THE THEORY OF SECURITY AND INSECURITY (PART I)

Colonel (ret.) Professor Eng. Eugen SITEANU PhD*

Abstract: *The author of this paper shows his opinions on the security/insecurity sciences and security/insecurity theory as a follow-up of the ideas presented in the article „Metasecurity – a concept of intempestive geometry" published in Annals Series on Military Sciences, Vol. 9, Issue 1/2017, moving on to a new theory. It is impossible to speak about a theory of security separated from a theory of insecurity (or non-security) as the issue here is a single antinomic phenomenon, known ever since antiquity as an aporia. The two opposing tendencies of the world (security and insecurity) and the fight between them resulting in their permanent reciprocal exclusion essentially represents the cause and engine of movement and development in the world, as the processual aspect of its development is always a conflicting one. This theory is actually a paradox, as it contains a contradiction between security and insecurity.*

The statement may be regarded as a contradiction, but it is still prone to demonstration. The security/insecurity system allows for demonstrating both the first statement (security) and the second statement (non-security), as it will be shown in the lines below.

Keywords: *security / insecurity, theory, science, truths.*

The contradiction which seems impossible to solve between security and insecurity is actually an antinomy, as both theses (security/insecurity) have grounds for demonstration. This antinomy has been known since ancient times as an aporia. The famous Kant himself conceived four theories of pure reason. The first of these theories pointed out that the world is both finite and infinite. In the same vein, we could state that the world has both security and insecurity which is a real truth to be held as self-evident. An

* Prof. univ. dr., membru corespondent al Academiei Oamenilor de Ştiinţă din România, E-mail: esiteanu@yahoo.com

antinomy of security states that the one who fights against any opposing forces in order to gain absolute security is forced to face, finally, the ultimate result of insecurity and death. However, this is an antinomy that needs to be demonstrated. We will start with a few examples: Hitler, Caesar, Darius, Alexandru the Great, Ceauşescu, Saddam Husein, Anwar Saddat etc. Each of them created security and generated insecurity. Another kind of example would be the states such as: Germany (in World War 1 and World War 2), the Roman Empire, Persia, etc.

The unity and fight of contrary (opposite) forces represent the essence of dialectics as a theory of development. The two opposing tendencies of the world, security and insecurity as well as the fight between them (their permanent exclusion) essentially represent the cause for movement and development in the world. This does not mean that the world has to be uncertain, dangerous, dangerous and tragic, always on the brink of disaster. It only means that the processual character of its development is always a conflicting one.

So, the theory of security and insecurity does not represent a paradox as it contains a contradiction between security and the contrary aspect of security (the concept of non-security or insecurity). Therefore, the theory is paradoxical (strange or weird), as the concept itself is contradictory, yet prone to demonstration. Within this system – security / insecurity – both concepts, security and insecurity, are prone to demonstration.

In Law it is said *„let us listen to the opposing side"*. In the security science, what security is to one side is insecurity to the other side and the other way around. So, we cannot speak of a security science as it may mean not abiding by a law principle mentioned here, but rather of the science of security and insecurity or the science of security and non-security.

Another antinomy is represented by the terrorism/anti-terrorism binom. Thus, there are certain countries that oppose the definition of the terrorist (or terrorism) given by the USA that considers Islamic Jihadists terrorists, while Iran considers them freedom fighters. Similarly, Vietnam considers American intervention as a terrorist action, in total contrast with the official opinion of the United States: *„Applied to the world stage, the Standard would allow individual countries to establish individual definitions of the term "terrorist". The problem lies where countries disagree with the definition of terrorist. The United States may deem an Islamic jihadist as a terrorist, while Iran deems the same individual as a* *hero. Similarly, Vietnam considers the Vietnam Conflict as a terrorist action by the United States. Under the terms of the ISACS, Vietnam could potentially name all U.S. military veterans of the Vietnam conflict as "terrorists".*"[1]

Let us consider a set of elementary events $\{e_i\}$ that represents the number of victims at each terrorist attack, namely all N possible results of an experience that have the property of being two by two incompatible and equally possible. Obviously, each elementary event has the probability 1/n and n=N for at a very large amount of evidence, the elementary event that is equally possible occurs each time with a relative frequency 1/N. If an event is part of the $\{e_i\}$ set which is the union of an „*m*" number of distinct elementary events: $A = e_1 \cup e_2 \cup e_3 \cup ... \cup e_m$ and $e_i \cap e_j = \emptyset (i \neq j)$.

The probability of an event, noted as P or p, is the ratio between the „*m*" number of cases favourable to producing A and the total „*n*" number of possible cases of the same „experience" on condition that absolutely all cases are equally possible.

Therefore, the definition of people security in case of terrorist attack is the probability p=m/n, in which: „*m*" is the number of favourable cases and „*n*" is the total number of cases.

The event that is subjected to estimating the people's security is the insecurity event (their chances of getting hurt). More precisely, there are natural and man-made insecurity events, these being: casualties, wounded and sick people, displaced people etc. That are noted as such: A-casualties, B-wounded people, C-sick people, D-displaced people etc. Thus, each insecurity event A, B, C or D are taken individually (as they do not occur simultaneously). The result is therefore a reunion of events (A, B, C, D) for which security is: $S(t) = P(\overline{A} \cup \overline{B} \cup \overline{C} \cup \overline{D}) = P(\overline{A}) + P(\overline{B}) + P(\overline{C}) + P(\overline{D})$.

Function $F(t) = P(A \cup B \cup C \cup D) = P(A) + P(B) + P(C) + P(D)$.

Obviously, F(t)+S(t)=1.

This statement can be represented schematic (figure no. 1).

Consequently, always S(t) is positioned on bisecting line. In the same way F(t) is positioned on bisecting line (figure no. 1).

Security and insecurity are part of nowadays world of contradictions.

[1] Jason Wong, *International legal affairs*, in Small Arms Defense Journal, Spring 2010, p. 18.

We have become accustomed to stating that in this year or in this semester or trimester the frequency of terrorist attacks in a certain country or region has grown or has become smaller.

At this point we should clarify the meaning of this indicator – frequency – used in practice. In the first place, frequency (be it absolute or relative) is the frequency of an event of insecurity and from a statistic point of view we need to specify whether it is about absolute or relative frequency. In any random experiment (including those related to security /insecurity) the frequency of insecurity event can be expressed either by a natural number (0, 1, 2, 3, ..., k), which makes it absolute frequency, or through a sub-unitary number (or percent) in case of relative frequency. Terrorists „produce experiences" out of killing people, no matter if they are children or women. Let us analyze an „experience" and an „event" A resulting from that „experience". If terrorists repeat it several times under similar circumstances, we consider „k" the number of occurrences of event A and (n-k) the number of non-occurrence of A.

It results that the relative frequency of event A is $f_n = k/n; 0 < k < n$ and $0 < f_n < 1; \forall n$.

For most mass phenomena, such as the security/insecurity phenomena, the frequency f_n, in case of a very big number *„n"*, tends towards a constant figure.

For $f_n(\varnothing)=0$ we have an impossible event, while for $f_n(E)=1$ we have a certain event which happens in each experience.

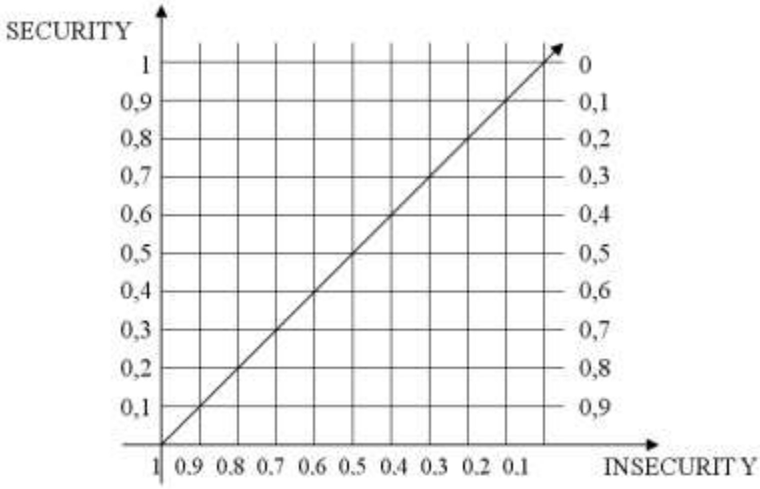

Figure no. 1 Diagram of security/insecurity

The phenomenon of security and insecurity is unique, namely there is only one phenomenon in which the sum of security and insecurity always equals 1 (100%), for instance when security is 1, insecurity is 0 and the other way around, when insecurity is 100% security equals 0 (figure no. 1). We can talk about security in relation to insecurity and the other way around, about insecurity in relation to security, the same way in which the Chinese talk about Yin and Yang entities.

For two incompatible insecurity events (that cannot happen together) $A \cap B = \varnothing$ it results that:

$$f_n = (A \cup B) = f_n(A) + f_n(B);\ F_n(A) = p;\ F_n(B) = q;\ F_n(A \cup B) = p + q;$$

$$F_n(A \cup B) = \frac{p+q}{n} = \frac{p}{n} + \frac{q}{n} = f_n(A \cup B) = f_n(A) + f_n(B).$$

If two insecurity events (A and B) are compatible (they have at least one common case/result within the same experiment /the same test) it results that:

$$f_n(A \cup B) = f_n(A) + f_n(B) - f_n(A \cap B).$$

Having Ω a space of elementary insecurity events and associated to one insecurity experiment composed of n elementary events and $A \subset \Omega$ comprising „m" elementary events, then the function

$P : P(\Omega) \rightarrow R, P(A) = \frac{m}{n}$ is called classical probability, that has no sense if the number of possible cases tend towards ∞. This is the reason why in defining the security/insecurity probability (P) we start from the experimental (practical) notion of frequency of an insecurity event.

Within the theory of security/insecurity, it is necessary to analyze the notion of insecurity event (an event that produces insecurity) as the concept of security/insecurity is defined according to the events of insecurity produced by RTVH (risks, threats, vulnerabilities and hazards). Moreover, it is also necessary to differentiate between types of insecurity events dividing them into events of natural insecurity and man-made events of insecurity. In order to measure the level of insecurity of an organization, system, state, etc., we first determine the frequency of occurrence of the insecurity event in order to estimate the capacity of the organization /state to prevent or oppose insecurity events. The security function (S) is the probability of a state / organization / system etc. to work without insecurity events in a certain period and in certain historic circumstances.

Another definition: the security function is a parameter measuring the probability that the organization/state/system might accomplish its function /mission in a certain interval of time, without insecurity events (that represent unsettling actions of the organization/state/system that they take out of their normal state of functioning so as not to be able any more to accomplish (at the requested standards) one or several of their functions. These are quantitative definitions of the security function.

Maintaining the security of a system/state through the existence of certain reserves or reserve elements/ sub-systems is called redundancy.

The security probability represents a percent that shows how many times an organization or system functions without insecurity events, in a certain interval of time, within a certain number of attempts. The security function can also have a qualitative definition, namely the ability (quality) of a state / system / organization to accomplish its mission /function without insecurity events throughout a certain period of time and under certain historic circumstances.

Judging from the definitions mentioned, we could draw certain conclusions, among which that one that security is characterized by:

- its adjustment in time according to the historic periods (stages of development of society), through increasing the complexity of society and security depending on the scientific and technologic progress (technology);

- the probability of functioning without events of insecurity that is expressed through a percent or a sub-unitary number, for instance 50% or 0.5 for a period of 200 days, which will mean that the state/ system/ organization is going to work without events of insecurity for 100 days;

- accomplishing normal functioning (preserving the level and standards of functioning of the system/state);

- timely mending the functions affected /deteriorated by the events of insecurity. The function of security represents a probability (p) depending on time, with values comprised between 0 and 1 (0 and 100%) that is $0 \leq p(t) \leq 1$ and in accordance with the quantitative definition of the security function we may write the regard:

$$p(t)=p(t>T),$$

in which T is a limit of the functioning time without insecurity events. This regard is the function of security:

$$S(t)=p(t>T) \quad (1)$$

The security theory analyzes both the architecture (structure) and the causes of insecurity events, namely their dynamics, it seeks for models for preventing them and for those of functional re-adjustment (Ra) of the systems /states /organizations as well as of their preservation / re-modelling (Cv) (these two together with the security in functioning (sig.) are the three components of security). *„Functioning in a security state depends on the level of security in functioning, the possibilities of modelling parameters, as well as the capacity of the system (organization) not to become dangerous through functioning or consequences. This requires facilities of liability and viability, transparency or dilution of the influences of destructive factors (crimes) as well as functional re-modelling or blocking in case of imminent dangers.”*[2]

[2] Ilie Gheorghe, *Risc şi securitate*, Vol. I, Editura UTI Press, Bucureşti, 2015, p. 23, A se vedea şi Siteanu Eugen, Bedros Naianu, Ilie Gheorghe, *Fiabilitatea produselor tehnice,* Editura AISTEDA, Bucureşti, 2000, p. 134.

It results that security

$$S=Cv+Ra+Sig. \quad (2)$$

Regard (2) is called security of the system/state/organization etc., that may also be expressed with a different formula[3]:

$$S = \sum_{i=1}^{k-n} m_i S_i + S'_c \, ; \; n \leq k \quad (3)$$

In regard (3):

k-n – is the number of sub-systems that contribute to security;

Si – security of sub-system i;

m_i – weighting factor of sub-system i;

S_c – component due to the characteristics of the system.[4]

Thus, the security of a system (organization, community etc.) can be considered the capacity of the system *„to preserve its functional characteristics under the action of disruptive factors or that may cause such mutations so as to become dangerous to the environment, the health or lives of people it serves or it is served by (including those living together in a certain risk zone) or to cause material, information or moral damage"*[5].

The security science has developed and diversified together with society itself due to the development of science and technology, resulting in the occurrence of new domains: aircraft security, railway security, airport security, nuclear plant security, CBRN security, food security, information security, cyber security etc. Thus, we may speak of the history of security or about historic security in the sense that in every historic stage there was a certain type of security specific for the age we refer to. Consequently, in the future, there will probably be a lot of talk about cognitive security /knowledge security as we already enter the age of knowledge (cognitive society).

Modern approaches have appeared lately in the management of new emerging risks as there was a need of stochastic optimization of risks that became more varies and proliferated (for instance: extreme draught, water shortage, desertification, dramatic increase of the quantity of industrial waste, decrease of agricultural crops, the extinction of certain species, excessive pollution, deforestations etc.). Consequently, the theory of security uses new

[3] Idem.
[4] Idem.
[5] Idem.

disciplines: theory of chaos, theory of dissipating systems, theory of fractal geometry, theory of bifurcations etc., and newer theories appeared to replace the old ones. For instance, in the old cause-effect theory now there is a difference between a causal relation and a triggering factor and the new theory is also approached in the perspective of structural-phenomenological approach which is both inter and trans-disciplinary, relying on the triad: information-energy-matter.

The unity of the security-insecurity phenomenon has a great variety of approaches due to the theory of human security, of individuals, its actual object of study which is common to several disciplines of security.

In order to analyze the security environment it is necessary to study the general behaviour of individuals and their communities which may be: closed, open and cooperating. At the same time, it is important to study the implications of security in the sustainable development of the society.

The technology of security should also study and specify the methods (procedures) of analyzing the desired security level, of finding, collecting, identifying and analyzing the statistical security information, as it should analyze the values of security indicators, study the connections among them and the efficacy of security systems as well as the procedures of maintaining security through the preservation (re-modelling) of systems/organizations etc. and their functional re-adjustment.[6]

The concept of security is not only probabilistic but also statistical as determining the security characteristics is calculated according to the data collected about insecurity events from a statistic population. The repartition or distribution of insecurity events is offered by a discreet random variable which takes a certain value within a determined series of values associated with a repartition of probability. This discreet random variable associated to the instance's insecurity events happen can be expressed thus[7]:

$$X\left(p_i = f\left(x_i\right)\right); \qquad i = 1,2,...,n \begin{cases} 1^\circ f\left(x_i\right) \geq 0 \\ 2^\circ \sum_{i=1}^{n} f\left(x_i\right) = 1 \end{cases} \tag{4}$$

[6] Eugen Siteanu, Bedros Naianu, Gheorghe Ilie, *Fiabilitatea produselor tehnice*, Editura AISTEDA, 2000, p. 15.
[7] Idem.

where $pi = f(xi)$ represents the probability function that defines the distribution of insecurity events (random variable). The mending function of the random variable (in this case the happening of insecurity events) is the following:

$$F(x) = \int_{-\infty}^{x} df(x) \tag{5}$$

All insecurity events $x=x_i$ are incompatible as they do not occur simultaneously but consecutively.

The theory of insecurity events makes certain comparisons between the penetrating capacity of terrorist groups two decades ago, *„p_1"*, the current penetrating capacity *„p_2"* and the rejection capacity *„r"*. In figure no. 2 we notice that p_2 capacity is much higher than p_1 and the domain of variation of p_2 power, represented by the dotted line crosses on the lower side the domain of variation of the capacity of rejection *„r"* (tinted area), which means that within that tinted area, p_2 capacity > cap. r. This means that in that area terrorist attacks are successful or that the attempted rejection of terrorist attacks by security forces has failed.[8]

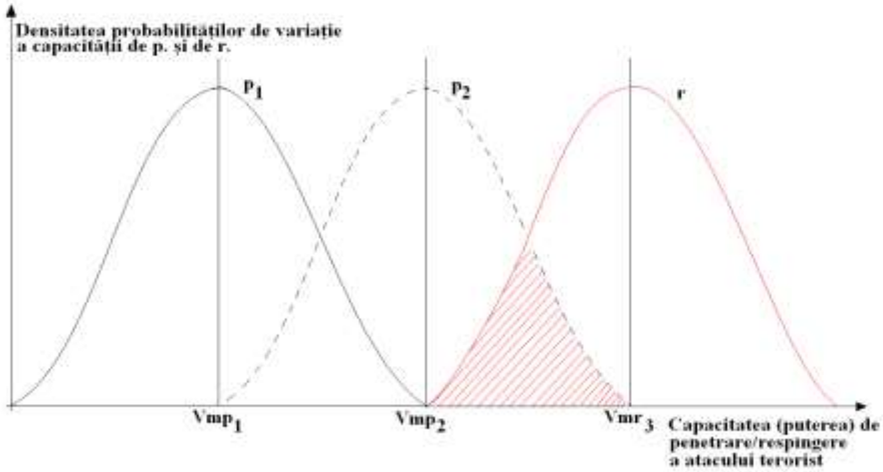

Figure no. 2. Density of probabilities of power variation of terrorists' attacks and that of rejecting the attack according to the capacity (power) of penetration /rejection of the terrorist attack

[8] *Ibidem*, pp. 26-27.

Legend: Cap=capacity; p=penetration; r= rejection of the terrorist attack; p_1=at time t_1 (two decades ago); p_2=at time t_2 (nowadays).

People have been „terrorized" (threatened) for ages and will, undoubtedly continue to be so by natural or atrophic phenomena that are both complex and repeatable and that is the reason why they have been trying ever since the old ages to find mathematical models that may help them better understand these phenomena. Such a mathematical model is the theory of probabilities which models the random mass phenomena which have the property of stability (of the phenomenon). These phenomena are complex as they depend on a variety of variable factors significantly influencing results. The unpredictable terrorist attacks depend on numerous factors such as: the physical qualities, the health, the psyche, the education etc., the weapon used, weather factors, factors related to the target(s), dimensions, shape, distance of shooting etc. Natural phenomena such as severe storms, hurricanes, flooding or earthquakes etc. take place in each country, region, area, place, in similar circumstances, sometimes in exactly the same circumstances. For instance, Texas tropical storms have occurred in more or less the same circumstances for a very long time. A lot of phenomena of this sort have certain stability in their occurrence.

In order to study insecurity phenomena, we take as model the union theory and we use several models: mathematical deduction and induction, mathematical computing (algebraic, integral or differential). Moreover, the law of big numbers is used in order to make the connection between probability and the frequency of insecurity events.

Starting with the 17th century, the theory of probabilities has developed probabilities that have a connection to society's daily life (economic, social, military) including the necessity of ensuring people's security.

Security activities can be organized on scientific/mathematical bases in order to provide a just interpretation of data and phenomena related to insecurity events and to create statistical models of the insecurity events, to make exact prognoses and ensure security by making rapid and correct decisions.

Therefore, the security analysis could use probabilistic models and statistical studies. The theory of probabilities is a rigorous model of study for mass random phenomena that repeat themselves in relatively identical circumstances and have a certain stability of frequencies. The research methods for the theory of security/nonsecurity ensure satisfying the demands of modern technique. The theory of probabilities is at the core of the theory of liability, viability and security, the theory of systems etc. The experience (experiment) can be applied, repeatedly, through tests and samples (test no. 1, test no. 2 etc.) in studying tropical storms, hurricanes, earthquakes and other insecurity phenomena.

In addition, the theory is used by terrorists in case of shootings with air defense or land missiles, artillery means etc. and by the security forces training in special firing ranges.

The repetition of each of the experiences mentioned is called a test. Examples of tests are, for instance, repeating shootings at targets with different categories and calibres of weapons. Each result obtained from any experience or test represents a random event (in case of security/insecurity studies we are rather interested in the events of insecurity). For instance, obtaining a breach in the target (hitting the target following shooting). Any of the above-mentioned events is an elementary event as it has only one case likely to happen within each experience taken as an example. Security forces could make use of the equally likely events for misleading terrorists. For instance, if following trailing or certain information authorities find out the exact place where terrorists are supplied with weapons or ammunition etc. flawed armament or ammo could be placed there. Thus, if for instance a terrorist would like to buy projectiles from a crate in which there are four projectiles of which two are functional and two are flawed, the terrorist can take out a good projectile or a bad projectile. This is an example of event within a certain experience with the same chances of success, that is P=50%. Choosing a functional or a flawed weapon or ammunition out of a lot of weapons represents the certain event (E) of the experience mentioned according to the theory of probabilities. The certain event (E) is that event which occurs for certain at each experience. If somebody intentionally puts in a crate only flawed weapons/ammunitions, the terrorist would be unable to choose a functional item as this would be an impossible event (Φ), namely an event that does not occur within any experience (if there are only flawed weapons in the crate, it is impossible to take out a good one), as there is no case in which it can be achieved.[9]

If we analyze the terrorist attacks of September 11 2001, from the USA, we come to the conclusion that the planes turned into cruise missiles by the terrorists have all reached their targets except for one that fell on the field.

Three events resulted in hitting their targets (the Twin Towers and the Pentagon), while the fourth event actually was missing the target. Thus, we are dealing with two kinds of contrary (opposed) events that are complementary given the whole lot of possible cases of the respective experience. If the event is A (hitting the target), the event contrary to A (represented by $\overline{A}$, that is „nonA” or „CA”) actually is the event realized in those instances when A is not realized.

The results are the following obvious relations:

$$\overline{\overline{A}} = A \tag{6}$$

$$\overline{E} = \Phi \tag{7}$$

$$\overline{\Phi} = E \tag{8}$$

Relation (6) means: the event contrary to A actually is event A itself.

Relation (7) means: the event contrary to the certain event (E) is the impossible event (Φ).

Relation (8) means: the event contrary to the impossible event is the certain event.

The compatible events are those that can happen simultaneously within a certain experience, namely they could happen / be produced at the same time (the occurrence of one does not prevent occurrence of the other). For instance, the fourth experience with the plane hijacked by terrorists produced two compatible events: missing the target and the death of all the passengers on the plane. Thus, the explosion of the plane and the missing of the target are two compatible events. The examples mentioned above lead us to the conclusion that the occurrence of the event of target hitting by the plane flown by terrorists excludes the occurrence of the other missing event as these two are incompatible (namely, they cannot happen simultaneously).

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[9] Daniela Răchiţan, *Elemente de teoria probabilităţilor şi statistică. Aplicaţii în domeniul militar*, Editura Academiei Trupelor de Uscat, Sibiu, 1998, pp. 8-9.

Actually, in the last example, the two events are at the same time incompatible as well as contrary.

If two insecurity events happen, whose occurrence did not influence the probability of occurrence of the other event then the two events are independent. Two events are dependent on each other if the occurrence or lack of occurrence of the former affects the occurrence of the latter within the example. For instance, the event of intervention of security forces is influenced by the event of occurrence of a terrorist attack.

The whole amount of elementary insecurity events associated to a certain experience (an experiment) represents a complex system of insecurity events (Ω). For instance, when a terrorist shoots at a person $\Omega = \{m, r, s\}$, where „m" means a lethal strike, „r" is wounded, and „s" means that the person walked away unharmed.

Insecurity events can also be represented as unions, when an event can be interpreted as a sub-union of the union made of all the possible cases of the experience. For instance, if a terrorist has a gun with 5 bullets and fires against a group of five people hitting persons no. 1, no. 3, and no. 4, an event can be written as $A = \{1,3,4\}$, this being a sub-union of the union of all possible cases of the experience $\{1,2,3,4,5,0\}$, where *„0"* means that the terrorist did not hit any person. *„A"* = any result of a gun being shot at a person is an event *„Am"* if the person is dead, *„Ar"* if the person is wounded. It results that:

$A_m \subset A$, namely *„A_m is included in A"*, and $A_r \subset A$ means *„A_r is included in A"* or *„A includes Ar"*.

If $B \subset A$ it results that $B \cup A = A$ and $B \cap A = B$.

In order to explain the union between two events (A or B) we consider that upon shooting 3 bullets by a terrorist at 4 people (numbered from 1 to 4), the event $A = \{2,3\}$ and the event $B = \{1,3,4\}$, in the first case hitting people 2 and 3, and in the other hitting people no. 1, no. 3 and no. 4, then the occurrence of event A or B is mathematically expressed as $A \cup B = \{1,2,3,4\}$. Certainly, $A \cup \overline{A} = \Omega$, and the occurrence of events A and B is: $A \cap B = \{3\}$.

The security of an individual or human security can be expressed through a function that shows the probability that the life span (without getting hurt in an insecure event) may exceed a certain span of time T. First of all, we should say that harming a person's health is the event indicated by the estimation of a person's security. This physical or psychological damage is actually the changing of the normal state of the person's health that harms the basic functions of his/her body. Taking into consideration the large number (n) of organs (elements) composing the individual, if el_j represents the number of elements damaged in a time interval t_j, and v_j is the frequency of suffering damage, $v_j = \frac{el_j}{n \cdot \Delta t_j}$.

The probability of living without damage is the indicator resulting from the definition of security. This indicator is calculated in a different way using the frequency function f(t) of the law of human being's evolution in time.

$$S(t) = \int_T^{\infty} f(t)dt \tag{9}$$

The harming probability is:

$$V(t) = 1 - S(t) = \int_0^T f(t) = \lambda(t)S(t) \tag{10}$$

The intensity of harming is a ratio between the number of elements that are harmed following after t moment, within an interval Δt and the number of elements that are still in good condition at that moment t:

$$\lambda(t) = \frac{nf(t)}{nS(t)} \rightarrow \lambda(t) = \frac{f(t)}{S(t)} \rightarrow f(t) = \lambda(t)S(t) \tag{11}$$

The frequency of becoming ill (figure no. 3) is represented function of the person's time span and the same figure also presents the age at which people were assassinated within an „experiment" (in a „test"): t_1, t_2, t_3, ..., t_{n-1}, t_n:

Curve „a" represents the frequency (intensity) of illnesses experienced by a human being throughout his/her life. The vertical segments marked with 1, 2, 3, 4, 5, 6, ... are the actual moments when the lives of certain people that should live according to curve „a" from childhood towards old age, are ended by the deadly attacks of terrorists. These tragic moments are marked with: t_1, t_2, t_3, ..., t_{n-2}, t_{n-1}, t_n. Terrorists take people's lives at any age, that is in any moment (t_1 ..... t_n).

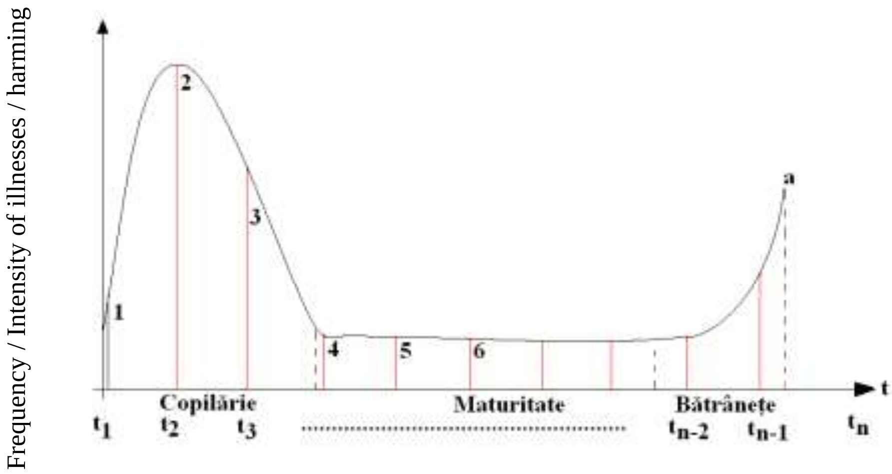

Figure no. 3. Graphic representation of the moments of killing people according to the age of each person killed by the terrorists

If the security (the security function) of an individual „i" is Si(t) and the probability of an individual's mortality is $M_i(t) = 1 - S_i(t)$, then the level of security of the whole population (figure no. 4) made up of „n" individuals is going to be:

$$S_{pop}(t) = 1 - \prod_{i=1}^{n} \left(1 - S_i(t)\right) \quad (12)$$

The average time between two harming events:

$$m = \int_0^\infty t \cdot f(t)dt = \int_0^\infty S(t)dt \quad (13)$$

We are going to choose a significant example: if the security of each individual in a collectivity is $S_i(t)$=0.9, namely S_i is constant S_i=90%, then relation (12) becomes $S_{pop}=1-(1-0,9)^n$ or $S_{pop}=1-(0,1)^n$.

If n=10 individuals, $S_{pop}=1-(0.1)^{10} \Rightarrow S_{10}=1-(0.000000000,1) \Rightarrow S_{10}=0.9999999999$

S_{100}=0.(9) 100 times 9

S_{1000}=0,(9) 1000 times 9

S_{10000}=0,(9) 10000 times 9.

In conclusion, the security of a certain people is higher than the security of each individual and for the case we have taken as an example the security of the population is higher proportionally with the increasing number of individuals.

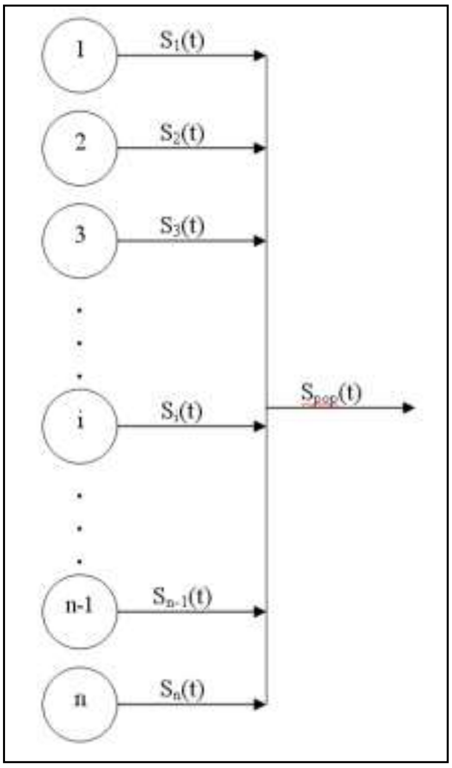

Figure no. 4. Graphic representation of individuals' security (S_i) and of the security of the whole population (community) made up of n

Optimizing security:

If people are within a technical system (ship, aircraft, train, nuclear plants, electrical plants, industrial or chemical installations etc.) then their security depends on the security of that technical system, as in figure 5, in which *„C"* represents costs, *„S(t)"* – security, *„2"* – Curve of expenses for purchasing the system, *„1"* – Curve of exploitation and maintenance expenses and *„3"* – Curve of total expenses. Optimal security is obtained where „C" is lowest.

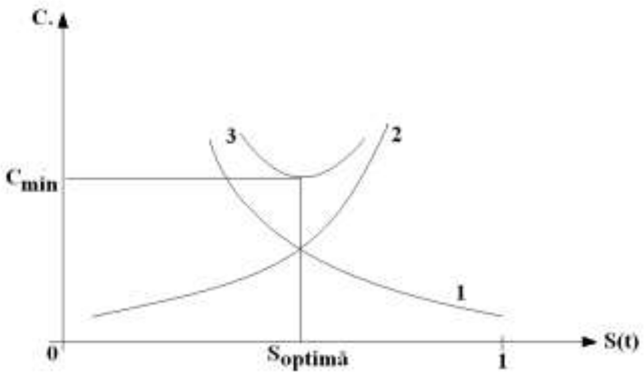

Figure no. 5. Variation of expenses for ensuring security and choosing optimal security according to C_{min}.

$$S(t) = (t > T) \quad M(t) = P(t < T) \rightarrow S(t) + M(t) = 1 \qquad (14)$$

The function of harming frequency f(t) is a ratio between absolute frequency f and the number of days, months or years T taken in consideration in the interval (0, t):

$$f(t) = \frac{f}{T} \quad M(t) = \int_0^t f(t)dt \qquad (15)$$

Rate of damage:

$$z(t) = f(t)/S(t) \qquad (16)$$

Average time of functioning without being harmed:

$$m = \int_0^t tf(t)dt = \int_0^t S(t)dt \qquad (17)$$

Dispersion:

$$D = \int_0^t (t-m)^2 f(t)dt \qquad (18)$$

Real security is expressed through the indicators $\hat{z}(t)$, $\hat{m}$ and $\hat{S}(t)$, where this sign/stress $\wedge$ expresses the characteristics resulting from the closer or more distant history. These values are called security indicators.

Indicators of people's real security

If we analyze the life of a population of N_0 people starting with a certain moment we mark as t=0 and after a while „*t*" only N(t) people are still alive (the others being dead) it means that the $N(t)/N_0$ ratio is the relative frequency of the people who have stayed alive. In case N_0 is a sufficiently big number, the ratio $N(t)/N_0$ tends, at limit, towards the probability of immortality of the person (people) at time „*t*" (the time taken into consideration with the N_0 people). Obviously, when the time interval we take into consideration is higher, the value of probability is going to be different. The time taken into consideration for analysis can be divided into intervals Δt so as at a certain moment „t_i", the time interval is $(t_i, t_i + \Delta t)$. The number of dead people that occur up to moment „*t*" is going to be: $n(t) = \sum_{i=1}^{t/\Delta t} n(\Delta t)i$, while the number of people left alive is going to be:

$$N(t) = N_0 - n(t) \tag{19}$$

The probability of staying alive until moment „t" is going to be:

$$S(t) = P(t > T) = \lim_{\substack{N_0 \to \infty \\ \Delta t \to 0}} \frac{N(t)}{N_0} \tag{20}$$

The function of real security has a few properties[10]:

$$S(t=0) = 1;\ S(t \to \infty) = 0;\ 1 \geq S(t) \geq 0 \tag{21}$$

The result of the three properties is that the function of real security is decreasing.

Each population has a different graphic representation of the real security function (figure no. 6).

The function of mortality:

$$M(t) = \lim_{N_0 \to \infty} \frac{n(t)}{N_0} \tag{22}$$

This function also has three properties: $M(t=0) = 0$; $M(t \to \infty) = 1$; $0 \leq M(t) \leq 1$.

For the purpose of statistic calculus, we use the expression: $F(t) = n(t)/N_0$.

[10] Eugen Siteanu, Bedros Naianu, Gheorghe Ilie, *op. cit.*, p. 45.

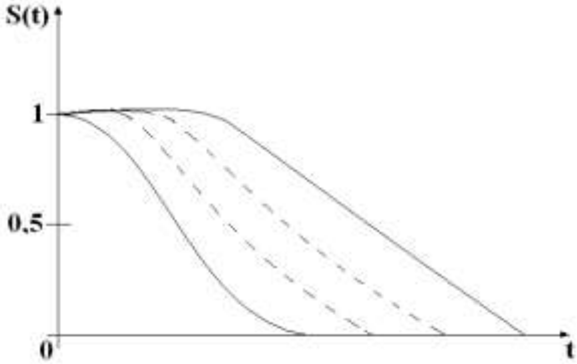

Figure no. 6. Variation of security functions of certain systems according to time

The graphic representation of the mortality function is used for determining the number of dead people in a certain interval of time *„t”*, as the cumulative curve shows how the number of dead people grows in time. This function is called the repartition function. The distribution of people's lifespan is shown by the indicator: *„density of repartition of the lifespan”* or *„density of probability of lifespan”* (the function of mortality density, figure no. 7). This indicator represents the limit of the ratio between the probability of mortality in the time intervals $(t, t+\Delta t)$ and Δt, when this time interval Δt tends towards zero. The expression of this indicator is: $f(t) = \lim_{\Delta t \to 0} \frac{P(t \le T \le t + \Delta t)}{\Delta t}$.

This statistic indicator is the ratio between the number of dead people in a certain amount of time (a month, a year etc.) and the number of people (N_0) at the initial moment. $f(t) = \frac{n(\Delta t)}{N_0 \Delta t}$.

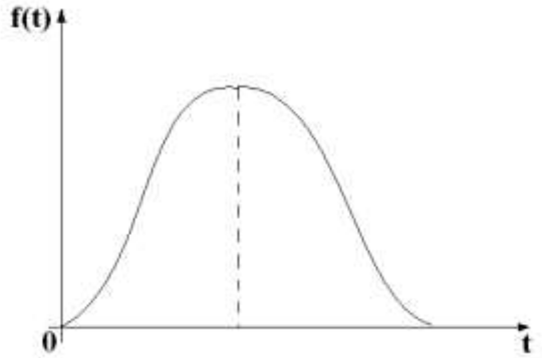

Figure no. 7. Function of density of mortality (harming events)

From the relation $S(t) = \lim \frac{N(t)}{N_0}$ we can derive the number of people that are going to be alive at „*t*" moment: $N(t) = N_0 S(t)$. The number of people who will be alive at $t + \Delta t$ moment is going to be: $N(t+\Delta t) = N_0 S(t+\Delta t)$. The difference between the two numbers shows the number of dead people in the interval Δt: $n(\Delta t) = N(t) + N(t+\Delta t) = N[S(t) - S(t+\Delta t)]$.

It results that:

$$f(t) = \frac{n(\Delta t)}{N_0 \Delta t} = \frac{N_0[S(t) - S(t+\Delta t)]}{N_0 \Delta t} = \frac{S(t) - S(t+\Delta t)}{\Delta t} \qquad (23)$$

When Δt tends towards zero it results:

$$f(t) = \lim_{\Delta t \to 0} \frac{S(t) - S(t+\Delta t)}{\Delta t} = \lim_{\Delta t \to 0} \frac{S(t+\Delta t) - S(t)}{-\Delta t} \qquad (24)$$

Thus: $f(t) = -\frac{dS(t)}{dt}$, which is the derivative of the security function with a minus sign.

Knowing the expression $M(t) = 1 - S(t)$ it results that:

$$f(t) = -\frac{dS(t)}{dt} = \frac{dM(t)}{dt} \qquad (25)$$

Consequently, f(t) shows the speed of reducing the likelihood of people staying alive, respectively the speed of mortality growing.

The properties of the density of likelihood of the lifespan/mortality (figure no. 8) are the following[11]:

- the points on f(t) curve show the limit value of the frequency of mortality in the respective time unit all along the lifespan;

- by making a derivative of the security function, we obtain the function of density of probability of the lifespan/deathspan.

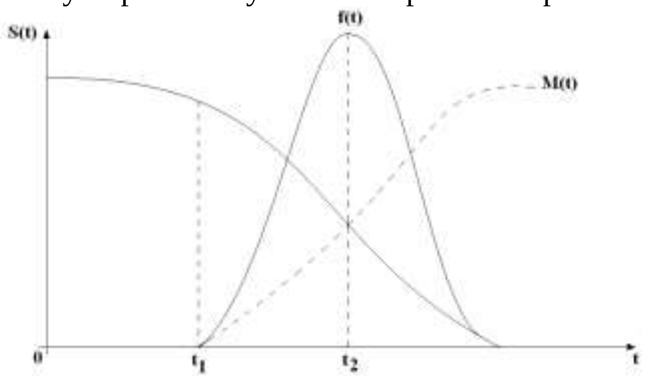

Figure no. 8. Graphic representation of the functions of security, mortality and density of mortality f(t)

People, and especially their leaders, have always been concerned, since ancient times, with their security; thus, the Code of Hammurabi made in year 1750 B.C. wrote: *„If a builder builds a house for a person and he does not make it a solid construction and the house he built crumbles down and kills its owner – the builder will be killed too*". This issue has nowadays become much more complex as people's security depends on the quality of infrastructure, buildings, ships, aircraft (during takeoff, flight, or landing) etc., that is the quality of all the technical systems among which some are large or complex technical systems, consisting in millions of elements or sub-systems. The higher the complexity of these systems, the more fragile they become, since their security depends on absolutely all their components. Thus, even if one or several elements seem minor and lacking significance, one of these or several that costs/cost only a few dollars may break down and lead to the destruction of the whole system. For instance: the deterioration/burning, because of an electrical fault, of a thermostat (a few dollars' worth) of an oxygen tank within Apollo – 13 spaceship (US

[11] Eugen Siteanu, Bedros Naianu, Gheorghe Ilie, *op. cit.*, p. 48.

space program) which exploded and produced enormous damage (350 million dollars).

Indicator z(t), called the mortality rate, or intensity of mortality (risk of mortality /harm) is extremely important as using it may lead to calculating the security or the security level in each moment we are interested in. Actually, it is the probability of a person's organ to be harmed in the time interval $(t, t+\Delta t)$ or the probability that an individual who has lived up t_p *„t”* moment, to suffer an accident or to be killed by a terrorist in the next interval of time $(t, t+\Delta t)$. It reveals the number of people harmed or killed any terrorists in the time unit. Thus, z(t) is the indicator called the density of repartition of mortality (harming) at t moment on condition that the individual is not harmed or killed by terrorists up to that moment[12].

$$z(t) = \lim_{\Delta t \to 0} \frac{P(t < T < t + \Delta t)}{\Delta t}; T > t;$$

$$z(t) = \frac{n(\Delta t)}{N(t)\Delta t} = \frac{n(\Delta t)}{N_0 S(t)\Delta t}$$

$$z(t) = \frac{f(t)}{S(t)} = -\frac{1}{S(t)}\frac{dS(t)}{dt} \to z(t)dt = -\frac{ds(t)}{S(t)}$$

After integration, it results that: $\ln S(t) = -\int_0^1 z(t)dt$.

At moment t=0, S(t)=1 and thus it results that:

$$S(t) = e^{-\int_0^1 z(t)dt} \tag{26}$$

When the ratio of breaking down is constant ($z(t) = \lambda$) during a certain interval of time:

$$S(t) = e^{-\lambda t} \tag{27}$$

By using relation (26) we calculate the probability that a person /individual who had lived up to t_1 moment might not suffer an accident or be killed by terrorists in the next interval of time either (t_1, t_2). The probability of staying alive in the interval (0, t_2) is:

[12] Ibidem, p. 49.

$S(t_2) = e^{-\left[\int_0^1 z(t)dt + \int_{t_1}^{t_2} z(t)dt\right]} = e^{-\int_0^1 z(t)dt} \cdot e^{-\int_{t_1}^{t_2} z(t)dt}$; because $e^{-\int_0^1 z(t)dt} = S(t_1)$, it results that $S(t_2) = S(t_1) \cdot e\int_{t_1}^{t_2} z(t)dt$ and as the expression $e^{-\int_{t_1}^{t_2} z(t)dt} = S(t_2 / t_1)$, which is the functions of security during the interval (t_1, t_2) it results that $S(t_2 / t_1) = S(t_2) / S(t_1)$.

When z(t) is constant and $z(t) = \lambda$ it results that:

$$S(t_2/t_1) = e^{-\lambda(t_2 - t_1)} \qquad (28)$$

The average of (m) lifespans (mathematical life expectancy) is actually the average value of lifespan, which is the average of the total lifespan.

$$m = \int_0^\infty tf(t)dt \qquad (29)$$

This integral is solved through parts: |

$$m = -\int_0^\infty t\frac{dS(t)}{dt} \cdot dt = -tS(t) \Big|_0^\infty + \int_0^\infty S(t)dt \qquad (30)$$

The first term is zero and thus:

$$m = \int_0^\infty S(t)dt \qquad (31)$$

If z(t) is constant

$$m = \int_0^\infty e^{-\lambda t}dt = \frac{1}{\lambda} \qquad (32)$$

When the lifespans for all N_0 individuals/people (t_1, t_2, t_3, ..., t_{No}) are known, then the value of *„m”* is given by the relation:

$$m = \frac{\sum_{i=1}^{N_0} t_i}{N_0} \qquad (33)$$

In practice, the whole duration of t time is shares. In Δt intervals of time and for each Δt interval we determine the number of *„n_i”* dead (harmed) people because of terrorist attacks and *„t_i”* (the average of times corresponding to the interval „*i*”) and it results that $m = \frac{\sum_{i=1}^{t/\Delta t} n_i t_i}{N_0}$, where „*t*” is the moment when all the N_0 people are dead (harmed).

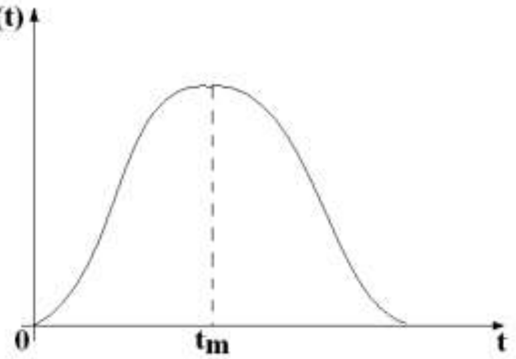

Figure no. 9. Density of mortality f(t) and median of lifespan t_m

The median of lifespan „t_m” (figure no. 9) is the value of lifespan that divides the area under the f(t) curve in two equal parts, which would mean that by integrating function[13] f(t) between 0 and t_m it results that: $\int_0^{t_m} f(t)dt = \int_{t_m}^{\infty} f(t)dt = \frac{1}{2}$.

If, for instance, in a park there are 4 people (no. 1, no. 2, no. 3 and no. 4) who are attacked by two terrorists (a and b) each of whom has a gun with 3 bullets and terrorist „a” shoots three people, which means producing the event A={1, 3, 4}, while the other shoots only two people, that is, event B={2,4}, then the occurrence of event A or B is $A \cup B = \{1,2,3,4\}$, which means a union of event A and event B, while the junction point of the two events will be $A \cap B = \{4\}$, which means that both A and B events were achieved simultaneously (figure no. 10).

[13] *Ibidem*, p. 54.

The union of events is expressed: $\bigcup_{i=1}^{n} A_i$, while the junction point of events is: $\bigcap_{i=1}^{n} A_i$.

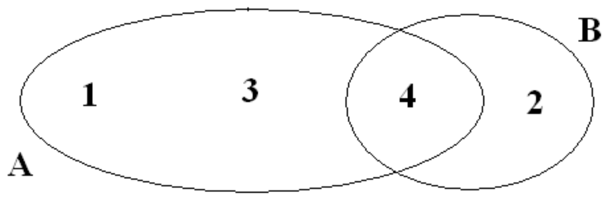

Figure no. 10. Set of events A and event B hence their intersection and union

If X_i is the number of terrorist attacks in an interval „i” (of 1 year, respectively of 3 years), and n_i is the absolute frequency showing how many times X_i value occurred in the „n” intervals of time, then:

$$X = \begin{pmatrix} x_1 & x_2 & x_3 & \dots & x_n \\ f_1 & f_2 & f_3 & \dots & f_n \end{pmatrix}$$

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
X_i	5	2	6	3	10	5	4	3	4	3
Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
X_i	2	3	3	5	4	9	3	3	4	3
Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
X_i	2	4	4	6	3	8	22	14	10	12
Year	2000	2001	2002	2003						
X_i	13	24	43	46						

Table no. 1. Absolute frequency of terrorist attacks

Period	1971-1973	1974-1976	1977-1979	1980-1982	1983-1985	1986-1988	1989-1991	1992-1994	1995-1997	1998-2000	2001-2003
$\mathbf{n_i}$	11	19	10	8	18	10	9	13	44	35	113
$\mathbf{f_i}$	0,0379	0,0655	0,0345	0,0276	0,0621	0,0345	0,031	0,0448	0,1517	0,1207	0,3897

Table no. 2. Absolute and relative frequencies of terrorist attacks during 3-year-long intervals

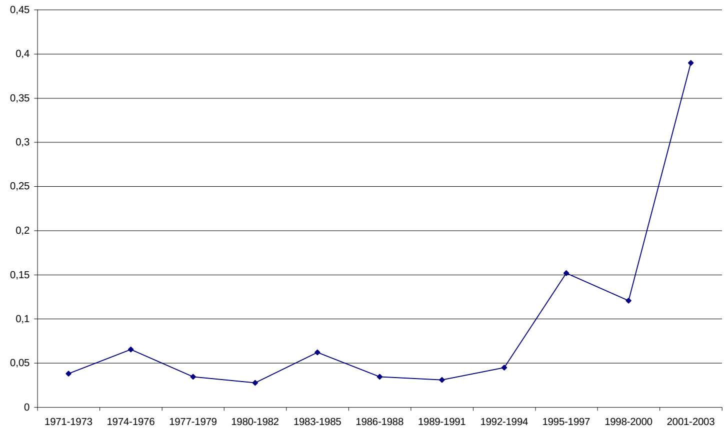

Figure no. 11. Frequency of terrorist attacks for interval i=3 years, between 1971 and 2003

As shown in figure no. 11 starting with 1995 the frequency of yearly terrorist attacks or on 3-year intervals, has started to grow exponentially, unlike during the interval 1971-1995 when the frequency was almost constant (it oscillated around the value f_i=0,045).

Absolute frequency „n_i" and relative frequency „f_i" of the event (ev.) of the number of attacks per year															
ev.	2	3	4	5	6	8	9	10	12	13	14	22	24	43	46
n_i	3	9	6	3	2	1	1	2	1	1	1	1	1	1	1
f_i	3/34	9/34	6/34	3/34	2/34	1/34	1/34	2/34	1/34	1/34	1/34	1/34	1/34	1/34	1/34
Absolute cumulated frequency „n_c"															
n_c	3	12	18	21	23	24	25	27	28	29	30	31	32	33	34

Table no. 3. Absolute, relative and cumulated frequencies

According to the values of the cumulated frequencies, we draw the graph of the polygon made up of these frequencies (figure no. 12)

POLYGON OF CUMULATED FREQUENCIES

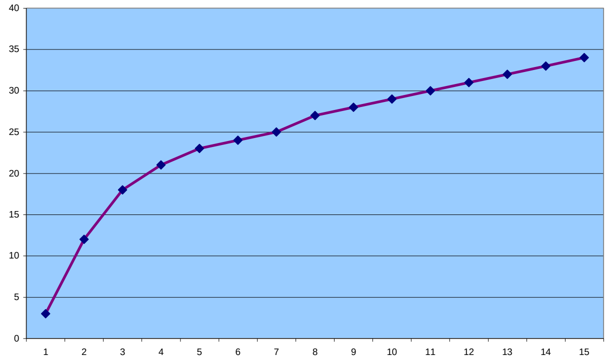

Figure no. 12. Polygon of cumulated frequencies

The polygon of relative frequencies can be drawn according to the values in table no. 3 (figure no. 13).

POLYGON „f_i" OF RELATIVE FREQUENCIES

Figure no. 13. Polygon „f_i" of relative frequencies

Figures show that the most frequent (f_i) were a number of 2-5 terrorist attacks /year, logically explained through the fact that a large number of terrorist attacks/year are more costly and harder to organize.

1970		**1971**		**1972**		**1973**		**1974**		**1975**	
m	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***
58	*30*	*15*	-	*95*	*209*	*36*	*1*	*237*	*473*	*27*	*185*
88		15		304		37		710		212	
1976		**1977**		**1978**		**1979**		**1980**		**1981**	
m	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***
76	-	*11*	*33*	*54*	*59*	*251*	*600*	*85*	*200*	*5*	-
76		44		113		851		285		5	
1982		**1983**		**1984**		**1985**		**1986**		**1987**	
m	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***
48	*27*	*386*	*168*	*120*	*83*	*382*	*105*	*11*	*108*	*100*	*16*
75		554		203		487		119		116	
1988		**1989**		**1990**		**1991**		**1992**		**1993**	
m	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***
262	-	*174*	-	*2*	-	*17*	-	*29*	*242*	*35*	*1149*
262		174		2		17		271		1184	

1994		1995		1996		1997		1998		1999	
m	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***	***m***	***r***
121	*425*	*204*	*5911*	*168*	*2500*	*71*	*241*	*404*	*5556*	*17*	*46*
546		6115		2668		312		5960		63	
2000		**2001**		**2002**		**2003**					
m	***r***	***m***	***r***	***m***	***r***	***m***	***r***				
33	*118*	*3293*	*343*	*642*	*1780*	*752*	*2711*				
151		3636		2422		3463					

Table no. 4. Absolute, relative and cumulated frequencies

Based on absolute frequencies (table no. 4) we draw the polygon of absolute frequencies of the bi-annually number of dead and wounded people.

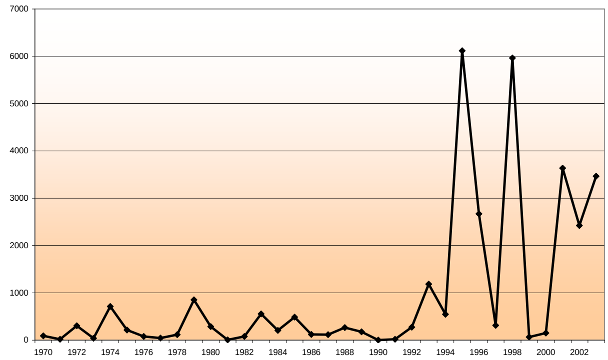

Figure no. 14. Polygon of absolute frequencies
of the bi-annual number of dead and wounded people.

1970 - 1971	**1972 - 1973**	**1974 - 1975**	**1976 - 1977**	**1978 - 1979**	**1980 - 1981**	**1982 - 1983**	**1984 - 1985**	**1986 - 1987**
103	341	992	120	964	290	629	690	235
1988 - 1989	**1990 - 1991**	**1992 - 1993**	**1994 - 1995**	**1996 - 1997**	**1998 - 1999**	**2000 - 2001**	**2002 - 2003**	
436	19	1455	6661	2980	6023	3787	5885	

Table no. 5. Bi-annual absolute frequencies

Based on the values of bi-annual absolute frequencies we draw the polygon of absolute frequencies (figure no. 15).

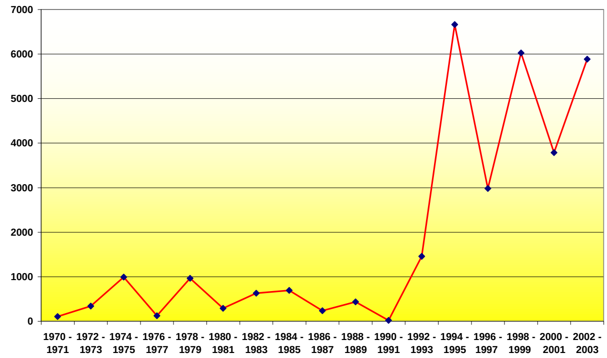

Figure no. 15. Polygon of absolute frequencies of the number of dead and wounded people during 2-year-long intervals

This last graph shows that the absolute frequency of the number of dead and wounded people during 2-year-long intervals has suddenly started to grow since 1992. Therefore, we may say that western countries might have foreseen that the number of terrorist attacks will grow considerably in future years and, consequently, could have taken timely and efficient measures for countering these attacks, including those on September 11, 2001.

BIBLIOGRAPHY

ILIE G., *Risc şi securitate*, Vol. I, Editura UTI Press, Bucureşti, 2015;

RĂCHIŢAN D., *Elemente de teoria probabilităţilor şi statistică. Aplicaţii în domeniul militar*, Editura Academiei Trupelor de Uscat, Sibiu, 1998;

SITEANU E., NĂIANU B., ILIE G., *Fiabilitatea produselor tehnice*, Editura AISTEDA, Bucureşti, 2000;

WONG J., *International legal affairs*, in Small Arms Defense Journal, Spring 2010.