INFORMATION ANALYSIS AND PRESENTATION IN FORECASTING

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Unlike problem solving in TRIZ, a forecast of technical system evolution offers not a separate solution, but a field, a tree of solutions which exhibit significant variability and information redundancy.
How not to sink in the information sea, how not to lose a logical line of forecasting and the key information which allows the user to solve his problems? The expert who executes a forecast and the customer who uses the obtained information view the situation in different ways. Therefore, presentation of the forecast results is an important stage. Our technique of constructing a forecast tree, analyzing and presenting the available information removes some of these problems.

Key words: TRIZ, forecast, evolution laws, evolution line, information presentation, evolution tree.

Problems of Information Presentation in Forecasting

Executing a forecast project encounters an acute problem of information presentation to a customer. The expert who executes a forecast and the customer who uses the obtained information view the situation in different ways. The customer knows deeply the situation on the factory floor and evaluates the obtained forecast solutions from his own frame of reference. He often cannot or does not want to realize the solution which is ideal from the point of view of the TRIZ expert. Due to this, a forecast usually results not in a single solution but in a scenario including several evolution versions and concepts of a forecast technical system (FS). The great volume of materials to be studied by the customer has a negative effect on the perception quality and subsequent realization of the forecast.

The forecast is meant for top-managers who are usually very busy and unwilling to deal with ample papers. Forecast scenarios of FS evolution are difficult to describe in a few sentences. Thus, a contradiction arises. For the customer to correctly understand the meaning of the forecast proposals, the scenario should be big and detailed while for the customer to read the scenario and to realize it properly, it should be as short as possible. To resolve this contradiction and to make the information presentation operation simple and customary, we suggest that information be presented graphically as FS evolution trees.

Forecasting is aimed at determining the future evolution direction of a system under analysis. The forecasting method includes information, analytical, solving, conceptual, and verification stages [1]. In forecasting, we collect information about available FS prototypes, describe them by using a specific set of models, detect key problems and contradictions, resolve them, develop concepts of probable evolution of the forecast system and its subsystems, verify the developed concepts and form a scenario of introducing an improved FS. The problem of forecasting, especially with respect to big systems of a complex structure consists in the abundance of information about subsystems and FS.

The problem is how to systematize collected information, what is to be done if not all necessary information is available, how not to loose the logical thread of forecasting. At this stage, helpful are also methods of processing and systematizing the collected information in a tree-like form. Such a structure is based on the evolution lines of technical systems. In the software program "TechOptimizer", we have developed a large number of evolution lines based on objective laws and trends of technical system evolution. They may be used to describe key problems of FS transformation in the process of evolution and the main steps of these transformations. Our method of forecast information systematization in the form of evolution lines and evolution trees simplifies and improves the forecasting method [2].

Constructing an Evolution Tree

The proposed method for constructing an evolution tree is based on the use of an objective classification criterion – the technical system evolution laws [3]. Lines and trends, constructed on the basis of the objective TS evolution laws, linked together and represented by evolution trees are an optimal information structure. Each evolution line has generalized descriptions of transformation versions and transitions between these versions; it may also have illustrations of specific examples of FS transformations and versions. In forecasting, we approach evolution of FS elements from the point of view of the objective evolution laws and build trends and each transformation as evolution lines. Representing the information about FS by a tree-like structure also provides a clear picture of basic transformation versions and their structure. This method allows seeing all major transformations of FS even when information on such evolution trends of this system is insufficient or even absent.

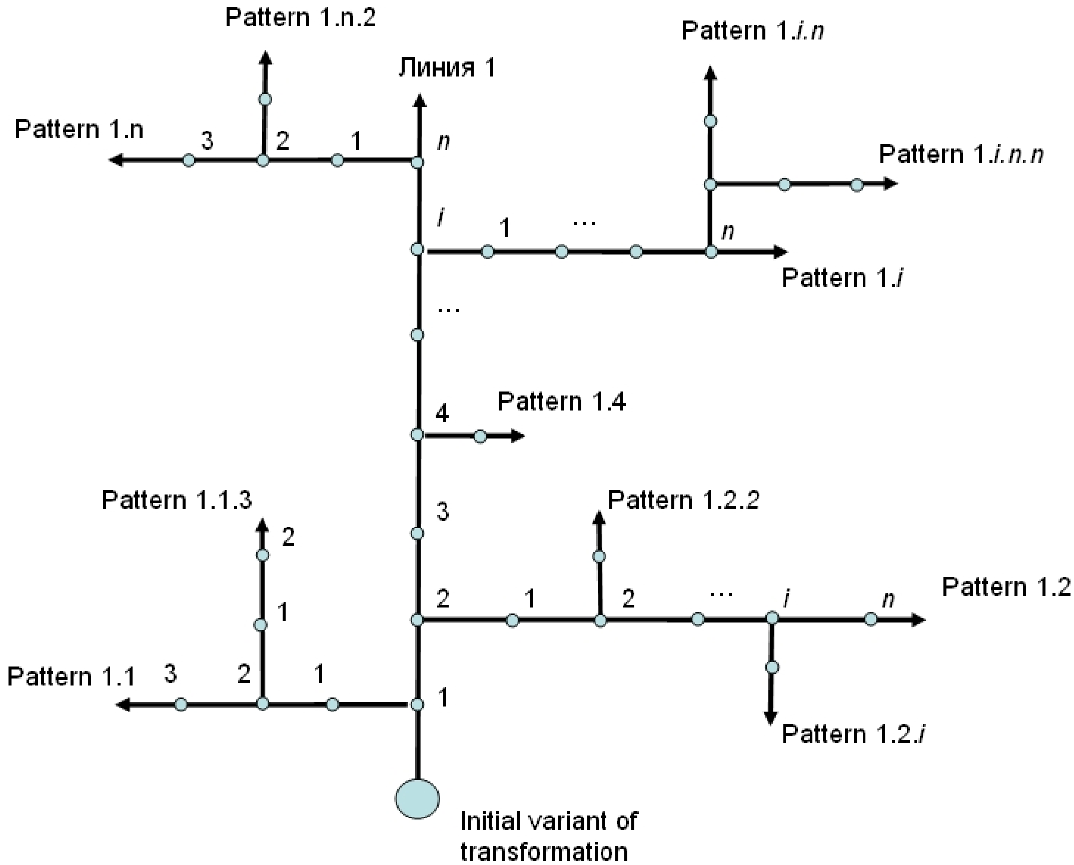

Fig. 1. The evolution tree structure.

The picture describes the principle of constructing a tree-like structure at the information-collecting stage. With such information presentation, each new transformation line may start from any step, any previous transformation version. Each step of the evolution line may serve as a starting step for the evolution of other lines. As the information is accumulated, the tree branches may change themselves and change their position. The final version of the tree submitted to a customer is usually more ordered and free of inessential details.

Constructing an evolution tree for FS should start from its simplest version. Normally, it is a monolithic, rigid object of a simple shape confined by flat surfaces and having no internal structure.

Fig. 2. Steps of “Segmentation of objects and substances” evolution line.

In principle, any evolution line may become a “trunk” – the main axis of an evolution tree. However, evolution lines with particularly significant transformations of elements, such as “Segmentation of objects and substances” are more convenient to use (fig. 2):

- monolith,

- two pieces,
- several pieces
- powder,
- paste or gel,
- emulsion or suspension,
- liquid,
- foam,
- gas,
- plasma,
- field,
- vacuum

Transformations performed in accordance with this line have the most significant distinctions of kind. As a result, it is easier to see and evaluate the FS transformation steps during analysis, to obtain starting points for transformations of objects along other evolution lines.

After selecting the trunk, “branches” of FS evolution tree are constructed. The “branches” of the tree, the evolution lines growing away from the trunk are also constructed according to certain rules. First, we choose FS or its subsystem version which is the simplest one in the context of technology evolution. Then versions of their subsequent transformations are constructed based on the resources available in the system. Then additional resources are introduced – objects, processes and links in accordance with the line called “Introduction of substances and fields”, upon which the turn of such evolution lines as “Mono-bi-poly”, “Segmentation of objects and substances”, “Geometrical evolution” comes. The performed transformations result in the possibility of dynamizing FS, providing mobility, and mobile modification of parameters of elements, which corresponds to the “Dynamization” line. The next line, “Controllability”, describes the possibility of operational control of FS and, when the system becomes controlled, it is necessary to perform coordination of the system’s elements – “Coordination” evolution line. The last to be constructed are the branches of the “Trimming” line. We describe one and the same FS and its subsystems from the point of view of different evolution lines. This allows systemic evaluation of coming transformations of FS without missing out any key transitions.

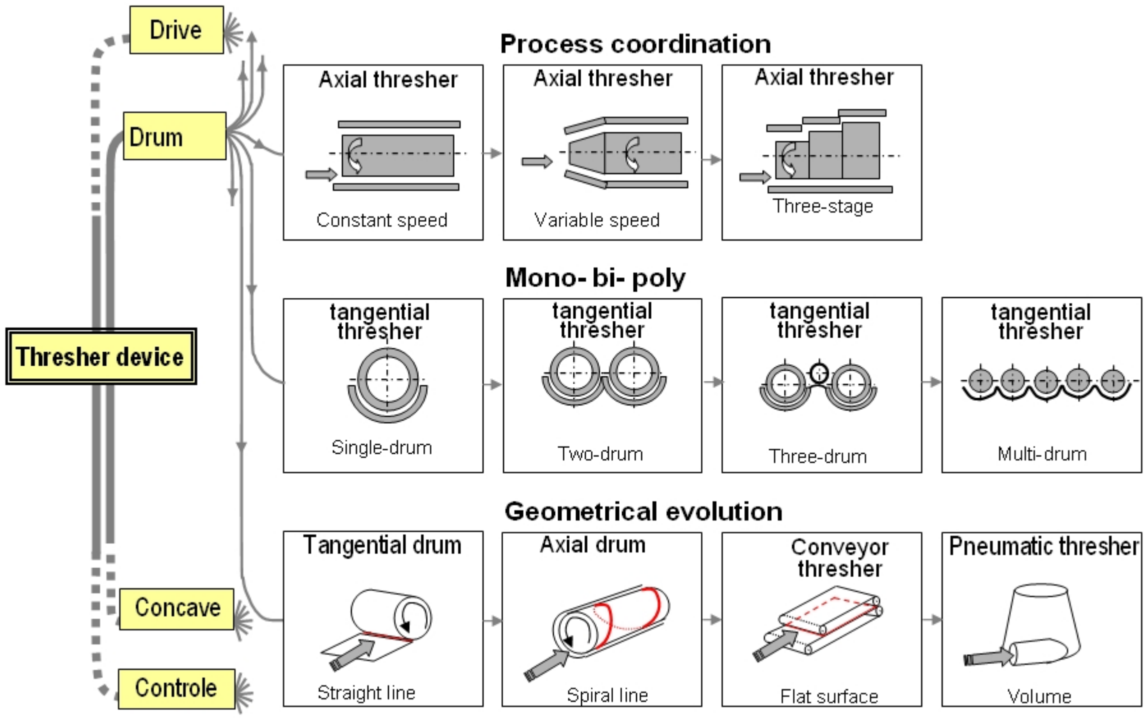

Fig. 3. Branches of the evolution tree for combine.

We employ a radar diagram to evaluate the evolution level of FS. The number of steps made by FS along each evolution line is applied to the radar diagram axis and is compared to potential ones. The figure gives a diagram which evaluates the evolution line of a grain-harvesting combine.

Examples of Method Application

Example 1. The display evolution tree. Two years ago, Nikolay Shpakovsky wrote and published in Japan an electronic book, dedicated to the evolution of displays, and developed the display evolution tree [4].
Example 2. The pillow evolution tree. It is described in the article by G. Severinets published in "TRIZ-pro" book. The article offers effective solutions and the pillow evolution line constructed according to this method [5].
Example 3. The evolution tree of threshing mechanisms of combines is given in the article by P.Chuksin published on TRIZland site [1].

Thus, the proposed method of representing the information about FS by evolution trees may be used both at the information collection and analysis stage and at the stage of submitting the forecast project to a customer. The method is based on the use of objective classification criterion – the TS evolution laws. Lines and trends, constructed on the basis of objective laws of technical system evolution, linked together and represented by an evolution tree are information organized in the optimal manner. The method meets the demands for the optimal information structure.

Short methodology for constructing and using an evolution tree.

Steps to be followed for constructing an evolution tree.

1. Selecting the principle evolution line which reflects the most significant transformations of FS during its evolution. This line will become the trunk of the tree;

2. Describing the transformations of FS or its subsystems in the form of transformation lines in accordance with the objective evolution laws (introducing of substances and fields, mono-bi-poly, trimming, dynamization, geometrical evolution, etc.);
3. Representing the FS transformations by pictures-pictograms;
4. Applying the pictograms to the evolution tree;
5. Finding some examples of corresponding transformations of FS for each evolution line in books or patents, applying them instead of pictograms;
6. Evaluating the number of steps made by real FS prototypes along corresponding evolution lines;
7. Putting the number of steps onto the radar diagram and comparing it to a potential one.

Conclusion

The proposed method for presenting information about a forecast technical system in the form of an evolution tree simplifies the forecast methods and makes the forecast result easily comprehensible to the customer.

1. The method of constructing evolution trees is based on the use of the objective classification criterion – the laws of technical system evolution. Generalizing the obtained lines and trends on the basis of objective laws of FS evolution in the form of evolution trees is the optimal way of information presentation.
2. The method of constructing FS evolution trees allows seeing all fundamental transformations even when information about such FS versions is scarce if at all.
3. Presenting the FS information graphically, as a tree-like structure, makes it possible to simultaneously and distinctly see basic transformation versions and their structure.
4. Each evolution line includes a set of rules of transitions between the transformation versions and is illustrated by specific examples of versions of a specific technical object.
5. The method allows quantitative estimation of FS evolution along its basic evolution trends by means of a radar diagram.
6. The method illustrates all the directions of FS transformations, both past and future, and enables the customer to make a reasoned choice of improvement directions by himself.

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