

# The Risk Evaluation Expert System of World EXPO 1996

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In this paper an expert system is presented for the evaluation of potential risk factors of World Exposition organised in the year 1996 in Budapest.

The system was developed under a contract with the World Expo Office in Budapest during 1991. The experts engaged by the Expo Office defined eight different categories of potential risk factors containing about 180 concrete risk elements. As traditional decision support approaches and risk analysis methods were not applicable, an expert system was built to handle the problem in its complexity. A special method was also developed to score different alternatives by the use of demons.

## Introduction

In December 1989 the Bureau International des Expositions (BIE) accepted the joint letter of intent of the Austrian and Hungarian government declaring their wish to hold a world exposition in Budapest and Vienna in 1995.

The proposed theme of the world exposition was "Bridges to the Future". The slogan represented the necessity of cooperation between East and West.

Political changes in Eastern Europe and so in Hungary made the theme to be outworn, the strict political difference between the two parts of Europe disappeared.

A long, mainly political debate started in Hungary about the necessity of a World Expo in Hungary in its recent political and economic situation.

Meantime in May 1991 a referendum in Vienna voted against the organisation of an Expo in Vienna.

The new situation forced the Hungarian government to revise the decision on the organization of an EXPO in Budapest and its timing.

Finally, in December 1991, the Hungarian parliament and the government decided to change the theme and the concept of the EXPO and to postpone it to 1996. One of the main arguments was that in 1996 there will be the 1100th anniversary of the existence of the Hungarian state.

Based on the new concept, Hungary will organize a decentralized EXPO with many official sites all over the country but with one large central exposition area in Budapest. It would be the first World Expo with several official sites.

The basic project in Budapest involves 36 hectares of area with 60,000 m<sup>2</sup> exhibition pavilions and approximately 65,000 m<sup>2</sup> of buildings for other use.

Beside the basic project, in the neighbourhood of the EXPO, a new 200 ha city centre is to be built with 445,000 m<sup>2</sup> of floor space. This centre includes

- convention centre (40,000 m<sup>2</sup>)
- international trade centre (100,000 m<sup>2</sup>)
- shopping centre (15,000 m<sup>2</sup>)
- office buildings (75,000 m<sup>2</sup>)
- hotels and catering establishments (101,000 m<sup>2</sup>)
- telecommunication and information technology centre
- technology park

General improvement of the infrastructure is a precondition of a successful EXPO. This improvement includes among others:

- motorway connection between Vienna and Budapest
- construction of the Budapest inner ring
- construction of the inner parts of highways M5 and M6.
- construction of a new bridge over the Danube
- modernization of the Budapest-Hegyeshalom railway line
- modernization and development of the existing shipping quays
- modernization of Terminal 1 and Terminal 2 of Budapest Ferihegy Airport
- realization of a telecommunication and information system providing the most up-to-date services at the sites of the World Expo
- significant increase in hotel capacity for Budapest (8-12,000 bed)
- establishing and operating a new hospital

The estimated total cost of the basic program was about 2 billion US\$.

Related to the preparatory activities of the 1996 World Expo, the most often used word was **risk**.

The World Expo Office decided to finance a study made by several experts in various fields. The Budapest University of Economic Sciences was requested to control and summarize the activities of the experts.

The experts defined the following eight categories of risk: political, economic, financial, technical, operational, legal, organizational and others. The list of all possible risks contained 179 elements.

The experts agreed that the classical decision support systems and risk evaluation methods were not adequate to handle the problems related to the EXPO'96. For certain problems these kind of methods could be useful, but to the overall risk due to the particular decisions could be possible to evaluate only with an expert system (Hayes-Rooth and al. 1983, Waterman 1986).

## The Risk of the EXPO'96

The experts defined 179 individual risk factors within eight categories as it was mentioned previously. Definition of rules describing the relations amongst the elementary risk factors that was the initial point of a knowledge based system focusing on risk management. The different risk categories can be explained as follows.

### The Risk Categories

The political risk factors include refugee problem, political changes in Central and Eastern European region, political cooperation between municipalities and the central government, particular interests of political parties, differences between Budapest and the countryside, priorities of cultural and economic objectives, etc.

The economic, financial risk arose from the timing of the event, lack of financial sources, inadequate (under) estimation of the development costs, inappropriate estimation of costs and benefits, bad cooperation between the national and foreign entrepreneurs, less visitors, large number of poor visitors, high risk of creditors, weakening economic perspective of the country, etc.

The technical risk is associated with the risk of design, cooperation with the authorities, lack of infrastructure, ecological risk, energy supply, participation of the national industry, connecting national and international standards, quality problems, short time for the realization.

The operational risk comes from inexperienced organizers, less practiced marketing companies, ecological problems, misuse of equipment, bad infrastructure (e.g. crowd), accidents, terrorists.

The legal risk is based on an ineffective regulation, bureaucracy, intensive international cooperation, undefined local and central governmental hierarchy.

The organizational risk is associated with a coordination, indefinite concept, philosophy of the EXPO, lack of the experience in the management of large projects, contradictions between the capital and the countryside.

The above mentioned risk factors support a broader interpretation of risk. A more specific interpretation of risk, associated with investment

projects. Estimates of the probability of future costs and benefits, focusing primarily on financial data: impacts of other factors could be expressed only in limited way.

In connection with the EXPO, a wider interpretation of risk is necessary. Financial point of view (economic risk) might be incorrect, since the EXPO is not a plain investment, but a coordinated sequence of events in several sites in a large time interval.

### Handling the Risk

In our case the well known methods such as decision tree analysis, utility function are not appropriate. Of course, in some aspects these methods are very useful, and after the decision the standard project management methods could be applied, but according to our knowledge there is no integrative (quantitative) model to support a decision to organize an EXPO or not. Again, how one can handle the risk in this case? Our procedure, briefly, is based on grouping the risk factors and looking for logical links among the groups.

According to the decision theory risk factors can be characterized as **technical, political and structural interconnections**.

The technical aspect of the risk factors means that there is no sufficient information about the consequences of our decisions, the environment. This kind of risk can be decreased by using models, forecasts, input-output analysis, etc.

The political feature of the risk factors is expressed by a hierarchycal scale of values. Decisions are motivated by contradicting priorities, objectives, interests. Handling the political risk assumes the good articulation of objectives, interests. Scenario-analysis, background studies of the decision situation, decision makers themselves can give useful hints.

Structural interconnection is also a source of uncertainty, since the decision problems cannot be always isolated, decomposed to the desired extent. Separated problems can be handled, but all the connecting relations and their dynamic connections also must be controlled. The decision depends on how deeply the factors and their effects were investigated, whether the best solution methods had been found.

The most important part of the risk management in connection with the EXPO was handling the risk of the **state budget**.

### The Risk of the State Budget

BIE expected the financial guarantee of the Hungarian government. The problem of guarantee was, that although the planned balance of costs and revenues would be zero, the risk of the budget did not change, because it depended on low probability events: in some cases it was a money back guarantee. It means, the most unwanted events have to be taken also into consideration.

The direct budgetary liability concerned the preparation of the territory, development of the infrastructure. There are two sources of risk related to the budget:

- the actual expenditures are higher than the calculated and/or
- the calculated revenue is less than the expected

According to the practice, a 30% overdraft of costs was quite likely considering the level of organization and the technological level. While the over-expenditure on entrepreneurial level could be compensated by business conform methods, in case of government investments the extra cost should be paid only from the budget.

Due to the experts' opinion concessions also need significant contribution from the budget. If the concession fails, the whole cost should be paid by the budget. On the revenue side the uncertainty of the EXPO revenues is a risk factor. The primary reasons of less revenue are less visitors and/or less expenditure.

According to the most pessimistic calculation the state guarantee of the EXPO could be covered with 57 billion Forints. In the best case this figure was 25 billion (1 US\$ = 80 Ft).

In the moment of the decision the amount is invariant to the duration, the topic and the sites of the EXPO. The proposal concerns an event-oriented EXPO. An EXPO on a larger scale would cause much more significant multiplier effects, the overall profit would be much greater. With a larger EXPO the liabilities of the budget would remain the same, but the risk would grow up. From this point of view a constrained EXPO is the only reality.

A diffused organization at the same time gives the opportunity to spread the risk over the country.

An organic version of development can also be a real alternative. This is to start a smaller, state guaranteed EXPO, and all the augmentations are organized on an entrepreneurial basis. All the real estate development, infrastructure development gives the opportunity to realize more revenues, still the risk of the budget remains unchanged.

### The Expert System

The EXPO'96 risk evaluation expert system consists of about 130 rules expressing the effects and relations of different risk elements in an appropriate hierarchy. To different alternatives different risk values are assigned which increase or decrease the risk of the organization of a successful EXPO.

### The Tools Used

To implement the expert system the ALLEX PLUS expert system shell was used (ALLEX PLUS User's Manual 1991). This is a commercially available expert system shell developed by MULTILOGIC (actually Applied Logic Laboratory) running under OS/2, UNIX and on Transputers. The selected version was the OS/2 version because the Program Office has an IBM PS/2 token ring network under OS/2. Another reason for selecting ALLEX PLUS was its ability to handle Hungarian characters. (Later an

English version was also developed for the representatives of the BIE.)

ALLEX PLUS is a frame based expert system shell with limited forward and complete backward reasoning capabilities. The system consists of a development environment, runtime system and knowledge base converter (for the use of external text editors). The expert systems developed with ALLEX PLUS have access to dBASE, ORACLE, ASCII databases and C, CS-PROLOG programs.

The simplicity of the knowledge representation language and the incremental development possibility makes the finishing of a working prototype very easy and short. The structure of ALLEX PLUS is shown in Figure 1.

ALLEX PLUS is written in CS-PROLOG (Communicating Sequential PROLOG) a commercially available parallel PROLOG language developed also by MULTILOGIC. Some parts of the risk evaluation expert system, mainly the graphical output, were programmed in CS-PROLOG (Futo and al. 1989).

### Programming in ALLEX PLUS

#### *Rule-based programming*

Domain experts have specialised knowledge about a specific problem domain. This knowledge and others taken from data can often be expressed as a set of IF-THEN rules, where IF part contains the preconditions and the THEN part contains the conclusion and actions. The rules are to be applied for different facts as a condition for

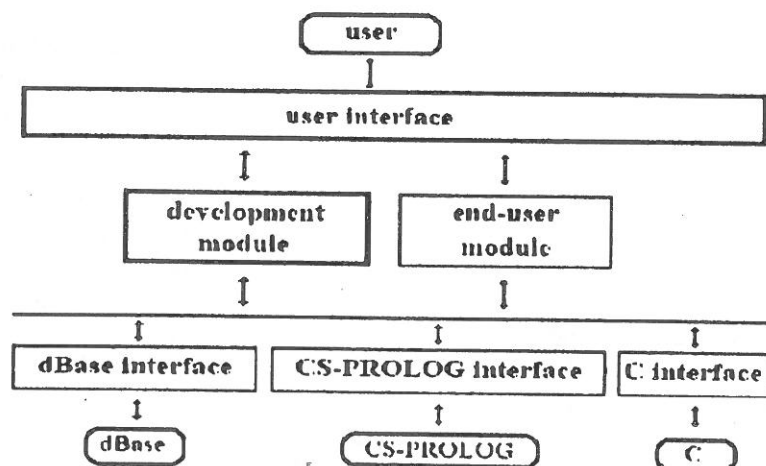


Figure 1: The ALLEX PLUS Expert System Shell

creating new facts as consequences. By using variables in rules ALLEX PLUS significantly reduces the number of rules needed.

### Frame-based programming

Related pieces of knowledge or data are grouped within one structure, a **frame**. A frame has any number of attributes known as **slots** which have **values**.

These values are often not stated explicitly, but **inherited** from other frames called ancestors. Frames can form complex hierarchy with multiple child-parent relations. Frames differ from records of procedural languages in the ability of inheritance, minimizing data replication. ALLEX PLUS also supports multiple inheritance.

### Logic programming

PROLOG is the most widely used logic programming language, and we chose to use ALLEX PLUS' implementation. It is based on the first order predicate calculus, has a built-in pattern matcher for solving symbolic problems and has a backtracking mechanism, searching automatically in a large solution space.

### The inference machine

An inference machine provides reasoning power by linking rules together into chains through matching the condition of one rule with the conclusion of another. This mechanism, the inference strategy, being the heart of an expert system can chain either forwards or backwards.

**Forward-chaining** is used when one starts from the knowledge base of facts, applies them to rules generating new facts which, by matching conditions, can trigger other rules etc.

In turn, **backward chaining**, i.e. goal driven reasoning is used when the value defined by the conclusion of a rule is needed. To get the appropriate value it is necessary to fulfil all the preconditions of the rule. The preconditions are matched against the conclusion part of other rules until only facts or user answers remain as preconditions.

The ALLEX representation language (ARL)

The ARL for rules, demons, frames is simple and English-like, making the knowledge base virtually self-documenting. It supports the following constructs:

- frames,
- demons,
- rules,
- metafacts,
- environment.

### Frames

Frames are a convenient formalism for representing classes of objects. The frame is an extension of the notion of record in conventional programming languages.

The equivalent of a field of a record is a slot of a frame. Thus a frame for a car may have the following slots:

```

frame car                                name of the frame
is_a vehicle .                            relations of the frame
is_ancestor_of volkswagen
    ford
    fiat
    type_of_vehicle
    has_wheel = 4
    carrying
    colour slots
    age
    power
  
```

Other frames may represent different types of cars like Volkswagen, Ford, etc. and a particular car is an **instance** of a Volkswagen, e.g.:

```

frame my_car
is_a volkswagen
    age = 10
    colour = purple
  
```

What makes frames a powerful formalism is not the similarity with records, but the possibility of **inheritance**.

Frames can be organized into a hierarchy with more general frames above less general ones. This hierarchy is expressed by two relations, **is\_a**

and its inverse relation **is\_ancestor\_of**. Inheritance works on values as well as on attributes, i.e. a general frame inherits the attributes or values of more general ones. Thus if one is interested in the number of wheels of my\_car which is\_a Volkswagen, whose ancestor is car, then the value of 4 (has\_wheel) will be inherited.

In a complex frame system inheritance is executed depending on the inheritance strategies. These strategies are the **breadth-first** and the **depth-first**. If a conflict occurs i.e. several ancestors exist, then the inheritance strategy determines which ancestor frame is to be considered. If the value of a slot is to be determined by inheritance, a so called **inheritance tree** is constructed having as root the frame to which the slot belongs to. This inheritance tree consists of the ancestors of the frame and of the ancestors of the ancestors etc. If the strategy is breadth-first then the ancestors of the nearest level are selected one after another in case of unsuccessful initial choice. In case of the depth-first strategy first the "leftmost" ancestor is selected to provide the value of the slot. If this ancestor cannot provide the right value, then the "leftmost" ancestor of this ancestor is selected, until the whole tree has been parsed. In ALLEX PLUS weight also could be assigned to frames to control the selection of frames on the same level in the inheritance tree.

There are special slots, the so-called **metaslots**, which provide meta-information referring to slots. These pieces of information are following: *type, protection, inheritance, input, default, range, question, source, menu.*

### Rules

The knowledge expressing logical connection between concepts and static objects (frames, attributes) can be represented by rules of **if-then** structure. These rules can also execute actions if their preconditions become true.

The general form of a rule is:

```
if      statement_1
       :
       :
and statement_n
then  action_1
       :
       :
and action_k
```

```
and      statement_n
then     frame ^ attribute is value
and action_1
       :
       :
and action_k
```

where *frame ^ attribute* means the "attribute of frame".

In rule definition symbolic variables (identifiers starting with upper-case letters) can be used as well which get their actual value by pattern matching during the inference. The scope of these variables is to make general application of rules possible, reducing the memory requirement of the knowledge base.

The following functions can be executed by actions:

- set and reset attribute values
- define and erase frames, attributes
- execute external programs (CS-PROLOG, C)
- I/O operations
- quit to the operation system
- suspend or abort consultation

### Demons

Before or after the change of the value of an attribute one can execute a sequence of actions with or without condition. These conditions and actions are associated with a structure called **demon**.

The general form of a demon is:

```
if      statement_1 or
       :
       :
and statement_n
then  action_1
       :
       :
and action_k

if      then
       :
       :
and
action_k
```

In the first case the sequence of actions is executed only if all the statements of the condition become true, however in the second case the actions are automatically executed.

As the rules, demons may also contain symbolic variables.

### Goals

The inference strategy needs a **goalsequence**, that is a sequence of  $frame\_n^{attribute\_1}$ , ...,  $frame\_n^{attribute\_n}$  attributes. The aim of a consultation (a dialogue between the user and the expert system) is to evaluate these attributes.

### Development interface

A knowledge engineer has numerous tools for developing expert systems, by editing, tracing and testing concrete knowledge bases.

### File operations

ALLEX PLUS can handle several types of files that are distinguished from each other by their extensions:

- knowledge base files,
- data files (attribute values),
- print files (written in ALLEX syntax),
- system files (written in binary form),
- CS-PROLOG files (external CS-PROLOG programs).

ALLEX PLUS can append the content of several knowledge base files, data files and CS-PROLOG files.

### Editors

For building a new knowledge base or modifying an existing one it is possible to use internal editors.

Special editors are used to define different types of knowledge base elements: frames, rules, demons, goals, strategies and end-user environment definitions.

These editors can be easily used for developing, the knowledge engineer has only to select from a menu or fill in a given form. The system checks the syntax of input elements. Screen footnotes describe possible actions in a given situation, furthermore help files give additional information.

### Data elements

It is possible to directly modify attribute values (to give a new value, delete the value of a given attribute or delete all attribute values), or list existing attribute values.

### Viewing knowledge base elements

Knowledge base elements can be displayed without editing them. The form displayed is similar to that of printing mode, it can easily be read by the user. It is possible to display the hierarchical system of frames (child and parent relations) as well as rule net (where *Rule\_1* and *Rule\_2* are connected if the conclusion part of *Rule\_1* matches one of the condition statements of *Rule\_2*) A part of the frame hierarchy and of the rule net of the risk evaluation expert system is shown in Figure 2. and Figure 3.

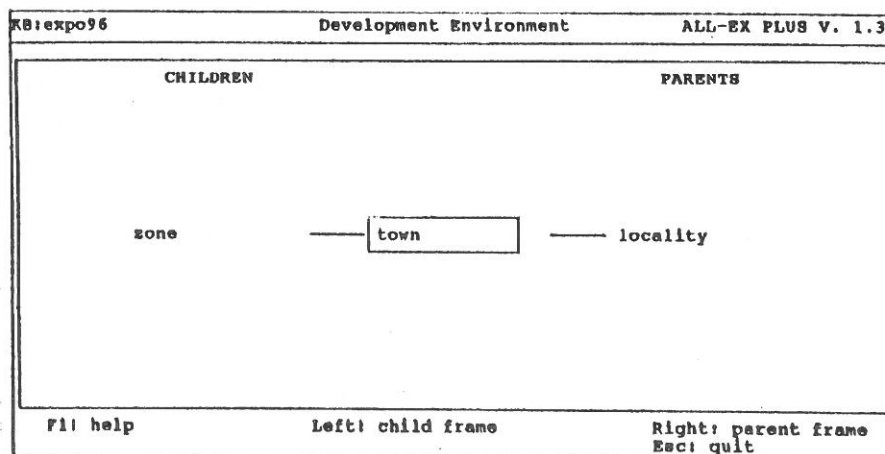


Figure 2: Frame hierarchy in ALLEX PLUS

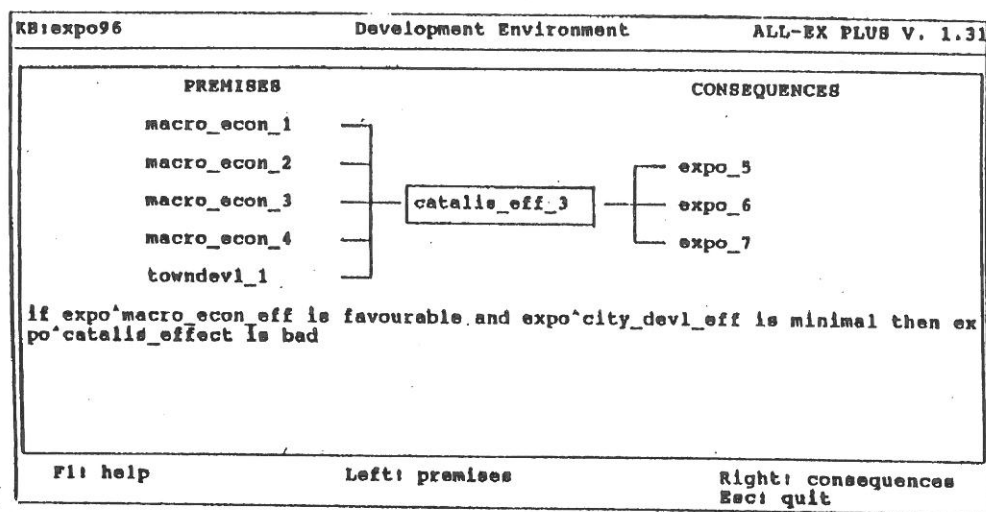


Figure 3: Rule net in ALLEX PLUS

### Consultation

The current knowledge base is used to run a consultation. If trace option is off, the system works as if it were the end-user system, i.e. it suspends the consultation only if a user answer is needed. In this case one can either answer the question at once and the inference mechanism continues the consultation, or issue special commands:

- Why (explains the reason of the question);
- Abort (aborts the consultation);
- or some of the commands appearing in the main menu, eg. View.

After executing the command (except Abort) the question reappears.

### Interactive trace mechanism

When setting the trace option on in the main menu, the consultation commands (Start, Restart, Evaluate, Whatif) will be executed with the Interactive Trace Mechanism (ITM). After starting the consultation the system changes to the trace screen, where it is possible to follow the inference process of ALLEX PLUS.

Breakpoints can be set for keywords, rules, demons or attributes. The user of the system enters in communication with ITM at each breakpoint. The trace screen is changed to the normal consultation screen only if a question is displayed. After answering the question the trace screen reappears.

### Restart consultations with modified user answers

After executing a consultation the user may want to change some of the original answers. Issuing the Whatif command, after deleting the selected user answers ALLEX PLUS restarts the consultation with the same knowledge base, using the previously given (and not deleted) user answers.

### Explanation of inference

After a successful execution of a consultation ALLEX PLUS can explain how a given attribute obtained its value. The examination of the inference tree can be done step-by-step.

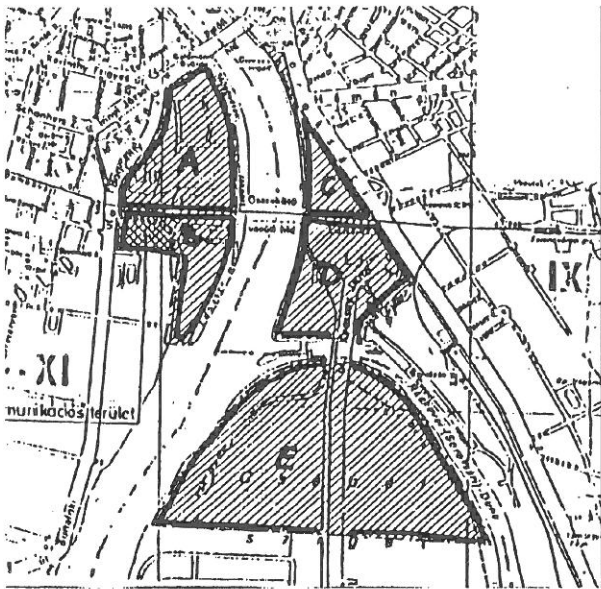
### The Risk Evaluation Expert System

The EXPO'96 risk evaluation expert system consists of about 80 frames organized in a three-level hierarchy and of about 130 rules defining the relations between the frames. About 80 demons were used to watch certain slot value changes.

### Basic considerations

The EXPO' 96 was planned to be located in the southern part of Budapest on both banks of the Danube. Six different combination of sites were defined. See Table 1. and Figure 4.





- A University city
- B Bay of Lagymanyos
- C Ferencvaros railway station
- D Ferencvaros
- E Csepel island

Figure 4: The EXPO sites in Budapest

Table 1: The sites of the EXPO

site no.	area 1.	area 2.
1	University city	Bay of Lagymanyos
2	Ferencvaros railway station	Ferencvaros
3	Ferencvaros	Csepel island
4	Csepel island	
5	University city	Ferencvaros railway station
6	Bay of Lagymanyos	Ferencvaros

The two main objections against the EXPO'96 were its cost and its negative environmental impacts.

The expected construction costs relative to the different sites are given in Table 2.

The environmental impact was expressed by rules related to the public transport, slop water handling and air pollution.

The actual situation on the selected sites is shown in Table 3.

Table 2: Expected construction costs

site no.	infrastructural cost K Ft/m <sup>2</sup>	building costs K Ft/m <sup>2</sup>
1	28.12	5.26
2	40.32	14.53
3	42.36	11.41
4	42.01	6.17
5	28.96	9.20
6	35.38	12.02

1 US\$ ~80 Ft

Table 3: Present environmental situation

site no.	public transport	slop water	air pollution
1	bad	unsolved	high
2	bad	unsolved	suportable
3	good	solved	suportable
4	good	solved	suportable
5	bad	unsolved	high
6	good	solved	suportable

A rule expressing the environmental impact is of the following form:

Label: environment\_effect\_1

Weight:0

if site\_alternative ^ type is T  
 and T ^ public\_transport is not bad  
 and T ^ slop\_water\_handling is solved  
 and T ^ air\_pollution is supportable  
 then site\_environment\_effect is positive

Originally three different themes were proposed for the EXPO'96:

- peaceful communication
- meeting of cultures
- global environment

The EXPO'96 could be organized in exposition-oriented or event-oriented ways.

Different themes and orientations are attractive in different ways and could be sponsored also in different ways. This fact was expressed with the use of several rules like the following:

Label: *sponsoring\_occasion\_1*

Weight: 0

if *expo ^ topics* is "peaceful communication"  
then *expo ^ sponsoring\_occasion* is good

Label: *sponsors\_1*

Weight: 0

if *expo ^ sponsoring\_occasion* is good  
and *expo ^ type* is "exposition oriented"  
then *expo ^ number\_of\_sponsors* is acceptable

To show a complete deduction line the following rules from the knowledge base could be given:

Label: *attractivity\_1*

Weight: 0

if *expo ^ expected\_no\_of\_visits* is high  
and *expo ^ working* is undisturbed  
and *expo ^ connected\_events* is successful  
and *expo ^ number\_of\_sponsors* is acceptable  
then *expo ^ attractivity* is high

Label: *expo\_5*

Weight: 0

if *expo ^ image* is good  
and *expo ^ multiplier\_effect* is not missing  
and *expo ^ financment* is ok  
and *expo ^ attractivity* is high  
and *expo ^ environmental\_effect* is positive  
then *expo ^ organisation* is successful

The quantitative qualification of the risk

The most important problem during the realisation of the risk evaluation expert system was the **classification of the results.**

We decided to use a scoring method to qualify different alternatives. The method was based on the use of demons.

Weights were assigned to a number of slot values, expressing risk factors. Depending on the user's answers and the deduced values the current risk parameter value was incremented or decremented by the corresponding weight. At the beginning the risk parameter is set to 1000. If the answer of the user or the value determined during the inference had a risk increasing / decreasing effect, the current value of the risk parameter is appropriately modified, that is if the risk increased the parameter value is decremented and

vica-versa. The risk factors could be asymmetrical, that is the existence or nonexistence of the same factor can decrease - increase the value of the risk parameter in a different way.

As it can be seen from the above mentioned scoring the higher the score of an alternative the lower is its risk.

Five categories were defined - the image of the EXPO, multiplier effect of the EXPO on the economy, financing, attractivity, environmental effects - as major categories by which the risk factors can be ranged.

The following tables show different weights for risk factors.

Table 4: Scores for the image of the EXPO

Image of the EXPO (starting value 100)	yes	no
Countries will have influence on central decisions	30	-25
Local authorities can mobilize local resources	25	-20
The coordination will be effective	40	-50

Table 5: Scores for financing the EXPO

Financing (starting value is 300)	yes	no
There is a state guarantee	100	-100
The external infrastructure exists	25	-25
The remaining time is not enough	-15	15
Lobbies are very strong	-10	10
Plans are not exact	-15	15
Plans are not executed as prescribed	-10	10
Legal frames are missing	-25	25
The internal political situation is unstable	-25	25
The structural change of the economy is slow	-25	25

Table 6: Scores for the attractiveness of the EXPO

Attractiveness (starting values 200)	yes	no
The infrastructure works appropriately	15	-15
Public security is good	10	-10
International situation is stable	25	-25
The staff is professional	10	-10
The theme of the EXPO is appropriate for sponsoring	20	-20
The cooperation between the capital and the countries is good	30	-30
The cooperation between the government and the municipalities is good	30	-30
The attractivity of other events exceeds the attractivity of the EXPO	-25	25
Visitor's costs are high	-10	10

Finally the **environmental effects**: starting value is 200, positive effect is 200, negative effect is -200.

A demon used to modify the current value of the risk parameter has the following form:

Label: d72

Weight: 0

Attribute : visitors ^ cost

Type : after

If visitors ^ cost is high

and expo ^ risk is ExpoRisk

and NewExpoRisk is ExpoRisk - 10

then set(expo ^ risk,NewExpoRisk)

The above demon definition means that demon d62 is watching for the slot value visitors'cost and if the system is deducing that the visitor's costs are high then the demon modifies the value of the expo ^ risk parameter by -10. Slot values with initial upper-case letter mean variables.

The rule defining the visitor's costs is:

Label: visitors\_costs\_2

Weight: 0

if region ^ living is expensive

and expo ^ ticket is expensive

and region ^ transport is expensive

then visitors ^ cost is high

Table 7. shows how the alternatives are ranked depending on the different scores.

Table 7: Quantitative summary of risk factors

The organisation of the EXPO is	
without any risk	1401 – 1800
not too risky	1301 – 1400
with acceptable risk	1001 – 1300
very risky	901 – 1000
not possible	0 – 900

### Calibration

The expert group spent a lot of time on the calibration of the system. Several alternatives were tried with expected scores and the weights and score limits were appropriately modified.

Theoretically the expert system implicitly contains more than 20.000 different alternatives.

During consultation the user can check the score (risk) of a given version. After each consultation it is possible to use the **What if** facility to see how the risk of the given version could be modified by giving different answers to the questions asked by the system.

### How the expert system was used

The expert system was delivered together with a report explaining the knowledge base and the basic assumptions. Some of the most important alternatives defined by the government commissioner of the EXPO were displayed.

An important result was that it was practically impossible to organise an EXPO in Budapest in 1996 without any considerable risk under the recent conditions. The best alternatives were “not too risky” and the most likely ones “with acceptable risk”.

## Conclusion

The paper described an expert system which was used by the World Expo Office to evaluate the risk of the organisation of EXPO'96 in Budapest Hungary.

Different slot values represented the appropriate risk factors, weights were assigned to the slot values and the different possible alternatives were stored with the use of demons.

Expert system methodology was selected for the risk evaluation of the EXPO'96 because of the complexity and uncertainty of preconditions. An interesting result of the use of the expert system was that no EXPO without significant risk could be organised in Budapest in 1996.

## Acknowledgement

We want to thank Dr. Etele Baráth former government commissioner of the EXPO, Enrique Grosser financial director of the EXPO Office, Péter Gauder technical director of the EXPO Office for their collaboration during the development of the expert system. Special thanks to Gábor Kőrösi for the development of the user interface.

## Remarks

The content of the EXPO-alternatives described in this paper is in accordance with the state of the

preparatory work completed during 1991 and at the beginning of 1992. After May 1992 the persons invoked in this work and the directives of the preparations have changed. This paper focuses mainly on the methodology of risk management and the use of the expert system on the example of the EXPO.

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