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K. V. Badmaeva

THE TECHNIQUE OF ADAPTIVE CONTROL IN DESIGN AND DEVELOPMENT PROCESS OF SPECIALIZED DATA WAREHOUSE

The technique of adaptive control in process of designing and developing data warehouses is proposed. The technique provides original formalization of the design and development of the data warehouse model and it takes into account the operating conditions and specific information about data domain. The description of the design and development of specialized data warehouse using the management model in the notation eEPC ARIS-methodology is executed.

Keywords: specialized data warehouse, adaptive control, designing, materialization of views.

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S. N. Masaev, M. G. Dorrer

COMPANY MANAGEMENT SYSTEM ESTIMATION ON THE BASIS OF ADAPTIVE CORRELATION TO THE ENVIRONMENT

The method of the structure and indicators analysis of company business processes based on the calculation of simple correlation between historic series of expenses is offered.

Keywords: correlation, adaptation, process, system analysis, management.

After the global crisis outbreak companies have changed a lot: stronger integration of companies, lead to numerous consolidations, acquisitions and mergers.

The Russian companies are not an exception. Holdings (hereinafter referred as to production systems) will be a general moving force, which diversified scope of the activity and the work was in hand inside. It is a gathering moment, but the other process has not completed yet – creating the model of decision-making system. If it is, Russian companies can be considered well-functioning systems and not just a collection of heterodeneous assets [1].

A holding company manager will find the following difficulties, when managing the holding companies the decision-making system of holding (further production system):

– intercommunication between the companies is inaccurate measurement, subjectivity;

– intercommunication between accounting system and decision-making system;

– a lot of complex methods of decision-making system;
– holding companies have different development vectors and conflicting purposes.

One original way is correlative adaptation which was described for physiology of group's humans in hard living conditions (far North city, polar expedition, or a hospital, for example) in 1985 by A. N. Gorban, E. V. Smirnova.

The crucial question is: what is the resource of adaptation? This question arose for the first time when Selye published the concept of adaptation energy and experimental evidence supporting this idea [1; 2].

In modern "Encyclopedia of Stress" it is written: "As for adaptation energy, Selye was never able to measure it..." [3].

After that their work (A. N. Gorban, E. V. Smirnova, T. A. Tyukina) was published in May 2009, they have been studing ensembles of similar systems under load of environmental factors. The phenomenon of adaptation has similar properties for systems of different nature. Typically, when the load increases above some threshold, the adapting systems become more different (variance increases), but the correlation increases too. If the stress continues to increase the second threshold appears: the correlation achieves maximal value, and starts to decrease, but the variance continues to increase. In many cases this second threshold is a signal of fatal outcome approaching.

This effect is proved by many experiments and observations of groups of humans, mice, trees, grassy plants, and on financial time series. A general approach to explanation of the effect through the dynamics of adaptation is developed. H. Selye introduced the term "adaptation energy" for explanation of adaptation phenomena. They formalized this approach in factors – resource models and developed models hierarchy of adaptation. Different organization of interaction among factors (Liebig's versus synergistic systems) leads to different adaptation dynamics. This gives an explanation to qualitatively different dynamics of correlation under different types of load and to some deviation from the typical reaction to stress.

In addition to the "quasistatic" optimization factor – resource models, dynamical models of adaptation were developed, and a simple model (three variables) for adaptation to one factor load was formulated explicitly.

In economics, we use the published results of data analysis for equity markets of seven major countries over the period 1960–1990 and for the twelve largest European equity markets after the 1987 international equity market crash. Some of the results obtained in econophysics [4] also support our hypothesis.

We study micro economic systems (hereinafter referred as to production systems-companies). In our research work we have considered data of economic systems (special case is development sector) since 2004. In April 2008 we applied the program of decision-taking system estimation in economic system (SM. city) [2].

For it we completed the following problems:
– made mathematical formulation the discrete- multivariate system for economic system (hereinafter referred as to production systems-companies);
– made calculations and analyzed plan/fact of sample estimation correlation matrixes, correlation graph G;
– made resources allocation (special case is cash) among functions of economic system.

Making mathematical formulation the discrete-multivariate system for economic system (hereinafter regarded for as production systems-companies). Follow the systems theory (R. Kalman and other, 1971) representable system S consider

$$S = \{T, X, V, h, \varphi\}. \quad (1)$$

The notation:

$T = \{t \,/\, t = 0, 1, 2, ...\}$ – discrete set of time (window of time).

X – phase space of system, $x(t) = [x^1(t), x^2(t), ..., x^n(t)]^T \in X$ – n – variable phase vector, state vector, and $x^*(t) = [x^{*1}(t), x^{*2}(t), ..., x^{*n}(t)]^T \in X$ – n – variable phase vector, suboptimal estimation by R. Bellman.

The variable phase vector of economic system is $x^i(t)$ – financial expenditure for the functions (describe all action, business process) of economic system. There are unification accounts, functions in special program. Study table 1 as an example. For the research 417 functions (the variable phase vector of economic system) were used.

V – space analytic estimates of system, $V(t) = [v^1(t), v^2(t), ..., v^s(t)]^T \in V$ – s – vector analytic estimates.

$\varphi : T \times X \to X$ – transition functions of system, is:

$$x(t+1) = \varphi(x_0, x(t)), \quad (2)$$

where $x_0 = x(0)$.

$h : T \times X \to V$ – function analyzes the space of points (observation function), is:

$$v(t) = \xi(x(t-1), x(t-2), ..., x(t-k)). \quad (3)$$

Use the variable phase vector $x(t)$ for prior periods. The parameter k is depth horizon (in our special case k = 6 months). Matrix is defined

Table 1

The accounts, functions

Name of project	Activity category	Item of income/expenses	Subclause of income/expenses	Functions of S (variable phase vector) (x^i)	Plan $x^{*n}(t)$	Fact $x^i(t)$
Project 1	Investments Capital outlays	Development planning	Development planning	The water-system design x^1	$x^{*1}(t)$	$x^1(t)$
Day-to-day operation,	Finances	Disposition of profits	Profit-and-loss last years	Inventory x^2	$x^{*2}(t)$	$x^2(t)$
Day-to-day operation, Principal activity	Operating activities	Services of other company	Other services of other company	Other x^3	$x^{*3}(t)$	$x^3(t)$

$$X_k(t)=\begin{bmatrix} x^T(t-1) \\ x^T(t-2) \\ \dots \\ x^T(t-k) \end{bmatrix}=\begin{bmatrix} x^1(t-1) & x^2(t-1) & \dots & x^n(t-1) \\ x^1(t-2) & x^2(t-2) & \dots & x^n(t-2) \\ \dots & \dots & \dots & \dots \\ x^1(t-k) & x^2(t-k) & \dots & x^n(t-k) \end{bmatrix}. \quad (4)$$

Execute centering and normalization components of matrix $X_k(t)$.

Then

$$\mathring{X}_k(t)=\begin{bmatrix} \mathring{x}^T(t-1) \\ \mathring{x}^T(t-2) \\ \dots \\ \mathring{x}^T(t-k) \end{bmatrix}=\begin{bmatrix} \mathring{x}^1(t-1) & \mathring{x}^2(t-1) & \dots & \mathring{x}^n(t-1) \\ \mathring{x}^1(t-2) & \mathring{x}^2(t-2) & \dots & \mathring{x}^n(t-2) \\ \dots & \dots & \dots & \dots \\ \mathring{x}^1(t-k) & \mathring{x}^2(t-k) & \dots & \mathring{x}^n(t-k) \end{bmatrix} \quad (5)$$

$$\mathring{X}_k^T(t)=\begin{bmatrix} \mathring{x}(t-1) & \mathring{x}(t-2) & \dots & \mathring{x}(t-k) \end{bmatrix}=\begin{bmatrix} \mathring{x}^1(t-1) & \mathring{x}^1(t-2) & \dots & \mathring{x}^1(t-k) \\ \mathring{x}^2(t-1) & \mathring{x}^2(t-2) & \dots & \mathring{x}^2(t-k) \\ \dots & \dots & \dots & \dots \\ \mathring{x}^n(t-1) & \mathring{x}^n(t-2) & \dots & \mathring{x}^n(t-k) \end{bmatrix} \quad (6)$$

and calculate $R_k(t)=\dfrac{1}{k-1}\mathring{X}_k(t)\,\mathring{X}_k^T(t)=\|r_{ij}(t)\|$

$$i,j=1,\dots,n, \quad (7)$$

$$\text{where } r_{ij}(t)=\frac{1}{k-1}\sum_{l=1}^{k}\mathring{x}^i(t-l)\,\mathring{x}^j(t-l). \quad (8)$$

Value $r_{ij}(t)$ is a sample correlation coefficient (Pearson coefficient) between variables $x^i(t)$ and $x^j(t)$ of window time t and $R_k(t)$ – sample correlation matrix between the variable phase variable of window time t for depth horizon k.

Thereby (4, 5) diagonal matrix R_k is $r_{ij}(t)=1$ for all $i,j=1,\dots,n.$ and all t, and other coefficient from –1 to +1 ($-1\le r_{ij}\le 1$).

On the basis of sample correlation matrixes (7) we create correlation graph of the system $G_i(t)$. Show relationship among the functions of the system figure 2 and figure 3.

The sample correlation matrix $R_k(t)$ for observation function is:

$$v(x(t-1),x(t-2),\dots,x(t-k))=R_k(t). \quad (9)$$

The observation function is integral representation action of the system. We have opportunity to the analyze the behavior of multivariate system, so we find and control change evolved from the company operation as well as caused by management and exopathic.

Then we single out correlation indicators. Indicators is graphs $G_i^{\text{sum\_total}}(t)$ – absolutely summable of sample correlation coefficients i's function this other, $G_i^{\text{sum\_neg}}(t)$ – sum negative of sample correlation coefficients and $G_i^{\text{sum\_plus}}(t)$ – sum of sample correlation coefficients is more than 0, $G_i^{\text{difference}}(t)$ – sum of sample correlation coefficients. Change for window time the G shown figure 1.

$$G_i^{\text{sum\_total}}(t)=\sum_{j=1}^{n}\left|r_{ij}(t)\right|:\left(\left|r_{ij}(t)\right|\ge r_{\text{sign}}\right), \quad (10)$$

$$G_i^{\text{sum\_plus}}(t)=\sum_{j=1}^{n}r_{ij}(t):\left(\left|r_{ij}(t)\right|\ge r_{\text{sign}}\right)\cap\left(r_{ij}(t)>0\right), \quad (11)$$

$$G_i^{\text{sum\_neg}}(t)=\sum_{j=1}^{n}r_{ij}(t):\left(\left|r_{ij}(t)\right|\ge r_{\text{sign}}\right)\cap\left(r_{ij}(t)<0\right), \quad (12)$$

$$G_i^{\text{difference}}(t)=G_i^{\text{sum\_plus}}(t)+G_i^{\text{sum\_neg}}(t), \quad (13)$$

where r_{sign} – significance of sample correlation coefficient for data of sample correlation matrix with parameter k which is depth horizon.

All graphs $G_i(t)$ account for window time T including the relationship between functions of the system figure 2, figure 3.

Made calculations and analyzed plan/fact of sample correlation matrixes, correlation graph *G*. Figure 1 shows the important events in economic system.

1. *Drawing up/making up an estimate* – the budget of construction.

2. *Getting a permit for construction* – the document authorizing the start of project construction and favorable for obtaining a bank loan.

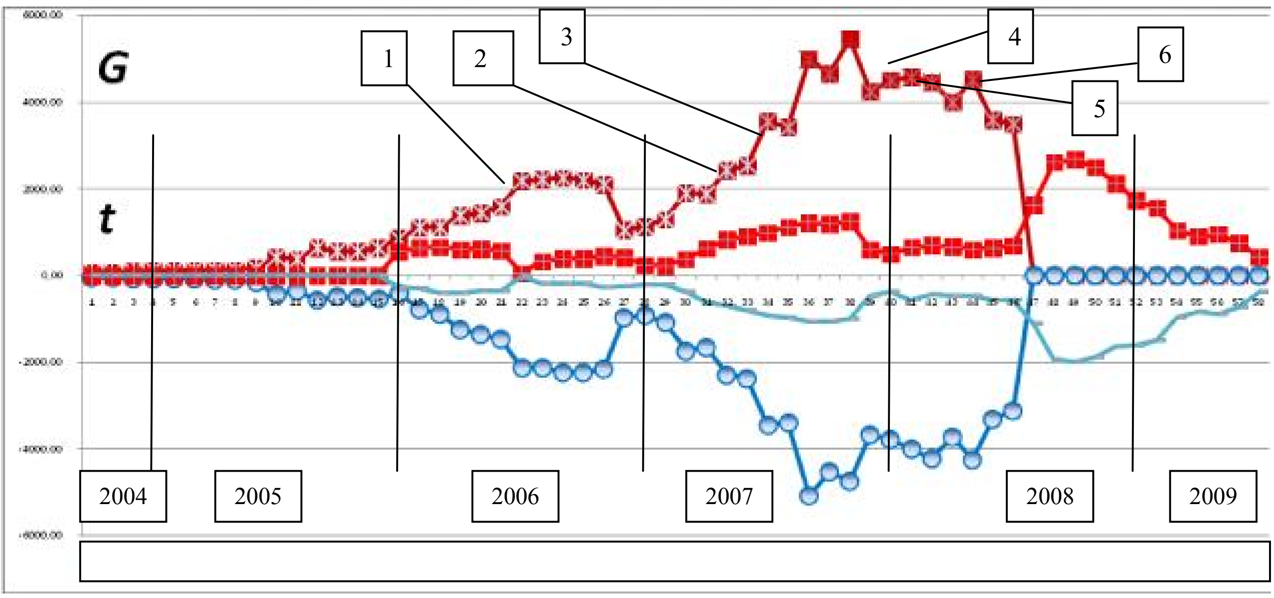

Fig. 1. The diagram variable phase vector of economic system in dynamics

3. *Creating the TQM* – creating regulations and standards for the company.

4. *Getting finance* – getting a loan from the Savings bank («Sberbank»)

5. *Starting the project construction* – starting the construction of residential property.

6. *Creating similar/identical/analogous hereinafter production system-companies*.

The larger the value of $G_i^{\text{sum\_total}}(t)$ is, the larger crisis our system experiences.

The functions involved in the economic activity of the production system are interrelated (figure 2).

Within the reported/determined period you can analyze separate functions and determine their influence on the system (figure 3). After that you can find principal functions for allocating money in the company (table 2) [5].

Resources allocation (special case is cash) between functions of the economic system. Functions that have high correlation get more money. The method of R. Bellman is used for financial allocation among corporate objectives, strategies and functional systems (table 2).

The article described the method to get control of heterogeneous assets.

You can use it – to determine and fix the period of stress in economic system (hereinafter reffered to as production systems-companies); to optimize the process of management; to allocate resources (special case is cash) between functions of economic system.

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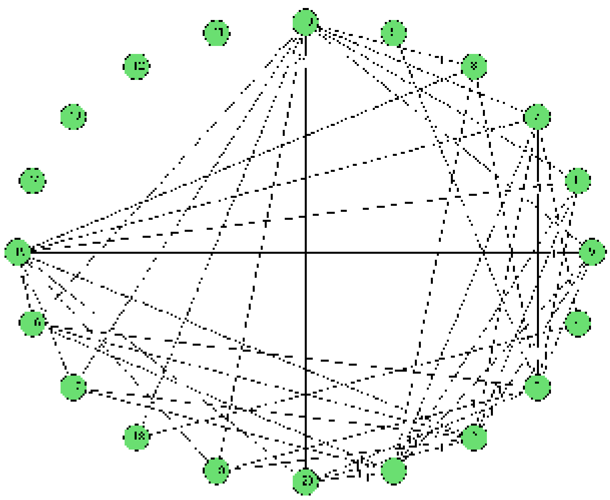

Fig. 2. Correlation graph the profits of hereinafter production system-companies $G_{20}^{\text{difference}}(38)$

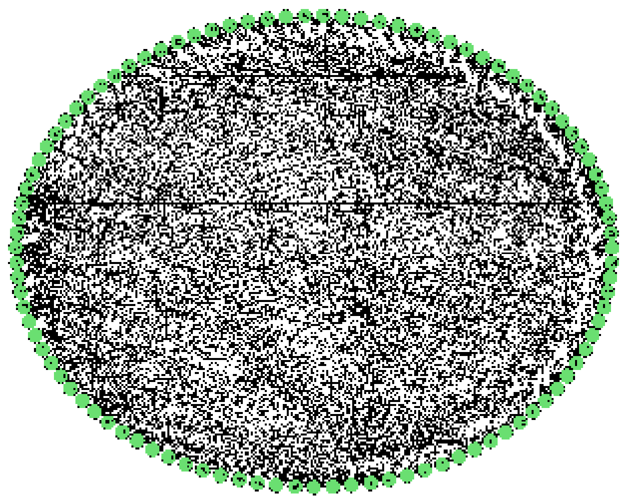

Fig. 3. Correlation graph $G_{417}^{\text{difference}}(38)$ the principal functions of profits and costs in hereinafter production systems-companies

Table 2

Allocation of money (in US dollars)

		The corporate objective					Result of operations
		Increase in assets 30 %					
		The competitive strategy	The strategy of active influence	The development strategy	The strategy of scientific manpower	The strategy of project elaboration	
Project	The function systems	Allocation					
X	HR	146 328	24 388		78 042	341 432	590 190
	IT	189 536	13 538	270 765	67 691	81 230	622 760
	TQM	378 140	113 442	378 140		756 279	1 626 000
	Economics		166 367	1 164 566		1 996 398	3 327 330
	Production		246 647	493 295	147 988	2 959 769	3 847 700
Result of operations		714 003	564 382	2 306 765	293 721	6 135 108	10 013 980

С. Н. Масаев, М. Г. Доррер

ИНТЕГРАЛЬНАЯ ОЦЕНКА УПРАВЛЕНИЯ КОМПАНИЕЙ В ОКРУЖАЮЩЕЙ СРЕДЕ НА ОСНОВЕ МЕТОДА КОРРЕЛЯЦИОННОЙ АДАПТОМЕТРИИ

Рассмотрен структурированный метод анализа интегральных показателей выполнения бизнес-процессов компании, основанных на вычислении корреляции между временными рядами ее расходов.

Ключевые слова: корреляция, адаптация, процесс, системный анализ, управление.

УДК 519.2+004.02+336.7

Л. И. Покидышева, Е. В. Покидышева

СТРУКТУРНЫЙ АНАЛИЗ ИНТЕГРАЦИИ ПОДСИСТЕМ МЕТОДОМ ГЛАВНЫХ КОМПОНЕНТ*

Освещены методы анализа кризисных ситуаций на примере финансовых данных. Приведены результаты оценки интеграции компонент денежно-кредитной и банковской системы в период экономического кризиса 2008 г. Представлена методика выявления подсистемы, выполняющей доминирующую роль в адаптационном ответе на кризисные ситуации.

Ключевые слова: кризис, адаптация, интеграция подсистем, денежно-кредитная политика, банковская политика.

Одним из критериев успешной модернизации российской экономики является полномасштабное финансовое участие в ней российской банковской системы.

Разразившийся мировой финансовый кризис повлек за собой изменения в российской экономике и акцентировал внимание многих ученых-экономистов на исследовании причин его возникновения и предотвращения в будущем. В связи с этим становится актуальным изучение состояния денежно-кредитной и банковской системы в период мирового финансового кризиса.

В работах [1; 2] авторами построена система моделей адаптационного ответа на кризисные ситуации, основанная на концепции «адаптационной энергии» [3; 4]. Для применения этих моделей к реальным системам с целью управления их необходимо сделать более реалистичными путем декомпозиции. Ресурс не просто направляется на нейтрализацию различных факторов, но поступает в распоряжение различных подсистем, которые, в свою очередь, нейтрализуют действующие факторы.

В данной работе мы представляем разработанную в [5] методику декомпозиции фактор-ресурсных моделей адаптации, на модели подсистем рассматриваемой системы. Анализ взаимодействия факторов и системы сведен к взаимодействию факторов и подсистем.

Для изучения интеграции подсистем в эксперименте мы использовали метод главных компонент и находили, параметры каких подсистем дают значительный вклад в первую главную компоненту. Этот подход дает возможность исследовать изменение конфигурации подсистем при увеличении давления внешних факторов [6; 7].

Выдвинута гипотеза о том, что степень интеграции подсистем зависит от величины внешних воздействий [6]. Известно, что в первую подсистему входят показатели с номерами $j = 1, \ldots, n_1$, во вторую подсистему – с номерами $j = n_1 + 1, \ldots, n_2$, в k-ю подсистему входят признаки с номерами $j = n_{k-1} + 1, \ldots, n_k$, причем $n_k = m$, где m – количество исследуемых подсистем.

Если первая главная компонента коррелирует с k исследуемыми показателями m различных подсистем, то для i-го периода имеет место соотношение

$$y_i = a_{i1}z_1 + a_{i2}z_2 + \ldots + a_{in_1}z_{n_1} + a_{in_1+1}z_{n_1+1} + \ldots + a_{in_2}z_{n_2} + \ldots + a_{in_k}z_{n_k},$$

где $i = 1 \ldots K1$, $K1$ – количество исследуемых периодов, $n_k = m$.

Иначе можно записать

$$y_i = \sum_{j=1}^{n_1}(a_{ij}z_j) + \sum_{j=n_1+1}^{n_2}(a_{ij}z_j) + \ldots + \sum_{j=n_{k-1}+1}^{n_k}(a_{ij}z_j).$$

Делим сумму модулей коэффициентов корреляции a_{ij} для каждой подсистемы на количество $n_1, n_2, \ldots, n_k$ показателей соответственно.

Получаем совокупность значений $\{u_{ip}\}$, где i – номер исследуемого периода; p – номер подсистемы, $p = 1 \ldots m$:

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