

Computer aided tool for personal protection equipment generation

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Summary

The worldwide trend in the hazard elimination of building works through equipments of the personal protection, prevents to the active access to them generation. This active approach forms assumes for the hazards appreciation, their effects analysis and their awareness elimination through awareness using of the personal protection equipment.

The paper presents computer model for generation of asking outputs in the area of selection and exploitation the necessary personal protection equipment on the specific building site in dependence from the specific conditions and hazards, coupling with the building processes performance on it.

KEYWORDS: occupational health and safety (OHS), personal protection equipment (PPE), building industry, computational.

1. INTRODUCTION

One of the specific building production characters are big safety hazards, which result not only from building processes, but mainly from conditions, in which are performed.

The occupational health and safety (OHS) has got in building industry, as well as in building production long tradition. Back in period of “planned economy” all (national) building companies had adapted and applied occupational health and safety systems, which more or less had flown only from obligatory legislation. But the market economy period relayed formation of many especially small building companies, which mainly because of dates running or costs “economizing”, do not follow neither obligatory legislation. The absence of this field in company system management is often reasoned by them as the finance defect for such “non-productive” activities assurance. Creation of an effective occupational health and safety system brings to companies not only staff satisfaction - as internal customers, but also its effects and production rate increasing, because only satisfied worker, who is not exposed to hazards (suspecting employer responsibility for its occupational safety) can satisfy an external customer - investor.



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From system approach point, in western countries OHS system is in companies built as the first, unlike the actual trend in Slovak Republic, where is quality management system established as the first (often only formally, because of order receiving). The environmental management system is in companies established as the second. Only as the last, or as the component of integrated management system, is established the occupational health and safety management system. Whereas just in this field exist many obligatory legislation, which demand performance and application of various tools, at company level, or also in level of particular activities performance directly at building site.

2. THE BUILDING INDUSTRY SAFETY – ALL THE EUROPE PROBLEM

The building industry is ranked among national economy sector, where is fatal injury occurrence according to European agency for occupational health and safety bigger than in other sectors. But also accident hazard is by much bigger, as average in EU is. After statistics is two-timed more possible, that building industry staff receive an accident, which is not fatal, that average worker in other industries.

The survey, which was held in Great Britain attained into estimation that costs connected with occupational accidents and with bad health state in building industry sector – including costs for lost times, absence at the workplace and charges connected with health and insurance - presented 8, 5% of the project costs.

Because of lack of financial and organizational resources, many small and medium companies have got only limited knowledge and capacity pertinent to occupational health and safety covering. Therefore the agency evolves intensive activities in so called good practice field.

Information about good practice should help to companies act in accordance with existing legislation. In many cases are regular requirements clear, but sometimes, although law refers, what is necessary for its fulfilling, does not refer how to achieve or assure it in practice. The law often does not refer about that, which forms, equipments or tolls is possible to use, in order to its appointments were effectively transmitted just there, where have to affect and especially, in order to be clear to people, for which is dedicated and who have to observe it.

One of such field, which markedly contributes to safety prevention directly at building works, is the field of planning and applying of personal protection equipment.



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3. ACTIVE APPROACH TO PERSONAL PROTECTION EQUIPMENT (PPE) SUPPLYING ON BUILDING SITE

After legislation regulations the building contractor is compulsory to provide to persons, who arrive on building site (workplace) with his mind, personal protection equipment corresponding with their hazards. This obligation is in detail appointed by government direction about conditions of personal protection equipment providing.

By this regulation is essentially changed the approach into personal protection equipment (PPE) providing. Instead of simple and directive instruction for protection resources using, as it was in history, every employer has to identify severally all hazards, resulting from actual activities as well as conditions, in which they are realized. The sector lists elaborated in history by ministries, had not responded to requirements of individual employee protection in specific conditions.

The present regulations directly place duty on employer to elaborate "tailor-made" list of provided PPE, according to real hazards and risk amount. Every employer has to actively approach in this manner into generation of self list of PPE, following appraisal and valuation of hazards in every activity, which his employees perform. Then he has to examine the lists and propose how to avoid risks, advise his employees with this, create the list for PPE providing and ensure their providing and application control.

This active approach into PPE generation makes suppositions for:

- appreciation of safety hazards according to specific conditions at workplace and realized activities character,
- reviewing of amount and possible hazards effects,
- conscious elimination of all aspects, which an accident can cause,
- conscious application of PPE by all employers at the workplace.

In the sense of law about work inspection, inspectors have powers to verify practices for hazards appraisal by employer. Besides control of PPE application directly on building site may demand also demonstration of following documentation:

- list of PPE
- documentation interpreting hazard appraisal practice (system description)
- documentation of employees information about hazards, risks and dangers, for which are PPE intended
- employees information how to protect against the danger, hazards and risks (details of trainings and trainings records)



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4. THE ALGORITHM OF PERSONAL PROTECTION EQUIPMENT (PPE) FOR BUILDING WORKS DOCUMENTATION GENERATION PROPOSAL

One of the legislation regulations „defects“ is, that they order what is prohibited or what has to be done, but they does not offer any system of how to cover practically these commands or prohibitions. That is why the article authors had created an algorithm and consequently an software tool, which permits to building companies employers by simple and especially system method prepare all the government instruction requirements about personal protection equipment providing conditions.

In creation of the tool for documentation of PPE for employees' generation, we were appeared from following anticipations:

- ✓ fulfilment of general government regulations requirements in conditions of personal protection equipment providing, by adapting for building industry specifics
- ✓ simply manageable tool for required outputs generation
- ✓ generally available (standard) software
- ✓ possibility of final documentations various combinations depending on necessity and purpose place
- ✓ documentation directness for particular buildings (workplaces)
- ✓ possibility of already executed analysis (buildings, actions) archiving
- ✓ possibility of fast generation following archived analysis
- ✓ possibility of revaluation (actualization) especially in changed working conditions

From follow analysis of law regulations, employer responsibilities and especially requirements of government regulations about personal protection equipment providing conditions were defined inputs and required outputs.

4.1. The inputs definition

Among main inputs were arranged the regulations appendices, worked into databases. The appendix which involved works list, in which PPE have to be offered (in division also for concrete body part protection), has been chosen as “jumping-off” for the model and consequently has been selected according to building works specifics.



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Input databases (created following government regulations appendices)		
D1	Appendix nr.2	PPE list – PPE groups structured for concrete body parts or body member protection: head, ears, eyes and face, breathing apparatus, limbs, legs, trunk and belly, all body, skin and other.
D2	Appendix nr.3	Hazards list - 4 main groups: physical, chemical, biological and other dangers, while for building works are specific mainly physical dangers (workplace position in regard to earth top, bad surface of floors and communications, press, stroke, section, slash, lash, chafing, reeling, unfolding and falling objects, deficient image, noise, judder, ...)
D3	Appendix nr.4	Operations list Operations in which PPE have to be offered, structured following concrete body parts and members protection.
„jumping-off“ see picture1		
D4	Appendix nr.5	List of criteria for PPE selection - Hazards reasons and types, against which concrete PPE should protect.

4.2. The outputs definition

The outputs according to government regulations about personal protection equipment providing conditions, reproduce required documentation. In form of indirect outcomes permit fulfilment of next regulations conditions, which are information offer about dangers and allowance of their systematic reevaluation

Required outputs (according to government regulations)	
V1	Hazards analysis
V2	PPE character (against what protects)
V3	Specific types of PPE
V4	Application conditions (especially application time – PPE durability)
V5	PPE list
Indirect outputs:	
Vn6	Apprising of dangers – information about dangers
Vn7	Hazard reevaluation (in building site conditions changes)

Considering the required outputs, were connected also next two new databases, which permit to choice also specific types of PPE, available on market, were can be inserted data concerning PPE application, PPE keeping up, but also data about concrete contractor. (Db5). Next database (Db6) is PPE application time (durability), which is unlike history defined by employer, regarding conditions and intensity of operations realized it means PPE abrasion. The database is directly from the software available for number data modification. From input and output



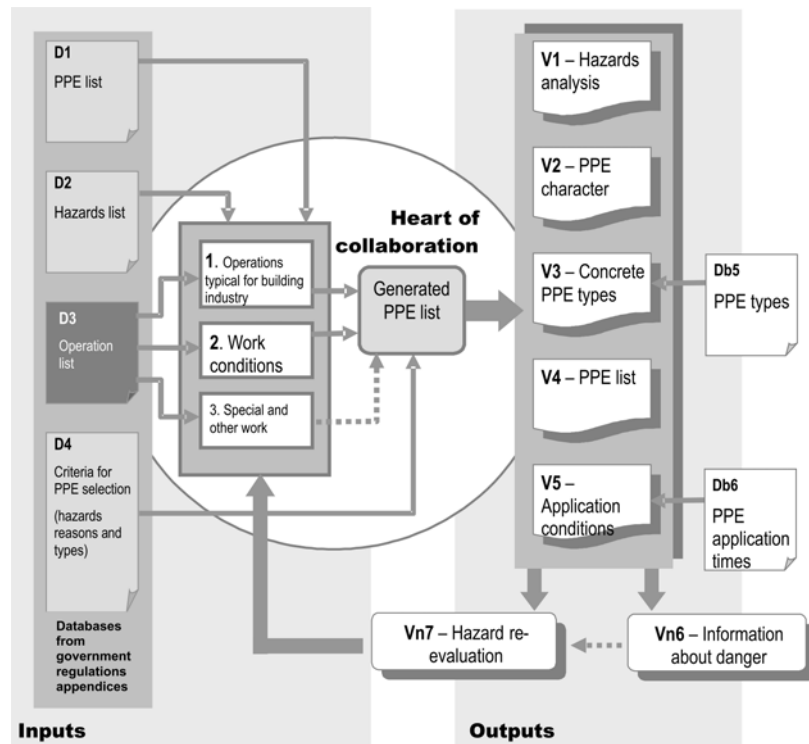
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parameters was consequently created the model with work name **GENOPSTAV** (PPE for building works generation).

4.3. The algorithm for PPE generation

The hearth of the system is operations list from government regulations appendix, where are inscribed operations, in which in generality have to be offered PPE to all employees. For PPE specifically for building works generation needs, was needed the list redistribute into three sub lists. So condition for simpler “listing” among processes was created.

Sub list 1	list of operations typical for building industry (earth works, scaffold works, formwork installation and dismanting, ...)
Sub list 2	list of operations expressive working conditions (works in heights, work in cuttings, work in noise, work in winter and cool, ...)
Sub list 3	list of other special and another operations , only sporadical works on building site



Picture 1. Algorithm of the model GENOPSTAV for PPE generation



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The heart of the system is the heart of bearing collaborative relations (Picture 1). On presented sub lists are automatically tied, as well as particular dangers, which impend in existing operation, as needed PPE, by which should be these dangers minimized. On so generated list of PPE is then automatically connected next database, which identify dangers reasons and types, against which should involved PPE protect. This connection is important for these outputs, by which employer should inform their employees about dangers, which impend them in particular works performance.

5. CREATION OF THE SOFTWARE ENVIRONS FOR THE TOOL OF PPE GENERATION

As it results from the model algorithm, the software for particular inputs into required outputs transformation has to be data basely oriented. In this cause, and in cause of general availability, in the model processing was applied software **MS Access**, which is the part of MS Office Professional packet. It is data basely oriented software, supporting creation, processing and consequent transformation of the inputs into required outputs. By this manner ensued the software architecture of the tool for personal protection equipment generation (Picture 2), which is structured into three bearing parts (tabs, forms and output reports).

Particular input databases of the model were executed into software environs by tabs, which were each other connected by mentioned relations. Next was needed to offer and create particular forms for import of inputs and outputs forms and ensure collaboration (cooperation following date) among tabs. The output of the software model is in reports version – so in output printing formations. These reports are beforehand presented, divided according to offered data type.

After particular form filling by data, by tool Microsoft Visual Basic was created code for total database action assign.

The outputs can be modified by many methods, according to final user requirements. In this manner different structures of output formations can be achieved:

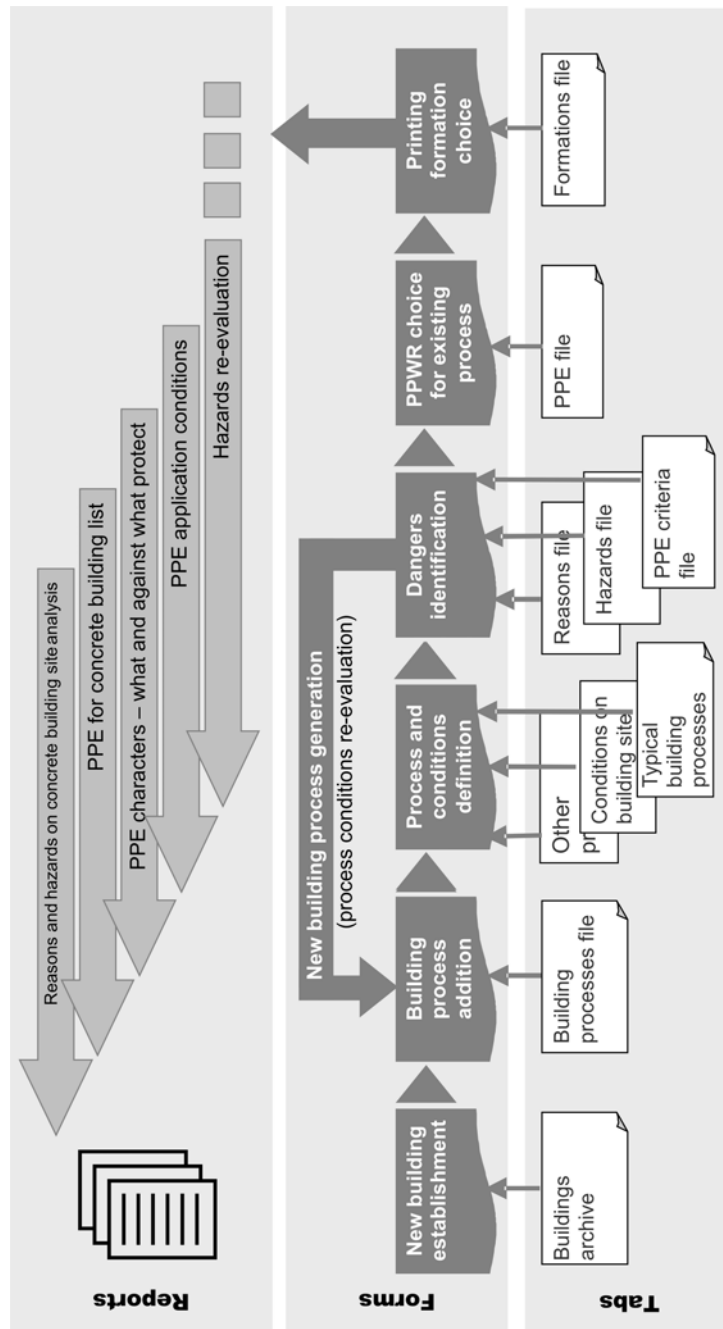
- risk processes list on existing building site
- risk processes list on existing building site including PPE
- PPE list on existing building site
- list including PPE and all at once hazards, which flow from existing work and against which should PPE protect etc.

The model and its outputs provide bases for next, by government regulations required activities, among which belong information of employees with possible



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hazards and in case of working conditions on building site changes, the model permit fast and simple hazards re-evaluation.



Picture 2 Software architecture of the model GENOPSTAV



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Example of specific project outputs for concrete construction and concrete building site

CAUSE AND DANGER ANALYSIS AND THE RELEVANT PPE			
Structure Code:	000-000-003	Processed by:	Ing. Peter Kozak
Structure Name:	Extension of Cobalt X-ray Cover, Košice	Analysis ordered by:	StavaIP Košice
Structure Place:	Košice	Structure made by:	StavaIP
Date of work:	18.1.2005		

Brickwork demolition

WORK, CONDITIONS	CAUSE OF DANGER	PPE
construction work	falling things/items	safety helmet
building and structure demolition	items falling at front site of foot	safety shoe with resistant sole against sticking and pruning
work with pneumatic tools	continual noise, impulsive noise	ear muff
fragments splinters raised from work	particles with high energy as glass	safety goggles
high dustiness tools	solid and liquid matter contaminating air	respirator

Delivery and assembly of roof LEXAN

WORK, CONDITIONS	CAUSE OF DANGER	PPE
construction work	blow, hit	safety helmet
handling with sharp edge tools	rough, sharp and pointed tools	safety gloves
assembly work	blow, hit	safety helmet
work on roofs	step on sharp, pointed tools	safety shoe with resistant sole against sticking and pruning
near crane work	site grip	safety helmet
work in high	fall from high, or fall to deep	safety tool against fall, safety rope
work in high	blow, hit	safety helmet
work outside at rainy and cold weather	hot or cold materials, site temperature	clothing against unfriendly weather



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6. CONCLUSIONS

The article is a contribution into risks reduction and information increasing about safety prevention in building industry. The article presents the model for required outputs execution in field of personal protection equipment providing in building practice conditions, which permitted elaboration of the effective software tool for all needed documentations for their effective management generation.

The aim of the article is also to mention the possibilities of usual software tools application in concrete building practice tasks solution. It is possible to facilitate many administration works and help to concerned workers in needed activities performance by creation of such tools.

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References

1. <http://www.build.gov.sk/> *Information - Year 2004, year of occupational health and safety in building industry.*
2. <http://ew2004.osha.eu.int> *European week of occupational health and safety. The building industry safety.*
3. <http://agency.osha.eu.int/publications/factsheets/> *Health and safety on small construction sites.*
4. Health and Safety Executive, Great Britain, *The costs of accidents at work*, HSG96, 1997.
5. Kozlovská, M., Kozák, P., Satisfied and healthy worker – condition of building company effects. In: *Building market*, year VII, nr.3, pages 26-29, MC SR: 2150/99.

