The Technology of Creation of the Standard Base for Socio-Economic Dimensions

[1]L.B. Shabanova, [1,2]M.R. Safiullin, [1]I.P. Demidov and [2]N.M. Khabirova
[1]Kazan Federal University, 420008 Kazan, Russia
[2]Center of Advanced Economic Research, Academy of Sciences,
Republic of Tatarstan, Kazan, Russia

Abstract: Practice education standards for assessing and comparing (comparing/contrasting) heterogeneous properties of controlled processes of socio-economic spheres. Design technique and technology to create a reference framework for processes in socio-economic sphere and on this basis to apply for measuring operations scientific methods of metrology. In this researchers methods of imitating and semantic modeling in a complex with methods of the economical and statistical analysis are used. Possibility of creation of the expert system reproducing technical and operational properties of natural market metrology, formation of general estimated function and a comparable measure of productivity for a set of diverse and multidirectional indicators is discussed. The model of creation of reference base for private indicators providing an integrated rating assessment of a condition of various organizational structures and processes is developed. The conclusion is that in terms of multidirectional indicators the most viable scheme of management of organizational systems is the formation of the reference base, the formation of normative-evaluative, the synthesis of multidimensional processes to one-dimensionality of a single criterion.

Key words: Indicator, scale, modeling, assessment, management, integral evaluation

INTRODUCTION

The main difference between natural-science (physical, technical, tool) measurements and socio economic measurements is the presence of the standard base, i.e., reference units of measure (weight, length, frequency, temperature, etc.) and high-precision measuring tools. The latter are used in legislative and applied metrology, at creation of scales, in operations of checking measuring instruments. Measurement is an algorithmic comparison operation contrasting the results of observation with tags (numbers, characters, symbols and so forth.) measurement scale. The registered supervision by means of the corresponding scales are estimated multiply on degree of proximity to reference levels or to indications of precision control devices. As a result concrete values or their intervals with a certain accuracy, reliability, certainty are established. The description of scales is in detail stated in special literature therefore we will be limited to their short classification:

- Scale of items (nominal, classification)
- Ordinal (rank) scale
- Scale of intervals
- Quantitative scales (relationships, differences, absolute)

The data registered in these scales (indicators, parameters, characteristics of states) fix only the volume, the size of the controlled phenomenon and act no more than necessary but insufficient information for social and economic (system) measurements. Here, the valuable and target measure of controlled processes, a measure of degree of satisfaction of requirements by this or that level of an indicator, a measure of validity of administrative decisions is required. In social and economic measurements the calculating and settlement phase, some dependences, ratios, formulas established according to this or that justification with this or that theory prevails but thus for the estimated indicators of constant constitute reference base in its classical understanding isn't present. Therefore, requirements of natural-science metrology in their idealized, correct and full-fledged option can't be distributed to social and economic processes. The main and common goal of the research is to spread the natural science of metrology requirements to measure the state of organizational systems and their effectiveness. A specific goal of this fragment of researches is development of a technique and technology of creation of reference base of measurements as one of the main signs of natural-science metrology.

MATERIALS AND METHODS

Identification and assessment of conditions of difficult multi-purpose objects in economy and the social sphere assumes not only recognition of various nature of their characteristics, degrees of their expressiveness on

various measuring scales but also the allocation stage (or giving) sense of this information, its substantial filling, generalization and transformation to knowledge is required. This stage remains for the person, out of exact metrological procedures with all accompanying risks, problems it can be carried to substitute metrology as it doesn't even bear a faint resemblance to the natural-science absolutely fairly. Other type of scales on which connection between a variation of the settlement or directly registered signs and their high-quality interpretation would be established is necessary. It is a class of the qualimetric scales allowing to fill with the contents concept of a standard for social and economic measurements. Such scales are called standard-estimating.

Attempts of searches in economy of certain standards in the sphere of material and material ideas of consumption (that is standards, standards of consumption, sets of goods and services and so forth) most often are low-useful to the purposes of an assessment of productivity of labor efforts of people, including the concrete enterprises, firms, corporations, their divisions. Therefore in practice identification of qualitative level of indicators is connected with various ways of group and the statistical analysis of the data representing the saved-up experience. Obvious advantage of such ways is their commonality and possibility of obtaining qualitative distinctions not only at the moment, but also in a retrospective that allow to trace their dynamics.

The intellectual argument of persuasiveness of the analysis and assessment of activity of any administrative, organizational and economic structures as a rule is followed by the link to typicality of supervision, to their frequency, repeatability for last periods. A small amount of objects or results is specified: the front lines improved the averages which are lagging behind inadmissible. At traditional, informal ways of an assessment of situations their comparison at a small number of the above gradation (zones) is habitual for the expert and is used for accumulation and systematization of experience, extent of mastering which directly characterizes competence and qualification of the person exercising control. As a rule, the expert rather surely can characterize the borders dividing ranges of each of indicators for which it is fair, in his opinion, this or that quality standard. This extremely important moment speaks about need of allocation on an axis of any indicator of a small number of the characteristic (basic) points identified as a result of studying the experience of functioning the objects. This circumstance focuses development of formal technics of the typological analysis uniting some linguistic variable with function of empirical distribution of data. And is

more concrete, it can become object of imitating and semantic modeling. The principles of division of the base set of observations on different typological groups should preferably take into account the natural character of the qualitative analysis of human (experts, specialists, decision-maker) of single-row numerical sequences. Formally, this opportunity opens the disciplines known in metric scaling methodology which can link the unambiguous relations quantitative and qualitative variations in the properties.

Generally speaking, in theory, the typicality of the results and consequences of a labor activity is not public (production) relation. It acquires the property, it becomes the object of study only as a point in the systemic analysis of situations where the consideration involved in public relations: purposes, requirements, interests, experience, time, etc. Using the typology of the distribution of private characteristics in the impact analysis introduces the need or rather the intensity, a raft of economic interest in a particular property and therefore, the accumulated point of view of the consumer on this property. Note that the cumulative (integral) function of the empirical distribution of all of the assessment criteria specifies the quantile based measure (rating) and simultaneously values of distribution density relationship of typicality of the observations.

RESULTS AND DISCUSSION

Researchers will set the task of allocation the entire set of observations of a small number of the typological groups having the contents, useful to problems of management. In other words, it is the analysis on a phase of concrete valuable purposes on each of controlled properties and a typology of their realization. The specification of the purposes in the conditions of the competitive environment in the most universal and concentrated look is expressed by the widely adopted orientations at management: to catch up with leaders, to outstrip or force out competitors, to occupy the niche in the market, to keep up with the main group, to adopt experience of successful objects, etc. Their realization in a semantic form is equivalent to the use of concepts inadmissible, badly, satisfactorily, well, progressively, perfectly, etc. Such purposes integrally unite two systems of interconnected concepts: first, identification of objects (results) on a qualitative sign (the leaders, who are successfully working, the main group which is lagging behind), secondly, nature of the mass character of supervision (atypical, low-typical, rather typical, the most typical). If borders of these concepts (groups, zones, gradation of equivalence) on a scale of a single dimension

are defined, the projection of boundary tags to a scale of an initial indicator and on it will set the corresponding zones of various denominations. It is obvious that as a standard the best gradation of data in their basic set can be chosen (or it is interpreted as a standard). Such approach turns a standard into the purpose of management, allows to unify and to verify extremely concept of a standard for diverse and multidirectional indicators in socio-economic measurements.

Sequence of transformations when to each initial measurement there corresponds to the high-quality interpretation, the extent of achievement of the purpose (satisfaction of requirements), at the level of conceptual operators it is possible to represent as follows:

$$\{x_{i,j}\} \Rightarrow \{F_{i,j}\} \Rightarrow \{Sc_{i,j}\} \Rightarrow \{H_{i,j}\}$$

Where:

$\{x_{i,j}\}$ = The operator of collecting and transformations of data of statistical and current supervision, reduction of a set of i-characteristics (i = 1, 2, 3, ..., n) j-objects (j = 1, 2, 3, ..., m) to a comparable form

$\{F\}$ = The operator of data of diverse indicators, in different units of measure to a single unified commensuration (as that in the measure of orders of quantiles is chosen and reasonable)

$\{Sc_{i,j}\}$ = The operator of formation of normative rating scales and standards on all controlled properties

$\{H_{i,j}\}$ = The operator of formation of a metrics of distances between the actual levels of indicators and reference

The listed operators include as standard operations of data processing within methodology of nonparametric statistics (they are in detail described in special and scientific literature) and special settings, parameters and programs within imitating and semantic modeling. In detail all technology of data processing for conditions of socio economic measurements is stated in the monograph published in Germany (Demidov, 2013).

Generally the quantity of zones of data equivalence (i.e., gradation, groups of constant quality) can be unlimited, however, their greatest possible number no more than seven. In the qualitative analysis of numerical ranks it can be excessive owing to difficulties of their substantial interpretation. We will emphasize that at absence of special requirements to number of gradation of quality it is expedient to stop on their four-zonal differentiation. It can be proved a wide circulation in everyday life of people of system of mark estimates 2÷5. One of its remarkable advantages it doesn't demand explanations and justifications. Everybody perceives it

since school years consistently as absolutely natural semantic scale of quality standard of knowledge. Addition at least of one point demands essential explanations concerning redistribution of the content of other gradation and still the bigger number of new qualitative zones in general does inconceivable all system of estimation. It is known that more differentiated systems of mark estimates don't find a wide circulation, are applied selectively and with a large number of various (not obvious) reservations and explanations.

Further, in determining the distance between the actual level of the estimated properties and a standard there is a task to coordinate the typicality of relations with numerical scales of initial indicators. Most simply tags of limits of data of various typicality and preference can be defined, successively considering the integrated groups and their qualitative content. In particular, halving of all set of the ordered observations on two 50 percentage groups at once divides all data on lagging behind and front lines concerning distribution center and its role can carry out the arithmetic average, a median, mode and other indicators. The requirement to them their strength, stability at repeated observation over group of the objects entering a reference set. If 50 percentage half of supervision to halve everyone once again, we will receive three quartiles of distributions of an order: 0.25; 0.5; 0.75. Round these tags it is possible to form some zones of various typicality and preference of data (Adler and Chernykh, 2001; Burkhanova, 2008; Demidov and Matveev, 1990; Demidov, 2013; Korneychuk, 2007; Odegov and Rudenko, 2011; Omelchenko, 1997; Shabanova and Demidov, 2010; Vechkanov, 2011; Weismann *et al.*, 2013; Zhuravel, 2013). It is trivial and rather obvious way of formation of scales. Thus, on an axis of any indicator three boundary values dividing on a scale x four zones constant (for different indicators) but variable on advantage (threshold, step) qualities can be received. Therefore, we formulate two important definitions.

Definition A: The state estimation of object on a single indicator consists in reference of its level to one of qualitatively various typological groups given on a basic set of observations and forming system ordered on typicality and preference of the zones used to manage the state of objects.

Definition B: Reference levels (or intervals) on a set of diverse and multidirectional properties (indicators) are set uniformly, on the basis of their high-quality levels determined by a basic (reference) set of observations.

The uniform symmetric partition of statistical observations on groups often is used in applied

researches, in technical and technological systems, in metrology, at quality control of production, etc. It can be defined as the process of a priori classification of the data collected on the basis of a single typology. However, for organizational, human-machine, intellectual systems uneven, asymmetrical division of statistical sets into natural groups (zones, parts, clusters) which unite on the basis of proximity, similarity of data each other quite often locates or are allocated in the analysis of behavior (poll) of subjects of economic activity: consumers, businessmen, experts, managers, etc. Such division can be referred to process of a clustering (natural classification) when borders between zones have to be established, proved in addition, proceeding at the same time and from substantial essence of problems of classification and estimation and from this that the subject of the solution of problems of management is the person-the head, the analyst, the expert, etc. Universality and the all-acceptability of approach is proved in imitating and semantic modeling, in the axiometric appendices, in methodology of artificial intellectualization of information processes. The example of such justification is given in research of Bespalova.

When preprocessing real statistical selections there can be a need of calculation of quantiles of the demanded order (x_q). For example, in the absence of standard values of orders of quantiles in basic data, at correction of borders of zones of equivalence, etc. In this case it is possible to resort to a method of piecewise and linear approximation of empirical function of distribution:

$$x_q = x_0 + \frac{x_1 - x_0}{F(x_1) - F(x_0)} \cdot \left[q - F(x_0) \right]$$

Where:

x_0 and x_1 = Respectively the beginning and the end of the interval containing a required quantile of x_q

$F(x_1)$ and $F(x_0)$ = Values of function of distribution on the ends of this interval

q = Order of a required quantile

For example, estimated by Bespalova, values of standard quantiles on a corporate indicator x "economy of energy resources for the reporting period in (%) to a limit" form set of tags (boundary values) and thereby, on an axis of an indicator the standard rating scale is formed. Elementary operation of comparison of any reporting level of a concrete indicator with system of tags on scales at once determines the level of its high-quality development (by reference of reporting level to this or that zone of a

scale). At equality of an indicator and borders of any zone the assessment is made in favor of the estimated object. Comparison allows to avoid various functional and mathematical operations with "root" single measuring instruments of properties of the

studied objects. Similarly, essentially redundant operations are overcrowded, for example, techniques and practices of the traditional statistical-analytical and qualimetric analysis. On allocated on scales basic (reference, main) values of an indicator analytically structures experience, both on spatial and on temporary variability of a sign. Retrospectively we will note that a choice of any real combination of tags on an indicator axis for definition of qualitative standards, involving reference data, has to remain transparent and rather constant in time and concerning any properties.

One of the main advantages of use of tools of scaling is opportunity the organization of monitoring (continuous tracking) of a variation of indicators and preservation of standards in their invariable substantial sense at any dynamics of numerical levels. It is for this purpose convenient to use a method of adaptive automatic fine tuning of intervals of group (boundary standards) according to the current values of the registered data. Its main advantage in that the watching mode of supervision will be organized according to quality standard of properties but not with their quantitative values which act only as secondary signs for a self-explanation primary. Application of a method can also be referred to known standard operations of statistical data processing (for example, a method of "the sliding window"). Besides, the idea of the known principle of dynamic programming the principle of an optimality of Bellman is realized. Regular recalculation of tags of scales after each reporting period restores entry conditions of estimation and thereby, everyone the subsequent assessment of a state will be optimum rather previous situation. Process of multistep search of an optimum and therefore, the trajectory of states formed in time according to the specified principle is reproduced, belongs to the class of the optimum.

Figure 1 shows the actual movement of tags on a standard rating scale on an indicator "x" in dynamics, for two periods of t and (t+1) for shops of the main production of the real industrial enterprise. At the most various estimates of conditions of social and economic objects in system (intellectual) measurements the
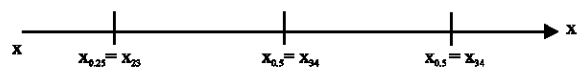

Fig. 1: Divsion of boundary values

(X_{29}) Unacceptable level	(X_{34}) Acceptable level	(X_{45}) Good level	x High level
Low-typical	Rather typical	The most typical	Rather typical and low-typical
$X_{0.1} = 1,404$	$X_{0.366} = 1,702$	$X_{0.75} = 2,516$	

Fig. 2: Standard rating scale of an indicator x-"economy energy resources for the reporting period in (%) to a limit"

x<1.57	1.57<x<1.76 $x_{0.1} = 1.57$	1.76<x<5.1 $x_{0.1} = 1.76$	x>5.1 $x_{0.1} = 5.11$ x(%)
Unaccepted level x<0.94	Accepted level 0.94<x<1.97 $x_{0.1} = 0.94$	Good level 1.97<x<4.81 $x_{0.35} = 1.97$	Advanced level x>4.81 $x_{0.75} = 4.81$ x(%)
Unaccepted level	Accepted level	Good level	Advanced level t-1

Fig. 3: Dynamics of change of tags of a scale on an indicator "x" for two periods t and t+1

Table 1: Illustration of preference changes and typical data for four zones of quality

Name of levels indicator on a scale preference	Name of levels indicator on a scale typicality	Border of zones on F(x)
Bad, inadmissible, significantly lagging behind	A typical and low-typical	<0.1.0
Rather bad, below average	Rather typical, rather frequent	0.1-0.36
Average level	the most typical and frequent	0.36-0.75
Rather good, high	Rather typical, small and typical, a typical	>0.75

standard can be set only by gradation (zone) of high values of indicators. And it is unimportant whether it is set by the range of variations, an attributive sign, a linguistic variable, settlement size or dot value. The nature of such standard ideals target, administrative, axiological, i.e., absolutely another, than at physical standards. Remaining invariable in qualitative sense, they at the same time in a numerical form can be dynamic and unstable, specific and concrete will change according to the changing experience. It, by the way, explains why in economy and the social sphere it is difficult to choose, prove as ideals, standards, bases of comparison some relatively constants. The methodology of standard and estimated scaling is available, in a sense the only instrument of formation of such sizes.

The choice of the described way of construction and correction of rating scales and standards allows to determine in each cycle of a start-stop verification regime by all properties dynamic set of reference sizes an expected and target trajectory of reference conditions of object. In econometric terminology is an ideal equilibrium trajectory and in the modern language of business and management it is a trajectory of the sustainable harmonized development with a high potential of competitiveness. The reference states set, for example, in (Fig. 2 and 3, Table 1) by an indicator variation on the basis of "the advanced level" (x >5.1 for the period t and x >4.81 for the period t+1) will also play a role of analogs

of those ultraprecise precision devices or reference samples of units of measure which are used in applied metrology, in operations of checking of gages, in natural-science, physical and technical measurements in algorithmic measurements. All other gradation set by either concrete value or an interval or a semantic (classification) sign are estimated on degree of proximity to a standard. Thus, the standard of any concrete quantitative property is understood as the whole range of variations (a clot of values, a cluster, a bunch of data) which is identified uniquely from the qualitative point of view.

If to consider that activity of any social and economic object-multi-purpose and multidimensional, its result (state) at each concrete moment of time will be characterized by a set of pair combinations: first, ideal, reference (rather steady) trajectories, secondly, real, more dynamic actual trajectories. However, this set of pair combinations doesn't come within miles of a huge combinatory set of combinations of the real indicators expressed in physical units of measure. Here also there is a minimization of dimension of economic space, "curse of dimensionality" is overcome.

Similar situation with any other indicators of activity (financial, social, production, organizational, ecological and so forth). We will notice that all described monitoring procedures are realized in information model and the developed information infrastructure as the automatic

operations which aren't demanding in general any expenses of human researchers including also operations of the qualitative analysis of situations. At a planning stage administrative links of competitor companies can be guided on opened (in the internet) set of the scales reflecting the general (group) dynamics of progress and shortcomings with concrete reference values on all indicators.

In essence, the game scheme of situational management is realized. It is known that the essence of situational management of difficult objects consists in replacement of a vast set of the situations developing in the course of functioning of real object, the initial, "squeezed" description of the generalizing situations macro-descriptions (in our case scales). Application of similar macro-descriptions significantly simplifies a choice of options or search of an available optimum at adoption of administrative decisions. The used axiometric principles of formation of standards of states give considerable procedural advantages at aspiration to objectivize and unify technology of measurement. Indeed, the algorithmic description of creation of reference base of criteria allows will come nearer to operations of natural-science measurement, to provide minimization of dimension of possible space of signs in absolutely clear form, to unify a scale of intensity of the allowed deviations, to order (to range, rank) indicators on degree of their remoteness from ideal, qualitatively high values (Demidov and Matveev, 1990; Shabanova and Demidov, 2010).

CONCLUSION

By results of long-term researches and experimental introduction of reference base of corporate level it is possible to draw conclusions: assessed function can't be realized according to requirements of natural-science metrology without adequate reference base; information containing in scales and in reference sizes is continuously updated in real time, allows to satisfy general, absolutely necessary and there is enough naturel needs of an middle and top level of management in the advancing knowledge of scenario conditions of activity for the forthcoming periods (on all criteria without exception); the stated technique (model) and technology of creation of reference base corresponds to the modern communication and information environment in which any organizational systems and objects function; the main (for authors) result of the given interpretation of a standard consisted in development of constructive model of synthesis of single properties (but it already a subject of other publication).

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