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Experimental and Simulated Research On Decision Making For The Reliability of Technological Systems

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Abstract: Starting from the observation that, at the end of the first decade of the XXI century, after a prolonged and traumatic transition to the pluralist democracy and market economy, Romania longer has to recover significant differences from the other Member States of the European Union, together with the acquiring and the implementation of the principles and practices of sustainable development in the context of globalization. With all the realized progress in the last years, it is a fact that Romania still has an economy based on intensive consumption of resources, a society and an administration still in searching of a unitary vision and a natural capital affected by the risk of some damages that may become irreversible. Excellence level of the technological systems reliability is the result of interactions oriented from the design level towards the technological systems exploitation, including the maintenance of the economic regime that generating savings and projected revenue.

Keywords: Process of production, Reliability, Analysis of the processing, Decisional analysis, Adopting the decision, Cost of production, Decisional methods and techniques.

JEL Classification: M11, M15, L61

Introduction

The main way to increase the resource productivity is the structural adjustment of the economy by increasing the specific share of the products, processes and activities which used a small amount of energy and material resources, but generates a high added value.

As the research direction, it can be started from the system performance analysis in the context of the imposed mission - to ensure achievement within a technological process of the following elements:

- ✓ Parts conform to the specifications;
- ✓ Compliance with time limits, respectively productivity;
- ✓ Compliance with the limits of cost.

In this regard, the operational capacity or effectiveness of a system (system effectiveness) is the ability to successfully perform a task in a given time when it operates under specified conditions. This property is dependent on both the system performance and reliability of its features. Industrial investment funds are linked by the perceived risks.

Method

The main descriptors that can take into account, when comparing the products and technological processes, refer to their quality, the advantages and shortcomings of existing conventional technologies, the quality - reliability correlation and the risk - quality – reliability one in the various operational technological systems and efficiency in a determined projection horizon.

Processing and interpretation of the experimental/simulated data

Numerous specific problems in the modern engineering find their solution after the analysis and numerical processing of the experimental data.

Statistical study of a population is realised by processing the obtained information from any number of items. Number of chosen items is called the selection volume. The larger the selection volume exists, the more real statistical processing results are.

In general, these values are presented in the form of correlation tables between the independent variables and a dependent variable by it. For example, in the two-dimensional case, if we denote by x the independent variable and the dependent variable y, in an expressed relationship of dependency there is a relation:

$$y = f(x), \tag{1}$$

n values determined experimentally, may be presented in the table form (Table 1).

Table 1. Presentation of the experimental values

x	x_1	x_2	x_3	...	x_i	...	x_{n-1}	x_n
y	y_1	y_2	y_4	...	y_i	...	y_{n-1}	y_n

Values

$x = x_1, x_2, ..., x_i, ..., x_n$ are called support points (nodes);

$y = y_1, y_2, ..., y_i, ..., y_n$ are called support values (nodal).

Handling the presented data in the table form is difficult and not suitable for further processing using the tools of mathematical analysis (derivation, integration, etc.).

Therefore, it is arisen the question of determining the mathematical expression of dependence (relation 1).

Appendix 1

Simulation reliability and nonfiabilităţii for Cp and Cpk values of indices between 0.8 and 1.4

Table 1: Simulated values of reliability indices Cp and Cpk values between 0.8 and 1.4

T	R1(T)	R2(T)	R3(T)	R4(T)
0	1.00000000	1.00000000	1.00000000	1.00000000
10	0.00006345	0.23904443	0.92219933	0.98421890
20	0.00000000	0.05714224	0.85045161	0.96868685
30	0.00000000	0.01365953	0.78428591	0.95339991
40	0.00000000	0.00326524	0.72326794	0.93835421
50	0.00000000	0.00078054	0.66699721	0.92354595
60	0.00000000	0.00018658	0.61510439	0.90897138
70	0.00000000	0.00004460	0.56724886	0.89462682
80	0.00000000	0.00001066	0.52311652	0.88050863

90	0.00000000	0.00000255	0.48241770	0.86661323
100	0.00000000	0.00000061	0.44488528	0.85293713
110	0.00000000	0.00000015	0.41027291	0.83947684
120	0.00000000	0.00000003	0.37835341	0.82622898
130	0.00000000	0.00000001	0.34891726	0.81319018
140	0.00000000	0.00000000	0.32177126	0.80035714
150	0.00000000	0.00000000	0.29673725	0.78772663
160	0.00000000	0.00000000	0.27365089	0.77529544
170	0.00000000	0.00000000	0.25236067	0.76306043
180	0.00000000	0.00000000	0.23272684	0.75101850
190	0.00000000	0.00000000	0.21462054	0.73916660
200	0.00000000	0.00000000	0.19792292	0.72750174
210	0.00000000	0.00000000	0.18252438	0.71602096
220	0.00000000	0.00000000	0.16832386	0.70472137
230	0.00000000	0.00000000	0.15522815	0.69360009
240	0.00000000	0.00000000	0.14315130	0.68265432
250	0.00000000	0.00000000	0.13201403	0.67188129
260	1.00000000	1.00000000	1.00000000	1.00000000
270	0.61149277	0.81219207	0.92219933	0.97141117
280	0.37392340	0.65965596	0.85045161	0.94363966

Table 1 (continued)

T	R1(T)	R2(T)	R3(T)	R4(T)
290	0.22865145	0.53576734	0.78428591	0.91666211
300	0.13981871	0.43514598	0.72326794	0.89045582
310	0.08549813	0.35342212	0.66699721	0.86499873
320	0.05228149	0.28704664	0.61510439	0.84026943
330	0.03196975	0.23313700	0.56724886	0.81624711
340	0.01954927	0.18935203	0.52311652	0.79291156
350	0.01195424	0.15379021	0.48241770	0.77024315
360	0.00730993	0.12490719	0.44488528	0.74822280
370	0.00446997	0.10144863	0.41027291	0.72683199
380	0.00273335	0.08239577	0.37835341	0.70605271
390	0.00167143	0.06692119	0.34891726	0.68586749
400	0.00102207	0.05435286	0.32177126	0.66625934
410	0.00062499	0.04414496	0.29673725	0.64721177
420	0.00038217	0.03585419	0.27365089	0.62870874
430	0.00023370	0.02912049	0.25236067	0.61073470
440	0.00014290	0.02365143	0.23272684	0.59327451

450	0.00008738	0.01920950	0.21462054	0.57631348
460	0.00005344	0.01560181	0.19792292	0.55983736
470	0.00003268	0.01267166	0.18252438	0.54383226
480	0.00001998	0.01029182	0.16832386	0.52828474
490	0.00001222	0.00835894	0.15522815	0.51318169
500	0.00000747	0.00678906	0.14315130	0.49851043
510	0.00000457	0.00551402	0.13201403	0.48425860
520	0.00000279	0.00447845	0.12174325	0.47041422
530	0.00000171	0.00363736	0.11227155	0.45696562
540	0.00000104	0.00295423	0.10353675	0.44390151
550	0.00000064	0.00239941	0.09548152	0.43121089
560	0.00000039	0.00194878	0.08805299	0.41888307
570	0.00000024	0.00158278	0.08120241	0.40690770
580	0.00000015	0.00128552	0.07488481	0.39527468
590	0.00000009	0.00104409	0.06905872	0.38397424
600	0.00000005	0.00084800	0.06368591	0.37299687
610	0.00000003	0.00068874	0.05873110	0.36233333
620	0.00000002	0.00055939	0.05416178	0.35197464
630	0.00000001	0.00045433	0.04994796	0.34191210
Table 1 (continued)				
T	R1(T)	R2(T)	R3(T)	R4(T)
640	0.00000001	0.00036901	0.04606197	0.33213723
650	0.00000000	0.00029970	0.04247832	0.32264182
660	0.00000000	0.00024342	0.03917348	0.31341787
670	0.00000000	0.00019770	0.03612576	0.30445762
680	0.00000000	0.00016057	0.03331515	0.29575353
690	0.00000000	0.00013041	0.03072321	0.28729828
700	0.00000000	0.00010592	0.02833292	0.27908476
710	0.00000000	0.00008603	0.02612860	0.27110606
720	0.00000000	0.00006987	0.02409578	0.26335545
730	0.00000000	0.00005675	0.02222111	0.25582643
740	0.00000000	0.00004609	0.02049229	0.24851265
750	0.00000000	0.00002006	0.01482142	0.22128953
760	0.00000000	0.00001629	0.01366830	0.21496313
770	0.00000000	0.00001323	0.01260490	0.20881758
780	0.00000000	0.00001075	0.01162423	0.20284773
790	0.00000000	0.00000873	0.01071986	0.19704855
800	0.00000000	0.00000709	0.00988585	0.19141517

810	0.00000000	0.00000576	0.00911672	0.18594283
820	0.00000000	0.00000468	0.00840743	0.18062694
830	0.00000000	0.00000380	0.00775333	0.17546303
840	0.00000000	0.00000308	0.00715012	0.17044675
850	0.00000000	0.00000251	0.00659383	0.16557387
860	0.00000000	0.00000203	0.00608083	0.16084031
870	0.00000000	0.00000165	0.00560773	0.15624208
880	0.00000000	0.00000134	0.00517145	0.15177530
890	0.00000000	0.00000109	0.00476911	0.14743622
900	0.00000000	0.00000089	0.00439807	0.14322119
910	0.00000000	0.00000072	0.00405589	0.13912667
920	0.00000000	0.00000058	0.00374034	0.13514920
930	0.00000000	0.00000047	0.00344934	0.13128544
940	0.00000000	0.00000039	0.00318098	0.12753214
950	0.00000000	0.00000031	0.00293350	0.12388615
960	0.00000000	0.00000025	0.00270527	0.12034439
970	0.00000000	0.00000021	0.00249480	0.11690388
980	0.00000000	0.00000017	0.00230070	0.11356174
990	0.00000000	0.00000014	0.00212171	0.11031514
1000	0.00000000	0.00000011	0.00195664	0.10716136

This dependence can be determined on the basis of some equations:

- Rational. This type of equation is deducted theoretically, based on some laws or known strategies, following to determine the values of some constants that these expressions are contained, based on the experimental data.
- Empirical. This type of equation is deduced experimentally. The analytical representation of functional dependency between variables of this type of equation is done in two stages:
- Setting form of the dependency relationship;
- Determining the appropriate values of the parameters.

Experimental data processing, in the previously presented manner, appeal to the approximation theory. This area of mathematics provides practical admissible solutions where the exact methods are impossible to be approached.

The specific mathematical operations to the approximation theory are:

a. Interpolation. Interpolation means the mathematical operation to find a function, F(x), allowing for some values of x in the range $[x_1, x_2]$, the estimation of the function values f(x).

A necessary condition to determine the interpolation function F(x) is coincident with the function f(x) in the nodal values:

$$\begin{cases} F(x_1) = y_1 \\ F(x_2) = y_2 \\ \ldots \\ F(x_i) = y_i \\ \ldots \\ F(x_n) = y_n \end{cases} \tag{2}$$

For this reason, the interpolation is recommended to be used in conditions in which:

- Experimental values are relatively accurate, unaffected by the significant error;
- The number of experimental values is relatively small - failure to comply with conditions leads to a complex relationships, difficult to use;
- The function f(x) is known, but its expression is complicated and/or very difficult to measure and manipulate.

b. Extrapolation. Extrapolation is the mathematical operation to find a function, F(x), to estimate the values of the function f(x) for any value of x, situated outside of the range where there are determined the nodal points, $(x < x_1) \cup (x_n < x)$.

c. Regression. As origin, this mathematical operation comes from statistics where it was developed for researching and describing the dependence between the random variables. This technique can be successfully applied to the study of the dependence of first form between two presented variables presented in a table form. Regression is the mathematical operation that determines the parameters values of a function drawn through the experimental points, from the condition of minimizing of the distance between the function f(x) and the adopted model F(x):

$$d(f,F) = \left\{ \int_{x_1}^{x_n} [f(x) - F(x)]^2 \cdot dx \right\}^{1/2} \tag{3}$$

From a practical viewpoint, the relation 3 is not used only in cases where f(x) is known, but because of its complexity is seeking a simpler expression and easier to use.

In most cases where we use the regression is not known expression of f(x). In these situations there are using an expression, less rigorous:

$$d(f,F) = \left\{ \sum_{i=1}^{n} [f(x_i) - F(x_i)]^2 \right\}^{1/2} \tag{4}$$

Relationship 4 called the principle of Gauss-Legendre, or the method of the least squares. For this reason, the regression is recommended to be used in conditions in which:

- The experimental values are affected by significant error;
- The number of experimental values is relatively high and using the interpolation leads to obtain some complex relationships, difficult to use;
- The function f(x) is known, but its expression is complicated and/or very difficult to evaluate and manipulate.

After a series of measurements, such as those shown in Table 1. on the dependent variable y, for the different values of the independent variable x, arises a question to find the functional dependency form, F(x) and the parameter values of this function.

Choice the function F(x) is essential for the success of using the regression method. Unfortunately, there is not a direct method to allow the specifying of the most suitable model of F(x).

If there is legitimate that we know a priori about the shape of the relationship between variables, then we use as the regression equation their mathematical expression. If there isn't such a theoretical basis, it proceeds to a qualitative analysis of the essence of phenomena and if it concludes that there may be a link between variables, to choose the best regression model, we can apply the following rules:

1. Experimental data are plotted. There are obtained a number of n points;
2. There are visual plotted a curve that approaches the most of the experimental points. Then there are effectively plotted, a corresponding curve, looking for to give equal weight to all scored points;
3. It is considered the appropriate functional form of the curve traced and then choose an equation which closely match to the empirical curve shape;
4. There are calculated the values of the parameters of this curve using the principle of Gauss-Legendre, according to relation 4; It considers the degree of concordance between the experimental points and the empirical curve obtained in step 3 by calculating the value of some concordance indicators;
5. If there are several potential mathematical models which shape could be modelled, for the arrangement on graphics of n experimental points for each, in part, there are completed the 4 and 5 steps.
6. Depending on the values of the indicators of concordance and/or other theoretical or practical considerations, it is determined the most suitable model.

Type of the adopted mathematical model for F(x) determines the type of regression used to represent the experimental data.

Another method for approximating the curve is represented by the correlation coefficient.

The coefficient of correlation $r_{x,y}$ is used to measure the intensity of the linear relationship between two variables x and y.

The coefficient of correlation is given by the relation:

$$r_{x,y} = \frac{n\sum xy - \sum x \cdot \sum y}{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}} \quad (5)$$

where n represents the number of experiments.

If the coefficient of correlation $r_{x,y}$, between the two analyzed values, is closed to 1, then there is a linear functional dependence. If the coefficient of correlation $r_{x,y}$, is closer to 0, then the connection between the two variables is lower.

Of course, in order to determine the coefficient of correlation, there is a series of programming environments which may be used successfully.

Graphical representation of data

Conclusions on the analyzed populations are taken from samples drawn from those populations, so by processing the collected data sets.

These data must be processed, meaning their compacting in a convenient form to reduce scattering of information contained by them, a scattering that may occur due because the large number of measurements or because the way of collecting, presentation and data storage.

Regardless of the care taken to obtain a data set by conducting of some independent measurements under the identical conditions, it can be produced random deviations of data from the true value, so measuring it becomes a random variable.

If the random variable is continuous in time or space it is a continuous random variable, and if it is represented by the discrete values it is a discrete random variable.

During repeated measurements of a variable under the identical measuring condition, each of the measured values tends to take a central value lying within the range. Central value and he values scattered around it can be determined from the probability density of measurement that describes the frequency with which it takes a certain value in a certain range of values.

Because their total gross form the obtained results from the measurements constitute a disordered crowd of values, for an easier interpretation, they are plotted.

There are several ways to plot the results obtained from measurements: histogram, frequency polygon, cumulative frequency chart.

All these are based on the so-called frequency table, which is actually an arrangement of data in a number of categories - classes, recording the number of measurements belonging to each class.

The variation interval of the results is divided into elementary intervals of the same length, recording the number of corresponding values for each such portion. For n obtained results from the measurements there are calculated the difference between the maximum and the minimum.

Grouping interval length d is given by Sturges's formula:

$$d = \frac{\Delta_{max} - \Delta_{min}}{1 + 3.22 \cdot \lg n} \tag{6}$$

Because d is usually a decimal number, it is rounded to an integer number that is closest to the found value.

Histogram. (Figure 1) If n_i represents the absolute frequency of the class $(_i, _{i+1})$, the distribution of these frequencies can be realised in a system of rectangular axes in which a rectangle has the base the class $(_i, _{i+1})$ and the proportional area with the absolute frequency n_i. The histogram is allowed to view the variable trend and density.

If the absolute frequencies are too high, so uncomfortable to plot, there are calculated the relative frequencies:

$$f_i = \frac{n_i}{n} \tag{7}$$

n_i - absolute frequency corresponding to the class (frequency class number);
f_i - relative frequency;
n - selection volume (total number of observations).

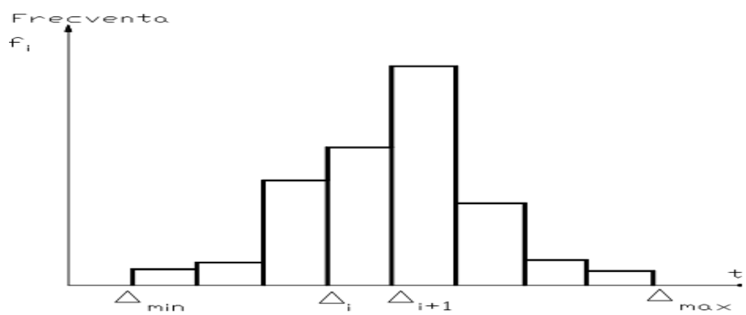

Fig1. Histogram

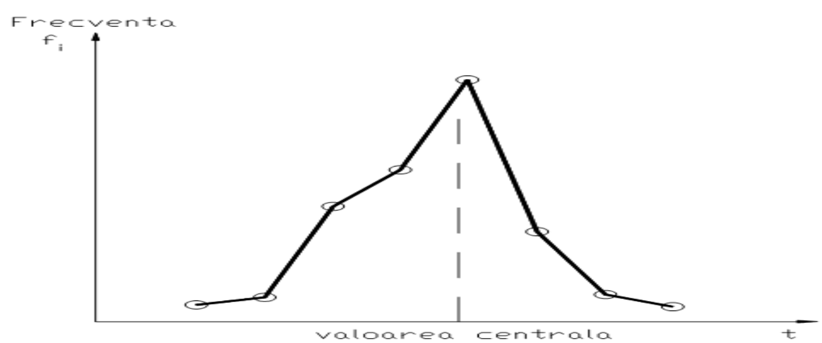

Fig2. Frequency Polygon

Frequency polygon (Figure.2) is obtained by joining through the line segments the middle of upper bases of the rectangles that forming absolute or relative frequency histogram. Cumulative frequency graph (Figure.3) expresses the relationship between the upper limit of classes studied xi and cumulative frequency F(xi) of the respective classes. It is obtained representing points Ni (i, fk), cu k=1, ..., i in a rectangular coordinate system.

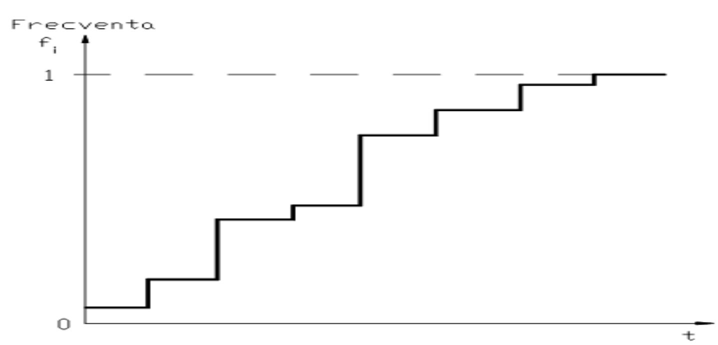

Fig3. Cumulative frequency graph

It is determined the total range of variation of the measured characteristics and they are divided into classes. The question is the number of classes and their limits. Using too little or too much of classes can adversely influence the subsequent analysis. For n small, the number of classes should be chosen convenient so that n_i 5 for at least one interval. For n 40, the number of classes can be calculated with the equation:

$$k = 1.87 \cdot (n-1)^{0.40} + 1 \quad (8)$$

By examining the histogram / frequency polygon can draw conclusions on the distribution of the measured variable, the central value and the dispersion of measurement results[1].

Results

Case study on reliability estimation of technological processes

In Table 1 are presented centralized the capability indices used to simulate the correlation capability – reliability of the technological processes.

Table 2. Centralization of the capability indices of the technological processes

Capability index	Symbol	Relations of calculating
Potentiality index	C_p	ITS/INT ; $(T_s - T_i) / 6s$
Capability index	C_{pk}	$\min\{C_{pkinf}, C_{pksup}\}$ $C_{pkinf} = \lvert z_{inf} \rvert / 3,\ z_{inf} = (T_i - \bar{x})/s$ $C_{pksup} = \lvert z_{sup} \rvert / 3,\ z_{sup} = (T_s - \bar{x})/s$

Table 2: Simulated values of non-reliability for values of the Cp and Cpk indices ranging from 0.8 and 1

T	F1(T)	F2(T)	F3(T)	F4(T)
0	0.00000000	0.00000000	0.00000000	0.00000000
10	0.38850723	0.18780793	0.07780067	0.02858883
20	0.62607660	0.34034404	0.14954839	0.05636034
30	0.77134855	0.46423266	0.21571409	0.08333789
40	0.86018129	0.56485402	0.27673206	0.10954418
50	0.91450187	0.64657788	0.33300279	0.13500127
60	0.94771851	0.71295336	0.38489561	0.15973057
70	0.96803025	0.76686300	0.43275114	0.18375289
80	0.98045073	0.81064797	0.47688348	0.20708844
90	0.98804576	0.84620979	0.51758230	0.22975685
100	0.99269007	0.87509281	0.55511472	0.25177720
110	0.99553003	0.89855137	0.58972709	0.27316801
120	0.99726665	0.91760423	0.62164659	0.29394729
130	0.99832857	0.93307881	0.65108274	0.31413251
140	0.99897793	0.94564714	0.67822874	0.33374066
150	0.99937501	0.95585504	0.70326275	0.35278823

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160	0.99961783	0.96414581	0.72634911	0.37129126
170	0.99976630	0.97087951	0.74763933	0.38926530
180	0.99985710	0.97634857	0.76727316	0.40672549
190	0.99991262	0.98079050	0.78537946	0.42368652
200	0.99994656	0.98439819	0.80207708	0.44016264
210	0.99996732	0.98732834	0.81747562	0.45616774
220	0.99998002	0.98970818	0.83167614	0.47171526
230	0.99998778	0.99164106	0.84477185	0.48681831
240	0.99999253	0.99321094	0.85684870	0.50148957
250	0.99999543	0.99448598	0.86798597	0.51574140
260	0.99999721	0.99552155	0.87825675	0.52958578
270	0.99999829	0.99636264	0.88772845	0.54303438
280	0.99999896	0.99704577	0.89646325	0.55609849
290	0.99999936	0.99760059	0.90451848	0.56878911
300	0.99999961	0.99805122	0.91194701	0.58111693
Table 2 (continued)				
T	F1(T)	F2(T)	F3(T)	F4(T)
310	0.99999976	0.99841722	0.91879759	0.59309230
320	0.99999985	0.99871448	0.92511519	0.60472532
330	0.99999991	0.99895591	0.93094128	0.61602576
340	0.99999995	0.99915200	0.93631409	0.62700313
350	0.99999997	0.99931126	0.94126890	0.63766667
360	0.99999998	0.99944061	0.94583822	0.64802536
370	0.99999999	0.99954567	0.95005204	0.65808790
380	0.99999999	0.99963099	0.95393803	0.66786277
390	1.00000000	0.99970030	0.95752168	0.67735818
400	1.00000000	0.99975658	0.96082652	0.68658213
410	1.00000000	0.99980230	0.96387424	0.69554238
420	1.00000000	0.99983943	0.96668485	0.70424647
430	1.00000000	0.99986959	0.96927679	0.71270172
440	1.00000000	0.99989408	0.97166708	0.72091524
450	1.00000000	0.99991397	0.97387140	0.72889394
460	1.00000000	0.99993013	0.97590422	0.73664455
470	1.00000000	0.99994325	0.97777889	0.74417357
480	1.00000000	0.99995391	0.97950771	0.75148735
490	1.00000000	0.99996256	0.98110202	0.75859204
500	1.00000000	0.99996960	0.98257229	0.76549361
510	1.00000000	0.99997531	0.98392818	0.77219787

520	1.00000000	0.99997994	0.98517858	0.77871047
530	1.00000000	0.99998371	0.98633170	0.78503687
540	1.00000000	0.99998677	0.98739510	0.79118242
550	1.00000000	0.99998925	0.98837577	0.79715227
560	1.00000000	0.99999127	0.98928014	0.80295145
570	1.00000000	0.99999291	0.99011415	0.80858483
580	1.00000000	0.99999424	0.99088328	0.81405717
590	1.00000000	0.99999532	0.99159257	0.81937306
600	1.00000000	0.99999620	0.99224667	0.82453697
610	1.00000000	0.99999692	0.99284988	0.82955325
620	1.00000000	0.99999749	0.99340617	0.83442613
630	1.00000000	0.99999797	0.99391917	0.83915969
640	1.00000000	0.99999835	0.99439227	0.84375792
710	1.00000000	0.99999961	0.99681902	0.87246786
720	1.00000000	0.99999969	0.99706650	0.87611385

Table 2 (continued)

T	F1(T)	F2(T)	F3(T)	F4(T)
730	1.00000000	0.99999975	0.99729473	0.87965561
740	1.00000000	0.99999979	0.99750520	0.88309612
750	1.00000000	0.99999983	0.99769930	0.88643826
760	1.00000000	0.99999986	0.99787829	0.88968486
770	1.00000000	0.99999989	0.99804336	0.89283864
780	1.00000000	0.99999991	0.99819559	0.89590226
790	1.00000000	0.99999993	0.99833598	0.89887829
800	1.00000000	0.99999994	0.99846544	0.90176924
810	1.00000000	0.99999995	0.99858483	0.90457754
820	1.00000000	0.99999996	0.99869493	0.90730556
830	1.00000000	0.99999997	0.99879646	0.90995558
840	1.00000000	0.99999997	0.99889010	0.91252985
850	1.00000000	0.99999998	0.99897645	0.91503052
860	1.00000000	0.99999998	0.99905608	0.91745970
870	1.00000000	0.99999999	0.99912952	0.91981943
880	1.00000000	0.99999999	0.99919725	0.92211170
890	1.00000000	0.99999999	0.99925970	0.92433843
900	1.00000000	0.99999999	0.99931730	0.92650151
910	1.00000000	0.99999999	0.99937041	0.92860274
920	1.00000000	1.00000000	0.99941939	0.93064391

930	1.00000000	1.00000000	0.99946456	0.93262672
940	1.00000000	1.00000000	0.99950622	0.93455284
950	1.00000000	1.00000000	0.99954464	0.93642390
960	1.00000000	1.00000000	0.99958007	0.93824146
970	1.00000000	1.00000000	0.99961274	0.94000707
980	1.00000000	1.00000000	0.99964287	0.94172219
990	1.00000000	1.00000000	0.99967065	0.94338829
1000	1.00000000	1.00000000	0.99969628	0.94500675

Simulated the correlation capability - reliability is based on the generation of 3000 values. To calculate the capability indices there were used the relationships from the Table 2. Substituting the simulated values of the capability indices there is obtained the correlation capability - reliability - non-reliability of the technological processes.

Based on the data from Table 3 there were obtained the simulated values of reliability and non- reliability of the technological processes presented in Appendix 1.

Table 3 Average of the operational period

Cp	Cpk	p
0.80	0.80	0.016395072
0.90	0.90	0.006933948
1.00	1.00	0.002699796
1.10	1.10	0.000966848
1.20	1.20	0.000318217
1.33	1.33	6.60733E-05
1.40	1.40	2.66915E-05
1.50	1.50	6.79535E-06

Reliability, respective the non-reliability of the simulated technological processes for values of the capability index ranging from 0.8 and 1.33, are plotted in Figure .4 and Figure .5.

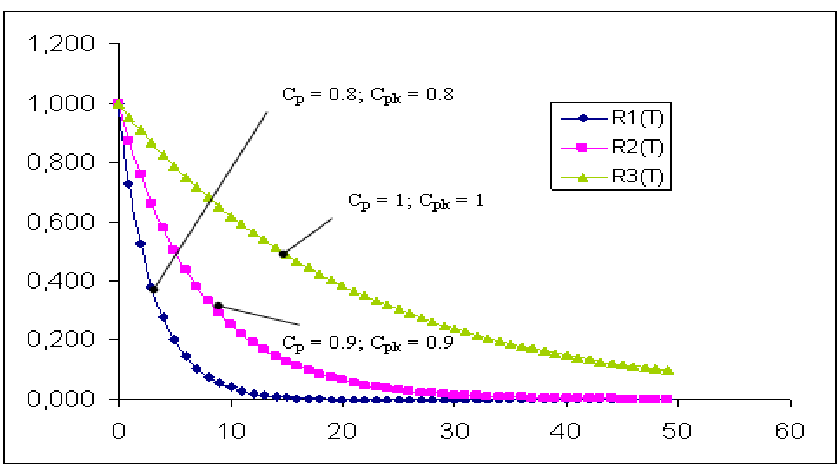

Fig4. Reliability for values of the Cp and Cpk indices ranging from 0.8 and 1

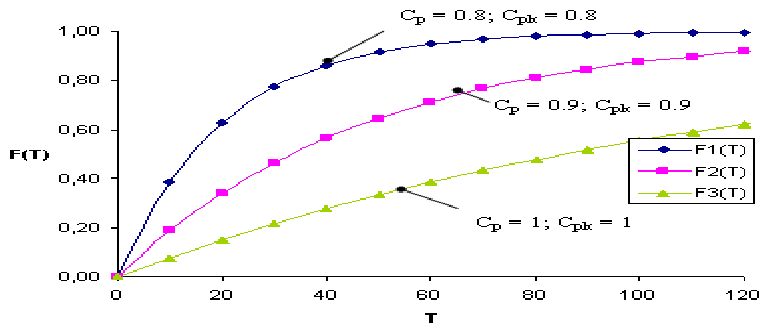

Fig5. Non-reliability for values of the Cp and Cpk indices ranging from 0.8 and 1

It is noted that for $C_p = 0.8$ and $C_{pk} = 0.8$, the reliability of the technological processes records a sharp decline.

The reliability, respective the non-reliability of the simulated technological process for values of the capability index ranging from 0.8 and 1.33, are plotted in Figure 6 and Figure 7.

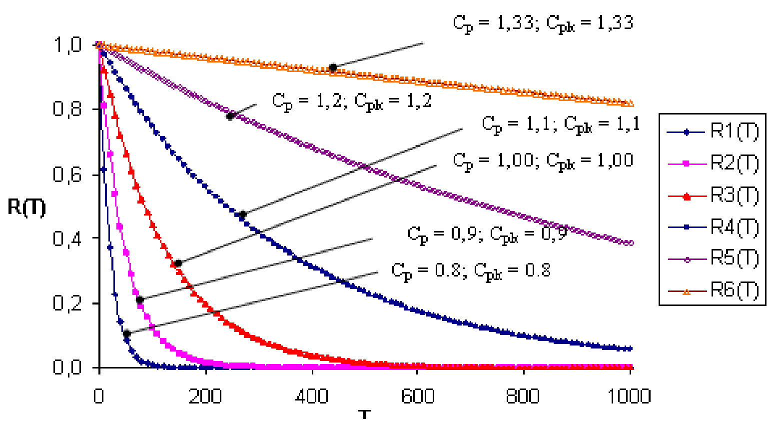

Fig6. Reliability for values of the Cp and Cpk indices ranging from 0.8 and 1.33

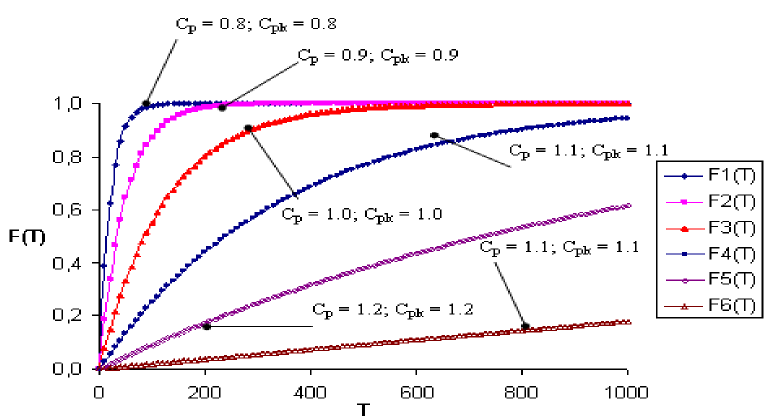

Fig7. Non-reliability for values of the Cp and Cpk indices ranging from 0.8 and 1.33

Based on the presented concepts on the progress of systems, a development direction is the achievement of some standard models of structural decomposition of the specific activities of some projects classes encompassing the processes for fixing the costs. It can achieve the specific software that would allow a detail and refinement of the planning of these types of projects, with obvious effects on the efficiency and quality of the projects. It can develop databases on technological systems and can identify and estimate the parameters of used statistical distributions and the reliability indicators for technological systems in our country.

Conclusion

The defining element of the national development strategies is to connect Romania to a new philosophy of development, own to the European Union and widely world shared - the sustainable development. We can say that the correct decisions for the products quality and processes are ranged between the concrete objectives for moving, within a reasonable and realistic time, at the development model generating high added value, propelled by interest in knowledge and innovation, oriented towards the continuous improvement of people's lives and their relationships in harmony with the natural environment.

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