 2014].

Table 7 shows there are more effective ways of fraud detection than internal audit, in respect of both average value of losses detected and average times of detection. Research suggests these comprise: notification by law enforcement for its highest value of detected losses and surveillance/ monitoring, account reconciliation and IT controls for the fastest loss detection. Internal audit is a major, yet not the most effective method that requires continuing improvement.

It appears importance of detection methods varies depending on business size measured by number of employees and depending on a region of an enterprise's operation. These results are summarised in Tables 8, 9 and 10.

Table 8 Detection Method by Size of Victim Organisation (in %)

Detection Method of Occupational Frauds	<100 Employees	+100 Employees
Tip	34.2	45.1
Management Review	18.8	15.3
Internal Audit	9.8	16.5
By Accident	8.4	6.2
Account Reconciliation	8.2	5.8
Document Examination	7.3	2.4
External Audit	5.4	1.9
Notified by Law Enforcement	2.4	1.9
Surveillance/Monitoring	1.9	2.3
IT Controls	1.6	0.9
Confession	1.1	0.6
Other	0.8	0.4

Source: [ACFE 2014].

Table 8 indicates both organisations employing more than 100 and fewer than 100 workers see the following as key methods of fraud detection: tip, management review and internal audit. Differences relate to effectiveness of these methods, naturally greater in larger organisations, doubtless due to higher numbers of control tools and more formalised and expanded control systems.

Table 9 Detection Method by Region – Europe and Asia (%)

Detection Method of Occupational Frauds	Western Europe	Eastern Europe and Western and Central Asia	Asia Pacific
Tip	39.8	53.8	53.9
Management Review	16.3	10.3	11.7
Internal Audit	12.2	16.7	10.9
By Accident	10.2	5.1	3.1
Account Reconciliation	7.1	3.8	6.3
Document Examination	2.0	1.3	1.6
External Audit	2.0	2.6	3.1
Notified by Law Enforcement	6.1	2.6	2.3
Surveillance/Monitoring	3.1	1.3	2.3
IT Controls	0.0	1.3	1.6
Confession	1.0	1.3	1.6
Other	0.0	0.0	1.6

Source: [ACFE 2014].

Table 10 Detection Method by Region – America and Africa (%)

Detection Method of Occupational Frauds	Canada	USA	Latin America and the Caribbean	Middle East and North Africa
Tip	43.9	38.4	36.8	35.3
Management Review	19.3	18.4	14.0	15.7
Internal Audit	3.5	13.1	22.8	33.3
By Accident	8.8	8.2	7.0	5.9
Account Reconciliation	8.8	5.3	7.0	3.9
Document Examination	5.3	5.9	3.5	0.0
External Audit	3.5	4.0	1.8	0.0
Notified by Law Enforcement	1.8	2.0	3.5	0.0
Surveillance/Monitoring	5.3	2.5	1.8	2.0
IT Controls	0.0	1.1	0.0	3.9
Confession	0.0	0.6	1.8	0.0
Other	0.0	0.5	0.0	0.0

Source: [ACFE 2014].

The results in Table 9 and 10 imply three methods of fraud detection are prevalent in virtually all regions. These are: tip, management review and internal audit. Like in respect of impact of organisation size on methods of fraud detection in place, their effectiveness also varies depending on degrees of their development and methods of application employed. Internal audit is of maximum significance in the Middle East and North Africa – 33.3% of fraud detected, Latin America and the Caribbean – 22.8%, and Eastern Europe and Western and Central Asia – 16.7% of detected economic abuse.

Conclusion

Internal audit has evolved over the years and is currently a tool of managing economic performance of an organisation. This is made possible by evaluating business effects of its operation, i.e. costs and benefits and their effect on the environment, as well as by using internal audit as a method of fraud detection.

Internal audit is currently exercised as a method of fraud detection – of approximately 14% of all fraud. Tipping (more than 40%) and management review (around 15%) were seen as more effective ways of detecting fraud.

Research suggests internal audit is not the most effective method of fraud detection - notification by law enforcement is found more effective for the value of losses discovered and surveillance/ monitoring, account reconciliation and IT controls for the shortest durations of fraud detection.

The research undertaken shows selection of fraud detection methods is not determined by a region of an organisation's operations. Area of operation (region) influences effectiveness of fraud detection methods applied, on the other hand. Internal audit is of key importance in the Middle East and North Africa (33.3% of fraud detected), Latin America and the Caribbean (22.8%), and Eastern Europe and Western and Central Asia (16.7% of detected abuses).

The research demonstrates effectiveness of fraud detection methods in place is determined by business size. It is greater in larger enterprises which employ more than 100 people than in organisations of fewer than 100 employees. This is doubtless due to higher numbers of control tools and more formalised and expanded control systems in place there. Company size does not affect the range of fraud detection methods in use, though.

It can be concluded that internal audit is clearly an important method of fraud detection which requires improvements, particularly in small businesses, however.

Literature:

1. HERBAN A., STUSS M., KRASODOMSKA J.: *Audyt wewnętrzny jako narzędzie wspomagające efektywne nadzorowanie korporacji.* Kraków: Wydawnictwo Uniwersytetu Jagiellońskiego, 2009. 155 p. ISBN 978-83-233-2730-1.
2. KIZIUKIEWICZ T.: (ed.) *Zasady audytu wewnętrznego w sektorze finansów publicznych.* Warszawa: Difin. 2012. 478 p. ISBN 978-83-7641-568-0.
3. LISIŃSKI M.: *Audyt wewnętrzny w doskonaleniu instytucji*. Warszawa: Wydawnictwo Polskie Encyklopedyczne, 2011. 405 p. ISBN 978-83-208-19144.
4. LÜCK W.: Die *Zukunft der Interne Revision. Entwicklungstendenzen der Unternehmeninternen Uberwachung.* Berlin: Erich Schmidt Verlag, 2000. 107 p. ISBN 978-3-503-04892-2.
5. MAUTZ R.K.: *Fundamentals of Auditing.* New York: John Wiley&Sons Inc. 1964. 109 p. ISBN 978-047-157-78-50.
6. INTERNATIONAL STANDARDS OF PROFESSIONAL PRACTICE INTERNAL AUDIT. Altamonte Springs: The Institute of Internal Auditors, 2011.
7. MOELLER R., WITT H.N.: *Brink's Modern Internal Auditing.* New York: John Wiley&Sons Inc., 1999. 167 p. ISBN 3-9000-51-07-0.
8. RAMAMOORTI S.: *Internal Auditing: History, Evolution and Prospects*. In: Research Opportunities in Internal Auditing. Altamonte Springs: The Institute of Internal Auditors, 2003. 24 p. ISBN 0-89413-498-1.
9. RATLIFF R.L., REDING K.F.: *Introduction to Auditing: Logic, Principles and Techniques.* Altamonte Springs: The Institute of Internal Auditors, 2002.

10. ROLA Z.: *Kontrola wewnętrzna, kontrola finansowa i audyt w jednostkach sektora finansów publicznych.* Ostrołęka: ALPHApro, 2003.134 p. ISBN 839-197-610-6.
11. SAUNDERS E.J.: *Audyt i kontrola wewnętrzna w przedsiębiorstwach.* Częstochowa: PIKW S.A., Educator, 2003. 34 p. ISBN 978-839-223-97-27.
12. SAWYER L.B., DITTEHOFER M.A., SCHEINER J.H. :*Sawyer's Internal Auditing.* Altamonte Springs: The Institute of Internal Auditors, 2003.
13. WHITTINGTON O.R., PANY K.: *Principles of Auditing.* Boston: Irwin McGraw Hill, 1998.243 p. ISBN 0-256-16779-6.
14. WINIARSKA K.: *Internal audit w 2007 roku. Standardy międzynarodowe – Regulacje krajowe.* Warszawa: Difin, 2007. 266 p. ISBN 978-83-7251-722-7.
15. WOLAK-TUZIMEK A.: *Determinanty rozwoju małych i średnich przedsiębiorstw w Polsce*, PWN, Warszawa 2010. 93-100 p. ISBN 978-83-01-16332-7.
16. WOLAK-TUZIMEK A.: *Uwarunkowania rozwoju polskich przedsiębiorstw*, Politechnika Radomska, Radom 2006. 61p. ISSN 1642-5278.
17. *REPORT TO THE NATION ON OCCUPATIONAL FRAUD AND ABUSE*. Austin: Association of Certified Fraud Examiners, 2014.
18. *REPORT TO THE NATION ON OCCUPATIONAL FRAUD AND ABUSE*. Austin: Association of Certified Fraud Examiners, 2012.
19. *REPORT TO THE NATION ON OCCUPATIONAL FRAUD AND ABUSE*. Austin: Association of Certified Fraud Examiners. 2010.
20. *REPORT TO THE NATION ON OCCUPATIONAL FRAUD AND ABUSE*. Austin: Association of Certified Fraud Examiners. 2008.
21. *REPORT TO THE NATION ON OCCUPATIONAL FRAUD AND ABUSE*. Austin: Association of Certified Fraud Examiners. 2006.

Primary Paper Section: A

Secondary Paper Section: AH

PROCESS MAPPING AND FEASIBILITY OF IT´S PRACTICAL IMPLEMENTATION WITHIN THE PUBLIC ADMINISTRATION IN SLOVAK REPUBLIC

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Abstract: This article deals with the process mapping which is applied as a tool improving the effectiveness of public administration. The aim is to summarize the theoretical learning and to propose the recommendations improving the existing status. The author summarizes the gained theoretical knowledge from the field where he focuses mainly on process classification and process management. Author performed a pilot NPS survey and analyses the key outcomes. As well he formulates the recommendations with the aim to drive the process improvement and optimization in the public sector.

Keywords: public administration, process mapping, financial effectivity, process management, process improvement, customer satisfaction, net promoter score.

1 Introduction

The public administration in Slovakia is influenced by number of the factors affecting its operation. We may report the multifactorial influence or the specific factors as in particular the innovations, new technologies, economical, organizational and managerial ways of guidance and so on. Many trends and changes are directly impacting the activities of the public administration organizations and represent new challenges which the public administration has to deal with. And then it is only the matter of the particular organizations, management and the emploeés how they approach the issue.Our article presents the trend concerning the transition from the functional management to the process management within the public administration. The trend substantially consists of the process mapping and its subsequent optimization emphasising the positive economical aspect leading to the inside of the organization where, on one hand, we are talking mainly about the process ownership, economical contribution, advisability, transparency, efficiency of the respective actions and on the other hand, we are talking about the direction outside to the specific output in the form of satisfied clients, the consumers of the service provided by the public administration bodies in selected authorities within Slovakia.

1.1 Process and the process mapping

There are many definitions of the process and we are choosing the definition actual for the self-government. According to Nenadál (2001) and team the process is a limitted group of mutually linked working activities of predefined inputs and outputs. Its commencement and the end are clearly and acurate defined. The inputs always represent the defined input parameter and the outputs are the result of the process activities. The initiation of the process, its running activity and the process end are specified and the same another related sequent processes. The outputs need to be compared: real versus required. In terms of gaining the rational results and giving the satisfaction to the customers - citizens it is necessary to manage the processes. The key tool of understanding the flow of the processes is the mapping of them. The process maps provide us with a complex scheme of the process and in particular it is shown in mutual connections. The process mapping is the communication tool of the process management (Fiala, J., Ministr, J., 2003, p.89). The process map shows the description of the processes, the inputs and the outputs, and the parameters monitoring the processes. During the process mapping as per Šmída (2007) we strive to find especially the following: The role of the process, its products and whom they are assigned to, where and by what the process starts and terminates, what processes are mutually connected and how they are interlocked, the flow of basic sub-processes and of their activities, the sections where the process is taking its course, the inputs consuming by the process (including IT), the inputs and the outputs of any activity, the responsibility for the activities, the sub-processes and the processes.

A process map shows the input-output relations of the process activities and the bodies. By means of the process sequence chain are executed the activities needed for the inputs transformation to the outputs. (Fiala J., Ministr J., 2003, p. 12). Through the process mapping it is feasible to identify the critical interfaces and the time overlapping the sub-processes. In some cases there are also the weak points, irrational and absent or unnecessary activities. The process map enables the documentation and the understanding of not only the actual process. By the subsequent detailed analysis we may, above all, refer to the inadequacies. And by subsequent implementation of new activities, process steps and proposed solutions or by elimination of unnecessary or ineffective process steps and activities we are able to elaborate a new process map serving as the reference document of specific organizational unit. Basically the process map may be created and modified only by the process owner, or the dedicated process operational team.

The key items of the process mapping according to Fiala and Ministr (2003) are as follows: i. the graphical presentation of the elements (objects, information) and activities (manual or automatic) the purpose of which is the proper and transparent presentation, ii. the process map has to provide the evidence of the activities to be realized by the system and based on the proposed specific system, iii. the process map should be consistent and hierarchic – the main activities on the highest level and the details on the lower levels, iv. logging of any resolution and continuous assessment of the process map development.

The term process mapping, generally indicated as the basic element within the process of transformation from strategic to operational, can be found both in private sphere and in public administration. The lawmaker or the rule maker, eventually the management specifies the desired statuses which are to occur and, in principle, it is transformed to the real life. Then the role of the respective organizations and the organizational units and their employees is to realize the operational activities needed for making the generally defined and desired statuses applicable and executable in practice. The creation of transparent and especially correct process maps is realized by utilization of the graphical presentation. In contrast to the verbal description the graphical presentation is more formal and of higher expectation that the process will be understood by various persons or by operational teams likewise. The process, the activity, impulse and the relation are the basic elements of any model / process map (Řepa, 2007, p. 71).

Several graphical presentations with related methods are in existence. Thus we may report not only simple operational realization but also the sequence of the process activities of high rate of repeatability where the operation assumes the particular activities within concrete situations and not marginalizing the fact, that any situation which may occur cannot be both mapped and described precisely. From that reason it is important to let the operational authority to make the resolutions of the concrete situations and to apply the most appropriate solution for final service customer and currently to respect the terms specified by the lawmaker resp. the rule-maker. This flexibility of making decisions is considerable mainly in term of the effectiveness since it expects that by providing the reasonable rate of decision-making of the concrete situation enable more effective, better and faster decision and will avoid the stalemate situations when the employee could not know the fix or he could not realize the action as far as the process does not expect it.

At this stage we would like to highlight the Capability Maturity Model Integration (CMMI) which divides the processes of the organizations according to the level of its maturity. Not existing: no process exists and the organization does not notice any problem. Under occurrence of the respective actual situations the reactions of the organization and its units are

spontaneous. Incidental: is disposed by any organization with undefined own processes. The activities are solving by ad-hoc approach and based on the respective officers knowledge. Presumably it is possible to see the problems. It is objective that the organization is successful only at the cost of enormous working effort of the individuals. Repeatable: only intuitive – an effort to create the standard processes exists. There are identified the main characteristics of the performance of the processes to be realized. Formalized: Defined and described are the courses of activities and the same of the inputs and of the outputs. Possible problems among the activities are solved during the definition of the process and not at the termination of it. Measurable: an added management and control process. The real data on the process running are collected and resulting in the measures determined by the management. Optimized: the process is of the best probable state thanks to continuously improving processes and thanks to the observation of the best practices within other organizations. The source of the activities intended to optimize and to eliminate the failures and the causality is the standard component part of the process (Basl, 2008, p.115).

1.2 Process management and it´s contribution to public administration

The contributions of the process managing are manifesting in all sections of the organizations within the public administration. So that the organization could be successful the process management must be implemented by it and its employees need to be allowed to improve and to amend the working processes creating the basis of overall increased efficiency of the organization regardless of either private or the public sphere. The transition from functional management to the process management is the assumption of it. In generally may be stated that it is needed to provide the individuals, the operational teams or the groups within the organization or out of it, with the access to the relevant information and with the ability to measure, analyze and then to evaluate the results of implemented processes tending to the achievement of the aims of the organization in general. The aim of the organization activities should motivate the individuals or the operational teams to eliminate the surplus, unnecessary and ineffective process activities but rather to perform the critical and important process activities and to make it more effective for the purpose of the faster gaining of the aim. The top management of the organization has to define the clear long-term and short-term strategies so that the individuals could identify the aims and may perform the change from the strategic to operational. The practice shows the examples where the process changes are tested by small so called pilot teams. These teams are sufficient for making the statement regarding the success of the process change and they review the desired or non-desired results. The small in advance specified sample is enough for testing of all relevant activities and for reporting the found measurements, methods, results and the costs that may be, where necessary, applied within the larger organization the process alteration is designed for. The efficiency of applied processes has to be monitored and measured continuously on defined interval basis. If a positive trend occurs it needs to be analyzed and quantified backwards – the need of the route cause analysis. The critical step which represents the highest contribution must be appointed and consecutively repeated to validate it is not an incidental event. In case of the negative trend the critical activity of the existing process needs to be changed. After that we can continue to measure further results. Consequently we may essentially state if the aim is completed or if it is not completed.

Pursuant to BPI manual with creating the processes it is necessary to follow several principles as per so called SMART methodology. In particular to enforce the fact that the aim we are striving to reach through the process should be; i.: specific- we are able to specify its term and to identify it; ii.: measurable – the conditions and the tools of measurement must be created and then it is possible to report the results of the activities; iii.: achievable – the defined goal should be obtained by us through chosen working practice; iv: realistic – the aim should be obtainable under either existing conditions or under the conditions altered by the process; v: time bound– the period of our striving to obtain the goal should be timely limited.

2. Net promoter score (NPS) as a process improvement tool

According to Owen and Brooks (2008) the net promoter score (NPS) may be defined as the most progressive methodology of the observation of the loyalty. The NPS initially represented an important task implemented in the observation of the companies and their client mutual relations. The pioneer of the net promoter approach Reichheld (2003) stated that this enabled to express what lot of companies intuitively understood, that within their client basis exist the persons contributing the growth of the company by their both purchasing behaviour and their recommendations (the promoters); and another person's preventing the growth of the company by their negative recommendations (detractors) and finally the persons representing the unrealized opportunity (passive promoters). We assume that this methodology is feasible within the public administration too. Particularly the task of NPS is to find the reasons of the client dissatisfaction and then through the specific measures to contribute the remedy, the improvement and the consistent growth.

Thus the NPS is not a terminal station and it is an indicator enabling to initiate the measures tending to the improvement of the internal processes openly influencing the overall future clients´ satisfaction. It is feasible based on gained both the respective figures and the clients´ feedback. The public administration does not produce the specific commodities but it provides the service. In particular it is important to make a qualitative analysis of the provided service. The way of providing the service is not settled by the legislation. The legislation arranges only the fact that the service has to be provided or that it may be provided. The basic difference in comparison to the private sphere is that the citizen, in most cases, may not choose the provider of the service optionally. The citizen is entirely dependent on the authorized body. As the citizen/client has mostly no alternative option it may be named as quasi „market monopoly position of the public administration body„. In contrary to the private sphere the public administration authorities are not competitive. The public administration authorities primarily are not tending either to the generation of the profit or to the economic growth. Consequently the practice does not show that the clients dissatisfied with one office shall turn to the office with better reference or to another one with what the clients´ previous experience was positive.

Tab. 1: Key differences/similarities between public administration and private sector in terms of NPS approach

Key differences /similarities	
Private sector	*Public administration*
Growth	The growth cannot be measured
Competition	Very limited competition
Process approach	Lack of process approach
Effectiveness	Effectiveness
Loyalty	Very limited possibility to measure loyalty
Customer satisfaction	Customer satisfaction
Inclusion of employees	Inclusion of employees
Efficiency	Efficiency
Inclusion of clients	Inclusion of clients
Quality	Quality
Managerial functions	Managerial functions
Innovations	Innovations

Source: Author´s elaboration

The table 1 shows our opinion regarding the key differences/similarities of both sectors especially we want to expand on the competition piece at this stage. In general we cannot say that there is absolutely zero competition in public sector. We have to consider the specifics of the authorities which are dealing with social service facilities. Let´s take the example of the retirement homes. Most frequently the founder is a certain regional authority. This authority may both to define and to implement its own original end to end concept of a retirement home. Such concept may differ from other concepts in a positive

or negative way. As well a retirement home is not bounded with territorial or material scopes. With that said a pensioner can freely decide only based on his own judgment or available references if the particular retirement home satisfies his needs and/or the desired standard of services. On the other hand a building authority cannot implement its own concept neither can acquire citizens from other districts. Pursuant to the provisions of law a building authority has to provide a service within a particular territory and to the specific group of individuals. With that said that the citizen whose permanent residence is the town of Veľké Kapušany cannot deal with the building authority in any other town or district. The Building authority in Veľké Kapušany is the only appropriate authority. Another good example of possible competition between authorities might be the activity in the sphere of the confirmations. Any town authority issues an authentication of a signature. And the notary may do the same. Here we can see a clear mutual overlap of both the private and the public sectors and the possible competition between the authorities. The authorities can be competitive regarding the provided levels of quality and service, required time spent, distance nevertheless with pricing. In our point of view the lower price and the required time spent are the most competitive advantages in comparison to private notaries. In terms of the process approach the private sector especially the transnational corporations are using the process approach in a very good way making sure they are optimizing their processes to meet the customer demands. In the public administration we rarely see this approach in the authorities operations and customer facing roles or departments. On the authority´s side the lack of process understanding and the non-ability properly and simple to explain to the client what needs to be done results in the multiple visits. We believe that the multiple visits increase the costs; required time spent and is decreasing the effectiveness and quality of the particular authority. Our small NPS pilot in Veľké Kapušany presents the fact that the authorities should focus on reduction of multiple contacts needed to fix the clients demand. If a certain case needs one contact to be arranged and we observe that other same cases need significantly more contacts to be closed then the authority has the process issue which needs to be dealt with. The authority needs to apply the root causing to identify the gap and to work on a solution.

Regarding the terms of the loyalty, in our point of view the client has no other choice then to deal with the appropriate authorities according to law with few examples of exceptions we have described earlier. Moreover we believe that the inclusion of clients can be very helpful to the authorities in public administration. The client´s feedback can be and should be used for increasing the quality of the provided service in the way leading to full client´s satisfaction. Many clients are willing to share their experience and are pointing out the process gaps, unnecessary bureaucracy, inefficiency, unwillingness and indifferences of employees in solving the client´s problems, lack of information sharing, lack and level of communication etc. All the above detailed feedback of the clients may improve the functioning of the particular organization. We believe the innovations are crucial for customer satisfaction either. Transfer of the information between the authorities, online databases with necessary up to date information, particular forms available for downloads, ability to arrange at least some matters online etc. need to become a must have otherwise the New Public management will remain only a theory in Slovak republic

2.1. Practical application of the NPS in public administration – applied methodology

The NPS is calculated as the difference between the net promoters and the critics (detractors) of the existing particular company. The promoters and the detractors ratio was found on the basis of the responders representative sample answers to the question "How likely would you recommend the company products and the service to your friends and known persons?" The answers were measured through the scale in the range from 0 (I absolutely do not recommend) up to 10 (I do highly recommend). The responders with the answers 9 and 10 were specified as the net promoters. The responders answering in the range from 0 to 6 were specified as the critics. The responders answering between 7 and 8 were specified as neutral or the passive promoters. Then the overall NPS was calculated through the pattern: NPS = net promoters (%) – critics (%). The range of the NPS values may be between plus 100 and minus 100.

Tab. 2: NPS score of the Town office Veľké Kapušany

NPS=35,3%	*Town Office Veľké Kapušany*	*July-September 2014 N=105*
net promoters		52,3%
passive promoters		30,5%
detractors		17,1%

Source: Author´s elaboration

At Veľké Kapušany Town Office was realized the NPS inquiry from June to September 2014. The sample consists of 105 responders the clients of the Town Office who were asked to complete the anonymous questionnaire of 10 questions right after the termination of the communication with the officer. All completed questionnaires were scanned and filled with the registry. Regarding the answer to the ultimate question „How likely would you recommend the products and the service of the office to your friends and well known persons?" 55 responders i.e. 52,3% indicated the score 9 and 10 (the range was from 1 to 10) where 1 means I should absolutely do not recommend and 10 means I should strongly recommend. These responders were ranked as the net promoters. Other 18 responders i.e. 17,1% answered this question in the range from 1 to 6. These responders were ranked as the detractors. And 32 of responders i.e. 30,5% answered this question in the range from 7 to 8 whereby they were included to the group of either neutral or passive promoters. Veľké Kapušany Town Office overall NPS score = 35,3%.

2.2. NPS pilot project in Veľké Kapušany

Together with Dr. Gyimesi the head of the Town Office Veľké Kapušany we elaborated the questionnaire and then the employees, after finishing their work with client, submitted the questionnaire to the client for the completion. The questionnaire was anonymous and besides other 9 questions it included also the ultimate NPS question utilized at the private sphere questioning: "To what extent would you recommend this office products and service to your friends and well known persons?" The questionnaire consists of 10 questions, 8 of them are of the scale from 1 to 10 and two questions are of yes/no types of answers. In spite of the fact that within the public administration the clients have mostly no option to choose the office arranging their matters we believe that the clients´ answers are of sufficient value for consideration of the extent of the clients´ satisfaction regarding the public administration authority service. Along with the clients´ satisfaction with the service of the authority we were establishing also the opinions of the Hungarian nationality citizens regarding their satisfaction with application of the Hungarian language at Veľké Kapušany Town Office and how many of them are demanding to process their official business in the language of this national minority. This analysis is essential also in relation to legitimacy of stronger striving of Hungarian political representation regarding the strengthening of the national minority member language rights. In close future we want to realize other NPS inquiries at chosen authorities and to compare it. Within the public administration the sense of NPS is to gain the client information repeatedly, to make the analysis of it and systematically eliminate the addressed failings and gaps.

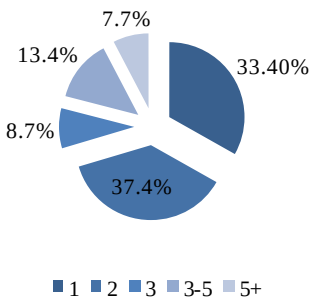

Fig. 1: How many times did you visit this office until you arranged your mater? (Author´s Elaboration)

The question accentuated by us was the question No.9 „ How many times did you visit this office till you arrange your matter?“ Only 33% of the responders said that they were able to arrange their mater successfully for the first time. The responders counting 37% needed two visits to arrange their matters and almost 30% of the responders needed 3 and more contacts to arrange their matters. We believe that the marked reduction of the numbers of the contacts resp. the less personal visits of the client needed for arrangement of the respective mater shall contribute the higher client satisfaction. It should be applicable the less contacts needed for arranging the respective matter the higher is the client satisfaction with the service provided by the office. The aim should be the arrangement of the matter for the first time. For this it is necessary to adjust the officers´ way of work and to verify the most often reasons of the repeated contacts regarding the same matter and to minimize these contacts through the adequate and targeted measures.

3 Process management – levels of organization maturity

Further on we will describe the maturity of the organizations within the public administration. The lowest level (1) represents the chaos and the absence of any process within the organization. Within the public administration in Slovakia no organization should be at this level and it has to realize all necessary activities to occur on the top of the pyramid. This lowest level is absolutely unacceptable and inconvenient within the public administration in Slovakia. The next level (2) represents the legislation, enactments and the rules i.e. the level where the work of the organization consists of specific even not satisfied process level and with particular method or several procedures. We do not recommend this level too since we are regarding it insufficient, ineffective and absenting a structural process solving for operation of the effective organization. Next level (3) is representing by documented process maps where the organization has a detailed overview of its processes however this situation, by itself, does not resolve the problem of the efficiency of the organization. The sole documentation of the processes is not a systemic solving but it is one of the first and basic steps. It is an important milestone on the way to improved and more effective processes within the organization. This third level is not recommended by us too. The fourth stage represents the level where the organization applies the concrete key process indicators (KPI). Based on the predefined criteria and then on performed measurements the organization is capable to monitor and to interpret its processes. This level includes the benchmarking and we recommend it. The final and the highest fifth level represents the continuous process improvement (CPI) and on this, by us recommended highest level, we are expecting a continual activity of the organization and not only a simple ad hoc action. Based on the particular process activities, remedies, measures, arrangements and changes the organization continues to simplify, to improve and to make its activity more effective. This level expects the method of the „best practice sharing“ by the organizations and by the respective organizational units. Within the public administration the aim of any organization should be to achieve this mentioned status. Moreover, in the fields where it is applicable, the public administration has to adopt the successful models of the private sector and to approach the public administration more closely to the citizen who is the final consumer of its service. The feedback provided by the citizens should serve to the public administration as an impulse eliminating the process limitation, the deficiencies, the excessive bureaucracy and inefficient resolutions and on the contrary it should start or continue to support the activities evaluated by the citizens as useful and positive ones. In the direction inside the public administration we recommend to realize an investment to the educational process of its employees and to enable their careers so they become the experts in their positions. The same we recommend to revalue the actual way of making the assessment of the public administration employees interested in and requiring the process change perhaps even positive contributing the process changes however the conditions under which they are working are not favorable and have no background. The absence of both the support and the development are resulting in the loss of the employees´ motivation to perform the changes for the benefit of the organization.

4 Conclusions

The process approach and the adequate process mapping is a practical and useful tool also in the public administration. The processes within the public administration has to be optimized both in inside and in outside directions. Although the process owner should reflect the specifics in the state or self-government, the correct implementation and usage of the process mapping can be in general an asset for any organization within public administration. In particular it is related to the improvement of provided service; the simplified procedures; an rapid, transparent and easy access to the essential information; the option of an accelerated procedure for an extra payment; the consultations and so called „end to end approach“. It is critical to make sure that the implemented processes are not definite and process owner may amend the existing process where necessary so that it reflects the changing environment. As far as the employee of the public administration is limited by the legislation arranging the state to be occur and not the way how to realize it there is offering a feasibility to apply the process mapping in terms of gaining the demanded changes right here. Management of the particular organization has to support any effort related to process approach incl. the implementation of the process mapping in a way leading to success and contributing the customer satisfaction which is the outcome of the service. We also believe that the implementation of maybe slightly amended net promoter score methodology in public administration will be an asset for any organization in terms of feedback and customer needs. NPS is basically articulating the voice of the customer and this voice must be heard also by the organizations in the public sector.

Literature:

1. Basl, J., Tuma, M., Glasl, V.: Modelování a optimalizace podnikových procesu, Západočeská univerzita, Plzeň, 2002. p.140 ISBN 80-7082-936-2.
2. Fiala, J., Ministr, J.: Prúvodce analýzou a modelovaním procesú. Ostrava: Vysoká škola baňská – Technická uviverzita, 2003. p.109 ISBN 20-248-0500-6.
3. Nenadál, J.: Měření v systémech managementu jakosti, Praha: 2001, p.310. ISBN 80-7261-054-6.
4. Owen and Brooks, Answering the ultimate question: how net Promoter can transform your business, San Francisco, Yossey-Bass, 2008.
5. Reichheld, F.F.: The one number you need to grow, Harward Business review, 2003 p. 46-54,
6. Šmída, F.: Zavádění a rozvoj procesního řízení ve firmě, Praha: Grada Publishing, 2007. p.300. ISBN 8024716794.

Primary Paper Section: A

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DETERMINANTS OF MANAGEMENT OF THE 21ST CENTURY, THEIR IMPACT ON COMMUNICATION AND THE UNIVERSITY EDUCATION

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Abstract: Successful organizations must adapt their strategies to the changing trends. Dynamic management development will place high demands on the professional and personal skills of graduates. The ability to think in context, to estimate future development, to search for new opportunities in a changing environment, to adapt to changes, flexibility, creativity, intuition, is gaining importance. If a college wants to educate managers for the 21st century who will be able to face the turbulent changes, then it needs to itself be an example and change attitude towards the traditional form of management of higher education institutions, to traditional forms of education, to traditional communication. This paper is therefore aimed at shaping the social system through the so-called organisation themes. Attention is paid to the topic of educational strategies aimed at activating forms of teaching.

Keywords: management, communications, higher education, organizing themes, interaction, active learning methods

1 DETERMINANTS OF MANAGEMENT OF THE 21ST CENTURY AND INTRUSION INTO THE UNIVERSITY ENVIRONMENT

The intent of universities is to prepare for practice highly trained and knowledgeable staff in the studied areas. In addition to the theoretical foundations in these specializations a school is also, in our opinion, an educational institution. Each individual will live in a society, but lead an individually different life (objectively, subjectively and in terms of delights). In terms of the fundamental objectives, it is therefore desirable to educate students about the openness to new knowledge, procedures, facts and people. It is also desirable to lead them to criticism and mutual tolerance, independence and creativity, emotional certainty and value diversity, to understanding other people and to be independent and responsible for their own actions. Current tasks of higher education certainly include creating space for developing students' own experiences, opportunities for active student activities and support of individualized learning paths. On the other hand, the school should organize joint activities, cultivate critical thinking, enabling deeper thinking and feeling.
Dynamic management development will include high demands on the professional and personal skills of the graduates. The ability to think in context, to estimate future development, to search for new opportunities in a changing environment, to adapt to changes, flexibility, creativity and intuition are gaining importance.

What ensured the success of companies in the past - specialization, planning and solid organizational structure, is losing importance in the real world of the 21st century. Successful organizations must adapt their structure to changing trends. These are flexibility, creativity, intuition and quick response to change. Changes to the requirements of the way organizations are managed. The starting point is to focus on a new role. The manager should abandon efforts to manage the staff and determine how to achieve the goals. He should believe in the ability of his people, he should focus on outcome rather than on processes of their achieving. It is expected decentralization of decision-making powers and responsibilities. In addition, a rising generation Y changes the approach to work. They have different attitudes and priorities than their parents. They don´t live to work, they work to live.

If a college wants to educate managers for the 21st century, who will be able to face the turbulent changes, then the college itself must be an example and change its attitude towards the traditional form of management in institutions of higher education, to traditional forms of education, to the traditional communication. People management and their control are among the supporting school activities and can´t be done without communication. If the staff and students do good and meaningful work without seniors and teachers always telling them what to do, this procedure would surely contribute to a reduction in costs (in the case of schools) and increase the efficiency of higher education for students. Proven factor of the practice of many companies is the effect of the social system of the company and the authors are convinced that it can be partially transferred into the university environment. According to Niklas Luhmann communication of today's complex society is not tied to understanding as it is in traditional society but to success or failure, so we can either incline to communication, to communication sense, and we will be successful, or refuse to participate in communicating sense and in this context we will be unsuccessful. According to him, a key role in shaping the social system is the so-called organizing theme. It is a topic which is spontaneously discussed during informal meetings, but also in regular formal communication. If the formal goal of the school is achieved - for example the achievement of comprehensive knowledge and student knowledge, skills and general competencies within the selected field of study and focus - then it will become the organizing theme, people will spontaneously begin to behave so that their activity fulfils their goals. Effective and clear communication is essential because it creates a social system from a group of people and enables the development of organizing themes.
The meaningful vision and strategy is required to fully exploit the internal potential of school, healthy corporate culture based on values, functional internal and external communications across all media. The required condition is a result of heads of departments´ hard work, where the school management plays a strategic role. It must lead by example and implement given trend into the strategic plan of the school regarding the internationalization of higher education, college financing, use of new technologies in education, teaching and learning. These three areas are interconnected, leading to a gradual paradigm change in higher education, the need for greater understanding of the needs, requirements and expectations of students and all stakeholders to create value and innovative forms of teaching. If they become organizing themes, there is a real chance that the school will eventually reach excellent quality.

1.1 Determinants of Quality of Education

In most cases, the main priority of schools is the quality of education. The difficulty of this task begins in deciding which college to choose. Main problem is quality, evaluation and implementation in real life. Promoting and requiring quality from teachers and other staff is difficult. Colleges are surrounded by turbulent environment - if someone reaches a certain level of quality, new impulse always comes, new technology and the realization that some things, some processes can be done or controlled even better – the so-called raising of the bar of quality. That the quality can always improve. Quality of education cannot be separated from other activities. Quality education cannot be separated from quality research. Quality is linked to other strategic priorities - innovation of curricula, adaptation of curricula to meet practical requirements, focus on the employability of graduates, and ensuring efficient use of financial resources, improvement of infrastructure, improvement of internal and external communications etc. - it is all connected. From this perspective it is a very difficult task for a college to establish criteria for the implementation of changes, ways of evaluating their attainment level, concretization of strategic objectives for individual sites, academics and support staff. All priorities can become organizing themes.

If the school wants to achieve strategic objectives and planned results, it is always necessary to manage all the activities that lead to fulfilment of prescribed vision. The school must operate like a living organism. If you alter some sections (for example an

increase in the number of students, reduction of financial subsidies), the consequences will appear in other sections (reduced level of education, increased number of students in groups).In managing change and growth the school cannot do without a new layout and new processes described. Causal relationships play a large role in the school, without understanding the individual elements and monitoring of logical laws we can´t successfully manage it. Continuous improvement of school performance is a prerequisite for its success in the market. When building a management system it is necessary to respect the critical success factors. Typically, in this context we refer to: quality, cost, time and knowledge of workers.

So far, we have been looking at the quality from the point of view of the school which is the producer of certain values. Let us now have a look at the customer's view - primarily at the students' view, then at the view of the graduates, but also at the view of a potential employer, of the parents etc. Global economy, the Internet, telecommunications, mobile transfers of technology, the transfers of knowledge and the mobility of the students and of the teachers bring a visible shift from the traditional hegemony based on the production of values to a permanent dominance of customers and consumers. The result is a new view of the quality from the customers' and the consumers' point of view. In general, each customer prefers higher quality to a lower price and to a faster satisfaction which both take place simultaneously and in one particular moment. Emphasis is not already put on a choice of one particular option, but it is placed on providing some additional options. In fact, the emphasis is put on the price, on the quality of education, on the way of educating and on the way of assessing and of acquiring knowledge and of skills, also, it is put on applying the knowledge in the occupational area etc.There is not a customer who would not prefer the elimination of the trade-offs and who would not want all the things at once. The customer does not wish to get his or her satisfaction in parts. The customers' satisfaction is separated according to separate dimensions, but he or she exists only as an integrated set of indivisible and of mutually determining values. According to Jakubíková, it is necessary to offer the customers some values and solutions, but not some products and promises. Today's customers have little time but they have a big amount of information. For their money they expect high quality, better services and higher values. The added value for the students can be teacher controlled through active methods of learning.

2 ACTIVE METHODS OF THE UNIVERSITY EDUCATION

Inertia, scepticism and fear of change can create a mix that slows down the creativity of teachers and students, suppresses innovation and withholds progress which is brought and enabled by new technologies and by new teaching methods. Many university teachers try hard to increase the share of an independent work of students in the learning process by the use of active methods of teaching and by implementing the cooperative or rather the collaborative procedure of teaching. Their experience shows that these methods, such as the method of learning in small groups (small group learning) encourage the skills of solving problems, encourage critical thinking and also encourage interpersonal communication skills. They can also increase the students' involvement and their interaction. The use of active methods is justified in all places where does not matter just the development of cognitive skills, but also where matter the practising of the skills that enable the use of knowledge in practice. In case of the cooperative or of the collaborative learning, these methods also have a strong social dimension and help include the acquired skills in the social context. These methods are applied in the problem-oriented learning and in the collaborative work of students on common topics (within the cooperation in teams - team based learning).Usually, it is also necessary that the students identify themselves with the solved problem ("take it as their own problems") and work with it not only according to their individual abilities and preferences, but also in a way that corresponds to their accepted social role in the group (according to the roles by Plamínek - the thinker, who creates ideas, the mover, who stimulates the performance and the caregiver, who cares about the well-being. The roles should include the roles of the Belbin model which consists of nine parts).

The task of the teacher is to support not only the processes of individual learning, but it is also to create conditions for the social dimension of learning. Furthermore, it is also to reach a situation where the students mutually exchange their experience, critically evaluate their opinions and agree on the strategies leading to their common aims. In this sense, the creation of a working team is also a setting up of the social environment that is involved in the learning process, creates the relationships influencing the results of the process and the environment and, also transforms itself in dependence on the "learning history", in fact according to the shared experience and knowledge, which participants gain during this process of learning. The cooperative and the collaborative learning has significantly transformative nature and it is used everywhere where the aim is to induce a change in both the cognitive and the affective competencies of individuals (which is a traditional subject of teaching) as well as in their social characteristics and in their social abilities (competencies development)..The teaching is mostly applied with regard to opening of the possibilities of positive and of value-based management changes which require an active attitude - students are apart from expert-level competencies, also trained on this civic role. This aspect of education is often discussed and it is often applied in relation to the issue of the sustainable development where the concept of the social learning plays an increasingly important role. Students need to do activities that they have to be learn, it is necessary to lead them to the so-called 'in-depth approach' to studying.

According to Průcha, among the basic characteristics of the active learning belongs:

- students work more actively rather than only listen;
- less emphasis is put on delivering of information and more emphasis is put on the developing the skills of students;
- it contains higher levels of thinking (analysis, synthesis, evaluation);
- participants do some activities (self-studying, discussion, written evaluation of the subject discussed);
- more emphasis is put on the development of students' own attitudes, opinions and values.

Through their self-consciousness, students will learn to accept the feedback. They will be able to solve potential problems and conflicts immediately , constructively and without any emotions. During the lessons, they are going to create an innovative and creative environment in which they are going to feel good and will be willing to work on their development. Criticism will not be a personal attack, but a way to improvement.

The digitisation of the field of life and of the youth groups' lifestyle which are most interconnected with computer activities and with the Internet activities also leads to changes in cultural activities and it enables changes in teaching methods. Young people today are "digital indigenous people" addicted to mobile technologies. They live in the world of Google, YouTube, Twitter, Facebook, Snapchat, Instagram and in many other forms of social media. If teachers do not admit this fact about reality and if they do not keep the pace with the trends and with the changing environment, then their behaviour can be considered irresponsible. A Nobel Prize winner, a physicist called Carl Wieman has published the podcasts of all of his regular lectures and of all of his study materials for students in a digital form. He has made the real course of his lectures available on his YouTube channel, on iTunes and on the Open University videos. He has had the courage to use some technologies in innovative ways, also the willingness to take risks and to try new ways to engage students in learning. As an effect of the students' searching for information on the Internet, even during lectures, the students have been evaluating the truthfulness and the originality of the sources, have been comparing the taught knowledge with the information from the Internet, have been

discussing different approaches, have been sharing their opinions, experiences, have been interactively involved in the teaching and in a non-violent (activativisation) way, they have been acquiring the required knowledge.

In the pedagogical concept of L. Andersen, the pedagogical strategy deals with thoughts. A university student manages to pay attention during not interrupted teaching about 15-20 minutes, then his or her concentration decreases. Attention also decreases at the moment when a student listens only to the subject for which he or she does not have the necessary prerequisites. To this term is slightly related the preparation of a student for a lecture or for a practice lesson.Petr Piťha points out that without the necessary amount of knowledge, people cannot think very well, because they do not have the matter to think about and they do not have anything to associate with the new information and also, they do not have anything to compare it with.

The use of the inductive methods is supported by research findings that students learn in a way that they incorporate new information in already existing cognitive structures and it is improbable that they could learn something new, if the information has no apparent connection with the things they already know and with the things they believe in.

The inductive methods of teaching and learning are terms that cover a variety of teaching methods, such as surveys, problem-oriented learning, project-based learning, use of case studies in teaching, application of the research procedures and just-in-time learning. These methods have many common features -apart from that all of them can be classified as inductive, all of them are focused on the student (learner-centred), which causes that students have more obligations and more responsibility for their own studying as compared to the traditional deductive approach based on lectures. In practical terms, it has been proved as a good practice for the author to assign specific tasks to the students for the following lectures or practice lessons. The check of the prepared material in the introduction of the lesson and the use of the material during lectures for discussion, teaches students to have a disciplined attitude to doing homework, forces them to think, takes of care of their creativity and motivates them to an active receiving of information.

The job of a teacher does not end with “an interactive presentation of the topic" within the classes. The teacher should after every lesson within his or her own self-consciousness evaluate the procedure of educating, if and how many students were actively involved and if they have gained the presumed competencies and the required skills .It is also necessary to evaluate, to verify the probability of the realisation of the determined study objectives and to re-evaluate continuously the subject when it is enlarged . In this situation, there is also valid the statement "less can be sometimes more." A teacher should provide some feedback to students so that students know how their learning proceeds (this is the so-called 'formative assessment'). Evaluation does not have to be done only by the teacher, but it can also be done by students - this can include self-assessment, mutual assessment between classmates and an assessment of the group's work by another group of students.

Lectures, practice lessons, evaluations etc. should have their order and rules anyway - the arrival to school at an accurate of all participants, responsible attitude to preparation at home, meaningful discussions, respect for the opinions of the others, assessments of situations in advance and clearly set priorities ... If an order is absent, a school changes to an entertainment facility, a lecture to a multimedia show or a theatre performance by the lecturer.

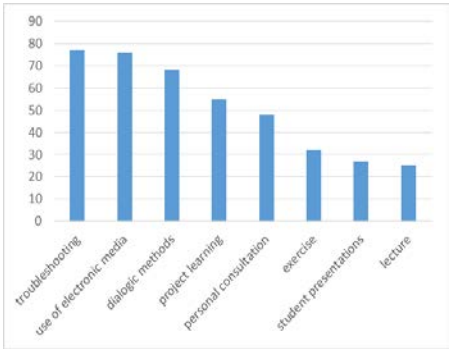
3 DATA FROM THE PRACTICE, STUDENTS' OPINIONS

The outcome from learning, the learning methods and the evaluation methods are not always properly interconnected. There can be absent the interconnectivity of the curriculum itself. In syllables, there are used general descriptions of the outcomes (student is going to learn, student is going to get to know...) which is very hard to assess. The suggested solution - do not mismatch terms of the types of outcomes with their meaning, those are professional knowledge, professional capabilities and general eligilibities.Professional knowledge should include everything that a student is able to explain, analyse, synthesise, evaluate, compare...(the declarative knowledge of the field of study). Professional skills - situations when students can use their knowledge in practice - these are the things they can realise, design, solve, create, improve (the functional skills in the field of study). General eligibilities express in what context and to which extent and responsibility the qualified person is able to apply the professional knowledge and the professional skills. For general competencies can be regarded the ability of presentation, of making judgments and their formulation. It also includes processing the data about the activity of students and teachers in syllabus and in the support of studying .Next, it includes creating the outcome from the learned data about the field of study, their subsequent processing within the levels relevant for individual subjects and the continuity of individual objects defined in the prerequisites. Furthermore, it includes not evaluating a thing which is easily assessed - for example test results, but it is necessary to evaluate realistically the acquired complex knowledge and capabilities by applying innovative forms of assessment.

An extensive and long-term (longitudinal) research by a well-known American sociologist, Professor Richard Arumah and by his colleague, associate professor Josip Roks published the results of the CLA (Collegiate Learning Assessment) tests which focus primarily on the ability of the reading comprehension, on reconstruction of the main arguments and on the level of writing skills, on which critical thinking is based. The scientist stated that for the last fifty years there has been a new record in the reduction of time which American students dedicate to studying. Still, in the sixties, almost 70% of students prepared for school more than 20 hours a week. Nowadays only 20% of students spend so much time studying textbooks. The authors are convinced that critical thinking has degenerated and has become a mere phrase and many things are concealed behind it, only not the ability based on hours spent with difficult pieces of writing and with writing seminar papers. But, let us come back to the Czech environment.

The questionnaire focused on creating the profile of the second-year students of the master's degree program at VŠFS during the academic year 2013/2014 asked the following question: From the following means of the educational process at the school what should be present more and which means should be present less? Assess each of the them on a scale of 1 (more) - 3 (as many as now) - 5 (less). The students' opinions are summarised in the graph 1. They have confirmed that even students prefer the activativisation forms of teaching presented in chapter 2.

Figure 1: Students' preferences in the choice of methodological means of teaching



Source: Adapted by the authors according to ANÝŽOVÁ, P., ZICH, F. The final report about the questionnaire. 2014. Praha. Internal material VŠFS, o.p.s.

In the survey by VŠFS, o.p.s. done in 2014, was formulated a question about the extent of learning options and about the level of student's participation in his or her own process of studying. Number of questions were related to the judgement of the following parameters: the maximal use of time to acquire new knowledge, studying most of the recommended literature, full use of consultations with teachers, responsible attitude to preparing for exams, use of the school library, regular attendance at lectures, preparing for seminars and for practice lessons, using the possibilities of discussions with the other classmates, the amount of effort dedicated to studying. All the statements were rated on a scale from 1 (definitely yes - agreement with the statement) to 5 (definitely not - disagreement).

Most of the respondents (92 %) stated that they prepared for exams in a responsible way, similarly high number (88 %) of respondents also stated that they attended the lectures regularly. Three quarters of the students stated that they also prepared for the seminars / practice lessons in a responsible way and during their study they used the maximum of time to acquire new knowledge. Only one half of the respondents stated that they fully used the school library and that the lecture subjects they discussed with their classmates. Only 37- 47 % of respondents stated they studied the prescribed literature and exploited the potential of consultations with educators. Half of the respondents then finally admitted that they could have dedicated more effort to their studying. Table 1 shows the average number of hours per week spent studying and working according to the fields of the university studies.

It can be implied from the facts shown above that students in the Czech Republic do not pay much attention to their preparation at home. The suggested solution - to support students in the in-depth comprehension by developing their interest and motivation for preparation at home and self-studying, which can be based even on the proceeding work activities. The interest of the students will be peaked by the attractiveness of the taught topic, by relevant and meaningful outcomes which are possible to be used in practice. And we are back to the active involvement of students, back in the way of evaluation of the target activities and of the constructive interconnection of the fields of study with the needs and with the demands of the labour market. In other words - if the school was able to secure employment of students in a particular field on the basis of the specified quality requirements, it would then create motivation for its students for their in-depth approach to studying.

Table 1: Average number of hours per week spent studying and working according to the university majors of study

study	study at school	self-study	paid work
law	11,9	9,2	35
pedagogical	10	8,4	30,2
healthcare fields	19,7	10,7	29,3
humanitarian	12,8	9,1	28,6
economic	12,4	8	26,4
agricultural	15,5	8,5	20,7
science-oriented	16	10,8	20,7
zechnical	22	11,1	18
arts-oriented	21,7	13,4	17,8

Source: FISCHER, J., VLTAVSKÁ, K. et al. [Online].Credo. EUROSTUDENT V: Selected results of the survey in the CR. November 19, 2013. p.78 © 2013-2014 Ministry [Cit.2014-11-01] Available from http://kredo.reformy-msmt.cz/vybrane-vysledky-eurostudent-soubor

Conclusion

The aim of the article was to discuss the current changes in management, which were brought about with the development of technologies, the competitive environment and trends in the management of successful companies. These changes also influence the environment of universities. Dynamic development of management has high demands on professional and personal qualities of graduates. Within the educational process, it is necessary to learn to think in many relations, to estimate the future development, to search in a changing environment for new opportunities and to adapt to changes. Employers expect communication, presentation skills, flexibility, adaptability and creativity. If a university wants to educate managers for the 21st century who will be able to face the changes mentioned above, then it is necessarily that the school itself serves as a good example. It has to change its approach to the traditional form of management of the university institutions. Specifically, the management of people and control of them belong among the supporting school activities and cannot be done without communication. The authors draw attention to the trend of the so-called organizing themes. On basis of their experience (as a teacher and as a student) they paid attention mainly to topic of the pedagogical strategies focused mainly on the activativisation forms of teaching, on the possibilities of the use of the Internet and on the modern forms of communication in the process of education. Use of these methods of teaching / learning develops critical thinking and interpersonal communication; it can increase an active participation of students and their mutual interactions, all of which are all very important skills for the future success of graduates in the labour market. The article focused mainly on the teaching strategies dealing with ideas, on the activities leading students to an active participation during lessons and to a proper preparation at home. They are aware that the realisation of the complex implementation and of the evaluation of an excellent quality of the university institution is a matter of its strategic management, but the implementation itself depends on the coordination of school's aims with the aims of individuals (teachers, students, other staff, stakeholders), on the ability to accept the challenge of management of the 21st century and on the speed of implementation of the social system of the school via the so-called school organisation themes.

Literature:

1. BROŽ,D. *Svoboda volby jako princip managementu 21. století?* Hospodářské noviny. Příloha Kariéra a vzdělávání. 13.3.2013. ISSN 1213-7693.
2. CEJPEK, V. a kol. *Jak rozvíjet kvalitní vysokoškolské vzdělávání*. Metodika IPN Kvalita. Praha: MŠMT, 2014. 66 s. ISBN 978-80-87601-22-8.
3. DLOUHÁ,J. a kol. Metodika týmové spolupráce a tvorby týmů pro vysokoškolské vzdělávání. 2010. Praha: Centrum pro otázky životního prostředí Univerzity Karlovy v Praze. 69 s. Publikace nemá ISBN.
4. FISCHER, J., VLTAVSKÁ,K. a kol. [online]. KREDO. *EUROSTUDENT V: Vybrané výsledky šetření v ČR.* 19.11.2013. s. 78 © 2013 – 2014 MŠMT [Cit.2014-11-01] Dostupné z http://kredo.reformy-msmt.cz/vybrane-vysledky-eurostudent-soubor
5. ISHIKAWA, Kaoru. *Co je celopodnikové řízení jakosti? Japonská cesta: principy, postupy, metody*. 1. vyd. Praha: Česká společnost pro jakost, 1994. 205 s. ISBN 80-02-00974-6.
6. JAKUBÍKOVÁ, D. *Strategický marketing. Strategie a trendy.* 2. rozšířené vyd. Praha: Grada Publishing, a.s., 2013. 368 s. ISBN 978-80-247-4670-8.
7. JANIŠOVÁ D., KŘIVÁNEK M. *Velká kniha o řízení firmy. Praktické postupy pro úspěšný rozvoj organizace.* 1.vyd. Praha: Grada Publishing, a.s., 2013. 400 s. ISBN 978-80-247-4337-0.
8. KOPŘIVA, T. [online]. *Pohled pod pokličku strategického uvažování vysokých škol.* 29.8.2014. [Cit.2014-11-17]. Dostupné z http://kredo.reformy-msmt.cz/strategicke-uvazovani-vysokych-skol?utm_source=msmt-ipn&utm_medium=referral&utm_campaign=vrr2-nw5
9. KOUCKÝ,J. , KOVAŘOVIC, J. [online] *Vysoké školy se vyrovnávají s požadavky 21. století*. 16.července 2014. Vysoké školství ve světě. [Cit. 2014-11-15]. Dostupné z http://vsmonitor.wordpress.com
10. LANG, H. *Management – trendy a teorie*. 1.vyd. Praha:C. H. Beck. 2007. 288 s. ISBN 978-80-7179-683-1.
11. LUHMANN,N. *Sociální systémy. Nárys obecné teorie.* 1.vyd. Brno:CKD. 550 s. ISBN 8073251000
12. MATĚJČKOVÁ,T. [online] *Vysoké školy nevzdělávají, jen umožňují nicnedělání.* 14.11.2014. © 2014 MAFRA, a.s., ISSN 1213-1385. [Cit.2014-11-14]. Dostupné z http://ceskapozice.lidovky.cz/vysoke-skoly-nevzdelavaji-jen-umoznuji-nicnedelani-f9c-/recenze.aspx?c=A141014_1 83845_pozice-recenze_l ube

13. NANTL,J., ČERNIKOVSKÝ,P. a kol. *Národní kvalifikační rámec terciárního vzdělávání, Díl 1. Národní deskriptory.* 1. vyd. 2010. 48 s. Publikace nemá ISBN.
14. NENADÁL, J. *Moderní management jakosti: principy, postupy, metody*. 1.vyd. Praha: Management Press, 2008. 377 s. ISBN 978-80-7261-186-7.
15. O MALLEY, B. *Embrace digital age or face irrelevance – Martin Bean.* 14 November 2014 University World News Issue No:343. ISSN 1756-297X.
16. PETŘÍKOVÁ, R. *Jakost a lidský faktor*. 1. vyd. Ostrava: VŠB – Technická univerzita Ostrava, 2008, 104 s. ISBN 978-80-248-1735-4.
17. PRŮCHA,J. a kol. *Pedagogický slovník -- Nové, rozšířené a aktualizované vydání*. 7. akt. a roz.vydání. Ostrava:Portál. 2013. 400 s. ISBN 978-80-262-0403-9
18. ROHLÍČKOVÁ,L., VEJVODOVÁ,J. *Vyučovací metody na vysoké škole*. 1.vyd. Praha: Grada Publishing, a.s., 2012. 288 s. ISBN 978-80-247-4152-9.
19. SVĚTLÍK,J. *Marketingové řízení školy*. 2. aktual. vyd. Praha: Wolters Kluwer. 2010. s. 325. ISBN 978-80-7357-494-9
20. VEBER, J. *Řízení jakosti a ochrana spotřebitele: principy, postupy, metody*. 1. vyd. Praha: Grada Publishing, a.s., 2002. 204 s. ISBN 80-247-0194-4.
21. WACHTER, B. *Questioning the student mobility imperative.* 14 March 2014, University World News, Issue No:311. ISSN 1756-297X.

Primary Paper Section: A

Secondary Paper Section: AM

CHILDREN'S CONCEPTIONS OF SOCIAL PATHOLOGY PHENOMENA: INTERPRETATIONAL FRAMEWORK OF SELECTED PRIMARY SCHOOL PUPILS

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Abstract: This article presents individual outcomes of the grant project and its specific research into children's conceptions of internet addiction, gambling and religious sects. The qualitative research objective was to identify selected social pathology phenomena in the young population aged 10 to 15 years. There were in total ten participants recruited from two primary schools. Analysis of the three most interesting cases revealed elementary aspects of the genesis of children's conceptions. Based on a comparison of the cases selected and with the use of in-depth interviews it was found that conceptions of internet addiction, gambling and sects vary qualitatively. Individual factors influencing children's conceptions were also specified.

Keywords: children's conceptions, primary school pupils, social pathology phenomena, qualitative research

1 Introduction

Many forms of social pathology phenomena[1] have been subject to numerous research and epidemiology studies. And many reveal the tendency of children and young people of our so called 'information society' to develop addictions to psychoactive substances as well as the non-drug related dependencies. The selected phenomena include - *gambling* - (Nešpor, Csémy, 2005; Valentine, 2008; Forrest, McHale, 2012), a problematic internet use - *internet addiction disorder (IAD)* - (Vondráčková, 2011; Šmahel, Brown, Blinka, 2012; Sinkkonen, Puhakka, Meriläinen, 2014), and addiction to destructive religious ideology - *a sect phenomenon* - (Maniscalo, 1997; Furseth, Repstad, 2006). The research shows that Czech children and young people are some of the most vulnerable in the world in terms of alcohol addiction, drug misuse or other hazardous activities (Nešpor, 2012).

Unlike today, the IAD, gambling and sects used to be rare occurrences (if not entirely absent) before 1989 in the former Czechoslovakia. These phenomena have become omnipresent but often overlooked by the modern Czech democratic society in terms of understanding. Undoubtedly, these phenomena jeopardise our society and therefore a child's life and development. Children and young people should have at least a basic understanding about these phenomena to be able to take an adequate approach. The task of educational institutions is to convey necessary information and to minimise the impact of social pathology phenomena on the lives of children and young people. The phenomena discussed so far have become a part of today's reality that they form. Moreover, they significantly contribute (often in a negative way) to a socialisation of a child (pupil). Social pathology phenomena have been a subject of many research studies. However, we now know only a little about attitudes and approaches of those who are endangered the most - children and young people. Therefore this research investigates and presents children's conceptions to the selected social pathology phenomena, i.e. IAD, gambling and sects.

1.1 Theoretical foundation of children's conceptions

It is a generally accepted fact that a child makes his own so-called naive notion or preconception/ child's conception (Barrett et al., 1993; Held, 2001). Children's conceptions and their genesis stem from important schools of thought utilised in pedagogical psychology. They include a theory of scientific concept development that was formulated by L. S. Vygotsky, and cognitive psychology proposed by J. Piaget and his psychological theories. Piaget as well as Vygotsky considers some differences between the two groups of children's ideas (conceptions) about a particular phenomenon (Škoda, Doulík, 2011).

Vygotsky distinguishes *spontaneous* (*common)* concepts and *scientific* concepts. Spontaneous concepts are forms of thinking that develop through child's practical activities or during close interaction with people, whereas scientific concepts arise during pupil's learning processes at school. (Doulík, 2005) Vygotsky says that the development of scientific (socio-scientific) concepts takes place within a systematic liaison between a teacher and a child who acquires higher psychological functions under adult's supervision (Vygotsky, 2004). At school a child's learning is transmitted in a certain *system* that is crucial for scientific concept development. On the other hand, concepts that originate in day-to-day living through spontaneous learning are acquired in *isolation*. A problem of the scientific concept formation (e.g. as part of formal education process) is its initial verbalism and inadequate support of practical means, experiences, experiments, observations, etc. Traditional education poses a threat. It remains at verbal level without an adequate practical support resulting in child's adoption of non-meaningful words simulating and imitating the presence of particular concepts. In this case a child acquires words but not concepts, and becomes unable to utilise such knowledge in a meaningful way. He/she learns blank verbal schemes and cannot integrate them into their inner knowledge system. (Škoda, Doulík, 2011) Scientific concepts must be supported by certain levels of mature thinking. Therefore, spontaneous (common) concepts cannot be ignored when forming scientific concepts! At the same time, scientific concepts are affected by previously acquired spontaneous concepts, because both types are not isolated in child's mind, they merge and interact. (Doulík, 2005)

Piaget's view considers imminent cognition of qualitative specificity of child's thinking that is based on purely spontaneous concepts and ideas. The non-spontaneous concepts that have developed under the influence of people who were present in a child's life reflect the level and attributes of the adult's reasoning rather than the child's at a particular operational level. Piaget and Vygotsky, however, agree with the idea that a child projects specific elements of their own thinking in the process of learning and processing a concept. He/she creates their own conceptions. Piaget applies this thesis to spontaneous concepts, whereas Vygotsky supports its validity related to both, scientific as well as spontaneous concepts. (Doulík, 2005)

Piaget's intellectual development (i.e. a problematic of learning and development) may be simply interpreted as a gradual replacement of specific qualities of a child's thinking by durable and more sophisticated adult reasoning. With increasing age the child way of thinking disappears until it is no longer present. The developmental process is understood by Piaget as a gradual and continuous replacement of particular forms of thinking with other forms. Whereas, *Vygotsky* believes the developmental process is a continuous formation of new attributes and higher and more complex realms of thinking that originate from elementary and simpler forms. The gradual growth of higher thinking consequently resembles fully developed reasoning. (Doulík, 2005)

1.2 Characteristics of children's conceptions

Children's conceptions are recognised as a set of specific knowledge and notions or interpretational models of an

[1] Modern terminology also refers to the term *risk behaviour*. It is mainly used in relation to pupils and school environment. *Social pathology phenomenon*, on the other hand, refers to the context of entire society. It covers phenomena that cross boundaries of social norms and maybe perceived by society as threatening. In relation to this study the term social pathology phenomena is regarded as a more suitable one than the risk behaviour.

individual and are influenced by many factors. Content structure of knowledge in forms of thought clusters and notions create an idiosyncratic unique knowledge pattern (i.e. cognitive dimension) that is accentuated by an individual´s emotional component (affective dimension).

It is often the case that children's (pupils') conceptions may differ from the adults' interpretational framework (including teachers, parents, and specialists). That is why the children's conceptions are so important for teaching (from a theoretical point of view they are subject to research practices, and from a practical point, the pupils enter school environment with their interpretational framework and subjective theories embedded - in other words - a pupil is not a 'tabula rasa'). Children's conceptions, however, shape the understanding of different content structures of their knowledge (their epistemological character). It is possible to analyse the structures only if they relate to a particular content, a process, a rule, a phenomenon etc. A competent person (such as a teacher) can consequently decide on adequate didactic approach for their analysis and possible modification (e.g. if children's conceptions are not in accordance to a particular scientific theory, or socially accepted).

1.3 A review of the current research on children's conceptions

Research into children's conceptions mainly focuses on areas of natural science (Nakhleh, 1992; Stover, Saunders, 2000; Mandíková, Trna, 2011). Social scientific subjects are far less studied. The disparity may be due to a difficulty to set (in) correct criteria of the so called lay interpretational framework (children's conception) of a social phenomenon, its objective, and scientifically accepted interpretation. Despite the fact it is still possible to find many interesting studies which present stimulating material for this project (theoretical as well as methodological). These include a study by Pivarč, Škoda and Doulík (2012) who conducted a quantitative analysis of grammar school student's misconceptions to alternative religiosity, or a study by Barett and Buchanan-Barrow (2005) who investigated pupil's understanding of a society's function.

Most research studies choose quantitative methodology, whereas this study supports a qualitative methodology as it enables characterisation of pupils' content structures in more detail and emphasises the individual's understanding and interpretation of the social pathology phenomena. This is the key objective of this study. The research problem originates from the research objective and its formulation is as follows: *What are children's conceptions to the selected social pathology phenomena?* Children's conceptions to the selected phenomena are investigated as so-called multidimensional entities (Škoda, Doulík, 2011) and include cognitive dimension (phenomena understanding) and affective dimension (pupils' attitude). In line with the study objective and its problem the following questions are specified:

- Questions focused on pupils' understanding and notions (e.g. what is their understanding of internet addiction (netholism), gambling, sects; what is it; why does it exist; how, why, when does an addiction appear and who is susceptible; what do they know about IAD, gambling and sects; etc.).
- Questions directed at pupils' attitudes (e.g. how do they relate to IAD, gambling and sects; what importance does it have; can the phenomena be beneficial in any way; can they be harmful; etc.).

2 Children's conceptions of social pathology phenomena: basic description of research methodology

This investigation is to some extent inspired by a multiple case study as its research strategy. Compared to others (ethnography, grounded theory) it is regarded the most suitable design, because it allows to outline children's conceptions and to find answers to questions: 'how' or 'why' a specific notion of reality occurs. At the same time the researcher has almost no opportunity to influence the phenomena standing in the forefront of his interest.

The qualitative research was conducted in 2013 (April to October). Research sample includes primary school pupils from the same town in the Central Bohemia. They are children and young people aged 10 to 15 years (5th, 7th and 9th grade), of different socio-cultural background (e.g. under threat of social exclusion), and of various personal, family and social histories (e.g. victims of bullying). The diversity of the sample representatives is a deliberate choice, because it is those factors that may project into and interfere with the variability of children's conceptions. There were in total 10 participants (3 boys and 7 girls). But due to limited extent of this project the following analysis only includes outline and interpretations of three most interesting cases of children's conceptions.

An in-depth interview was conducted with semi-standardised questioning. The questions (see above) focus on experiences, opinions, knowledge (cognitive dimension), and pupils' feelings and attitudes (affective dimension) related to the phenomena. Individual interviews were recorded on a camera at the school premises. On average there was a time limit of 10 to 15 minutes for each theme (IAD, gambling, and sects). The researcher's role may be considered as non-biased; he acted as "a stranger" (Šeďová, 2007). The data was transcribed and subject to a content analysis which enables identification of the level (of complexity) of children's conceptions. In addition to an in-depth and systematic analysis of empirical data the analysis of variable factors was also performed. Especially those factors that have a direct influence on shaping the children's conceptions are under close scrutiny.

Due to the young age of the participants it was necessary to obtain the written consent of their legal representatives and of their school principal. Pupils and their parents were informed about the research purpose and all the ethical aspects involved (i.e. anonymity, voluntary participation, opportunity to withdraw from the study anytime, etc.). Some study limitations emerged during the individual interviews. Some of the younger pupils would give answers that were socially acceptable (Smith, Mackie, 2006), and some had difficulties to verbalise their ideas. Even the use of camera by the researcher had probably some influence on pupils' responses.

2.1 Participants characteristics

- *Kateřina, 10 years old (5th grade primary school)*

Kateřina commutes to a larger school in town. She has no problems in terms of education and school results. She has many friends and feels she is accepted in her class. She has been growing up in a complete family with a little brother, and with sufficient financial support.

- *Sára, 13 years old (7th grade primary school)*

Sára goes to a primary school in the town centre. Her school results are average and she had some behavioural problems in the past. She had been experiencing problems with class acceptance. She has also had conflicts with the teachers and on some occasions she even bullied her classmates. She had been growing up in a complete family without any siblings. Currently she lives with her mother in an asylum house.

- *Jaroslav, 15 years old (9th grade primary school)*

Jaroslav goes to the same primary school as Kateřina. He lives in a village and has to commute to school. He has been growing up in a dysfunctional family without his biological father, but his mother has a boyfriend. He has four siblings (two younger sisters and two older brothers who have been prosecuted for some criminal offences including distribution of class B drugs - cannabis). The family is under threat of social exclusion. Jaroslav lives in problematic social, emotional and material conditions that make studying more difficult.

Please note: the real names were concealed to ensure protection of identity.

3 Findings and their interpretation

It is impossible to project the findings validity into the whole population of children and young people. It is only possible to keep within the frame of the research sample. Jaroslav, Sára and Kateřina's conceptions are briefly outlined and interpreted for each phenomenon individually. Based on analysis of the categories the factors presented are those that are predominant in children's conceptions to the social pathology phenomena.

3.1 Internet addiction disorder (netholism)

All pupils had problems to understand the term 'netholism'. Sára demonstrates some effort to explain the term as follows: *"I think it's some kind of crude manner, smashing things or anything really"*. The rest of participants cannot sufficiently verbalise their ideas and state that they are unable to clarify such a technical term. Perhaps, this is the case because the term is not a commonly used word. After netholism was explained the pupils express the following associations: Sára: *"yeah that people play various games and they have to finish it. Because they get nervous if not finished so they get stuck, because they have to finish it and so become addicted. They do it every day so they can't be without it"*. Kateřina: *"addiction is mostly when they get used to the internet, those kids. When the parents allow it, then the kids create Facebooks and so on. Well and then they're hooked, they're on it all the time (they don't go out, but stay on the internet all the time)"*. Those interpretations prove that the pupils relate addictions to particular activities that they know personally and identify with them. Pupils' interpretational frameworks are very varied even in terms of causes. Jaroslav's comment: *"these people haven't enough friends at school and generally. They don't know life, he knows only the internet and computer and nothing else. It's not my case. I am always outside with my friends. I'm not interested in the internet very much"*. Sára and Kateřina also suggest the lack of friends as a cause of internet addiction. Additionally, it is mentioned that the addiction can occur at the age of 10. Pupils' opinions once again reflect their experiences from the environment they live in. All pupils state that some of their classmates or friends can be regarded as addicted.

Participants' attitude to internet addiction or to people who suffer from it is outlined as follows: Sára: *"the people have worse character than the normal people. When they play games, they can be dangerous - like the addict can harm even his parents if they forbid him from playing. To me he can't be dangerous, if I don't provoke him"*. Jaroslav comments: *"people who are addicted to the internet are weird. But for me it can't be dangerous. I'm not scared to ever become addicted."*

3.2 Gambling

The term gambling is frequently used term in today's media and so it is expected that pupils understand it better. Unlike the previous term the gambling definition and understanding is more precise. Jaroslav explains it as follows: *"yeah that's clear. It's something to do with a slot-machine, they are people addicted to slot-machines. They spend evenings in casinos, and lose lots of money, because they usually lose. Gambling comes from psyche, because it makes people more relaxed if they hit the bottom. Age is not important - someone can start playing when 17 already."* Sára's comment is: *"gambling is addiction on slot-machines, rullete, cards and so on. The person likes it. If he's nervous he can relax."* Kateřina's reaction is: *"that's the machine playing''*. Jaroslav proposes an interesting suggestion when asked about addiction development and its impact: *"when you have no job, you can see some hopes that you could win, so you try anything that there is. It's also about boredom. You need to kill time and you can't sit and watch telly for ever..."* Jaroslav also believes that gambling may have influence on interpersonal level: *"it's good that you can talk to other people, play with them and so on."* Similarly to IAD all respondents think that gambling presents a threat especially among men and it develops between ages 17 and 25 (compare to Nešpor, Csémy, 2005). Age and gender stated by the pupils probably relates to their understanding and assumption that only people aged 18 and older are allowed to enter such places as bars and casinos, and that more men than women visit these places. Clearly the pupils understand the term and are able to interpret it correctly even though their definitions and concepts vary. As already mentioned this is the case because the term is in common use. In addition, there are numerous casino bars situated near schools and this may also influence the conceptions of pupils' cognitive dimension.

Jaroslav's attitude to gambling is more or less neutral. However, it is obvious that he is strongly influenced by his family environment. He is fairly open about the fact that there were problems with pathological gaming in his family too - his oldest brother used to be addicted for some time: *"I don't know if it was harmful to him, he just wanted to beat some time"*. On the other hand, Kateřina verbalises a different attitude to gambling. For her it is something unacceptable, something to be ashamed of: *"I think I would be looked down on at home or at school, if I played the machines. It has no sense to me"*. Clearly Kateřina's relation to her parents is very important for her. They influence her beliefs. Sára's attitude is somewhat indifferent: *"I can't say, I just don't know. Maybe, it can be bad for the family when someone spends a lot of money in gambling... anyway, for me it's not dangerous or beneficial"*.

3.3 Sects

A term 'religious sect' is very problematic. There has been no consensus agreed in terms of its definition. It is a commonly used term in the media as well as in public, but it takes many forms (Furseth, Repstad, 2006). Czech people embrace it as potentially dangerous when describing a religious group. The term 'sect' is explicitly outlined in the educational material of Czech primary and secondary schools.

Defining the term was an uneasy task even for the young participants. Kateřina imagines it as a group of people who give loans (it may be interpreted as her personal experience when her parents applied for a financial loan): *"people who give papers for money loans."* Sára claims: *"I'd say they are secluded groups not open to all. Someone is leading it. They have meetings, demonstrations (when for example something is about to be demolished), they negotiate"*. Jaroslav stated: *"hmm, I'm not sure. I'd say they are some kind of morons. I don't believe in God so I don't care about these things and wouldn't want to belong to any such group."* The participants make the following statements about the possibility of sect addiction: Kateřina: *"I think that nobody can become addicted to this, it's not like internet."* Sára: *"it's not for kids, it's more for the grown ups."* Jaroslav: *"you can become addicted to drugs and so on, but to a religious sect full of morons?"* The pupils perceive the term 'religious sect' as too abstract, because its content saturation is formed by ideas that are not concrete (they refer to undefined social groups), or they have incorrect ideas about it (people who lend money).

Pupils' responses imply their more positive attitudes to the phenomenon. This is possibly because of their inadequate understanding of the sect problematic. When the concrete questions are asked which relate to attitude and significance, the responses are as follows: Kateřina: *"they can be beneficial. They've lent us the money for example. I think it's good that such people exist."* Sára: *"it's something mysterious maybe you have to undergo a ritual to be a member. I wouldn't be afraid to get in, because it could be an adventure, to fulfil the tasks and generally to be the member."* Jaroslav: *"I've never met anyone like that and don't want to. It definitely can't be beneficial for me in any way."*

3.4 Factors influencing children's conceptions

Children's conceptions are a result of a wide range of influences. They are determined and shaped by many factors. To list all that contribute to the genesis of children's conceptions would be practically impossible (Pivarč, Škoda, Doulík, 2012) as also demonstrated by the study analysis.

Analysis identified the following factors that have impact on variability of children's conceptions: Interpretational framework of the social pathology phenomena is reflected by their *experiences and spontaneous aspects* of their current understanding. The *after-school factors* seem to be crucial for shaping their own episteme. Especially the *family environment* falls into this category. Its emotional, social and economic values that project into children's conceptions give it a unique profile. Other important factors include *media and peers*. Despite their intensity it needs to be realised that those elements may involve provision of incomplete or incorrect information, and may interfere with the pupils' attitude formation.

On the other hand, *school and its preventative programmes* have a much lesser effect on formation of children's conceptions. The pupils involved are not willing to accept the programmes designed by their school, because they see it as another tedious teaching of a certain social problematic (most often drugs, alcohol and problematic sexual behaviour). The effectiveness of preventative programmes is minimal, because the programmes are limited to verbal transmission of knowledge (e.g. discussions, film screenings). These findings are in line with other research studies (e.g. Nešpor, 2012).

Children's conceptions to the selected social pathology phenomena are also influenced by a pupil's ability to cognitively process information from his/her environment, to integrate it to his/her knowledge system, and to use it. This ability is dependent on an ontogenetic development of an individual's intellect (thought process maturation). Moreover, older pupils (such as Sára and Jaroslav) have more complex conceptions of social pathology phenomena (they are able to facilitate their inner representations in a more complex way and to employ multi-conceptual thinking).

4 Conclusion

This research suggests that individual interpretational frameworks of the selected social pathology phenomena are qualitatively varied among the pupils involved. These patterns are the result of a wide range of factors (peers, media, ontogenetic development, family environment, etc.) these project into children's conceptions. The purposeful impact of school institutions and their preventative programmes have no direct effect on the shaping of children's conceptions to the selected social pathology phenomena. A school is a place where pupils adopt a burst of intellectual knowledge from many fields. However, it should also be a place where pupils receive useful and relevant information about the modern social pathology phenomena, and where they adopt socially accepted approaches to them. In line with this the school should refrain from provision of preventative programmes and teachings that are based on one-way transmission of the knowledge. There needs to be more of an interactive programme where pupils gain social skills and learn to critically evaluate existing information, especially if acquired through after-school activities. It is this after-school environment that may present the source of incorrect or incomplete information leading to the development of undesirable behaviour and attitudes of an individual.

Literature:

1. BARRETT, M., BUCHANAN-BARROW, E. (eds.). *Children's understanding of society*. New York: Psychology Press, 2005. 323 p. ISBN 18-416-9298-0.
2. BARRETT, S., ABDI, H., MURPHY, G., McCARTHY-GALLAGHER, J. Theory-based correlations and their role in children's concepts. *Child Development*. 1993, vol. 64, no. 6, p. 1595–1616. ISSN 0009-3920.
3. DOULÍK, P. *Geneze dětských pojetí vybraných fenoménů*. Ústí nad Labem: Univerzita J. E. Purkyně, 2005. 173 p. ISBN 80-704-4697-8.
4. FORREST, D., McHALE, I. Gambling and Problem Gambling Among Young Adolescents in Great Britain. *Journal of Gambling Studies*. 2012, vol. 28, no. 4, p. 607–622. ISSN 1573-3602.
5. FURSETH, I., REPSTAD, P. *An introduction to the sociology of religion: classical and contemporary perspectives*. Burlington: Ashgate, 2006. 241 p. ISBN 07-546-5658-6.
6. HELD, Ľ. Príroda - deti - vedecké vzdelávanie. In KOLLÁRIKOVÁ, Z., PUPALA, B. (eds.). *Předškolní a primární pedagogika/ Predškolská a elementárna pedagogika*. Praha: Portál, 2001. p. 347–361. ISBN 80-7178-585-7.
7. MANDÍKOVÁ, D., TRNA, J. *Žákovské prekoncepce ve výuce fyziky*. Brno: Paido, 2011. 245 p. ISBN 978-80-7315-226-0.
8. MANISCALO, M. A New Global Risk: the Rise of the Killer Sects. *International Review of Sociology: Revue Internationale de Sociologie*. 1997, vol. 7, no. 3, p. 485–497. ISSN 0390-6701.
9. NAKHLEH, M. Why some students don't learn chemistry: Chemical misconceptions. *Journal of Chemical Education*. 1992, vol. 69, no. 3, p. 191–196. ISSN 0021-9584.
10. NEŠPOR, K. Prevence návykových nemocí v rodině. *General Practitioner/ Praktický Lékař*. 2012, vol. 92, no. 6, p. 342–344. ISSN 0032-6739.
11. NEŠPOR, K., CSÉMY, L. Kolik je v České republice patologických hráčů? *Česká a slovenská psychiatrie*. 2005, vol. 101, no. 8, p. 433–435. ISSN 1212-0383.
12. PIVARČ, J., ŠKODA, J., DOULÍK, P. *Analýza miskoncepcí alternativní religiozity u žáků vybraných gymnázií*. Ústí nad Labem: Pedagogická fakulta UJEP, 2012. 206 p. ISBN 978-80-7414-520-9.
13. SINKKONEN, H., PUHAKKA, H., MERILÄINEN, M. Internet use and addiction among Finnish Adolescents (15–19 years). *Journal of Adolescence*. 2014, vol. 37, no. 2, p. 123–131. ISSN 0140-1971.
14. SMITH, E., MACKIE, D. *Social psychology*. New York: Psychology Press, 2006. 688 p. ISBN 978-184-1694-092.
15. STOVER, S., SAUNDERS, G. Astronomical misconceptions and the effectiveness of science museums in promoting conceptual change. *Journal of Elementary Science Education*. 2000, vol. 12, no. 1, p. 41–52. ISSN 1090-185X.
16. ŠEĎOVÁ, K. Proces kvalitativního výzkumu a jeho plánování. In ŠVAŘÍČEK, R., ŠEĎOVÁ, K. et al. *Kvalitativní výzkum v pedagogických vědách: pravidla hry*. Praha: Portál, 2007. p. 51–82. ISBN 978-80-7367-313-0.
17. ŠKODA, J., DOULÍK, P. *Psychodidaktika: Metody efektivního a smysluplného učení a vyučování*. Praha: Grada, 2011. 208 p. ISBN 978-80-247-3341-8.
18. ŠMAHEL, D., BROWN, B., BLINKA, L. Associations between online friendship and Internet addiction among adolescents and emerging adults. *Developmental Psychology*. 2012, vol. 48, no. 2, p. 381–388. ISSN 0012-1649.
19. VALENTINE, G. *Keeping gambling fair and safe for all*. Birmingham: Victoria Square House, 2008. 52 p.
20. VONDRÁČKOVÁ, P. Závislostní chování na internetu - případová studie. *Česká a slovenská psychiatrie*. 2011, vol. 107, no. 5, p. 301–306. ISSN 1212-0383.
21. VYGOTSKIJ, L., S. *Psychologie myšlení a řeči*. Praha: Portál, 2004. 136 p. ISBN 80-7178-943-7.

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CRE-ACTIVE YOUTH PROMOTING CULTURAL HERITAGE FOR TOMORROW

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Abstract: The term conservation includes complex and differentiated valorisation activities of the cultural and natural heritage which link the past to the present. So do young people, bridging the past, the present and the future. This paper presents some examples of projects based on creative access for young people enabling them to be active contributors in the conservation and promotion of cultural heritage creatively, fostering volunteer work as well as new ways of employability. It focuses on the added value youth participation can offer at the individual (sense of accountability, active civic engagement, identity and competences building) and societal level (inter-cultural and inter-generational dialogue, appreciation of cultural differences, youth-friendly innovations).

Keywords: heritage, degradation, conservation, youth participation, volunteer..

1 Introduction

According to the Convention Concerning the Protection of the World Cultural and Natural Heritage [1], the cultural heritage is the legacy of physical artifacts (monuments, groups of buildings and sites) and intangible attributes of a group or society which are of outstanding universal value from the point of view of history, art, science, aesthetic, ethnology and/or anthropology. It provides testimonies to, and links between the past and the present [2].

The state of conservation of many very old important cultural objectives is impacted not only by the environment aggressiveness, but also by domestic and industrial activities, and by the cultural and environmental education level of people. Over time deterioration and degradation processes can affect the physical, structural and functional state of artifacts leading to the partial or complete deletion of the messages they convey. These processes can be grouped into [3] natural deterioration/degradation - caused by the action of climatic factors, normal physical, chemical and biological factors, or natural disasters (earthquakes, volcanic eruptions, floods, lightning, etc.) and, conscious (anthropogenic) deterioration/degradation - caused out of ignorance, negligence, carelessness or inattention by anthropogenic catastrophes, such as vandalism (due to war, fanaticism, architects and developers, large-scale tourism and people's inappropriate behaviors based on educational deficiencies, etc.) [4].

To stop and prevent these processes, as well as to valorise the cultural heritage and to preserve its historical messages from the past for the future generations it is necessary to intervene efficiently and effectively with conservation processes. In a broad sense, the term conservation includes investigation/research activities, preservation, restoration, valorisation and hoarding [3, 5].

Adopting a participatory approach, community members can be motivated to redefine their individual roles and responsibilities consciously, voluntarily and creatively [1, 6, 7], taking an active stand in the conservation processes of cultural heritage.

2. Volunteering for cultural heritage

The European Union since many years and especially in 2011 (the European Year of Volunteering) engaged local administration representatives responsible for cultural and educational policies, trainers from public and private structures, cultural associations and non-governmental organizations in actions promoting (young) citizens' (active) participation.

In 2012 the Volunteer Service Center Tuscany (Servizi Volontariato Toscana) - Cesvot from Italy and Promo P.A. Foundation issued The Magna Charta of volunteering for cultural heritage (La Magna Charta del volontariato per i beniculturali) and Guide to the use of voluntary informed (Guidaall'uso del volontario informato) aiming to create practical guides and framework for recognition, scheduling and organization of the volunteer work in cultural heritage [8].

In the same direction, the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions has presented in 2014 an integrated approach to cultural heritage for Europe, stating that cultural heritage as a shared resource and a common good offers important educational and volunteering opportunities for young people beside promoting inter-cultural and inter-generational dialogue [9].

At the present young people across the world are increasingly involved in cultural heritage preservation, valorisation and promotion [2] and their participation is based on cultural rights to access and participate freely in cultural life, to express their views on all matters affecting them and to participate in the cultural life of the community, developing and sharing knowledge and cultural expressions [10, 11].

Enabling youth to contribute with their participation to the promotion of cultural heritage in creative and innovative ways has many benefits: it strengthens one's sense of identity and belonging, supports personal development of potentials, resources and competences (individual well-being) as well as active citizenship (civic engagement) and inclusion in the (trans)cultural communities and in the (multicultural - intercultural) society (societal well-being).

Youth are a bridge between past, present and future generations and key agents in promoting heritage values that can favor intercultural understanding and respect for cultural diversity [2].

Considering the fact that young people represent the 25% of the world's population, involving them in the cultural heritage conservation means to develop attitudes and practices based on transmitting and promoting civic, cultural and participatory values such as [2, 12, 13]: respect for history and cultural diversity, loyalty, honesty, intercultural understanding of the social usage of cultural property and its preservation, teamwork and accessibility – equal rights and opportunities for informed engagement (access and participation) in the cultural life of a community, responsibility and voluntary participation and transparent dialogue.

These values, promoted in connection with new technological developments, have stimulated new ways of interpreting knowledge, a better understanding of the importance of both tangible (monuments, historical centers, natural reserves, etc.) and intangible heritage (traditional know-how, music, literature, etc.). By exploiting the benefits of online information and internet access, skills development training courses are also being integrated, whenever possible, into the agenda of youth forums, teacher-training seminars, workshops and volunteer action camps [14].

The World Heritage Education Programme of United Nations Educational, Scientific and Cultural Organization (UNESCO) strives to involve youth with many different projects and activities such as Youth Forums, skills development training courses, educative workshops and seminars, the World Heritage Volunteer Programme and its main tool, the World Heritage in Young Hands, an educational resource kit for school teachers, existing in 37 national language versions that has reached at least one million young students [15].

2.1 Creative involvement of young people

Engaging youth through volunteer work, employment and local entrepreneurship, recreational, and educational (and training) initiatives is vital for achieving sustainable, whole-community (pro-active and citizen-centered) and long-term development with partnerships between different stakeholders and actors, between non-profit and for-profit organizations [16].

Several projects can be mentioned as good examples regarding involvement of young people directly both as target group and giving them active roles recognizing them as resources and added value.

At a broad, international level, the World Heritage Volunteers initiative launched in 2008 to mobilize young people and youth organizations in World Heritage preservation and promotion consists of awareness raising youth action camps, involved so far over 2000 national and international volunteer participants [17].

Neighbouring countries also do cooperate. The project Living Fountains - Reviving Water Wells and Ponds, implemented within the 2007-2013 Slovenia-Italy Cross-Border Cooperation Programme, for example, envisaged the restoration and arrangement of 32 water wells and ponds as monuments of cultural heritage shared in the cross-border Karst area. It involved active participation of pupils from primary and lower secondary schools in creating material on the cultural and historical value of water wells, educational trails and revive events (with poetry, art, concerts, etc.) linked to the historical aspect of the cultural heritage represented by water wells [18].

At the national and local level involvement of youth in cultural heritage promotion is also vital, like for instance in developing countries, such as Albania, where youth, despite being a large portion of the society, often feel excluded from most of the political and societal processes. They face various challenges, such as unemployment, mobility issues, lack of updated educational resources, low living standards, corruption, juvenile delinquency, lack of consistent youth policies or programs to allow them participation [19]. Joint efforts of local and national organizations to raise awareness of youth civic engagement in cultural heritage protection are often successful in obtaining benefits for the youngsters and for the society.

The Ministry of Culture in Albania, for instance, lately aims to build a network called Friends of Cultural Heritage [20],involving 166 primary and secondary national schools to volounteer in maintaining heritage objects, on one hand saving on employed staff members in times of general economic crisis, on the other hand enhacing youngsters' accountability and contribution to the cultural heritage as they are themselves engaged in identification, protection, preservation and promotion of heritage buildings and cultural monuments in the vicinity of their schools.

Another project, titled From Gjirokastar, Made in Gjirokastra [19], aims to encourage young people toward cultural heritage market of artcrafts products for their permanent employment. The City of Gjirokastra promotes the development of youngsters' creative skills by supporting their employment in the field of cultural heritage and the production of souvenirs for the tourist market.

The Cultural Heritage Without Borders Regional Restoration Camps [21], winner of a 2014 European Union Prize for Cultural Heritage / Europa Nostra Award in the category of "Education, Training and Awareness-Raising", represent another simple and successful training model, which developed and grew from a few national students in 2007 to multiple sessions in four countries in 2013, with a diverse array of participants in the Western Balkans. The main objectives were to use cultural heritage to build relations among young professionals, creating conditions for reconciliation as a prerequisite for peace and democracy, and to preserve traditional crafts and techniques.

Another example which aims to propose and promote actions and /or projects regarding restoration and heritage development in the context of local community can be found in the activity of the Union REMPART, member of the European Forum Heritage Association and of the CCSVI (international voluntary work co-ordination committee), recognised as a public utility organisation by the Ministries of Culture, Youth, Education, Environment, Social Affairs, and Foreign Affairs as well. By their concrete actions on cultural heritage assets, they contribute to the planning and local development. They are also in a process of awareness raising and training of young people about cultural heritage in a dynamic of citizenship education through participation in collective actions [20].

3. Conclusions

The potential of cultural heritage is a creative force that brings youth together in a process based on participation and the young creative generation is increasingly becoming a resource for amelioration of the status quo. Youth and creativity (including innovation to create youth-friendly accessible resources and methodologies) are valuable sources of help in actively overcoming challenges related to cultural heritage preservation, valorisation and promotion and general societal and economic challenges. With their active involvement society can foster inclusive and sustainable growth.

Cultural events and activities based on direct involvement of youth promote the basic rights to have access and to participate in the cultural life of a society. Engaging youth in different cultural projects and activities have the immediately effect to transform them from ordinary users of cultural heritage and cultural space in volunteer, spontaneous, self-mobilized, self-determinated supporters who become part of a shared culture which respects their contribution. In this direction this short paper presented some examples of projects having young people actively contributing to the promotion and preservation of cultural heritage for future generations at local, national, cross-border and international levels.

Further research could focus and explore more in detail the added value and benefits at individual and collective level of engaging vulnerable and disadvantage youth through cultural heritage maintainance and promotion in ways that are inclusive and appealing to them: young people from hystoric and new minorities (from different linguistic, cultural, ethnic, religious backgrounds), those who face poor employment

Literature:

1. United Nations Educational, Scientific and Cultural Organization, Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris, 1972 (http://whc.unesco.org/en/conventiontext/)
2. http://www.un.org/esa/socdev/documents/youth/fact-sheets/youth-cultureasavector.pdf
3. Perusini, G., Il restauro dei dipinti e delle sculture lignee. Storia, teorie e tecniche, Udine, Del Bianco Editore, 2004, p. 99, ISBN 978-88-900564-5-1.
4. Benarie, Michel, Vandalism and cultural heritage, European Cultural Heritage, Newsletter on Research, Vol. 2, No. 2, pp. 3–6, 1988.
5. Sandu, I., Aspecte interdisciplinare ale ştiinţei conservării patrimoniului cultural, Catalogue EUROINVENT International Workshop 2013, Iaşi, Editura Universităţii Alexandru Ioan Cuza, 2013, pp. 67–93, ISBN 978-973-703-891-3.
6. Bass, S., Dalal-Clayton, B., Pretty, J., Participation in strategies for sustainable development, Environmental Planning, No. 7, International Institute for Environment and Development, London, United Kingdom, pp. 118, 1995, ISBN 1- 84369-043-8.
7. Brown, Nicole A. (coordinator), A Guide to Teaching Participatory and Collaborative Approaches to Natural Resource Management, St. Lucia, USA, Caribbean Natural Resources Institute (CANARI), 1999
(http://www.canari.org/267guide.pdf).

8. Velani, Francesca, Rosati, Claudio (editors), La magna charta del volontariato per i beni culturali. Dal progetto alla convenzione tipo, Firenze, Centro Servizi Volontariato Toscana, 2012, p. 15
9. European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the regions,
(http://ec.europa.eu/culture/library/publications/2014-heritage-communication_en.pdf)
10. Fribourg Group (Editor), Cultural Rights. Fribourg Declaration, 2000, Fribourg, p. 6
(https://www1.umn.edu/humanrts/instree/Fribourg%20Declaration.pdf)
11. United Nations, *Convention on the Rights of the Child*, Geneva. 2009, 31 p.,
(http://www.coe.int/t/dg3/children/participation/CRC-C-GC-12.pdf)
12. United Nations Population Fund, Marshall A. (editor), *Generation of Change: Young People and Culture. State of world population 2008. Youth supplement*, ISBN 978-89714-902-0,
(https://www.unfpa.org/webdav/site/global/shared/documents/publications/2008/swp_youth_08_eng.pdf)
13. Watson, Steve, Waterton, Emma, Heritage Community Engagement, International Journal of Heritage Studies, Vol. 16, No. 1–2, pp. 1–3, 2010
14. National Museum Directors' Conference, *Museums and galleries: Creative engagement*, 2004, London, Science Museum and dsprint / redesign, pp. 10-16, ISBN 0-9536047-6-4
15. United Nations Educational, Scientific and Cultural Organization, *World Heritage in Young Hands. To know, cherish and act. An educational resource kit for teachers*, 2002, ISBN 92-3-103843-5, (http://whc.unesco.org/en/educationkit/)
16. Duxbury, Nancy, Campbell Heather, Developing and Revitalizing Rural Communities through Arts and Culture, Small Cities Imprint, Vol. 3, No. 1, pp. 111–122, 2011
17. United Nations Educational, Scientific and Cultural Organization, World Heritage Education Brochure, (http://whc.unesco.org/en/wheducation/pg3-4)
18. Living Fountains Project, www.livingfountains.eu
19. Blerina, G., *Volunteerism Perceptions and Realities in the Albanian Youth Sector*, United Nations Volunteers, 2009, p. 19, ISBN 978-92-95042-94-0
20. Ministria e Kulturës, Raport publik për 300 ditët e para, 2014 (http://www.kultura.gov.al/files/news_files/Raporti_300_ditet_Print_min_kultures.pdf)
21. Cultural Heritage Without Borders, Regional Restoration Camps, (http://chwb.org/albania/activities/rrc)
20. REMPART (http://www.rempart.com/)

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INNOVATION AS A FACTOR OF COMPETITIVENESS OF SMALL AND MEDIUM – SIZED ENTERPRISES

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Abstract: Innovation is a fundamental way of preserving and developing position of an enterprise in a very dynamic, occasionally even unpredictable market. It is understood as introduction of new products to a production process or improvement of existing products. The principal objective of innovative actions undertaken by enterprises is to expand their product ranges, improve their quality, and increase the market share or competitiveness of an enterprise. This paper is intended to evaluate and analyse the effect of innovation on competitive standards of Polish enterprises. Statistical analysis is employed and relevant literature is reviewed.

Keywords: enterprises, innovation, competitiveness

1 Introduction

Innovation increasingly affects strength and competitiveness of enterprises. The ability to innovate is largely the foundation for gaining competitive edge in the market. Innovative businesses develop innovative markets, change structures of existing markets and destroy sources of revenue for earlier innovative businesses. A set of new technologies promotes technological changes, creates new jobs, and generates economic growth [Audretsch, 1995, pp. 441-457, Bartelsman, 2004].

Rates and directions of technology changes are determined by distribution and allocation of resources. In this context, access to capital plays a key role in enabling innovation [Dosi, 1990, pp. 299-319]. High barriers (including financial) to investors may arise from great costs of innovative investments and long periods of time between research and development work and commercialisation of its results. As a possible consequence, innovative firms collapse when faced with numbers of insurmountable obstacles

Regrettably, innovation of Polish enterprises remains relatively low. Persistence of such a situation can have significant adverse effects on innovation of Polish enterprises in future.

The question arises, therefore, of Polish SMEs' innovation and competitiveness. It is the goal of this paper to assess and analyse the impact of innovation on competitiveness of Polish businesses. To this end, literature and results concerning innovation and competitiveness are reviewed and the authors' research is then referred to a survey by the Public Opinion Research Centre and compared to concepts posited by the literature.

2 The concept and nature of innovation

Innovativeness, understood as the ability to create innovative spaces capable of generating and diffusing innovation, plays a major role in operations and development of contemporary enterprises. Innovation is explained as a process of a creative utilisation of knowledge, transformation of knowledge possessed by an organisation or obtained from outside into new products, services or processes [Cavagnoli, 2011, p. 111].

The concept of innovation first entered economic sciences in 1911. A number of definitions are proposed in the literature, the most famous being that by J. Schumpeter, who saw the point of innovation in using production resources in novel ways and thus in freeing them from current applications. Additionally, he regarded innovation as [Schumpeter, 1939, p. 84]:

- Launching of a new commodity or a commodity type that consumers have not had contact with before.
- Introduction of a new production method as yet untested in a given industry sector.
- Opening of a new market where an industry of a given country has not been present, regardless of whether the market has existed or not.
- Finding a new source of raw materials or intermediate products regardless of whether it has existed before or must be created.
- New organisation of an industry, e.g. creation of a monopoly.
- This approach is broad as it comprises technical, technological, marketing and organisational aspects.

Specialist literature offers numerous definitions of innovation, formulated both by theorists of economics and other scientific disciplines and by specialists - practitioners of business and management. It should be noted, however, that innovation remains hard to explicate and involves such notions as creativity, novelty or change [Sieradzka, 2013, p. 2729].

Innovation means a unique tool of entrepreneurship that provides resources with new opportunities for creating goods [Drucker, 2010]. This is improvement and development of existing production, operation and service technologies, introduction of new solutions to organisation and management, improvement and development of infrastructure, especially as it relates to collection, processing and supply of information. These are goods, services or ideas perceived as new, even if existing for long [Kotler, 1999, pp.15-28]. Innovation is a series of events which should ultimately, by implementation of a new solution, bring benefits to an organisation [Tidd, Bessant, 2009, p. 19].

The latest OECD [Oslo Manual] and Eurostat publications define innovation as: implementation of a new or significantly improved product (commodity or service), process, a new marketing or organisation method in business practice, in a workplace and external relations. Benefits from implementation of innovations are captured within an enterprise, which is therefore the centre of the innovation process. Thus, innovation policies must affect an enterprise, its conduct and operations. There is a variety of paths towards innovation. It may become an invention or a new approach to business, or improvement of an enterprise management system by implementing controls such as e.g. internal audit, which contributes to improvement and streamlining of the management system, and consequently to improvement of an enterprise's performance [Lament, 2011, pp. 166-186, Lament, 2013, pp. 247-255].

3 Determinants of innovation

The difference of innovation from routine activities of an enterprise is based on four pillars: innovativeness, complexity, risk and potential conflict [Peter, 2011, p. 47]. Innovative activities are characterised by a broad variety of activities and complicated cause-and-effect relationships.

Innovation dynamics of an enterprise, understood as intensity of innovative activities, are a result of macro-conditions connected to the so-called national innovation system (including priorities and instruments of innovation policies), maturity of an industry, etc., as well as micro-conditions relating to a given enterprise and its market environment (including enterprise size, its legal organisation, business profile, market standing, etc.).

These conditions determine the ultimate ability and tendency to innovate. They also cause that new products must be launched in the market highly cost-effectively and very fast. Innovations in an enterprise cannot be accidental – they should be analysed and evaluated on a systematic basis [Lohmann, 2010, p. 3].

Those enterprises that exhibit optimum feedback between potential and adequate motivations for development changes will

have the best conditions conducive to a rapid pace of innovative activities [Lubimow-Burzyńska,Marczuk, 2007].

Specialist literature proposes two types of classifications of innovation determinants, based on different criteria [Janasz, Kozioł, 2007, p.8]:

- external and internal determinants;
- materialised and non-materialised determinants.

Internal (endogenous) factors operate inside an enterprise and relate to its tangible and intangible resources. Views differ, however, concerning detailed composition of internal determinants of innovativeness [Bozic, Radas, 2009, pp. 438-450].

Table 1. Internal factors of enterprise innovation

Direct factors	Indirect factors
• Accumulated human capital resources • Accumulated knowledge resources, measured as spending on research and staffing with research personnel • Materialised knowledge resources in the form of plant and equipment purchased and buildings • Non-materialised knowledge resources in the form of licences and patents acquired • External knowledge resources assimilated as positive knowledge externalities from the environment and via cooperation with external organisations • Commercial resources • Organisational resources	• Financial resources of an enterprise • Debt of an enterprise • Size of an enterprise

Source: the authors' own compilation based on: [A. Wziątek-Kubiak, E. Balcerowicz, 2009, pp. 18-19].

External determinants of innovation, on the other hand, come from national and international environment of an enterprise and its resources. These determinants are therefore defined by an environment in which an enterprise operates, including [Wziątek-Kubiak, Balcerowicz, 2009, p.19]:

- Broadly defined institutional conditions (thus, not only entities but also rules determined by the existing legislation and inherited principles of operation), including policies of states and local authorities.
- Actions of other entities (including foreign suppliers and joint ventures) in the same geographical area and sector as an enterprise.
- Cooperation with market players – enterprises, research institutions, state and private, local and central institutions, etc.
- Behaviour of consumers and other market players.
- Innovation determinants are also divided according to the criterion of their materialisation. Non-material determinants are known as knowledge or intellectual resources (Table 2)

Table 2. Determinants of innovation according to the criterion of materialisation

Materialised factors of innovation	Non-materialised factors of innovation
• Machinery and equipment used in the production process • Materials and intermediate products • Telecommunications and IT infrastructure	• Patents, licence • Databases • Research • Human capital • Commercial resources reflecting perception of a firm • All organisational processes integrating units engaged in innovative activities and other parts of an enterprise

Source: the authors' own compilation based on: [A. Wziątek-Kubiak, E. Balcerowicz, 2009, pp. 20-21].

A range of studies link innovation determinants to the innovation potential of an enterprise, of which the latter actually takes advantage. The potential is seen as a multi-dimensional framework encompassing product, process, market, strategic and behavioural innovation [Wang, Achmed, 2004, pp.303-313]. An interesting approach to cultural aspects of the innovation potential is offered by C.B. Dobni, who distinguishes the intention to innovate, innovation infrastructure, market orientation and environment for implementing innovations [Dobni, 2008, pp.540-541].

Size of an enterprise appears as a major factor of enterprise innovation, particularly since opposing views of the matter are advanced: of high innovativeness of small businesses and, conversely, great innovativeness of large enterprises. A review of relevant literature on the subject confirms the company size, commonly measured with numbers of staff, is examined also in the context of innovation of especially manufacturing enterprises. H. Forsman and H. Rantanen, who undertake an extensive review of the literature, state the results concerning relationships between the broadly-defined development of innovation and business size do not produce any decisive conclusions. They cite a variety of results that differ from the received opinions, e.g. relate some research that concludes small and large companies are more innovative than medium-sized enterprises [Forsman, H. Rantanen, 2011, p. 28].

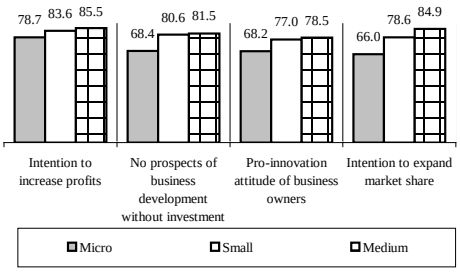
4 Innovation of SMEs

Market factors related to changes of consumer preferences, manufacturing and technological progress, and intensifying competition have considerable influence on levels of enterprise innovation. Regrettably, factors restricting innovative activities of enterprises operate in economies as well. A national fiscal system is the fundamental barrier [Svidroňová, 2014, pp. 344 – 353].

Based on the Report 'Polish SMEs on the way to modernity. A categorisation by size', basic reasons for and obstacles to innovation can be determined. The survey was conducted by the Public Opinion Research Centre on a cross-national sample of 1500 active private enterprises from 26 April to 1 August 2013. Businesses in all 16 regions and employing between 2 and 249 people were queried. Data in this publication suggest:

- The intention to improve profits, lack of a potential for business development without investing in innovation, pro-innovative attitudes of owners, and the will to increase market share were the most commonly stated reasons for implementing innovations.
- The intention to improve profits was indicated as the key reason for implementing innovation by 80% SMEs. Medium-sized businesses displayed most choices of this kind (86%) and micro-firms the fewest – 79%.
- Medium-sized businesses had most indications for all the remaining reasons for implementing innovations. The lowest share normally corresponded to the smallest firms. This means that far more factors (other than the four listed in the survey) are important for decisions to implement innovations made by this segment.
- The difference between indications by medium-sized and micro businesses was the most dramatic with regard to the intention to increase market share. 85% medium-sized and 66% small entrepreneurs selected this factor as the main reason for innovating. Thus, medium-sized companies were much more interested in improving their market standing than micro-firms, the latter being often minor market players.

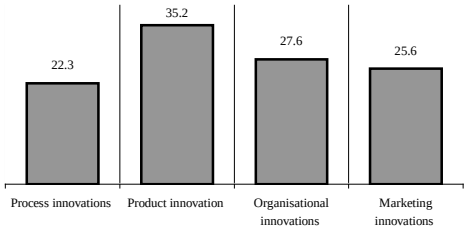
Fig. 1. Reasons for implementing innovations



Source: The authors' own compilation based on [Raport, 2013, p. 39].

In 2013, 51% SMEs declared they had introduced innovations to their businesses in 2010-2012. Product innovations were cited most frequently (implemented by 35% firms established before 2013). Process innovations accounted for a minimum share – introduced by merely 22% enterprises.

Fig 2. Types of innovations implemented in 2010-2012



Source: The authors' own compilation based on [Raport, 2013, p.37].

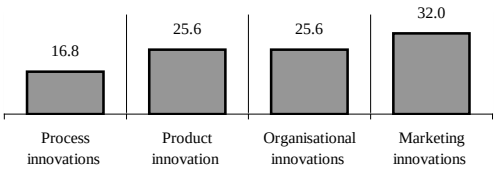
Medium-sized firms were distinct leaders of all innovation types. Nearly 60% introduced product and organisational innovations and almost a half predicted implementation of marketing and process innovations. Micro-enterprises had fewest affirmative indications in each group of innovations. In 2010-2012, as many as 73% of such businesses failed to implement any process innovation, 69% – organisational or marketing innovation, and 61% - product innovations [Raport, 2013, p. 36].

These authors carried out their own survey among a group of enterprises operating in the Mazovian region in October 2014. Respondents were interviewed by means of email surveys. The survey questionnaire (research tool) was distributed among 200 enterprises. In parallel, phone calls were made to invite to take part in the survey and to monitor its progress. In effect, 48 correctly filled questionnaires were returned concerning 2010-2014, which corresponds to feedback of 24.0%.

The survey was conducted among private enterprises, i.e. businesses owned by self-employed individuals and domestic companies.

Marketing innovations can be noted to prevail among those introduced. They averaged 32.0% in 2010-2014. Medium-sized enterprises implemented the most (approx. 53%) innovations of this kind. Entities with up to 9 workers showed the poorest performance, on the other hand. It is clear that fewest businesses taking part in the national survey implemented process innovations and the same is true of results generated by the authors. This can be caused by limited or absent financial resources for introduction of costly changes to methods of manufacturing or organisation.

Fig. 3. Types of innovations implemented in 2010-2014



Source: The authors' own research.

Our research implies spending to purchase machinery and equipment of similar parameters dominated in the entire period, growing by 4.0 percentage points. Enterprises restricted buying machinery for the sake of new technologies due to high prices. On average, expenditure on state-of-the-art machinery was 54.5% lower than the spending to purchase machinery of similar parameters. Investments targeted at environment protection deserve special attention. They exhibit a growth trend, constituting 13.6% of expenditure at the end of October 2014. Research and development spending is not and is not expected to be the central area of investment by SMEs in the face of the low scales of production and high costs of such research. The authors' results do suggest, however, that Polish entrepreneurs, though still to a limited extent (7.0% on average), understand the need of such investments to improve competitiveness of their businesses.

Table 3. Types of investments by the enterprises surveyed in 2010-2014 (%)

Item	2010	2011	2012	2013	2014
Machinery, equipment of similar parameters	14.2	15.4	20.0	15.8	18.2
State-of-the-art machinery, equipment	7.1	7.8	13.3	8.3	9.1
Licences, patents	-	-	6.7	11.5	9.5
Environment protection	11.4	13.0	13.3	10.5	13.6
Research into new products	7.5	7.7	6.3	9.4	4.5
Improvement of product quality	6.2	-	-	4.9	8.9
Access to the internet	7.1	8.2	13.5	9.6	9.2
Modernisation of office infrastructure	6.9	15.3	13.5	10.1	13.4
Introduction of new products/ change of product packaging	14.2	7.8	7.2	5.2	9.0

Source: The authors' own research.

5 Innovation and competitiveness of polish enterprises

The process of globalisation, growing competition and emergence of knowledge society all contribute to social, economic and technological changes. Innovation facilitates the process of adjustment to these changes.

Innovation is today the key condition of enterprise survival and development (the driving force of development). It is the fundamental means to gaining and maintenance of the competitive edge, a guarantee of a stable market position. It plays the role of a major instrument of competitive rivalry, i.e. aggressive actions involving 'penetration into' a market and defensive actions to protect an existing business from threats posed by current and potential competitors.

The market economy, via its immanent competition mechanism, provides natural stimulations to innovate, since this is by introducing innovation that an enterprise is capable of [Duda, Wolak-Tuzimek, 2014, pp. 213-216]:

- Improving and modernising its manufacturing processes, productivity and quality of labour;
- Better adapting to requirements of its environment and adequately developing competitiveness of its products;
- Liquidating barriers and improving efficiency and effectiveness of its resource allocation;
- Improving work organisation and methods, and conditions of safety at work;
- Replacing living labour with improved organisation and productivity of work.
- Innovation has become a special resource as it enables enterprising actions for effective allocation of material, financial and organisational resources actually and potentially in place and optimum configuration of competitive advantages.

Innovation occupies a special place among the factors conditioning competitiveness of enterprises. It decides not only the rate and directions of economic development but also largely determines forms and structure of global cooperation of enterprises. Thus, it is a factor determining competitiveness of enterprises in the context of globalisation.

The survey conducted by the Public Opinion Research Centre lets one note the diminishing importance of pricing as the factor building the competitive edge (a fall by 36.5 percentage points), as well as a rising significance of product quality (22.5 percentage points) and quality of customer service (5.8 percentage points). These tendencies prove enterprises correctly perceive the market, since buyers are increasingly guided by

quality not prices of products when making their decisions to purchase.

Table 4. Factors constituting competitive advantage of SME in the market

Item	2004	2005	2006	2007	2008	2011
Pricing of products/ services	51.9	57.6	64.3	57.3	52.0	15.4
Quality of products/ services	20.9	18.7	15.2	21.7	26.8	43.4
Quality of customer service/ continuing customer relations	9.5	9.6	5.9	5.6	5.5	15.3
Narrow specialisation, specialist knowledge and skills	5.8	6.2	4.2	4.3	5.2	8.3
Ability to adjust products/ services to customer requirements	5.6	4.7	5.5	2.9	3.8	9.8
Novel, innovative nature of products/ services	1.8	1.0	0.6	0.9	0.2	2.4

Source: The authors' own compilation on the basis of [Monitoring, 2013, p.67]

Analysis of innovation of enterprises in Poland continues to affirm the conclusion of low and even declining innovation standards of these enterprises. In 2008, merely 0.2% of businesses competed by means of innovative nature of their products. Three years later, the ratio rose by 2.2 percentage points to reach the highest level (2.4%) in the entire period under discussion. Our own results appear to point to a dwindling importance of price (by 6.8 percentage points) and a growing role of product and service quality (by 9.2 percentage points). An identical regularity is confirmed by results of the national survey.

Table 5. Sources of enterprises' competitive advantage in 2010-2014 (%)

Item	2010	2011	2012	2013	2014
Price of products/ services	33.3	27.3	24.1	25.0	26.5
Quality of products/ services	39.1	45.4	43.7	47.4	48.3
Innovativeness of products	6.7	8.2	5.4	6.2	6.2
Originality of products	4.3	2.6	2.6	2.5	2.6
Management staff	3.7	3.1	3.2	3.0	1.8
Other	12.9	13.4	21.0	15.9	14.6

Source: The authors' own research.

A limited impact of product innovativeness and originality on competitiveness of enterprises can be observed. A similar dependence emerges from the CBOS survey. It should be pointed out, though, that enterprises operating in the Mazovian region competed by means of innovativeness and originality of their products to a greater extent. These indicators equalled 6.5% and 2.9% on average.

This low standard of innovation should be attributed to attitudes and strategic choices of enterprise management. Searching for and raising financial capital continue as the prevailing strategic objectives. Enterprises avoid actions which are capital-consuming, risky, and bring benefits delayed in time. Investments into research and development are certainly one of those. In addition, as the centrally planned economy collapsed, specialist institutes that used to support enterprises in the field of state-of-the-art, e.g. technological knowledge, vanished from the market. This was exacerbated by loosening ties of cooperation with the world of science. Poland's joining the European Union showed that Polish enterprises lack confidence to compete in international and global markets.

5 Conclusions

Issues of enterprise innovation and competitiveness are subjects of numerous discussions, both among scientific and business practitioners. Enterprises implementing innovations are often said to be far more profitable that those which do not spend on innovating. In effect, businesses introducing innovations should be more competitive in the market. Observations of this kind made these authors compare empirical results with the propositions offered by specialist literature.

The survey conducted by the Public Opinion Research Centre implies Polish SMEs are normally driven to innovate by: economic motivations, that is, the intention to raise their profits or market share; and by pro-innovative attitudes of entrepreneurs and the latter's perception of the dependence between development and innovativeness of their business. This holds true for all the enterprise gropings, both micro, small and medium-sized.

In 2013, 51% SMEs declared they had introduced innovations to their firms in 2010-2012. Product innovations were the most common (35%), with process innovations enjoying minimum popularity with entrepreneurs - implemented by merely 22%. Enterprises active in the Mazovian region also most seldom invested in process innovations (16.8%), with marketing innovations being the most popular (32.0%).

Polish SMEs had pursued low-price strategies, which do not foster innovation, until 2010. The share of enterprises competing by means of quality can be seen to rise only since 2011. The surveys conducted by both the Public Opinion Research Centre and by these authors point to a diminishing role of product pricing and a growing role of quality as the factor laying foundations for an enterprise's competitive edge, which should bolster innovativeness of enterprises.

Regrettably, enterprises operating both in Mazovia and in the rest of Poland competed by means of product innovation and originality or with know-how to limited extents.

Innovativeness of enterprises should enhance their competitiveness. The economic theory suggests a close dependence between those two factors. However, the surveys conducted by both the Public Opinion Research Centre and by these authors demonstrate the role of product innovation and originality in building competitive edge of Mazovian and Polish SMEs is minor. Until recently pricing and then quality of products and services have been the fundamental competitive factors. This may be a reason for a low standard of innovation and thereby of competitiveness of Polish SMEs.

Literature:

1. Audretsch, D.B.: *Innovation, growth and survival*. International Journal of Industrial Organization 13 (4), 1995. 441-457 pp. ISSN 0167-7187.
2. Bartelsman, E. et al.: *Microeconomic evidence of creative destruction in industrial and developing counties*. New York : World Bank Policy Research Paper No 3463, 2004.
3. Bozic, L., Radas, S.: *The antecedents of SME innovativeness in an emergingtransition economy*. Technovation, Vol. 29, Issue 6-7, 2009. 438-450 pp. ISSN 0166-4972.
4. Cavagnoli, D.: *Conceptual Framework for Innovation*. An Application to Human Resource Management Policies in Australia. Innovation: Management, Policy & Practice, Vol. 13, Issue 1, 2011. 111 p. ISSN 1447-9338.
5. Dobni C., B.: *Measuring Innovation Culture in Organizations*. European Journal of Innovation Management, Vol. 11, Issue 4, 2008.540-541 pp. ISSN 14601060.
6. Dosi, G.: *Finance, innovation and industrial change*. J Econ Behav Organ 13, 1990.
7. Drucker P.F.: *The Practice of Management*. HarperCollins, 2010.
8. Duda, J., Wolak-Tuzimek, A.: *Determinants of Innovative Activities of Polish SMEs*. In Stefko R., Frankovsky M., Vraves J. (eds.), Business, Management and Social Sciences research, Bookman s.r.o. for Faculty of Management, Presov: University of Presov, 2014. 213-216 pp., ISBN 978-80-8165-052-9.
9. Forsman, H., Rantanen, H.: *Small Manufacturing and Service Enterprises as Innovators. A Comparison by Size.* European Journal of Innovation Managemen, Vol. 14, Issue. 1, 2011. 28 p., ISSN 14601060.

10. Janasz, W., Kozioł, K.: *Determinanty działalności innowacyjnej przedsiębiorstw*. Warszawa: PWE, 2007.8 p. ISBN 83-208-1658-0.
11. Kotler, Ph.: *Marketing Management: Analysis, Planning, Implementation, and Control*. Prentice Hall, 1999. 15-18 pp.
12. Lament, M.: *Control mechanisms within an enterprise*. In Wolak-Tuzimek A., Sieradzka K. (ed.), *Enterprise facing the challenges of the global economy*, Radom: Politechnika Radomska, 2011. 166-167 pp., ISSN 1642-5278.
13. Lament, M.: *Ocena wypłacalności zakładu ubezpieczeń a system informacyjny rachunkowości*. Warszawa: Cedetu.2013. pp.247-255, ISBN 978-83-7556-595-9.
14. Lohmann, C.: *Innovations-Controlling.* RKW Rationalisierungs- und Innovationszentrum der Deutschen Wirtschaft e.V., Eschborn: Faktenblatt 9/ 2010. 3 p. ISSN 1619-7372
15. Lubimow-Burzyńska I., Marczuk M.: *Innowacyjność w samorządzie terytorialnym*. In G. Bartkowiak (ed.), Szanse rozwoju ziem zachodniego pogranicza - aspekt regionalny i globalny, Zielona Góra : Zachodnia Wyższa Szkoła Handlu i Finansów Międzynarodowych im. Jana Pawła II, 2007. 35-45 pp. ISBN: 978-83-89932-03-7.
16. *Monitoring kondycji sektora MSP w latach 2010-2012. Słabe i mocne strony mikro, małych i średnich przedsiębiorstw. Raport z wyników badań*. Warszawa: PKPP Lewiatan, 2013. 67 p.
17. Oslo Manual, Available at http:// www.oeced.org [cit. 12.11.2014].
18. Peter, J.: *Innovationscontrolling: Der Einsatz von Kennzahlen und Kennzahlensystemen*, Hamburg : Diplomica Verlag GmbH, 2011. 47 p. ISBN 978-3-8428-5569-4.
19. Raport *Polskie MSP na drodze ku nowoczesności. Ujęcie według klas wielkości.* Available at http:// www.parp.gov.pl [cit. 27.11.2014].
20. Schumpeter, J.A.: *Business Cycles. A Theoretical, Historical and Statistical Analysis o f the Capitalist Process.* New York-London: McGraw-Hill, 1939. 84 p.
21. Sieradzka, K.: *Innovativeness of enterprises in Poland.* Acta Univarsitatis Agriculturae et Silviculturae Mendelianae Brunensis, Vol. LXI, No. 7, 2013. 1729 p. ISSN 1211-8516.
22. Svidroňová, M.: *Tax laws affecting the sustainability of NGOs in Slovakia*. In Current Trends in Public Sector Research XVIII. Brno: Ekonomicko – správní fakulta, Masarykova univerzita, 2014. 344-353 pp. ISBN 978-80-210-6111-3.
23. Tidd, J., Bessant, J.: *Managing Innovation. Integrating Technological, Market and Organizational Change.* John Wiley & Sons, Ltd. England, 2009. 19 p. ISBN 978EUDTE00010.
24. Wang, C.L., Ahmed, P.K.: *The Development and Validation of the Organisational Innovativeness Construct Using Confirmatory Factor Analysis*. European Journal of Innovation Management, Vol. 7, Issue 4, 2004. 303-313 pp. ISSN 14601060.
25. Wziątek-Kubiak, E. Balcerowicz, L.: *Determinanty innowacyjności firm w kontekście poziomu wykształcenia pracowników*. Warszawa: PARP, 2009. 18-21 pp.

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SOME CONTEXTS OF PUPILS´ PRIMARY SOCIALIZATION AND VALUE MANIFESTATIONS

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This contribution has been created within the project SGA UJEP 43201 15 0005 01 in Ústí nad Labem – The Role of the Family in the Pedagogical Context.

Abstract: The primary socialization within the realm of the family influences the level of secondary socialization at school and subsequently in society and this influence is of cardinal importance. This contribution deals with some features of such socialization, in a selective way, with the results of a research study dealing with a monitoring of value manifestations on the part of pupils in the fourth, fifth and sixth forms of primary education in the Czech Republic, as it relates to some selected characteristic features of their family background. With the help of Pearson's chi-squared test it is possible to show, by means of actual situations, those values the family implanted in the pupil's personality. Thus this article concerns the current issue of forming the value vision of the world and thereby the child's positive adjustment to this world.

Keywords: primary socialization within the family, pupils´ value orientation, middle school age, characteristic features of families, research study results.

1 The Family – a Background to the Value Vision of the World

The family is the first community that influences the pupil in the process of forming the basis for its values arising from experience. In so doing, it is not only a matter of isolated aspects, but of integrally related elements of the child's complex motivational whole in which its needs are interconnected with interests, emotions, attitudes, targets and an overall sense of purpose (Čáp, Mareš, 2007). It is the very family which, by means of its attitudes, directs the child towards everything it considers significant, valuable, for which it is necessary to strive, what must be protected, etc. Thus, the family can be regarded as the child´s first socializing environment or mediator. The attitudes on the part of the family to values (time, love, honour, work, health, egoism, consideration towards others, creativity, money, etc.) expresses its value orientation and has a significant influence not only on its life style and its integration into society, but also on a specific value mission directed towards those children living in these families (Hábl, 2011).

The formation of values is always a dual process in which the family strives for the child´s adaptation to its family rules and simultaneously the child's level of self restraint. This is an interactive process in the course of which a personality with internalized values is being formed and concurrently the cultural continuity is being transferred by means of those values acquired within this realm. During the course of this process, the family community is also at the mercy of influences emanating from the wider external environment with which the child's principles and values are confronted. Every disharmony in family values (i.e. for instance honour, love, diligence, etc.) with the values of the society in which they operate (for instance the one in which it is not worth cheating, lying, or not working, etc.) is a challenge to the level of moral maturity on the part of the family (Eyrovi, 2000). The family is the most significant social microstructure, within which the process of the integration of an individual are put into effect (Dunovský, 1986). For that reason, and justifiably so, the family is frequently designated as a crossing point in the life of an individual and society. This applies mainly in relation to the child, its development and socialization, in which the family plays a decisive and irreplaceable role. Thus the family, as a primary agent of socialization, has a permanent influence upon the individual's development and self-awareness (Jedlička *et al.,* 2004). By means of its life style, the family significantly anchors the conception of values and priorities by means of which the child perceives and eventually also evaluates the world.

During the school age, the child falls into a period of external, dependent morality, which results from the analysis of the child's moral judgment (Vacek, 2008). The child goes through this period from the age of six until ten or eleven years (During this period, one tendency becomes evident in children - to look at duty and some related factors, regardless of any external circumstances in which this individual finds itself. The child perceives and understands its duties and rules by means of authority as correct or wrong. It is impossible to overlook the fact that it is concerned with a dual process. On the one side there is a development of moral deduction and the individual's character is determined by laws arising from the sequence of developmental stages, associated with the process of its maturation. On the other hand, however, this process with increasing age, is influenced more and more significantly by the process of socialization and education. Duality of this moral development is confirmed also by Kohlberg in the theory of the three basic groups of moral development with six developmental stages (Helus, 2007).

Upon entering school, the child's value orientation can be understood as an imprint of the value orientation of its family. With the child's advancement to higher forms and with its total development, we can observe the maturation of the originally acquired values into its own values, which are compared with the value hierarchies of its peers and other persons of the same age. According to Kohoutek, (2002) the value orientation determines man's value orientation and life style since it reflects the sense and aim of man's actions. In his self-awareness, the value orientation manifests itself by opinions and attitudes to various facts associated with the preservation of man as a living being (i.e. physical and mental health), with the development of man as a personality (life principles and tenets), as well as man's self-awareness (experiences and feelings). In this context of the following well-known typology of value orientation, the following aspects are usually dealt with:

a) Theoretical – its aim is to acquire learning , the value is cognition,
b) Economic – its aim is self-protection, the value is usefulness,
c) Aesthetic – its aim is looking for harmony, the value is beauty,
d) Social – the aim is doing good, the value is love,
e) Political – the aim is manipulation of other people, the value is power,
f) Religious – the aim is self-interference, the value is unity with God.

Value orientation according to Sekera (1994) has been dealt with in the following inquiry.

2 Methodology of Research

This Research project has been carried out in eleven schools of the Ústí and Litoměřice Districts, where a sample of 480 pupils of fourth, fifth and sixth forms has been monitored. The respondents age distribution was characterised by 24% representation of nine-year old pupils, 32% representation of ten-year old ones, 29% representation of eleven-year olds and 15% representation of twelve-year old pupils. The distribution of the sampling set according to sexes was relatively/comparatively uniform. Boys created 53 % and girls 47 % of respondents. Basic arbitrary variables have been represented by the parents´ educational level, the type of the family (The categories of the complete, incomplete and complemented family[1] has been made use of in the tested sample of pupils), the number of siblings in the family, the pupils´ sex and the school class. By means of the monitored dependent variables manifestations from pupils´ values, such areas were categorized as performance, moral and economic values, the power of influence, which was assessed by means of the four-degree Likert scale: *Strongly Agree, Agree, Disagree, Strongly Disagree* (the tables to make it transparent show the aggregate of positive and aggregate of negative pupils´ reactions). In terms of research, the dependent variables

[1] For more details see Vomáčková, Cihlář (2013)

characterizing qualities and of the pupils themselves from the manifestations acknowledged by their families. To prove statistically significant differences between the sets, or in case of the impact of various factors, we have applied an important test (Pearson Chi–square test). The application of this test resulted from the character of the acquired data. A significance level has been left at the standard 5% level (significant under the circumstance that $p<0.05$). The zero hypotheses concerning independence between variables have been rejected in case that the valued dropped below the value of 0.05.

3 Selection of the Resulting Findings

3.1 Context of the Parents´ Education

In general, the parents´ education is considered as one of the factors giving preferential treatment to the child in secondary socialization. This fact applies, in particular, to the child´s potentialities and to the parents´ abilities, just as their willingness to create conditions for children's development. In all the monitored relations, (manifestations of the values of the pupils themselves, as well as those of their parents) we have shown a statistically significant influence of the parents´ education level as an independent variable in two cases. In both of them, these were manifestations belonging to the category of performance values. The parents´ education level proved to be statistically significant in relation to the scope of pupils´ passively spent time in those pupils from the monitored sample (Pearson Chi-square: 27.9587. p=0.005614). A positive reaction (aggregate of the categories Strongly Agree and Agree) to the assertion: I spend my time sitting passively in front of the TV set or computer, or at the radio, etc., prevailed over the negative reaction with students from the families of both university educated parents (ratio 60 : 40), of one secondary –school educated parent and one parent with only primary education (ratio 77: 23), and of both parents with primary education (ratio 54 : 46). In the case of students coming from a family of one university educated parent and one secondary-school parent, it was to the contrary, i.e. a negative response prevailed over a positive one (ratio 54 : 46); and among those students coming from families with both secondary educated parents, the reactions were essentially equivalent (ratio 50 : 50). Table 1 provides documentary evidence of this fact.

Table 1: Parents´ education and the passive spending leisure time of their children

Parents´ education	Strongly Agree, Agree	Strongly Disagree, Disagree	Difference
Both Univ. Edu.	60.2 %	39.79 %	20.41 %
Univ. + Sec. School Edu.	46.15 %	53.84 %	-7.69 %
Both of them Sec. School Edu.	49.77 %	50.23 %	-0.46 %
Sec. School + Prim. School Edu.	76.92 %	23.08 %	53.84 %
Both Prim. School Edu.	53.65 %	46.34 %	7.31 %

Thus, surprisingly, the most active pupils from the families of two university educated parents were not present in the context of performance values in the tested sample. It is possible to deduce that with this category of parents it was the work career and the heavy work load that created more favourable conditions to spending passive leisure time for their children than it is in the families with one university educated parent and one secondary school educated parent, where it is possible to harmonise the career of one of the parents with the care of the other parent of the family. Children emanating from university educated parents find themselves in a situation comparable to those children of those parents having only a primary school education, where the categorical rejection of passively spent leisure time (*Strongly Disagree*) was the highest of all groups (32 %). On the contrary, the most jeopardized pupils in that sense were children from the families of one secondary school parent and one parent with primary school education, in which passivity has been confirmed in nearly 77 % of the cases. In this case, also from the point of view of the prevailing agreement with rejection of the given statement, it is a signal of the growing danger of the uncontrollable impact of multimedia with all its consequences on the pupils´ psyche, their value orientation, speech, attention, etc. (Helus, 2009).

In compliance with the above-mentioned level of activity or passivity on the part of the pupils themselves during their leisure time, we have to mention the impact of the factor relating to active participation on the part of their parents in their children's free time activities (for instance their riding bicycles together, reading, singing, playing cards together; some parents also bring children to their workshops, take part in their performances, competitions, concerts, etc.) This again embodies one of the performance values, this time examined from the point of view of their diversely educated parents (Pearson Chi-square: 21.3851 p=0.045033). In this case, the result of all questioned pupils of all groups of diversely educated parents is expressed in terms of the prevailing degree, or if they spend their leisure time actively, their parents also participate in the leisure time spent in that manner (aggregate of Strongly Agree and Agree). Thus, the pupils´ positive reaction in all such cases exceeded the negative reaction, but within a different category, such as 48% enhancement among university educated parents, 60% enhancement in the case of one university educated parent and the other in that of secondary school educated parent, 47% enhancement in secondary school educated parents, 31% enhancement with one parent secondary school educated and the other possessing only primary education, 26% enhancement where both parents are only primary school educated. The highest score in the tested sample was again exhibited in the case of parents represented by one university educated person and one secondary school educated person, followed by both parents with university education and both with secondary school-educated parents. Provided that pupils of these parents spend their leisure time in an active way, this activity is supported, carried out or supervised, in a prevailing manner, also on the part of their parents. This result is documented by Table 2.

Table 2: Parents´ education and their level of participation in their children's free time

Parents´ education	Strongly Agree, Agree	Strongly Disagree, Disagree	Difference
Both Univ. Edu.	74.08 %	25.92 %	48.16 %
Univ. + Sec. School Edu.	80.00 %	20.00 %	60.00 %
Both of them Sec. School Edu.	73.48 %	26.52 %	46.96 %
Sec. School + Prim. School Edu.	65.38 %	34.62 %	30.76 %
Both Prim. School Edu.	62.79 %	37.21 %	25.58 %

Education, on the contrary, manifested itself as a variable for example in relation to the cultivation of work cooperation within the family, the ability to achieve credits and to the formation of the family's "team spirit". The pupils were asked to confirm whether it holds true within their families that "He that eats the kerner must crack the nut" (or simply "No pain, no gain"). Their responses have not revealed any statistical connection with the achieved education level on the part of their parents (Pearson Chi-square: 14.5727, p=0.265657) and it is possible to hypothetize, that parents cultivate the ability to achieve or gain credits (or have credit) in their childrens'free time acitivity, irrespective of the achieved level of education. In spite of that the greatest emphasis on the ability to gain credits (the aggregate of Strongly Agree and Agree) was laid, according to respondents, on the part of one secondary school educated parent and the other, primary school educated (92 %) followed by both university educated parents (81 %). On the contrary, the weakest emphasis on the ability to achieve credits was placed on pupils of the monitored sample (the aggregate of Strongly Disagree and Disagree) in the case of their parents represented by one secondary school educated parent and the other university educated (25 %) and in the situation where both parents possess primary education (23 %). The data is exhibited in Table 3.

Table 3: Employing the principle of "No pain, no gain" in the context of parents´ education level

Parents´ education	Strongly Agree, Agree	Strongly Disagree, Disagree	Difference
Both Univ. Edu.	80.56 %	19.44 %	69.45 %
Univ. + Sec. School Edu.	74.55 %	25.45 %	69.10 %
Both of them Sec. School Edu.	79.13 %	20.87 %	72.61 %
Sec. School + Prim. School Edu.	92.31 %	7.69 %	92.31 %
Both Prim. School Edu.	76.74 %	23.25 %	62.79 %

3.2 Family Classification Context

All current problems are projected into the type of family which possess all characteristic features in it. Thus the family can be nuclear, marital, two-generational, intimate relational or privately individualized (Helus, 2007). The family as such is "expressed as" the child's personality and behaviour in relation to other people, to its activities as well as his attitude to himself. Out of all the tested relations of the family type to the value manifestations of pupils, some statistically conclusive relations have been demonstrated relating to the parental pattern in its approach to life (manifestation of the child´s identification with the parents´ values, performance achievements and /or economic orientation - Pearson Chi-square: 15.9455, p=0.014055) and in the case of actively spent time on the part of parents with their children (manifestation of parental priority- "a child", their willingness to actively participate in the sharing and development of the child, its enrichment and preparation for life - Pearson Chi-square: 21.4946, p=0.001496).

In principle, the parental pattern accompanies the conception of all three monitored groups and suggests the pupil's identification with his parents´ approaches to life in the sense of "I wish to be and do things like them". The strongest disagreement with this case has been expressed by pupils emanating from incomplete families (more than one fifth), although just like in the remaining two types of families (complete and completed) identification with the parental approach to life has prevailed even here. The fact that the degree of identification in the completed families has exceeded the degree of identification (aggregate of Strongly Agree and Agree) in complete families by approx 10 per cent points, has been evaluated as interesting – see Table 4.

Table 4: Type of the family in connection with the acceptance of parental models on the part of pupils

Type of the family	Strongly Agree, Agree	Strongly Disagree, Disagree	Difference
Complete Family	85.15 %	14.84 %	70.31 %
Incomplete Family	77.50 %	22.50 %	55.00 %
Completed Family	95.91 %	4.08 %	91.83 %

In the course of the research, a statistically significant connection with the level of participation of these families in pupils´ free time activities manifested itself in a similar fashion as with the independent variable of education level with respect to the type of family. The amount of time which, in this case - seen through the child´s eyes – this type of family devoted to their children (aggregate of *Strongly Agree* and *Agree*) in the research sample was significantly decreasing in the case of complete families (77 %) and to those families additionally completed (53 %). The least leisure time spent together, according to the pupils´ reaction, was revealed in completed families (47 %) and in incomplete families (34 %) – see Table 5. In this case one question remained unanswered– whether the time level on the part of the family with respect to active participation on the part of the family in the recreational time spent together supports, along with the level of the energetic approach to the course of their children's life, including also to the overall development of their potentialities. Significant is that the subject of this question was not focused on how many diverse activities the free time of parents had been spent with children (neither had the independently developed activities of children been monitored concurrently and without their parents' participation). The lowest participation level on the part of the family completed for spending the pupils' leisure time in a manner that it does not have to apply, was expressed, in terms of their value orientation, adverse effects - even in the context of the above mentioned pupils´ identification with their parental patterns. Among other things it depends on the family "control mechanisms" and on the level of purposefulness and independence of the pupils themselves.

Table 5: Type of family in the context of the jointly spent leisure time

Type of the family	Strongly Agree Agree	Strongly Disagree Disagree	Difference
Complete Family	76.97 %	23.03 %	53.94 %
Incomplete Family	66.25 %	33.75 %	32.50 %
Completed Family	53.06 %	46.94 %	6.12 %

It is possible to relate the above stated consideration even in oppostion to the monitored contexts with regard to the type of family and the reaction of pupils to the following statement: "My parents have never had time for me". By not being able to prove statistical connection between both the variables (Pearson Chi-square: 11.3519, df=6, p= 0.078102), we have confirmed at least certain equivalence among the monitored types of families. It means that the questioned pupils similarly expressed their own indifference as well as their parents´ (i.e. time devoted to their children) irrespective of the type of the family they came from – see Table 6.

Table 6: From the point of view of the family type "my parents have never had time for me"

Type of the family	Strongly Agree, Agree	Strongly Disagree, Disagree	Difference
Complete Family	18,79%	81,22%	-62,43%
Incomplete Family	22,50%	77,50%	-55,00%
Completed Family	24,49%	75,51%	-51,02%

Irrespective of the matter and to what extent the pupils comply with the statement "My parents have never had time for me" increases in complete families (19 %) via incomplete families (23 %) up to (additionally) completed families (24 %) (the aggregate of *Strongly Agree* and *Agree*) and no matter how much the degree of rejection of this statement decreases proportionally, it is of no avail that the completed family would be different in terms of statistical significance than in the case of the other two monitored types of families. In spite of the fact that the results offer a couple of significant negative deviations, for instance the categorical rejection of the monitored statement (*Strongly Disagree*), which is revealed among individual types of families, i.e. from complete up to completed families, a decreasing difference min. by 10%.

3.3 The Context of the Number of Siblings

The order of birth and the number of siblings are considered to be very significant factors in relation to the child´s development. Oerter and Montada (1995) point out advantages and shortcomings of the upbringing within families with one or two parents and in multiple families. The present development suggests that any compensation or disadvantages for children coming from multiple families can be much more difficult than with the so called manifestations of being the only child (Helus, 2009, p. 75). In the tested set of pupils, the statistically significant context of becoming a sibling showed itself with the family sharing work and entertainment (Pearson Chi-square: 25.3656, p=0.013191) and with the intolerance toward deceit (Pearson Chi-square: 20.3754, p=0.015739).

The highest level was among single children (91 %) who made a positive statement in connection with the family with respect to sharing and cooperation and they were closely followed by pupils with three siblings (90 %) and pupils with two siblings (87 %) – see Table 7. It is possible to assume that "social isolation/loneliness" on the part of the only-child family, is compensated by the highest possibility on the part of the parents

by the level of accent placed on the component of the work they are to carry out at home, by the level of their participation in recreation or entertainment. An impression may arise from the above-mentioned statements that single children/the only-child situation are considered more likely to emulate their parents. In families with more members, it is possible to suppose that the prime motive for the degree of family communicativeness is based rather on the demand for social justice, i.e. that everybody gets the same duties within the family, and that everybody is given a chance. Maintaining a certain distance (81 %), pupils with only one sibling reacted positively to the necessity of the family sharing work and entertainment and surprisingly the weakest positive reaction was expressed by pupils with three or more siblings (78 %), who also demonstrated most frequently occurring negative reactions (the aggregate of Strongly Disagree and Disagree exceeded 22 %). It is highly probable that the most inconclusive result regarding the number of these respondents in the group has contributed to this result as well. However in spite of that, one question remains open – what types of family communities these were in the specific case and or whether some other influences, rather than the number of siblings, were not also projected into the result, such as cultural traditions. The expectation that a directionally proportional result will arise, i.e. the more children within the family, the greater the accent on cooperation and collaboration in terms of work, entertainment, has not been confirmed in this research on the basis of the pupils´ statements.

Table 7: The context of the number of siblings and the family attitude towards the sharing of work and entertainment

Number of siblings	Strongly Agree, Agree	Strongly Disagree, Disagree	Difference
0 Sibling	91.23 %	8.77 %	82.46 %
1 Sibling	80.58 %	19.43 %	61.15 %
2 Siblings	86.73 %	13.26 %	73.47 %
3 Siblings	89.65 %	10.34 %	79.31 %
> 3 Siblings	77.78 %	22.23 %	55.55 %

The relation between the number of siblings in the family and the rate of the development of the learner's tolerance towards deceit (i.e. I can succumb to temptation and secretly take what does not belong to me) has demonstrated a statistically significant difference as well. Due to the low percentage on the part of pupils with more than three siblings, this group has been eliminated from this research – see Table 8.

Table 8: Context of the number of siblings with respect to the tolerance of deceit/fraud

Number of siblings	Strongly Agree	Agree	Strongly Disagree	Disagree
0 Sibling	5.26%	7.02%	80.70%	7.02%
1 Sibling	1.08%	7.55%	77.70%	13.67%
2 Siblings	3.06%	3.06%	72.45%	21.43%
3 Siblings	10.34%	6.90%	62.07%	20.69%

From the results, it is evident that however dominant the categorical rejection (*Strongly Disagree*) of the misappropriation of things belonging to another person is, in all sibling combinations, a decline is in the case of the only–child family to that of three siblings in a family is also evident. The difference between these extreme positions is demonstrated in nearly 20% and it necessarily raises the question as to what lies behind the revealed discrepancy. According to the results of the tested sample, the hypothesis arises that in those families with more members, their children are less immune to temptation, they succumb more easily and more frequently to temptation and a priori admit to the misappropriation of things to the greatest extent (*Strongly Agree* 10 %).

The above–mentioned factors, however, must be placed into the context of a family with more members, which creates a wider range of social relations, the tangled network which provides an even wider room for temptation and falling prey to it (see the action radius of new things instead of the worn-out old one, i.e. modern things versus the old-fashioned one, the thing that is dirty versus the clean one). In the family community we do not speak about strangers but closely related persons and the seriousness of the act described as "taking something that does not belong to me secretly" acquires a different character than for instance in the school setting. Going to the cinema and taking a pair of new shoes belonging to an older sister without her knowing about it, is not the same as taking secretly the fellow student's pair of new shoes when leaving school. The difference is evident not only from the temporal point of view (transitivity versus permanence of the consequence of the action defined as "misappropriation" of a thing belonging to someone else), but also the relational point of view. In this context the being found out would reveal benevolence and more proactive behaviour towards close persons within the family environment than the tolerance of deceit committed on a stranger.

The sibling, however, did not succeed in statistically confirming any other connections of the monitored independent variable, i.e. for instance, confirmation of the relationship from the category of economic values, when pupils answered the question whether they act economically (i.e. whether they switch off lights, do not waste water, do not ask constantly for new clothes, whether they are finishing the meals on their plates, etc.). The expectation of the tendency of becoming more economical in connection with the growing number of children within the family was the initial hypothesis. As Table 9 suggests, this hypothesis has not been confirmed (Pearson Chi-square: 14.6769, p=0.259601).

Table 9: In the context of the number of siblings with frugal education

Number of siblings	Strongly Agree, Agree	Strongly Disagree, Disagree	Difference
0 Sibling	85.96 %	14.04 %	71.92 %
1 Sibling	81.66 %	18.35 %	63.31 %
2 Siblings	78.57 %	21.43 %	57.14 %
3 Siblings	79.31 %	20.68 %	58.63 %
> 3 Siblings	77.78 %	22.23 %	55.55 %

4 Conclusion

A family categorised as a primary group, is a unique community which directs and forms a child in a significant manner. The family setting with its "laws" imprints on the child's consciousness in its heart and at the same time significantly determines its behaviour, not only for the present, but also in the distant future. It is possible to say that a positive or negative nature of the child is significantly formed within the family. It holds true for all key value relations (Bedrnová, Nový, 2009):

- to other people (for instance amicable behaviour or conduct, ability to cooperate, trustfulness, benevolence or toleration, self-sacrifice, sincerity, but in a similar way those values such as animosity, strictness, lying, austerity, domineering behaviour, coarseness, meanness);
- to the community, to the world (e.g. conscientiousness, morality, humanism, altruism, respect for nature, as well as for chauvinism, depravation/immorality, nationalism),
- to one´s own activity (for instance attentiveness, diligence, persistence, conscientiousness, accuracy, similarly for those such as laziness, indolence, negligence, superficiality),
- to him/herself (for instance modesty, self-criticism, self-esteem, in a similar fashion to conceitedness, egotism, pride, lack of common sense).

Parents - as the closest persons - are responsible for the advancement of the values which strengthen humanity in children and along with humanity also their positive tuning and an active approach to their future development (not only for the period of their school attendance). An evident trend during the last years – that of transferring family duties to school – can be considered, from this point of view, to be the most harmful and deforming relation of a child with respect to all the above-mentioned categories since it relegates the role of school in opposition to that of the family instead of allowing both communities to have an integral effect on the development of the pupils´ system of values.

Literature:

1. BEDRNOVÁ, E., NOVÝ, I. a kol. *Psychologie a sociologie řízení.* Third completed ed. Praha: Management Press, 2009. ISBN 978-80-726-169-0.
2. ČÁP, J., MAREŠ, J. *Psychologie pro učitele*. Ed. 2. Praha: Portál, 2007. pp. 655. ISBN 978-807-3672-737.
3. DUNOVSKÝ, J. *Dítě a poruchy rodiny.* Praha: Avicenum zdravotnické nakladatelství, 1986. pp. 129.
4. EYROVI, L., R. *Jak naučit děti hodnotám*. Praha: Portál 2000. 160 s. ISBN: 80-7178-360-9.
5. HÁBL, J. Character Formation: A Forgotten Theme of Comenius's Didactics. *Journal of Education and Christian Belief*, vol. 15, no. 2, 2011. ISSN: 1366-5456.
6. HELUS, Z. *Dítě v osobnostním pojetí: obrat k dítěti jako výzva a úkol pro učitele i rodiče*. Ed. 2. Praha: Portál, 2009. pp. 286. Pedagogická praxe. ISBN 978-80-7367-628-5.
7. HELUS, Z. *Sociální psychologie pro pedagogy.* 1st ed., Praha: GRADA Publishing, Praha 2007. pp. 280. ISBN 978-80-247-1168-3.
8. JEDLIČKA, R., KLÍMA, P., KOŤA, J., NĚMĚC, J., PILAŘ, J. Děti a mládež v obtížných životních situacích. Nové pohledy na problematiku životních krizí, deviací a úlohu pomáhajících profesí. Praha: Themis, 2004. pp.478. ISBN 80-7312-038-0.
9. KOHOUTEK, R. *Základy užité psychologie.* VUT Brno: FinalTisk, 2002. pp. 544. ISBN 80-214-2203-3.
10. OERTER, R., MONTADA, L. (eds.) *Entwicklungs-psychologie.* Weinheim: Beltz 1995.
11. SEKERA, J. *Hodnotová orientace a mezilidské vztahy v pedagogických sborech*. Repronis Ostrava: 1994, pp. 119. ISBN 80-7042-3.
12. VACEK, P. Rozvoj morálního vědomí žáků, metodické náměty k realizaci průřezových témat. Praha: Portál, 2008. pp. 126. ISBN 978-80-7367-386-4.
13. VOMÁČKOVÁ, H., CIHLÁŘ, D. *Rodinné propylaje v pedagogickém nástinu.* Ústí n. L.: UJEP, 2013. pp. 133. ISBN 978-80-7414-659-6.

Primary Paper Section: A

Secondary Paper Section: AM

F MEDICAL SCIENCES

FA	CARDIOVASCULAR DISEASES INCLUDING CARDIO-SURGERY
FB	ENDOCRINOLOGY, DIABETOLOGY, METABOLISM, NUTRITION
FC	PNEUMOLOGY
FD	ONCOLOGY AND HAEMATOLOGY
FE	OTHER FIELDS OF INTERNAL MEDICINE
FF	ENT (IE. EAR, NOSE, THROAT), OPHTHALMOLOGY, DENTISTRY
FG	PAEDIATRICS
FH	NEUROLOGY, NEURO-SURGERY, NUERO-SCIENCES
FI	TRAUMATOLOGY AND ORTHOPAEDICS
FJ	SURGERY INCLUDING TRANSPLANTOLOGY
FK	GYNAECOLOGY AND OBSTETRICS
FL	PSYCHIATRY, SEXOLOGY
FM	HYGIENE
FN	EPIDEMIOLOGY, INFECTION DISEASES AND CLINICAL IMMUNOLOGY
FO	DERMATOLOGY AND VENEREOLOGY
FP	OTHER MEDICAL FIELDS
FQ	PUBLIC HEALTH SYSTEM, SOCIAL MEDICINE
FR	PHARMACOLOGY AND APOTHECARY CHEMISTRY
FS	MEDICAL FACILITIES, APPARATUS AND EQUIPMENT

FEM CALCULATIONS OF POROUS TITANIUM STRESS-STRAIN BEHAVIOUR UNDER THE TENSILE LOAD

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Abstract: This paper deals with FEM calculations of the porous titanium specimen stress-strain behaviour during the tensile load for two different porosities and two different pores diameters. Moreover, simulations results are compared and discussed with those achieved for cast titanium. Totally, four semi-empirical equations were used for prediction of porous titanium elastic modulus. Three of them, Phani-Niyogi, Coble-Kingery and Maiti relations revealed very good agreement with experimental data. Ideal material used in traumatology should exhibit good strength, fatigue and corrosion resistance and also good bone cells adhesion and osteointegration with reduced risk of the shielding effect. Brand new idea of the titanium implants with gradient porosity is presented.

Keywords: biocompatible, FEM, porous titanium, shielding effect, traumatology, von Mises stress

1 Introduction

Pure titanium and titanium alloys represents frequently used biocompatible materials. Titanium and its alloys are commonly used in traumatology because of its good biocompatibility [1,2,3], favourable osteointegration [4,5], excellent mechanical properties and corrosion resistance [6,7,8]. However, cast titanium elastic modulus is approximately 100 GPa and frequently used titanium alloy Ti6Al4V is about 110 GPa [4,5,6]. Human bones elastic modulus ranges within 15 – 30 GPa and depends on gender, age and health status [1,2,3].

The difference between human bones and titanium implants elastic modulus causes so called shielding effect, that may result in the necessity of reoperation [9,10,11]. Adjustment of the mechanical properties is necessary for reducing and even eliminating of the stress shielding phenomena. On the other hand, porous titanium implants represents perspective trend in development of new generation implants. Porous implants allows improved surface cells adhesion, osteoblastic proliferation and reduced risk of future reoperation [12,13]. The main potential thread of the porous titanium implants usage are insufficient mechanical properties (tensile strength, compression and fatigue resistence). Such as casting defects and/or manufacturing defects. Also pores in titanium matrix represents stress concentrators. The main aim of this paper is the evaluation of the maximal von Mises stress and its dependence on total porosity and pore size. Finite elements method was used for calculation of the porous titanium stress-strain behaviour. Results achieved for porous titanium models were compared with cast titanium model.

2 Calculation methods

Titanium microstructure was programmed using Digimat software. The models designed in Digimat were transferred to Abaqus software. Mesh of FEM model consisted from tetragonal elements with global size approximately 0.05. FEM calculations were performed for cast titanium model and for porous titanium models. Tensile stress with fixed displacement (u = 0.01) was applied for all models. The first variable used in the simulations was total porosity – 0, 10, 20, 30 and 40 %. Meanwhile, 0 % total porosity represents cast titanium implant, total porosities within 10 – 40 % represents porous titanium implants that can be suitable because of its improved bone cells proliferation and reduction and/or supression of the shielding effect [10,11,12]. The second varied variable was pore diameter 200, 300 and 400 μm. Pores diatemeters used in the simulations are commonly recommended due to its positive effect on bone cells proliferation [14,15,16,17].

3 Results and discussion

Firstly, simulation of cast titanium model was realized. If an ideal model is presumed (lack of casting defects and any porosity), homogeneous stress-strain field is achieved. Moreover, for calculated fixed displacement (u = 0.01) ultimate stress of titanium (1000 MPa) was not exceeded, see Fig. 1

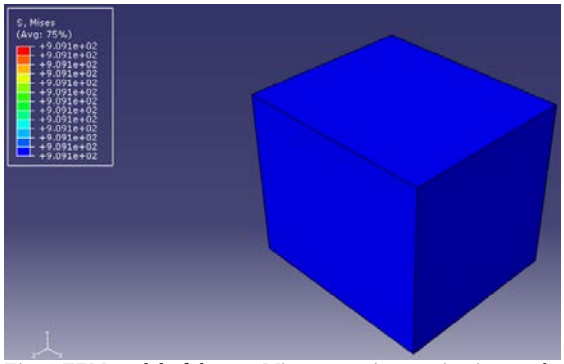

Fig. 1 FEM model of the von Mises stress in cast titanium at the end of tensile deformation (u = 0.01).

Titanium models with 10% total porosity and different pore diameters revealed that ultimate stress was not exceeded in all cases. Maximum von Mises stress values were concentrated in spheric shape pores. With increasing pore size also heterogeneity of stress-strain field increased, see Fig. 2

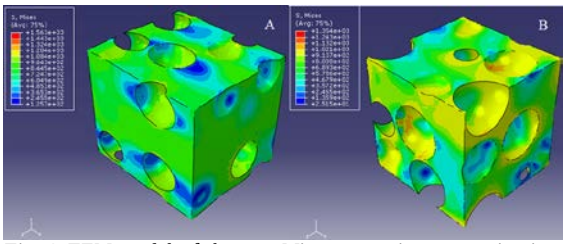

Fig. 2 FEM model of the von Mises stress in porous titanium (10% porosity) at the end of tensile displacement (u = 0.01). Pores diameter: 200 μm – A, 400 μm - B.

Both higher titanium matrix porosity and bigger pores size contributes to the increasing maximal values of the von Mieses stress and also increases stress fields heterogeneity. The porous titanium model with 40% porosity and different pores diameters exhibited the fact that ultimate stress was passed for all three pore diameters. This fact indicates intensive local plastic deformation, see Fig. 3

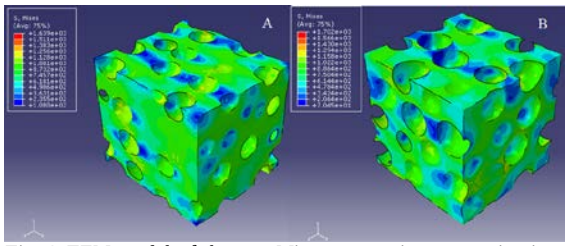

Fig. 3 FEM model of the von Mieses stress in porous titanium (40% porosity) at the end of tensile deformation (u = 0.01). Pores diameter: 200 μm – A, 400 μm - B.

Although, the main variable contributing to the increasing von Mieses stress values in titanium matrix is porosity, proper combination of the porosity and pores diameter may reduce risk that ultimate stress will be passed. As it can be seen on Fig. 4, combination of 30% porosity and 200 μm pores diameter did not exceeded ultimate stress value, as the combination of same porosity and bigger pores diameters did, see Fig. 4

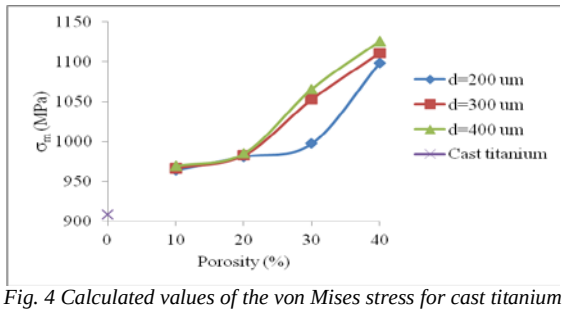

Fig. 4 Calculated values of the von Mises stress for cast titanium and titanium matrixes with different porosity and pore diameters.

However, from the medical point of view, also bigger pores with diameter up to 500 μm are necessary.

In an ideal case, elastic modulus of the titanium implants should be the same and/or similar to the human bone elastic modulus. In our calculations we used four common equations proposed by Phani and Niyogi [18], Coble and Kingery [19], Maiti [20] and Hardin and Beckermann [21]. Phani–Niyogi relation allows to determine elastic modulus of the porous titanium matrix, see Eq.1

$$E = E_0(1-\frac{P}{P_C})^n, \quad (1)$$

where E is porous matrix elastic modulus, E_0 is typical cast titanium elastic modulus, P is matrix porosity, P_C is critical matrix porosity (≈ 0.83) when ultimate stress converges to zero and n is material constant (≈ 1.68) [22]. Coble and Kingery used their equation to describe the elastic modulus of porous alumina, see Eq.2

$$E = E_0(1-1.86P+0.86P^2). \quad (2)$$

Maiti derived equation that can be used both for porous materials with closed (power is 3) and open pores (power is 2), see Eq.3

$$E = E_0(1-P)^2. \quad (3)$$

Finally, Hardin and Beckermann proposed their equation for determination of porous 8630 steel elastic modulus, see Eq.4

$$E = E_0(1-\frac{P}{2})^{2.5}. \quad (4)$$

Meanwhile, Phani–Niyogi, Coble-Kingery and Maiti relations gives very similar results, Hardin-Beckermann model seems not suitable for determination of porous titanium elastic modulus. According to the Phani–Niyogi, Coble-Kingery and Maiti relations porous titanium implants with 40% porosity exhibited elastic modulus very close to the human bones one, see Tab. 1

Tab. 1 Titanium elastic modulus calculated using Phani-Niyogi relation – E_1, Coble and Kingery – E_2, Maiti – E_3, Hardin and Beckermann – E_4.

Porosity (%)	E_1 (GPa)	E_2 (GPa)	E_3 (GPa)	E_4 (GPa)
0	100	100	100	100
10	81	82	81	88
20	63	66	64	77
30	47	52	49	67
40	33	39	36	57

Moreover, calculated values for elastic modulus (E_1, E_2, E_3) were compared with experimental data [17]. It was confirmed that Phangi-Niyogi, Coble-Kingery and Maiti relations can be used for tentative determination of the porous titanium elastic modulus. The main risk of the porous titanium implants application can be their insufficient strength and fatigue behaviour. These contradictory requirements can be met by appropriately chosen functionally gradient materials and/or by development of the titanium implants with porosity gradient. The implant core made from sintered low porosity titanium can ensure good strength, fatigue and corrosion resistance. On the other hand, highly porous surface layers of the titanium implant can be optimized for perfect bone cells adhesion and osteointegration with minimal risk of the shielding effect and/or reoperation caused by aftersurgery infection.

4 Conclusion

FEM simulations deals with titanium models that are characterized by different porosity and pore diameters. Moreover, elastic modulus of the porous titanium is calculated using Phani–Niyogi, Coble-Kingery and Maiti relations. According to our simulations the most influential variable that affects stress-strain concentration and stress-strain fields heterogeneity is matrix porosity. Although, increasing pores size also contributes to the maximal values of the von Mises stress. Due to the fact that optimal titanium implants properties are contradictory, new proposal of the porous titanium with gradient porosity is presented. The future works will be focused on development and testing of the new progressive materials intended for biomedical applications.

Literature:

1. Niinomi, M. Fatigue performance and cyto-toxicity of low rigidity titanium alloy, Ti 29Nb–13Ta–4.6Zr. Biomaterials 24 (2003) 2673–2683.
2. Traini T, Mangano C, Sammons RL, Mangano F, Macchi A, Piattelli A. Direct laser metal sintering as a new approach to fabrication of an isoelastic functionally graded material for manufacture of porous titanium dental implants. Dental Materials 24 (2008)1525–33.
3. Lütjering G, Williams JC. Titanium. second ed. New York: Springer-Verlag Berlin Heidelberg; 2007, pp 20–195.
4. Webster, T.,J., Ergun, C., Doremus, R.H., Enhanced functions of osteoblasts on nanophase ceramics, Biomaterials 21 (17) (2000) 1803–1810.
5. Rupp, F., Scheideler, L., Rehbein, D., Axmann, D., Geis-Gerstorfer, Journal of Biomaterials 25 (2004) 1429–1438.
6. Bauer, S., Schmuki, P., Mark, K., Park, J. Engineering biocompatible implant surfaces Part I: Materials and surfaces. Progress in Materials Science 58 (2013) 261–326.
7. Davis JR. ASM International. Handbook of materials for medical devices. Materials Park, OH: ASM International; 2003.
8. Ratner, B.,D., Hoffman, A.,S., Schoen, F.,J., Lemons, J.,E. Biomaterials science. Amsterdam: Elsevier; 2004.
9. Gallo, J., Losták, J., Langová, K. Long-term survival of the uncemented Balgrist cup. International Orthopaedics, 37(8): 1449-1456, 2013.
10. Gallo, J., Goodman, S.B., Konttinen, Y., Wimmer, M., Holinka, M. Osteolysis around total knee arthroplasty. A review of pathogenetic mechanisms. Acta Biomaterialia, 9(9): 8046-8058, 2013.
11. Nich, C., Takakubo, Y., Pajarinen, J., Ainola, M., Salem, A., Sillat, T., Rao, A., Raška, M., Tamaki, Y., Takagi, M., Konttinen, Y., Goodman, S.B., Gallo, J. Macrophages – Key

cells in the response to wear debris from joint replacements. Journal of Biomedical Materials Research. Part A, 101(10): 3033-3045.
12. Mrázek, F., Gallo, J., Stahelová, A., Petrek, M. Coding variants of TLR2 and TLR4 genes do not substantially contribute to prosthetic joint infection. Inflammation Research, 62(5): 483-487, 2013.
13. Navrátilová, Z., Gallo, J., Mrázek, F., Losták, J., Petrek, M. MBL2 gene variation affecting serum MBL is associated with prosthetic joint infection in Czech patients after total joint arthroplasty. Tissue Antigens, 80(5): 444-451, 2012.
14. Karageorgiou V, Kaplan D. Porosity of 3D biomaterial scaffolds and osteogenesis [J]. Biomaterials, 2005, 26: 5474−5491.
15. Li, B.Q., Wang, C.Y., Lu, X. Effect of pore structure on the compressive property of porous Ti produced by powder metallurgy technique. Materials and Design 50 (2013) pp 613 – 619.
16. Jiang H.C, Du, H., Xie, H.M., Rong, L.J. Investigation on the micro-deformation characteristics of porous NiTi shape memory alloy using SEM moirč method. Acta Metallurgica Sinica 2006;42:1153–7.
17. Li, B.Q. Wang, C.Y., Lu, X. Effect of pore structure on the compressive property of porous Ti produced by powder metallurgy technique. Materials and Design 50 (2013) 613–619.
18. Phani, K.K., Niyogi, S.K. Elastic modulus-porosity relationship for Si_3N_4. Journal of Materials Science Letters 6 (1987) pp 511 – 515.
19. Coble, R.L., Kingery, W.D. Effect of Porosity on Physical Properties of Alumina. Journal of American Ceramics Society 39 (1956) p. 377 – 385.
20. Maiti, S.K., Gibson, L.J., Ashby, M.F., Deformation and Energy Absorption Diagrams
for Cellular Solids. Acta Metallurgica (1984) p. 1963 – 1975.
21. Hardin, R., Bexkermann, C. Effect of Porosity on Mechanical Properties of 8630 Cast Steel," in Proceedings of the 58th Technical and Operating Conference, SFSA, Chicago (2004).
22. Zhu, K., Li, C., Zhu, Z., Liu, C.S. Measurement of the dynamic Young's modulus of porous titanium and Ti6Al4V. Journal of Materials Science Letters 42 (2007) pp 7348–7353.

Primary Paper Section: F

Secondary Paper Section: FI, JG

G AGRICULTURE

GA	AGRICULTURAL ECONOMICS
GB	AGRICULTURAL MACHINES AND CONSTRUCTION
GC	PLANT GROWING, CROP ROTATION
GD	FERTILIZATION, IRRIGATION, SOIL TREATMENT
GE	PLANT CULTIVATION
GF	DISEASES, PESTS, WEEDS AND PLANT PROTECTION
GG	ZOOTECHNICS
GH	NUTRITION OF FARM ANIMALS
GI	FARM ANIMAL BREEDING AND FARM ANIMAL PEDIGREE
GJ	BDISEDAISES AND ANIMAL VERMIN, VETERINARY MEDICINE
GK	FORESTRY
GL	FISHERY
GM	FOOD INDUSTRY

THE DIFFERENT EFECTS OF DROUGHT ON SOIL MICROBIAL ACTIVITIES AND SOIL HYDROPHOBICITY IN PERMANENT GRASS COVER AND ARABLE LAND

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Abstract: The present work deals with the influence of drought on microbial activities and soil hydrophobicity in permanent grass cover and arable land. The values of basal respiration were chosen as indicator of microbial activity and the values of unsaturated hydraulic conductivity were used as indicator of soil hydrophobicity level. From March to October 2014 (during vegetation period) parameters were measured at two different experimental sites -the first one was permanent grass cover and the second one was arable land. Significant differences in effects of drought on individual experimental sites were found.

Keywords: Microbial activities, permanent grass cover, arable land, soda lime, hydraulic conductivity, soil hydrophobicity.

1 Introduction

In Central Europe, changes in weather conditions are predicted in future. Precipitation totals will be the same, but their layout will be changed in growing season. This situation will have a major impact on agricultural production and the stability of natural ecosystems.

Water deficit during drought spells is one of the most significant stress factors in crop production worldwide. It can lead to significant yield reduction or even crop failure. Beside the negative effects of water stress on the yield quantity, the quality can also be influenced. Even though the Czech Republic is not generally characterized as a drought prone region of Europe, drought (and flooding) still occurs and represents one of the most important climatic extremes in terms of economic damage. This is demonstrated by the examples of severe droughts recorded in 1935, 1976 and especially in 1947. Within recent years, this region of Central Europe experienced droughts in 2000, 2001 and 2003, with the first of these being particularly damaging (Hlavinka et al., 2009).

Quality and healthy soil is an essential prerequisite for ensuring production and non-production functions of agriculture. The primary consequence of quality and soil health is soil fertility. In recent years, Czech farmers have faced to decline of soil fertility and degradation of land resources. The direct causes of soil fertility depletion include: climate changes (long period of drought – precipitation totals are the same but their layout has been changed), cultivation of fragile and marginal lands, soil erosion and decrease in the organic matter application. Drought threat has significant consequences to soil carbon and nutrient cycling, thus significantly affects microbial activity in soil (Elbl et al., 2014).

There is increasing evidence that microbial activity has a direct influence on the stability and fertility of ecosystems. Soil microorganisms synthesize and secrete extracellular enzymes which constitute an important part of the soil matrix. Enzymes play an important role in soil nutrient cycles and, consequently, factors influencing soil microbial activity will affect the production of the enzymes which control nutrient availability and soil fertility (Hueso et al., 2012).

In particular, recent studies have emphasized the importance of microbial nutrient mobilization for the regulation of plant growth in nutrient-deficient systems. Consequently, such climatic changes may be particularly important in nutrient-limited habitats like heaths, and studies of soil and microbial processes at the ecosystem scale are needed to improve our understanding of temperate heathland ecosystem responses to changing climate (Jensen et al., 2003). Conversely, arable soils represent large system that is significantly influenced and controlled by human activities, and that affects the state of the environment. Therefore, the effect of human activity must be studied to find out how to minimize the impacts of climate change on our society and environment.

In present study the changes in soil microbial activities and soil hydrophobicity were quantified in response to 1) influence of drought and 2) type of soil ecosystem.

2 Materials and methods

The above objectives of work were tested by field experiment located at two experimental sites with different regime. The first one was heath – natural ecosystem and the second one was field – anthropogenically influenced ecosystem.

2.1 Experimental design

Basal respiration or cumulative production of CO_2 and level of soil hydrophobicity was measured at two different sites: a) Havraníky and b) Žabčice. Experimental site Havraníky (See Figure 1) is located in National Park Podyjí on the border between Czech Republic and Austria. Havraníky heath is an extremely dry area where annual climatic averages are 550 mm of precipitation and 9 °C mean of annual air temperature. The microbial activity and soil hydrophobicity was measured in the stand of *Carici humilis-Callunetum* and *Potentillo arenariae-Agrostietum vinealis,* which are situated on Bohemian Massif (biotite granite). Six areas were selected at these experimental sites: three located in the vegetation *Calamagrostis epigejos* and three in the vegetation of *Festuca ovina* (See Figure 3).

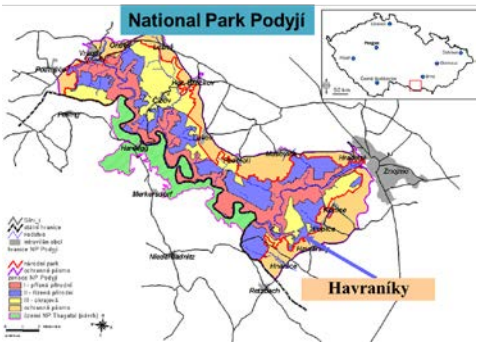

Fig. 1 The first area of our interest – Havraníky heath (authors: Záhora, Elbl)

Experimental site Žabčice (See Figure 2) is situated 30 kilometers south of the Brno where annual climatic averages are 480 mm of precipitation and 9.3 °C mean of annual air temperature. The microbial activity and soil hydrophobicity was measured on arable land (chernozem); estimated pedologic-ecological unit (BPEJ) 00401.

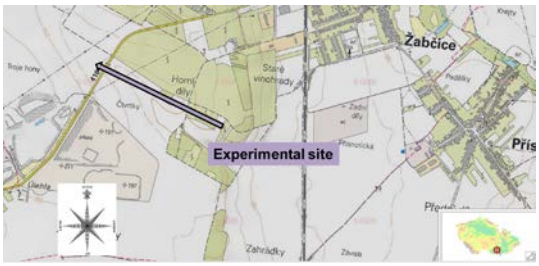

Fig. 2 The second area of our interest – Žabčice field (author: Elbl)

2.2 Determination of soil respiration

From March to October 2014, the basal respiration (BAS) was measured using soda limes granules at individual experimental sites at monthly intervals. Soda limes granules were applied into rhizosphere and non-rhizosphere soil, because: Soil respiration has two major components, which are heterotrophic respiration (based on decomposition and mineralization of soil organic matter, largely by microorganisms) and root respiration (Bujalský et al., 2014). Only values from rhizosphere soil are presented. BAS was measured by the method using soda lime granules according Keith & Wong (2006). This method was modified for measurement of CO_2 production from arable land and permanent grass cover.

Fig. 3 Application of measuring probes with soda lime granules at experimental site Havraniky (author: Elbl).

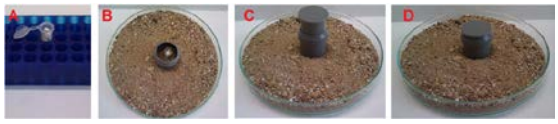

Fig. 4 Laboratory testing of measuring probes (author: Elbl).

The results of basal respiration (production of CO_2) were expressed in g of C m^{-2} day^{-1} and calculated by the modified formula, which was adjusted according Keith & Wong (2006):

$$\text{Soil } CO_2 \text{ efflux (g C m}^{-2}\text{ day}^{-1}) = \left\{\frac{\text{sample weight gain (g) - mean blank weight gain (g)} \times 1.69}{\text{chamber area (m}^2)}\right\} \times \left[\frac{24\text{ h}}{\text{duration of exposure (h)}}\right] \times \left[\frac{12}{44}\right] \quad (1)$$

2.3 Determination of soil water repellency – hydrophobicity

Soil water repellency (SWR) is a widespread phenomenon, which affects infiltration as well as soil water retention and plant growth (Schaumann et al., 2007). SWR or soil hydrophobicity directly affects water motion in soil. High soil hydrophobicity slows water infiltration, i.e.: hydraulic conductivity is lower, and conversely (Buzcko et al., 2005 and Robichaud et al., 2008). Therefore, values of unsaturated hydraulic conductivity (K) were used as indicator of level of SWR.

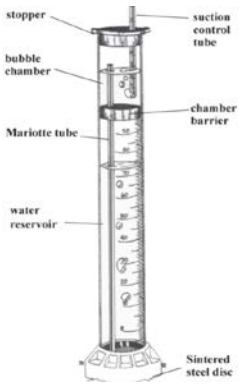

Fig. 5 The Mini-Disk Infiltrometer (Robichaud et al., 2008)

K was calculated based on the measured volume of water that infiltrated into the soil - cumulative infiltration, which was measured using Mini-Disk Infiltrometer (MDI) at monthly intervals.

Robichaud et al. (2008) describe the use of MDI for measuring soil hydrophobicity as follows: When the infiltrometer is placed on a wet-table soil surface, the suction from the soil side of the porous disk is able to break the water surface tension across the disk and water passes from the infiltrometer into the soil. As water passes through the porous disk into the soil, bubbles rise in the main chamber and in the bubble chamber. When the MDI is placed on strongly water repellent soil, there is not enough suction to break the water surface tension across the porous disk and no water infiltrates the soil. The suction on the infiltrometer side of the disk is controlled by the "suction control tube" (0.5 to 7 cm) at the top of the infiltrometer.

The calculation of K was performed by Šindelář et al. (2008), Lichner et al. (2007a, 2007b) based on these formulas:

$$I = C_1 t^{1/2} + C_2 t + C_3 t^{3/2} \quad (2)$$

where: I is cumulative infiltration, C_1 [$m \cdot s^{-1/2}$] and C_2 [$m \cdot s^{-1}$] are parameters of function and t [s] is time. These parameters are related to soil sorptivity and hydraulic conductivity of the soil. C_1 and C_2 are defined by according to Eq. (3) and (4).

$$C_1(h_0) = A_1 S(h_0) \quad (3)$$

and

$$C_2(h_0) = A_2 K(h_0) \quad (4)$$

where: $C_1(h_0)$ and $C_2(h_0)$ are the functions of the soil water content θ and suction (h_0) [cm]. A_1 and A_2 are dimensionless coefficients. Editing of Eq. (3) and (4) are necessary for the calculation of soil sorptivity S and unsaturated hydraulic conductivity of the soil K.

$$S(h_0) = C_1/A_1 \quad (5)$$

and

$$K(h_0) = C_2/A_2$$

where: C1 and C2 are calculated from Eq. (3) and (4). These parameters are obtained on the basis of values of cumulative infiltration for time, which is measured by MDI. A_1 and A_2 are dimensionless coefficients but variable with the total time of infiltration. These parameters were determined by Van Genuchten Eq. (6) and (7), which was described by Zhang (1997).

$$A_2 = \frac{11.65(n^{0.1}-1) \times exp[2.92(n-1,9)\alpha h_0]}{(\alpha r_0)^{0.91}} \quad (6)$$

For $n \geq 1.9$

$$A_2 = \frac{11.65(n^{0.1}-1) \times exp[7.5(n-1.9)\alpha h_0]}{(\alpha r_0)^{0.91}} \quad (7)$$

For $n \leq 1.9$

where: α and n are retention parameters of soil, r_0 is radius of MDI and h_0 is pressure energy of MDI. The values of A_2, which were calculated according Eq. (6) and (7), are presented in the Table 1. Only values of A_2 were calculated, because they are necessary for calculating the hydraulic conductivity.

Table 1 Van Genuchten Tables – the values of A_2

	radius	**2.3**	**h_0 [cm]**						
	alpha	n/h_0	-0.5	-1.0	-2.0	-3.0	-4.0	-5.0	-6.0
			A_2						
Sand	0,15	2,7	2,8	2,4	1,7	1,2	0,9	0,6	0,5
Loamy sand	0,12	2,3	3,0	2,8	2,4	2,1	1,8	1,6	1,4
Sandy loam	0,08	1,9	3,9	3,9	3,9	3,9	4,0	4,0	4,0
Loam	0,04	1,6	5,5	5,7	6,3	6,9	7,5	8,3	9,0
Silt	0,02	1,4	7,9	8,2	8,7	9,3	9,9	10,5	11,2
Silt loam	0,02	1,4	7,1	7,4	7,9	8,5	9,2	9,9	10,6
Sandy clay loam	0,06	1,5	3,2	3,5	4,2	5,1	6,2	7,4	8,9
Clay loam	0,02	1,3	5,9	6,1	6,6	7,2	7,9	8,6	9,3
Silty clay loam	0,01	1,2	7,9	8,1	8,5	8,9	9,4	9,9	10,4
Sandy clay	0,03	1,2	3,3	3,6	4,1	4,7	5,4	6,1	7,0
Silty clay	0,01	1,1	6,1	6,2	6,4	6,6	6,8	7,0	7,2
Clay	0,01	1,1	4,0	4,1	4,3	4,5	4,7	5,0	5,2

Fig. 6 Detail of water infiltration into arable soil (author: Elbl)

2.4 Statistical analysis

Potential differences in values of BAS (cumulative CO_2 production) and unsaturated hydraulic conductivity were identified by one-way analysis of variance (ANOVA) in a combination with the Tukey´s test. All analyses were performed using Statistica 10 software. The results were processed graphically in the program Microsoft Excel 2010.

3 Results and discussion

Microbial activity

Soil respiration is responsible for most of the CO_2 released from terrestrial ecosystems into the atmosphere. Although respiration depends on temperature, the relationship between respiration and temperature may vary among soils (Bujalský et al., 2014).

Respiration is probably process the most closely associated with life. It is aerobic or anaerobic energy-yielding process. In the cell, reduced organic or inorganic compounds serve as primary electron donors and imported oxidized compounds serve as terminal electron acceptors (Bloem et al., 2006) and respiration represents one of the most important indicators of microbial activity in soil. For our research, soil basal respiration (BAS) was used for indication of microbial activity in soil. BAS is defined as the steady rate of respiration in soil originating from the mineralization of organic matter (Pell et al., 2006).

Basal respiration was determined as cumulative production of CO_2 during 24 h from rhizosphere soil and it was measured at experimental sites Havraníky and Žabčice. Six areas were selected at experimental sites Havraníky: three located in the vegetation *Calamagrostis epigejos* (CE) and three in the vegetation of *Festuca ovina* (FO). And three areas were selected at experimental site Žabčice (on arable soil; identified as Z).

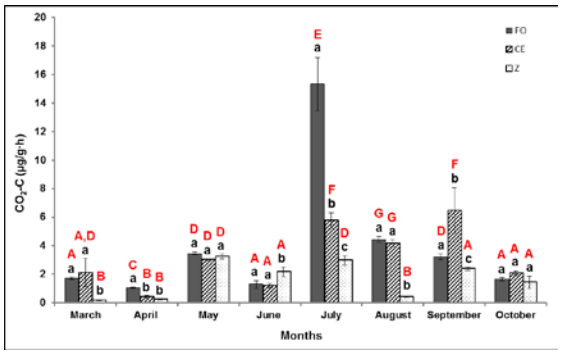

Fig. 7 Basal respiration (mean ±SD, n = 3); different small letters indicate a significant differences (P<0.05) between individual variants within the same group (month) and different uppercase letters indicate a significant differences between all individual variants (regardless months).

Soil respiration is often reported as a temporal mean that represents a plot, a stand, or a given ecosystem. From repeated measurements within a plot or stand, relationships between the respiration rates and soil climate can be resolved and annual rates of soil respiration can then be estimated through modeling (Martin & Bolstad, 2009). The above results indicate significant differences (ANOVA; P<0.05) in microbial activity (BAS) between individual experimental sites. The lowest values of BAS were found in March, April and October; this situation was caused by climate conditions (low temperature). The Figure 7 shows the highest significant differences in BAS between FO, CE and Z were found in months (July and August) of the highest temperatures and long periods of drought. Influence of temperature on microbial activity (See Figure 8) in soil was confirmed by Creamer et al. (2014).

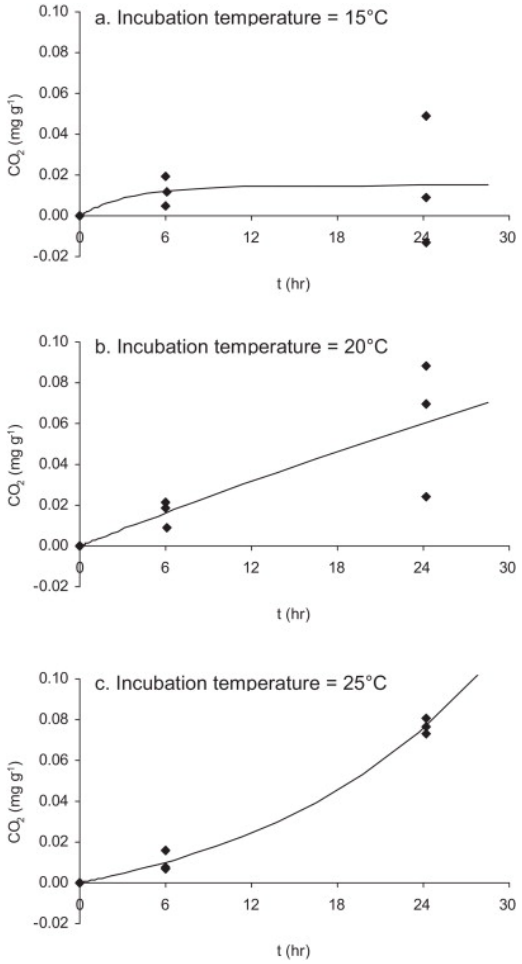

Fig. 8 An example (Hungary, grassland site, loam soil) of a typical response of CO_2 during the incubation period, for the three contrasting experimental incubation temperatures of a) 15 °C; b) 20 °C and c) 25 °C. Solid line shows best fit using the negative exponential model (Creamer et al., 2014).

Consider differences between individual variants and values of BAS in these months (July and August). The significant highest BAS was always found in variants FO and CE from about100 to 400 % in comparison with Z. These data indicated that the drought had different effect on grassland and arable land or different effect on natural ecosystem and ecosystem which is affected by human's activities.

In the short term, increased microbial activity can have a positive effect on soil properties, but in the long term it can cause depletion in soil fertility. High microbial activity accelerates the decomposition of soil organic matter and depletion of nutrients. Moreover, this state can result in a change of soil parameters (soil fertility – content of nutrients) and subsequently in the (bio)diversity of plants on the soil surface. The above changes

can be a major problem for our agriculture and nature. Balser & Firestone (2005) stated that soil microbial communities mediate many biogeochemical processes that are central to ecosystem functioning, including carbon (C) mineralization to CO_2, nitrogen (N) cycling, and trace gas production and consumption. Moreover, a modification of the soil microbiota may in turn affect soil processes, providing a positive or negative feedback on plant productivity. Despite the crucial role of soil microorganisms in mediating belowground processes, the issue of how the diversity of soil microbiota influences processes such as decomposition or nutrient mineralization remains poorly studied Malchair et al. (2010).

Soil water repellency

SWR or soil hydrophobicity is a natural phenomenon that occurs in many ecosystems ranging from tropical to subarctic regions influenced by biotic and abiotic factors, and has been reported by many authors to reduce infiltration capacity, enhancing overland flow and even runoff production at the catchment scale (Schnabel et al., 2013). Many regions of the world are predicted to experience water scarcity due to more frequent and more severe droughts and increased water demands (Müller & Deurer, 2011).

K was used for quantification of SWR and it was calculated based on the values of water infiltration which were measured at the above experimental sites (FO; CE and Z) at monthly intervals. K represents important parameter for the determination of soil hydrophobicity degree as it represents ability of soil to accept water. Influence of SWR on water infiltration of water into soil was described by Buzcko et al. (2005) and Robichaud et al., (2008).

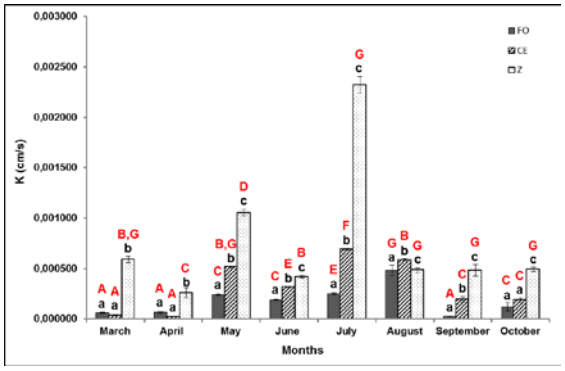

Fig. 9 Hydraulic conductivity (mean ±SD, n = 3); different small letters indicate a significant differences (P<0.05) between individual variants within the same group and different uppercase letters indicate a significant differences between all individual variants (regardless months).

The Figure 9 shows significant differences (ANOVA; P<0.05) in values of K, the highest values of K were always detected in variant Z (except August) during the vegetation period (from April to September). These data indicated the low level of SWR of arable soil surface in comparison with soil at other experimental sites.

Moreover, significant differences in K were found between FO and CE (from May to September). The highest values of K were always found at experimental sites CE. CE (*Calamagrostis epigejos*) is an invasive plant that sequentially occupies experimental sites Havraníky. The soil under CE has a higher level of SWR. This fact indicates a different life strategy of this plant allowing its rapid expansion to places where it previously did not occur. Müller & Deurer, (2011) state that water use efficiency by plants can be negatively affected by soil water repellency (SWR). There is a presumption that the CE in this way (by changing soil hydrophobicity) displaces the native species (*Festuca ovina* - FO).

Buzcko et al. (2005) state that SWR is a function of many factors including the soil water content, the previous wetting and drying of the soil, temperature, relative ambient air humidity, and the amount and quality of the SOM. Therefore, significant differences in SWR between arable soil and permanent grass land were found. Consider the highest values of K in variant Z which indicate the low level of SWR and consequently the soil's susceptibility to erosion phenomena. Cosentino et al. (2010) point to the fact that there is a direct linkage between the amount of hydrophobic compounds and stability of soil aggregates. Therefore the level of SWR must be monitored, because SWR can affect soil water retention, stability of soil aggregates and soil fertility (plant growth). Influence of SWR on soil properties was studied and confirmed for example by Buzcko et al. (2005), Schaumann et al. (2007) and Schnabel et al. (2013). The importance of the hydrophobicity for sorption of elements is shown in the Figure 10.

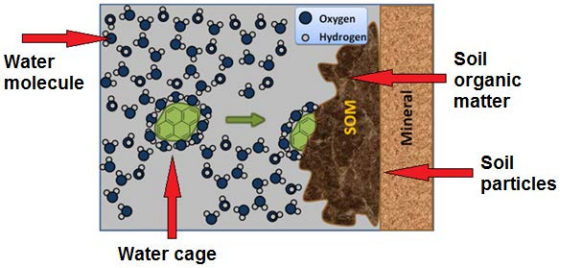

Fig. 10 Sorption driven by hydrophobicity (modified by Thompson & Goyne, 2012).

The optimal degree of soil hydrophobicity is essential for the resistance of the soil aggregates to erosion phenomena.

4 Conclusions

The main reason for examining the impact of drought on soil hydrophobicity is its effect on the stability of soil aggregates, the erodibility of the soil, the soil fertility and availability of nutrients. Changes in microbial activities and changes in the composition of microbial communities due to drought may be reflected in shifts of the soil hydro-limit values.

This can be very important for agriculture in the Czech Republic, because changes of weather conditions were detected there. Exactly, we expect long period of drought and short period of intensive rainfall. Changes of rainfall have negative influence on hydraulic conductivity. Its value decreases and, conversely, level of hydrophobicity increases. The higher hydrophobicity of arable soil could have a negative effect on the leaching of mineral nitrogen, water content in soil, and soil fertility.

Literature:

1. BALSER, T., C. & M. K. FIRESTONE. Linking microbial community composition and soil processes in a California annual grassland and mixed-confer forest. *Biogeochemistry*. 2005, vol. 73, no. 3, pp. 395-415.

2. BLOEM, J., D. W. HOPKINS & A. BENDETTI. *Microbiological methods for assessing soil quality*, Cambridge, CABI Publishing, 2006, 316 p. ISBN 978 0 0851 99 098 9.

3. BUCZKO, U., O. BENS & R. F. HÜTTL. Variability of soil water repellency in sandy forest soils with different stand structure under Scots pine (*Pinus sylvestris*) and beech (*Fagus sylvatica*). *Geoderma*. 2005, vol. 126, pp. 317-336.

4. BUJALSKÝ, L., S. KANEDA, P. DVORŠČÍK & J. FROUZ. In situ soil respiration at reclaimed and unreclaimed post-mining sites: Response to temperature and reclamation treatment. *Ecological Engineering*. 2014, vol. 68, pp. 53-59.

5. CONSENTINO, D., P. D. HALLET, J. C. MICHEL & C. CHENU. Do different methods for measuring the hydrophobicity of soil aggregates give the same trends in soil amended with residue? *Geoderma*. 2010, vol. 32, vol. 1-2, pp. 221-227.

6. CREAMER, R.E. et al. Measuring basal soil respiration across Europe: Do incubation temperature and incubation period matter? *Ecological Indicators*. 2014, vol. 36, pp. 409-418.

7. ELBL, J., L. PLOŠEK, A. KINTL, J. HYNŠT, S. JAVOREKOVÁ, I. CHAROUSOVÁ, L. KALHOTKA, O. URBÁNKOVÁ. Effects of drought on microbial activity in rhizosphere, soil hydrophobicity and leaching of mineral

nitrogen from arable soil depending on method of fertilization. *World Academy of Science, Engineering and Technology*. 2014, vol. 8, no. 8, pp. 741-747.
8. HLAVINKA, P., M. TRNKA, D. SEMERÁDOVÁ, M. DUBROVSKÝ, Z. ŽALUD & M. MOŽNÝ. Effect of drought on yield variability of key crops in Czech Republic. *Agricultural and forest meteorology*. 2009, vol. 149, no. 3-4, pp. 431-442.
9. HUESO, S., C. GARCÍA & T. HERÁNDEZ. Severe drought conditions modify the microbial community structure, size and activity in amended and unamended soils. *Soil Biology & Biochemistry*. 2012, vol. 50, pp. 167-173.
10. JENSEN K. D., C. BEIER, A. MICHELSEN, & A. EMMETT. Effects of experimental drought on microbial processes in two temperate heathlands at contrasting water conditions. *Applied Soil Ecology*. 2003, vol. 24, pp. 165-176.
11. KEITH, W. & S. C. WONG. Measurement of soil CO_2 efflux using soda lime absorption: both quantitative and reliable. *Soil Biology and Biochemistry*. 2006, vol. 38, no. 5, pp. 1121-1131.
12. LICHNER L., P. HALLETT, D. S FEENEY, O. ĎUGOVÁ, M. ŠÍR & M. TESAŘ. Field measurement of soil water repellency and its impact on water flow under different vegetation. *Biologia* (section Botany). 2007a, vol. 62, no. 5, pp. 537-541.
13. LICHNER L., T. ORFÁNUS, K. NOVÁKOVÁ, M. ŠÍR & M. TESAŘ. The impact of vegetation on hydraulic conductivity of sandy soil. *Soil & Water Res.*2007b, vol. 2, no. 2, pp. 59-66.
14. MALCHAIR, S., H. J. De BOECK, C. M. H. M. LEMMENS, R. MERCKX, I. NIJS, R. CEULEMANS & M. CARNOL. Do climate warming and plant species richness affect potential nitrification, basal respiration and ammonia-oxidizing bacteria in experimental grasslands? *Soil Biology and Biochemistry*. 2010, vol. 42, no. 11, pp. 1944-1951.
15. MARTIN, J.G & P.V. BOLSTAD. Variation of soil respiration at three spatial scales: Components within measurements, intra-site variation and patterns on the landscape. *Soil Biology & Biochemistry*. 2009, vol. 41, no. 3, pp. 530-543.
16. MÜLLER, K. & M. DEURER. Review of the remediation strategies for soil water repellency. *Agriculture, Ecosystems & Environment*. 2011, vol. 144, no. 1, pp. 208-221.
17. PELL, M., J. STENSTROM & U. GRANHALL. Soil respiration. In BLOEM, J., D.W. HOPKINS, A. BENEDETTI (Eds.). *Methods for assessing soil quality*, Cambridge, CABI Publishing, 2006, 316 p. ISBN 978 0 0851 99 098 9.
18. ROBINCHAUD, P. R., S. A. LEWIS & L. E. ASHMUN. *New procedure for sampling infiltration to assess post-fire soil water repellency*. Res. Note. RMRS-RN-33. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 2008, 14 p.
19. SCHAUMANN, G., B. BRAUN, D. KIRCHNER, W. ROTARD, U. SZEWZYK & E. GROHMAN. Influence of biofilms on the water repellency of urban soil samples. *Hydrological Processes*. 2007, vol. 21, no. 17. pp. 2276-2284.
20. SCHNABEL, S., M. PULIDO-FERNANDEZ & J. F. LAVADO-CONTADOR. Soil water repellency in rangelands of Extremadura (Spain) and its relationship with land management. *CATENA*. 2013, vol. 103, pp. 53-61.
21. ŠINDELÁŘ, R., P. KOVAŘÍČEK, M. VLÁŠKOVÁ, J. HŮLA & M. KROULÍK. Measurement of water infiltration into soil using round infiltrometer mini disk. *Agritech-Science*. 2008, vol. 2, pp. 1-6, [In Czech].
22. THOMPSON, A. & K. W. GOYNE. Introduction to the Sorption of Chemical Constituents in Soils. *Nature Education Knowledge*. 2012, vol. 4, no. 4, pp. 7-9.
23. ZHANG, R. Determination of soil sorptivity and hydraulic conductivity from the disk infiltrometer. *Soil Science Society of American Journal*. 1997, vol. 61, no. 4, pp. 170-174.

Primary Paper Section: G

Secondary Paper Section: EE, EH, DF

A REVIEW OF AGGRESSIVE BAHAVIOR IN HORSES

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Abstract: The aim of this work is to describe different types of aggressive behaviour in horses. Knowledge about reasons and signs of aggressiveness in horses is essential to improve horses management, welfare and both human and horse safety. There are different factors responsible for behavioral development. Environmental and biological aspects of aggression should be considered. The influence of parents and humans, nervous system structure, hormones level ect. are strongly connected with aggressive behaviors. There are various types of aggression, from natural (dominance hierarchy) to abnormal (aggression against offspring, self-directed aggression). The most common causes of aggressive behavior are: dominance related aggression, fear induced aggression, hormonal disorders, unsuitable conditions and diseases. Awareness about those factors will help to handle horses properly or choose appropriate treatment.

Keywords: horse, aggression, behavior,

1 Introduction

Human–horse relationship has a long and varied history. The first motivation to domesticate horses was meat, but equine industry became progressively more important and horses were used in transportation, sport, and now, they are more and more used as companion animals (Hausberger et al., 2008). In all these cases there are problems with interspecific communication. If there are huge misunderstandings it may lead to accidents (minor incidents: bites, jostles, crushes). The usual victims are veterinarians and stable stuff, that is why there is a great need to know reasons of horses aggressive behavior (Hausberger et al., 2008). Furthermore, fear is an emotion that causes most of human-horse accidents in relation to sudden, unexpected reactions. What is more, defensive aggression may occur if a horse has no possibility to escape (Hall et al., 2012). Nevertheless, equestrians and breeders should be able to recognize behavioral signs of horses mental state to improve their welfare. Those signs may relate to health problems that may induce undesirable reactions to humans (Hall et al., 2012; Hausberger et al., 2008). Knowledge of horse body language will allow to assess the problem, discover its reasons what is necessary to find a proper treatment (Houpt, 1977). On the one hand, horses became more like companion animals, on the other hand, breeding and rearing of horses is a part of rural economy and take place mostly on farms (Søndergaard, 2003). What is more, there is a great number of horses that show abnormal behavior, what is quite often caused by humans. To provide horses welfare at appropriate level it is important to know the factors that influence behavioral development (Søndergaard, 2003).

Horses are great runners and their survival tactic is to flee from predators. They are known as beautiful and majestic animals with strong flight or fight response. Still, there are some situations when horses can behave aggressively. Some of those behaviors are natural (dominance hierarchy), other abnormal (self-directed aggression, aggression against offspring). Knowledge about primary reasons of those behaviors will improve horses management, welfare and both human and horse safety. That is why in the present paper, we will review the scientific knowledge on different aggressive behavior types in horse and factors that cause them.

2 Biological aspects of aggression

The behavior is the result of interaction between the nervous system, hormones, and neurotransmitters, as well as the experience gained by the animals. To understand horses behavior properly it is important to know its biological basis.

2.1 The nervous system

The limbic system is the responsible for emotions part of nervous system. It contains numerous brain structures that operate in an integrated way. Part of the brain that is accountable for the aggression is hypothalamus (Nowicki, 1978). Researches show that different structures of the brain are responsible for different types of aggression. The structures of the brain not only cause the reactions, but also inhibit them. For example destruction of central nucleus of the amygdala resulted in increased dog's aggression, and the damage of medial nucleus caused calmness in dogs (Sadowski, 2003).

2.2 Genetic

An evidence for genetic basis of animal behavior is domestication. With selection during centuries people lowered the level of aggressiveness in horses and cows, produced new breeds of many species, produced hens that are quiet (Nowicki, 1978). Numerous studies on dogs have shown that specific genes are responsible for a certain behaviors, like shyness in Bassets that is conditioned by the dominant gene. Furthermore, selection has resulted in the huge diversity in dog breeds, which are characterized by different behavior patterns. Some of them tend to behave aggressive, while others are extremely calm. It was found that after a few generations of selection an aggressive behavior in dogs can be reduced (Takeuchi, Houpt, 2003).

Horses during centuries were selected on behavior. Still some thoroughbred lines may be more aggressive than others, because those horses were selected for speed regardless to cooperation with them. Another evidence for genetic basis of behavior may be a research done on the arabian mares from Egyptian Agricultural Organization (EAO). Nine from one hundred and seven mares with foals rejected their nursling and behaved aggressively. All this mares came from one of several lines held by EAO (Houpt, 2000).

2.3 Hormones

Males are known to be more aggressive than females. An exception from this can be mother with her offspring. It is proved that androgens are responsible for aggressiveness (Sadowski, 2006). Effects of those hormones is known to be important in fetal life. In dogs, unborn females were treated with testosterone which caused higher dominancy level to compare with normal females. However, males still were more aggressive. Furthermore, males are exposed on androgens, produced in testicles, during puberty what increase aggressiveness (Houpt, 2005). It is proved that castration lowers aggression in horses. Geldings will still exhibit aggressive behavior but it is seen much rarer and its intensity is not as severe as in stallions. What is more, an important role in shaping the behavior is the age at which the animal has been castrated and an individual experience (Houpt, 1986). Furthermore, testosterone that naturally occurs in females is responsible for intensity of aggressiveness in mares (Van Dierendonck et al., 1995). Probably mares are exposed at similar decrease of estrogen and progesterone level as women. Those variations cause PMS, mood changes and are often accompanied by aggression in women (Houpt, 1980). Moreover, a granulosa tumor of the ovary may elicit masculine behavior and increased aggression (Houpt, 1986). On the other hand, the presence of dopamine and serotonin in dogs and humans reduces the level of aggression (Takeuchi, Houpt 2003).

3 Environmental influences on aggression

Almost in all species aggressive behavior can be observed when animals feel hunger or if there are too much individuals in small area (Houpt, 2005). Furthermore, researches on rats show that maternal care is important for developing future behavior patterns. Orphans rats showed increased aggressiveness, fearfulness and lower ability to learn (Takeuchi, Houpt, 2004). If it is about horses, it has been observed that foals learn the aggressive behavior from their mothers (Van Dierendonck et al., 1995). Moreover, inappropriate horses handling can induce

aggressive behavior. It can be caused by ignorance when innocent behavior of the foal may turn into aggression or by violent handling that cause fear induced aggression.

4 Signs of aggression

Horses use all senses to communicate. The non verbal communication is very easy to read for other individuals. People, during long-term observations, learned to read most of the horses "body language" signals what is essential for communication with them. Unfortunately human sense of smell is no comparative to animals and the equine voice communication is very poor. That is why all practitioners should be able to observe and recognize facial and posture signs of aggressive behavior.

Typical signs of aggressive behavior are:

- small eyes with flashing sclera
- ears laid back against its head
- lips pulled up that teeth are often seen
- nostrils will be dilated causing wrinkles and the air is drawn loudly
- rapid tail movements
- sometimes squealing can be heard
- tensed skeletal muscles
- body turned toward the object of aggression (Pruchniewicz, 2003).

In equine community the physical contact is not often seen, the animals use mostly the threat to reduce energy loss. Using body language horses convey his intentions to other horses so that actual fights can be avoided (Waring, 2003). Signals and postures indicating aggression are very varied and show different types of interactions. For better understanding those signal it is important to know ethogram of aggressive behavior in horses.

1. Ears position: ears lay flat to the neck, the head pointing towards the object of aggression.
2. The bite threat: the ears lay back along the neck, the head directed to the object of aggression, teeth can be seen, the bite movement but without physical contact.
3. Bite: as in point 2, but with physical contact. The attacker does not more than two steps to the recipient. The bite can occur suddenly with violent jump on the object.
4. The threat of kicks: ears along the neck, rump addressed to the recipient, and one of the pelvic limb is lifted.
5. Kick: as in step 4 the fact that there is a kick necessarily the contact.
6. Attack: the neck extended, ears are laid back against his head, pushed flat against the skull. The threat of bites and kicks can occur. The reaction is rapid. Two steps toward target are made.
7. Chase: chasing of another individual. Usually at gallop with ears laid back. The longer the distance, the less violent reaction than attack.
8. Fight: with physical contact. Series of bites and kicks with high frequency.
9. Pushing: pushing aside another individual with shoulder
10. Strike: attack with front limbs with or without contact
11. Threat approach: Approach the receiver with ears backward (not flat against the neck). Head is not extended as far as in ears laid back. (Vervaecke et al., 2006).

Furthermore, it was observed that there are sex differences in way of expressing aggressive behaviour. Mares usually use hind legs, while stallions climb and attack with the front limbs (as a typical form of attack or defense). An active defense, as well as agonistic behaviors are considered as aggression in many sources. In this article agonistic behaviors are also considered. Horses usually flee from danger, but when they have no place to escape thy change tactic to active defense (Pruchniewicz, 2003).

5 Intraspecific aggression

Intraspecific aggression is usually a normal behavior that is observed in wild horses. As far as it is not very intensive it is natural behavior in domesticated horses. However, there are some situations when abnormal behavior occurs as a result of frustration or diseases.

5.1 Dominance hierarchy

Horses are typical herd animals with highly developed social behaviors. There is established hierarchy in the group what is essential for its survival. Stable hierarchy reduces the number of injuries and energy lost (Greevy, 2004). It is suggested that body mass, physical condition, age, previous agonistic interactions, parents place in the hierarchy and the level of individual aggression are factors that influence place in the hierarchy (Rho et al., 2004). Aggressive behavior is the most important factor that places an individual in the herd (Vervaecke et al., 2006). Once the hierarchy is established, aggression from most dominant horses is rarely observed because other horses respect their dominance. Conflicts often occur when a horse's critical distance is exceeded by another individual (about 60%). While aggression as a response to received is rarely observed (Heitor et al., 2006).

A rapid growth in number and intensity of aggressive interactions is observed after a new horse enters the group until a new hierarchy is established (Nowicki, 1978). The duration of agonistic behaviors depends on new horse's temperament and level of aggression (Houpt, 1987). What is more, this phenomenon also occurs in nature when mares migrate from their native herd (this happen probably to reduce inbreeding). Fillies usually join groups with familiar to them mares but unfamiliar stallion (Monard, Duncan, 1996). Research shows that introducing new stallion to the group of mares does not affect predetermined hierarchy amongst them (Heitor et al., 2006). The stallion is not always the most aggressive individual in the herd and not always stands at the top of the hierarchy. It can be observed that geldings may be more dominant, what suggests that previous experience is more important than the castration (Houpt, Keiper, 1982). It is proven that aggression can be much lower if new horse is placed next to other horses behind the fence. In horse industry, it is very important to reduce agonistic interaction and those behaviors occur with much lower frequency if animals know each other earlier. The fence gives horses possibility to see and smell each other. Furthermore, the high level of aggressive behaviors is observed during feeding if horses are kept in herds. It is important to put a few fodders in different places on pasture that submissive horses will have access to food. However, it was observed that dominant individuals usually finish earlier and push away submissive horses from full fodders (Houpt, Wolski, 1980).

5.2 Age of mares and foals and the level of aggression in the herd

Age is positively correlated with the dominance. It has been observed that older mares were dominant, and the younger subordinate. Most interactions are seen between mares under 5 years old because those mares do not have stable rank in the herd. It was found that level of aggressive behavior decrease with the age of the animal due to gaining a stable position in herd. What is more, in 95.4% aggression from one side was observed. Fights between two mares in 75% were among young, under five years old mares (Rho et al., 2004). Furthermore, most of agonistic behaviors occur between mares without foals (70%), then, between the mare without foal and mother with offspring (23%), while aggression between the two mothers was quite rare (7%). On the other hand, with approaching date of birth an increase of aggression intensity can be observed (both offensive and defensive). For a few days after parturition these interactions are high, but with aging the foal maternal aggression decrease (Rho et al., 2004).

5.3 Aggression directed on foals

Foals are rarely exposed to attacks, because older horses usually tolerate younger individuals. However, the literature reports several cases of infant killing by stallions. It was observed that

stallion may kill other stallion offspring. This behavior is rare but horse breeders should be aware of these phenomena. These attacks are similar to those against young, sexually maturing colts that are expelled from herd. The male grabs the foal's neck or back, shakes it and throws it. Similar behavior can occur in geldings (Houpt, 1984). What is more, nurslings can be rejected by their mothers. The lack of maternal instinct can lead to aggressive behaviors and its strongest form mares can bite the foal's neck and even throw it in the same way as the stallions do. This abnormal behavior is observed mainly in primiparous. It is suspected that the lack of experience, postpartum stress syndrome and lack of contact during first hours after parturition are the main factors that influence the foal rejection (Houpt, 1984).

6 Interspecific aggression

Horses aggression can be directed at people or other animals, regarding to specific way of horse keeping this kind of aggression is usually seen toward dogs. Feral horses behave aggressively toward predators like wolfs. Interspecific aggression may occur at various forms.

6.1 Domination toward human

Horses, mostly stallions, may try to dominate over people. Nowadays the horses value depends on his willingness to submit to human authority. If horses are not trained to respect people the aggressive behavior may be worse causing dangerous situations (Houpt 1984). What is more, horses can learn quickly and it is essential that to handle stallions properly an experience is required. Improper training may cause that cooperation with those horses will be impossible. There are some individuals who examine people all the time. Domination is usually demonstrated by disobeying orders, pushing or showing aggression (mostly from front like biting or prancing). Consistent, confident handling will do a lot to reduce dominant behaviors.
Maternal aggression

Mares after parturition may be aggressive towards other animals and humans. A mare natural behavior is to protect her foal from "strangers". During first days after parturition the highest level of aggression is observed. Mares usually are not aggressive toward familiar to them people, however horse breeders should be aware that maternal aggression can occur toward them (Houpt, 2000).

6.2 Learned aggression

Unaware, inexperienced people can teach a horse some aggressive behaviors. For example, it is often seen that horses are fed from hand. Some individuals are very impatient and start to behave nervous, people seeing this go to those animals earlier. The horse is rewarded for this kind of acting and in the future he will do the same. What is important, demanding can be seen with anger and in some cases horses bite to get food.

Due to stallions excitability a lot of people are afraid of them. To avoid contact horses are often kept in isolation. This solution does not solve the problem but also increase it. Lack of exercise and contact with other animals has strong, negative impact on the stallion mental state (Parelli, 2002).

6.3 Fear induced aggression

As mentioned above, threatened horses with no possibility to escape may behave aggressively. Furthermore, horses remember well experiences from past. It is often seen that some individuals are afraid of specific objects, people, colors, that are associated with pain or discomfort. Unfortunately this kind of fear, if caused by humans may lead to aggressive behaviour in horses (Dietz, Huskamp, 2008). Mostly veterinarians are exposed on attacks due to unpleasant for horses veterinary treatments (Houpt, 2005). Aggression during taking a horse from pasture is not rare. Some horses have very strong social needs and feel not safe alone. Another reason of this behavior may be the fear of what happen after (improper handling or riding that cause pain). To choose proper treatment it is important to look trough different possibilities to find the reason (Houpt, 1984). Recreational horses often work with inexperienced people who unaware may cause the pain. In those horses aggressive behavior is seen during brushing or saddling and riders are mostly exposed to bites (Walendowska, Nowicka-Obedient, 1991). If a horse is very sensitive, but well behaved the redirected aggression from person to an object can be observed.

7 Self-directed aggression

Self-directed aggression is sex-related behavior because it is mostly seen in stallions. Auto aggression occurs in horses that feel the presence of other individuals but have no contact with them. In particular, if mares are kept nearby and the stallion is locked for a long time. This is an evidence that limited space has a negative effects on horses.

The stallion or gelding bites himself at flank or near the knee. At the same time animals sometime also kick and squeal. This behavior is a risk for horses and humans health. Sometimes self-directed aggression can be induced by physical reasons and it this case those behavior is not related to sex. It has been suggested that neurological diseases, including rabies, may be the main problem. Also, other diseases like colic or dermatitis such as allergy may be the reason of auto aggression (Houpt, 1983).

8 Conclusion and perspectives

The scientific literature and data from horse farm shows that aggression is very important issue that still is not fully known. There is still need to conduct researchers about factors that cause developing this behavior. This knowledge allows keeping horses without exposing them to unnecessary suffering and protecting people from accidents.

Abnormal aggression is usually caused by humans. Inappropriate handling of dominant and fearfulness horses may cause the growth in the problem. What is more, wrong management, keeping horses in too small area, isolation or feeding mistakes may induce development of aggressiveness. If there is genetically determined "malice", it occurs rarely. Still, this phenomenon is difficult to prove. There are no established methods. What is more an analysis of chromosome structure is expensive, and to prove which changes are responsible for the aggressive behavior can be very difficult. Researchers on mice revealed some genes that are responsible for aggression: monoamine oxidase A, serotonin 5-HT1B receptor and α-calmodulin-dependent protein kinase II (CaMKII). This enzyme is required for activation of tryptophan hydroxylase which is the rate-limiting step in serotonin synthesis (Bowling, Ruvinsky, 2000).

Knowledge about aggressive behaviors in horses has practical aspects. First of all, prevention is always better than treatment. The priority should be horses welfare. What is more, treatment is expensive and may not result in full recovery. The ability to recognize aggressive behaviors and dominant horses will help to manage them. For example, people may predict which individuals should not stand next to each other or be aware of proper feeding subordinate horses.

Literature:

1. Bowling, W., Ruvinsky, A. *The genetics of the horse*. Wallingford: CABI Publishing, 2000, ISBN 0-85199-429-6.
2. Choe, J., Rho, J., Srygley, R. *Behavioral ecology of the Jeju pony (Equus caballus): Effects of maternal age, maternal dominance hierarchy and foal age on mare aggression.* Ecological Research. XIX. 2004, 55-63 p.
3. Dierendonck, M., Schilder, M., Vries, H. *An Analysis of dominance, its behavioural parameters and possible determinants in a herd of Icelandic Horses in captivity.* Netherlands Journal of Zoology. XLV. 3. 1995, 362-385 p.

4. Dietz O., Huskamp B. *Praktyka kliniczna: konie.* Łódź: Galaktyka, 2008. ISBN 978-83-7579-058-0.
5. Duncan, P., Monard, A. *Consequences of natal dispersal in female horses*. Animal behaviour. LII. 3. 1996, 565–579 p.
6. Greevy, P. *Equine behavior: a guide for veterinarians and equine scientists*. Toronto: W.B. Saunders Company, 2004, ISBN 0702026344.
7. Hall, C., Huws, N., White, C., Taylor, E., Owen, H., McGreevy, P. *Assessment of ridden horse behavior*. Journal of Veterinary Behavior: Clinical Applications and Research. VIII.2. 2012, 62-73 p.
8. Hausberger, M., Roche, H., Henry, S., Visser, E. K. *A review of the human–horse relationship.* Applied Animal Behaviour Science, CIX. 1. 2008, 1–24 p.
9. Heitor F., Mar Oom M., Vicente, L. *Social relationships in a herd of Sorraia horses. Part I. Correlates of social dominance and contexts of aggression.* Behavioural processes. LXXIII. 2. 2006, 170-177 p.
10. Houpt, K. *Horse Behavior : Its Relevancy to the Equine Practitioner*. I. 2. 1977, 87–94 p.
11. Houpt, K. *Equine biorhythms.* Equine practice. II. 3. 1980
12. Houpt, K., Wolski, T. *Stability of equine hierarchies and the prevention of dominance related aggression.* Equine veterinary journal. XII. 1. 1980, 15-8 p.
13. Houpt, K., Keiper, R. *The position of the stallion in the equine dominance hierarchy of feral and domestic ponies.* Journal of animal science. LIV. 1982, 945-950 p
14. Houpt, K. *Self-directed aggression: A stallion behavioral problem*. Equine practice.V. 2. 1983, 6-8 p.
15. Houpt, K. *Foal rejection and other behavioral problems in the postpartum period*. The Compendium on the Continuing Education for Practicing Veterinarians. VI. 1984, 144-148 p.
16. Houpt, K. *Behavioral problems in horses*. Equine practice. IV. 1986.
17. Houpt, K. *Abnormal behaviour*. Veterinary Clinics of North America: Farm Animal Behaviour. III. 2. 1987, 357-367 p.
18. Houpt, K. *Equine maternal behavior and its aberrations.* International Veterinary Information Service: www.ivis.org. 2000.
19. Houpt, K., Takeuchi, Y. *Behavior genetics*. Clinical techniques in small animal prctice. IX. 4. 2004.
20. Houpt, K. *Domestic animal behawiour*. I. Ames: Blackwell publishing, 2005, ISBN 978-0-8138-1676-0
21. Nowicki, B. *Zachowanie się zwierząt gospodarskich.* Warszawa: pwril, 1978, ISBN 83-09-00689-6.
22. Parelli, P. Ogiery wymagają savvy. Koń Polski. XII. 2002.
23. Pruchniewicz, W. *Akademia jeździecka*. I. Warszawa: Chaber PR -Akademia Jeździecka, 2003, 12-16 p. ISBN -83-91841-0-4.
24. Sadowski, B. *Biologiczne mechanizmy zachowania się ludzi i zwierząt*. Warszawa: PWN, 2006, ISBN 9788301153588.
25. Sigurjonsdottir, H., Stevens, C., Vandemoortele, H., Vervaecke, H., Vries, H. *Aggression and dominance in matched groups of subadult Icelandic horses (Equus caballus).* Japan ethological society and springer. XXV. 2006.
26. Søndergaard, E. *PhD thesis by Eva Søndergaard*. DIAS rapport Animal Husbandry. LV. 2003.
27. Walendowska, A., Nowicka-Posłuszna, A. *Ocena niektórych zachowań koni wierzchowych.* Koń Polski. III. 1991.
28. Waring, G. *Horse Behaviour*. New York: William Andrew Publishing, 2003, ISBN-9780815514848.

Primary Paper Section: G

Secondary Paper Section: GG

I INFORMATICS

IN INFORMATICS

THE SYSTEM FOR AUTOMATIC TRAIN CONTROL SIMULATION

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Abstract: The paper deals with the issue of the design and implementation of a train control simulator. This system allows evoking different potential traffic situations. It is also possible to search for the best solution of those situations. Much attention is devoted to the image processing possibility. Acquired information from an image can be used for development of a decision support system for rail vehicles. It can be also used for a cargo or an undercarriage inspection of a rail vehicle. The visual information transmission from a rail vehicle into a computer is described in detail. Several methods for image processing have been tested. The best results have been acquired with the Rapid object detection using a boosted cascade of simple feature algorithm. Further in the paper, possibilities of robustness increase as well as time requirements decrease of the whole solution are discussed.

Keywords: decision support system, rail vehicles, image processing.

1 Introduction

Much effort has been devoted to increase the safety of transportation. Intelligent elements are integrated into decision support systems for vehicles, driven by men. This article is focused on land transportation, especially rail vehicles. Systems for scene recognition, traffic signs recognition or rail signs recognition are used as a drive assistant. Advance decision support systems are based on different kinds of sensors. The most sophisticated systems use a computer vision. Some of these systems actively interfere into driving of a vehicle. An example of that functionality could be break activation, when sensors detect an obstacle on the road. Another example could be that those systems can monitor the speed of the vehicle and control it according to a speed limit. In the field of rail vehicles it is not research of decision support systems on that high level. In the Czech Republic, long-term monopole existed in the field of rail transportation in the form of the only one company. The development of decision support systems for rail vehicles was on the brink of interest in the past, due to its influence. Nowadays, competitive environment opens new opportunities for the application of the newest research results.

Two directions of this possible application can be distinguished. One of them is inspection. It can be focused on rails, undercarriage of a vehicle and some cargo. The purpose of this application is to prevent an accident. Image processing algorithms are able to detect parts of rails [8], [4] and vehicles [5], which are damaged. Rail track inspection is time consuming process. Use of computer vision algorithm brings cost reduction and a safety increase. Results from [8] can be seen in Figure 1. Algorithm is able to detect railroad ties (red) and their boundary (yellow), spikes (blue) and anchors of a railroad (green).

Figure 1: Diagram of the whole solution
Source: [8]

A plate on the railroad ties detection is shown in Figure 2. It is detailed look on the rails. Red line shows the rail track detection. Green rectangle identifies the railroad tie. And finally purple rectangle illustrates position of the tie plate. Spikes and anchors detection is realized in the further processing of this image. Then, the system is able to inspect those parts.

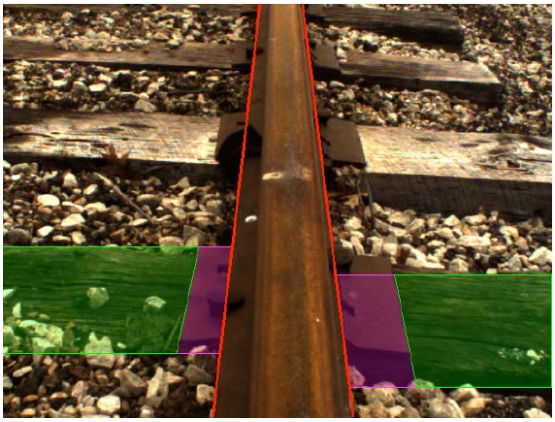

Figure 2: Delineated Tie and Tie Plate location Estimations
Source: [8]

The other direction is rail tracks recognition. This approach benefits from the geometric rules of rail tracks. Another advantage is their continuity. It can be predicted the appearance of the rail tracks in the image sequence. Based on these facts, it is possible to minimize detection error rate. Most often the application of this approach is obstacle detection [3], [2]. First, it is necessary to transform the scene according to geometric rules. Scheme of this transformation can be seen on figure 3. Transform of the Image of the real rail tracks is shown in Figure 4.

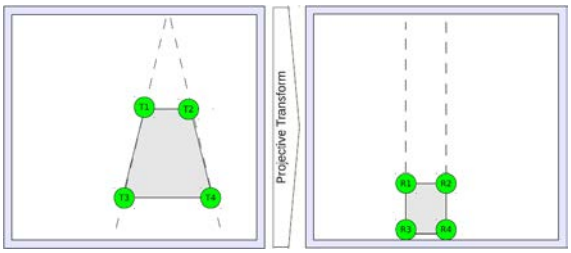

Figure 3: Projective transform mapping the corners of the trapezoid of the cabin view to the corners of the rectangle of the bird's-eye view.
Source: [3]

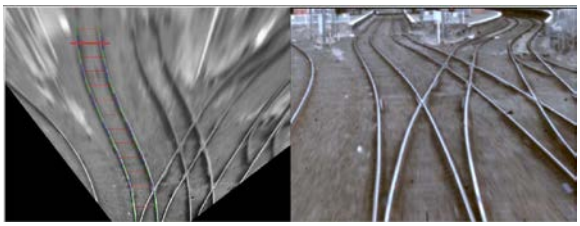

Figure 4: Transform of the image with rail tracks.
Source: [3]

Thanks to this transformation it is possible to detect the rail tracks and also detect obstacles that can be on them. Example of the detected rail track is shown in Figure 5. Red line indicates direction of the track.

The main goal of this work is the design and implementation a train control simulator. It is expensive or nearly impossible to create some traffic situations in real environment. This simulator allows to explore these situations. That was the motivation for creating this solution. This system serves mainly for supporting a research activity. Supporting of an educational process is the secondary goal.

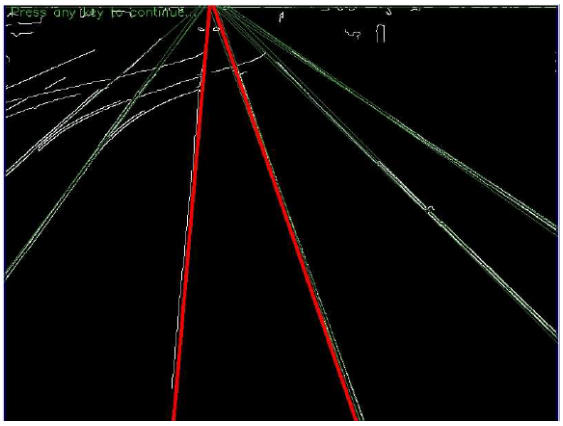

Figure 5: Detection of rail tracks.
Source: [3]

2 Used approach

The system for simulation of the train control was created in the laboratory of the rail vehicles that exists at Mendel University in Brno. A model railroad with different kinds of rail vehicles is available in the laboratory. Scales of the models are H0 (1:87) and TT (1:120). Vehicles can be controlled from a computer. Software can work automatically or in a manual regime. Vehicles are controlled by signals, which are modulated and distributed through the rail tracks together with the power supply. These vehicles are equipped with microcontrollers, which allow controlling two user outputs. User can control electronic in the vehicle using these outputs. Power supply for the whole vehicle is realized by the collector placed on the wheels.

The paper is focused on image processing. The main goal is to acquire information suitable for controlling a rail vehicle. Integration of miniature cameras into rail vehicles was necessary for a proper function of the whole system. Camera connection to the computer is wireless. A/D converter serves for digitization of the visual information. Images are processed in C++ programming language using OpenCV library (Open source computer vision) [6]. Two methods for object recognition were tested. Speed up robust features [1] and rapid object detection using a boosted cascade of simple feature [9]. The scheme of the whole designed solution is shown in Figure 6.

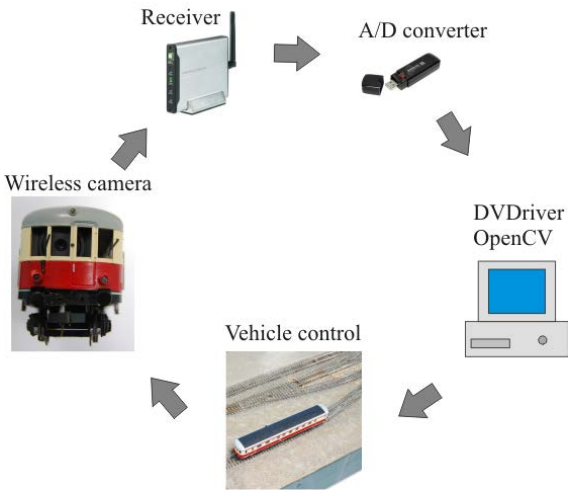

Figure 6: Diagram of the whole solution

Computation load is increasing according to the number of searched objects. The problem of higher time consumption of the Rapid object detection using a boosted cascade of simple features algorithm can be partially avoided using the dedicated powerful server. Image, acquired by the camera is send via computer network for further processing. This approach can bring significant time saving. The solution to this technical problem is discussed in detail in [7].

3 Achievements

Integration of a small camera into a model of a rail vehicle was the first step. A set of a wireless camera with a receiver was used. The camera is supplied direct from the rail tracks in the same way like the model vehicles. Supply voltage for the camera is adjusted by a DC to DC converter, see Figure 7-B2. The front and side views of an integrated camera is shown in Figure 7-A and 7-B1. The camera is controlled by the microcontroller of the vehicle, see Figure 7-B3. It is possible to focus on objects in a specific distance thanks to manual focus of the camera. This approach allows to take a sharp image of the object (e.g. traffic sign).

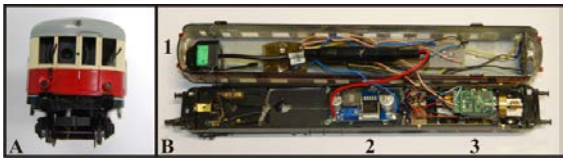

Figure 7: Integrated camera: A) front view, B1) side view, B2) DC/DC converter, B3) microcontroller

The camera is sending an analogues signal according to the PAL standard with resolution 720×576 px. The transfer of an image is realized in 2.4 GHz. The analogue signal is the output of the receiver. A USB A/D converter is used for the received signal digitization. A video stream is necessary for further processing. The converter itself cannot create a stream. DVDriver software is used for creation of a video stream. This software is able to emulate a webcam, so it is possible to grab an image in any time moment.

The OpenCV library [6] is used for image processing. C++ is used as the programming language. The input image is acquired from the DVDriver software in the real time. Two states of the art algorithms were used for the purpose of traffic sign recognition. One of them was Speeded up robust features [1]. The algorithm searches important points in an image. These points represent a specific object. Unfortunately, this algorithm application does not bring desired results. The biggest problem was high false positive rate. Better results were achieved with Rapid object detection using a boosted cascade of simple features algorithm [9]. Images obtained from the camera were used for training of a classifier. The algorithm needs positive and negative images for training. Positive samples were processed using createsapmles utility from OpenCV. From one traffic sign in an image it is possible to create more positives samples. The sample position is deformed and simulates the view under different angles. This approach is possible, because a traffic sign is a 2D object. Another source of positive samples could be the document from Railways of the Czech Republic company: „Dopravní a návěstní předpis“. Generated positive samples are then stored to the vec file. Images obtained from the record of the rail tracks serve as negative samples. The negative samples do not contain desired traffic signs. Hundreds of the negative samples were used for training. After training, the classifier was able to detect the desired traffic sign, see 8-A. False alarm rate was acceptable during testing rides. The system proved the ability to detect the sign even in a noisy image, see 8-B.

Information obtained from the surrounding environment makes possible the adaptive control of the rail vehicle. The speed and direction of the vehicle can be changed based on this information.

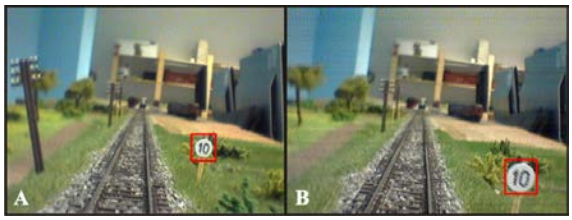

Figure 8: Sign detection: A) good quality image, B) image with noise

4 Discussion

The described system is able to recognize rail traffic signs in a given environment. A little disadvantage could be a relatively complex process of classifier training. Especially preparing the samples is demanding. Training of a classifier is also a time consuming process. But, it is necessary to do these steps only once for each object. The detection process input is a cascade of simple features.

The acquired video stream is delayed about one second in comparison to the real time. It depends on wireless signal quality. The delay is caused by the wireless connection of the camera and need of the digitization process. That is a disadvantage from a technical view. This delay is not a critical obstacle for the research in the laboratory. In reality this delay can be eliminated using an industrial camera with a USB3 connection.

4 Conclusions and future work

In the paper there is described the system for automatic train control simulation. It is focused on the computer vision. Its technical solution of image transmission from a rail vehicle into a computer is described in details. Two methods for scene recognition were tested. The first method, Speed up robust features, does not bring desired results. Problem being, the too high false positive rate. The second method, the Rapid object detection using a boosted cascade of simple features provides sufficient results. Thanks to this, it is possible to continue in the research in the field of automatic train control.

The future work will be focused on increasing robustness of the proposed system. The approach in image processing and the scene recognition can be improved. The rail traffic signs and railroad have clear geometric rules. Thanks to those rules, it is possible to reduce a size of a search area in an image. The smaller search area can bring a significant reduction of a computation load and increase of reliability of the system.

The proposed system allows evoking different potential traffic situations. Also it is possible to search for the best solution of those situations. Simulations can be focused on testing of Decision support systems, rail vehicles inspection and obstacle detection on the rail tracks.

Literature:

1. Bay, H., Tuytelaars, T. and Gool, L.: *SURF: Speeded Up Robust Features.* In: Proceedings of the ninth European Conference on Computer Vision, 2006, ISBN 978-3-540-33832-1 pp. 404–417. DOI 10.1007/11744023_32.
2. Gschwandtner, M., Pree, W. and Uhl, A. *Track Detection for Autonomous Trains*. In: 6th International Symposium, ISVC 2010, Las Vegas, NV, USA. Las Vegas: Springer Berlin Heidelberg, 2010, pp. 19-28. ISBN 978-3-642-17276-2, ISSN 978-3-642-17277-9. DOI: 10.1007/978-3-642-17277-9_3.
3. Maire, F. and Bigdeli, A. *Obstacle-free range determination for rail track maintenance vehicles.* In: Control Automation Robotics & Vision (ICARCV), 2010 11th International Conference. Singapore: IEEE, 2010, pp. 2172 - 2178. ISBN 978-1-4244-7814-9. DOI: 10.1109/ICARCV.2010.5707923.
4. Mandriota, C., Nitti, M., Ancona, N. Stella, E. and Distante, A. *Filter-based feature selection for rail defect detection*. In: Machine Vision and Applications. New York: Springer-Verlag, 2004, pp. 179-185. ISSN 0932-8092. DOI: 10.1017/s00138-004-0148-3.
5. Mazzeo, P. L., Stella, E., Ancona, N. and Distante, A. *Visual Detection of Hexagonal Headed Bolts Using Method of Frames and Matching Pursuit.* In: Second Iberian Conference. Estoril, Portugal: Springer Berlin Heidelberg, 2005, pp. 277-284. ISBN 978-3-540-26153-7, ISSN 978-3-540-32237-5. DOI: 10.1007/11492429_34.
6. Open source computer vision. OpenCV [online]. 2014 http://opencv.org/
7. Prochazka, D., Popelka, O., Koubek, T., Landa, J. and Kolomazník, J. *Hybrid SURF-Golay Marker Detection Method for Augmented Reality Applications*. In: Journal of WSCG. 2012. Volume. 20, number. 3, pp. 197-204. ISSN1213-6972. URL: http://wscg.zcu.cz/wscg2012/full/E17-full.pdf
8. Sawadisavi, S., Edwards, J.R., Resendiz, E. Hart, J.M., Barkan C.P.L and Ahuja, N. 2009. *Machine-Vision Inspection of Railroad Track*. In: Proceedings of the Transportation Research Board 88th Annual Meeting, Washington, DC, January 2009.
9. Viola, P. and Jones, M. *Rapid object detection using a boosted cascade of simple features*. In: Computer Vision and Pattern Recognition, IEEE, 2001 pp. 511–518. ISBN 0-7695-1272-0, ISSN 1063-6919. DOI: 10.1109/CVPR.2001.990517.

Primary Paper Section: I

Secondary Paper Section: IN

J INDUSTRY

IN	INFORMATICS
JA	ELECTRONICS AND OPTOELECTRONICS
JB	SENSORS, DETECTING ELEMENTS, MEASUREMENT AND REGULATION
JC	COMPUTER HARDWARE AND SOFTWARE
JD	USE OF COMPUTERS, ROBOTICS AND ITS APPLICATION
JE	NON-NUCLEAR POWER ENGINEERING, ENERGY CONSUMPTION AND UTILIZATION
JF	NUCLEAR ENERGY
JG	METALLURGY, METAL MATERIALS
JH	CERAMICS, FIRE-PROOF MATERIALS AND GLASS
JI	COMPOSITE MATERIALS
JJ	OTHER MATERIALS
JK	CORROSION AND MATERIAL SURFACES
JL	FATIGUE AND FRACTURE MECHANICS
JM	STRUCTURAL ENGINEERING
JN	CIVIL ENGINEERING
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JP	INDUSTRIAL PROCESSES AND PROCESSING
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JR	OTHER MACHINERY INDUSTRY
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JW	NAVIGATION, CONNECTION, DETECTION AND COUNTERMEASURE
JY	FIREARMS, AMMUNITION, EXPLOSIVES, COMBAT VEHICLES

MATHEMATICAL AGGREGATION OPERATORS AND THEIR APPLICATION TO MECHANIZED EARTHWORK PROCESSES

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Abstract: Equipment selection is a critical factor of many construction projects especially in the heavy construction projects where the equipment fleet may represent the largest portion of bidding price. Construction companies, developers and builders have a lot of things to consider before purchasing a right type of equipment. The importance of the criteria is expressed by weights, which are chosen by the experts or the decision makers. In this paper, a multi-criteria method based on weighting functions and aggregation operators was implemented into earthwork processes for comparing dozers which are available on the market. The key mathematical models for multi-criteria decision analysis are presented and the proposed model can be used like a tool for comparison of some types of mechanization.

Keywords: optimization, aggregation operators, mechanization, dozers

1 Introduction

Earthwork processes are involved in construction and in building process and they can be a fascinating part of a construction project because of powerful heavy equipment. The scope of these processes varies from a small amount of earth to moving millions of cubic meters of earth. The one thing that all soil processes have in common is that careful planning is the key to success. Traditionally, a project manager uses deterministic methods in analyzing soil processes, although real processes are stochastic. Considerable efforts have been made in development of efficient techniques and procedures for soil processes and many techniques have been developed so far.

The most of authors are interested in estimation of the actual field load spectrum which has to be designed properly. They aim to provide a new approach in estimating the minimum sample size of the transmission load of a wheel loader under multiple operating conditions. Zhang and Chu [9] studied the wheel loader and provided methods to estimate the sample size of load time history according to the extreme load values. Because the extreme load value poses a threat to structures by sometimes causing static failure, it is also studied in other fields. Naess and Gaidai [4] estimated the actual extreme values with the relationship between the extreme values and sample time series. Hence, the mean and standard deviation of the extreme load values are selected as other criteria for estimating the sample size of load signals. Wang et al. [8] focuses on determining the minimum sample size of the transmission load of a wheel loader under multiple operating conditions based on multi-criteria decision making technology. The weight values of the chosen criteria are determined, where the eigenvector and entropy information methods, together with linear combination weighting, are adopted. The optimal minimum sample size is estimated based on the feasible values determined by the three criteria and their corresponding weight values. Presently the majority of studies published in the literature focus on the optimization of equipment selection are based on diverse complex factors. Machine selection method and evaluation problem has been studied extensively. In contemporary equipment selection process for earthwork, the best alternative of machines is evaluated against multiple criteria rather than considering a single factor. Shapira and Goldenberg [7] developed a model which is based on an analytical hierarchy process which was developed by Thomas Saaty. The developed model is capable of providing users with results to compare with different alternatives based on several criterions for selection of equipment based on highest score. Its hierarchy was structured by dividing the problem into four criteria and eighteen sub-criteria, which were tackled in accordance to three perspectives: cost evaluation, benefit evaluation and total evaluation. Bascetin [1] have used Analytical Hierarchy Process approach for the equipment selection in final decision in the area of mining operations. The criteria for equipment selection are clearly identified what enables to decision makers to examines strength and weakness of loading-hauling systems by comparing them with the respect to appropriate criteria. In this study a computational example is provided to justify one of the multi-criteria methods. Applications of this method will increase effectiveness of building machines selection from the point of key criteria of optimizing, thus speeding up whole process of equipment selection.

2 The characteristic of dozers and the importance of selection the right piece of machine

In this study a computational example is provided to justify selected multi-criteria optimization method and method of scientific analysis and synthesis. These methods were implemented into are of earthwork processes, especially for comparing some alternatives of dozers like a main heavy equipment using for pushing earth, sand or rocks used in road building and construction. Dozer is classified like a tracked tractor that has an integral metal blade used to drive a significant magnitude of soil, sand, rocks, etc., generated during construction. Dozers are huge and robust tracked equipment and dozers weight is distributed by the wide tracks over vast area. They are designed preliminary for cutting and pushing material relatively for short distance (the tracked dozers for 60 meters, the wheeled dozers for 100 meters). The most economical application of dozers is their application mainly for the cutting of soil and for earthmoving at least, because with the increasing distance it has brought about losing soil and the performance of dozer is decreased. Selection of the right piece of dozers like main heavy equipment which can commonly be seen on the construction sites have to be based on a thorough analysis of the technological, economic and organizational aspects.

The choice of a particular type of dozer depends on the type and size of building, type and scope of work that the machine will perform during its operation and character of working activities which will be performed by the machine. Optimal choice of the machine also affects the composition of the soil type, the workability of soil, the groundwater level, the technical parameters of the machine, its performance, cost, estimated time for using the machine and also the nature of other mechanization that will work in the machine fleet. The first equipment selection step involves matching the right machine to the work physical task. Each piece of construction equipment is specifically designed by the manufacturer to perform certain mechanical operations that accomplish the work activity. Two types of failure can occur for all equipment. Structural or mechanical failure occurs when the machine is overloaded or stressed beyond the physical capabilities of its components. Stability failure occurs when the machine is overloaded or placed in a situation where it cannot remain balanced and upright. Using machines matched to the task will greatly increase the chance of avoiding failures and should be a primary goal of equipment selection. One of the most important considerations when selecting a piece of equipment is the availability of the right machine with proper and timely service, maintenance, and repair.

The right machine must not only match mechanical functions, but also power, capacity, and control requirements. Dealer or rental agency location proximity and staff competency will influence downtime and turnaround for service. The physical properties of clay, gravel, organic matter, rock, sand, or silt to be moved or excavated has a direct influence on the type and capacity of equipment selected for a specific work activity. The ease or difficulty of removing and handling soil or any material directly influences the amount of machine productivity. The composition of the soil and the amount of moisture in the soil influence the heaped capacity that the bucket can hold or the

blade can push. Soil type and stability are also important to the engineer because the size of the particles, physical properties, and behavior when the moisture content is changed greatly influences the site and foundation design. Sometimes the soil must even be replaced or stabilized using other types of soils or additives. These decisions influence the types and capacities of the equipment needed by the contractor for the site work and ultimate construction of the foundation system.

Desired productivity is also a major influence on earth machines selection. Meeting the schedule for the quantity of work to be accomplished is the goal. The required hourly production of a piece of machinery is primarily determined by the amount of work to be done and how fast it has to be done. The amount of time the contractor wants to spend or has to spend on excavation or earthmoving will greatly influence the size of machinery chosen for the work. If there is a large volume of dirt that needs to be moved quickly, a large piece of machinery will probably be most efficient. If there is a small amount of dirt to be excavated, a smaller piece of machinery makes more sense. Equipment selection is typically company-specific and directly influenced by specific project and financial considerations. Equipment needs are further influenced by the complexity and uniqueness of a specific work activity. Contractors typically stretch the versatility of a piece of equipment by using it for multiple types of work. The goal is always to match the best hourly cost to the required production for the work activity. Each piece of equipment is specifically designed to perform certain mechanical tasks. Therefore, base the equipment selection on efficient operation and availability.

3 The selection of dozers and the choice of the normalization procedure

Selection of the right piece of machines for earthwork processes, like the right man for the job, affects field productivity. Productivity directly influences profitability. Using a machine that does not have enough capacity will slow down productivity. Using a machine with too large capacity might increase productivity to some extent, but will ultimately negatively affect profitability, because of the cost of operation of the oversized machine. This contribution illustrated the comparison of some types of the dozers like main heavy equipment with application multi-criteria optimization. The first step of comparing options for selected track-types dozers is the set of dozers and their characteristic submitted for analysis in the introductory phase – see Table 1. It is necessary to determine the criteria which are the most important in the process of the multi-criteria optimization. It is necessary to determine the criteria which are the most important in the process of the multi-criteria optimization.

Table 1: The selected types of dozers and their characteristics available on the market

THE TYPES OF THE DOZERS	Transport weight (kg)	Number of units (m^2)	Performance (m^2/h)	The price of machine (EUR)
D3K XL (LRC)	7 795,000	2,640	1 584,000	64 702,071
D3K2 XL	7 958,000	2,640	1 900,000	64 702,071
D4K LGP	8 510,000	3,150	2 835,000	84 563,929
D5K2 XL	9 314,000	2,780	3 336,000	96 431,571
D8T	38 488,000	4,990	5 988,000	463 195,750
D6N LGP	17 997,000	4,080	4 896,000	199 154,107
D7E STD	25 996,000	3,900	4 980,000	391 412,929

In the Table 1 they are selected track-type dozers and their parameters which have to be minimized or maximized to choose the most appropriate dozer in case of our criteria. The caterpillar was the main resource used to get information and characteristic of selected dozers which was determined like criteria which are important in the multi-decision making process. However, as shown in Table 2 below, some of the criteria have to be minimized and some of them have to be maximized to reach the optimal dozer with selected criteria of optimality. The comparison of alternatives depends on the choice of the normalization procedure at first, secondly on aggregation method. In order to compare values for selected criteria we choose normalization of data to the scale [0,1]. The point of linear normalization is to make variables comparable to each other. The reason this is a problem is that measurements made using such scales of measurement as nominal, ordinal, interval and ratio are not unique. Instead, you need to reduce the measurements to the same scale, and then compare. Normalization is the process of reducing measurements to a "neutral" or "standard" scale. In the Table 2 we can see normalized outputs for selected type of dozers.

Table 2: Normalized outputs for selected type of dozers

THE TYPES OF THE DOZERS	Transport weight (kg)	Number of units (m^2)	Performance (m^2/h)	The price of machine (EUR)
D3K XL (LRC)	0,000	1,000	1,000	0,000
D3K2 XL	0,005	1,000	0,928	0,000
D4K LGP	0,023	0,783	0,716	0,050
D5K2 XL	0,049	0,940	0,602	0,080
D8T	1,000	0,000	0,000	1,000
D6N LGP	0,332	0,387	0,248	0,337
D7E STD	0,593	0,464	0,229	0,820
	MIN	**MAX**	**MAX**	**MIN**

For the brevity, the normalization description notation $x_i = U_j(a_i)$ has been used. Thus $x_1, \ldots, x_n$ are the input values and the values $v_1,\ldots,v_n$ are normalized outputs. We apply a linear normalization which is performed according to the formula:

$$v_i = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}}, \quad (1)$$

where normalized vector fulfills the following conditions $0 \leq v_i \leq 1$, while minimum $v_i = 0$ and maximum $v_i = 1$.

3 The evaluation of selected dozers by weighting functions and aggregation operators

In this paper the evaluation of selected dozers is presented by weighting functions and aggregation operators. Weights in aggregation reflect the different importance of single inputs to be processed. For the comparison of selected dozers the evaluation by mixture operators has to be chosen. For an interval $I \subset R$, let $D:I^2 \rightarrow R$ be given by $D(x,y) = (x-y)^2$. Then for any weighting functions $g: I \rightarrow [0,\infty]$, the operator $A_{g,D}$ is a mixture operator given by a mathematical model:

$$A_{g,D}(x_1,\ldots x_n) = \frac{\sum_{i=1}^{1} g(x_i).x_i}{\sum_{i=1}^{1} g(x_i)}. \quad (2)$$

In multi decision making process the expression has to be minimized:

$$h(r) = \sum_{i=1}^{n} g(x_i).(x_i - r)^2, \; r \; I \quad (3)$$

The function h is differentiable and:

$$h'(r) = -2.\left(\sum_{i=1}^{n} g(x_i).x_i - r.\sum_{i=1}^{n} g(x_i)\right) \quad (4)$$

$A_{g,D}$ need not be monotone increasing, in general. Ribeiro and Pereira have shown that any non - decreasing piecewise differentiable weighting function $g : [0; 1] \rightarrow [0;1]$ such that

$$g \geq g' \quad (5)$$

More general, for a non-decreasing differentiable weighting function $g : [a; b] \rightarrow [0,\infty]$, if

$$g(x) \geq g'(x).(b - x), x \in [a, b], \quad (6)$$

then $A_{g,D}$ is an aggregation operator.

In our case study after normalization, we have to determine the global ranking $r^{A}_{norm} : A \rightarrow [1;\infty]$ based on an aggregation function $A :[0;1]^n \rightarrow [0;1]$. The normalized inputs will be aggregated by a mixture operator $A:[0;1]^4 \rightarrow [0;1]$ with a weighting function $g : [0;1] \rightarrow [0;1]$ given by:

$$g(x) = x + 2,$$

$$Ag, D(x_1,...x_4) = \frac{\sum_{i=1}^{1} g(x_i).x_i}{\sum_{i=1}^{1} g(x_i)} = \frac{(x_1+2).x_1+(x_2+2).x_2+(x_3+2).x_3+(x_4+2).x_4}{x_1+2+x_2+2+x_3+2+x_4+2} \quad (7)$$

The results of aggregation normalized inputs and resulting global ranking are summarized in the next Table 3.

Table 3: Aggregation normalized inputs and resulting global ranking

THE TYPES OF THE DOZERS	g (x) = x + 2	Ranking
D3K XL (LRC)	0,700	**7**
D3K2 XL	0,684	**6**
D4K LGP	0,602	**3**
D5K2 XL	0,619	**4**
D8T	0,500	**2**
D6N LGP	0,493	**1**
D7E STD	0,635	**5**

Table 3 shows us which alternatives were the best and which were the worst with application of weighting functions and aggregation operators. So with this application the track-type dozer D6N LGP is the best solution in terms for our optimal criteria.

4 Conclusions

Multicriteria optimization is a key factor to achieve success in any discipline, especially in a field which requires handling large amounts of information and knowledge base. The application of multi-criteria methods proved as an effective methodology thanks to its ability to combine various criteria in order to select the best alternative in terms of our key criteria of optimality. It is a reasoning process and the model of multi-criteria analysis is based on the set of possible alternatives and the number of the criteria which can be qualitative, quantitative or mixed. The importance of the criteria is expressed by weights, which are chosen by the experts or the decision makers and can be normalized real numbers or weighting functions. In this paper, a multi-criteria method based on weighting functions and aggregation operators were implemented into earthwork processes for comparing dozers which are available on the market. The key mathematical formulas for multi-criteria decision analysis are presented and the proposed model can be used like a tool for comparison of some type of machines. The comparison of alternatives depends on the choice of the normalization procedure at first, secondly on aggregation method. Recall that all of the multicriteria methods which were developed so far are only a support for a decision maker in the process of decision making because they are almost subjective and the chosen method depends always on the decision maker.

Literature:

1. BASCETIN, A.: *A Decision Support System for Optimal Equipment Selection in Open Pit Mining: Analytical Hierarchy Process*. Istanbul University, Journal of Geoscience, vol.16, 2003, p.1-11.
2. FRANK, B., SKOGH, L., ALAKÜLA, M. *On wheel loader fuel efficiency difference due to operator behaviour distribution.* 2nd Commercial vehicle Technology Symposium, 2012, Germany, Pp. 329-346. ISBN 978-3-8440-0798-5.
3. JRADE, A., MARKIZ, N. *A Decision –Support Model Utilizing a Linear Cost Optimization Approach for Heavy Equipment Selection.* Construction Research Congress, 2012, pp. 100-109.
4. NAESS, A., GAIDAI, O. *Estimation of extreme values from sampled time series.* Journal of Structural Safety, Vol.31, 2009. Pp. 325–334.
5. RIBEIRO, R.A., PEREIRA, R.A.M. *Weights as functions of attribute satisfaction values*. Proceedings of the Workshop on Preference Modeling and Applications (EUROFUSE) 2001, Granada, Spain, 2001.
6. RIBEIRO, R.A., PEREIRA, R.A.M. *Generalized mixture operators using weighting functions: A comparative study with WA and OWA.* European Journal of Operational Research vol. 145, 2003. Pp. 329-342.
7. SAPHIRA, A., GOLDENBERG, M. *AHP based equipment selection model for construction projects.* Journal of Construction Engineering and Management, vol. 131, no. 12, 2005, pp. 1263-1273.
8. WANG, J., WANG, N., WANG Z., ZHANG, Y., LIU, L. *Determination of the minimum sample size for the transmission load of a wheel loader based on multi-criteria decision-making technology.* Journal of Terramechanics, Vol. 49, 2012. Pp. 147-160, ISSN 0022-4898
9. ZHANG, Y., CHU, W. *Determination of the sample size to the load of transmission of the loader*. Chinese of Mechanical Engineering, Vol. 12, 1994. Pp.16–20.

Primary Paper Section: J

Secondary Paper Section: JN, JQ, JR

THE REQUIRED REINFORCEMENT AREA FOR THE CONTROL OF CRACK WIDTHS IN CONCRETE STRUCTURES

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Abstract: Visible cracking occurs when the tensile stresses exceed the tensile strength of the material. Visible cracking is frequently a concern since these cracks provide easy access for the infiltration of aggressive solutions into the concrete and reach the reinforcing steel or, other components of the structure leading to deterioration. The design of a structure with reduced width of the cracks can be done using a variety of standards and guidelines. The individual guidelines introduce different procedures for design of the amount of the reinforcement for the cracks width limitation. This paper deals with calculation of the required reinforcement area for the crack widths limitation according to national annexes of the standard EN 1992-1-1, Model Code 2010 and other standards and their differences in the design of the structures.

Keywords: watertight concrete, cracks width, minimum reinforcement area, cracks spacing

1 Introduction

In concrete, mortar and cement paste shrinkage takes place from the very beginning of the life of the material. In early age volume change can be both swelling and shrinking, but later shrinkage is relevant, which is caused by water movement in the porous and rigid body. During the hydration of cement (in the first 2 to 8 hours), while the cement paste is plastic, fresh concrete and cement mortar undergoes a volumetric contraction (plastic shrinkage) and free water content is moving toward the external surface of the specimen. After compaction and subsidence of particles due to its surface tension water is absorbed from the capillary pores towards the external surface and evaporated. Volume reduction of the outer layer is inhibited by the inner part of the material, and this can result map-like wide cracks. During the hydration of cement paste also a volume change occurs (autogenous shrinkage), due to the hydration products (cement matrix) volume is less than the volume of the raw materials (cement + water). However, the extent of hydration prior to setting is small, and once a certain stiffness of the system has developed, the contraction induced by the loss of water due hydration is greatly restrained. Withdrawal of water from concrete in unsaturated air causes drying shrinkage. A part of this drying shrinkage is irreversible and should be distinguished from the reversible moisture movement caused by alternating storage under wet and dry condition. Plastic, autogenous and drying shrinkage together are called early age shrinkage. [3], [6]

Influencing factors of early age shrinkage in mix design:

- cement content of the paste; specific surface area of cement
- fine aggregate content (under 0.125 mm particle size); specific surface area of fine aggregate
- water-cement ratio
- total aggregate content
- type of aggregate; water absorption capacity/water content of aggregate
- applied admixtures
- compacting rate of paste
- porosity
- other added components e.g. fibres.

Shrinkage of concrete depends on the temperature of concrete and its surroundings, on relative humidity and on the velocity of air movement as well as the curing and composition of the concrete. To fulfil the requirements of crack-free structures is often a problem during the design and construction of concrete and reinforced concrete structures, e.g. exposed concretes, hydraulic engineering works, gas- and water- tight concretes. Crack formation is also disadvantageous from the point of view of durability. [3], [6]

2 Design of reinforcement area according to EN 1992-1-1

2.1 The control of cracks width with the direct calculation

This control is based on the conception shown in Fig. 1.

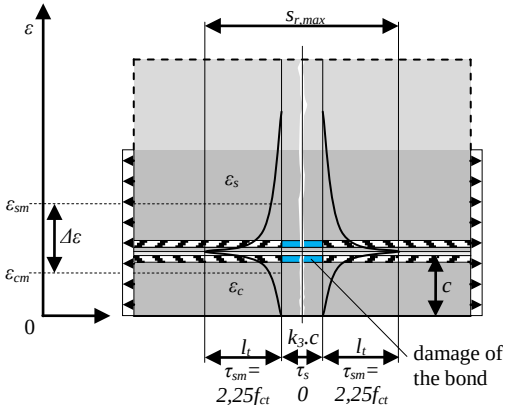

Fig. 1 Conception of calculation of crack width according to STN EN 1992-1-1 [4]

The crack width may be calculated from the expression:

$$w_{s,\max} = s_{r,\max} \cdot (\varepsilon_{sm} - \varepsilon_{cm}) \qquad (2.01)$$

where

$s_{r,\max}$ - is the maximum crack spacing [mm]

ε_{sm} - is the mean strain in the reinforcement under the relevant combination of loads

ε_{cm} - is the mean strain in the concrete between cracks

Difference of the mean strains may be calculated from equation:

$$\varepsilon_{sm} - \varepsilon_{cm} = \frac{\sigma_s}{E_s} - k_t \cdot \frac{f_{ct,eff}}{\rho_{p,eff} \cdot E_s} \cdot (1 + \alpha_e \cdot \rho_{p,eff}) \geq 0.6 \frac{\sigma_s}{E_s} \qquad (2.02)$$

where

σ_s - is the stress in the tension reinforcement assuming a cracked section [kPa]

E_s - design value of modulus of elasticity of reinforcing steel [kPa]

k_t - is a factor dependent on the duration of the load [-]

$f_{ct,eff}$ - is the mean value of the tensile strength of the concrete effective at the time when the cracks may first be expected to occur: $f_{ct,eff} = f_{ctm}$ or lower $(f_{ctm}(t))$, if cracking is expected earlier than 28 days [kPa]

$\rho_{p,ef}$ - is the effective reinforcement ratio [%]

$= A_s / A_{c,eff}$

A_s - is the area of reinforcing steel within the tensile zone [m2]

$A_{c,eff}$ - is the effective tension area [m2]

α_e - is the ration E_s / E_{cm} [-]

E_{cm} - is the secant modulus of elasticity of concrete [kPa]

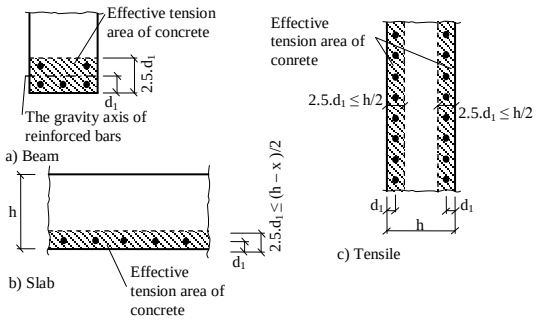

Fig. 2 Effective tension area

The maximum crack spacing calculated from the expression:

$$s_{r,\max} = \begin{cases} k_3.c + k_1.k_2.k_4.\dfrac{d_s}{\rho_{p,eff}} & s \le 5.(c + \dfrac{d_s}{2}) \\ 1.3\cdot(h-x) & s > 5.(c + \dfrac{d_s}{2}) \end{cases} \quad (2.03)$$

where

c - is the cover to the longitudinal reinforcement [m]

d_s - is the bar diameter [m]

k_1 - is a coefficient which takes account of the bond properties of the bonded reinforcement:
= 0.8 for high bond bars
= 1.6 for bars with an effectively plain surface (e.g. prestressing tendons)

k_2 - is a coefficient which takes account the distribution of strain:
= 0.5 for bending
= 1.0 for pure tension

k_3 - is the recommended value
= 3.4

k_4 - is the recommended value
= 0.425

s - is the spacing of bars [m]

h - is the overall thickness of a cross-section [m]

x - is the neutral axis depth in the stage II [m]

2.1 Minimum reinforcement areas according to EN 1992-1-1

$$A_{s,\min} = k_c.k.f_{ct,eff}.\frac{A_{ct}}{\sigma_s} \quad (2.04)$$

where

$A_{s,\min}$ - is the minimum area of reinforcing steel within the tensile zone [m^2]

k_c - is a coefficient which takes account of the stress distribution within the section immediately prior to cracking and of the change of the lever arm:
For pure tension $k_c = 1.0$
For bending or bending combined with axial forces
- For rectangular section and webs of box sections and T-sections:

$$k_c = 0.4\cdot\left[1 - \frac{\sigma_c}{k_1\cdot(h/h^*)\cdot f_{ct,eff}}\right] \le 1$$

where

σ_c - is the mean stress of the concrete acting on the part of the section under consideration

h^* $h^* = h$ for $h < 1.0m$
$h^* = 1.0m$ for $h \ge 1.0m$

k_1 - is a coefficient considering the effects of axial forces on the stress distribution:
$k_1 = 1.5$ if N_{Ed} is a compressive force
$k_1 = \dfrac{2\cdot h^*}{3\cdot h}$ if N_{Ed} is a tensile force

k - is the coefficient which allows for the effect of non-uniform self-equilibrating stresses, which lead to a reduction of restraint forces
= 1.0 for webs with $h \le 300mm$ or flanges with widths less than 300 mm
= 0.65 for webs with $h \ge 800mm$ or flanges with widths greater than 800 mm
Intermediate values may be interpolated.

A_{ct} - is the area of concrete within tensile zone. The t ensile zone is that part of the section which is calculated to be in tension just before formation of the first crack.

3 Adjustment of calculation according to DIN EN 1992-1-1/NA

DIN EN 1992-1-1/NA introduces the following changes in the calculation:

1.) Changes in the equation for the calculation of the cracks spacing:
- coefficient $k_3 = 0$, because DIN EN 1992-1-1/NA is not considering the loss of bond of reinforcement and concrete near the crack
- conjunction of coefficients $k_1 \cdot k_2 = 1$; allowed only high-bond bars
- coefficient $k_4 = 1/3.6$, which corresponds to the stress in bond $\tau_{sm} = 1.8\cdot f_{ctm}$ for high-bond reinforcement

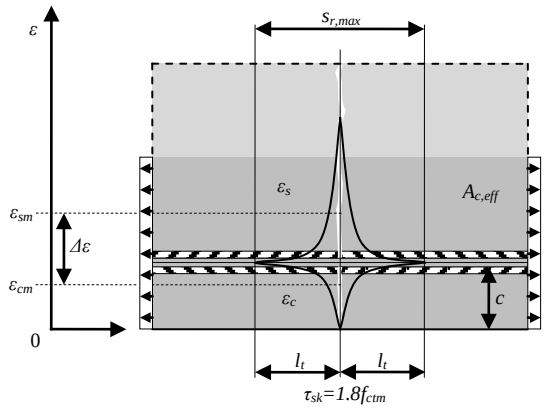

Fig. 3 Conception of calculation of crack width according to DIN EN 1992-1-1/NA [4]

Taking into account the above assumptions of DIN EN 1992-1-1/NA applied for maximum cracks spacing:

$$s_{r,\max} = k_3.c + k_1.k_2.k_4.\frac{d_s}{\rho_{p,eff}} = \frac{d_s}{3.6\cdot\rho_{p,eff}} \le \frac{\sigma_s\cdot d_s}{3.6\cdot f_{ct,eff}} \quad (3.01)$$

2.) Effective mean value of the tensile strength of the concrete $f_{ct,eff}$ [kPa]
- if is possible to determine with certainty the formation of cracks in the first 28 days
$= 0.5\cdot f_{ctm}$ if a crack is created at the time 3 to 5 days
$= \max(f_{ctm}; 3.0MPa)$ - hardening concrete
$= \max(0.5\cdot f_{ctm}; 1.5MPa)$ - green concrete
- if is not possible to determine with certainty the formation of cracks in the first 28 days
$f_{ctm} \ge 3.0MPa$ - ordinary concrete
$f_{ctm} \ge 2.5MPa$ - lightweight concrete

3.) Effective tension area $A_{c,eff}$ is determined based on the Fig. 2. However, it is necessary to take into account the

extra diagram in Fig. 4, taking into account the effect of the thickness of the element on the effective thickness of the tension area.

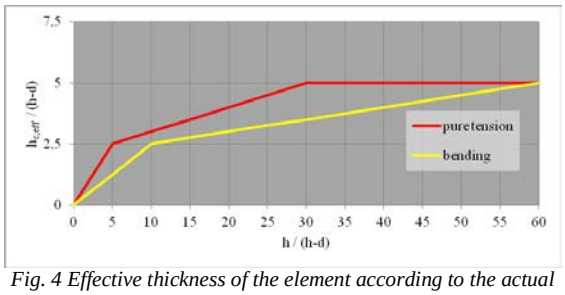

Fig. 4 Effective thickness of the element according to the actual thickness of the element [1]

4.) Changes in the equation for minimum reinforcement area

k - is the coefficient which allows for the effect of non-uniform self-equilibrating stresses, which lead to a reduction of restraint forces,

- in the presence of tensile stresses induced due the Eigen-stresses from restraints (e.g. a decrease in heat of hydration) 0.8

k = 0.8 for h ≤ 300mm

k = 0.5 for h ≥ 800mm

Intermediate values may be interpolated.

- when the tensile stress is induced by external stress (e.g. slump supports) applies: k = 1.0

4 Calculation according to Model Code 2010

$$w_d = 2.l_{s,\max}.(\varepsilon_{sm} - \varepsilon_{cm} - \varepsilon_{cs}) \quad (4.01)$$

For the length $l_{s,\max}$ the following expression applies:

$$l_{s,\max} = k.c + \frac{1}{4}.\frac{f_{ctm}}{\tau_{bms}}.\frac{\varphi_s}{\rho_{s,ef}} \quad (4.02)$$

where:

k - is an empirical parameter to take the influence of the concrete cover into consideration. As a simplification $k = 1.0$ can be assumed.

c - is the concrete cover

τ_{bm} - is mean bond strength between steel and concrete (Table 1)

The relative mean strain follows from:

$$(\varepsilon_{sm} - \varepsilon_{cm} - \varepsilon_{cs}) = \frac{\sigma_s - \beta.\sigma_{sr}}{E_s} + \eta_r.\varepsilon_{sh} \quad (4.03)$$

where

σ_s - is the steel stress in a crack

σ_{sr} - is the maximum steel stress in a crack in the crack formation stage, which, for pure tension, is:

$$\sigma_{sr} = \frac{f_{ctm}}{\rho_{s,ef}}.(1 + \alpha_e.\rho_{s,ef}) \quad (4.04)$$

where

$$\rho_{s,ef} = \frac{A_s}{A_{c,ef}}$$

with $A_{c,ef}$ = effective area of concrete in tension

α_e - is the modular ratio $= E_s / E_{cm}$

β - is an empirical coefficient to assess the mean strain over $l_{s,\max}$ depending on the type of loading (Table 1)

η_r - is a coefficient for considering the shrinkage contribution

ε_{sh} - is the shrinkage strain

Table 1: Values for τ_{bms}, β a η_r for deformed reinforcing bars [5]

	Crack formation stage	Stabilized cracking stage
Short term, instantaneous loading	$\tau_{bms} = 1.8.f_{ctm}(t)$ $\beta = 0.6$ $\eta_r = 0$	$\tau_{bms} = 1.8.f_{ctm}(t)$ $\beta = 0.6$ $\eta_r = 0$
Long term, repeated loading	$\tau_{bms} = 1.35.f_{ctm}(t)$ $\beta = 0.6$ $\eta_r = 0$	$\tau_{bms} = 1.8.f_{ctm}(t)$ $\beta = 0.4$ $\eta_r = 1$

5 Comparisons of standards

The comparisons of standards were made using the program MS Excel. The comparison of the overall required reinforcement area for crack width limitation under all the above standards shows the Fig. 8. Then, the comparisons were made influence of an individual parameters, which focus on differences in the standards STN EN 1992-1-1, DIN EN 1992-1-1/NA, Model Code 2010 (Fig. 5 to Fig. 7). In Fig. 9 is shown the comparison of the eight selected standards.

All comparisons were based on the following assumptions:

- concrete class C25/30 and cement class S,
- reinforcing bars grade B 500B with diameter = 16 mm,
- structural class S3, exposure class XC2, XC3, => the cover to the longitudinal reinforcement c_{nom} = 30 mm,
- maximum crack width $w_{k,max}$ = 0.2 mm,
- age of the concrete t = 5 days.

5.1 Comparison influence of the individual parameters

The approaches of individual standards are nearly identical. The biggest difference between the calculations is the determination of the cracks spacing.

When comparing of the individual parameters to the standards DIN 1992-1-1 and STN EN 1992-1-1 were observed for the slab thickness 2.0 m following the effects:

1. the coefficient k: 16.8% increase of the reinforcement area according to STN EN 1992-1-1,
2. the effective area of the tensile concrete $A_{c,eff}$: 18.8% increase of the reinforcement area according to DIN EN 1992-1-1,
3. the equation for the calculation of the cracks spacing: 35.4% increase of the reinforcement area according to STN EN 1992-1-1.

These differences can be observed for the various slab thicknesses in the following comparisons.

The influence of coefficient *k*

Fig. 5 shows the differences of required reinforcement area due to different values of the coefficient k. For comparison, the procedure selected in the required reinforcement according to EN 1992-1-1, the values of the coefficient were taken from the standards DIN EN 1992-1-1/NA and STN EN 1992-1-1

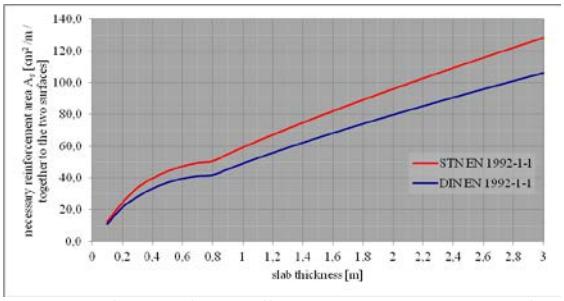

Fig. 5 Influence of the coefficient k to the required area of reinforcement

The influence of the effective area of tensile concrete $A_{c,eff}$

In contrast to other influence has the determination of the effective area on the basis of DIN EN 1992-1-1/NA the opposite effect than any other adjustments that standard, i.e. causes an increase in the required area of the reinforcement. This phenomenon can be observed in Fig. 6. For the calculation of the required area of the reinforcement was used the approach of EN 1992-1-1. The effective area of reinforcement was determined on the basis of DIN EN 1992-1-1/NA and STN EN 1992-1-1/NA.

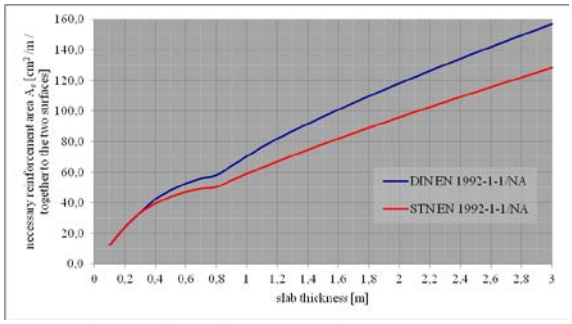

Fig. 6 Influence of the effective area of the tensile concrete $A_{c,eff}$

The influence of the coefficient k_1 to k_4

Given that the equation for calculating the distance between the cracks consists of several coefficients whose values differ depending upon the standard was made compare the influence of coefficients k_1 to k_4 to the required area of reinforcement shows Fig. 7. The values of the coefficients are selected on the basis of the individual standards. The calculation was made according to EN 1992-1-1.

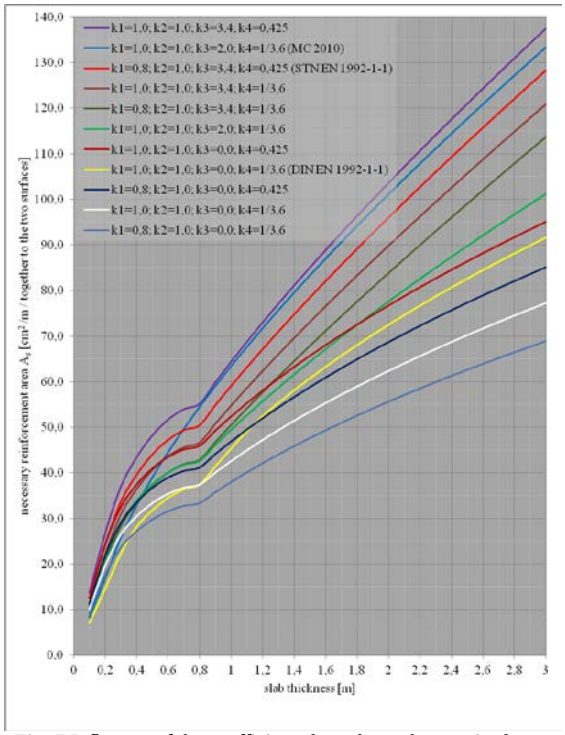

Fig. 7 Influence of the coefficients k_1 to k_4 to the required area of reinforcement

The influence of the equation for the calculation of cracks spacing

Fig. 8 highlights the differences caused by different approaches to calculate the cracks spacing. For comparison, the procedure selected in the draft reinforcement according to EN 1992-1-1, distance calculation cracks was performed using the coefficients k_1 to k_4 according to STN EN 1992-1-1, DIN EN 1992-1-1/NA and the Model Code 2010.

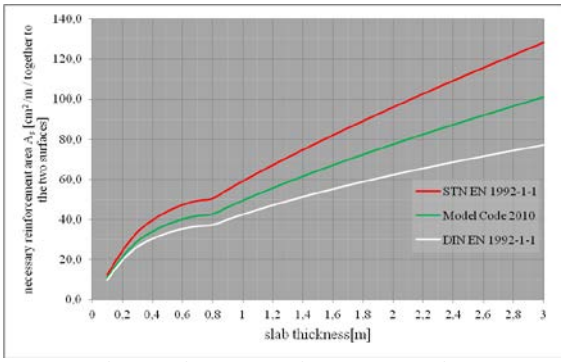

Fig. 8 Influence of the relation for calculating of the cracks spacing on the amount of a required reinforcement

The results of the comparison of the various standards

For the comparison (Fig. 9) of the required reinforcement area for the control of the crack widths were chosen the results of these standards: BS 8007, SIA 262, Model Code 1990, SS EN 1992-1-1, NF EN 1992-1-1, Model Code 2010, STN EN 1992-1-1, DIN EN 1992-1-1.

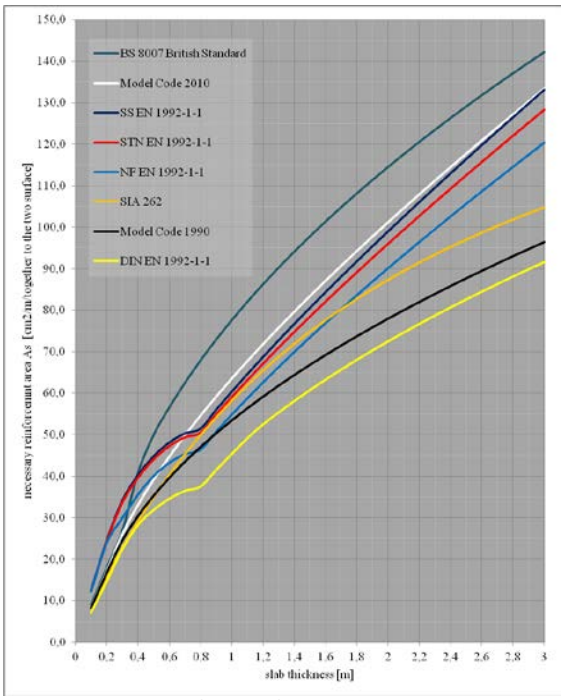

Fig. 9 Comparison of the reinforcement area according to the various standards

6 Conclusions

Cracking in concrete will occur in all but the simplest and smallest of structures. In the structure subjected to hydrostatic pressure a through-crack, of any size, can form a water path, which may result in leakage or wet patches occurring. It is the responsibility of the designer to limit design crack widths to a predetermined size to restrict or prevent water from leaking through the concrete into the basement. The principal and most effective method to control restrained shrinkage and thermal movement cracking is by the provision of sufficient reinforcement. The design approach for early-age thermal cracking adopted by STN EN 1992-1-1:2006 is broadly similar to that of DIN EN 1992-1-1/NA but there are some significant and important differences as follows:

1. the value of the coefficient k, which allows for the effect of non-uniform self-equilibrating stresses, which lead to a reduction of restraint forces is according to DIN EN 1992-

1-1 lower by the 0.8 times than according to STN EN 1992-1-1,
2. the loss of bond of reinforcement and concrete near the crack in DIN EN 1992-1-1/NA is not taken into the consideration.

The analysis of different standards for the design of reinforcement required to control the crack width revealed, that significant savings in reinforcement area can be obtained using the DIN EN 1992-1-1/NA. Many parameters in STN EN 1992-1-1 vary according to DIN EN 1992-1-1 which causes an increase in steel reinforcement and a significant increase in cost. The main reason for the concentration of our research work to the mentioned topic is to find out the decisive parameters and try to derive their real values. The results demonstrate highly significant differences of the required reinforcement area according to the selected standards.

Literature:

1. *DIN EN 1992-1-1/NA: Eurocode 2: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken - Teil 1-1: Allgemeine Bemessungsregeln und Regeln für Hochbau; Nationaler Anhang*, Berlin, 2010.
2. *EN 1992-1-1: Eurocode 2. Design of concrete structures - Part 1-1: General rules and rules for buildings*, Brussels, 2004.
3. FENYVESI, O.: *Early age shrinkage cracking of concretes*, In: Conference of Junior Researchers in Civil Engineering, Budapest, Hungary 2012 , pp. 51-57.
4. FINGERLOOS, F.: „Der Eurocode 2 für Deutschlad - Erläuterungen und Hintergründe, Teil 3: Begrenzung der Spannungen, Rissbreiten und Verformungen," *Beton- und Stahlbetonbau 105*, Bd. 8, pp. 486-495, 2010.
5. *Model Code 2010: Final Draft*, September 2011.
6. SmeBV (2012): Guidelines for Watertight Concrete Structures–White Tanks (in Slovak), SKSI, Bratislava 2012.
7. *STN EN 1992-1-1/NA: Eurokód 2. Design of concrete structures – Part 1-1: General rules and rules for bulíldings; National Annex*, Bratislava, 2007.
8. *NF EN 1992-1-1/NA: Mars 2007: (National Annex France).*
9. Model Code 1990: Final Draft, 1991.
10. BS 8007:1987: Design of concrete structures for retining aqueous liquids, British Standard.
11. BFS 2013:10 EKS 9 (National Application rules in Sweden).
12. SIA 262:2013: Bauwesen, Betonbau, Schweizer Norm SN 505 262, Zurich, 2013.

Primary Paper Section: J

Secondary Paper Section: JM, JN