Підтверджено, що для зображень поверхні розподілена дисперсія, силуети інтенсивності та знімки інтенсивності характеризують ступінь обробки поверхні матеріалу, структурні властивості тощо. Розроблені алгоритми ґрунтуються на декомпозиції простору обчислення статистичних ознак, зокрема, стовпцями та рядками зображення, за максимальними (мінімальними) значеннями інтенсивності, розмірами інтенсивності у фрагментах.

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# INFO-LOGICAL STRUCTURE OF INDUCTIVE TECHNOLOGIES OF THE SEARCHING SYSTEM-INFORMATION-ANALYTICAL RESEARCHES



**Розглянута структура індуктивної технології системних інформаційно-аналітичних досліджень з позицій інформаційно-логічних зв'язків її підсистем та блоків. Згідно з цим підходом описано увесь технологічний процес системних інформаційно-аналітичних досліджень інноваційного спрямування від постановки проблеми до ухвалення рішення стосовно вибору фінального результату.**

**Ключові слова: аналітичне дослідження, логічна структура, інформація, критерії.**

**In this paper the structure of inductive technology of system-information-analytical researches from the standpoint of informative-logical relationships of its subsystems and blocks has been observed. Under this approach, the whole technological process of system-information-analytical researches of innovative direction is described from the formulation of the problem before making of decision regarding the choice of the final result.**

**Key words: analytical research, logical structure, information, criteria of choice.**

## Introduction

The modern technologies of system-information-analytical researches often focused not only on creating the professional answers to solve a specific problem in a specific subject areas, but also are an important technological tools for constructing a solid analytical algorithms for solving complex problems.

Such tasks might include several not related or frequently just tangential spheres, and intelligent ways to solve them belong just towards the system-information-analytical researches (SIAR) [1].

**1 Classification of modern system-information-analytical researches**

Fig. 1 provides the classification of modern system-information-analytical researches (SIAR) in two main directions that we conventionally named as:

1) system-information-analytical research of compiling direction;

2) system-information-analytical research of innovative (searching) direction.

The results of these two directions have the fundamental differences. The first type of research generates so-called *secondary information products* synthesized on information and knowledge from previously received primary sources. The second type is aimed at creation of such primary sources, i.e., aimed at *creation of new knowledge*. Both types (directions) are belong to the general field of system-analytical studies. In the future, we will consider only the second type SIAR of innovation, or search character. As examples, among many other such tasks, could be the strategic planning, technical, economic, environmental, agricultural, social and other fields.

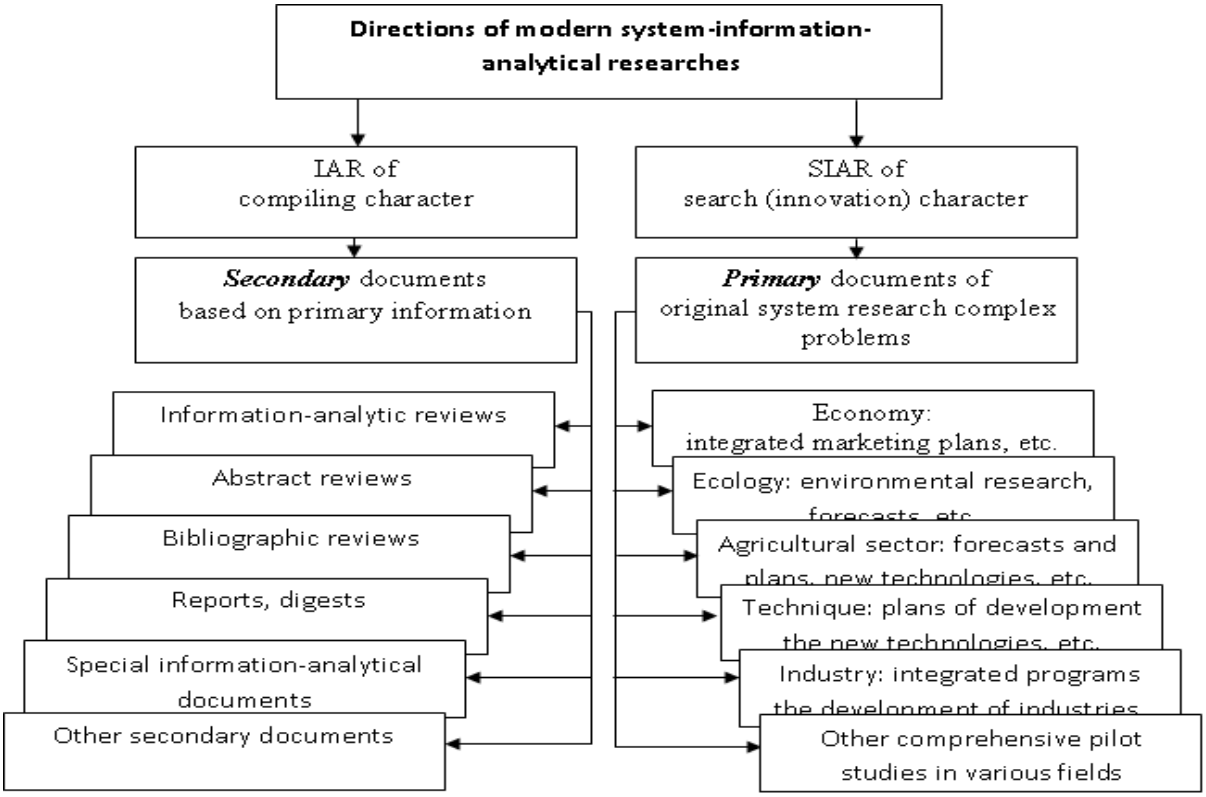


*Fig.1. Classification of destinations (types) of modern SIAR.*

**2 The brief theoretical information on inductive technologies SIAR**

The result of solving the pricing regulation problem will be considered as the document of information and recommending (consulting) nature, which would contain the certain mandatory sections and meaningful content.

Recall, that the result $R^*(I_b^*)$ in inductive technology of system information-analytical researches is a specific document $D\{R^*(I_b^*)\}$, which reflected the results of system subjective analysis of a complex object (process, phenomenon or problem at all), based on constructed during study optimal information

basis $I_b^*$, conform with the requirements, has the information-consulting nature, endowed with a certain official status, and access level [2]. $D\{R^*(I_b^*)\}$ means ready and prepared according to the requirements document, built on a set of optimal results $\{R^*(I_b^*)\}$ that may still be some sketchy character. This alone results $R^*(I_b^*)$ differ from $D\{R^*(I_b^*)\}$.

In [2] – [3] described in detail the procedures and special criteria for inductive SIAR technology (IT SIAR). In Fig. 1 the information-logical structure of inductive technology of system information-analytical researches of complex systems is provided. Below we consider a brief description of the presented structure and the basic stages of creating a meaningful document $D\{R^*(I_b^*)\}$ that we would have to create with use the inductive technology SIAR already without deep examining of objects IT SIAR.

*Stage I.* The formation of the upper level expert committee (ECUL) and the construction of initial information base $I_b^1$; the formation of analytical groups A and B to perform a system-analytical researches and synthesis of optimal information basis $I_b^*$, which should generate result of $R^*(I_b^*) \in \{R^*(I_b^*)\}$.

*Stage II.* The creation the matrix of "target" result [2]:

$$E = (e_{ij}) = \begin{pmatrix} e_{11} & \cdots & e_{1n} \\ \vdots & \ddots & \vdots \\ e_{m1} & \cdots & e_{mn} \end{pmatrix}, \quad (1)$$

where the *i*-th row, $i = 1, 2, \ldots, m,$ represents one of the indisputable claims to the "target" (benchmark) of the study result agreed with the position of the expert committee ECUL, and the *j*-th column, $j = 1, 2, \ldots, n$, represents the possible grade ratings of *i*-th element. Row, in our case, is one of the necessary sections of the document and line items meaning formalized peer reviews (requirements) to its units listed, are also proposed and agreed upon by experts. The elements $(e_{ij})$ of matrix $E(R^0(I_b^0))$ formalized by a specific algorithm based on initial findings of the upper level experts. For example, it may be a median on the set of peer opinions on this item $(e_{ij})$. It is important to note, that the matrix $E(R^0(I_b^0))$ concerns only to forms of future result and to the importance of reflection in it the most important positions as well as their parts. Moreover, unlike the well-known information-analytical techniques such as, for example, Delphi method, etc., the fundamental point is that the members of ECUL who agreed with generalized estimated tolerances $(e_{ij})$ of matrix $E(R^0(I_b^0))$, cannot change their conclusions on the future result shape for the whole analytical project. The semantic component of all these positions is performed by analytical groups and tested by ECUL at each step the next phase III.

*Stage II.* The creation the "target" result matrix $E(R^0(I_b^0))$ [2], that concerns only to forms of future result and to the importance of reflection in it the most important positions as well as their parts. The semantic component of all these positions is performed by analytical groups and tested by ECUL at each step the next phase III.

*Stage III.* The realization of information-analytical project by the following iterative procedure.

Step 1. The results $R_k(I_b^1)^{(A,B)}$ by analytical groups A and B are synthesized; those results include only the initial information basis $I_b^1$ and for each such result, the experts exhibit estimates in the matrix of $W_k^{(A,B)}$, formalized by the same principle as for the matrix $E(R^0(I_b^0))$. The matrix $W^A$

displays the formal *k*-th result of $R_k(I_b^s)$ achieved by the analytical group A on *s*-step research ($s=1,...,S$) and, respectively $W^B$ reflects the formal *k*-th result of $R_k(I_b^s)$ achieved by the group B at the same *s*-step of research.

Each synthesized result by system corelevancy criteria [2] – [3] is evaluated as:

$$CR_{corel}=\sqrt{\sum_{i=1}^{m}\sum_{j=1}^{n}(\delta_{ij}^2)_{W^A W^B}} \tag{2}$$

and by system relevancy criteria as:

$$CR_{rel}=\sqrt{\sum_{i=1}^{m}\sum_{j=1}^{n}(\delta_{ij}^2)_{W^{(A\wedge B)}E}}\ , \tag{3}$$

where $\delta_{ij}^2$ are the some matrix of $\Delta^2=(\delta_{ij}^2)$, elements of which and equal to the squared differences of the same elements in the matched matrices $W(R_k(I_b^s))^{(A\wedge B)}$ and $E(R^0(I_b^0))$ as well as matrices $W(R_k(I_b^s))^A$ and $W(R_k(I_b^s))^B$ respectively. Each listed matrix has dimension of $n\times m$.

In addition to these criteria for the evaluation and to good management of general course of the analytical project the third criterion of information bases balance [3] is used. This criterion is responsible for monitoring informative component in inductive technology SIAR. It is designed for selection at each step of this inductive procedure only in form and content the such information $I_{bs}^+$ for which requests would matched for both analytical groups to deliberate approximation of the current information base to optimum $I_b^*$. The ambiguity in queries are not allowed. The criterion of information bases balance is as [3]:

• for one step of research:

$$\begin{gathered} CR_{inf}(I_b)=\sum_{k=1}^{K}\delta_{sk},\quad s=1,\ldots,S \\ where:\ \delta_{sk}=\begin{cases}0, & if\quad I_b^{sk(A)}=I_b^{sk(B)}\\ 1, & if\quad I_b^{sk(A)}\neq I_b^{sk(B)}\end{cases}\end{gathered}\ , \tag{4}$$

and where K is the number of valid questions in requests on research s-step, and thus on s-step the project moderator could supplies the both analytical groups with the unit ("portion") of additional information $I_b^{s+}$ for minimizing the criterion:

$$I_b^{s+}=\arg\min_{I_b^s\in\Im_b} CR_{inf}\{I_b^{sA},I_b^{sB}\}, \tag{5}$$

where $\Im_b$ is the set of all requests for information from both groups on step of s;

• for the whole analytical cycle of the innovative project:

$$CR_{inf}(I_b)=\sum_{s=1}^{S}\sum_{k=1}^{K}\delta_{sk}\rightarrow\min\ . \tag{6}$$

Further, the information monitoring system begins to operate. An additional target portion of the monitoring information formed by the Information Support Group (ISG – see Fig. 2). This portion of information should complement the already existing ensemble, in order to improve results, bringing them to reference result.

Step 2, ..., S. The analytical results $R_k(I_b^s), k=1,2,...,K$, $s=1,...,S$, based on the results of previous steps and targeted information are synthesized. Once synthesized, each outcome should be checked by using the both criteria (2) – (3).

At each step the criterion of (5) used as well with the accumulation of (6).

Minimum value of criteria (2) – (3) indicate the stop of inductive procedure of optimal result synthesis $R^*(I_b^*)$ (or a limited set of such results).

The last step of the IT SIAR-procedure is a step in which:

1) the result that is the best for the criteria and satisfy the customer is obtained;
2) the result that can be improved, but it had satisfied the customer is obtained;
3) the resources of project (time, money, etc. for example) are exhausted.

*Stage IV.* Forming the optimal results and consulting document $D\{R^*(I_b^*)\}$. At this stage the two analytical groups A and B under the control of the project moderator already for creating the final document are activated.

*Stage V.* Transfer of the final unique result, framed in document $D\{R^*(I_b^*)\}$.

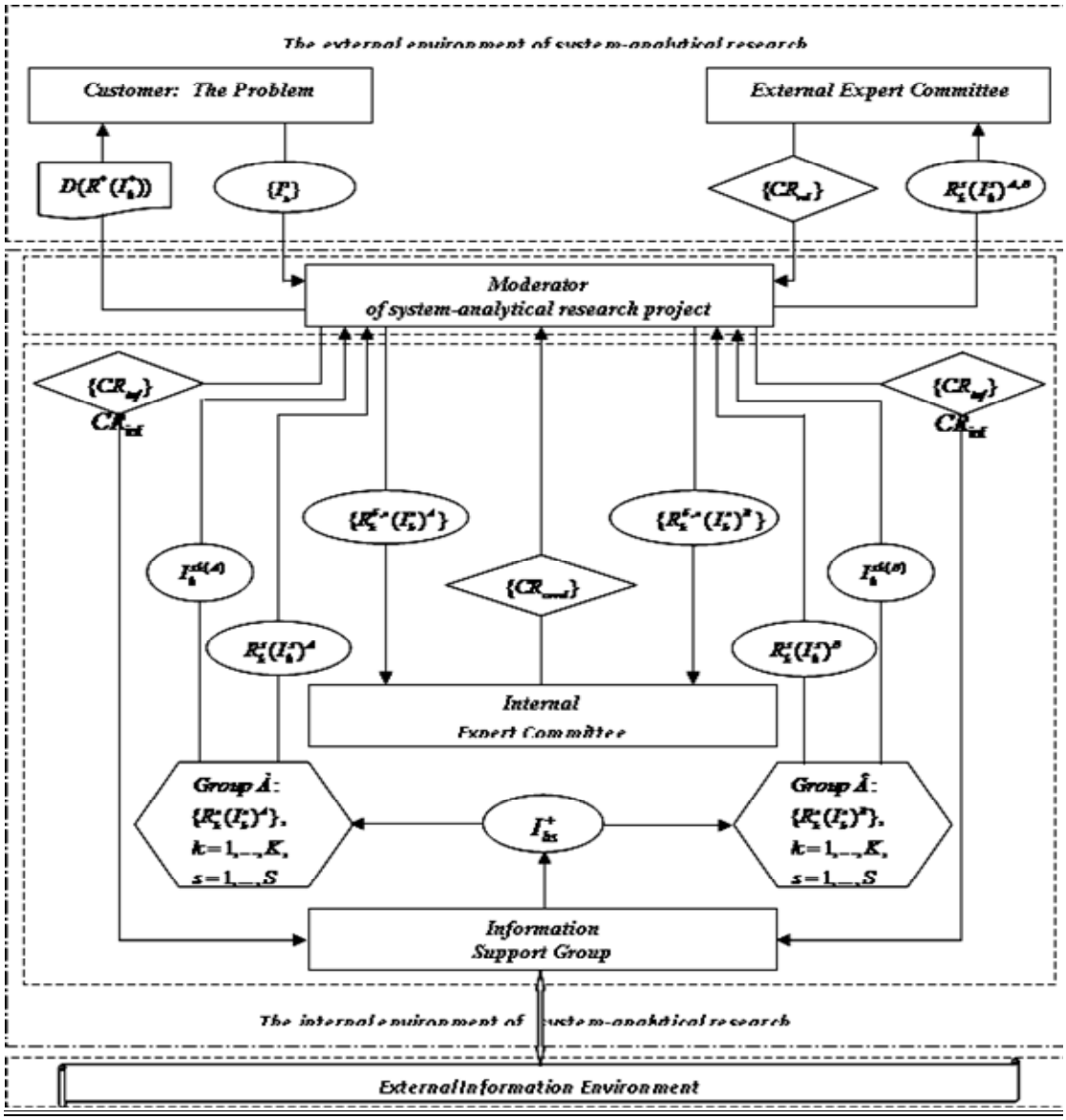


*Fig. 2. The information-logical structure of inductive technology of system information-analytical researches of complex systems*

**Conclusions**

In this paper the structure of inductive technology of system-information-analytical researches from the standpoint of informative-logical relationships of its subsystems and blocks was considered. Whole technological process of IT SIAR of search-type, from problem statement up to choosing of the final result, was described.

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# УСУНЕННЯ ДИНАМІЧНИХ ЧАСТКОВИХ СПОТВОРЕНЬ ДЛЯ ВІДТВОРЕННЯ ЗОБРАЖЕНЬ НА ОСНОВІ ІНТЕГРАЛЬНО-ДИФЕРЕНЦІАЛЬНОГО ПІДХОДУ



**Запропоновано метод реконструкції зображення, частково спотвореного рухом. Характер спотворення – змаз фону з неспотвореним переднім планом. Для реконструкції використовуються алгоритми автоматизованого пошуку спотвореної ділянки, диференціювання та інтегрування зображення, математичної морфології та деконволюції.**

**Ключові слова: зображення, передній план, морфологія, деконволюція.**

**Reconstructive method for images, distorted by partial motion blur with unblurred inclusions, is proposed. It involves the algorithms of automated blur detection, images differentiation and integration, mathematical morphology and deblurring.**

**Key words: image, foreground, morphology, deconvolution.**

## Постановка проблеми

У галузі цифрової обробки зображення багато уваги приділяється деконволюції розмитих рухом зображень. Здебільшого йдеться про обробку рівномірно спотворених зображень, тобто таких, на кожній ділянці яких відбулось спотворення однакової природи. Характер спотворення зображення визначається значенням функції розсіяння точки (ФРТ). Для рівномірно спотворених зображень значення ФРТ однакове для усього зображення. Такі зображення покращуються одним із давно відомих способів (віннерівська фільтрація, метод Люсі-Річардсона тощо). Однак жоден з цих методів не можна застосувати, якщо спотворення часткове, оскільки одночасна обробка всього зображення, на якому є спотворені та неспотворені ділянки, призведе, зрозуміло, до ще більшого спотворення зображення. Такі зображення з частковим спотворенням (надалі розглядатимемо