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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 APROACH 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 revaluation

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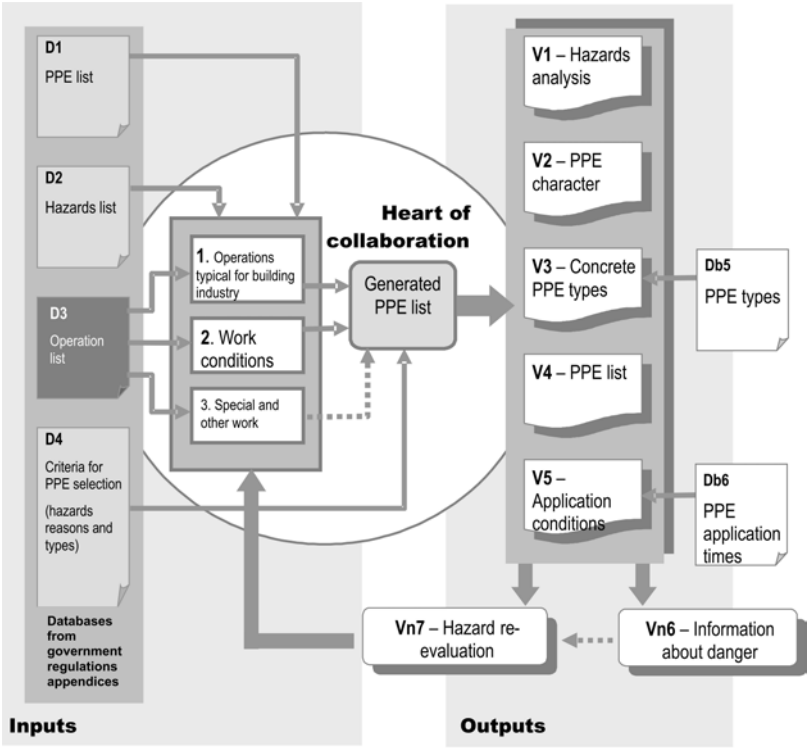
parameters was consequently created the model with work name **GENOPSTAV** (PPE for building works generation).

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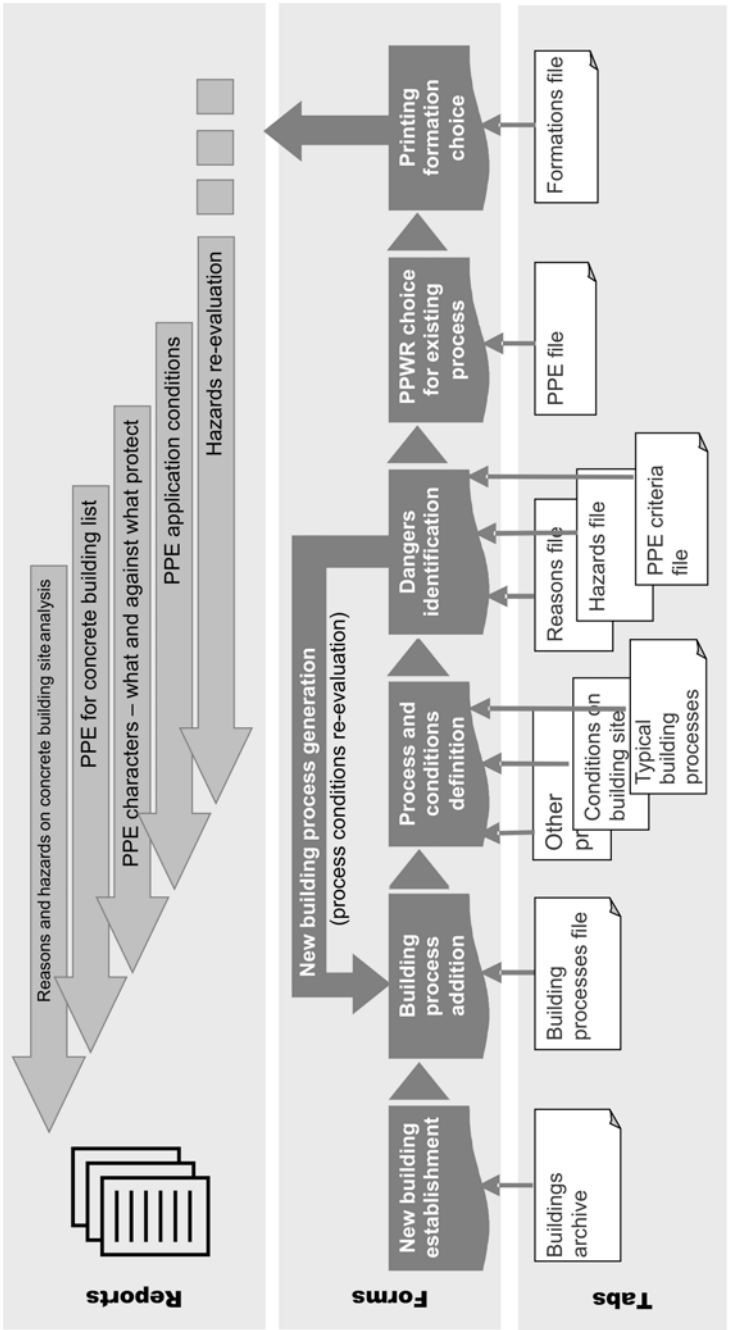
hazards and in cause of working conditions on building site changes, the model permit fast and simple hazards re-evaluation.



Picture 2 Software architecture of the model GENOPSTAV

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Computer aided tool for personal protection equipment generation

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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Computational modeling of building process time behavior

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Summary

The network analysis methods present the main tool for building schedule execution by computer. The principal element of network, which is the building time behavior model, is the building process at various aggregating level. The networks topology models technological and organizational relativities of the building processes.

The classical network analysis methods mostly perceive an activity as one network element, with two events namely start and finish, not allowing the fact, that each building process has got its internal time structure, which is relatively complicated.

In the paper is in detail executed division of building processes and their time parameters. The internal time structure is explained by various graphical models and mathematically are defined the interaction continuities among internal events of one building process. The time structure of one building process, defined in this manner, consequently permit define mathematically the conditional ties - relations among processes so that the final mathematical model will represent the real building time structure.

KEYWORDS: building process, activity, milestone, dummy process, real process, aggregated process, summary process, network analysis, network, network topology, arc, node, earliest start, earliest finish, latest start, latest finish, process duration, date of an event, resource.

1. INTRODUCTION

Most building companies aim at integrated information management system, processing by computers in its every side. The main principle of such integration is saving of all primary and also processing data about particular building objects into properly ordered data bases and permanent reflection of these data into calendar time. Determining element of building management scheme, which allow modelling of data in time, is building schedule. Therefore is necessary to have a building schedule computational processing as at full just model of factual building processes behavior model.

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Network analysis methods present the main tool for the building schedules execution by computer. Particular methods allow mathematical modelling of the projects by networks. The holder of building production in network is operation, i.e. building process on various aggregating level. The network topology describes activities relative connection method in the model. Classical network analysis methods have general application, but in them using for building process mathematical modelling rise inaccuracies, which markedly reduce the final model quality, i.e. building schedule quality.

The processes relativities have got their particularities in building industry. The network building model topology should represent real technological and organizational relativities of particular building processes. In application of concrete network analysis method for building time behavior modelling by computer is possible define in network topology only such relations among processes, which actual method, applied for computer programme can mathematically define. Also modelling of the building process internal time, technological and spatial structure is possible only in dimension, which actual computer programme affords to its user.

2. COMPUTATIONAL MODELING OF BUILDING PROCESS TIME BEHAVIOR

The network analysis methods present the base of computer programmes for projects behavior mathematical modelling creation. The network analysis methods intended for mathematical modelling of building schedule should respect particularities of building process internal structure, as well as particularities of their interaction relativities. For suitable mathematical definition of relations between events, exact analysis of building processes and knowledge about their internal time structure is necessary.

2.1 The building processes division

The building process is process of production**,** whose final product is a building construction, a building object or a building (operation, activity, partial stage, object, complex process). Time of the process duration is the function of the production amount (content in financial or physical measure units) and of work force load. It has requirements on resources (operation articles and working means). It is possible to factorise the building process in term of time and resource assessment into real process and to him pertaining internal and external dummy processes. Complexity of the building process internal time structure depends on amount and mutual relativities of processes, which are aggregated in the process.

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It is possible to divide building processes in term of time and resource assessment in network into:

- **real process** – the building process part**,** which has requirements on resources, for all that the resources requirements are fragmented (calculated) equally for all its duration time,
- **dummy process** – it can not exist independently, it always connects on an event (start or finish) of other activity, process, process set up or milestone. It has not requirements on resources (it is not resource appreciated). Its time assessment is derived from the building process technological structure, whose component it is, or from technological and time structure of the process set up, on which it is fixed. Among dummy processes belong for example the process development, settlement and reduction, deferments and technological intervals between processes, next time determination of the processes set up or its parts time duration (summary process) etc.
- *Note: in arc-defined networks of the processes set ups is term dummy activity used for designation of not only dummy processes, but also for designation of knot of two activities events, such designation is not accurate and do not satisfy with actuality. In such denotation it means an "activity relation". Also between events of two dummy processes can be time relativity, i.e. their events can be each other relative by the relation.*

Next it is possible to divide **dummy processes** into:

- **internal dummy processes** (development, settlement, reduction), by change of their time assessment does not come directly about change of earliest and latest terms of the real process start and finish, into which are allocated, but they can influence time weight of relations on previous or following processes events.
- **external dummy processes** (deferments and technological intervals – i.e. necessary intervals before start and after finish of the real process or its part). Their events terms are defined by relativity towards other building processes. By the change of their time assessment and their events terms is possible to come about change of earliest and latest terms of the real process start and finish, into which they are allocated.
- **summary processes** – (also term process heading and the process set ups heading is used) indicate time interval from the start of the first to the end of the last from grouped processes. The terms of the summary process events vary only in dependence on events terms changes in the grouped processes set up.
- *Note: in some literature is for summary process applied term "aggregated process", what is suitable only for cases of time-evaluated processes net models without their resource evaluation. If the processes net model elements have requirements on resource, it is necessary to distinguish between summary and aggregated process.*

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- **aggregated process** – it arises by integration of several activities or building processes into one process. It involves time and resource evaluated real process and time evaluated dummy processes (while time evaluation of dummy processes can be nought). Its time and resource evaluation is derived from the process set up parameters, which are in this process aggregated, while requirements on resources are in its real process fragmented (calculated) equally for all its duration term.
- *Note: Resources requirements are in aggregated process fragmented (calculated) equally for all its duration term. If it means only formal aggregation of the processes into one title, in such term arose summary process has got characters or dummy process, has got its own time evaluation, derived from grouped processes events terms, but has not got own resources requirements. Resources requirements are calculated from grouped processes requirements and therefore they can be unevenly distributed during the summary process duration term. The summary process and the aggregated process have got different parameters, therefore should not be these terms each other replaced.*
- **milestone** – is created by one event, which indicates important project state, or its part, it has not got resource evaluation and has got nought duration term. Such event can but must not have in advance defined earliest, latest or stabile date.

2.2. Time parameters of the building process

Among time parameters of the building process belong:

- operation process duration (in elected measure units)
- process development date
- process reduction date
- process settlement date
- time deferment (in time units or in work amount %)
- technological interval (in time units)
- terms (non-calendar or calendar) starts or finishes of the process or its part (earliest, latest, bound earliest, bound latest or stabile term).

The time parameters of the building process can be defined by constant (by account, by calculi, stochastically, deterministically), or as variable, in dependability on other parameters of the process or other processes values.

2.3. Models of the building process time structure

There are many abstract models for formulation of the building process time structure:

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- verbal (time structure is stated by definition of parameters and their time evaluations),
- mathematic (time structure is stated by mathematical substances),
- graphical models (time structure is stated by graphical presentation).

For better visualise, better information relative density are all three types of the model normally applied together.

The building processes and their set ups network analysis, which is in its reality the complex of mathematical methods of the project modelling by networks, uses the combination of all three types of abstract models. The base is created by the network, which is supplemented by radical or computed values of time parameters, eventually by definition of the process and by particular mathematical apparatus, which serves for network elements parameters evaluation (arcs and nodes).

For mathematical and graphical formulation of relativities among particular time parameters of the building process or building process set up are applied such identifications:

i, j, k, ... – indexes for general identification of the process,
a, b, c, ... – indexes for identification of the partial processes,
A,B,C ... – indexes for identification of the aggregated processes,
(i+0), (k+0) till *(i+7), (k+7), ...* - indexes of the building process *I, k* events arcs,
t_i - process *i* duration term,
T_i - general identification of the process *i* event term,
U_i - general identification of the process *i* event,
Z_i - start of the process *i*,
K_i - finish of the process *i*,
Ro_i - development of the process *i*,
Us_i - settlement of the process *i*,
Zu_i - reduction of the process *i*,
Pr_i - technological interval of the process *i*,
Od_i - deferment of the process *i*,
tRo_i - development date of the process *i*,
tUs_i - settlement date of the process *i*,
tZu_i - reduction date of the process *i*,
tPr_i - technological interval duration date of the process *i*,
tOd_i - deferment of the process *i* duration date,
TZ_i - date of the process *i* start,
TK_i - date of the process *i* finish,
TRo_i - date of the process *i* development finish (settlement start),
TZu_i - date of the process *i* reduction start (settlement finish),
T_1Pr_i - date of technological interval finish after process *i* development,
T_2Pr_i - date of technological interval duration finish after process *i* finish,
T_1Od_i - date of deferment duration start before process *i* start,

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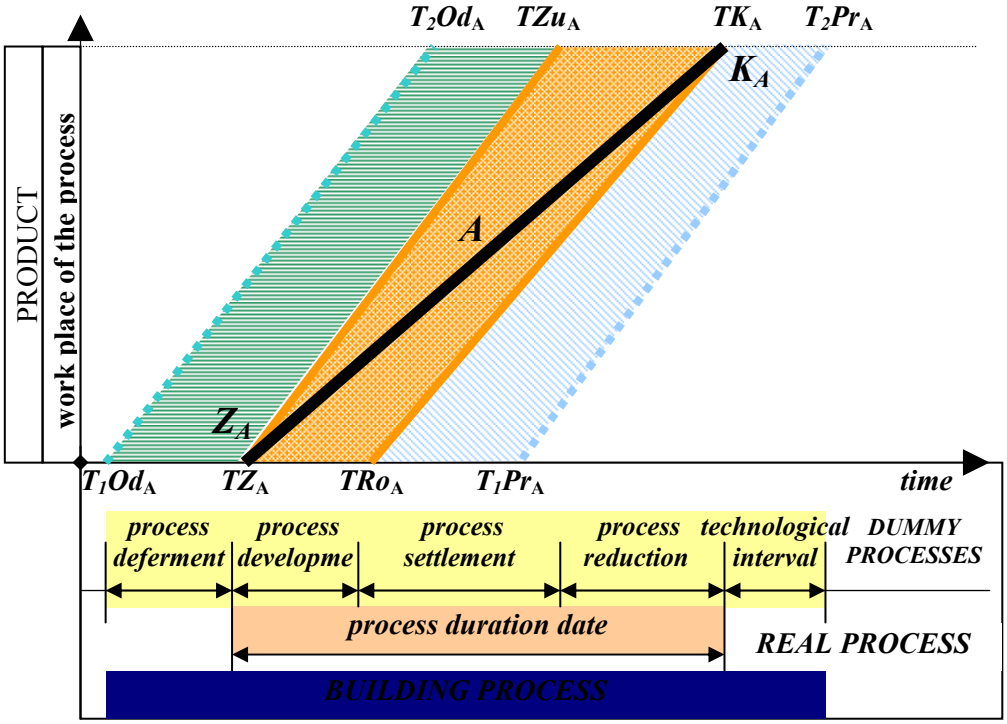
T_2Od_i - date of deferment duration start before process i reduction start.

For mathematical and graphical expression of relativities between parameters of the processes and the relations among processes in network of the process set up (for solution by network analysis), are applied following identifications:

NT - bound date (taken by real or relative calendar date),
TM - earliest event date, taken "by computation ahead",
TP - latest event date, taken "by computation aback",
ZM_i - earliest start of the activity i date,
KM_i - earliest finish of the activity i date,
ZP_i - latest start of the activity i date,
KP_i - latest finish of the activity i date,
ε_{ij} - time evaluation of the relation between events U_i and U_j

On the picture nr.1 is in time-spatial diagram image behavior of the building process A, which consists of the real process and to it pertaining dummy processes.



Picture 1. In time-spatial diagram presented behavior of the process ***A*** and to it pertaining dummy processes: deferment, technological interval, development, settlement and reduction of the process

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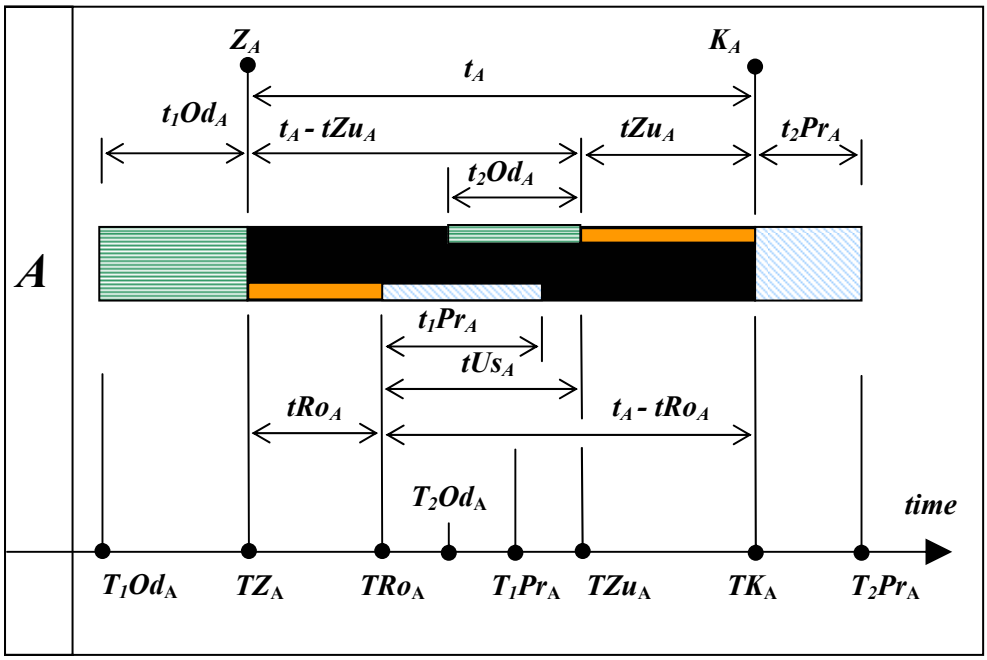
On the picture nr.2 is the same process presented in line schedule, where are equally graphically distinguished its real part and dummy processes: deferment, technological interval and development, settlement and reduction of the process.



Picture 2. Presentation of the process ***A*** and its real and dummy processes in line schedule

In case, that dummy processes, i.e. development, reduction and external dummy processes have got nought time evaluation and the process settlement date is the same as the process duration date, graphical presentation of the process *A* is in diagrams reduced into vector (Z_A, K_A).

In arc-defined network, which serves as a basis for mathematical building process model, one node of the net responds mostly to one building process. For specification of particular building process time parameters mostly only definition of parameters with their computed or taken time evaluation situated directly in the process node is applied.

Mathematical schemes for the terms of the building process (its real and dummy processes) events computation (earliest and latest), defined by actual network analysis methods, are fixed into verbal definition of the net elements and are not directly image of their graphical description. On the picture nr.3 is described the node, which presents the process *A*, where are in node presented the process time parameters evaluations (its real and dummy processes) and their events terms *TM* and *TP*.

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i	ZM_A	KM_A	tRo_A	TM_{Ro}	TP_{Ro}
	A		tZu_A	TM_{Zu}	TP_{Zu}
			t_1Pr_A	TM_{Pr1}	TP_{Pr1}
			t_2Pr_A	TM_{Pr2}	TP_{Pr2}
t_A			t_1Od_A	TM_{Od1}	TP_{Od1}
	ZP_A	KP_A	t_2Od_A	TM_{Od2}	TP_{Od2}

Picture 3. The node of node-defined network, which presents the building process ***A***, where are by definition presented time parameters and events terms of real and dummy processes of the process ***A***

Such node is then one element (node), which is in node-defined diagram consequently interconnected by arcs presenting technological and organizational knots among processes. Definition of these arcs consists of relation type identification and its time evaluation. Methods of description and definition of relations among processes have got particular network analysis methods different, but in principle all the methods have got for certain processes relativities styles defined concrete mathematical algorithms for underlying processes events terms determination.

Note: In computer processing and accounts in processes net is necessary identify (by constant or by account in dependability on other process parameters values) for particular processes (net nodes) only duration dates of their real and dummy processes and relation type between processes. Time evaluation of the terms is accounted automatically following defined mathematical algorithms for method relations, which is used by software. The outputs are then mostly processed in line schedule or in time-spatial diagram.

If is necessary directly graphically express mathematical relativity between events terms of one building process, as well as among events terms of all process set up, it is suitable to describe network as arc-evaluated. The number of the net model elements is on the one hand several fold enlarged, because one net node responds to every process event, which must be tied in the network by one or by several arcs with different event of one or several processes. On the other hand right formed, described and evaluated arc-defined diagram enables to define correctly the mathematical relations among particular real and dummy processes events.

Note: In computer processing and accounts in processes net is not necessary to draw the network topology. The processes parameters processes, as well as processes relativities can be taken for example column ally. The network analysis and its mathematical apparatus is the toll, which enables from like that taken data to form a flexible building model and to show the outputs for example by line schedule form.

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2.4. Description of events and building process behavior by arc-defined network

For the building process description (its internal technological structure, i.e. real process events relation and into him pertaining dummy processes) by arc-defined network (see picture nr.4), seven time evaluated arcs with following evaluation are necessary:

t_A - process A duration date – (real process, which is resource evaluated)

tRo_A - process A development date,

tZu_A - process A reduction date,

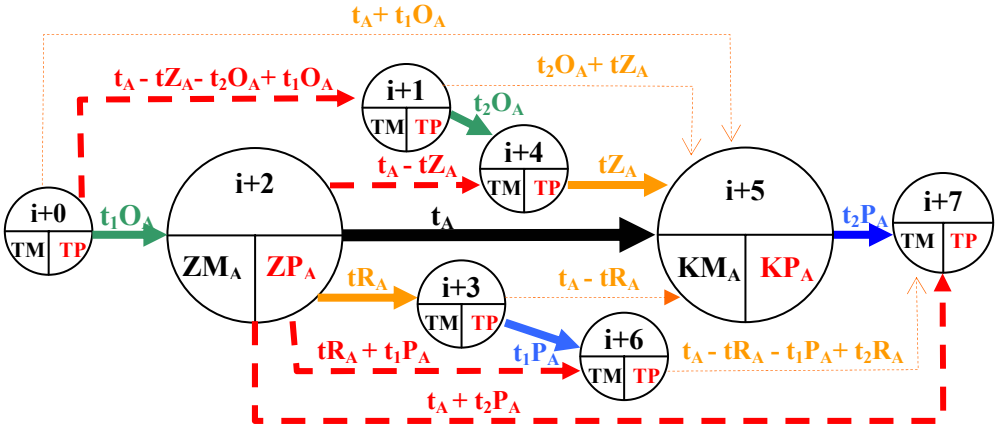
t_1Pr_A - technological interval after process A development duration date,

t_2Pr_A - technological interval after process A finish duration date,

t_1Od_A - deferment before process A start duration date,

t_2Od_A - deferment before process A reduction start duration date.

The settlement date tUs_A of the process A has not any own arc, it is only time interval between events TRo_A and TZu_A and can acquire plus, nought and minus value (description of arc for the process settlement is not necessary, it does not extend to terms accounts in the process inside).



Picture 4. Arc-defined network of the process A with description and time evaluation of the arcs (relations and behavior) and nodes (events) of real process and dummy processes

Dummy process can not exist independently, it is always tied to event (presented by node) of other process (real or dummy), with which has got same time evaluation at least in one node, i.e. has got at least one generic node with other process. For six dummy processes of the process A events description, only six other nodes are therefore necessary.

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2.5. The arcs evaluation in arc-defined network of one building process

On the picture nr.4 is described arc-defined network of one building process.

By fat continual line is arc of the real process described, dummy processes are described by thinner continual line. Orientation of the arcs is presented by arrows. By linear fat line are described assistant arcs, which are used in mathematical account of *TM* and by linear thin line are described assistant arcs, which are used in mathematical account of *TP*.

The arcs evaluation in arc-defined network of one building process is inscribed on the picture nr.4. The assistant arcs evaluation is mathematically derived from the real process *A* and its dummy processes time evaluation.

2.6. Account of the events terms of one building process TM and TP

Each arc-defined network must verify one formal condition: „ the net has to have one input and one output node". Completion of the condition is necessary for the net numbering and for mathematical account of the events terms by "method ahead" and also by "method aback". From counted values *TM* and *TP* is possible to define critical path behavior in the net model. Regards of relativity, i.e. relations among particular events of the building process *A* real process and dummy processes can not create a cycle. The algorithm of the terms account by "method ahead" by "method aback" inside the process is the same as in classical method CPM. The difference is only in net arcs perception. The net arcs create not only real process and dummy processes, but also relations among particular events within the process.

Numbering of one building process network nodes is derived from number *(i+0)* of entry process node. While nodes events *(i+1)* till *(i+7)* respond to events described on the pictures 1 and 2 as follows:

node *(i+0)* - $\boldsymbol{T_1Od_A}$ - date of deferment before process *A* start duration start,
node *(i+1)* - $\boldsymbol{T_2Od_A}$ - date of deferment before process *A* reduction start duration start,
node *(i+2)* - $\boldsymbol{TZ_A}$ - date of the process *A* start,
node *(i+3)* - $\boldsymbol{TRo_A}$ - date of the process *A* development finish (settlement start),
node *(i+4)* - $\boldsymbol{TZu_A}$ - date of the process *A* reduction start (settlement finish),
node *(i+5)* - $\boldsymbol{TK_A}$ - date of the process A finish,
node *(i+6)* - $\boldsymbol{T_1Pr_A}$ - date of the technological interval after process *A* development finish,
node *(i+7)* - $\boldsymbol{T_2Pr_A}$ - date of the technological interval after process *A* finish duration finish.

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By mathematical account by „method ahead“, which runs following arcs orientations, i.e. following described arrows, are in particular nodes defined values of *TM*. The node *(i+0)* is beginning node with known value *TM*, if $t_1O_A=0$ and $t_2O_A=0$, then beginning node is the node with index *(i+2)* and with value ZM_A. From arcs evaluation and from value $TM_{(i+0)}$ are counted values $TM_{(i+1)}$ and ZM_A, consequently from value ZM_A are counted values *TM* in nodes *(i+3), (i+4), (i+5), (i+6)* and *(i+7)*.

Account by „method aback“ runs non-following the arcs orientation. Account begins in node with index *(i+7)* and value $TP_{(i+7)}$, if $t_1P_A=0$ and $t_2P_A=0$, then begins in node with index *(i+5)* and with value KP_A. From the value $TP_{(i+7)}$ is counted value $TP_{(i+6)}$ and value KP_A in node with index *(i+5)*. Consequently from the value KP_A are counted values *TP* in nodes *(i+4), (i+3), (i+2), (i+1)* and *(i+0)*.

Accounts of one process events dates are in the process set up tied by relations to dates of technologically or organizationally related processes. It depends on actual network analysis method possibilities, which relations among process events defines, into what volume is possible by relations in network model serious technological and organizational relativities of the building processes, i.e. into what volume can relations allow internal complexity of the building processes and their structures. It is not eligible in praxis to draw complicated networks. The network of one building process presents in principle only one element in processes set up network. In node-evaluated network the building process can be presented only by one net node and for example in schedule only by vector. The analysis of one process internal structure is the bases for mathematical definition of such relations among processes, which enable in processes models creation by network analysis method, allow the building industry particularities.

3. CONCLUSIONS

Unlike activities in other economic sector, the building process has got relatively complicated its own internal time structure. Classical network analysis methods mostly apprehend the activity as one network element, with two events namely start and finish. Besides simplified perception of the building process, some classical network analysis methods have got limited number of mathematically defined mutual relations among processes events (start and finish), what is the problem in the building process technological relativity definition in creation and especially in tuning of building time behavior mathematical model.

In the article the output of one building process time structure internal analysis is description of its arc-defined net model. In one process network are defined arcs, i.e. events relating to one process and arc, which each other interconnect the

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process events. Mathematical evaluation of the arcs is derived from duration date of building process real process and dummy processes. One building process values events dates are mathematically derived from input and output net node values.

Perception of the building process through its internal structure consequently enables definition within concrete network analysis method such relations among processes events, which enable model the building process with its special technological and organizational relativities of the processes. In each computer programme for building time planning lays an actual network analysis method. The program ability to discharge its user requirements, which rise in creation and tuning of building time plan model in pre-production, production and realization stage of the capital project, depends on its mathematical apparatus.

Acknowledgements

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Electronic portal for occupational health and safety management on building site

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Summary

In the paper is presented an internet information application, which is intended mainly to construction managers in order to support and help in health and safety on building site problems performing. The portal provides to its user the survey of health and safety management on building site centre fields main terminology, survey of obligatory legislation, but mainly survey of particular procession steps destined into right managing of these fields, as well as survey of obligatory health and safety documentation, what can help to construction manager in everyday work on building site in managing, controlling and surveying the health and safety state on building site. The portal also presents the communicational channel interposing the transfer of health and safety management outputs from building contractor company level into building environs in documentation form of real construction offer.

KEYWORDS: occupational health and safety management, portal, building site, construction, company, construction manager, tool

1. INTRODUCTION

The building industry belongs surely to traditionally high risk sectors from the point of work injuries statistics. In case of small and medium building companies is even accident rate in Slovak republic few ten percents bigger as the average in other European Union states is. It is concerned exactly the companies, in which occupational health and safety (OHS) field is not managed completion ally, it means, that for ensuring of employees safety and health protection are mostly performed only some activities, most often only work accidents investigation and trainings.

The purpose of the thesis, of which one of the outputs is presented in the article, was rivet into occupational health and safety management system especially in small and medium building industries, those amounts is the biggest in business subjects of this field in Slovak republic.

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2. PURPOSE AND ROLE OF THE ELECTRONIC WORK PORTAL

The electronic work portal is an internet application, which is dedicated mainly to construction managers and foremen, as building contractor representatives, for support and help in health and safety tasks during building realization performance and secondly to safety coordinator, person which is entrusted by the project investor, the person who should also insure, manage and control occupational health and safety on building site.

The portal uses especially as:

- **communication channel -** for transfer and interposition of information and outputs from occupational health and safety management at the company level into building site environs;
- **working tool -** for construction manager and foreman directly on factual building;
- **feedback -** completed agenda on the building site offers information about real state of occupational health and safety on building site.

Information, which portal consists and offers make easier to manager on building site work with occupational health and safety agenda completing and management and permits him simplification of control and survey state of OHS on building site.

To building contractor employees, it means to building workers, can the portal serve as very good aid for better understanding of tenets and principles of safety conduct on building site, where they daily perform their works.

3. THE ELECTRONIC WORK PORTAL STRUCTURE

The web site net is divided into following seven main contextual sections depending on seven chosen **central fields of occupational health and safety management on building site**, which were specified following the analysis of OHS state in building industry of Slovak republic and European Union:

1. Trainings
2. Safety coordination
3. Personal protection work resources
4. Accidents
5. Machines and equipments
6. Noise
7. Hazardous substances

Each of these contextual sections is divided into following five rubrics:

1. Terms

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2. Legislation
3. Main activities
4. Documents
5. Agenda

Content of particular rubrics:

- **Terms**
  - Explaining of important terms understanding – necessary for right use of other information from the portal content.
  - Resource for applied terms is terminology undertaken from at the present actual legislation, from European regulations and from Slovak technical norms pertinent to given problems.
- **Legislation**
  - Survey of at the present actual legislation Slovak regulations, statutes and instructions, eventually technical norms, which deal with OHS problems from the point of specified central fields of occupational health and safety management on building site.
  - The portal includes also full texts of obligatory legislation regulations with their assigning into particular fields of OHS management on building site.
- **Main activities**
  - Survey of main tasks and requirements flowing mainly from obligatory legislation, from internal company instructions in given OHS management fields; let us say generally recommended activities insuring safe performance on building site. Denominated key tasks and requirements are further explained with mention on responsibilities for their accomplishment delegation to particular persons attending the building realization.
- **Documents**
  - Survey and brief explanation of particular documents necessary for OHS on building site system management, which are elaborated mainly at the building contractor company level and have to be physically available on building site because of their effective transformation and application in daily practice during building works performance.
  - There are mainly documents, which provide information about remains risks on building site, about operation procedures and technologies, about right application of machines and equipments during building realization etc.
- **Agenda**
  - Survey and brief explanation of documents, which construction manager has to complete and manage on building site in the building realization phase. Primarily there are records and reviews important for OHS management on building site indication in case of controls from public

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authority carrying out check on OHS in companies. Secondly it is documentation, which serves as a feedback, if you like response on OHS management at the company level, because records safety state and building work environs level.

- There are some forms and record application forms, for example for evidence keeping and registration of work accidents and other unwanted incidents occurrence on building site, about trainings taking place directly on workplace, about provided personal protection work resources, records from testimonies after work accident etc.
- The practical advantage of electronic work portal is, that permits direct completion of particular available forms and application forms and their printing after completion.

4. THE ELECTRONIC WORK PORTAL OPERATION

As it is an interactive web site, the portal users come into system through internet. By this the system flexibility and possibility of its service from whichever computer on whichever place using is covered.

On left side of the monitor are situated hyperlinks of seven central fields of OHS on building site management, from which the user can select this one, in which is he interesting.

Consequently on the monitor right side arise hyperlinks of upper mentioned rubrics within the fields (terms, legislation, main activities, documents and agenda).

The user click to the rubric, of which information wants to apply or with which wants to work and next on the monitor arise all available information, if you like hyperlinks of other information, which are related with given OHS management field within taken rubric.

Full texts of legislation regulations and forms or application forms, which the portal includes, upraise after click on relevant hyperlink in new individual sight.

The user can whenever go back or ready open some another management field. Information from the portal is possible to print or remove into another text editor and so can be more applied.

Pictorial samples from the electronic work portal content are presented next:

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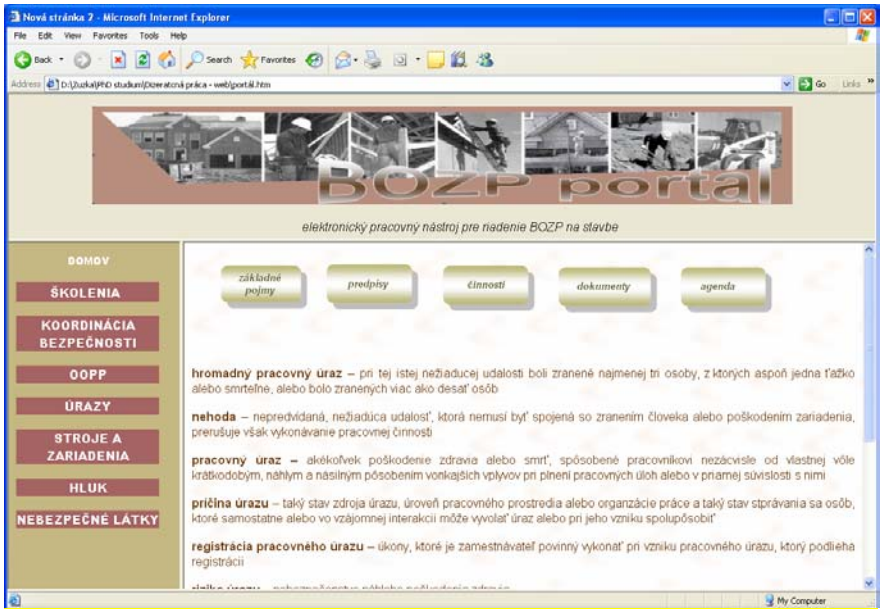

Figure 1. Content of the rubric „Terms" within „Accidents" field.

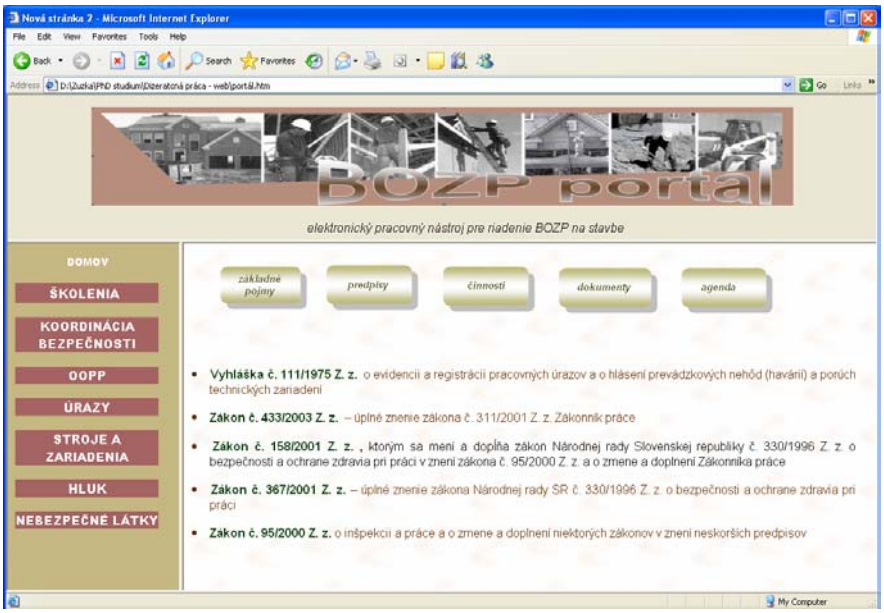

Figure 2. Content of the rubric „Legislation" within „Accidents" field

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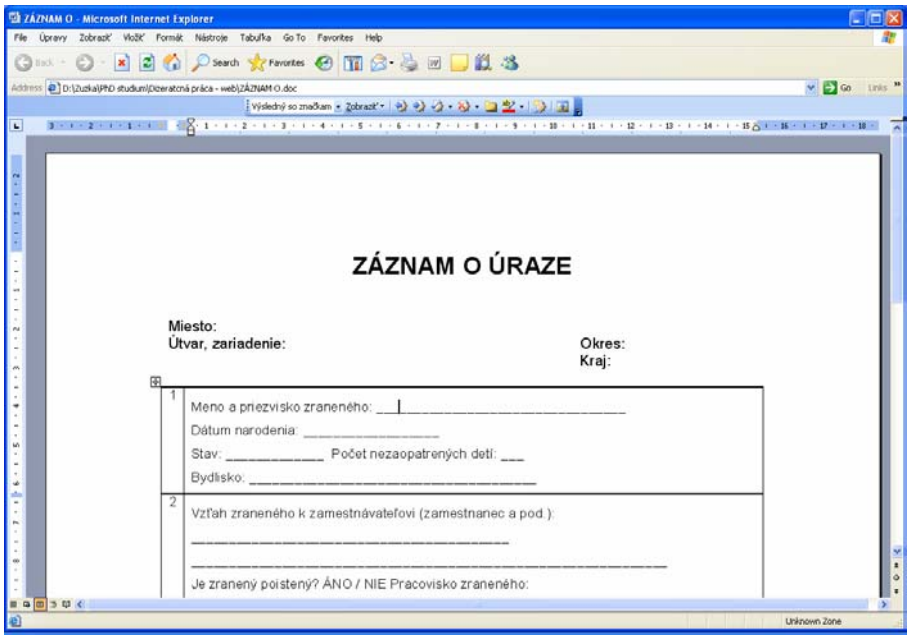

Figure 3. Application form for record of an accident completion situating in rubric „Agenda" within „Accidents" field

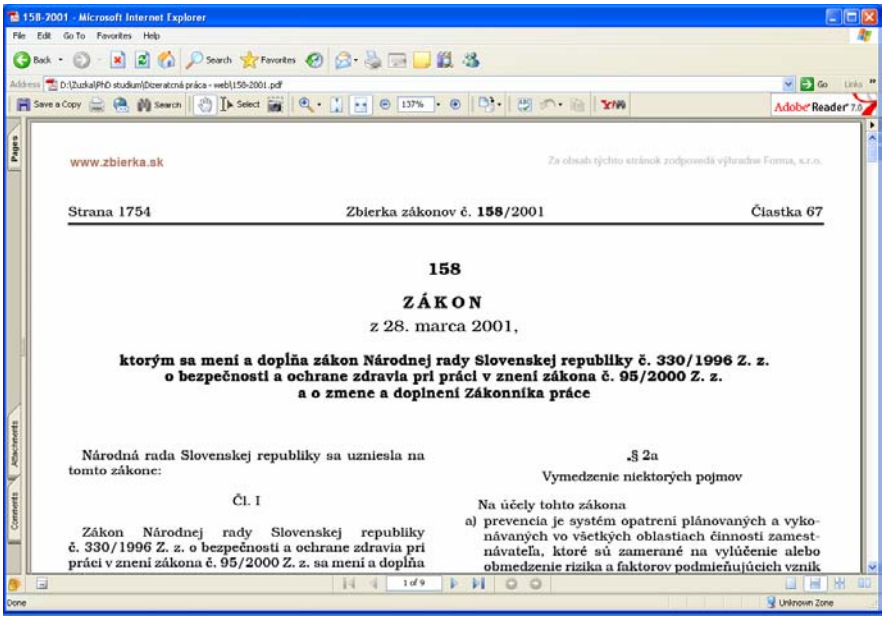

Figure 4. Full text of the regulation situated in rubric „Legislation" within „Accidents" field

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5. CONCLUSIONS

Establishment of occupational health and safety management system is only the first but certainly not satisfactory step, which company leading should perform on behalf of OHS state increasing. Only management system establishment is not guaranty, that it will be function system and that the system brings effect of OHS state and work conditions improvement, if its implementation into daily practice on company workplaces is not made. That is why is important along with OHS management system on company level establishment, keeping and improvement pay bigger attention to generation and creation of effective tools, which insure building realization management in terms of established OHS management system in company, what brings reduction of work accidents or other unwanted incidents amount on building sites.

Acknowledgements

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The complexity of the global environment

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Summary

The study approaches the corporate sector running its activity in a global market, looking at the challenges a global corporation is facing from an operational and management perspective in order to perform in a competitive and regulated global environment. It provides an understanding of how the global environment influences a company's strategy. The evolution of a global corporation often entails progressively involved strategy levels. The study describes these levels. It analyses the factors contributing to the complexity of the global environment. The study also analyses the manner in which cultural differences influence the company's own culture, strategy and ethics. In a global market, companies must perform their activity in compliance with certain codes of conduct.

KEYWORDS: globalization, code of conduct, governance, ethics, strategy, multinational corporations

1. OVERVIEW ON GLOBAL COMPANIES

Special complications confront a firm involved in the globalization of its operations. Globalization refers to the strategy of approaching worldwide markets with standardized products. Such markets are most commonly created by end consumers that prefer lower priced, standardized products over higher-priced, customized products and by global corporations that use their worldwide operations to compete in local markets. Global corporations situated in one country with subsidiaries in other countries experience difficulties that are understandably associated with operating in several distinctly different competitive arenas.

Awareness of the strategic opportunities faced by global corporations and of the threats posed to them is important to planners in almost every domestic industry. Among corporations headquartered in US that receive more than 50% of their annual profits from foreign operations are Coca-Cola, Gillette, Citicorp, IBM, Texas Instruments etc. In fact, the 100 largest US global earn an average of 37% of their operating profits abroad. Equally impressive is the impact of foreign-based globals that operate in the US. Their "direct foreign investment" in the US exceeds $90 billion, with Japanese, French and German firms leading the way.

Examples of global major constructions companies are listed below:

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- Turner Construction (US) provides comprehensive management services through the development, design and construction phases of general building projects. Turner's approach combines the established presence of a local firm with the strength, stability and resources of a global company.
- Vinci Construction (France), the French market leader and a world major in construction, brings together an unparalleled array of capabilities in building, civil engineering, hydraulic engineering and services.
- Hochtief (Germany): Being an international construction services provider, Hochtief designs, finances, builds, and operates complex projects of all kinds for you. Their global network gives us a presence on all the main markets of the world.
- Balfour Beatty (United Kingdom) serves the international markets for rail, road, utility systems, buildings and complex structures.
- Effage (France) The Group's principal activities are construction and civil engineering works. It operates in five segments: Construction and civil engineering, road construction, electrical contracting, metallic construction and car parks and concessions.

Understanding the myriad and sometimes subtle nuances of competing in global markets against global corporations rapidly is becoming a required competence of strategic managers. For example, experts in the advertising community contend that Korean companies only recently recognized the importance of making their names known abroad. In the 1980s, there was very little advertising of Korean brands and the country had very few recognizable brands abroad. The opening of the Korean advertising market in 1991 indicated that Korean firms had acquired a new appreciation for the strategic competencies that are needed to compete globally and created an influx of global firms. Many of them established joint ventures or partnerships with Korean agencies.

2. DEVELOPMENT OF A GLOBAL CORPORATION

The evolution of a global corporation often entails progressively involved strategy levels. The first level, which often entails export-import activity, has minimal effect on the existing management orientation. The second level, which can involve foreign licensing and technology transfer, requires little change in management or operation. The third level typically is characterized by direct investment in overseas operations, including manufacturing plants. This level requires large capital and a development of global management skills. Although the domestic operations of a firm at this level continue to dominate its policy, such a firm is commonly categorized as a true multinational corporation. The most involved strategy level is characterized by a substantial increase in foreign investment, with

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foreign assets comprising a significant portion of total assets. At this level, the firm begins to emerge as a global enterprise with global approaches to production, sales, finance and control.

"Some firms downplay their global nature (to never appear distracted from their domestic operations), whereas others highlight it. For example, a strong global orientation is evident at IBM, which operates in 125 countries, conducts business in 30 languages and more than 100 currencies and has 23 major manufacturing facilities in 14 countries." [10].

3. THE COMPLEXITY OF THE GLOBAL ENVIRONMENT

Global strategic planning is more complex than the domestic planning. There are at least five factors that contribute to this increase in complexity:

- Globals face multiple political, economic, legal, social and cultural environments as well as various rates of changes within each of them.
- Interactions between the national and foreign environments are complex because of national sovereignty issues and widely differing economic and social conditions.
- Geographic separations, cultural and national differences and variations in business practices tend to make communication and control efforts between headquarters and the overseas affiliates difficult.
- Globals face extreme competition, because of differences in industry structures.
- Globals are restricted in their selection of competitive strategies by various regional blocs and economic integrations, such as the European Union, the Latin American Free Trade Area.

4. CONTROL PROBLEMS OF THE GLOBAL FIRM

An inherent complicating factor for many global firms is that their financial policies typically are designed to further the goals of the parent company and pay minimal attention to the goals of the host countries. This built-in bias creates conflict between the different parts of the global firm, between the whole firm and its home and host countries, and between the home and the host countries themselves. The conflict is accentuated by the use of various schemes to shift earnings from one country to another in order to avoid taxes, minimize risk or achieve other objectives.

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Moreover, different financial environments make normal standards of company behavior more problematic. Thus it becomes increasingly difficult to measure the performance of international divisions.

In addition, important differences in measurement and control systems often exist. Fundamental to the concept of planning is a well-conceived, future-oriented approach to decision making that is based on accepted procedures and methods of analysis. Consistent approaches to planning throughout a firm are needed for effective review and evaluation by corporate headquarters. In the global firm, planning is complicated by differences in national attitudes toward work measurement and by differences in government requirements about disclosure of information.

Although such problems are an aspect of the global environment rather than a consequence of poor management, they are most effectively reduced through increased attention to strategic planning. Such planning will aid in coordinating and integrating the firm's direction, objectives and policies around the world. It enables the firm to anticipate and prepare for changes. It facilitates the creation of programs to deal with worldwide development. Finally, it helps the management of overseas affiliates to become more actively involved in setting goals and in developing means to more effectively utilize the firm's total resources.

5. GLOBAL STRATEGIC PLANNING

The strategic decision of a firm competing in the global marketplace becomes increasingly complex. In such a firm, managers cannot view global operations as a set of independent decisions. These managers are faced with trade-off decisions in which multiple products, country environments, corporate and subsidiaries capabilities and strategic options must be considered.

A recent trend toward increased activism of stakeholders has added to the complexity of strategic planning for the global firm. Stakeholder activism refers to demands placed on the global firm by the foreign environments in which it operates, be it governments or internal governance regulations.

6. ETHICAL ISSUES FOR MULTINATIONAL CORPORATIONS

Despite differences among nations in culture and values, which should be respected, there are moral norms that can be applied to multinationals:

- MNCs should do no intentional direct harm. This is clearly not peculiar to multinational corporations. Yet it is a basic norm that can be usefully applied

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in evaluating the conduct of an MNC. Any company that does produce intentional direct harm clearly violates a basic moral norm.

- MNCs should produce more good than bad for the host country. This is an implementation of a general utilitarian principle. This principles extends to the fact that more good will be done by helping those in most need rather than by helping those in less need at the expense of those in greater need. MNCs will do more good only if they help the host country more than they harm it.
- MNCs should respect the human rights of its employees. MNCs should do so whether or not the local companies respect those rights.
- MNCs should pay their fair share of taxes. Transfer pricing has as its aim taking advantage of different tax laws in different countries. To the extent that it involves deception, it is itself immoral. To the extent that it is engaged in to avoid legitimate taxes, it exploits the host country and the MNC does not bear its fair share of the burden of operating in that country.
- To the extent that local culture does not violate moral norms, MNCs should respect the local culture and work with it, not against it. MNCs cannot help but produce some changes in the culture in which they operate. However, they can consider changes in operating procedures, plant planning, which take into account local needs and customs.
- MNCs should cooperate with the local government in the development and enforcement of background institutions. Instead of fighting a tax system that aims at appropriate redistribution of income, instead of preventing the organization of labor and instead of resisting attempts at improving the health and safety standards of the host country, MNCs should be supportive of such measures.

7. GLOBALIZATION AND CULTURE

With globalization being the buzzword and every country joining the free trade bandwagon, competition has become real. Investment decisions relating to setting up of projects are examined thoroughly and global developments are factored into these projects to assess the risk-return matrix. And only if it passes through this stringent test of risk and return viewed against a global backdrop, steps are taken to consummate the project. So, typically in a global scenario, you have a company whose production base is in one country, the godown in another, back-office operations in a third country and corporate headquarters in the fourth. And, obviously, management of such international/global corporations would involve dealing with personnel, customers, suppliers, rooted in their own distinct local culture, which could be both a barrier and a challenge to the organization.

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The complexity of the global environment

What is culture? Does it impact on what international managers do? And if it does, how do you understand and manage it to benefit the organization in general and the managers in particular keeping the overall business objective? And how do we define culture? Culture is itself an amorphous term and there could be as many definitions as there are anthropologists, sociologists and writers. It is said that there are 160 different definitions of the term 'culture'. We will pick up the definition of scholar Clyde Kluckhohn. [13]. According to him, "Culture consists of patterned ways of thinking, feeling and reacting, acquired and transmitted by symbols, constituting the distinctive achievement of human groups, including their embodiment in artifacts; the essential core of culture consists of traditional (i.e. historically derived and selected) ideas and attached values." Another scholar, Triandis, presents a psychological perspective to the description. "Culture is a subjective perception of the human - made part of the environment. And this includes the categorization of social stimuli, associations, beliefs, attitudes, roles, and values individuals share." Culture thus is a melting pot consisting of many things gathered over a period of time in which religion and language play a great role. So, when international trade takes place, or managers migrate from one country to another, there is necessarily an interaction between two different and varied cultures. They could converge or they could diverge. And it is the international managers' prime duty to understand these cross-cultural differences, to iron them out to achieve their corporate objectives.

8. ETHICS AWAY FROM HOME

When we leave home and cross our nation's boundaries, moral clarity often blurs. Without a sense of shared attitudes and without familiar laws and judicial procedures that define standards of ethical conducts, there is no certainty for an individual or a business. Should a company invest in a foreign country where civil and political rights are violated? Should a company go along with a country's discriminatory employment practices? If companies in developed countries shift facilities to developing nations that lack strict environmental and health regulations, or if those companies choose to fill management and other top level positions in a host nation with people from the home country, certain standards will prevail. The question is "whose standards should prevail".

Even the best-informed and best-intentioned executives must rethink their assumptions about business practice in foreign settings. What works in a company's home country can fail in a country with different standards of ethical conduct. Such difficulties are unavoidable for businesspeople that live and work abroad. But how can managers resolve the problems? What are the principles that can help them work through cultural differences and establish codes of conduct for

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globally ethical business practice? How can companies answer the toughest question in global business ethics: what happens when a host country's ethical standards seem lower then the home country?

The most applicable answer is that managers cannot operate in another culture without being aware of the culture's attitude toward ethics. Companies must help managers distinguish between practices that are merely different and those that are wrong. When it comes to ethical behavior, companies should be guided by the following principles:

- Respect for core human values, which determine the absolute moral threshold for all business activities;
- Respect for local traditions;
- The belief that a context matter when deciding what is right and what is wrong.

"Philosophically speaking, the relativists believe that nothing is sacred and nothing is wrong. For absolutists, many things that are different are wrong. The reality is somewhere is between." [20]

In Japan, people doing business together often exchange gifts – sometimes expensive ones – in keeping with long-standing Japanese tradition. When US and European companies starting doing a lot of business in Japan, many Western business people thought that the practice of gift-giving might be wrong rather than dimply different. To them accepting a gift is like accepting bribe. As Western companies have become more familiar with Japanese traditions, most have started to tolerate the practice and to set different limits on gift giving in Japan than they do elsewhere.

Respecting differences is a crucial ethical practice. Research shows that management ethics differ among cultures; respecting those differences means recognizing that some cultures have obvious weaknesses as well as strengths. Managers in Honk Kong, for example, have a higher tolerance for some sorts of bribery than their Western counterparts, but they have a much lower tolerance for the failure to acknowledge a subordinate's work.

The core values for business can help companies begin to exercise ethical judgment and think about how to operate ethically in foreign cultures, but they are not specific enough to guide managers through ethical dilemmas.

9. CORPORATE CODES OF CONDUCT AND CRITICS

In the US and Western Europe corporate codes of conduct have become compulsory for most large corporations. According to recent studies, most

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multinational corporations have issued codes of conduct. These codes usually attempt to state the company's mission, values and goals and to describe its relationship to various stakeholders, both internal and external. Unfortunately, most of these codes suffer of a number of flaws:

- They are presented as public statements that lack specific content.
- While they mention the corporation's commitment to its customers, employees etc, they ignore the rights of these stakeholders in their dealings with the company.
- They make no provisions for internal implementation and code compliance is not integrated into the organization's procedures and reward structure; hence managers and employees are often uninformed about the codes and their content and do not take them seriously.
- They provide no basis or framework for communication with external communities about the efforts and results of the corporation in achieving the codes' objectives.

The inevitable result of these defects is that corporate codes of conduct are often treated with disdain by knowledgeable and influential opinion leaders among various stakeholder groups, as well as by outside analysts and the public at large.

Codes of conduct offer an invaluable opportunity for responsible corporations to create an individual and highly positive public identity for themselves. This is a reputation effect that can have a direct result on their bottom line in terms of increased revenue, customer loyalty, expanded markets, a productive work force and a supportive political and regulatory environment. Furthermore, an increased level of public confidence and trust among important constituencies and stakeholders would lead to greater freedom for management in the running of their business operations and insulate them from the actions of other less scrupulous firms in the market-place.

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Corporate governance – a global challenge

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Summary

The significance of corporate governance is now widely recognized, both for national development and as part of international architecture, addressing the converging interests of competitiveness, corporate citizenship, social and environmental responsibility. The study addresses the general international principles of corporate governance, it analyzes the circumstances for complying with the principles and gives an insight into investors' perception regarding this important aspect in the management of a corporation. The case study provides details on the South African code of corporate governance.

KEYWORDS: corporate governance, code of corporate governance, investor, principles, transparency, accountability, leadership, King Report, South Africa

1. INTERNATIONAL PRINCIPLES OF CORPORATE GOVERNANCE

"Corporate governance is concerned with holding the balance between economic and social goals and between individual and common goals. The aim is to align as nearly as possible the interests of individuals, corporations and society." (Sir Adrian Cadbury, Corporate Governance Overview, 1999, World Bank Report)

The significance of corporate governance is now widely recognized, both for national development and as part of international architecture, addressing the converging interests of competitiveness, corporate citizenship, social and environmental responsibility. It is also an effective mechanism for encouraging efficiency and combating corruption. Companies are governed within the framework of law and regulations of the country in which they operate. Communities and countries differ in their culture, regulation, law and generally the way business is done. In consequence, there can be no single generally applicable corporate governance model. Yet there are international standards that no country can escape in the era of the global investor. Thus, international guidelines have been developed by the Organization for Economic Cooperation and Development (OECD), the International Corporate Governance Network and the Commonwealth Association for Corporate Governance. The four primary pillars of fairness,

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accountability, responsibility and transparency are fundamental to international guidelines of corporate governance.

Fairness. The systems that exist within the company must be balanced in taking into account all those that have an interest in the company and its future. The rights of various groups have to be acknowledged and respected. For example, minority shareholder interests must receive equal consideration to those of the dominant shareholders.

Accountability. Individuals or groups in the company who make decisions and take actions on specific issues, need to be accountable for their decisions and actions. Mechanisms must exist and be effective to allow for accountability. These provide investors with the means to query and assess the actions of the board.

Responsibility. With regard to management, responsibility pertains to behavior that allows for corrective action and for penalizing mismanagement. Responsible management would, when necessary, put in place what it would take to set the company on the right path. While the board is accountable to the company, it must act responsively to and with responsibility towards all stakeholders of the company.

Transparency. Transparency is the ease with which an outsider is able to make meaningful analysis of a company's actions, its economic fundamentals and the non-financial aspects pertinent to that business. This is a measure of how good management is at making necessary information available in a candid, accurate and timely manner – not only audit data but also general reports and press releases. It reflects whether or not investors obtain a true picture of what is happening inside the company.

Corporate governance principles were developed, inter alia, because investors, with the era of professional manager, were worried about the excessive concentration of power in the hands of management. This protection against greed could on the other hand, erode the enterprise and encourage subservience. A balance is needed.

The 19th century saw the foundations being laid for modern corporations: this was the century of the entrepreneur. The 20th century became the century of management: the phenomenal growth of management theories, management consultants and management teaching, all reflected this pre-occupation. The 21st century promises to be the century of governance.

2. INVESTOR PERCEPTION

One of the difficulties, but also challenges, has been to provide sufficient empirical evidence that good corporate governance pays. In recent years, research has been

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developed that increasingly supports this position. In its Investor Opinion Survey published in June 2000, McKinsey & Co found that good governance could be quantified and was significant. For the survey, well-governed companies were defined as:

- Having a clear majority of outsiders on the board, with no management ties;
- Holding formal evaluations of directors;
- Having directors with significant stakes in the company and receiving a large proportion of their pay in the form of stock options;
- Being responsive to investors requires information on governance issues.
- The survey found that:
- More than 84% of the more than 200 global institutional investors indicated a willingness to pay a premium for the shares of a well-governed company over one considered poorly governed but with a comparable financial record;
- ¾ of these investors indicated that board practices were at least as important as financial performance, when evaluating companies for potential investment;
- The actual premium these investors would be willing to pay varied from country to country. In the United Kingdom, they would pay 18% more for the shares of a well-governed company than for the shares of a company with similar financial performance but with poorer governance practices. In emerging markets and markets perceived to have poor governance practices, this premium escalated to 22% for a well-governed Italian company and to as much as 27% for one in Venezuela or Indonesia.

3. LEADERSHIP IN CORPORATE GOVERNANCE

Corporate governance is essentially about leadership:

- Leadership for efficiency, enabling companies to compete effectively in the global economy, and thereby create jobs;
- Leadership of probity because investors require confidence and assurance that management will behave honestly and with integrity in regard to their stakeholders;
- Leadership with responsibility as companies are increasingly called upon to address legitimate social concerns relating to their activities;
- Leadership that is both transparent and accountable, otherwise business leaders cannot be trusted and this will lead to the decline of companies.

Some companies have appointed corporate reputation officers (CRO) to monitor how third parties view the company and to report to the chief executive on their findings. The CRO reports on matters such as customer satisfaction and customer perception of key service areas. Of even greater importance in the information age,

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particularly in IT companies, is the report on human resources aspects such as morale, skills, training, incentives, attraction of talent and succession. Other examples of so-called non-financial aspects of company performance include innovation, training, reciprocal relationships with defined stakeholders, management credibility as seen by third parties, technology (as compared with technology of competitors), internal audit, management information systems, risk management, service standards, productivity levels, bench marketing etc.

What stakeholders are looking for are reports that evidence good leadership and results. While communicating in financial terms is retrospective, this is in a common language that is understandable to all stakeholders. The difficulty with communicating the less defined sustainability or non-financial aspects is that no universal reporting standard or language has yet been developed.

What investors want are understandable measurements, to enable them to judge performance, conformance and sustainability on a common basis.

4. CIRCUMSTANCES AND FACTORS FOR GOOD GOVERNANCE

Apart from the value added to a company by good corporate governance, the recent onslaught of corporate scandals has compelled the world to acknowledge the profound impact of corporate governance practices on the global economy.

Interest in such practices has been fuelled by the international financial crises of the 1990s. In East Asia, in 1997 and 1998, it was demonstrated that macro-economic difficulties could be worsened by systemic failure of corporate governance, stemming from:

- Weak legal and regulatory systems;
- Poor banking regulation and practices;
- Inconsistent accounting and auditing standards;
- Improperly regulated capital markets;
- Ineffective oversight by corporate boards and poor recognition of the rights of minority shareowners.

The implications for companies are profound. Simply by developing good governance practices, managers can potentially add significant shareowner value. The results of this survey should also be apparent to policy makers and regulators in recognizing that the creation of a good governance climate can make countries, especially in the emerging markets, a magnet for global capital. The survey emphasized that companies not only need to be well governed but also need to be perceived in the market as being well governed.

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Historically, whilst focus on governing corporations has been financial, a balance sheet is only a record of one moment of the financial affairs of a company. Investors now want a forward-looking approach to reporting. What stakeholders want is a form of reporting from which they can see whether or not a company is likely to have sustained success.

5. CASE STUDY: REFORM OF THE SOUTH AFRICAN CODE OF CORPORATE GOVERNANCE

Code review and principles

The author of this study lived and worked in South Africa for a period of five years, acquiring significant experience of the country's financial market and corporate environment.

Corporate governance is of particular concern in developing economies, where the infusion of international investor capital and foreign aid is essential to economic stability and growth. Particular attention is given on corporate governance initiatives in South Africa, given its significance as an emerging market, its potential leadership role on the African continent and the country's notable corporate governance reform since the collapse of apartheid in 1994. The evolution of the country's corporate structure and the forces driving corporate governance reform over the past decade are notable. South Africa's initiatives can serve as models of enhanced corporate governance standards for the African continent.

Corporate Governance in South Africa was institutionalized by the publication of the King Report on Corporate Governance ("King Report 1994") in November 1994.

The King Committee on Corporate Governance was formed in 1992 under the auspices of the Institute of Directors to consider corporate governance, an aspect of increasing interest around the world, in the context of South Africa. This coincided with profound social and political transformation at the time with the dawning of democracy and the re-admission of South Africa into the community of nations and the world economy.

The purpose of the King Report was, and remains, to promote the highest standards of corporate governance in South Africa.

In 2002, the King Committee considered it appropriate to review corporate governance standards and practices for South Africa against developments that have taken place since the advent of the King Report 1994 in November 1994.

Four primary Guiding Principles were established for the purpose of this review:

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- To review the King Report 1994 and to assess its currency against developments, locally and internationally, since its publication on 29 November 1994;
- To review and clarify the earlier proposal in the King Report 1994 for an "inclusive approach" for the sustainable success of companies;
- To recognize the increasing importance placed on non-financial issues worldwide, and to consider and to recommend reporting on issues associated with social and ethical accounting, auditing and reporting, safety, health and environment;
- To recommend how compliance with a new Code of Corporate Governance for South Africa can be measured and based on outcomes.

A number of task teams were established to undertake a detailed review of specified areas of corporate governance, namely:

- The *Board and Directors* task team looked into issues regarding board practice, the status and responsibilities associated with executive, non-executive and independent directors, executive and non-executive director remuneration.
- The *Accounting and Auditing* task team considered developments surrounding auditing and non-audit services, accounting standards in relation to international developments, auditor skills required for reporting on non-financial aspects and the King Committee's previous recommendations regarding legal backing for accounting standards in South Africa.
- The *Internal Audit, Control and Risk Management* task team reviewed the role and function of internal audit and the scope and status of the internal auditor in relation to developments since 1994 against international best practice. It also investigated recommendations introducing risk management as a criterion for boards and companies in corporate governance.
- The *Integrated Sustainability Reporting* task team has the most compelling brief in that it had to analyse a wide range of complex, and in some cases, undefined area of reporting of a non-financial nature. Topics ranged from stakeholder engagement to ethics and ethical reporting, as well as social and transformation issues including black economic empowerment for example.
- The *Compliance and Enforcement* task team was required to consider the supervision and enforcement of existing statutory and regulatory provisions governing companies in South Africa and to make recommendations to improve compliance with governance guidelines.

While it has been noted that some of the recommendations contained in the King Report have subsequently been superseded by legislation, this should only be seen as addressing the minimum acceptable standards. As society in South Africa has evolved since 1994 through local developments and international circumstances, it is clear that business in this country continues to be faced with many challenges in

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a complex environment of political imperatives, globalisation and increasing relevance of stakeholder interests.

Main aspects of the Code

The Code of corporate practices applies to the following business enterprises:

- All companies with securities listed on the Johannesburg Stock Exchange (JSE) South Africa;
- Banks, financial and insurance entities as defined in the various legislation regulating the South African financial services sector;
- Public sector enterprises and agencies including any department of State or administration.

The King Report approaches the following main aspects:

- **Boards and Directors**. All companies should be headed by an effective Board, which can both lead and control the company. It should have executive and non-executive directors (including independent directors) to the extent appropriate. The concept of a unitary Board, consisting of executive directors, with their intimate knowledge of company's activities, remains the favourite Board structure for companies in South Africa. Management of business risk and the exercise of commercial judgment on behalf of the company can be positively enhanced by this mutual association and exchange of business experience and knowledge. The Board has a collective responsibility to provide effective corporate governance that involves a set of relationships between the management of the company, its Board, its shareowners and other relevant stakeholders.
- **Risk management.** The Board must decide the company's appetite or tolerance for risk – those risks it will take and those it will not take in the pursuit of its goals and objectives. The Board has the responsibility to ensure that the company has implemented an effective ongoing process to identify risk, to measure its potential impact against a broad set of assumptions and then to activate what is necessary to proactively manage these risks.
- **Internal audit.** The definition of internal audit as applied by the Institute of Internal Auditors is as follows: Internal audit is an independent, objective assurance and consulting activity designed to add value and improve an organisation's operations. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control and governance processes.
- **Integrated sustainability reporting.** In a corporate context, sustainability means that each enterprise must balance the need for long-term viability and prosperity – of the enterprise itself and the societies and environment upon which it relies for its ability to generate economic value – with the requirement for short-term competitiveness and financial gain. Compromising

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long-term prospects purely for short-term benefits is counter-productive. Failure to create this balance will prove potentially irreparable, and have far-reaching consequences, both for the enterprise and the societies and environment within which it operates. Social, ethical and environmental management practices provide a strong indicator of any company's intent in this respect.

- **Accounting and auditing.** The external audit provides an independent and objective check on the way in which the financial statements have been prepared and presented by the directors to all stakeholders. An annual audit is an essential part of the checks and balances required and it is one of the cornerstones of the corporate governance.
- **Compliance and enforcement.** All the principles embodied in a code on corporate governance are effective only if adequate remedies and sections exist to enforce compliance with those principles. Good principles of corporate governance often coincide with existing legal principles. The latter are those company law rules governing the duties of directors and senior managers in a legal entity. They also include various statutory duties imposed on directors and managers in terms of numerous legislative provisions.

The South-African context

Governance in any context reflects the value system of the society in which it operates. Accordingly, it would be pertinent to observe and to take account of the African worldview and culture in the context of governance of companies in South Africa, some aspects of which are set out as follows:

- Spirit collectiveness is prized over individualism.
- An inclination towards consensus rather than dissension helps to explain the loyalty of Africans towards their leadership.
- Humility and helpfulness to others is more important than criticism of them.
- African culture is non-discriminatory and does not promote prejudice. This explains the readiness with which Africans embrace reconciliation at political business levels.
- Co-existence with other people is highly valued. The essence of "ubuntu" (humanity) that cuts across Africa is based on the premise that you can be respected only because of your cordial co-existence with others.
- There is an inherent trust and belief in fairness of all human beings. This manifests itself in the predisposition towards brotherhood.
- Highly standards of morality are based on historical precedent.
- A hierarchical political ideology is based on an inclusive system of consultation at various levels.
- Perpetual optimism is due to strong belief in the existence of an omniscient, omnipresent superior being in the form of the creator of mankind.

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Monitoring and supervision across the entire spectrum of economic and commercial enterprise is impossible by any measure, and thus the recommendations contained in the Report remain self-regulatory. However, it would be in the self-interest of each company to take careful acknowledgement of the recommendations outlined in the Report and to adhere to these to the extent practicable and applicable.

6. CONCLUSION

In summary, successful governance in the world of the 21st century requires companies to adopt an inclusive and not an exclusive approach. The company must be open to institutional activism and there must be greater emphasis on the sustainable of non-financial aspects of its performance. Boards must apply the tests of fairness, accountability, responsibility and transparency to all actions and be accountable to the company but responsible towards the company's identified stakeholders. The correct balance between conformance with governance principles and performance in an entrepreneurial market economy must be found, but this will be specific to each company.

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