Risk Modeling in Plastics Processing for the Health System

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The paper concerns current engineering in plastics processing, the present day studies focusing on the rational solving of problems and on logical reasoning, on the usage of modern mathematical methods in leading and taking decisions, on the usage of instruments which have significantly changed and the development of business: computers, the internet, artificial intelligence. The practice uses engineering techniques by creating mathematical models. Appealing to scenarios ensures the improvement of decisions, involving answers on the improvement of quality and the rational usage of available human and financial resources. The research results are materialized through the development and effective use of a mathematical model in which the incoming data packets are obtained at a quantifiable levels of risk.

Keywords: plastics processing, risk modeling, decision scenarios.

In the industrial processing work of medical plastics, but not only, there is a basic element, namely the engineering techniques of decision taking. Many decrees and laws referring to safety and health work include risk evaluation. But, even without a legal request to make the evaluation, it is a good aspect because it allows the taking of efficient measures in order to improve productive activity, and the efficient usage of human and financial resources [1-4]. A loss function is established for any decision problem which establishes the loss associated to every adopted action consequence for each state of fact. Loss is often expressed in money form, but there are other establishing methods as well. Beside this, one can determine the risk function as a medium or an expected value of the loss, a definition implying probability functions. In the engineering context of the risk problem, the usage of the Monte Carlo simulation is made in order to evaluate the risk associated to the events of the analyzed system in uncertainty conditions.

Generally speaking, simulation techniques involve making a statistical–mathematical model. Such a simulation model must describe its functioning in the terms of the individual events of the analyzed system component [5-8].

The research applied in this domain has brought concrete results, allowing the creation of specific risk engineering decisions appliable in industrial systems, plastics processings, but it can extend its use to other areas as well.

Research methodology

In the industrial processing of the plastics domain, risk is obvious, being a combination of external and internal risk contributions [9, 10]. In the research and analysis program made at the level of industrial units, the known risks and their levels are summarized and presented in the fishbone diagrams of figure 1. There are 4 levels of external risk and 3 levels of internal risk. There are also 12 scenario versions for risk levels.

The dependence of damage estimated by risk scenarios. Concerning the scenarios about previous results, there are factors influencing the risk [11].

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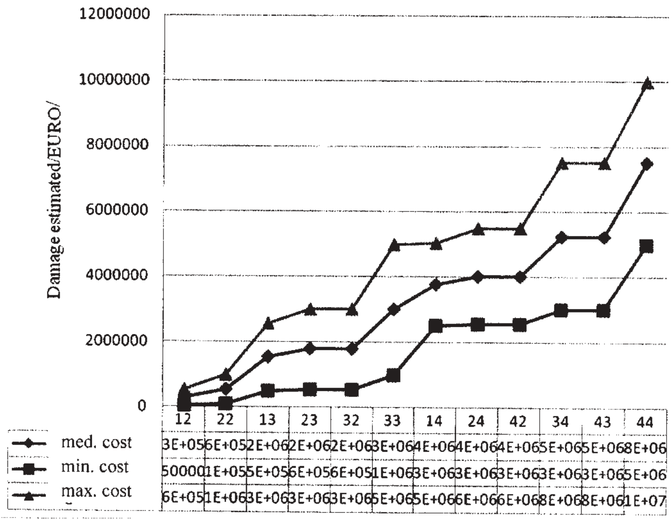

Fig.1.Risk levels

A risk modeling concept

In order to model risk 4, consequences have been taken into account as they appear at all risk levels:

-financial loss
-number of critical cases
-mass-media impact
-number of days in which activity is influenced

Risk level is determined through the relation:

$$\text{Risk level} = \text{Probability} \times \text{Impact (effect, consequences)} \qquad (1)$$

The probability expressed in five percentage intervals between 0 and 99.99% was adopted. Events having 100% probability were not taken into account because certainty does not need risk analysis.

The impact value is expressed on a scale of 0 to 4, corresponding to five levels of severity:

- 0-emergence of a zero impact event has no implication analyzed risks or consequences if they are not noticeable,
- 1 -a Grade 1 event with low consequences impact.
- 2 Grade 2 impact refers to noticeable consequences that may affect a project or activity,

Level	1	2	3	4	5
Probability	0% -19.99%	20% -39.99%	40% -59.99%	60% -79.99%	80% -99.99%

Table 1
THE ADOPTED RISK LEVELS AND THE PROBABILITY

Table 2
INPUT DATA

Nr. crt.	Financial losses	Injuries	Media	Acti-vity	Conse-quences
1	0.05	1	1	0	1
2	0.5	2	2	2	2
3	2.5	10	3	5	3
4	5	20	4	20	4
5	10	50	5	90	5
6	0.05	1	1	0	1
7	0.5	2	2	2	2
8	2.5	10	3	5	3
9	5	20	4	20	4
10	10	50	5	90	5
11	0.05	1	1	0	1
12	0.5	2	2	2	2
13	2.5	10	3	5	3
14	5	20	4	20	4
15	10	50	5	90	5
16	0.05	1	1	0	1
17	0.5	2	2	2	2
18	2.5	10	3	5	3
19	5	20	4	20	4
20	10	50	5	90	5
21	0.05	1	1	0	1
22	0.5	2	2	2	2
23	2.5	10	3	5	3
24	5	20	4	20	4
25	10	50	5	90	5

Table 3
EXAMPLE OF APPLICATION OF THE MODEL

For each risk indicator below, selecta value from the listand the likelihood that it happens			
Indicators	Selected	Indicators	Selected
The maximum financial lossesare estimated at.... EURO million	0.05	With probability	0.1
An estimated number of injuries of medium severity....injuries	2	With probability	0.5
On a scale of1 to 5, the impact inthe media wouldbe...	3	With probability	0.2
It is estimated that the work will be affected or suspended for a number of...days	20	With probability	0.5
The consequences (impact) will be at level	2	With probability	13%
The estimated risk in this scenario will be		**Very low**	

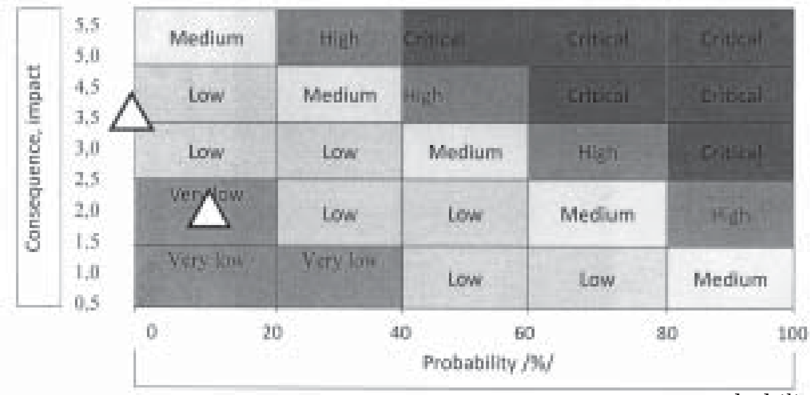

Table 4
LOCKING THE RISK MATRIX RESULT IMPOSED SCENARIO

- 3 - Grade 3 impacts are sufficiently serious and must be analyzed in detail,

- 4 grade 4 is suitable for the impacts of a disaster.

It was considered likely that the consequences happen, considering the modeling of risk assessment matrix, ie the risk classification of industrial plastics processing depending on the arising consequences. Ss multiple regression analysis resorted to taking as the dependent variable “ind_consequences” The independent variables are: ind_loss, ind_activity, ind_injuries, ind_media-impact. “Ind-injuries” refers to the impact on staff health and safety. The CENTURION Statgraphics program was used in conjunction with the developed calculation algorithm.

The financial loss can have value (in million) order: 0.05, 0.5, 2.5, 5, 10, corresponding to the 5 levels of consequences (1 – minimum, 5 - maximum). These values are associated with the probability that estimates will occur (between 0% and 100%). Also, if the value of the financial loss is different, loss is expressed as a percentage of the next highest value in the table. This percentage represents the probability of a financial loss.

The number of injuries as a medium severity indicator has the values of 1, 2, 10, 20, 50, corresponding to the 5 levels of consequences. These values are associated to a probability between 0% and 100%. If one estimates a different number of *injuries* medium severity, they are expressed as the percentage of the next highest value. This percentage represents the probability of the next highest value.

The *media impact* is evaluated on a scale of 1 to 5, where 1 is the lowest impact (up to an article in press), and 5 is the maximum impact (Press investigation that triggers investigations in upper forums). Again, there is the likelihood that such a media impact happens.

Generating risk consequences of an action is measured in the number of days in which the work unit is disrupted or interrupted. This number of days can have the values 0, 2, 5, 20 (equivalent to several weeks), 90 (equivalent to several months), depending on the seriousness of the consequences, associating them a probability of occurrence. If one estimates a different number of days, it is expressed as a percentage of the next predetermined unit, and the application proceeds with the likelihood of a default value.

As input data were used the values in table 2.

Based on data entry, was developed a regression model, the model explains 100% of consequences.

Based on the developed model, built algorithms for calculating the risk indicators are inserted and presumed

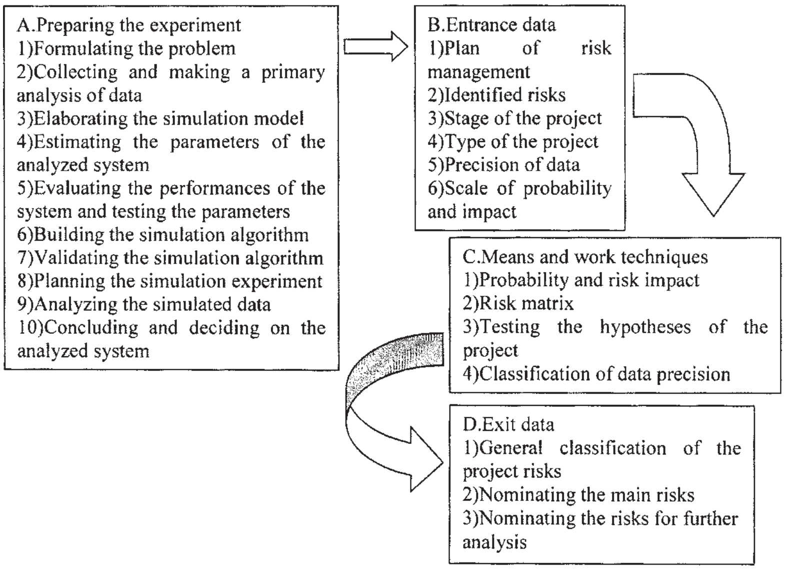

Fig. 2. The main steps in the risk assessment

levels, which will then be calculated as the risk of potential activities. We have to note that the consequences are rounded to the nearest integer calculations.

To calculate the probability that there is a certain result, one should do the following:

-to calculate the consequences for the other indicators of the affected levels of probability;

- to find the consequences at a normal level, for a level of probability unaffected by other indicators.

The likelihood of obtaining such consequences depends on the level and likelihood indicators of that body.

This methodology is used by the activity coordinator since before taking action it is necessary to discern the level of risk involved and to take appropriate actions. An example of this use is in table 3.

Automatically, a matrix associated risk is situated as a result imposed scenario (table 4).

Consequently, the accomplishment of a simulation experiment in the given domain is a complex process, developing during the main stages in figure 2.

Linked to the mathematical model developed and the positioning matrix risk level of the input data for a configuration scenario, one proceeds to setting up several scenarios by changing the logic of the input data until the risk is agreeable for policy coordination and the decision industrial unit.

Conclusions

Given the current concepts in risk engineering, there are involved abilities of program planning and statistic processing, the usage of information technology, the modeling and simulation of processes, accountancy and mathematics. Most important are the rational solving of problems and logical thinking, the usage of modern mathematical methods in the process of leading and taking decisions, the usage of instruments which have definitely changed the work of people with decision and the evolution of organizations in their business by fully utilizing the facilities offered by IT systems, the internet, the artificial intelligence. Organizations should pay attention to concepts and techniques, scientific tools and methods of organizing activities through projects. Increased efforts are noticed meant to set up the theoretical system engineering risks, expressed in the form of books, procedures, guidelines, studies, normative.

The analyzed research lines provide advantages for the coordinators of the employer due to:

-a better assessment of the resources (material, financial, human and informational),

-improving relations and satisfactions with partners and collaborators,

-shortening development stages, technological cycle milestones, diminishing of the research-development costs,

-the increase of the quality of the provided services,

-the increase of the satisfaction degree of partners,

-the output improvement,

-the more efficient correlation and coordination of activities,

-the increase of the satisfaction and stimulation degree of the employees,

-the increase of the capacity to apply changes inside the unit,

-the increase of the efficiency in the development of all the activities,

-an increased timeliness in decision making.

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