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# Creation and Protection of the Environment

**Summary**
Knowledge is a source of competitive advantage. In small enterprises there is simultaneous cooperation and competition. Knowledge management research is focused on large firms. Collaboration among small enterprises and with large firms is common. Information systems and information technology play a paramount role in coordinating and controlling joint ventures. Information system is a key tool in the management of knowledge sharing. This paper offer game-theoretic approach to answer the questions under cooperation and competition: what to share, with whom, when, under what conditions is paramount, and the role of information system in managing knowledge in small enterprises.

**Key words**
Knowledge management, information systems, Game-Theory

## 1. Introduction

In connection with the Tschernobyl nuclear power plant accident, accidents of tankers, ozone holes, or warming of the atmosphere, the condition of the environment is more and more frequently discussed. Since the issues assume a global nature and apply to all countries and all people in the world, the question of mankind´s survival is raised.

International treaties on the UNO grounds, as well as laws of individual countries are oriented to recourse and severe sanctioning of those who break the environmental protection regulations. However, there are no regulations to compensate for the already existing losses or impaired health of inhabitants caused by the environmental pollution. With respect to this, an emphasis starts to be placed on monitoring the condition of the environment, modelling of crisis situations, and developing protection systems in case of possible pollution or ecological catastrophes.

Until recently nature was capable of dealing with wastes originating in it. Man behaved as an integral part of nature. Industrial revolution and development of science and technology have brought about disruption of this equilibrium. Through burning forests, extraction of lumber, river and air pollution, and soil contamination, people are gradually disintegrating from nature, working against it. In reality, however, they are working against themselves.

There are some people who are concerned about the problems of creation and protection of the environment, and they actively engage in environmental protection. There are also some people who are not interested in the problem, and even those who consciously break the principles of environmental protection; however, there are no people whom these problems would not concern, or who would not be affected by consequences of this kind of approach.

## 2. Environmental Protection

A basic form of environmental protection is a rational utilisation of resources. Globally unjust drawing and distribution of resources widen the gap between advanced industrial and developing countries. For instance, the United States with merely 6% of world population consume 30% of energy and 40% of all resources [2]. It is neither realistic for developing countries to raise their standard of living to achieve that of the United States (disposable resources would not be sufficient), nor can advanced countries be expected to willingly give up their standard of living in favour of developing countries. In the area of environmental protection, it is necessary to focus on decreasing consumption, avoiding wastage of resources, and using alternative sources of energy.

Fossil and nuclear fuels belong to depletable sources of energy; consequently we should economize on them and search for opportunities of their replacement with other sources. The idea of atomic energy as an alternative to fossil fuels is unacceptable. Pollution, threat to safety, as well as carbon dioxide emissions connected with life cycle of nuclear power plants are a serious memento. We have to orient to renewable sources of energy, e.g. solar energy, geo-thermal energy, energy of wind, biogas, or soil energy, and avoid wasting energy in this way.

The greatest sources of environmental pollution are some kinds of industrial production and the power industry. However, air (atmosphere) or water pollution does not affect only its producer´s territory, its nature is global. Emissions from industrial enterprises, thermal power plants unfavourably

affect close as well as distant neighbours, frequently even the countries that pay a special attention to protection of nature. Pollution of a river in one country will result in ecological catastrophe in all the countries through which the river flows next. It is in particular by turning rivers into sewage and seas into cesspits that a potential source of livelihood needed in the case of continuing population explosion is eliminated.

Solid waste is not an exception either. Huge waste dumps, apart from taking up land, result in the leakage of impurities in the soil and water. Likewise, inceneration of ground waste is by no means problem free. Although burning waste enables us to save on land and energy (possibility of its use in heating), this activity also results in air pollution (often bigger than through burning coal in power plants).

The system of centrally planned economy and management as applied in our country in recent past as well as some chaotic decisions made at present have marked all areas of life. Centralisation of production, preference of quantitative indicators to qualitative ones, neglecting local conditions, excessive use of fertilizers and heavy mechanism in agriculture have contributed to deterioration of soil quality and in its contamination with harmful substances.

It is industrial production and the power industry that belong to "prominent" polluters of the environment. An inadequate structure of industrial production, utilised sources of energy and energy wasting have caused that practically all the areas of the environment are affected by the pollution (atmosphere, water and air).

Likewise, transport unfavourably affects the condition of the environment. Transportation of oil by tankers is a time bomb for all seaside countries and the sea itself. Lorry transport is poses a problem not only in terms of environmental pollution but also because of trafic collapse in places of main routes. A gradual replacement of rail transport with automobile transport, i.e. of railways with motorways, contributes to an increasing need for oil and consequently in environmental pollution. A hybrid motor (partly petrol, partly an electric one) or an electricity driven automobile is the right step in the right direction, as long as the electric energy used is produced from renewable sources, rather than nuclear or fossil fuels.

## 3. Creation of the Environment

Protection of the environment cannot be separated from its creation. In this context, issues related to quality of life are increasingly preferred to material welfare or quantitative growth. An intellectual aspect is getting to the forefront, implying a different value orientation, while the emphasis is laid on aesthetic and ethical aspects of life. On average, the quality of life is higher than in the past, but at the same time it surpasses our future expectations. Mankind faces the task (and duty towards next generations) to achieve global economic, social, and ecological equilibrium.

The quality of life is influenced, apart from other things, also by issues related to housing and standard of living. Concrete housing estates, their unfriendly, monotonous and uniform nature as well as the fact that they are insensitively located in the setting do no credit to the building industry. Public facilities of housing estates, services provided, and industrial buildings situated in residential areas fail to contribute to the quality of the environment.

Likewise, the impact of industrial revolution on urbanisation of the environment has been unfavourable. The need for labour force resulted in the concentration of people in large cities and thus in disproportionate distribution of population. Depopulation of countryside and overpopulation of cities are connected with all the problems of large cities: problems of dumps or landfills and their disposal, waste water treatment, supplying population with energy, environmental pollution, complex transport, etc.

However, concentration of population in cities means some loss of privacy or alienation. In the past agricultural production and manufacture enabled to perform most jobs at home or close to one´s home. People were born and died at home, amidst their closest relatives. Often the neighbours who lived at a distance of kilometres from one another used to be closer to one another than the inhabitants of apartment houses in present-day conurbations.

A lot of people would like to live in the country, or even in isolated settlements; until recently, however, this was impossible in view of the absence of jobs. Information and communication technologies are significantly changing the situation. They make it possible to work and educate oneself at home, to work in the field and communicate with colleagues or management. The time that managers and salesmen spend travelling in means of transport is becoming their working hours. All that is needed is a computer linked to the Internet, and man can become a master of one´s time.

Even when work at home (teleworking) is gaining ground in many countries, it is developing at a slower pace in Slovakia. A lot of firms are afraid that teleworking would constrain the management possibilities to control their employees and contribute to deterioration of work results. However, experience indicates that the very reverse is true. Teleworking helps eliminate stressful situations connected with travelling, harmonize family life with one´s job and use their professional knowledge and skills in practice. From the aspect of firms, employee performance is higher, labour costs are lower, there are savings on energy, and operating costs decrease. On the other hand, work performance and control of employees is more difficult to measure, which is a disadvantage. One of the main problems is a psychological aspect involved in mutual alienation of employees. Lack of informal talks and discussion may cause the absence of most recent information and the feeling of belonging.

The main advantage of teleworking is the possibility of harmonizing one´s hours of work and family life, the possibility of working when and how long one wants to. Most professional men have certainly come across with the following problem: when looking for a solution to some problem during their work time they were unable to come up with anything reasonable. It is only aftwerwards that they hit upon an idea and are able to work till late at night. From this point of view, teleworking offers better conditions for an effective utilisation of one´s disposable time.

Teleworking is asserted faster in smaller firms with a more flexible organisation structure. In this context, project organisation structures are frequently applied, which are characteristic of clear orientation to achieving a specific objective, limited time and a high flexibility. After the order has been executed, links disappear and another team or different links may be created.

The development of software through virtual teams of researchers enables to bridge time bands, save jobs, and significantly shorten the problem-solving period. International researcher teams make it possible for one team group to have a rest at the time when the other group is working (time zones) and lengthen the software development cycle to twenty-four hours. A newly developed code and documentation is distributed electronically via the Internet, and management activity is reduced to merely coordinating the work of software workers.

Teleworking, however, cannot be reduced to work at home. Apart from the possibility of working at random time, it is characteristic of the possibility of working at random place.

Many activities, e.g. architectural activity, often require peace and quiet and individual approach, on the other hand, also communication with colleagues and acccess to database centres. This seeming paradox may be resolved by means of teleworking. An architect who sets his studio in his own flat or house may perform a part of his work in a project organisation (meetings, creative discussions), part at home (his own studio), and part on the ground where the object is to be located.

Nowadays architects quite often use mobile graphical workplaces arranged in a caravan or a car. A designer moves over to the place of a building´s realisation and may consider specificities of a potential locality of the building in a design. By means of communication infrastructure (e.g. through a micro-wave connection) the designer may be in direct contact with his or her colleagues or with sources of information.

Information and communication technologies create condition even for the very reverse extreme: the possibility of acquiring detailed spatial data on the localities of construction, without the necessity of being physically present at the building site, through geographical information systems (GIS). The assumption of achieving this is to secure unbiased and relevant information on potential place of their realisation. A sensitive putting buildings/objects in the setting and their architectural project significantly influence the condition of the environment. The building of information systems and making them accessible via communication infrastructure enable designers to acquire recent information from any place, in a required form (text, graphics, sound, or other) and at a random time.

In order to be able to take into consideration specific features of potential localities of the construction, the designer needs information on existing or currently prepared objects at the place of putting the building in the setting, character of the ground, or hydrological and climatic conditions. Apart from that, the designer has to have access to geodesic and cartographic information, to data on soil conditions and the infrastructure, and to a lot of other information related to designing (geological information, real estate records, and the like). Apart from this, designers of industrial objects have to consider regulations related to the environment and needs of production process (transport, flow of material, staffing, sources of raw materials and the like).

In the past there were efforts made to build a comprehensive information system for the needs

of designing at a single place. These efforts ran against limited possibilities of the then accessible computers in terms of processor performance and memory capacities as well as the absence of quality communication infrastructure. Present-day supercomputers and parallel systems do not involve these constraints, in spite of it distributed database systems are preferred, which are based on the integration of territorially scattered and closely specialised databases through communication infrastructure. Advantages of this solution include achieving a higher expertise on the part of designers of applications, higher reliability and security of database, processing and responsibility for accurate data from the centre to the places of their origin and storage.

Information technologies play a highly important role also in environmental protection. A quality information system related to the environment facilitates the protection of the environment. Knowledge, understanding and anticipation of the amount, kind and structure of environmental pollution play a crucial role in identifying the right strategy of the battle against environmental pollution. The latter is a basis for monitoring and protection systems developed for the needs of preventing natural disasters (fires, floods) and accidents (e.g. in dams, nuclear power stations, chemical plants, etc.).

Detailed, space-oriented, factual data on the location of industrial enterprises, sources of energy and facilities, dangerous operations, nuclear power stations, and buildings of strategic importance, together with the procedures in case various ecological catastrophes or accidents, as well as information on unfavourable impacts on the environment, which are identified by measuring, monitoring or through surveillance, constitute a decisive component of protection systems. A well-trained personnel, adequate equipment and a coordinated approach, along with a quality information system are basic conditions of preventing or minimising the consequences of extraordinary events indicated.

A mutual integration of various security forces (army, police, and firemen, and task forces) through information systems, along with the access to sources of information and a quality information support, are therefore wholly justified requirements and conditions for building a quality system of protection.

In terms of readiness to deal with these situations, an important role is played by various simulation models, decision-making methods and expert systems, which offer model solutions to potential accidents or ecological disasters. It is better to simulate these situations on a computer than obtain experience on the basis or actual events, statistics on the condition of health of the population affected by these events, or casualties of accidents.

## 4. Support of Decision-Making Processes

Improvements of decision-making activity on investments and methods of their realisation are crucial conditions for a proportionate growth of cities, municipalities and housing.

Another important requirement is that the committee has to be composed of the best experts in each area of evaluation. In competitive tenders quite often even an excellent project hardly ever sees its realization, because only the best, i.e. winning, project is realized. It is necessary to create conditions for improving decision-making processes in order to select the best project in terms of accessible unbiased information on potential localities of construction and environmental needs. Investment activity is a major interference in the environment; consequently, potential negative impacts of proposals submitted have to be always well-considered and the ways of their minimization have to be searched for.

An example is close at hand. Slovakia´s metropolis is hopelessly fighting with traffic collapses at each minor traffic accident on its bridges or access roads to them. Solution to these problems is being searched for in the construction of other two bridges. It is common knowledge nowadays that a newly built "Košická" Bridge is not going to solve the traffic problems in Bratislava. At the same time, however, the traffic problem may lie in the initial decision on pulling lorry traffic in the city rather than in in a small capacity of bridges. Possibly, a tunnel below Koliba (a part of Bratislava) would eliminate a substantial part of the lorry traffic (towards the Czech Republic) from Bratislava´s area. The problem may also result from a wrong philosophy of traffic, an isolated approach to its solution, failure to view the conditions in their interrelations. For each decision it is necessary to assess possible alternatives/variants of the solution, apply multicriterial proposal evaluation, select the most suitable solution (project), and support it with justification. This is, after all, the structure of every creative activity, despite the fact that one, as a rule, fails to realise its internal composition.

Evaluation of investment projects is a classic problem of group evaluation and multi-criterial decision making. Each expert group member, while

assessing alternatives, tends to prefer the criterion that is closest to his or her profession and evaluates the project accordingly. Separate alternative solutions would probably be rated differently even when evaluated by the same expert. Therefore subjective evaluations made by experts need to be objectivised and the best solution has to be chosen on the basis of systemic approach .

Every option implies supressing other options, that is why it has to be well-considered and aequately justified. Every decision eliminating wrong past decisions generates a series of other decisions and possible approaches, connected with increased effort and costs (determined by previous decisions), which need not have been incurred in case of quality initial decision. For this reason, it is necessary to improve our decisions by applying decision-making support methods.

There are numerous methods based on the Delphi Method, factor analysis, valua analysis, fuzzy sets, decision-making trees or on simulation models. The present method is one of the possible approaches to the support of decision-making processes in the creation and protection of the environment.

One of the possible approaches to solving this problem is to modify individual evaluations made by specialists on the basis of knowledge and experience of experts, importance of evaluation criteria, as well as levels of experts´competence to give opinions on separate criteria. In the next part of the paper, multi-criterial method of target analysis [4], modified for the needs of evaluating alternative solutions to the projects [6] will be described.

The evaluation itself is preceded by the selection of criteria to be used in assessment of projects and the selection of experts who will evaluate the projects. Even though the method of expert exploration is based on the interdisciplinary composition of the committee and selection, if possible, the greatest experts in a given area, it need not necessarily safeguard an unbiased (objective) evaluation. In fact, specialists are known to be inclined to prefer their closely speciliazed standpoints to other views. An inadequate composition of the committee (e.g. prevailing number of specialists in some area) might determine results of evaluation well in advance.

An important requirement is that the committee be made up of the best professionals for each area of evaluation. Most tenders are based on the pre-requisite of physical presence of experts in a given time and at a given place. This kind of approach has some drawbacks, namely many experts may be unable to turn up on a particular day. The present method is based on an electronic discussion group and offline communication, i.e. experts may evaluate proposals whenever and wherever they like to. In this way it is possible to acquire the best experts in a given area (including those from abroad) to perform the evaluation, on condition they wish to participate and have the time available. The method is based on possible rectification of initial evaluation, while the evaluation takes place in several rounds and subsequent discussion. In this way it is possible to work one´s way iterativelly to a better solution than in case of one-round evaluation. This does not mean however experts are going to influence each other; instead, it offers the option to re-assess one´s decision after some time. Should the evaluation given by some expert differ considerably a moderator (anchor person) may invite the expert to give reasons for the evaluation. A differing idea should not at all times be ignored: sometimes it may indicate the expert concerned knows about the problem more than the others or has more information on the subject. Access to information stored in databases is another advantage of this approach. This option often does not exist if the evaluation is performed on the basis of physical presence in committees as a pre-requisite (in view of shortage of time). However, free decision making requires true information.

A frequent reasoning in favour of committee decision making is based on a possible leakage of information before results are announced. Apart from the fact that communication may be encrypted and credibility of experts may be confirmed with electronic signature, we have to realize creation and protection of the environment are public affairs. No properly operating system can do without feedback; consequently, along with specialist opinion also opinions of citizens and the public opinion (the media) have to be considered when evaluating environmental proposals. Results of evaluation (while anonymity of experts is preserved) may be posted on the Internet and modified on the basis of public discussion.

Objectivisation of evaluations made by separate experts is based on the modification of individual evaluations by specialists on the basis of professional knowledge and practical experience, importance of evaluation criteria, as well as the degrees of experts´ competence to comment on each criterion.

The points for an expert´s relevant experience, education and degree of competence, denoting the expert´s capability to comment on separate criteria

are used to calculate his or her competence weight $VE_k$ :

$$VE_k = (P_k + V_k).\frac{\sum_j \sum_{m_j} SK_{j,k,m_j}}{\sum_j \sum_{m_j} 1}$$

where $V_k$ denotes points assigned to experts for education; $P_k$ for practical experience, and $SK_{j\,k\,mj}$ denotes competence values for each criterion, representing experts´capability of commenting on separate criteria.

Criteria weights $VK_{j,k,m_j}$ denote *k-th* expert´s opinion on the importance of individual criteria, and thus also on the importance of evaluating these criteria. If the expert has at least a minimum competence to comment on some criterion ($SK_{j,k,m_j} > 1$) there is a ground for requiring to consider the evaluation of projects in points assigned by the expert according to a given criterion by the greater weight the higher is the weight of this criterion given by the expert ($VK_{j,k,m_j}$). If the expert is not competent to comment on the given criterion ($SK_{j,k,m_j} = 1$), the weight of the evaluation in points assigned by this expert according to this criterion will not depend on the weight specified by the expert, and the weight shall be assigned value 1. If, on the contrary, the expert has the highest competence to comment on the given criterion ($SK_{j,k,m_j} = 5$), evaluation in points by this expert shall be weighted by the exact weight of this criterion attributed by this expert.

It is obvious that the sought-for (modified) weight of project evaluation in points according to some criterion will depend on the importance of this criterion as given by the expert, as well as on the degree of the expert´s competence for this criterion. Criteria used for project evaluation may be grouped into blocks, while related criteria are usually grouped in one block. Consequently, the next data to be specified include: names of blocks and criteria that belong to a block concerned. By means of the weight of block ($VB_j$) an organization expresses the priority of some group of criteria and their importance in terms of planned objectives to be achieved through evaluation. Undoubtedly, these are the very criteria that will affect the objectivity of evaluation in some significant way.

A modified value of the $m_j$-th criterion given by the *k*-th expert in the *j*-th block is determined from the following relation:

$$VHC_{j,k,m_j} = \frac{1}{4}(VK_{j,k,m_j}.SK_{j,k,m_j} - (VK_{j,k,m_j} + SK_{j,k,m_j} - 5))$$

Evaluations in points assigned by the *k*-th expert to the *i*-th project on the basis of separate criteria and using modified weight criteria may be applied to calculate an aggregate evaluation of the *i*-th project from the *k*-th expert´s point of view, in grouping by block of criteria :

$$UHC_{i,j,k} = \frac{\sum_{m_j} HC_{i,j,k,m_j}.VHC_{j,k,m_j}}{\sum_{m_j} VHC_{j,k,m_j}}$$

Mean point value of the *i*-th project in the *j*-th block of criteria is then calculated by means of weighting $UHC_{i,j,k}$ values by competence degrees of experts $VE_k$ as calculated at the beginning :

$$SHC_{i,j} = \frac{\sum_k VE_k.UHC_{i,j,k}}{\sum_k VE_k}$$

In conclusion, mean point value of the *i*-th project is calculated by means of calculating $SHC_{i,j}$ mean value weighted by the weights of $VB_j$ blocks of criteria:

$$USHC_i = \frac{\sum_j VB_j.SHC_{i,j}}{\sum_j VB_j}$$

Afterwards, projects may be arranged in succession by $USHC_j$ values concerned, while the order may be made by separate blocks of criteria (by means of $SHC_{i,j}$).

The method described in [4] enables to assign weights of blocks by experts and competence weight by an expert on the basis of self-assessment (sources of information), or determine the order of projects with regard to testing invariables (number of recommendations/ refusals). However, these options are not relevant in terms of the needs of the application presented.

Variables used and their permissible values are given in Table 1:

| Symbol | Permissible values | Description |
|---|---|---|
| $P_k$ | 1, 2, 3, 4 | Point for the *k*-th expert´s experience |
| $V_k$ | 1, 2, 3, 4, 5 | Points for the *k*-th expert´s education |
| $VB_j$ | 1, 2, 3, 4, 5 | Centrally assigned weight of the *j*-th block of criteria |
| $SK_{j,k,m_j}$ | 1, 2, 3, 4, 5 | Degree of the *k*-th expert´s competence concerning the *m*-th criterion in the *j*-th block |
| $VE_k$ | <2,45> | Competence weight of the *k*-th expert |
| $VK_{j,k,m_j}$ | 1, 2, 3, 4, 5 | Importance of the $m_j$-th criterion in the *j*-th block from the point of view of the *k*-th expert |
| $VHC_{j,k,m_j}$ | <1, 5> | Modified value of the $m_j$-th criterion the j-th block from the point of view of the *k*-th expert |
| $HC_{i,j,k,m_j}$ | 1, 2, 3, 4, 5 | evaluation in points by the *k*-th expert of the *i*-th project according to $m_j$-th criterion in the in the *j*-th block |
| $UHC_{ij,k}$ | <1, 5> | Evaluation of the *i*-th project from the point of view of *k*-th expert, in evaluation according to the *j*-th block of criteria |
| $SHC_{ij}$ | <1, 5> | Mean point value of the *i*-th project in the *j*-th block of criteria |

Table 1. Variables Used and Their Permissible Values

## 5. Conclusion

Creation and protection of the environment constitutes a comprehensive process connected practically with all areas of human activity. Its nature is sectoral and interdisciplinary, and so it cannot be secured at the level of a single province or ministerial department, industry or even country. A global nature of the environment necessitates to solve these problems in interrelations, on the basis of cooperation between professionals from various areas of economic and social life.

Decision making is, in its essence, always a subjective process, depending on a management entity (person, committee, body). Therefore, it is suitable to objectivise these decisions by means of exact methods. There are several multi-criterial decision-making methods specialised in optimisation of decision making or partial decision-making stages. These methods are designed or modified in various ways, subject to the situation of executing the decision (under certainty, risk, or uncertainty). A decision depends on the situation, composition of evaluation and decision-making participants, on the method or possibility of measuring a risk or options of solution, and, obviously, on the time available to carry out the decision.

It is necessary to avoid rash solutions, which may be arrived at when we are pressed for time or when we lack adequate information. We should never be satisfied with the first solution that we come up with. Neither being pressed for time may be an excuse for this kind of approach. We have to work out alternative solutions and select the optimum one. It is only by chance that a single solution concides with the optimum solution.

## References


1. Fiala, J. (2002), Modelování a analýza produkčním systému. (Modelling and Analysis of Production Systems), Professional Publishing, Praha.
2. Charvát, J. (1974), Člověk a jeho svět (Man and His World). Avicennum, Praha.
3. Mlinarovič, V., Hozlár, E. (1993), Viackriteriálne rozhodovanie (Multi-criterial Decision Making). ES EU, Bratislava.
4. Križo, J. et al (1975), Redukčná systematická analýza cieľov (Systematic Reduction Analysis of Objectives). ÚAK, Bratislava.
5. Závodný, P. (2001), Počítačové siete a distribuované spracovanie dát (Computer Networks and Distributed Data Processing). SPRINT, Bratislava.
6. Závodný, P. (1982), Model komplexného hodnotenia variantných riešení projektov (Model of Comprehensive Variant Project Solutions). ŠPTÚ, Bratislava.
7. Závodný, P. (1993), Príspevok k riešeniu automatizácie tvorby a ochrany životného prostredia (Contribution to Solving the Creation and Protection of the Environment), University of Economics, Bratislava.



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