PART I

SUBJECTIVE EXTREMAL PSYCHOLOGICAL PRINCIPLE AND ITS APPLICATIONS

1. GENESIS OF THE PRINCIPLE

The cornerstone of the principle is a supposition that human's psych works in an optimal, in a certain sense, way in any multi-alternative situation. It was proposed to use the Jaynes' formalism, developed for the field of physical problems in the middle of the last century [4, 5], as a mathematical envelope of this psychological principle. In order to apply this formalism to the psych processes, it was necessary to introduce preferences of the first and second kinds. The preferences resemble probabilities, however they are not them. It was introduced the definitions of what the subjective entropy is as well as the subjective information.

Genesis of such a property of human's psych is not absolutely clear. But if we stay on the evolutionary position we have to acknowledge that history of evolution had a sequence of some sort of jump changes and periods of slow changes. In this case we hope to explain what the reason of the entropy maximum principle is.

Besides introducing the preferences, it was proposed the so-called psych temperatures and the scheme of a non-uniformity of the entropy space.

The main topic of the monograph is one of the examples of the mentioned principle application.

It has occurred that this principle has a very wide area of applications in different directions. Here we would like to overview the most important and obvious directions. We will describe a sense of such a direction and possible ways of corresponding solutions. The principle itself is described in the simplest form in the **PART III** of the monograph.

Talking about the principle's genesis it is indispensable to note (mention, point out) its major origins.

In fact, there were two main of them. These are the Jaynes' principle [4, 5] from statistical mechanics, and works in the field of information theory. In works [47, 46, 6, XXXII, XXX, XXXIV] there was an implementation of the Jaynes' principle into the sphere of psychology.

Later on the **ENTROPY PARADIGM** adopted from the publications of the predecessors revolutionized imaginations about human's (subject's, individual's) activity in any sorts of systems. Thus, there appeared **SUBJECTIVE ANALYSIS** [47, 46, 6], **SUBJECTIVE ENTROPY MAXIMUM PRINCIPLE** [6], application to the active systems theory [XXXIV], and a few applicable branches [I-XXXIV].

The principal conceptual framework of the discussed in the presented monograph approach was developed to a level of scientific theory in a series of the main previous publications [47, 46, 6, XXXII, XXX, XXXIV].

Now it looks like the principle deals with the economy, psychology, sociology, politics, education, medicine, of course engineering, safety issues, conflicts of any types etc.; wherever a subject's preferences have a crucial importance and play significant role [I-XXXIV]. Figuratively speaking we see the main practical value of the theory in the vast majority of the scientific disciplines; however the presented monograph is dedicated to the **LIGHT & SHADOW ECONOMY** concern which is considered hereinafter.

1.1 INITIAL CORNERSTONES OF THE THEORY

In this introducing **PART** we just mark the main moments of the concept. First of all, we were forced to introduce two kinds of preferences: object preferences and rating preferences. The principle and its different variants were introduced in monographs [47, 46, 6, XXXII, XXX, XXXIV] and a lot of papers [I-XXXIV], but the main notions of the theory are the preferences of the two kinds.

Object preferences are determined on the set of material or information objects (stuff). And a subject relating to this is supposed to be able to make a choice on the set.

Rating preferences are determined on the group of some subjects; and it is supposed that somebody could make a choice of one or several subjects from the group. As a particular case it could be set a problem of a group leader choice. Then, it has been introduced the so-called *mutual utility*. This theory has a lot of common properties with the generally accepted *utility theory*, but at the same time the proposed theory has several essential differences from it.

Mutual utility theory is the basement of aggregation of preferences in a social group. The utility transfer from one subject to other subjects could lead to the change of the available utility of the given subject. For example, if it is going about a transfer of some financial utility, then the transfer could lead to the change of the value of the available utility. Otherwise, if it going about, for instance, a scientific or political or economical knowledge, then such a utility could remain unchangeable for the delivering subject.

Mutual utility could be considered as a possibility of the given subject to give her/his own utility to some political party in the course of an election campaign. These contemplations are incomplete (not full). But the notion of mutual utility gives a possibility to arrange some schemes of preferences aggregations. The sense of our maximum principle differs from the well-known Jaynes' principle [4, 5], with the circumstance that in our form it contains subjective entropies [I-XXXIV].

1.2 THE SCIENTIFIC FIELDS OF THE PRINCIPLE POSSIBLE APPLICATIONS

Let us consider some particular directions of the proposed principle applications.

Economics

If there are several alternative ways of economical development, there could be an object of the subjective choice by someone who is a participant of the economical game. One of the examples of such a choice is given in monograph [XXXII].

An obvious area of the theory application is the economical crisis theory, dynamics of economical development, money theory and so on. Calculations for supply and demand are given in the monograph [46]. Corresponding dependencies are found theoretically basing on the principle. It is proposed the so-called theory of *"living points"*.

In the general case subjective information has been introduced as a difference between two entropies: unconditional and conditional after some events happened. It is shown how to calculate the cost of the subjective information and how it could be used in economical calculations.

Crisis Theory

This theory is also an object for subjective entropy maximum principle. A crisis is considered as an interaction of some different distributions of preferences. One of the main suppositions of the theory at all is the statement that all preferences distributions have their own determined carriers. In addition to this supposition, there are following ones: entropy spaces are not uniformed; they are divided with some borders which we name *"entropy thresholds"*. One of such a threshold has following property: if the corresponding subjective entropy is higher than the level of the threshold, the subject is not able to make a solution, to choose an alternative, because he/she hardly distinguishes the differences between the alternatives. If entropy crosses the threshold *from top to bottom (downwards)*, a solution could be made. This condition is a necessary condition of a decision making.

It is supposed as well an existence of a certain very low subjective entropy threshold. We name the threshold a zombie level. No one has resources to get back out from that area.

It has been proposed some entropy cards to illustrate a crisis development. In addition to the subjective entropy, subjective risk has been introduced. Simultaneous study of the entropy and risk allows discussing a crisis development in any case.

We distinguish *"cold"* and *"hot"* crises. Also there are inner crises and inter-subjects' crises. One of the problems is a crisis between groups of subjects, particularly between one subject and a group.

Safety of Active Systems

One of the directions tightly connected with the crisis theory could be named a problem of *"safety of active systems"*. Here it could be given some definitions of this topic. Firstly we have to determine the levels of safety, like it is done in the problem in the aviation safety. Let us remind here that it is introduced five types of states: *"normal"*, *"complicated"*, *"dangerous"*, *"damage without casualties"*, and *"crash"* – *"damage with casualties"*. In ICAO documents there are two kinds of events distinguished: *"incident"* and *"accident"*.

Applicably, in general sense, to general active systems, in particular to aviation systems, we have to determine:

1. What are active systems? There are several definitions of an active system. For example, Burkov and his collaborators (Novikov, Petrakov et al.) [57, XXXV-XLI].

We are going to get a position that all systems in activity of which there is someone who can make a decision in a multi-alternative situation are active systems. In our living activities we deal exclusively and only with active systems, whatever and whenever we do. It gives us a right to see the theory we discussed as extremely general approach.

In particular problems investigations, we use all tools about which we have already told. A set of alternatives, distribution of individual preferences of the two kinds, subjective entropies (corresponding with the object, rating preferences, and aggregated preferences), functionals of problems we need to maximize, entropy bars or thresholds, subjective risks (Bayes' type) and the critical levels for the risks are introduced and developed in the models of investigations [46, 6, XXXIV].

Notions of information and entropy death were also introduced in [46].

2. It was developed a *Hybrid Theory* connecting *Subjective Entropy Paradigm* [46] (*Subjective Analysis*) and Kolmogorov's model of Markovian stochastic process. In these models it has been used a so-called cognitive function which is connected with the subjective risk and the models of subjective probabilities [32, XXXIV].

As a particular case, a hybrid theory of models of mass service systems theory has also been developed.

The developed theory has been applied to investigations of several very complicated aviation events (crash of Il-62 in Sheremetevo, incident of Il-86 in Simferopol, crash of Polish Government Tu-154 by Smolensk and so on).

It was investigated the probability of wrong decisions made by two or three persons (cockpit crew).

Social Events (Information Wars, Psychological Wars)

A lot of social events could be described in terms and methods of the *Entropy Paradigm Analysis* [46, 6, XXXI-XXXIV], which opens new possibilities to see, understand, and forecast what is happening in social groups of different kinds.

Here we again take the supposition about a carrier of the preferences but in addition we consider some model of a collective intelligence which is supposed to have its own individual carrier.

One large section of the *Social Entropy Analysis* is an entropy theory of a crowd behavior. Investigations in this direction are at the very beginning at the moment. One of the essential problems is a problem of emergence of the leader of a group.

In this general social system dynamics we are interested in the following question: *"Could the subjective entropy of an isolated (in material and informative resources) system decrease?"*

We found some examples when such development is realized. But it could be said that the system is not absolutely isolated from its states memory in time. *"Today's"* distributions depend upon *"Yesterday's"* distributions and influence *"Tomorrow's"* ones.

We could forecast what will happen to an isolated group if it is *isolated* for some time.

These effects depend upon the so-called *Psychological Temperatures* which appear in distributions of subjects' preferences and rating preferences. In the case of rating preferences this temperature is called the *Social Temperature*. The level of such a temperature determines the state of the social group. For example, high social temperature corresponds to the *Social Hysteria*.

Here we consider different kinds of the social crisis. For instance, we are interested in how an inner conflict turns into a social one and backwards.

Application to Educational Problems

The presented theory is rather productive in applications to higher education problems. Here, we have relations between professors and students.

Another problem arising at teaching and studying process is a permanent overdoing of the relating documentation.

Modifications of educational curricula and programs are usually made under the influence of the responsible persons who elaborate and develop the changes to the educational documents (thus their preferences play some important and sometimes crucial role in the academician system of education).

Furthermore, the system is functioning in a cyclic style and that pertains not only with a daily routine lectures, practical and laboratory classes, seminars, and sessions. But it also touches the problems of every semester examination periods, practical trainings, year-to-year grade transferring, yearly graduation from the university, as well as the regular university's joining campaign. All these processes of the short-, medium-, and long-term prospects are accompanied with subjective preferences distributions and, not seldom, with different collisions of the subjective preferences distributions of the participants of the processes.

In order to resolve the troubles that may appear, the ministry, rectorate, directorates, and managing staffs try to elaborate normative documents (statute, provisions, rules, regulations, directives, orders etc.) helping in this.

An accumulation of the corresponding information, its processing, and generated reflective influences have unambiguous and definite features of a

managing or governing process elements (likewise in a controlled process in engineering systems of control) with a feedback, subjective preferences being determining factors at every even the smallest portion of the process and each just the tiniest piece of that.

Influence of students it is a separate theme of the research that has to be conducted through the prism of subjective analysis and at the angle of the subjective preferences entropy maximum principle. The point is that the students' influence gradually becomes more and more significant and it can be both positive (stimulating) and negative (degrading) in the sense of their intelligence evolution. That is the problem.

The closely adjacent problems are certain problems of relations between either the students within their academic groups, inter-groups, intercourses or the students and professors. In any case they are people and people interact via their individual preferences distributions.

Professor's and Student's distributions of their own subjective individual preferences can have a form of a unison (agreement, harmony) when the process of the academic knowledge propagation by the Professor and perception and digestion by the Student goes more active, faster, and more effectively or the subjective preferences distributions may have a form of a dissonance (disagreement, disharmony, conflict) as a result we may observe a collision leading to a poor effects of educational endeavors. All in all, it even may result a crisis between the Professor and the Student, which, surely, much better to prevent than uselessly strive to resolve afterwards if it has already happened.

The numerous examples of the presented in the monograph theory we can prolong endlessly. We would rather publish a separate book in regards with the remarkable educational applications of the principle. Herein we are going just to list briefly the principal types of possible applications.

Here they are. Work at the last courses implementing dividing of time between alternatives (likewise distribution of time between passive and active forms of studying or training). Bologna system dilemma – it is a classical style dilemma of perfection versus imperfection, better vs. worse, and newly emerged in opposition to obsolete.

The idea of module structure of educational process was proposed a few decades ago. It was introduced the notions of effectiveness and qualities of a deductive (an educational) module and corresponding numerical measures of the effectiveness and qualities. At the same time it was introduced the so-called deductive invariants.

The deductive invariants and modules suggested to represent the educational process were considered as some principal bricks in the whole structures of the educational planning.

Another kinds of the problems with subjective preferences in education are a dynamical class of problems involving taking into a consideration the issues connected with forgetting the studied information and transformations of preferences in time, as well as a statistical class of problems dealing with the

estimations of the canonical preferences distributions parameters and solving the arisen problems in the stochastic settings.

Due to the Bologna system implementation the wealth of relating to checking information results has been collected and accumulated. On the basis of the entropy paradigm, authors are sure that, a new method of checking, control, and managing the deductive process could be elaborated and implemented. Authors believe that students' preferences distributions and dynamics are to be investigated in parallel to the control process; it is expedient.

This approach is tightly connected to the idea of the problematical education. It sounds like a proposition of a set of alternatives to the students, out of which he/she has to make a choice of some of them.

One more thing concerning statistics that ought to be mentioned here is that statistical data is mostly known and some dissertation research has already been performed but in our opinion that was not deep enough. In accrual fact, there are huge statistics; and we add special tests.

Application to Medicine (and Engineering) for Strategies of Diagnostics

It is a typical problem of subjective analysis and theory of entropy methods. Generally, the object of studying is considered from the point of view of the entropy paradigm. Of course, we have to choose not only the right diagnosis (as a solution), but also to select the correct strategy for a cure from the available ones.

First problem is the correct diagnosis and second is and appropriate treatment with a suitable remedy / medicine or a proper surgery.

Risk is higher the higher probability of a wrong decision (strategy of treatment, cure) is. Healing effects are under the threat of the wrongness of the doctor's individual (subjective) preferences.

There is a very close analogy (similarity) in medical diagnosing and engineering objects maintenance. We can see here a clear role of the alternatives number at the engineer's (or doctor's, if we talk about medicine) disposal. All developed provisions of the subjective analysis theory could be successfully used in the field of both medical and engineering diagnosing.

The results of the theoretical research would help take into account the diagnostics parameters (such as temperatures, for example) in combinations within corresponding effectiveness functions in order to obtain subjective preferences in an explicit view.

In the process of engineering (medical) diagnosing the problem of a diagnosis choice out of several alternatives are usually resolved. Then it is chosen an alternative strategy for restoration (remedy).

All these systems are active; and, apparently, the developed method based upon the principle of the subjective entropy maximum is perspective in the areas [VII, X].

Application in Engineering Operation

One of the main possible implementations of the principle is to an operation of active transport systems in conditions of multi-alternativeness and uncertainty, likewise in the Manuscript of the Dissertation and its Author's Summary [XXIX]. The Dissertation for a doctor degree on the specialty 05.22.20 – Operation and

repair of transportation means was successfully defended at the National Aviation University, Kyiv, 2016.

The dissertation was devoted to elaboration of optimal control methods for safe operation of active transportation systems on the basis of mathematical modeling application results for complex systems functioning in conditions of multi-alternativeness and possible conflicts, with the help of the subjective entropy maximum principle postulated in subjective analysis.

Theoretical indexes of subjective preferences certainty / uncertainty were developed, which on the opposite of the traditional entropy show the individual preferences directions as well as they are more convenient tools for research and measures of the preferences certainty / uncertainty through their relative values and the sign of the certainty / uncertainty inclination.

Generalized models that reflect the principle dependence between individual preferences of subjects, who are the active elements of the operational control systems, and objective functions of effectiveness and safety in cases of discrete and continuous alternatives were developed.

Complex technical-economical-social criteria of transportation means operation and repair control, which take into consideration the existed multi-alternativeness and possible conflictability of operational situations explicitly, were developed.

When one deals with a process of operation, object of operation, the one conditionally extremizes the one's subjective entropy either consciously or subconsciously. Then, the proposed in the subjective analysis theory mathematical model explicitly yielding individual preferences may be used. Problems of flight safety optimization can be solved with the use of the principle as well [III-XVII]. In order to obtain the extremals of a variational problem one can apply the principle.

Application developed herein

In the presented monograph (pp. 21, 22) there obtained static estimations for optimal situation of two-component "Light and Shadow" economy in deterministic setting. An attentive reader may notice some development of those models with respect to probable managerial actions of both State and Shadow structures (pp. 34-43). This creates a certain dangers to the Firm on both sides and would change the discussed proportions by the Firm. Thus, the created model becomes helpful in conditions of governing the stochastic situation. More accurate predictions could be made with taking into account subjective risks likewise [32].