FÓRUM MANAŽÉRA

Teória a prax v riadení podniku

VEDOMOSTNÝ MANAŽMENT

VZDELÁVANIE

PÔSOBNOSŤ ČASU JE VIAC AKO MANAŽMENT ČASU

Obdobie, ktoré žijeme je charakteristické neustálym zrýchľovaním všetkých javov a procesov. Je to *obdobie „zrýchľovania zrýchlenia",* obdobie významných temporálnych zmien spôsobených najmä digitalizáciou vzťahov (stála digitálna dosiahnuteľnosť) a virtualizáciou reality (pracovných systémov).

Na posúdenie vlastných (i tímových) potrieb a možností, ale aj pre racionalizáciu procesov vedenia ľudí využívame parameter čas ako kvantitatívnu charakteristiku prebiehajúcich procesov. Čas vnímame ako samozrejmosť, ako vzduch na dýchanie. Takéto chápanie časových kompetencií však už nezodpovedá súčasným požiadavkám profesijného ani osobného života.

Viacerí bádatelia i celé výskumné tímy moderného sveta sa už dlhší čas venujú hľadaniu jednotlivých *„kvalitatívnych znakov" času* a ich zoskupovaniu pre využitie v konkrétnej situácii.

Z publikovaných výsledkov doterajšieho výskumu problematiky vyplýva, že pre efektívne hospodárenie s časom (pre racionálne využitie času) je potrebné.

- Významne *znížiť rozsah prijímaných informácií* (cieľov a rozhodnutí) a tým redukovať „stále spojenie" (mobil, smartfón) s pracovným tímom (večer, víkend, dovolenka), pretože je to zdraviu škodlivé a znižuje to pracovnú výkonnosť ;
- *Rešpektovať psychické (emocionálne) potreby (možnosti) ľudí* podľa ich typu (denné a nočné typy, multiaktívni ľudia, ľudia schopní plánovať aktivity v čase), čo je dôležité pre dosiahnutie temporálnej prospešnosti práce ;
- *Podporovať aktivity* na udržanie sviežosti tela a čulosti zmyslov (spoločné cvičenia, autogénny tréning, meditácie a pod.) ;
- *Rešpektovať schopnosť jednotlivých typov ľudí rýchle reagovať* na podnety (rýchli a pomalí jedinci) za poznania, že každý jedinec má svoje, individuálne „optimálne obrátky" (efektívne pracuje a dobre sa cíti) a že stále zrýchľovanie aktivít vedie k nekvalitnej práci, čím sa získaný čas stáva iba relatívnym ;
- *Zohľadňovať rozličnosti ľudí podľa ich vnútorného (biologického) rytmu* a ich potrebu vyrovnať sa s požiadavkami pracovnej činnosti (práca-odpočinok, striedanie pracovných činností), temporálne sa synchronizovať;
- Nepodceňovať *pôsobenie temporálnej empatie* (ľudí nočného typu nemotivovať ráno, pomalé typy ľudí nenútiť do zrýchľovania tempa práce).

Výsledkom daného reťazca temporálnych zmien práce by malo byť dosiahnutie stavu, že úspešné splnenie cieľov je aj emocionálne uspokojujúce. V spojení so selekciou prijímaných informácií, správnym stanovením priorít, určením naliehavosti realizácie aktivít je možné vytvoriť koncept temporálnych kompetencií, ako východisko pre prípravu a realizáciu náročných pracovných projektov, racionálnu organizáciu práce a optimálnu koncepciu hospodárenia s časom (využívania času).

Musíme rešpektovať a podriadiť sa poznaniu, že čas nemožno ušetriť, nemožno ho riadiť ani odstrániť. Čas možno iba rozumne (vy)užiť.

Ak v intenciách vyššie uvedeného pohľadu na charakteristiky parametra čas posudzujeme temporálne kompetencie uplatňované na väčšine našich univerzít, zdá sa, že všetky snahy merať efektívnosť práce pedagógov iba meraním kvantitatívnych znakov času práce, spracovávaním „šichtoviek" o ich prítomnosti na pracovisku sú potieraním výsledkov výskumu o kvalitatívnych charakteristikách času a ich význame pre zvyšovanie výkonnosti akademických zamestnancov a ich psychického uspokojenia z výsledkov svojej práce.

Trnava, december 2015

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OBSAH

E-LEARNING, AS AN EFFECTIVE TOOL FOR MANAGERS TO WORK IN A MULTICULTURAL ENVIRONMENT

BAKOVÁ Lucia, CHLPEKOVÁ Andrea

ABSTRACT
This paper focuses on multicultural work environment brought by globalization. Managers in such environment must think and work globally. It is essential that their skills are further developed. At the time of digitalization, it is necessary that managers have this kind of literacy and improve it also through training. Effective form of education, which also increases digital literacy, is the use of e-learning. The aim of the scientific paper is a detailed identification and description of development of education for managers through e-learning form on the basis of collected data of 159 employees of the largest engineering and automobile companies.

KEY WORDS
globalization, multiculture environment, managers, e-learning

INTRODUCTION

Globalization is a phenomenon which brings many changes on the globe. Many companies have moved away from being organized around self-contained national entities and instead have structures that transcend borders and integrate business across countries, they become multicultural (Staněk 2005). Work environment without boundaries is the motto of today's CEO (PwC 2015). Managers in these companies are facing a perfect storm – a changing workforce both demographically and culturally. The rise of technology and increasing workplace diversity have all made the need for competent multicultural leaders and managers essential (Blain 2012). There is a growing importance for managers and leaders to be multiculturally aware, knowledgeable and skillful..

WORK ENVIRONMENT WITHOUT BOUNDARIES

Every year PriceWaterhouceCoopers prepares an annual global CEO survey. In 2015, 1322 CEOs from 77 countries around the world were interviewed. 85 % of all these directors believe that cultural diversity and overall strategy within the companies have an impact on increasing business performance and 56% believe that cultural diversity helps them succeed in the new sector or region (PwC 2015). As companies look for ways to best apply their innovative ways, they need to have a good "mixture" of talented people who can think and work in different ways. In Slovakia, it is common, if a company fails to find a specialist in its ranks, to call on outside sources in Slovakia, if it does not succeed, the company searches abroad (Trend 2015). According to statements by experts from recruitment agencies, in the next five years we will needs to create 12,000 new jobs in the automotive and engineering industry. It is only a matter of time before our job market runs out and we will have to resort to qualified forces from abroad. With new investments, which are coming to Slovakia in the coming period, for example a fourth car manufacturer, it might happen within a year (McROY 2015). The cultural mix of the workforce in the enterprise need different approach from superior and in education. Even PWC has indicated in its analysis that the one-size-fits-all approach will not certainly work in the mix of talented people, therefore, companies are preparing a whole range of strategies to identify and develop exactly what people need. 81% of CEOs are looking for much wider range of skills in employees. Up to 71% of CEOs said that the company is looking for the right talent, not only in other companies but also in other countries. Developing the skills of existing employees in the company is also on the list of priorities of each company. 81% of CEOs said that it is necessary to provide them with new skills through continuing education as well as various mobility programs, moreover up to 89% of organizations are planning to enhance the mobility of their employees within its branches around the world during next two years (PwC 2015)

THE DEVELOPMENT OF MULTICULTURAL MANAGEMENT AND MANAGEMENT SKILLS IN TODAY'S GLOBALIZED ENVIRONMENT

In 2011-2012, Cegos (International Organization for Professional Development in Education) has executed analysis with a title „Development of multicultural management and management skills in today's globalized workplace. It points out that today's managers need to think and work differently in a global team. What is now required is radically different from how managers were trained, developed and coached in the past. In 2011 in another analysis carried out in the countries of UK, France, Germany, Spain and Italy, Cegos revealed that 20% of managers were not at all being trained and in comparison with 2010, there was a decrease in the training of managerial skills by 7%. This decrease in management education reflects that

every fourth manager has not undergone management training (Cegos 2011). From March until the end of June 2015, we surveyed the largest Slovak engineering and automotive companies, and investigated a sample of 135 surveyed managers in order to find out how many were trained in the company at the onset of the job. Upto 68% said they have not received any management training and even have not undergone any adaptation process. According to the HR Director of EDYMAX, Ltd., a personnel and consulting company, many managers lack the elementary management skills. Companies invest a lot of money in the training of regular employees but are forgetting about their managers. Many times the adaptation process is absent in the company, so the managers do not know what training programs they should undergo. Companies often think that formal education is sufficient and leave the manager alone with his individual development. CIPD (professional organization for human resources and people development) has interviewed 367 managers and 56 HR specialists in the UK. 6 out of 10 were not satisfied with the program of managerial skills development and 2 out of 10 respondents think that the program was ineffective. Our managers who have received training all claimed that the provided training program was sufficient for them (CIPD 2015). Enterprises should invest more in education of managers. It should be more effectively related to individual and business needs. The rise of technology is bringing new learning opportunities to companies.

Communication Technology (ICT) is used daily by nearly 49% of the population older than 14 years. A large proportion of the population can no longer dispense with some ICT for example up to 36% of respondents cannot imagine their lives without mobile phone, and one fifth of the population declares dependence on computers, laptops, tablets and Internet. During last decade, the approach to digital literacy of people has significantly changed, on the other hand, there is about 40% of the population who refuses to learn and adapt to new technologies, often, however, these are people over
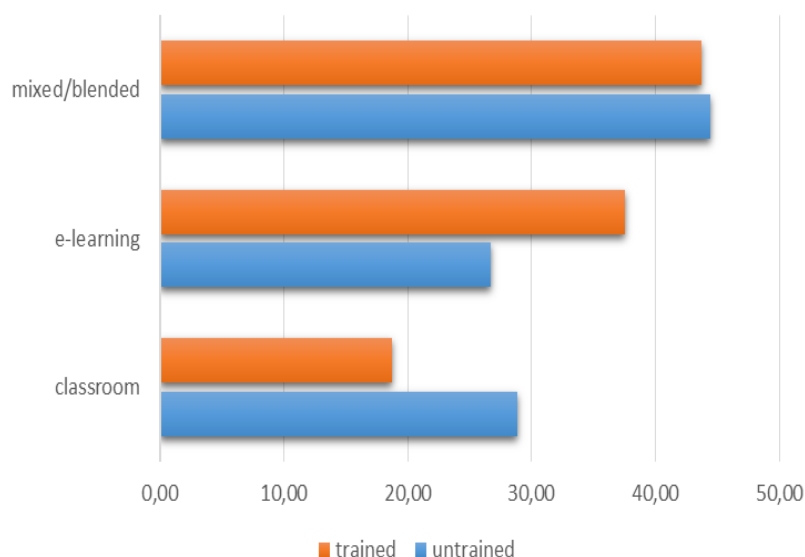
Fig. 1 *Preferred form of education trained and untrained employees of the analyzed company Source: own research)*

60 years, less educated, the unemployed but also manual workers (Velšic 2015).

Use of information technology was also the subject of our research. The entire sample consisted of 159 employees of the largest engineering and automobile companies, 10.3% of respondents were top managers, 37.9% middle management, 36.2% lower management and employees accounted for 15.5%. The outcome of this research showed that preferred form of education was different in employees, who completed education and people who have not completed it. The biggest difference was in the use of e-learning (Fig. 1). Up to 37.5% of employees, who have completed education, prefer electronic forms of learning

DEVELOPMENT OF TECHNOLOGY AND EDUCATION

Development of technology raises many questions about managing such as How can I get the best out of my multicultural team especially considering the fact that we have to manage a lot of people at a distance? Besides ability to understand cultural differences of a team, communication and other soft skills, a good multicultural manager in addition needs to have technical skills, such as the digital literacy. It is expected that he will be technically skilled at a very high level (CIPD 2015).

In 2015, Institute for Public Affairs published a research report, which compares the Digital Literacy in Slovakia during 10 years. According to this report, the intensity of Internet use in the last two years is growing rapidly and in 2015 Information and

According to Table 1, age group 55 and over, exclusively prefers an attendance form of education. On the other hand, respondents who went through training, lower and middle managers and people with Masters degree prefer learning through e-learning (tab. 1).

Tab. 1 Preferred form of training in the analyzed companies, the percentage of by-demographic aspects
  Source: own research

		Preferred form of training - untrained, the whole sample (N=116)			Preferred form of training - trained, the whoe sample (N=43)		
		class room	e-learning	mixed/blended	class room	e-learning	mised/blended
		28,89	**26,67**	**44,44**	**18,75**	**37,5**	**43,75**
Gender	female	13	9	18	13	6	6
	male	16	18	27	6	31	38
Age	18-24 rokov	0	0	0	0	0	0
	25-34 rokov	9	11	13	6	6	6
	35-44 rokov	9	13	18	0	31	19
	45-54 rokov	7	2	13	6	13	13
	55 a viac rokov	4	0	0	0	0	0
Education	primary school	0	0	0	0	0	0
	secondary school	0	0	2	0	0	0
	high school	9	2	9	13	0	13
	Bachelor's degree	0	2	4	0	0	0
	Master's degree	11	27	33	0	50	25
	PhD. degree	0	0	0	0	0	0
Job position	ordinary emploeey	13	2	4	6	0	0
	junior management	7	11	13	6	25	19
	senior management	7	11	18	0	25	6
	top management	0	9	4	0	0	13
Region	Bratislava	16	7	13	6	6	13
	Trnava	9	7	13	6	13	13
	Trenčín	4	2	0	0	0	0
	Nitra	0	4	7	0	6	0
	Žilina	0	4	4	0	13	6
	Banská Bystrica	2	0	0	0	13	0
	Prešov	0	0	0	0	6	0
	Košice	0	2	4	0	0	0
Major nationality of management in the company	Slovak	16	7	18	0	0	13
	English	0	0	0	0	0	0
	German	7	16	13	0	31	13
	Korean	0	2	4	0	13	6
	Italian	0	0	0	0	0	0
	Spanish	0	0	0	0	0	0
	French	4	2	4	6	6	6
	Japanese	0	0	4	0	0	0
	Dutch	0	0	0	0	0	0
	other	2	0	0	6	0	0
Size of the company	250 - 499	16	7	11	0	25	6
	500 -999	2	9	20	0	6	6
	1000 and more	11	11	13	13	19	25

In case of foreign studies carried out by Cegos, as in Slovakia and abroad, mainly managers and people with higher education prefer learning through e-learning, despite the fact that this form of education is ranked as second to preferred forms of learning. The main, or more precisely, the most common source of education is the fulltime form of education (seminars, training), 79% in Asia vs. 91% in Europe. The second most common source of learning is online learning, up to 58% is involved in online education in Asia, compared to 43% in Europe. A combined method of training in both continents is represented in 39% (Cegos 2013).

Until now, people who have ever undergone training through e-learning prefer this sort of education in 75%, on the other hand, only 45% of people who do not have this form of experience prefer such training. In the future, the traditional education will not go into oblivion because people require mix forms of education, however, education must be more personal, and must take into account demographic and cultural changes in the global market
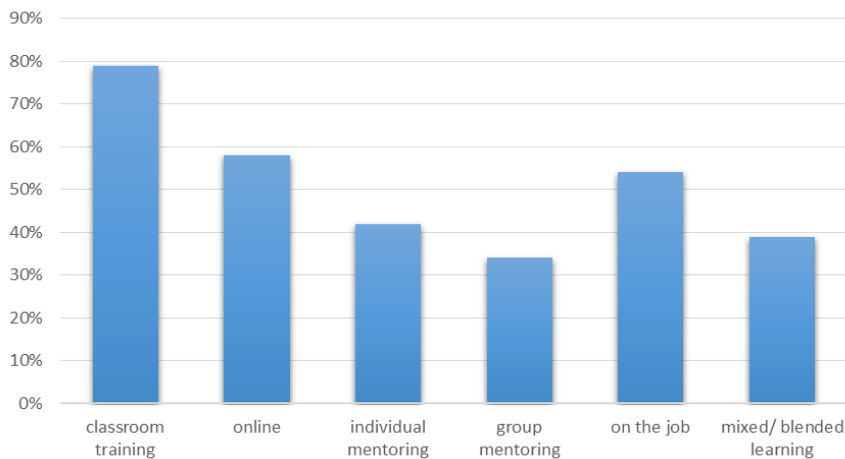
Fig. 2 *Forms of training, the average for the analyzed countries of Asia Pacific*
Source: Cegos 2013 own processing

- improving digital literacy of students,
- development of e-learning, which would reflect the student's request, i. e. all elements of interactivity will be used (use of serious game, online classes, online communication with coach or mentor), courses will be tailored to individual needs.

Threats
- unfavorable development of economical and social situation globally, that means companies will not have the financial means to implement e-learning system.

IS E-LEARNING AN EFFECTIVE FORM OF EDUCATION FOR MANAGERS?

This question can help answer using SWOT analysis. Which can help us to evaluate the strengths, weaknesses, opportunities and treats involved in a project or in a business venture (Fig. 3).

Strengths
- preferred form of education for managers and people with University degree,
- management of education, it is possible to study anywhere and anytime,
- flexibility for learner, the taken studies can be accessed at any time.

Weaknesses
- less digital literacy of learner,
- foreign surveys show that there are still many people who do not feel confident in such education system.

Opportunities
- in case of lower literacy of a student, the system should be made transparent, help and technical support should be available, then the student will feel more comfortable even in this form of education,

Fig. 3 *SWOT analysis - elearning*
Source: own processing

CONCLUSION

E-learning education must be sufficiently interactive, so that it captures and brings positive effects for management training. Surveys show that in the case of management positions, e-learning is very effective because managers do not have enough time for training and would like manages own time. The enterprise choose which way of ensuring e-learning decide to go, whether you hire system or create one yourself and will use it also for other employees.

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BUSINESS ETHICS AND ITS IMPACT ON CORPORATE CULTURE

ĎURIŠOVÁ Jaroslava, VAŇOVÁ Jaromíra

ABSTRAKT
Článok sa zaoberá podnikateľskou etikou a jej vplyvom na podnikovú kultúru. Podniková etika predstavuje normatívnu dimenziu podnikovej kultúry, odráža a zdôrazňuje pre biznis relevantné hodnoty a pravidlá. V centre pozornosti musí byť uvedomenie si citlivej spojitosti medzi hospodárnosťou, ziskovosťou, etickým, environmentálnym a sociálnym štandardom podnikania. Výskumy poukazujú na to že touto problematikou sa cielene zaoberajú skôr veľké podniky, malé jej venujú iba okrajovú pozornosť. Podnikateľská etika musí prenikať všetkými činnosťami a procesmi podniku a jej výsledkom sa musí stať etické správanie a konanie všetkých zamestnancov podniku.

ABSTRACT
The article deals with business/corporate ethics and its impact on corporate culture. Business ethics is a normative dimension to the corporate culture, reflecting and highlighting the business values and related rules. The focus must be on the awareness of sensitive link between economic efficiency, profitability and the ethical, environmental and social business standards. Research shows that the issue has been primarily addressed by large enterprises, while smaller companies pay it only marginal attention. Business ethics must permeate all activities and processes of a business, being manifested by ethical behaviour and performance of all company employees.

Kľúčové slová
podnikanie, trhové hospodárstvo, podnikateľská etika, podniková kultúra, etická orientácia ľudských zdrojov

Key words
Entrepreneurship, market economy, business/corporate ethics, corporate culture, ethical orientation of human resources

INTRODUCTION

Change in the management approach to human resources (as the most precious corporate resources) in multicultural businesses in the Slovak Republic should be considered as a change of managerial paradigm. It is necessary currently to seek and implement innovative elements in the personnel management activities and processes (human resources management), to motivate employees towards individual responsibility in favour of the collective performance and the team organization. Sustainable development of ethical environment and implementation of ethical standards in all the activities and processes in enterprises and organizations represent a prerequisite for successful business and efficient corporate culture.

The focus must be on the awareness of a sensitive link between economic efficiency, profitability and the ethical, environmental and social business standards. Multicultural businesses are increasingly focusing on quality, environmental protection, building the company surroundings (or local business environment), ethics and corporate social responsibility, as well as improvement of the relations with employees, customer-supplier partners, stakeholders and partners in the sectors of education, government administration etc.

MANAGERIAL ETHICS AND CORPORATE CULTURE

In the recent period, company culture (corporate culture) has become topical in modern management. Several authors (Kachaňáková et al. 2011; Kachaňáková 2010; Majtán, 1998) define corporate culture as a system of recognized attitudes, opinions, beliefs, assumptions and expectations which, though never officially recorded, form the way of how the human resources act in the organization. Majtán, M. states that corporate culture is manifested in the following areas:

1. Standards - unwritten rules of behaviour that greatly affect people's way of acting.
2. Hierarchy of values - recognition what is good or bad for the organization, which would be implemented, i.e., what it is considered important.
3. Company climate - working atmosphere in a company as perceived and recognized with regard of the qualities of corporate culture and its system of values.
4. Management style - way of behaviour and the application of managers' authority.
5. Structure and systems - these include the aspects such as the degree of the company structure flexibility and level of the bureaucratic management approach. (Majtán, 1998)
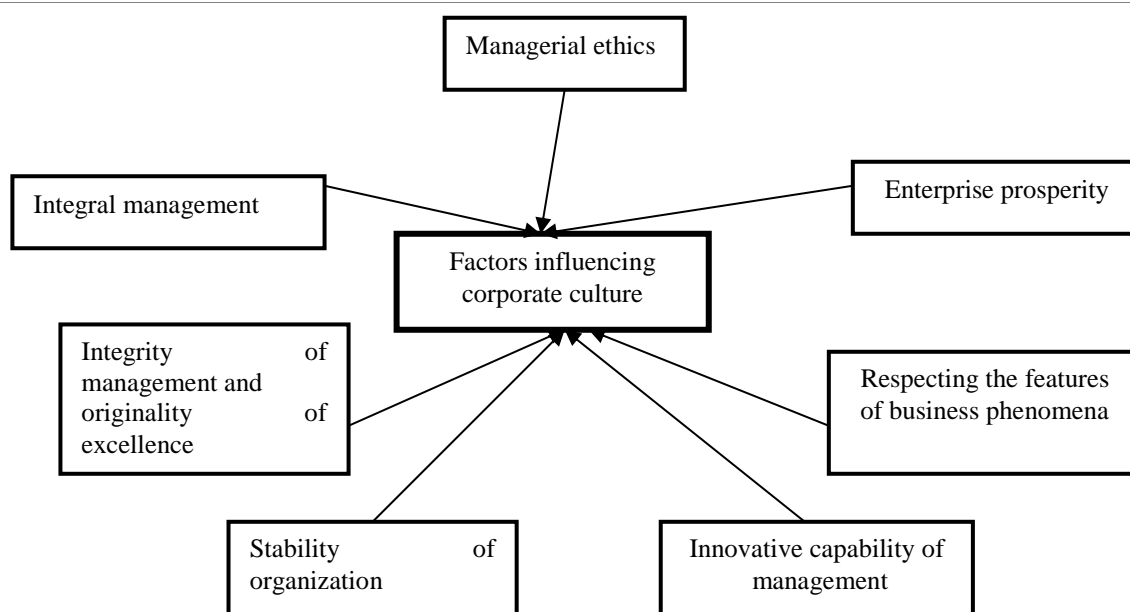
Fig. 1 *The factors influencing corporate culture (elaborated by author according to: Dytrt et al., 2011]*

Čambál et al. draw attention to the ethical principles that the managers should respect when making decisions:

> ➢ prefer society interests to company interests,
> ➢ prefer company interests to personal interests,
> ➢ reveal the truth in all cases of the corporate and personal acting.

These principles represent a general guide for managers on how to behave ethically in accordance with social values and their own moral principles. (Čambál, et al., 2000)

Corporate culture builds on the organization system of values:

> ➢ Organization's attitude to the market conditions - reflected in corporate strategy; business ethics can be expressed in ethical strategy.
> ➢ Ethics of economy - expressed in financial strategy, a part of business ethics, represents ethical economy via meeting the business liabilities.
> ➢ Ethics managerial competencies - managerial ethics is the basis for determination and implementation of managerial competencies in compliance with the HR strategy.

Methodology importance of ethical theories is important for managers in the process of making decisions that are of the both economic and also ethical nature. Corporate culture conveys a sense and orientation in the behaviour control and decision-making with regard to business goals.

CHANGE OF THE CORPORATE CULTURE PARADIGM

M. Sedlák highlights the necessity of a paradigm shift in both enterprises and organizations on the one hand, and globally in the national economy: *"Ethics of management .... goes far beyond the issues of corruption, theft and collusions. It concentrates on what our relations are like and what the relations with our employees, customers, shareholders, creditors, suppliers, distributors and neighbours, i.e. with members of the communities in which we operate should be ... "* (Sedlák, 2009). A crucial issue of ethics management is a continuous conflict between the economic performance of the company, measured by revenues, profits and liability to the shareholders, as well as the corporate social responsibility expressed in the form of the company duties (responsibilities), which are reflected in its obligations to employees, creditors, suppliers, distributors and members of the general public.
Fig. 1 shows the factors influencing corporate culture.

Significant moral decline accompanied by various negative phenomena is manifested not only in the USA, but also in Europe and in Slovakia. Favouring personal interests is typical for many entrepreneurs, managers, politicians and other high-ranking officials. Majority of respondents in one of the sociological research in Slovakia expressed their belief that the **Slovak society faces deep moral crisis**. It is, however, a typical attribute of the Western civilization in general (Sedlák, 2009).

M. Sedlák provides a solution: *"Unlike in the past, **we need a fundamentally different model of management and operation mode**. We should no longer persist in the false belief that all wisdom*

resides in the top management that can make decisions. We need a system where decisions are made by the people who have close understanding of the work. New era requires new forms of organization (principles of network organizations, team organizational structures). Organizations can achieve or maintain a competitive advantage only by innovations and modernization; they must become learning organizations." (Sedlák, 2009)

APPROACHES TO ETHICS IN ENTREPRENEURIAL PRACTICE

Corporate ethics is a normative dimension of corporate culture, reflecting and highlighting the business-related values and rules such as justice, truth, objectiveness, equality of rights and individual freedom, thus assuring the respect of basic human rights and ethical principles of social coexistence. In many enterprises, ethics is institutionalized through the Code of Ethics that clarifies what behaviour is expected from the company employees in various situations. It is essential that the company management and staff are persuaded about its importance and trust it. (Bednárik, Gubrická, 2013).

Our research conducted in 2013 on a sample of 135 industrial enterprises in the SR points to the fact that the issue is mostly addressed by larger enterprises. Smaller businesses address the issue more intuitive. The fact is confirmed by the response to the question whether company has a Code of Ethics. The results shown in Figure 2 indicate that the Code of Ethics are elaborated by 66% of large enterprises, but only by 20% of smaller businesses.
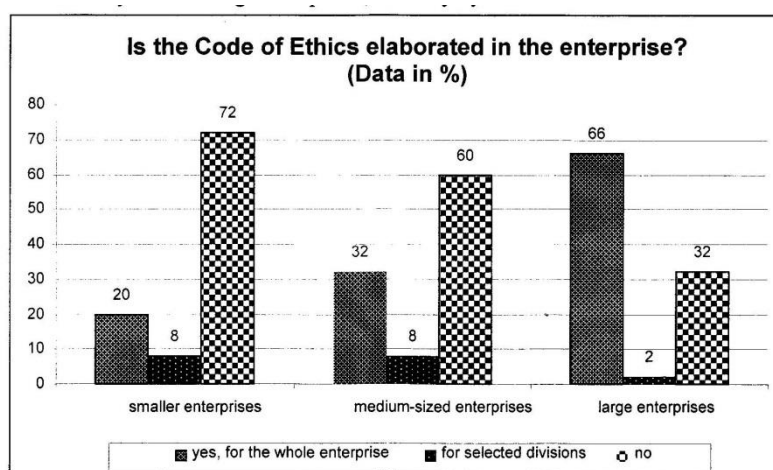

Fig.2 *Code of Ethics in the SR enterprises*

CONCLUSION

Entrepreneurial ethics is the processing, declaring and observing a system of the organizational and management standards of the moral, socially appropriate behavior and observance of human resources in the company and extra-company activities and processes in terms of the market economy. Entrepreneurial ethics expresses quality of corporate culture, pointing out clearly the values preferred in a company and reflecting humanism, solidarity, justice and moral foundations in an enterprise.

Aim of the company management in market economy is to make an effective use of all available resources (material, raw material, financial, energy ...), including **human resources in particular, for continuous innovative activities** in the field of inputs, production processes, technology and equipment along with outputs **in accordance with business ethics for sustainable development**. **Managerial and corporate ethics must permeate** all the company activities and processes, resulting in the **ethical behaviour and conduct of all company employees**, and manifested by the company reputation and goodwill along with the demand for the company products and services in favour of sustainable development.

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SATISFACTION OF EMPLOYEE AS A STABILIZING FACTOR AFFECTING THE FLUCTUATION OF PRODUCTIONS STAFF IN SELECTED INDUSTRIAL ENTERPRISES

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ABSTRAKT

In this article we deal with the issue of fluctuation and stabilization of production staff particularly in selected enterprises operating in the industrial sector.

One of the problems why the enterprises cannot keep their employees, is that they provide little or no attention to their stabilization. If the employee is not satisfied and feels that the company does not seem interested, he leaves.This is the reason why the enterprises meeting with high fluctuation especially at the operator position. The aim of the article is to explain and description relationship between stabilization and fluctuation, presentation the results of research that is focusing of satisfaction of employee.The purpose of the article is to explain and describe relationship between stabilization and fluctuation, present the results of research with its focus to satisfaction of employees and based on these results specify problems that have the greatest impact to deciding whether to stay or leave the company.

The main aim of the article is to clarify the relationship between stabilization and fluctuation of production staff and the impact of one of the stabilizing factors for maintaining these employee

KEYWORDS

stabilization, fluctuation, employee satisfaction

INTRODUCTION

Staff turnover is a natural part of any enterprise.Enterprises would without natural fluctuation stagnated and lost the competitiveness. Fluctuations may be characterized by multiple definitions. Even the authors themselves can define the term differently.

J. Stýblo (1992) defines the fluctuation as staff movement between the external social environment and enterprises where the employees leave from enterprises for different reasons.

M. Armstrong (2007) defines the fluctuation not only as departures but also arrivals of employees.

M. Antalova (2011) refers to fluctuation as a staff transfer from one place to another.

Based on these definitions can be fluctuation understand as staff mobility, not only between the exterior environment enterprise (from enterprise to another enterprise) and also the interior environment enterprise (from department to another department). In general, the healthy fluctuation rate is 5-7% (HRM, 2013). If this limit is exceeded it shall be considered as harmful.

For the evaluation of staff movement can be used different methods. There are a large number of formulas for calculating the level of fluctuation. Many of them are very similar and often differ from each other only in tiny details. As shown by an our research realized over the past three years the most commonly used formula for calculating the fluctuation is this formula.

$$\frac{the\ number\ of\ released\ employees\ during\ the\ year}{average\ number\ of\ employees\ in\ the\ given\ year} * 100$$

Using of this indicator is on the one hand relatively easy and illustrations, but on the other hand may lead to an incorrect assessment of the current situation in the enterprise, as it does not reveal the specifics of departures in relation to individual jobs and business units and length of employment departing (KACHAŇÁKOVÁ, 2001)

Ertl (2005) introduces the following formula for the calculation of fluctuation, based on the fact that the reduction the rate of fluctuation is focusing the plan of stabilization.

$$\frac{\begin{array}{c}the\ total\ number\ of\ terminated\ employment\\ during\ the\ period\ (year)\end{array}}{average\ number\ of\ employees\ in\ the\ period\ (year)} * 100$$

Reiß (2008)stated the following three formulas related to the fluctuation.

$$\frac{the\ number\ of\ departures\ over\ a\ certain\ period}{average\ number\ of\ employees} * 100$$

$$\frac{\begin{array}{c}the\ number\ of\ departures\ over\\ a\ certain\ period\end{array}}{\begin{array}{c}number\ of\ employees\ at\ beginning\ of\ period\\ +employees\ who\ came\end{array}}$$

$$\frac{the\ number\ of\ replacements\ for\ departures}{average\ number\ of\ employees} * 100$$

Pichňa (1994) states on calculating the fluctuation two types of formulas. The first of these formulas is at the enterprise level (micro level) and one at the state level (macro level).

$$\frac{\textit{number of employees who left for another job outside the enterpise}}{\textit{average number of employees at the same time in the system of enterprise}} * 100$$

$$\frac{\textit{number of employees who left for another job outside the enterpise}}{\textit{average number of employees at the same time in the work system of the landscape}} * 100$$

Based on the information which were provided us by selected industrial enterprises, is the average annual fluctuation of industrial staff around 21%.

To reduce staff turnover focuses the stabilization plan.Solving problems with stabilization is impossible without analytical and research activities. There is stability index, which reflects the tendency of employees to remain of enterprise (Alexy, 2003).

$$\frac{\textit{number of employees in the enterprise for 1 and more year}}{\textit{number of before 1 year}} * 100$$

As already mentioned in the article, Ertls calculation of the fluctuation is based onthe stabilization plan, which is calculated as follows.

$$\frac{\textit{the total number of employees working in the enterprise at least one year}}{\textit{the total number of employees working in the enterpise one year ago}} * 100$$

We have introduced a number of formulas to be used in calculating the staff fluctuation. The main reason is that each of the formula may show different information and it is good to use multiple formulas and their resulting values compared to gain a more objective view.

APPROACHES TO STABILISATION OF PRODUCTION STAFF

In the framework of the management of human resources is very difficult to find a definition of stabilization. This is due to the fact that it isn´t yet considered to be one of the classic personnel activities. The term is often defined by the concept of "stabilization effort" or as "the result of effort". In practice, there are three approaches to stabilization of the employees that take account of external as well as internal conditions of operation of the business.

1. Employees can no longer be considered a job for their own
At the present, the attention from expensive programs for groups of employees to move to abroad stabilization focused use of staffing tools. These tools focus on a specific employee or directly on a very narrow group of employees.

2. Stabilization as an effort to reverse the decision of the outgoing employee

A different approach represents a strategy referred to as "market – driven strategy". From the name this strategy shows that the determining factor that cause the movement of employees, is the labor market. At the time of the constant competition, enterprises cannot protect their employees to others oftentimes more attractive jobs. Therefore, enterprises in the implementation of this strategy, trying to affect only those staff who are key for them and that at that moment when they are decisions that the company leave. This approach captures the model developed by the Swedish company Universium. This model is a simple way of mapping individual staffing actions, which are important not only in terms of obtaining a key employee but also keeping them in business. This model is called "the competence supply chain".
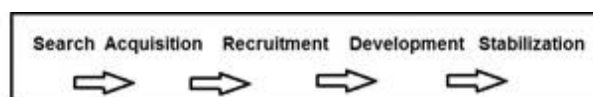

Fig. 1 *The competence supply chain (Universium)*

Solution for the stabilization of the employees "ex post" uses such tools, which could reverse the decision from an employee about leaving the business. Those can be for example bonuses, promotions or the possibility of stabilizing the international career, the possibility of further development, the changes in the working environment, ets. The use of these tools it the practice of elaborate. Depends on the procedures and standards of the undertaking concerned, namely that change requires a comprehensive solution (VANCLOVÁ, 2003).

Stabilization activity within this strategy present only "ad hoc" use a certain tool, which in most cases will begin to search up to the moment when the staff member decide to leave. These non-complex concept in many cases didn´t lead to uncovering the true causes of the discontent of the staff, which could be the impetus to the necessary changes. Stability instrument such as a bonus, we can get them in undertaking employee stabilization remained, however, it will be a short term solution and often reflected on the performance and behavior of the employees. What about his loyalty to the company, which is attempting to stabilize when it threatens to lose? In practice, companies regularly over collected information about why their employees unhappy, why they remain, and vice versa, which would lead to them leaving the company (VANCLOVÁ, 2003).

3. Stabilization encompassing all personnel activities
Businesses, for which it is retaining key employees a priority, they understand the stabilization of the complex. The essence of their approach is the prevention, i.e. the attempt to prevent the employee started thinking about leaving. A prerequisite is the desire to retain only key employees for the period that results from their tasks in the enterprise. In execution of personnel activities to

employees are treated as customers. The selection and formation of personnel policy respects not only the objectives of the enterprise, but also the requirement

Enterprise category	The number of employees	The annual turnover (€)	Annual balance sheet (€)
Micro enterprise	less than 10	less than 2 million	less than 2 million
Small enterprise	less than 50	less than 10 million	less than 10 million
Medium – sized enterprise	less than 205	less than 50 million	less than 43 million
Large enterprise	250 and more	50 million and more	43 million and more

Tab. 1 The categorization of enterprises according to the EU (the recommendations of the Commission 2003/361/ES)

of the employees. For personal tools that can be used individually and can be tailor to tailor to the needs of the employees about where the business primarily. All personnel activities are thus to a certain extent, become the activities of the stabilization and their instruments are a tool of stabilization. Day-to-day responsibility for the stabilization of the employees lies on the managers. These employees must realize what an important role in the process stabilization of the play. The human resources department in the company needs to process stabilization to manage and not to own (VANCLOVÁ, 2003).

If we want to find out why employees leaving the company, we have to know all the reasons, that them to lead. One of the standard tools in the management of human resources is the measurement of customer satisfaction of employees.

THE RESULTS OF A SURVEY OF EMPLOYEES SATISFATION AS ONE OF THE STABLISING FACTORS

The stabilization of the key employees for most businesses of vital importance and therefore they are doing for their maintain the maximum. Often times adopt a precautionary approach and at the same time, spent a lot of effort to get the outgoing employee to keep. Currently not enough staff to stabilize and motivate through money or other material benefits. To a large extent relates to the stabilization and motivation of employees with the ability to identify with their own businesses. The basic precondition for the stabilization and motivation is just identification with the company (URBAN, 2011).

If a company achieved with its employees higher stability, should be to try to be successful in their work. They should focus on how employees for their work performance to help improve training, how to better define their working tasks, as them for work to provide better tools or how to remove unnecessary obstacles to their work (URBAN, 2013).

Job satisfaction is important, relates, however, especially with the possibility to successfully perform their work and use it to their abilities. In other words, employees who carry out their job successfully, they

are more satisfied, more productive, work more stable and tend to have lower absenteeism and staff fluctuation. Employee satisfaction is among the basic factors affecting the achievement of the set objectives of the business and their identification with them.

From a short questionnaire survey, which was sent to the industrial enterprises, the size of these are large enterprises (see Tab. The categorization of enterprises according to the EU), we wanted to determine the satisfaction of employees in areas that have the biggest influence in their decisions whether to stay or leave the company.

The first two questions were identifying as we ask about the age and education of respondents. Businesses we asked that these questionnaires were filled out primarily to employees working in production.
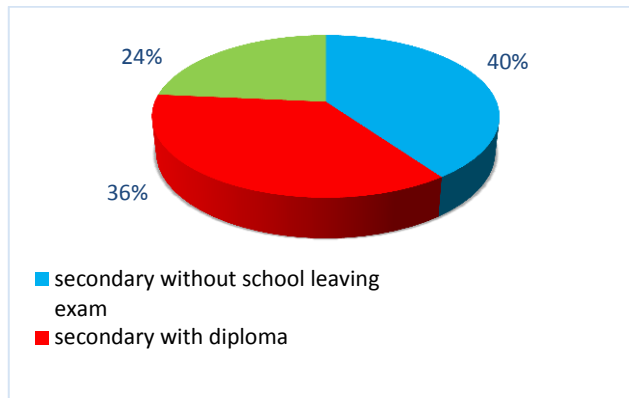
Age of the respondents

Employees have been divided into three groups. The largest representation of employees had in the interval from 20 to 40 years. This means that it is the employees in the most productive age.
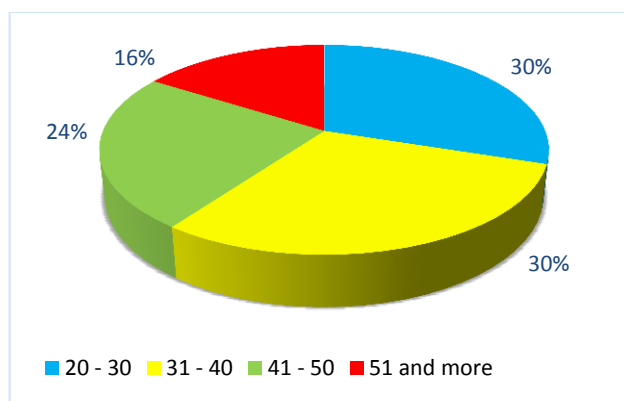
Fig. 2 Age of the respondents (own processing)

Education of the respondents

Most of the employees who participated in the questionnaire survey has the highest level of education secondary without secondary school leaving examination and 41%. In the chart isn´t referred to basic education, however, it has not put forward any of the respondents and therefore, it is not in the above chart.
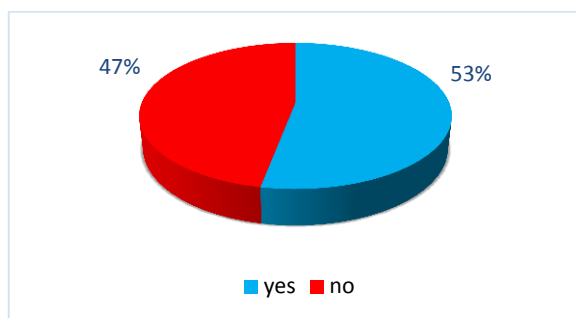

Fig. 3 *Education of the respondents (own processing)*

The next series of question was focused already on specific matters relating to job description and the provided benefits.

Satisfaction with job content

As you can see on Fig. 4, 53% of employees is safisfied with job content, on the other hand non-satisfied employees is 47%.

Fig. 4 *Satisfaction with job content (own processing)*

## Satisfaction with the system of remuneration

The employees aren´t satisfied with the system of remuneration, which is in their enterprise established. Only 43% of employees is satisfied with a given system of remuneration
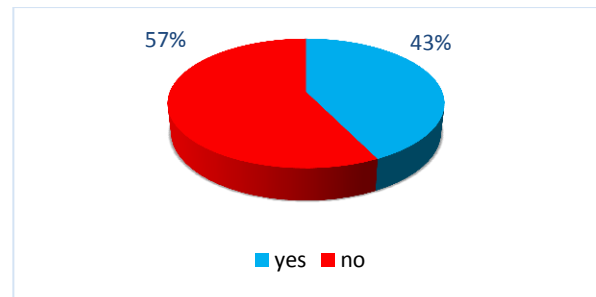
Fig. 5 *Satisfaction with the system of remuneration (own processing)*

## The most common causes of employee to leave

Most of the employees would have decide to leave due to salary conditions and up to 48%, the next would have left the company because of the working conditions and 20% employees aren´t satisfied with the approach to your manage.
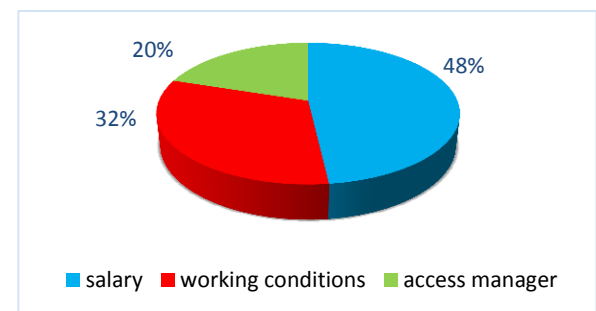
Fig. 6 *The most common causes of employee to leave (own processing)*

The most important benefits

As is apparent from the Fig. 7, for the employees it is no longer so clearly the most important benefit wage but also other employee benefits that the enterprise offers. Among the most common employment benefits, more vacation days, bonuses, paid off in the framework of the labor code. One important benefit for 16% of the employees is stable employment.
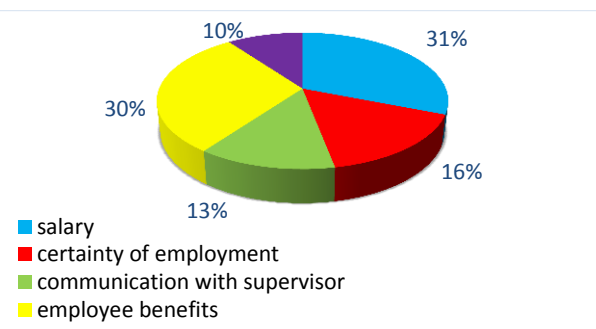
Fig. 7 *The most important benefits (own processing)*

The expanded menu of benefits

As seen on Fig. 8 to 46% of the employees would be welcoming had them undertaking to contribute to the holiday. 26% would prefer to have had them undertaking to contribute to health care. Whereas, was this questionnaire in determination, in particular for the production staff, it is understandable that the contribution to education would be appreciated just 4%.
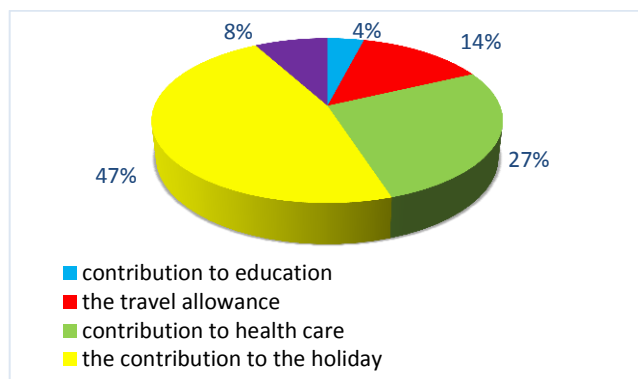
Fig. 8 The expanded menu of benefits (own processing)

From the questionnaire survey showed that more than half of the respondents, although satisfied of his job description however, they would welcome changes in the system of remuneration. It is also proved by the results of the third question, which was focused on the most common causes of employee leaves.When deciding on the departure of employees from the business have more influence with the salary and working conditions. Employees must be sure that they are paid fairly compared with other employees. On the other hand, the enterprises in the stabilization their employees should not focus solely on the method of remuneration, but also on the motivational system and the benefits that provides its employees with. From the research found that staff would like to extend the existing benefits of the other employee benefits, which can play an important role in the decision of the employee whether in the business further in both areas. Enterprises should its benefits be extended to employee benefits as a contribution on the holiday or health care. Just these two benefits, official would welcome most.

CONCLUSION

Between the enterprises and the employees to create different types of relationships. One expects from employment salary, remuneration for their results, else want from a company more interested to create a natural barrier for stronger, more stable bond. The creation of such a relationship is not single issue. The attachment of such a relationship helps to just stabilization through various stability factors, which also help reduce staff fluctuation and therefore the movement of employees from

enterprise to enterprise. The decrease in fluctuation has a beneficial effect increasing the work satisfaction and motivation.

Enterprises in which we conducted the survey we recommend to review the system of remuneration of employees, to make it more transparent and fairer in the eyes of all employees and to extend the existing system of benefits of other benefits as a contribution to the holiday or health care. Enterprises should focus on why employees are leaving, what reasons lead them to the fact that you are looking for jobs in other competitive enterprises.

On the basis of the facts we want in the next job to pay stabilization of production employees as well as from the point of view of the impact of competences first-lines managers. Thus, what role they play precisely the competences that have first-line manager available in stabilization these employees.

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MANAGEMENT OF UNIVERSAL SHELF STACKER

KORSHUMOV Alexander

ABSTRACT

Management of universal shelf stacker process many varied operations, whose are different in difficulty of solved problems, time of reaction of controller and next parameters. Usually is used one controller with all functions, which have many external input-output modules and have to solve parallel many tasks together. The control application have to be very complicated and blind with risk of collisions control processes and needed of solving control process priority. If the processes are separated to the groups, every group of processes solved with separate control automat. For simple processes, whose needs immediate reaction can be used simple and easy controller, complex control processes have to been solved with controller with sufficient performance, mathematical performance and adequate memory.
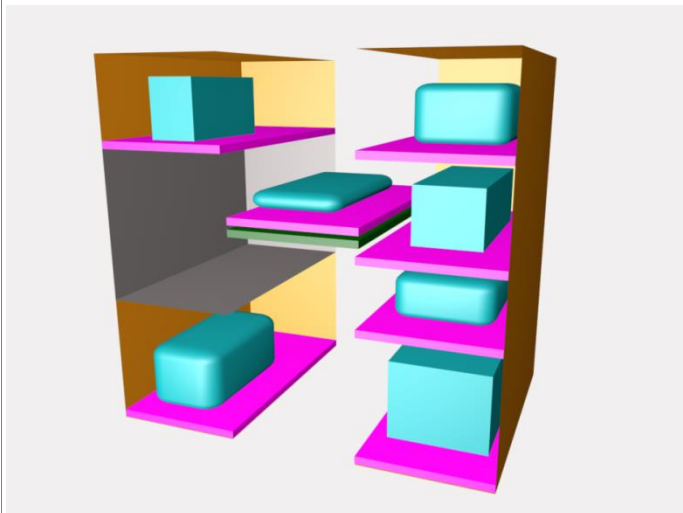
KEY WORDS
universal shelf stacker, control system, layers of control system, positioning, sensors, defragmentation

INTRODUCTION

Universal shelf stacker (USS), is device, that store shelves, so the residual space was minimized and the store space in USS is very effectively employed (see Fig. 1).

The device is contained from two towers, between them there is vertically moving device, which is manipulating with shelves (extractor). Extractor puts the shelf into tower on any position and

Fig. 1 *Scheme of USS, brown – towers of USS, gray – dispensing slot, magenta – shelf, green – extractor, cyan – items on the shelves*

removes the shelf from tower. Extractor can manipulate on time with only one shelf. The shelf can be placed in tower in any position, so don't make collision with other shelf or shelves or other item of mechanical construction of USS [1]. In tower (usually front) is situated dispensing slot, in which operating personal can handle with shelf content or a shelf. When shelf is putting into USS from dispensing slot, the maximum high of shelf is measured. This entry is very important for establishing of space for positioning of shelf. When the shelf is moved on extractor from dispensing space, the weight of shelf content is measured by special method. When weight limit is overrun, the USS does not put shelf into tower, but put it back into dispensing slot. Move of moving parts of USS is performed by actuators – three phase asynchronous motor, of which only one is connected to output of inverter. This solution is sufficient for moving, because from principle of USS results, that it is not possible moving vertical and horizontal direction together.

OBJECTIVES AND METHODOLOGY

Control system of USS is complicated set of electronic components, sensors, actuators, safety elements and so on. Control system must perform:

➢ synchronous performing more tasks with various priority of processing

➢ synchronous performing more tasks with various time of reaction

➢ performing input data from sensors, measuring components, back-coupling components, etc

➢ controlling many types of actuators

➢ communication with outer system

➢ communication interface for operating personal and servicemen

Process of management of USS must handle many various processes, whose are different their difficulty and time reaction [4]. Usually is done, that the process which need shorter time for reactions is simpler. The simplest processes need the shortest reaction time (e.g. emergency stop) and processes, whose we have to control on base of difficult algorithm, usually don't need immediate reaction (e.g. establish the best position on positioning shelf into tower USS).
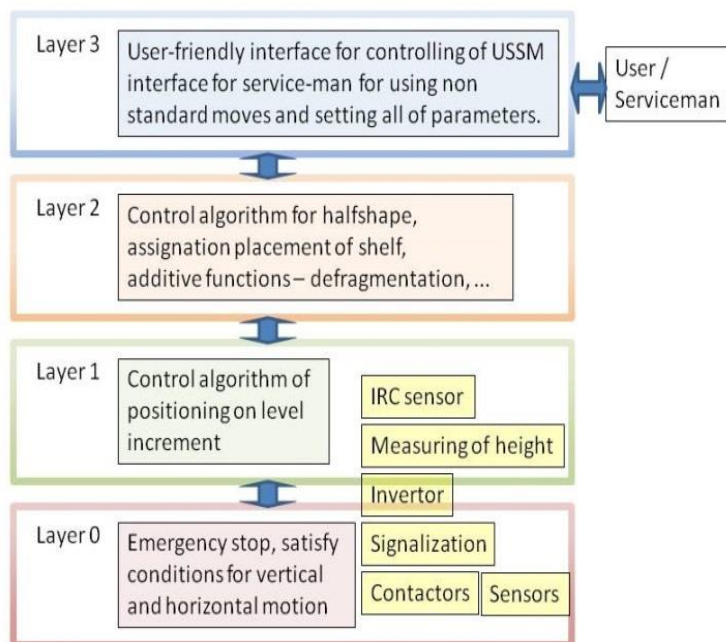
Fig. 2 Hierarchical structure of layers of control system of USSM

The control system for an easy processes needs usually the different hardware as control system for a difficult processes, therefore is control system of USS divided to 4 layers with vertical hierarchy. These layers are linked by communication channels (see Picture 2). Each of control layer can be realized on different hardware platform, but this fact not exclude joining any layers, with the same hardware platform, on one unit.

On hardware design, the layers can be make on next hardware platforms:

➢ 8-bit microprocessor (for example from Intel, Atmel, PIC, Fairchild, Motorola and others companies)
➢ 32-bit microprocessor from Atmel, ARM, Intel, Motorola or others companies
➢ Many types of PLC (Programmable Logic Controller) from many companies (B&R, Siemens, Unitronics, Panasonic, Rockwell Automation, ...)
➢ Industrial PC, for hard industrial environs.

Layers of control USS are divided by time of reaction and by functioning to 4 independent parts, whose are in vertical hierarchy structure.

• **Layer zero of control system of USS** collect data from sensors of position, sensors of end of position, sensors of presence of shelf on extractor and dispensing slot, synchronize and safety sensors. Layer zero too operate with actuators this way, that by its outputs manage connecting elements for enabling move and switch the power from frequency inverter between motors of moving parts. This

layer is the quickest and its reaction time is the shortest in control process of moving parts USS. Together the processes whose the layer zero control are very simple and easy. By this for control system of layer zero be enough simple programmable component, which can prepare data from more digital inputs and can control more digital outputs [7].

• **Layer one of control system of USS** sets collection of parameters in actuators, is doing partial control jobs as positioning on increment, harmonization of actuators moving on height measuring and weight measuring of shelves and so on. Layer one communicate with slave systems as: measuring barrier for measuring of height of shelf, frequency inverter for moving of actuators, layer zero and with master system, which is layer two. Layer one has to make quick reaction on change level on inputs, but together have to calculate on positioning and communicate on four different communicating channels.

• **Layer two of control system of USS** contains the lead control algorithms USS. It decides, if job is executable, that means, that algorithm defines, if is possible the shelf put into USS on base of measured height of shelf, measured weight of shelf and layout of positions of other shelves on USS. In the next step the layer two decide ideal position of shelf for economical using of storing space. The layer two resolve all option functions of USS as defragmentation of storing space, loading new shelves for using into USS and unloading shelves from using, temporary deleting the shelves from using and their return, recovering USS after electrical disaster, after emergency stop of device and so on. Layer two store operational and system data, and on this layer are stored all of parameters of USS (description of position of free zones, mechanical parts USS, packages of parameters for frequency inverter). On layer two are stored operational data as data package for operating USS, database of shelves, data backup, whose are using on recovering machine after non-standard break of operation [2,8].

• **Layer three of control system of USS** is graphical, user friendly interface, which is designed for users of USS and servicemen (HMI – Human Machine Interface). Layer three enables managing USS by menu very easy and users can use all of functions USS, whose are designed for level users, e.g. get shelf from USS. The Administrator can read,

by HMI, statistical data about activity of USS, frequency of using shelves, can manage users and its user rights for shelves (which shelf user can get from USS), can load and delete shelves into or from device and can temporary load and unload the shelves from using. Servicemen can by HMI completely set all of parameters USS in user-friendly interface, they can define mechanical view of machine, the places, where are located mechanical reinforcements of machine, dispensing slot. They can define positions of free zones, in whose are located shelves. Servicemen can check functions of all sensors of all types, which are located in USS. Servicemen can move independently with actuators by HMI in situations, when the moving is not safety or the moves are in opposite to basic logic of moving parts of USS.

RESULTS

Control unit of USS is made on 8-bit microprocessor base from Atmel company (layers zero and layer one) and on platform industrial PC (layers two and layer three).

Layer zero is implemented on microprocessor AtMega 128, which has sufficient memory space for software and has sufficient number inputs and outputs. To microprocessor are connected sensors for synchronizing position, sensor for maximum high and low position of extractor, sensors for scanning shelf on extractor and on dispensing slot (if the shelf is present on extractor or dispensing slot), sensors for end position (opened and closed) of door of dispensing slot and sensors of safety distance between shelves in towers and shelf on extractor. Outputs manage contactors, which are connecting motors of actuators to output frequency inverter, safety circuit (emergency stop) of frequency inverter and indication components on front panel of USSM. The software was made in programming tool BasCom. Reaction time (the time distance between change on input and change on output) of control unit is less then 1 ms. This reaction time is sufficient to stopping move of motors in case of disaster or if is needed emergency stop.

Layer one was made on microprocessor AtXmega128A1 because:
- it has sufficient number of communicating interfaces, the four from them is used
- it has technology named "event system", where function quadrature decoding establish position if IRC sensor without software addition
- it works on high frequency (32 MHz), so the input data are executed immediately and in real time is setting the outputs

On microprocessor is connected positioning sensor for vertical and horizontal move. Microprocessor is working with "increment" unit, this is the smallest unit of length, which can identify the sensor of position. Positioning controller provide regulation of position extractor (vertical move of shelf). Slave regulation of speed, current and moment of actuator provide frequency inverter.

Regulator of position for horizontal move of shelf is working with circular track of moving mechanism, which is partitioned to a few sectors. In each sector of track is doing different job, e.g. set of mechanism for snapping shelf, taking the shelf, moving the shelf from tower to end of extractor, moving the shelf on extractor, synchronization moving parts to base position and so on. For this, the positioning regulator switch the parameters of move and according them parameters of regulator too.

The layer one communicate with frequency inverter and when this communication is broken, stop the movement of moving parts of USS. By communication with frequency inverter are filling the groups of parameters into inverter after its turning on, switching between packages of parameters in inverter, setting actual frequency of moving, setting actual times of starting and stopping movement etc. Control of move direction is done by digital inputs of frequency inverter, because time of reaction of inverter on data communication is so long so is needed. When the weight is measuring, frequency inverter puts data into communication bus, and there are data about torque current, from which can be empirical derived weight of shelf. The layer one communicate too with measuring barrier. Height of shelf is measured on every time, when the shelf is moving from dispensing slot into USS on extractor. The height of shelf is continual measured from start of moving the shelf from dispensing slot to end of moving. The highest point is set as measured height, which is sending to the layer two for establish the best position on positioning shelf into tower USS. The layer one communicate with master layer two and slave layer zero, from which is reading the status of sensors and require connecting contactors of motors.

Layer two is realized on industrial PC, version "all in one" with touch monitor. This layer solve the base algorithms for moving of actuators (vertical and horizontal moving), must provide out of collision move of moving parts of USS. The basic long unit for vertical move is "halfprofile", on which the layer two counts. This unit is used for setting height of shelves and positions of shelves. One "halfprofile" is the same as four "increments" and the layer two make this calculations for layer 1 on end of calculation and determination of position for shelf. Layer two have to make primarily:
- calculation of position of shelf in USS, so the shelf can't collide with mechanical parts of USS (reinforcements) or other shelves or shelves contents, which are on shelves

located. This calculations are made on data about free zones, free spaces and shelves, stored in USS

- ➢ commands for mechanical move of actuators, so into dispensing slot of USS put the shelf, which is needed.
- ➢ commands for mechanical move of actuators, so the shelf from dispensing slot is move into USS on ideal position
- ➢ sequence of commands, whose make measuring of height of shelf, when it is moving from dispensing slot into USS on extractor
- ➢ sequence of commands for moving actuators for detection of weight of shelf
- ➢ working out of algorithm defragmentation of storing space
- ➢ working of command automat, which automatic executes the commands with reply about status after executing command
- ➢ recovery of device after power failure or emergency stop of USS or disaster or other not planed break of work USS

Layer two use many data collections, whose are stored in external data store. This failsafe data store has internal mechanism for preventing data loss and destroying. On layer two can be connected master system for managing material, which is stored in USS and by its can be assigned the commands for moving the shelves into dispensing slot.

Calculation of position of shelf in USS can be executed with other optional parameters, whose can affect the solution of algorithm, for example weight of shelf or frequency of using shelf. The basic parameter is economy of using storing space. The shelf is positioning in that free space, whose height is the same as height of shelf. If the free space with this height is not in USS, then the shelf is positioning into free space, where the residual space will be the smallest. If this free spaces is more then one (with the smallest residual space), then the shelf will be placed the lowest in the USS (criterion weight) or the nearest to dispensing space (criterion frequency of using shelf). Results of calculation of positioning of shelf in USS are commands in queue of command automat. The queue is generated by request for storing shelf in towers of USS and it contains the commands for moving of actuators, recording the data into data collection of shelves, measuring of height and weight of shelf and so on.

Procedure of defragmentation of storing space is doing for integration of residual spaces in USS, where isn't possible put the shelves, to a few free spaces with sufficient height for storage the shelves. The process of defragmentation has more levels, from simple moving of shelves down to complex calculation of positioning shelves, so that the most of free zones be fully loaded by shelves without residual spaces and other loaded free zones have a residual spaces with minimal height. After this calculation the control system must calculate the moving of shelves with minimum steps of move

shelves, but in condition, that in dispensing slot can be temporary loaded only one shelf for increasing the working free space for defragmentation.

Layer three is by economical reason designed too on industrial PC platform, as independent application, which is executing from application of layer two. A users can only login and logout on the basic screen and after login user can bring in any shelf, on which he has a privileges. By this command the shelf is moving to dispensing slot. The same procedure is using for taking away the shelf into USS. The user can also temporary delete the shelf from using and temporary deleted shelf again add to system and change the percentage of acceleration on moving with the shelf. Administrator can, in addition, manage users, it means create and delete users, manage privileges for using of shelves by users. Administrator can also insert a new shelves into system and remove a shelves from system [4,9]. Menu for servicemen can be used after log on and it consist of screens, whose describe the USS setup. On this screens the servicemen can see organization of shelves with the basic data about them, can define shelves positions, parameters, height, all what is needed. On screens can be seen organization of free zones too and servicemen can manage it, can manage description of mechanical elements, reinforcements, displacing slot, the start and end halfprofile. On the next screens the servicemen can check the status of all sensors by logical group and check their functions. The next group of screens enable a independent moves with actuators (motor for vertical moving of extractor, motor for moving shelf in horizontal direction, movement of door of dispensing slot). This moves can be make with positioning control or only basic move without any back-coupling. Menu for servicemen is designed for making backup of settings of USS, restore any single parameter or all parameter set and when the control unit was changed, the servicemen can by this tool initialize the module and restore all parameters in module from backup.

CONCLUSION

Hardware platform of layers of control module for USS is realized as is described by economical reasons and by minimizing the time for developing and programming all of described algorithms on all layers. The complex and difficult algorithm of calculating positioning of the shelf on optimal position and defragmentation of store space on layer two can be solved on platform PLC, but this solution is disproportional more expensive. The layer two can be realized too on platform 32-bit microprocessors or 8-bits microprocessors (for example AtXmega), but possibility of debugging on PC platform expressively shorts the time needed for developing control software.

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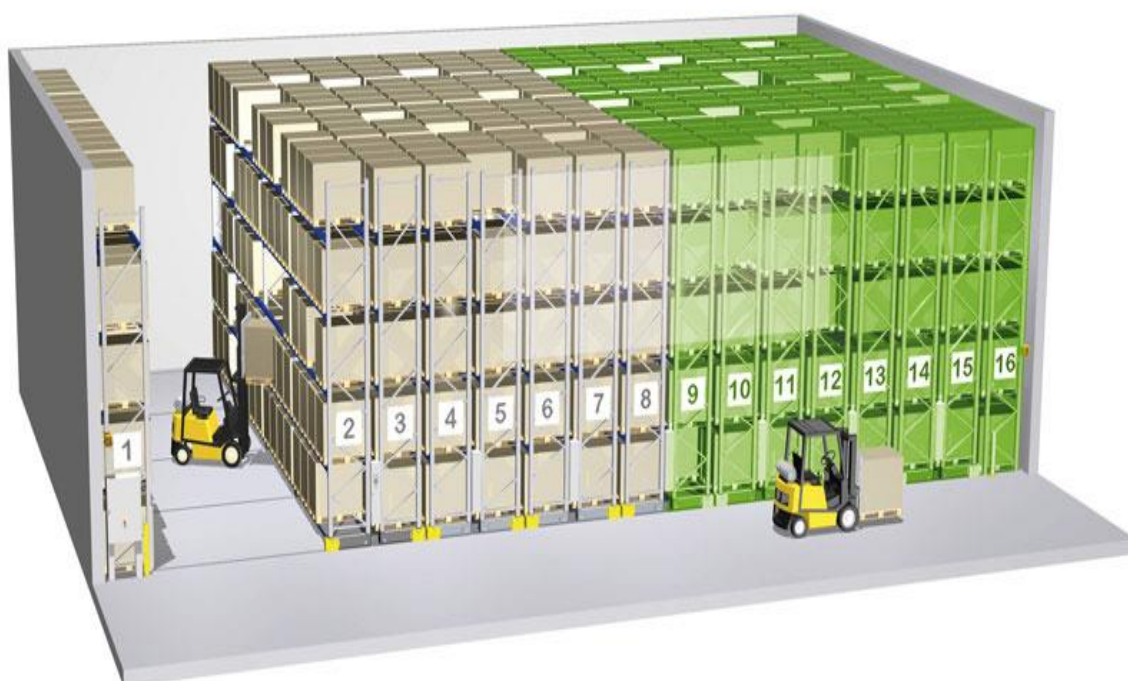
EQUATION OF ELLIPTIC TRAJECTORIES

LOZHKIN Alexander**,** LYALIN Vadim**,** TARASOV Vladimir

Abstract
Linearly independent non projective transformations are used for different types of applications. Direct analytical method for solving linear transformation of the characteristic equation is proposed. The theoretical basis of the method follows from the classical solutions with symmetries, but the method does not contain formulas with radicals. Automorphisms is dividing among set theory and universal algebra. This feature allows to use the method more efficient for other engineering tasks.

Keywords*:*
Diuedonne symmetries, kinematic scheme, linear transformations, set theory, universal algebra

1 INTRODUCTION

Models of height accuracy are used in CAD/CAM, space researches, pattern recognition, robotics, etc. Transfer of models to nano-level cannot be provided by approximate methods. We call attention to researches focus in the Euclidean plane $\mathbf{R} \times \mathbf{R}$ for reflections $\mathbf{R} \times \mathbf{R} \rightarrow \mathbf{R} \times \mathbf{R}$. The main question is how increment of Cartesian product is interacting with conducts of continuity. Gilbert formulating axioms for Euclidean plane $\mathbf{R} \times \mathbf{R}$ suggested that must be considered construction of linguistic rules. We obtain the Euclidean plane as text.

2 SEMIOTIC ANALYSIS OF MACHINE BUILDING DRAWING

The author dealt with problems of verifying vector geometric model after input from the digitizer in the early 80-ies. He was suggested to consider machine building drawing as text. V. A. Zvyagintsev proposed levels of study of natural language in linguistic semantics of classical linguistics. He singled seven levels [1]: sentence, phrase (syntagma), the word, morpheme, syllable, phoneme, distinctive feature. The text (discourse) is including as the eighth level synthesis additionally. The second most important result of this study is the idea of binary structure of levels of study. Six-tier structure of language of machine building drawing was proposal on the Zvyagintsev's base [14]: drawing, form, cut, geometric shape, point, hypercomplex number or scalar. The geometry and pattern recognition theory are alternate in the structure each by each.

The method of semiotic analysis by A. P. Ershov interpretation is chosen for solving of problems of verifying. The means is the most powerful method of artificial intelligence according to the authors. The method is dividing into three components [13]: syntax, semantics and pragmatics. Syntax is referred to in the study of the connections level of study (morpheme, word, sentence, etc.) commonly. Semantics studies of relation between the structures of different levels. Communication construction of language with the subject of the text is called pragmatics. All sections are combined in semiotics. An additional level is considered in natural languages and theory of programming languages [2].

The rule was allocated to resolve uncertainties [14] of structure of the study. Each level of study with a number semantically related to the level $n-2$ and $n+2$ is rule of levels relations. The law applies to artificial intelligence and could not be proved in the last century. This rule and semiotic analyze are allowed both conduct research on semiotics of language drawings and solve the problems of clarifying of geometric model.

Let have any area of knowledge $\mathbf{K}$. Propose that knowledge was produced on two theories: $\mathbf{K}'_1$ and $\mathbf{K}'_2$. Let theory $\mathbf{K}'_1$ is possessed of study levels $\mathbf{L}_{ij}$, when i - number of theory, j - routine number of study levels. Existing methods of knowledge's purchase in $\mathbf{K}$ from areas $\mathbf{K}'_i$ is carried out anthologies, logical deductions, etc. The study levels may be a member of different mathematical descriptions.

Let any binary normalization f was applied to rule $\mathbf{L}_{ij}$, then $\mathbf{L}'_{ij} = f(\mathbf{L}_{ij})$, when $\mathbf{L}'_{ij} \in B$, B - Boolean lattice. Structural linguistics may be used for study levels (symmetries in Euclidean plane) $\mathbf{L}'_{ij}$ in Zveginzev's interpretation presently. Relationships $\mathbf{L}'_{1j}$ and $\mathbf{L}^{\hat{}}_{2j}$ is main question in theory $\mathbf{K}$.

By analogy with H. Weyl transfer symmetry [3] we may be suggest that study levels in totalize theory $\mathbf{K}$ will positioned by low: $\mathbf{L}'_{11}$, $\mathbf{L}'_{21}$, …, $\mathbf{L}'_{1m}$, $\mathbf{L}'_{2m}$ (knowledge symmetry). Any rule $\mathbf{L}_{ij}$ is unique. Practice of used show that if cardinality of set is different then addition rules are appeared in law: $\mathbf{L}'_{11}$, $\mathbf{L}'_{21}$, …, $\mathbf{L}_{1m}$, $\mathbf{L}'_{2m}$. For simplicity, we yet realize that the following rule is power conservation levels of study: $m(\mathbf{K}'_1) = m(\mathbf{K}'_2)$.

Study level $\mathbf{L}_{ij}$ for knowledge area $\mathbf{K}_i$ may be defined in other descriptive language. This notation

may be distant from mathematics. Therefore, syntactically rules must be formulated:

1. Binary rule: $\mathbf{L}'_{ij} \in B$;

2. Rule of definition punctuality. For example, rule of accessories of element in set by Fraenkel. ZFC-axiomatics (Zermelo-Fraenkel-Curatowski) is followed from this notation.

3. Implication rule: $\mathbf{s}_{ijk} \rightarrow \mathbf{s}_{ij+2m} = 1$, where semantic rule (axiom) $\mathbf{s}_{ijk} \in \mathbf{L}'_{ij}$.

3 EXTENDED TABLE OF DIUEDONNE'S SYMMETRIES

The chain of linear transformations in homogeneous coordinates was used for solutions of ellipses intersection points. Let's have two ellipses E_i : $E_i \equiv \langle x_i, y_i, a_i, b_i, \varphi_i \rangle$, where $i \in \{1, 2\}$, (x_i, y_i) - coordinates of center ellipse, a_i, b_i - semi axis, φ_i - angle of rotation, $x_i, y_i, a_i, b_i, \varphi_i \in \mathbf{R}$, $\varphi_i \in [-\pi, \pi]$. The problem in classically research is solved by successive application of the methods of Descartes-Euler (fourth degree equation) and Cardano-Tartaglia (tree degree equation). The solutions are obtained with complex component: $x_n = x_{nR} + i x_{nC}$, where n - the number of roots, $x_{nR}, x_{nC} \in \mathbf{R}$ in some cases. The values x_{nR} and x_{nC} are comparable. Solutions are making to difficult. The calculation of the intersection points needed to obtain an analytical solution. To solve the problem had to turn to the theory of analytic geometry.

Hilbert formulating axioms for Euclidean plane suggested that must be considered construction of linguistic rules. We obtain the Euclidean plane as text by analogy with semiotic analyze of drawings according Leibniz's method of similarity. Levels of study of the text are internal relations in plane [4]. As basic postulates were used: permutation, mirror and with unitary matrix symmetries by Dieudonne [5]; table automorphisms and transfer symmetry by H. Weyl [3]; definition of symmetry by M. Born [15] binary automorphisms by F. Bachman [6].

Cartesian product was study in limits of ZF-set theory (Zermelo-Fraenkel) because set $\{\langle x, y \rangle, x\}$ was creating asymmetry in $\mathbf{R}^2$. The relational algebra by E. Codd was used Cartesian product [7]. This theory was used in many applications in quite a few times, but this supposition is conflict with ZF-theory by primary property: connections by Codd and set by A. Fraenkel. ZF-theory was build from automorphic rule $a \in A$ [8]. This rule is senselessly without relation $\in$. The relational algebra is not used if $A \equiv \varnothing$. Therefore, relational algebra is part of ZF-theory.

Main attention of research was devoted on permutation symmetry [9, 10]. The Euclidean plane is relation table. The proof is easy, because relation algebra may be working with finite and indefinite table. The conduct of symmetry was considered by relation algebra and semiotic analyze. Application of the method to the Dieudonne automorphisms show that binary symmetry belongs to two mathematical disciplines: set theory and universal algebra.

Extended table of Dieudonne symmetries was built on the base of knowledge symmetry and relational algebra:

1. Existing of set ($A \neq \varnothing$ Zermelo).

2. Existing of relation ($a_1 R a_2$ Codd).

3. Membership element of set ($a \in A$ Fraenkel).

4. Universal relation ($f : \Omega \rightarrow \Omega'$ implication).

5. Saving cardinality ($\mathbf{m}(A) = const$ Lagrange).

6. Saving power relations ($n = const$ in $C_1 x^n + C_2 y^n + C_3 x^{n-1} y^{n-1} + \dots + C_{k-1} x + C_k y + C_0$ Klein).

7. Linguistic order ($a_i \neq a_{i+1}$ Descartes).

8. Mathematical order ($a_i \prec a_{i+1}$, where $a_i, a_{i+1} \in \mathbf{R}$ Kantor).

9. Permutation ($a_i \leftrightarrow a_j$).

10. Mirror ($a_i \bullet -1 = -a_i$).

Since the connection between automorphisms 8 and 10 first opened Gilbert, the symmetry of knowledge may be named in his honor. Dedekind axiom called Klein automorphism, as the inverse element axiom determined by mirror symmetry. Symmetry with numbers 1 and 2 is combined $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$.

The rule interactions automorphisms is any relationship mapping function, operation, operator, transformation is performed in the Euclidean plane so that perform symmetry with minor number with possible preservation of symmetries following her. Inductive method is easy to prove the sufficiency of the hierarchy in the table. Interpretation of geometry was called informatics-linguistic because she is founded on linguistic and relational algebra.

Let's Klein's quadratic form [11]: $Ax^2 + 2Bxy + Cy^2 + Dxt + Eyt + Ft^2 = 0$. The parameter t assume geometrical signification if it has interpreted as trace of Linguistic order symmetry. Matrix of transformations in heterogeneous coordinates is object of set theory and so algebraically operations is not possible.

4 THE NON PROJECTIVE METHODS OF LINEAR TRANSFORMATIONS OF CENTRAL-SYMMETRICAL CONIC SECTIONS

Let exist own angle α of the quadratic form. This angle is forming angle β by permutation symmetry. The angles are definite non-orthogonal basis [13, 14]. Let centrally symmetric conic section with a parametric system of equations is $\begin{cases} x = k_x f_x(t) \\ y = k_y f_y(t) \end{cases}$, where $k_x, k_y, x, y, t \in \mathbf{R}$. Let conic

section is changed by linear transformation $\begin{pmatrix} a & h \\ g & b \end{pmatrix}$, where $a, b, g, h \in \mathbf{R}$. We must solve the characteristic equation $Tz = \lambda z$ [11, 12], where $z = \begin{pmatrix} x \\ y \end{pmatrix}$. The resulting curves are obtained by direct analytical method of linear transformations (DAM) of central-symmetrical conic sections (CSCS) with the following parameters:

$$\tan 2\alpha = \frac{2(bh + ag)}{(a^2 + h^2) - (b^2 + g^2)} \tag{1}$$

from classical method[12],

$$\tan 2\beta = \frac{2(ah + bg)}{((a^2 - h^2) - (b^2 - g^2))}, \tag{2}$$

$$\tan \alpha_1 = \frac{a \sin \beta - h \cos \beta}{b \cos \beta - g \sin \beta}, \tag{3}$$

and

$$\tan \alpha_2 = \frac{b \sin \beta + g \cos \beta}{a \cos \beta + h \sin \beta}, \tag{4}$$

$$\tilde{k}_x = k_x (a \cos \beta + h \sin \beta) / \cos \alpha \tag{5}$$

and

$$\tilde{k}_x = k_x (b \sin \beta + g \cos \beta) / \sin \alpha, \tag{6}$$

$$\tilde{k}_y = k_y (a \sin \beta - h \cos \beta) / \sin \alpha \tag{7}$$

and

$$\tilde{k}_y = k_y (b \cos \beta - g \sin \beta) / \cos \alpha. \tag{8}$$

For example, let consider the motion of a point located outside the axis of the flat rod. The system of equations describing the motion of the third point is $\begin{cases} x = e \cos t + c \sin t \\ y = c \cos t + (d - e) \sin t \end{cases}$, where d – crank length, e, c – coordinates of the point (x, y) in the coordinate system of the flat rod. Solution proposed method is $\begin{cases} x = (d - e + c \cot \alpha) \cos(t + \alpha) \\ y = (e - c \cot \alpha) \sin(t + \alpha) \end{cases}$ and $\begin{cases} x = (e + c \tan \alpha) \cos(t + \alpha) \\ y = (d - e - c \tan \alpha) \sin(t + \alpha) \end{cases}$ where $\tan 2\alpha = 2c/(2e - d)$.

Solution classical method for the transformation matrix $\mathbf{T} = \begin{pmatrix} e & c \\ c & d - e \end{pmatrix}$ by the inverse matrix

$\mathbf{T}^{-1} = \frac{1}{\det \mathbf{T}} \begin{pmatrix} d - e & -c \\ -c & e \end{pmatrix}$ is $\begin{cases} x = \lambda_1 \cos(t + \alpha) \\ y = \lambda_2 \sin(t + \alpha) \end{cases}$ or $\begin{cases} x = \lambda_2 \cos(t + \alpha) \\ y = \lambda_1 \sin(t + \alpha) \end{cases}$, where $\lambda_{1,2} = \frac{d \pm \sqrt{d^2 - 4((d - e)e - c^2)}}{2((d - e)e - c^2)}$. Angle α is not change.

As can be seen from the results, the proposed method allows to be used in subsequent calculations easily. For example, if you can solve differential equations.

5 THEORETICAL TESTS

Let's consider the sufficiency of all the theorems only.

Theorem 1 (Angles $\alpha_{1,2}$) *Angles α_1 (3) and α_2 (4) is equivalence.*

Proof. Let's equating the formula (3) and (4) in value $\tan \alpha$: $\frac{b \tan \beta + g}{a + h \tan \beta} = \frac{a \tan \beta - h}{b - g \tan \beta}$,

$(b \tan \beta + g)(b - g \tan \beta) = (a \tan \beta - h)(a + h \tan \beta)$ or $v_1 = v_2$. Let's show $v_1 = (b \tan \beta + g)(b - g \tan \beta)$:

$v_1 = b^2 \tan \beta + gb - gb \tan^2 \beta - g^2 \tan \beta$,

$v_1 = (b^2 - g^2) \tan \beta + gb(1 - \tan^2 \beta)$. The value $v_2 = (a \tan \beta - h)(a + h \tan \beta)$ is determinate:

$v_2 = a^2 \tan \beta - ha + ah \tan^2 \beta - h^2 \tan \beta$,

$v_2 = (a^2 - h^2) \tan \beta - ha(1 - \tan^2 \beta)$. Results equate to

$(a^2 - h^2) \tan \beta - ha(1 - \tan^2 \beta) =$
$= (b^2 - g^2) \tan \beta + gb(1 - \tan^2 \beta)$,

$(a^2 - h^2) \tan \beta - (b^2 - g^2) \tan \beta =$
$= gb(1 - \tan^2 \beta) + ha(1 - \tan^2 \beta)$,

$(a^2 - h^2 - b^2 + g^2) \tan \beta = (gb + ha)(1 - \tan^2 \beta)$,

$\frac{\tan \beta}{1 - \tan^2 \beta} = \frac{gb + ha}{a^2 - h^2 - b^2 + g^2}$,

$\frac{2 \tan \beta}{1 - \tan^2 \beta} = \frac{2(gb + ha)}{a^2 - h^2 - b^2 + g^2}$,

$\tan 2\beta = \frac{2(gb + ha)}{a^2 - h^2 - b^2 + g^2}$. The resulting formula coincides with the formula (2) and hence the angle α is the same in both formulas.

Remark. Theorem is intended to linearly independent transformations only.

Let's $c_{1,2} = \tilde{k}_{x1,2}$ and $d_{1,2} = \tilde{k}_{y1,2}$.

Theorem 2 (Parameters of transformation) *Parameters $c_{1,2}$ when $b \sin \beta + g \cos \beta \neq 0$ and $d_{1,2}$ when $b \cos \beta - g \sin \beta \neq 0$ are equivalence.*

Proof. 1. Let's assume the opposite for coefficient c. Let's $c_1 \neq c_2$ and $c_1, c_2 \neq 0$, than

$c_1 - c_2 = \Delta$ from (5) and (6):

$$\frac{b\sin\beta + g\cos\beta}{\sin\alpha} = \frac{a\cos\beta + h\sin\beta}{\cos\alpha} + \Delta,$$

$$\frac{1}{\sin\alpha} = \frac{a\cos\beta + h\sin\beta}{\cos\alpha(b\sin\beta + g\cos\beta)} + \frac{\Delta}{b\sin\beta + g\cos\beta},$$

$$\frac{\cos\alpha}{\sin\alpha} = \frac{a\cos\beta + h\sin\beta}{b\sin\beta + g\cos\beta} + \frac{\Delta\cos\alpha}{b\sin\beta + g\cos\beta}. \text{ We have}$$

from (4) and theorem 1 $\mathrm{tg}\,\alpha = \mathrm{tg}\,\alpha + \dfrac{\Delta\cos\alpha}{b\sin\beta + g\cos\beta}$.

Equality holds when $\cos\alpha = 0$ or $\Delta = 0$. Since $\cos\alpha$ in general not equal 0 then $\Delta = 0$ and parameters are equivalence.

2. Let's assume the opposite for coefficient d. Let's $d_1 \neq d_2$ and $d_1, d_2 \neq 0$, than $d_1 - d_2 = \Delta$ from (7 and (8): $\dfrac{b\cos\beta - g\sin\beta}{\cos\alpha} = \dfrac{a\sin\beta - h\cos\beta}{\sin\alpha} + \Delta$,

$$\frac{1}{\cos\alpha} = \frac{a\sin\beta - h\cos\beta}{\sin\alpha(b\cos\beta - g\sin\beta)} + \frac{\Delta}{b\cos\beta - g\sin\beta},$$

$$\frac{\sin\alpha}{\cos\alpha} = \frac{a\sin\beta - h\cos\beta}{b\cos\beta - g\sin\beta} + \frac{\Delta\sin\alpha}{b\cos\beta - g\sin\beta}. \text{ We have}$$

from (3) and theorem 1 $\mathrm{tg}\,\alpha = \mathrm{tg}\,\alpha + \dfrac{\Delta\sin\alpha}{b\cos\beta - g\sin\beta}$.

Equality holds when $\sin\alpha = 0$ or $\Delta = 0$. Since $\sin\alpha$ in general not equal 0 then $\Delta = 0$ and parameters are equivalence.

Theorem 3 (Own angle) *The own angle in classical method and direct analytical method is equivalence.*

Proof. Let's equating the formula (3) and (4) in value $\tan\beta$. Let's deduce the angle $\tan\beta$ of the formula (7): $\tan\alpha_2(a + h\tan\beta) = b\tan\beta + g$,

$\tan\alpha_2 a + h\tan\alpha_2\tan\beta = b\tan\beta + g$,

$\tan\alpha_2 a - g = b\tan\beta - h\tan\alpha_2\tan\beta$,

$\dfrac{\tan\alpha_2 a - g}{b - h\tan\alpha_2} = \tan\beta$. Let's deduce the angle $\tan\beta$ of

the formula (6): $\tan\alpha_1 = \dfrac{a\tan\beta - h}{b - g\tan\beta}$,

$\tan\alpha_1(b - g\tan\beta) = a\tan\beta - h$,

$\tan\alpha_1 b - g\tan\alpha_1\tan\beta = a\tan\beta - h$,

$\tan\alpha_1 b + h = a\tan\beta + g\tan\alpha_1\tan\beta$,

$\dfrac{\tan\alpha_1 b + h}{a + g\tan\alpha_1} = \tan\beta$.

Results equate to $\dfrac{\tan\alpha_1 b + h}{a + g\tan\alpha_1} = \dfrac{\tan\alpha_2 a - g}{b - h\tan\alpha_2}$,

$(\tan\alpha_1 b + h)(b - h\tan\alpha_2) = (\tan\alpha_2 a - g)(a + g\tan\alpha_1)$. We have from theorem 1 $\alpha_1 = \alpha_2$ than

$(b\tan\alpha + h)(b - h\tan\alpha) = (a\tan\alpha - g)(a + g\tan\alpha)$ or $v_1 = v_2$. Let's consider $v_1 = (b\tan\alpha + h)(b - h\tan\alpha)$:

$v_1 = b^2\tan\alpha + bh - b\tan^2\alpha - h^2\tan\alpha$,

$v_1 = (b^2 - h^2)\tan\alpha + bh(1 - \tan^2\alpha)$. Value

$v_2 = (a\tan\alpha - g)(a + g\tan\alpha)$ is

$v_2 = a^2\tan\alpha - ga + ag\tan^2\alpha - g^2\tan\alpha$,

$v_2 = (a^2 - g^2)\tan\alpha - ag(1 - \tan^2\alpha)$. Results equate to

$$(a^2 - g^2)\tan\alpha - ag(1 - \tan^2\alpha) =$$
$$= (b^2 - h^2)\tan\alpha + bh(1 - \tan^2\alpha),$$

$$(a^2 - g^2)\tan\alpha - (b^2 - h^2)\tan\alpha =$$
$$= ag(1 - \tan^2\alpha) + bh(1 - \tan^2\alpha),$$

$(a^2 - g^2 - b^2 + h^2)\tan\alpha = (ag + bh)(1 - \tan^2\alpha)$,

$$\frac{\tan\alpha}{1 - \tan^2\alpha} = \frac{ag + bh}{a^2 + h^2 - g^2 - b^2},$$

$\tan 2\alpha = \dfrac{2(ag + bh)}{a^2 + h^2 - g^2 - b^2}$. We find (1).

Let coefficients of matrix are $a = b = k$, $g = h = 0$. Angle β is equivalence $\tan 2\beta = 0/0$. Since the angle is not define. Let coefficients h and g are equality value ε, where $\varepsilon \to 0$, than $\lim\limits_{\varepsilon \to 0} \dfrac{4 \times \varepsilon \times k}{0} = \tan 2\beta$, $\infty = \tan 2\beta$ and $\beta = \pi/4$. Angle α is $\tan\alpha_1 = \dfrac{k\tan(\pi/4) - 0}{k - 0\tan(\pi/4)} = 1$, $\alpha_1 = \dfrac{\pi}{4}$ or

$\tan\alpha_2 = \dfrac{k\tan(\pi/4) + 0}{k + 0\tan(\pi/4)} = 1$, $\alpha_2 = \dfrac{\pi}{4}$. Angle α is turned out the same for both formulas. Coefficients $\tilde{k}_{x1,2}$ and $\tilde{k}_{y1,2}$ are $\tilde{k}_{x1} = k$, $\tilde{k}_{x2} = k$, $\tilde{k}_{y1} = k$, $\tilde{k}_{y2} = k$. Thus the formulas for converting performed in the vicinity of the transformation $\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} k & 0 \\ 0 & k \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix}$, but do not exist for accurate conversion.

Let coefficients of matrix are $a = b = \cos\varphi$, $h = -\sin\varphi$ and $g = \sin\varphi$. Angle β is equivalence $\tan 2\beta = 0/0$. Since the angle is not define also. Let coefficients of matrix are $a = b = \cos\varphi + \varepsilon$, $h = -\sin\varphi - \varepsilon$ and $g = \sin\varphi + \varepsilon$, where $\varepsilon \to 0$. Angle β will seek, as $b^2 = a^2$: $\lim\limits_{\varepsilon \to 0} \dfrac{0}{4\varepsilon\sin\varphi} = \tan 2\beta$, $0 = \beta$.

Angle α is $\tan\alpha_1 = \dfrac{\cos\varphi\tan 0 + \sin\varphi}{\cos\varphi - \sin\varphi\tan 0} = \tan\varphi$ or

$\tan\alpha_2 = \dfrac{\cos\varphi\tan 0 + \sin\varphi}{\cos\varphi + \tan 0(-\sin\varphi)} = \tan\varphi$. Angle α is turned out the same for both formulas. Coefficients $\tilde{k}_{x1,2}$ and $\tilde{k}_{y1,2}$ are $\tilde{k}_{x1} = 1$, $\tilde{k}_{x2} = 1$, $\tilde{k}_{y1} = 1$, $\tilde{k}_{y2} = 1$. Findings are consistent with the conclusion of the previous conversion.

Method can not be used to rotate $\begin{pmatrix} \cos\phi & -\sin\phi \\ \sin\phi & \cos\phi \end{pmatrix}$ and scaling $\begin{pmatrix} k & 0 \\ 0 & k \end{pmatrix}$ and some other transformations (see theorem 2) [10].

6 DISCONTINUOUS BEHAVIORS AND CONDUCTS OF CONTINUITY

Symmetry Hilbert does not define a non-orthogonal basis changes deformed shapes for different linear transformations. The symmetry determines only the order of automorphisms on table if we consider the components of the symmetry in it as a set. The author considered the universal relation is Euler symmetry (formula $e^{i\pi} = -1$) in earlier publications [10, 16, 17]. The careful examination of DAM suggests that it works precisely based on this formula, because it is founded on the use of trigonometric functions in the order of a Cartesian product. However, the inverse matrix method based on the change of the coefficients of discrete transform matrix, which suggests that classical method belongs to the set theory. Thus, two main symmetries are affected on the symmetries table: Hilbert's from set theory and Euler's from universal algebra. Symmetries are corresponded mainly two methods to obtain the parameters of linear transformations [18]. The conception is not conflict with Erlangen program.

Table 1 Distinctions between classic method and DAM

Alternative	Classical method	DAM
Base of method	Set theory	Universal algebra
Part of geometry	Algebraically	Differential
Common presentation of curve for solving	Quadratic or complex form	System of parametrical equations
Contingencies in finding of CSCS for linearly independent transformations (LIT)	Shear (in own basis)	Rotation, homothety
Symmetries using for result of CSCS	2	2
Computation of parabola's parameters	Possible	Not finding
Symmetries for parabola's finding	4 (in Klein's form)	0
Acceptable of LIT for Jordan curves	Rotation, homothety	Three groups
Principles of processing singular transformations (ST) and LIT	Various	Equal
ST groups	0	6
Formula of curve after equal ST for other curves	Individual	Common

The authors studied the expression of symmetry Euler not only for conic sections but also more complex forms. Four groups of linear $\mathbf{H}_1 = \begin{pmatrix} m & -n \\ m & n \end{pmatrix}$, $\mathbf{H}_2 = \begin{pmatrix} -m & n \\ m & n \end{pmatrix}$, $\mathbf{H}_3 = \begin{pmatrix} km & n \\ -kn & m \end{pmatrix}$, $\mathbf{H}_4 = \begin{pmatrix} m & kn \\ -n & km \end{pmatrix}$, where $k, m, n \in \mathbf{R}$, can be used DAM for any Jordan curve, but the method is not applicable for rotation and dilation for any curve, because they not change the discrete structure of Euclidean plane. Main distinctions between methods are present in table 1. Principal differences are showing in singularities but they are not important for technically sciences.

As the object of further studies performed lemniscates Gerono with a parametric system of equations $\begin{cases} x = \cos t \\ y = \sin 2t \end{cases}$. Application of Kantor symmetry for finding the parameters of a linear transformation does not produce results for the lemniscates [10]. Diligence of Klein's symmetry allows to find the parameters, but they do not correspond to the correct result. Therefore, two more symmetries must be placed from 4 to 5 symmetries at least.

The proposed theory allows the calculation of complex mechatronic systems. Let there be a simple kinematical mechanism built on the basis of three gears: central, moving inside the central wheel and moving outside of the central wheel (Fig. 1). Let a point on the first wheel moves according to the law $\begin{cases} x = r\cos t \\ y = r\sin t \end{cases}$. Let the motion of the second and third wheels are defined by the systems of parametric equations $\begin{cases} x = r\cos^3 \dfrac{t}{4} \\ y = r\sin^3 \dfrac{t}{4} \end{cases}$ (asteroid),

$\begin{cases} x = 3r\cos t - r\cos 3t \\ y = 3r\sin t - r\sin 3t \end{cases}$ (epicycloids).
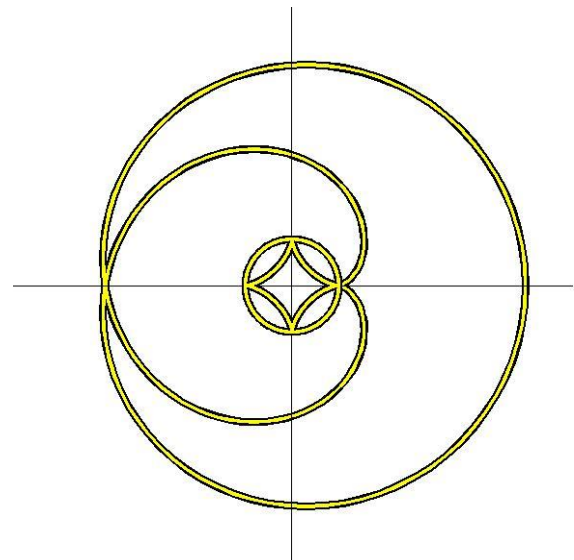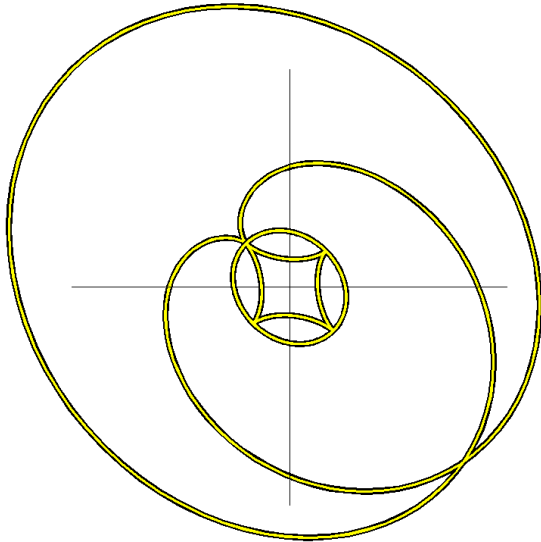

Figure 1 Simple kinematical mechanism

It is necessary to design an elliptical gear mechanism to the trajectory of the first wheel to a system of parametric equations $\begin{cases} x = -1.2r\cos t + r\sin t \\ y = 1.2r\cos t + r\sin t \end{cases}$ from second group, where $m = 1.2$ and $n = 1$. The method of calculation can be applied to all wheels. Geometric modeling results are shown in Figure 2.

Figure 2 Complex kinematical mechanism

The program algorithm is quite simple:

1. The requested transformation parameters;

2. We output the desired asteroid, epicycloids and ellipse will transform every part of the line of it. Output is black;

3. Forward transformation parameters;

4. Output a new curves with parameters obtained in yellow.

Example of geometric modeling the method is presented to calculate the trajectories in language AutoLisp AutoCAD 2009.

Solution of the characteristic equation $\mathbf{T}\vec{v} = \lambda\vec{v}'$ can be different. Vector $\vec{v}$ does not change after the transformation of the ellipse. Vector belongs to the set $\vec{v}' \in \left\{ \begin{pmatrix} x \\ y \end{pmatrix}, \begin{pmatrix} y \\ x \end{pmatrix}, \begin{pmatrix} -y \\ -x \end{pmatrix} \right\}$ after the transformation of the planar differentiable curve. Parameters symmetric transformations find possible and to simplify the system of parametric equations for the complex movements as a result. Real coefficients can be used in systems of parametric equations. Thus the analytical solution for calculating opened for the complex trajectories of the mechatronic system. Precision of designing is defined within a computer data storage and precision of machining equipment. People design symmetrical mechatronic systems as a rule. Therefore, most of mechatronic systems can be calculated using the method proposed in this paper.

7   APPLICATION FOR THE DESIGN OF KINEMATIC MECHANISMS

The circle and the ellipse are the basis for many of the kinematic mechanisms, such as a flat crank, crank, etc. Payment mechanism causes the trajectory of its motion [22]. The solution of differential equations can be obtained in an analytical form if the trajectory is given of the exact analytical formula.

Rational calculation of the trajectory of motion actuators automatic machines is important for efficient production [18]. The calculations of the motion trajectory of the kinematic mechanisms are often yields a system of parametric equations of a circle or ellipse $\begin{cases} x = a\cos t + h\sin t \\ y = g\cos t + b\sin t \end{cases}$, where $a, b, h, g, t \in \mathbf{R}$.

Experiments were carried out on the basis of the developed stand to check the adequacy of the developed mathematical model. The design of the stand was assembled from aluminum profiles, linear modules and fasteners RK Rose + Krieger. Simple and cheap robot to move along the path of the executive body of the ellipse and the circle may develop on the basis of the proposed mathematical model [20]. Experiments have shown a difference between the theoretical and actual trajectory less than 5%. This robot can be carved with milling cutter details in the form of an ellipse and a circle made of different materials, such as glass, metal, ceramics and wood. The robot can with laser burn in different materials is not necessarily circular holes.

8 CONCLUSIONS

A fundamental property of a relational table is used by the constancy of the Cartesian product of sets. Obviously, this property is not found in the table. Along with it there should be a similar property of the universal algebra. This may be the common property of the rings or something else. Answer could not be obtained. The table is based on the old basic researches. As set theory find first at table of automorphisms as classical method of linear transformations is more vigorous. Edgar Codd proposed thirteen rules for relational databases (Cartesian product) [17]. We used four of them only. Comparisons of Codd's rules and fundamentals of universal algebra would solve many technical problems. The wording of the missing symmetry of universal algebra can finally build an expanded table of binary Dieudonne symmetries, allow open versatile method for the parameters receiving of linear transformations of Jordan curves, precise many calculations used in the exact sciences such as robotics, cryptography, optimal management, etc.

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VIBRATION DIAGNOSTICS

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Abstract
For the factories it is essential, that the equipment and machines were available for the production process continuously. This is why we have to deal with the maintenance of the engines including diagnostics of machines and their main units. This analysis is dealing with the vibration diagnostics of conveyor's rolling bearings. The test measurements were taken at a maize seed production factory. After analyzing the technology of the factory we have assigned which conveyors are the most important in the process of production. The measurements were taken. Based on the results of the analysis we have suggested the implementing of the vibration diagnostics.

KEYWORDS
vibration diagnostics, conveyor´s rolling bearings

INTRODUCTION

The production imposes strict conditions on the reliability of the equipment and machines. These conditions can be fulfilled only by using modern maintenance systems. The modern maintenance systems for technical diagnostic procedures require greater expansion. Different areas of diagnostics are characterized by a significant improvement of the procedures and equipment, the utilization of research and practical experience. [1,3]

In order to ensure the capacity of the machinery and equipment, the maintenance can take actions, that can be grouped according to the following (see figure 1)..

- The task of **inspection and review** is provided, when the actual values of the measurable characteristics (diagnostic parameters) can be determined. This action is taken by the maintenance workers.
- During the process of **recovery, reconstruction and repair**, the goal is to reach the original (nominal) state (the replacement of the reserve for obsolescence). These actions are taken by the maintenance organization.

For the basic strategies, systems and methods ensuring the machine's and equipment's ability to function, see figure 2.
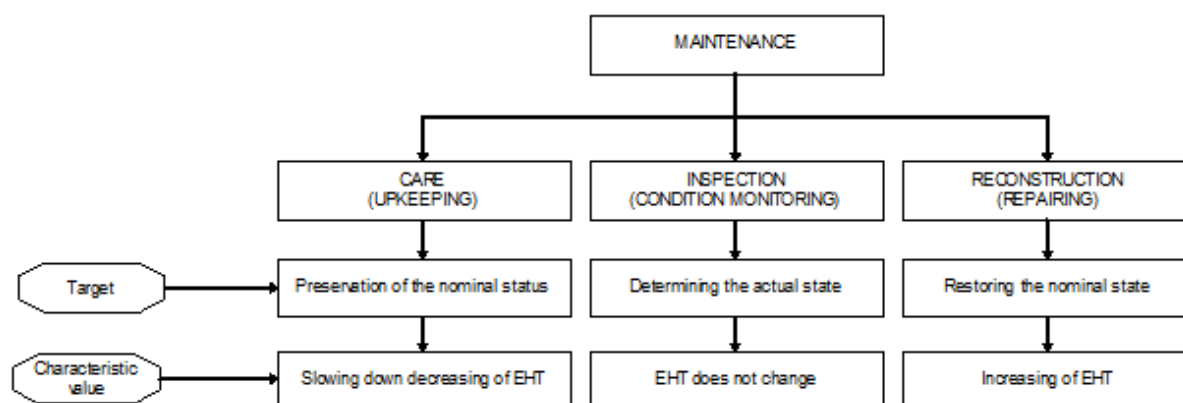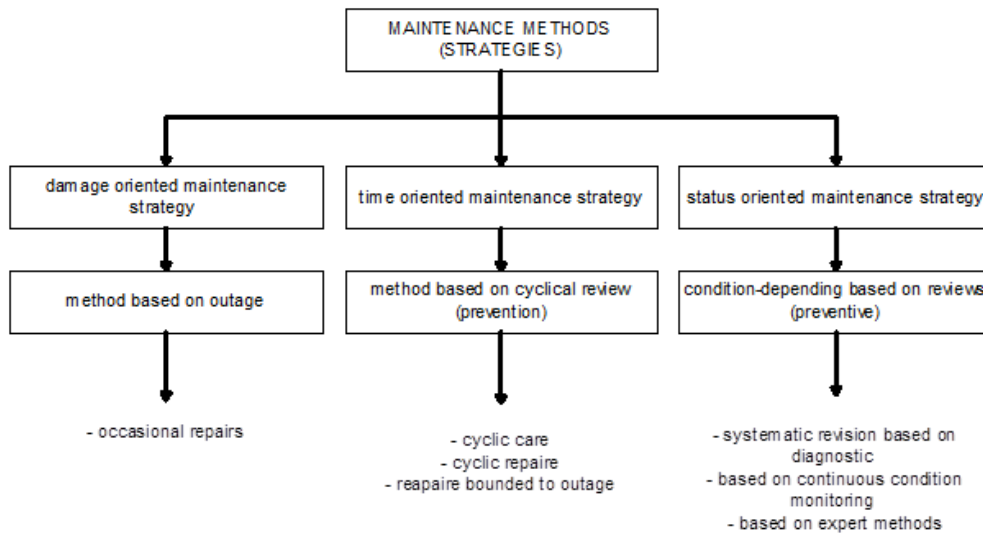

Fig. 1 The maintenance actions and characteristics [1]

- The task of **maintenance and care** is provided, if the actions taken include only the mitigation of the reserve for obsolescence. This action is usually taken by an operator.

Fig. 2 The basic strategies and systems for maintenance [2]

TECHNOLOGY OF THE MAIZE SEED PREPARING

The maize cobs are delivered to the factory. From the receiving hopper the maize is transported by conveyor towards the maize cleaning and selecting machines. Cleaned and sorted maize cobs are then transported to the dryer mines. From the dryer the maize cobs are transported to the shelling and cleaning tower's container by other conveyors.

From the previous it is clear, that the conveyors have a key role in the producing process.

The group of the machine maintenance measures include the technical diagnostic methods. The **aim** of these methods is to assess the supply function of the machines – in a suitable parameter value assessment. [1]

MATERIALS AND METHODS

We analyzed the production technology of maize seed production factory, and found the most important conveyors of the production process. We also determined the measurement points for vibration diagnostics at the selected machines and the measurements were taken there.

The measured results were recorded in a chart and illustrated with diagrams. Based on the results of the analysis we have suggested a maintenance system for the factory.
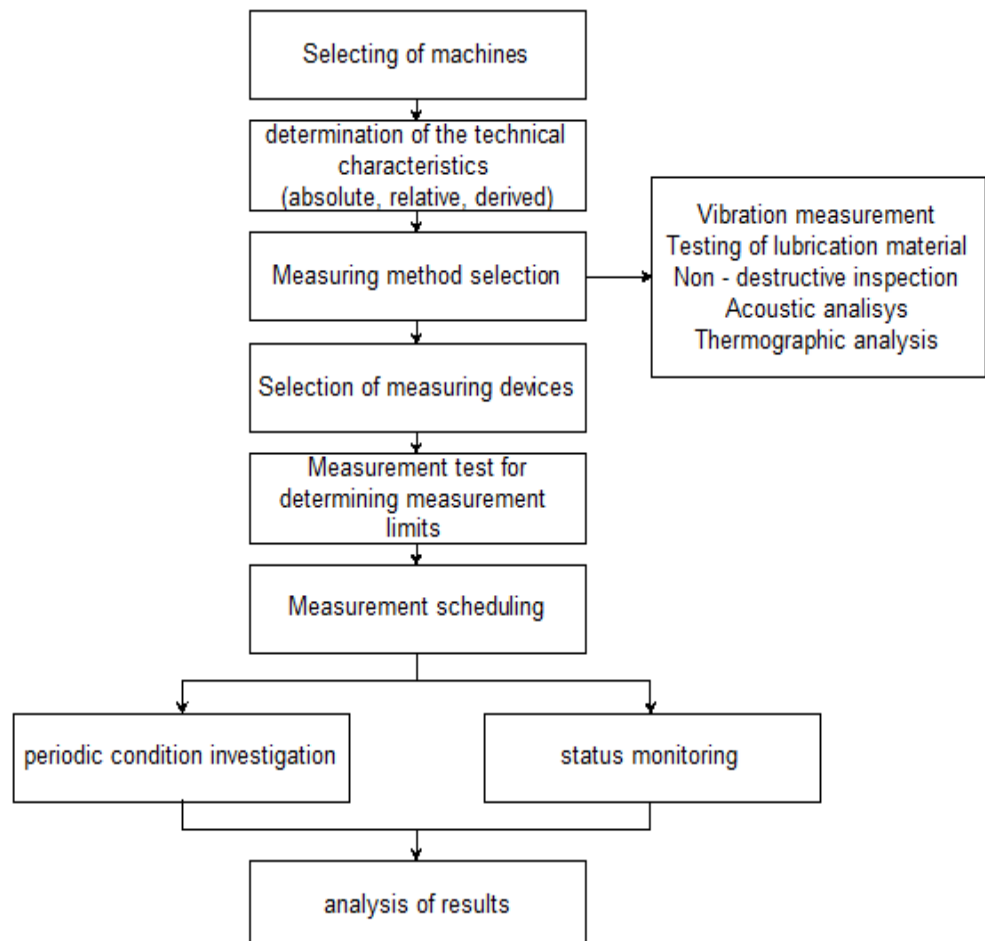
Fig. 3 Selection of the conveyor [2]

The conveyors have been selected based on the flow chart in figure 3.

For the measuring and testing we selected the conveyor for dryer outlet because this is the bottleneck of the manufacturing process. The damage of this conveyor leads to the stop of all production processes.

VIBRATION DIAGNOSTICS OF CONVEYOR´S ROLLING BEARINGS

Measurement process was done by the SKF CMVP 10 vibration measurement pen

Fig.4

For measuring of the lubrication film's thickness we used the SKF SEE PEN measurement pen.

Fig.5 *The CMBP 30 SEE PEN measurement pen*

The vibration diagnostic measurement was done before and during the main campaign and before the end of outage.

CLASSIFICATION OF VIBRATION AND SEE – VALUES OF THE CONVEYOR´S ROLLING BEARINGS

At the unloading conveyor line we examined the transmission bearings.

The results are presented in the table below.

Table 1 *Evaluation of the tests in the conveyor line's rolling bearings*

Date 2013	Transmission's electric motor bearing		Transmission's 1st bearing		Transmission's 2nd bearing	
	SKF PEN mm/sec	SEE PEN	SKF PEN mm/sec	SEE PEN	SKF PEN mm/sec	SEE PEN
09. Aug.	1,5	0	0,9	0	1,3	0
08. Aug.	1,6	0	1,2	0	1,3	0
06. Sept.	1,6	0	1,3	0	1,5	1
20. Sept.	1,7	0	1,3	0	1,6	2
04. Oct.	1,7	0	1,4	0	1,7	3
18. Oct.	1,8	0	1,4	0	1,4	0

Vibration speed classification using vibration measuring pen type SKF CMVP 10.

Value	Classification
Below 1,12 mm/s	Good
From 1,12 up to 2,8 mm/s	Appropriate
From 2,8 up to 7,1-ig mm/s	Inappropriate
Over 7,1 mm/s	Unacceptable
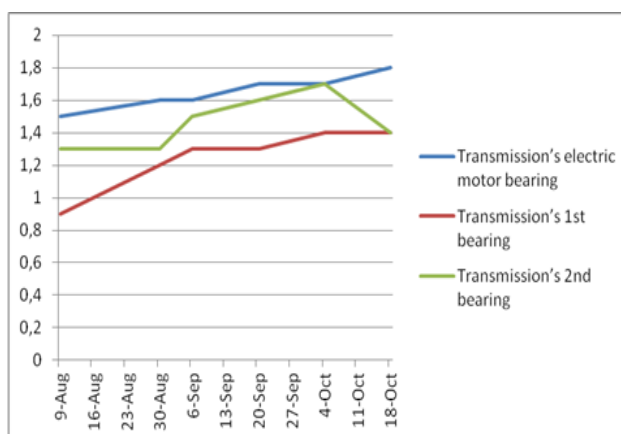
Fig.6 *Measurement results*

CLASSIFICATION OF SEE VALUE

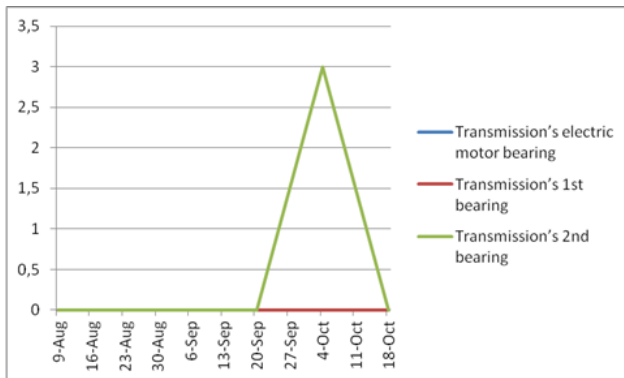| Value	Classification
Below 3 SEE	Good
From 3 to 20 SEE	Appropriate
From 20 to 100 SEE	Inappropriate
Over 100 SEE	Unacceptable

Fig.7

Figure 7 shows that after measuring provided on 4th October the bearing was lubricated and after this the thickness of lubrication oil film is enough.

RESULTS AND EVALUATION

Based on results from vibration diagnostic we made the following proposals for the factory:
- Vibration analysis of rolling bearings of conveyor belts shall be involved into the maintenance system;
- Rolling bearings of other machinery and equipment (e.g. wiping, cleaning gear, bucket elevators, etc.) participating in the process shall be involved into the condition-based maintenance system;
- Quality inspection of maintenance and repairing with methods of vibration detection.

Factory has implemented our proposals in the years 2013 and 2014 for inspecting maintenance and repairing processes.

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KNOWLEDGE MANAGEMENT CAPABILITY AND COMPETITIVE ADVANTAGE: AN EMPIRICAL STUDY OF SERBIAN ENTERPRISES

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ABSTRAKT

The focus of this paper is to identify which social demographics characteristics of human resources, affects the process of applying knowledge management through 9 dimensions in enterprises in Serbia. Research goals are directed to establish correlations between the independent variables (the characteristics of respondents) and the dimensions of knowledge management defined as the dependent variable. Statistically significant correlations are realized with the independent variables: the age and family status of respondents on the dimensions of the Information technology. Influence in the form of significant correlations can be seen in the impact of the workplace on the dimensions of the T-shaped skills (human resources), and on application process where the correlation is quite expressive. The relationship between variables of professional qualification is expressed in the following dimensions: organizational culture, the procurement process and competitive advantage. The sample consisted of 336 employees from 83 enterprises in Serbia.

KĽÚČOVÉ SLOVÁ

knowledge management, human resources, social characteristics, competitiveness.

INTRODUCTION

The purpose of this paper is based on current theoretical developments of this field and applying the concept of knowledge management in practice, consider the advantages and limitations, accordingly, to establish a management perspective of knowledge towards the creation and maintenance of competitive advantages of a modern organization. Competitive advantage of modern organization could have the appropriate use of knowledge by the media, and thus have a positive impact on certain organizational and business performance. The theory has so far shown, and practice has confirmed that the performance of knowledge management through specific dimension affects the productivity and competitiveness of enterprises. Because of consent of the most famous authors of this field, defining the dimensions of knowledge management, there is justification for this research. The problem of this research will consider the extent to which the enterprises in Serbia applied knowledge management through defined dimensions:

- *Organizational structure:* is defined as "rules, policies, procedures, the hierarchy of the responsibilities, encouraging and developing the system boundaries in organizational tasks within the firm" (Gold, 2001).
- *Organizational culture*: is defined as "shared values, beliefs, and training of employees in the organization (McDermott, 2001) and represents the most significant obstacle to the effective knowledge management (Gold, 2001).
- *Human resources (t-shaped skills):* This dimension is based on pre-designed employee skills that involve the level of understanding among employees in their own and other work areas (Lee, 2003). The skills that are deeply rooted in the horizontal (the horizontal part of the "T") and vertical (the vertical part of the "T") organizational structure. (Leonard-Barton 1995).
- *Information technology:* represent many aspects of the technology infrastructure that are part of effective knowledge management within the organization. These include business intelligence, collaboration, knowledge discovery, mapping knowledge, application of knowledge. Technology refers to systems that allow enterprises to collect, flow, access and use of technology throughout the enterprise (Smith, 2006, pp. 49). Technical systems within an organization determine how knowledge is carried throughout the enterprise and how much knowledge is accessible (Leonard-Barton, 1995).
- *The process of knowledge acquisition*: the acquisition of knowledge refers to the ability to search for and acquire new knowledge or completely create new knowledge from the existing knowledge through mutual cooperation (Inkpen, 1997).
- *Conversion process:* in this process come to the fore features, such as organizing, structuring, accessing, combining, implementation, coordination and convert knowledge into useful forms of organizational capabilities.
- *The process of applying knowledge*: Gold, Malhotra and Segars in this process include a variety of features such as storage, retrieval, application, contribution and sharing (Almeida, 1996). Within the organization it is refers to

how knowledge is used and applied (Gold, 2001).

- *Processes of protection of knowledge*: their objective is to provide knowledge, against improper or illegal use or theft protection, these processes are especially important if the knowledge is used to create and maintain competitive advantages within the enterprise (Porter-Liebskind, 1996).
- *Competitive advantage:* is considered as the company's target strategy (Porter, 1985), and it is described as a unique position that the organization has developed over its competitors by hiring human resources (Hofer, 1978).

METHOD & METHODOLOGY

The subject of this paper is to define the key dimensions of knowledge management, as well as defining the independent variables that have an effect on defining dimensions of knowledge management. The problem of this research is the assessment of the extent to which the enterprises in Serbia applied knowledge management through defined dimensions. We used a seven-point Likert scale, high scores are represented by full agreement, while the low result was a mismatch.

We used a questionnaire to measure knowledge management in enterprises through nine dimensions) (Nguyen, 2010). The questionnaire gives a global score of applying knowledge management, through 50 items which are grouped in nine dimensions. The questionnaire was created by Nguyen, TNQ, consolidating standardized questionnaires for individual areas of knowledge management: organizational structure (Smith, 2006); organizational culture (Smith 2006); human resources (t-shaped skills) whose operationalization dimensions developed by Lee and Choi (2003), followed by Chuang (2004) and Migdadi (Migdadi, 2005); Information Technology (Smith 2006); Measuring scale for procurement process dimension was created by Gold, Malhotra and Segars (2001) in the context of developing countries, as well as the measuring scale for the conversion process dimension created by Smith (2006); the implementation process (Smith 2006) measurement scale for the dimension of the process of protection approved by Gold, Malhotra and Segars (2001) (Gold, 2001) and Smith-a (2006) and competitive advantage (Chuang, 2004).

In addition to the questionnaire of knowledge management, we developed a questionnaire data on the respondent (gender, age, job description, professional qualification, family status, and workplace). The paper dimensions of knowledge management are defined as the dependent variable and the independent defines the characteristics of the respondent. The methods that were used are analytical and synthetic method and the method of content analysis, expert methods of scientific research (surveys for collecting data) and methods of statistical data analysis (Correlation analysis), i.e. We used a series of t-tests for independent samples, or series of one-way analysis of variance.

The study lasted nine months, from 1 March 2015 to 1 June 2015. In this period was researched and collecting relevant literature and collection of responses to questionnaires. The obtained data were processed in the IBM SPSS Statistics 22 and as an indicator of the validity of that i.e. significant correlation, was drawn boundaries of less or equal to 0.05. The responses from a total of 336 employees from 83 enterprises were obtained.

RESULTS AND DISCUSSION

Based on the conducted questionnaires on the dimensions of knowledge management, answers average was calculated, in order to review the extent to which the concept of knowledge management into practice through 9 dimensions defined in the surveyed enterprises. Ranking the average response is shown in Table 1 (Table 1.) and the response average of all sizes. Based on the analysis, it can be concluded that all the responses indicated an average of more than 4 (Information technology), according the answer 5 (The process of knowledge acquisition). The result is more than positive because it is 4.56 average response of all dimensions. The lowest average (4.33) gives a dimension of organizational structure. From this we can conclude that defined rules and policies, hierarchy of responsibility and the ability to develop tasks within the enterprise as a set of processes organizational structures in practice Serbian enterprises at least apply. The highest average, was given to the dimension of the implementation process (4.9). From this we can conclude that the enterprises in Serbia applied most process applications through storage, retrieval, application, contribution, and sharing knowledge. Average responses of all sizes is 4.56, from which it can be concluded that the application of knowledge management dimension is not fully developed and applied in enterprises in Serbia. Due to the fact that Serbia is a country whose economy is still developing, it is positive that the research results are not negative, but it is important to point out that the additional investment in all the processes and resources at all levels, in order to apply knowledge management to fully implement.

Table 1. *Average answers of dimensions of knowledge management*

Dimensions of Knowledge Management	Answers average
Organizational structure	**4.33 min**
Organizational culture	4.36
T-shaped skills (human resources)	4.66
Information technology	4.66
The process of knowledge acquisition	4.58
Conversion process	4.57
Conversion process	**4.9 max**
Processes of protection of knowledge	4.47
Competitive advantage (intense satisfaction of customer needs)	4.59
Average answers of all dimensions	**4.56**

With this research we tried to determine potential predictors of knowledge management, based on the social demographics characteristics of human resources and types of respondents' workplace. Due to the transparency of the results in tables are presented only those results that are statistically significant at the level of Sig. <0.05. As significant predictors were identified: workplace, age, qualifications, and family status. The correlation between the independent variable, age of respondents with nine dependent variables of knowledge management, the only statistically significant correlation was achieved with the dimension of information technology with Sig. $F_{(4,79)}=2.951$, (Sig. 0.025) (Table 2.). As a significant correlation between the independent variable, workplace of respondents with nine dependent variables of knowledge management, emphasized the correlation with the T-shaped skills (human resources) $F_{(1,82)}=4.120$ (Sig. 0.046) and

application process as very important $F_{(1,82)}=6.368$, (Sig. 0.014) which is shown in Table 3. (Table 3.). The correlation between the independent variable qualifications of respondents, proved to be very significant in the dimensions of organizational culture $F_{(7,76)}=2.078$ (Sig. 0.050), the procurement process $F_{(7,76)}=2.078$ (Sig. 0.050) and dimension of competitive advantage (intense satisfaction of customer needs) $F_{(7,76)}=2.549$ (Sig.0.021) which is shown in Table 4. (Table 4.). When you look at the impact between the independent variable family status with the dimension of knowledge management, significant correlation was achieved only with the dimensions of information technology $F_{(7,76)}=2.149$ (Sig. 0.48), which is shown in Table 5. (Table 5.).

Table 2. *ANOVA correlation of respondent's age on the dimension of knowledge management*

		Sum of Squares	df	Mean Square	F	Sig.
Information technology	Between Groups	361.230	4	90.308	2.951	**0,025**
	Within Groups	2417.436	79	30.600		
	Total	2778.667	83			

Table 3. *ANOVA correlation of the workplace on the dimensions of knowledge management*

		Sum of Squares	df	Mean Square	F	Sig.
T-shaped skills (human resources)	Between Groups	209.775	1	209.775	4.120	**0.046**
	Within Groups	4174.892	82	50.913		
	Total	4384.667	83			
The process of applying	Between Groups	559.887	1	559.887	6.368	**0.014**
	Within Groups	7209.101	82	87.916		
	Total	7768.988	83			

Table 4. ANOVA correlation of respondent's qualification on the dimensions of knowledge management

		Sum of Squares	df	Mean Square	F	Sig.
Organizational culture	Between Groups	532.236	7	76.034	2.078	**0.050**
	Within Groups	2780.467	76	36.585		
	Total	3312.702	83			
The process of acquisition	Between Groups	1434.913	7	204.988	2.776	**0.013**
	Within Groups	5612.075	76	73.843		
	Total	7046.988	83			
Competitive advantage (intense satisfaction of customer needs)	Between Groups	509.124	7	72.732	2.549	**0.021**
	Within Groups	2168.435	76	28.532		
	Total	2677.560	83			

Table 5. ANOVA correlation of family status of respondents to the dimension of knowledge management

		Sum of Squares	df	Mean Square	F	Sig.
Information technology	Between Groups	4590.084	7	65.583	2.149	**0.048**
	Within Groups	2319.582	76	30.521		
	Total	2778.667	83			

CONCLUSION

After completion of research, it has been found which social demographics characteristics of human resources have a significant association with knowledge management dimensions. Employee characteristics such as age, qualifications, workplace and family status of respondents, stand out as significant for application of knowledge management in enterprises in Serbia. Independent variables: years of service in the enterprise, gender and educational attainment showed no significant association with any management dimension. After determining what are the variables that may affect the management dimension, it is necessary to make a strategic approach that will utilize the results as guidelines for a strategy based on increasing the application and advancement of knowledge in the enterprise in Serbia at all levels.

In the future it would be good to examine the cause and effect relationship between businesses goals that people expect to achieve during the lifetime has an impact on the implementation of knowledge management and to what extent. It would be good to examine whether the application of knowledge management affects the job satisfaction of employees and to what extent. A sample of 336 respondents in this study, was a starting point for further research and it would be interesting to check the predictive value of these variables on a representative sample of 800 respondents. This sample will give us a fuller and more valid results. With the increase of the sample, it should be compared whether there has been additional, further significant correlation between the defined independent variables on the defined dimensions of knowledge management.

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MEASURING THE EFFECTIVENESS OF EDUCATION OF EMPLOYEES OVER 45 YEARS IN CONDITIONS OF INDUSTRIAL ENTERPRISES

SPIŠÁKOVÁ Alžbeta, KAŠNÍKOVÁ Kristína, CHLPEKOVÁ Andrea

ABSTRACT

In *this article we deal with the issue of measuring the effectiveness of education of employees over 45 years mid-level management in conditions of industrial enterprises. One of the main problems of why employees over 45 years do not want to educate themselves is that they think it is not effective in their case. The aim of this article is to explain and describe the evaluation of the effectiveness of educational activities of employees over 45 years, define the levels of measuring the effectiveness of educational activities and on the basic of results of the research indicate what kind of information the results can provide.*

KEY WORDS

education, training, measuring, evaluation, effectiveness, employees over 45 years

INTRODUCTION

In the majority of enterprises in the Slovak republic aimed at the industry are employees above 45 years of age. These employees constitute a substantial and of course a significant part of the organizational structure. We can say that they are the most valuable human capital, which significantly contributes to the functioning of industrial enterprises and achieving their goals. In the final analysis, they represent a kind of source for the industrial enterprises, which is able to create economic benefits. Education and therefore assessment of the effectiveness of education is a means of reconciling the increasing requirements of work and qualifications and also conduct themselves, employees over 45 years with the intention of what the most efficient attainment of the objectives and strategy of the organization.

THE ESSENCE AND IMPORTANCE OF EDUCATION OF EMPLOYEES OVER 45 YEARS

According to Vaverčáková, Keketiová and Polakovičová (2013) qualified human capital who has the necessary supply of knowledge, abilities, skills and creativity are becoming a major source of the success of the enterprises.

As mentioned Vodák and team (2011), education is an important signal that the employee points out that their company appreciates and sees them perspective. This allows them to achieve a higher degree of satisfaction in the performance of their work activities and also increase the competitiveness on the labor market.

The training of employees over 45 years of age in industrial undertakings is very important, because it is the servants who are in the business more years and are now an integral part for the operation and its functioning. These employees have many years practice in the industry, experience but also knowledge than mean for businesses invaluable value not only from the point of view of competitiveness but also in many other perspectives.

Education can be characterized as a permanent process in which adaptation occurs and changes in working behavior, their knowledge, skills and motivation of the employees that improve their previously acquired knowledge using different methods (KACHAŇÁKOVÁ, STACHOVÁ, STACHO, 2013).

Based on the above characteristics can be characterized process of education in enterprise as of conscious and purposeful acquisition of technical knowledge, practical skills and human experience. It is a process that is organized enterprises and includes training at work but also outside it. It is a systematic process of change of working behavior, level of knowledge and skills, and also affect work motivation of employees over 45 years.

EFFICIENCY OF EDUCATION OF EMPLOYEES OVER 45 YEARS

Efficiency, respectively effectiveness is performance. In English, there are two concepts, there are "effectiveness" and "efficiency". "Effectiveness" is understood as a category relating to the goals and achieving results. "Efficiency" is a performance, expressed the way how the result is reached. But, in Slovak language are not the corresponding expression for these two English words (MAGULA, 2004).

There are plenty of reasons why enterprises should paid attention to the education of their employees, not only younger but also older employees over 45 years.

Internet portal Sova (2007) mentions in his article the following reasons for education of employees over 45 years, which makes it possible partly to express the efficiency of education. This concerns the following:

- constantly discovering new knowledge and new technologies so that the skills and knowledge of employees over 45 years are obsolete,
- volatility of the market of goods and services depending on the variability of human needs necessitates a flexible response to industrial enterprises, as well as their employees,
- employees over 45 years must manage organizational change and must be so to speak, usable at different locations of in the performance of different work activities,
- greater focus on quality of products and services,
- greater customer orientation,
- changing the way organizations work and people management,
- globalization and internationalization requires the ability to move, communicate and do business in the international environment,
- still manifests the need for cost reduction and better use of technology.

Care development and education of employees over 45 years in terms of industrial enterprises brings the reputation of industrial enterprises and also facilitates the choice and stability of the employees mentioned age category. Continuous education and personal development of employees over 45 years in the middle level management is necessary to increasing the performance, but also for competitive advantage.

The notion of effectiveness relates the goals, outcomes and costs for education. Assessing the effectiveness of the order and at the same time a means of increasing the efficiency of education. Educational effectiveness can be evaluated from several angles or pages mainly by efficiencies as follows:

- overall social effectiveness,
- economic efficiency,
- pedagogical effectiveness.

Increasing the efficiency of the educational process is the optimization factors that promote efficiency, increasing the impact of the objectives, content, methods, teaching facilities, trainers, participants, social climate but also the motivation for the educational process (OPLETALOVÁ, 2006).

The effectiveness of vocational education are not in doubt. But still those on investments in enterprise training deciding not have a clear idea of how these processes can be evaluated.

THE REASON FOR MEASURING AND EVALUATING THE EFFECTIVENESS OF EDUCATION EMPLOYEES OVER 45 YEARS
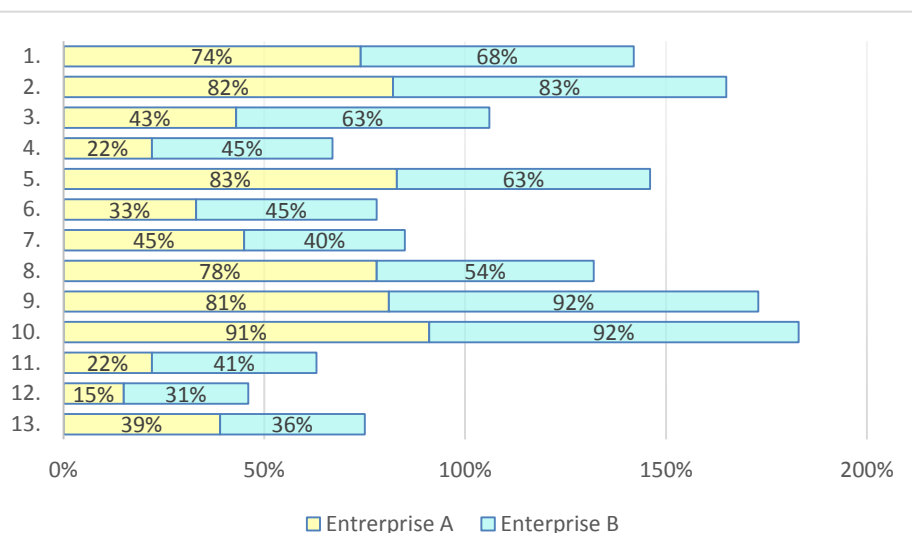
For measure and evaluate the effectiveness of employee training there are innumerable reasons such as financial aspects, the impact on enterprise competitiveness of the company, position in the market of good and services, position on the labor market and so on. These are the most prominent reasons, but there are also those are not dealt with company management too.

Through the research we found what are other reasons why the measurement of the effectiveness of employee training over 45 years is required. The research was conducted in two industrial enterprises in Slovakia, while it attended only mid-level managers over 45 years. Through the personal interview we have come to the following reasons on which employees are thinking:

1. not all employees over 45 years understand education as a chance for personal development and to help in overcoming their own blocks,
2. employees over 45 years are not convinced that education is meaningful,
3. only part of employees over 45 years participating in training activities was discarded exploit new knowledge in practice,
4. many employees over 45 years are afraid of change and change management,
5. employees over 45 years feel overworked and overall management of people are extracting so you do not have the capacity to further changes,
6. many times fear making demands on their co-workers and strictly required to comply with orders and recommendations, therefore skeptical about the application of new knowledge into practice,
7. to exploit new knowledge and skills are inconsistent and often time even negativistic,
8. "I like to change, but let it rather someone else to do first",
9. for some employees over 45 year mid-level management is difficult to be in the position of the pupil and be subordinate to the younger trainers,
10. many times are confident that the educational activity it is necessary to only went,
11. employees over 45 years do not like to share their experiences and knowledge with others,
12. on the other hand employees over 45 years sometimes overestimate or underestimate their abilities,
13. employees over 45 years are inconsistent with self-study and preparation for educational activity.

The percentage of the evaluation shown in Fig. 1 indicated that most employees are inclined to believe that educational activities need to be done, because they are mandatory. It is also for employees over 45 years hard to return to the role of pupils and be subordinate supervisor.

Fig. 1 *Another reason for measuring the effectiveness of employee training (own processing)*

MEASURE AND EVALUTE THE EFFECTIVENESS OF TRAINING OF EMPLOYEES OVER 45 YEARS

Measuring and evaluating the effectiveness of education helps determine goals and an estimation of the future investment related to human capital. The problem is that as a result of education, qualitative characteristics are quantifiable and difficult to bring about change and its size can be detected only indirectly. And this is the reasons why there are a number of diverse criteria and evaluation procedures. The key is therefore to establish criteria for evaluating the effectiveness.

It is not enough just to measure and evaluate the difference between knowledge and skills at the beginning and end of the educational process, such as test, practical test (only partly testifies to the quality of the program, lecturers, access to education and skills among participants in this process). Guest participants and teachers in turn can contain a high degree of subjectivity. Many times can be educated employees positively assessed educational activities that are not required extraordinary effort and active participation.

To assess the effectiveness of education is more important to transfer this new knowledge and skills into the workforce and activities. That they can best determine immediate superiors, it should be part of their management work – the management and evaluation of their employees. However in practice such an assessment is often done formally, it lacks the motivation and it loses the sense.

In terms of effective implementation of educational processes in industrial enterprises are important to their evaluation. Currently evaluating this investment can greatly help in the avoidance of doubt management that decides on business education.

Hablin (2008) suggested five levels of evaluating the effectiveness of training:

- reaction to the experiences of trainees from education. It is the most commonly used method for evaluating the effectiveness of training is evaluated on the basic of the questionnaire survey and prior learning process and after its completion,

- assessment of knowledge involves the measurement of the amount of substance learned in the course. This is the second easiest way to test the efficiency of education and uses it to 1/3 trainers,

- evaluation of operational behavior, which is the detection of the extent to which graduates training to apply their knowledge in the performance of work, as reflected in their performance,

- evaluation at the organizational unit level in which we try to determine the impact of changes in work behavior graduate courses the operation of business but where these employees work,

- evaluation of the final value which is to investigate the benefits of education for the entire company in terms of profitability the company and its preservation or growth.

When assessing is necessary to focus on the essential objectives of the educational activities. And although the aim of the education is to increase the enterprise efficiency, it can show the benefits of education and evaluation from the lowest rating level to a higher level and taking advantage of the criteria adequate conditions in the enterprise workplace.

When it is actually necessary to evaluate learning? Every single assessment process however takes time and costs money. Therefore, it is important to answer the question: When to evaluate? First you need to decide it the evaluation paid or has some meaning and benefits to industries and also for employees over 45 years. The adoption of this decision, it is necessary to focus on that more important than the amount of investment is that the money and resources were adequate and well used. For example, the cost of the evaluation will be only a small part of the total cost for education activities. If you will examine the impact of educational activities, it is necessary to decide what level and what methods will be used (MIKA, 2005).

We have for our research chose the following levels for evaluating the effectiveness of education as follows:

- evaluating the effectiveness of education at the level responses,
- evaluating the effectiveness of education at the level of the increase of knowledge,
- evaluating the effectiveness of education at the level of individual work performance,
- evaluating the effectiveness of education at the level on business performance,
- evaluating the effectiveness of education at the level changes due the culture of the company.

As can be seen, we have selected the levels of evaluating the effectiveness of education that are interlinked and are shown in Fig. 2 as follows.

Fig. 1 *Levels of evaluation of the effectiveness of education (own processing)*

Evaluating responses ensure gather information on the attitudes of employees over 45 years in industrial enterprises to educational activities, but also what is actually learned. It is a response to their experience of the process of learning what they think about the usefulness of the various stages of education and trainers, which would qualify the educational program or allowing them in educational activities did not comply.

Unless reactions are positive, the implementation of the acquired knowledge and skills into practice is more likely. On the other hand, the positive reaction tells us nothing about whether the knowledge and skills are relevant to the job performance of employees over 45 years in mid-level management.

Although this level of evaluation provides some feedback, it was definitely difficult to measure the effectiveness of educational activity. Evaluating the level of response speaks volumes as to whether training activity, for employees over 45 years, positive or negative. The evaluation in this case is based only on a subjective evaluation, and not on a real fact.

Reaction of employees for evaluation by the reactions shown in the figure Fig. 3. It is the most common remarks of participants of educational activity directly thereafter.

Given that the research was very difficult, not only in terms of time but for the assessment of individual levels of evaluation of the effectiveness of employee training over 45 years mid-level management, we have decided that we will only focus on the first three mentioned levels.

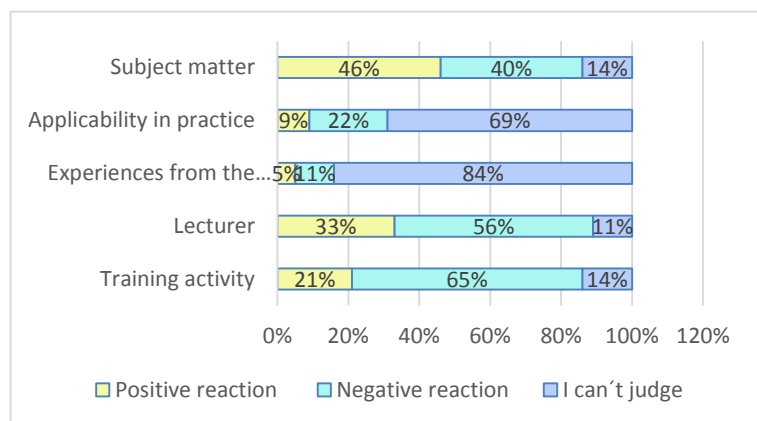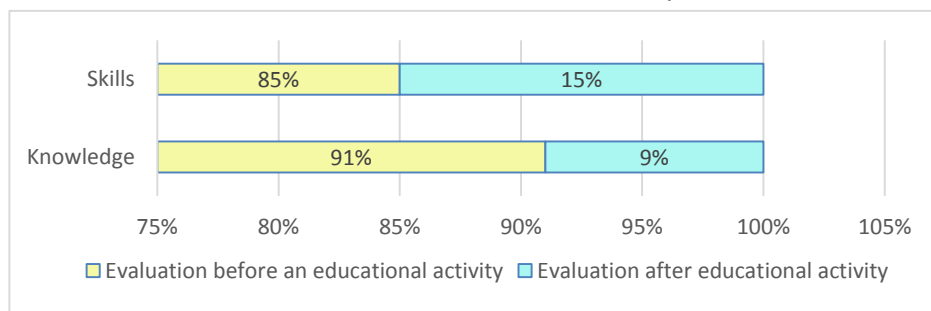**Evaluating the effectiveness of education at the level responses**

The most used method for evaluating the effectiveness of responses in terms of educational activities the questionnaire directly after the activities in question. An alternative method is to interview the staff after training activity. This process is more time consuming and the effort required for the evaluation. Another advantage is an immediate indication of whether the employees will in practice apply what they have learned. The disadvantage is the lack of connection between the response to education and impact on performance. The reactions can be affected by how interesting were the various educational activities for participants, instead to reflect on their relevance and usefulness (MIKA, 2005).

Fig. 3 *Evaluating the effectiveness of education at the level responses*

As can be seen in Fig. 3 in evaluating the effectiveness of education at the level of response was found exactly what we expected and it is that, assessment in this case is based only on subjective assessment and not on real facts. Employees over 45 years only expressed their response to that learning activity, and as can be seen in the evaluation of the survey, employees were not able to say whether the educational activity has benefits for their work activity.
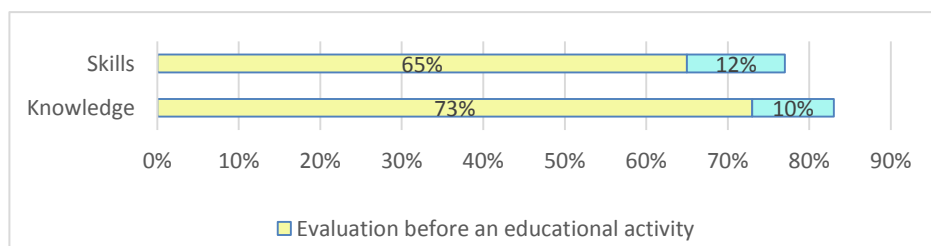
Evaluating the effectiveness of education at the level of the increase of knowledge

A suitable instrument for evaluating the levels were tests before and after training activity and questionnaires and interviews. Evaluation of the effectiveness of employee training over 45 years at this level was easier when there are clearly established baselines of current knowledge and skills of employees, because it just reviewed the acquisition of the following knowledge and skills. For evaluating the effectiveness of this level of education it is appropriate to use before and after the educational activity self-employee and precisely in writing or by practical testing.

The level is determined by what people learned (in this case employees over 45 in mid-level management). It is a transfer of knowledge and skills. Not classified relevance and contribution to the work of the employee performance.

Fig. 4 Evaluation of the effectiveness of education at the level of the increase in knowledge – self-assessment of employees (own processing)

Fig. 5 Evaluation of the effectiveness of education at the level of the increase of knowledge – evaluating by trainers (own processing)

As can be seen in the figure Fig. 4 and Fig. 5 are clear differences between the evaluation of the effectiveness of education at the level of the increase of knowledge among trainers and self-assessment staff. Employees over 45 middle management rate their skills and knowledge so that after the training activity evaluate that they already know everything and have ultimately increase to 100%. On the other hand, trainers evaluate educational activities realistic.

Evaluating the effectiveness of education at the level of individual work performance

At this stage, we were exploring and evaluate assessed the impact of training and development activities on the knowledge, skills, efficiency and attitudes that can be applied in practice, participants in educational activities - employees over 45 in mid-level management.

Basic methods that were used for evaluating the effectiveness of training in terms of individual work performance were structured interviews with participants and their direct superiors' managers, also questionnaires for participants - workers over 45 mid-level management and their direct superiors managers, qualifications obtained or feedback. The disadvantage of this evaluation was the need for sufficient resources to obtain feedback.

The research, we concluded that the evaluation of the effectiveness of education at the level of work performance is the finding that although we may have a structured interview gives a picture of the effects of educational activity on operational performance, but actually it can be evaluated as the test in practice.

CONCLUSION

We have chosen employees over 45 in mid-level management as a target group, as they are in most cases at the peak of their careers, or are approaching. They have achieved the necessary qualifications for the performance of a given work position and do not have or do not feel the need to further increase its capital which could be beneficial not only for business but also for their self.

Measuring and evaluating the effectiveness of education helps determine goals and an estimation of the future investment related to human capital. The problem is that as a result of education, qualitative characteristics are quantifiable and difficult to bring about change and its size can be detected only indirectly.

For the evaluating of the effectiveness of education of employees over 45 years mid-level management is much more important the transfer of new knowledge and skills into the working processes and activities. These employees assess themselves

know best or superiors (high-level management) – it is part of their managerial position. Evaluating of the effectiveness is a very complex process. Results does not provide the necessary information, because the efficiency is hardly measurable.

In conclusion we can say that on the base of established facts we want to work more on research of individual levels of evaluating of the effectiveness of education of employees over 45 years, because this issue is very extensive and is not yet deeply explored.

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