PROGRESS IN THE ADAPTIVE FORECAST MANAGEMENT OF THE ECONOMIC ORGANIZATIONS

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ABSTRACT

In times of economic instability a cautious and adaptive forecast management is greatly needed. There is the risk of consuming the resources in order to achieve specific objectives that have no market and, implicit, the risk of bankruptcy. Practically, in any given time the decision makers need to have alternative evolution strategies for different evolution hypothesis of the business environment. The authors come to meet these by developing an interactive system of assisting adaptive forecast management for economic organizations.

KEYWORDS: forecast, adaptive forecast management, degree of inertia, partially stable structure, change management, flexible optimization

JEL CLASSIFICATION: C53, C61

1. INTRODUCTION

In the context of perpetuating the states of economic instability there is an ever growing need to analyse the stability of forecasts (productions programs, plans) that are implemented based on the current activity. The answers to the questions: are the actual and the future objectives stable? If not, are they adaptable to the new requirements of the economic environment? What is the size of the changes: total or partial? What is the cost and the frequency of their adaptation? If the change is total, does the organizatoric and managerial structures need to be changed?

It is known that any forecast sets for a time horizon: what needs to be made (objectives), with what it will be made (materials), when it will be made (execution dates) and with what costs it will be made. Practically, small and medium horizon forecasts harmonize the objectives with the resources (Micu, D., Lefter, C., 2011).

What are the possible disturbance factors that trigger the activity of adapting the forecasts? Firstly there are *economic factors*: the change of the market's requirements, the change of the products and materials prices, the ability to buy the necessary supplies, the

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emergence of better performing competitors, etc., *social factors* such as: requests for salary increases, the difficulty of stabilizing skilled human resources, the emergence of armed conflicts that involve some employees, epidemics, *legislative framework*: fiscal changes, environmental law requirements regarding pollution standards, labour legislation etc.

When do the forecasts need to be adapted to the new conditions? As soon as a new disturbance generates activity interruption or when the costs of continuing the activity are very high and affect the enterprise financial equilibrium or at the end of a subdivision of the forecast horizon (month, trimester) or at the delivery of contracted orders for which there exists the prospect of cashing them.

Practically, the adaptability process needs to be a continuous one. The cost of adaptation is much lower if the necessary objectives change measures are provided in advance and the material base also before the moment in which achieving the initial objectives cannot go on.

All of these assume implementing an adaptive system of forecast management. This will follow in real time the adaptation of the objectives to the new requirements by substituting unsellable products with other ones that require similar materials with the ones provided in the material base, respectively substituting deficient material resources with others in conditions of quality at least identical to the initial ones but with a more efficient price or/and with a reduced unit consumption. It is possible that, in order to reduce specific costs relating to fabrication, the company may need to be refurbished. All of these actions will be reflected in the managerial performance plan and especially in the price / benefit ratio plan.

2. FORECAST STABILITY ANALYSIS IN THE CONTEXT OF ECONOMIC INSTABILITY

The issue of stability analysis of the developed forecasts has been addressed in literature by a relatively low number of specialists among which we would like to mention Andreica's works (1988, 2011). Most have focused their concerns for the national economy branches, or for long term future plans. These were related mainly to the planned objectives without looking at the general context of possible changes in the firm's management. The economic practice of recent years demonstrates that a large number of enterprises are "required" in order to survive to make profound changes in their organization as well as in their management. That is why, we will address the issue of forecast stability for a given time while maintaining the current organizational and managerial system as well as the case in which the concordance between the organizational structure, strategy, organizational culture, procedural organization and increasing the renewal capacity of the organization.

Any analysis regarding forecast stability is made through the prism of their possibility to adapt to new conditions. It is known that, forecasts are made with one or more years before their implementation, reason for recognizing the presence of many factors, parameters, variables whose evolution for the given timeframe cannot be accurately captured. Furthermore, the speed with which they change during the operation time can prevent achieving the expected objectives. However, in practice, any forecast becomes inert in relation to the change of inputs in certain limits, and that is why they need a certain degree of mobility, flexibility (Carnot et al., 2005).

In agriculture this mobility is provided even by their preparation method, because the forecast's objectives (even the annual ones) depend largely on natural factors. In the case of forecasts the same thing doesn`t happen because mobility gains a different tint. It is generated by the dynamic and the frequency of the previous enounced factor's changes, which forces us, most of the times, to update the forecasts. But particularly, we are interested in the allowed frequency for which the objectives and the forecast structure can be changed without affecting the possibility of their achievement. Their adjustment involves changes in the forecasted objectives. But this adjustment can be full or partial (local). Thus, adjusting the forecasts is a system's reaction (economic organization) to the objective changes and the random changes of the input factors and/or the ambiance. In the specialized literature even the opposite of the adaptation concept is revealed: their *inertia* that, obviously, reduces the possible speed change. It follows that, when the *adjustment* of forecasted objectives *will be local*, some of them will remain unchanged, representing the *inertial part* of the forecast.

What are the possibilities of partial adjustment of forecasts? The most frequent ones are: adapting production, resources, coefficients of unitary income and expenses and manufacturing technologies. For each one of them, it is possible to organize the resources or product substitution, or to change the volume characteristics (production, resources etc.) – if possible.

Thus, for now, we will analyse the case in which the enterprises (that operates based on already implemented forecast) are forced under the business development pressure to adapt their objectives to the new requirements of the market, respectively the possibilities relating to supplying resources. We will make this analysis based on the structure of an optimizing model for objectives with resources.

$$\begin{cases} [\text{opt}]\sum_{j=1}^{n} p_j x_j^l \\ \sum_{j=1}^{n} r_{1ij}^1 x_j^l \le d_1,\ i=\overline{1,m} \\ \sum_{j=1}^{n} r_{2ij} x_j^l \ge d_2,\ 1=\overline{1,L} \end{cases}$$

In which:

$\boldsymbol{x_j^l}$ = is the quantity that is to be made of the product ***j*** in the technological version ***l***;

r_{1ij}^l = the specific consumptions needed to make product ***j*** from resource ***i*** in the technological version ***l***;

r_{2ij} = the coefficients of the structural correlations between objective d_{2i} and the products ***j*** generated.

We will note d_{1ij}^l the consumption from resource ***i*** in the technological version ***l*** in order to make product ***j***; $d_{1ij}^l = a_{1ij} x_j^l$. Reporting this consumption to the unit of time, we will obtain the speed of manufacturing release (its equivalent $\boldsymbol{x_j^l}$) and the rate of resource consumption.

Changing some of the conditions of making the forecast may generate new changes in the production release intensity, resource consumption and the coefficients of these consumptions, reflected by the speed variation (acceleration) and expressed through these derivatives $\frac{dd_{1ij}^{l}}{dt}$, $\frac{dr_{1ij}^{l}}{dt}$ and $\frac{\boldsymbol{dx_{1ij}^{l}}}{\boldsymbol{dt}}$.

Because calculating derivatives is pretty difficult, we will use first order finite differences:

Δd_{1ij}^{l} = the increase of using resource ***i*** as a result of manufacturing product ***j*** in version ***l;***

Δr_{1ij}^{l} = the increase of specific consumption of resource ***i*** in order to manufacture product ***j*** in version ***l***;

$\boldsymbol{\Delta x_{j}^{l}}$ = the increase in manufacturing of product ***j*** in version ***l***.

Because the variation in a timeframe of the consumption of resources d_{1ij} depends on the variation of the factors that generates it, we have: $\Delta d_{1ij}^{l} = \Delta r_{1ij}^{l} x_{j}^{l} + r_{1ij}^{l} \Delta x_{j}^{l}$

Each one of these variations is upper limited, reason for which we will note these limits as such: $\overline{\Delta} d_{1ij}^{l}$, $\overline{\Delta} r_{1ij}^{l}$, $\boldsymbol{\overline{\Delta} x_{j}^{l}}$.

By substituting the maximum limits in the above relationship we might have an inequality. If $\overline{\Delta} d_{1ij}^{l}$ is bigger than the right side of the above equation (in which the maximum variation limits have been entered), then we will rewrite the equation like this:

$$\Delta d_{1ij}^{l} = \overline{\Delta} r_{1ij}^{l} x_{j}^{l} + r_{1ij}^{l} \overline{\Delta} x_{j}^{l}$$

In this case, the sizes of the upper variation limits of the 2 factors will restrict the possibility to adapt the plan. Furthermore, if $\overline{\Delta} d_{1ij}^{l}$ is smaller than the right part (in the above conditions), then he will limit the plan's adaptability possibilities. There are situations in which a factor's variation is null. In such cases, the adaptation possibilities shrink to one of the maximum variation limits of the 2 terms. In practice, knowing $\overline{\Delta} d_{1ij}^{l}$ one of the 2 factors is established at its maximal level and the other one is calculated accordingly.

$$\Delta r_{1ij}^{l} = \frac{1}{x_{j}^{l}} \left(\overline{\Delta} d_{1ij}^{l} - r_{1ij}^{l} \overline{\Delta} x_{j}^{l} \right)$$

Or:

$$\Delta x_{j}^{l} = \frac{1}{r_{1ij}^{l}} \left(\overline{\Delta} d_{1ij}^{l} - x_{j}^{l} \overline{\Delta} r_{1ij}^{l} \right)$$

Usually, these cases are rare when resources consumption is analysed for a single product. Practically the resource ***j*** is distributed to more products that are made using various technologies: $d_{1i} = \sum_{l} \sum_{j} d_{1ij}^{l}$

In this case, partial adaptation of resource ***i*** will be limited by the maximum levels $\overline{\Delta} d_{1ij}^{l}$:

$$\overline{\Delta} d_{1i} = \sum_{l} \sum_{j} \overline{\Delta} d_{1ij}^{l}$$

Noting with $\boldsymbol{V_0}$ the set of production technologies related to the optimal plan and with $\boldsymbol{O_0}$ the set of forecasted objectives (products), then the limit in which the forecasted resources can be adapted can be achieved, is given by the below formula:

$$\overline{\Delta} d_{1i}^{0} = \sum_{j \in J_0} \sum_{l \in L_0} \overline{\Delta} d_{1ij}^{l}$$

This size ($\overline{\Delta} d_{1i}^{0}$) depends largely on the possibility to adapt the expected objectives. Ideal would be if this was bigger than the ones caused by delivery deviations of resource ***i*** from the contracted level ($\overline{\Delta} d_{1i}$) : $\overline{\Delta} d_{1i}^{0} \geq \overline{\Delta} d_{1i}$

We would like to highlight the fact that the possibilities to intervene on this factor can be determined if internal resources consumption normative exist.

In some cases, founding objectives can be done on maximum consumption levels that are provided in regulations facilitating the possibility of a future forecast adjustment. Obviously, this procedure will give much more stability to the selected version but it will lead to waste of resources lowering the executants' interest in high capitalization of available resources.

3. FORECAST ADAPTABILITY ANAYSIS

Let's analyse the issue of forecast *adaptability* and achieving given objectives. Let $x_j^1 \;{}_1^0$, O_1, V_1 be the optimal forecast version that meets the following conditions:

$$\begin{cases} \sum_{j \in J_1} \sum_{l \in L_1} p_j^l \left(x_j^l\right)_1^0 = P_1 \\ \sum_{j \in J_1} \sum_{l \in L_1} r_{1ij}^l \left(x_j^l\right)_1^0 = \left(d_{1i}\right)_1, \; \mathrm{i} = \overline{1, \mathrm{m}} \\ \sum_{j \in J_1} \sum_{l \in L_1} r_{2ij} \left(x_j^l\right)_1^0 = \left(d_{2i}\right)_1 \end{cases}$$

Based on this structure of the forecast $x_1^0 = \; x_j^1 \;{}_1^0$ the necessary material base can be determined. Let the optimal forecast version described by the above equations be the initial version for the forecast time horizon $0, T$ and we will assume that at a random given time $t^* \in \; 0, T$ of the forecast horizon, the environment and internal production factors change thus influencing achieving the initial version. In consequence an updated version will be developed:

$$\begin{cases} \sum_{j\in J_2} \sum_{l\in L_2} \alpha_j^l \left(x_j^l\right)_2^0 = P_2 \\ \sum_{j\in J_2} \sum_{l\in L_2} \beta_{1ij}^l \left(x_j^l\right)_2^0 = \left(d_{1i}\right)_2 \\ \sum_{j\in J_2} \sum_{l\in L_2} \beta_{2ij} \left(x_j^l\right)_2^0 = \left(d_{2i}\right)_2 \end{cases}$$

Introducing the elements α_j^l, β_{1ij}, β_{2ij} we highlight the fact that by changing the conditions in which the forecast was made, the coefficients have also changed. We will call this structure of the forecast as being *stable* if: $O_1 \equiv O_2$ and $V_1 \equiv V_2$.

Observation: any random change that has appeared in the terms of making a forecast with stable structure will not affect achieving the objectives of the initial version. Furthermore, the means of achieving them will remain unchanged. However it is possible at most changing only the intensity of which the means are used, reason for which adjusting the base of the optimal version is null both in terms of widening and narrowing it.

The forecast structure will be *absolutely inert* if: $O_2 \in O_1$ and $V_2 \in V_1$. It results that the forecast will be absolutely inert if for some reason the adjustment of the optimal base (in terms or widening it) is not possible in the time horizon $0, T$. For such forecasts there are possibilities of narrowing them.

We find that for the 2 types of forecast structures (absolutely inert and stable) it is not possible that for the adjusted optimal version to introduce new objectives or means of achieving them. Furthermore, no matter the time t^*, when changes in the conditions to make the forecasts are involved, they lead to the change of the initial optimal base. If the objectives and the means of achieving them from the corrected forecast will be disjointed from those of the initial version, there will be the possibility of absolutely adjustment (full).

Thus, the forecast will be *absolutely adaptable* if: $O_1 \cap O_2 = \Phi$.

Most of the times the forecasts structures (initial and corrected) intersect: $O_1 \cap O_2 \neq \Phi$. We can characterize this intersection by the *degree of inertia* of the initial base (of the optimal forecast) at a given time $t \in \ 0, T$.

The main factors that influence the degree of inertia of the initial optimal forecast base are: *time, economic factors and preparing the material base*. The time factor does not influence, during the development of the updated forecast version, the forecast's adaptation because it will include the entire initial base developed until the moment t^*. This will influence the development mode of new versions of forecasts if the products have a large manufacturing cycle and if their release into production is required before the moment t^*.

If the economy or the branch moves from an intensive development strategy the forecasts will be affected when the new strategy will be implemented T' . If $T' > T$, then the base adaptation plan is null. If $T' < T$, modifying the initial base is possible for the period $[T', T]$ but the enterprise operation inertia degree will be much bigger and the necessary timeframe for the reorganization will be much longer.

As for the *economic factors* we would like to point out that any adjustment to the forecast to the new conditions will attract, usually, additional expenses that are the main analysis criteria of the opportunity to transition to a new way of working. They determine the increase of inertia in the initial optimal forecast in term of organization development.

It is possible that, by correcting the initial forecast, an already achieved part of it will be rejected (some capacities will be conserved if they refer to the investment plan). Ideal would be if the new forecast plans will include every achieved objective with the risk of reducing the chance of partial adjustment in its updating phase. In these conditions there is the benefit of reducing the possibility of disruptive events to occur.

Preparing the material base limits the forecast's adaptability for medium and large horizons mostly due to the resources that require a long acquisition time (or connected investments).

Furthermore, it is recommended that at the time of the forecast adjustment the additional objectives will not exceed more than 10-20% of the activity volume due to the limited possibility to assure the material base and/or if the remaining timeframe is too small for them to be carried out t^*, t .

Thus we conclude that the units that have in their manufacturing profile products with long manufacturing cycles have a greater degree of forecast inertia.

Furthermore, the adjusting of the forecast will be made when the additional expenditures occurred by the adjustment as well as the losses occurred by not adjusting it will be recovered through the new forecast version.

4. ORGANIZATIONAL CHANGES

Another issue that the adaptive forecast management of the enterprises needs to address is that of the organizational changes which may cover one or more of the 4 basic elements of the organization: strategy, technology, structure and the organizational culture. Romania still has an economy based on intensive resource consumption, a society that is still in search of a unified view and a natural capital affected by the risk of damage that can become irreversible. This approach involves a bigger effort from an organizational point of view and consistent resources spread over a longer period of time compared with previous. Usually, the strategy changes when the organizations are forced by survival reasons or as a reaction to some challenges. The accumulated experience in this domain does not recommend such changes during crisis or under the short-term pressure of time. Technological change involves the change/modernization of technological flow, changing the work conditions for the employees, the way the enterprise manufactures and markets its products and services (Badea, et al., 1999).

Changing the organization structure implies changing several organizational components which can generate resistance from the employees' part. It is natural, that any organizational change involves the change of its culture, on several levels (gaining new skills, changing attitudes, beliefs and behaviours).

The experience gained in our country and global in organizational change management pointed out that for its implementation the following steps must be taken (Luecke, 2003):

Step 1. Identifying the organization’s problems and solutions
Step 2. Developing a shared vision upon organizing and managing change in order to assure competitiveness
Step 3. Identifying the leadership
Step 4. Concentrating on the results – and not on the activities
Step 5. Initiating change in peripheral departments and natural spread to other departments, without imposing from top to bottom
Step 6. Formalizing the achieved success by instituting new policies, systems and structures at an organizational level
Step 7. Monitoring and adapting strategies as an answer to the issues raised by the change process.

In practice, implementing the change process must consider a certain degree of flexibility in order to allow adaptation over time and managing the deviations from the initial forecast. Moreover, the best solution is the personalized one for organization/department, respectively particular situation and the pursued objectives and not an “important” one; the human resources department must not be accountable for the implementation of the change process, detrimental to the department managers.

An essential problem in the organizational change management represents overcoming the employee`s resistance to change, that may resort to strikes, negligence at work, morale decrease.

Implementing change piecewise, successively, may result in time to a systemic change, but it will be sustainable if there is a change/shift of the balance between systems throughout the entire organization (Kebapci and Erkal, 2009).

5. INTERACTIVE SYSTEM FOR ASSISTING THE ECONOMIC ORGANIZATIONS ADAPTIVE FORECAST MANAGEMENT

To facilitate adaptation, in a short time, of the forecasts to the current and future evolution (estimated) a system that assists decision-makers has been developed both at a strategic and operational level (Andreica et al., 2014). We will present the steps and stages involved in accessing the system.

The steps necessary for forecast corrections are:

1. Economic indicators are initialized from previous forecasts with the current year’s values
2. The decision-maker selects the order in which the indicators will be simulated with the observation that the first one will have its evolution simulated independent of the others. Only the second and the other ones will be simulated in functional and structural correlation with the indicators simulated in previous iterations. There may be exceptions.
3. If the simulation is made independent of other indicators, then the system will use one of the 11 procedures included, thus showing the selected indicator’s evolution for the forecasted horizon.

4. If the simulation is made in correlation to other indicators, then for each indicator one or more predefined procedures will be generated in the system. It is possible that additional data or work hypotheses may be required.
5. The indicators values obtained in the 3rd and 4th stage will be validated by the users, and in case all the indicators have been simulated and the data was accepted by the users, the simulation module will come to a stop.
6. If not all the indicators have been simulated, then the procedure resumes from stage 2.
7. If all the indicators have been simulated but are not accepted by the users, then the procedure resumes from stage 2 with the reformulation of hypotheses.

Observation 1: The simulation module is based on a procedural simulation model of economic indicators structures that has been experimented in practice.

The steps necessary to correct the forecasts (plans) are:

Version 1**. The initial structure of the manufacturing classification remains unchanged**

Steps and stages:

1. In the initial harmonizing model of the resources with the objectives, the available resources are reduced with the ones related to the objectives (products) already made.
2. The objectives restrictions will be updated by decreasing the right member with the ones already made.
3. The restrictions of resources and objectives are relaxed by introducing tolerance variables.
4. The objective function is created by summing the associated tolerance variables and the weight coefficients whose value will direct the product selection process from the updated plan. The larger values will be associated to those resources for which the supply possibilities are limited, respectively to the objectives for which the correction margin is small. The optimization direction is to minimize the sum of the associated tolerances.

Stage 1. The harmonization model of the objectives with the resources is solved following the minimization of the tolerances sum. The optimal solution will show us if the initial equation system is compatible without the need of tolerances (if the objective function's value is 0) respectively, how much more resources we need to add and/or change the objectives in order to have a compatible equation system.

Observation 2. The users can associate tolerances only to some of the resources without changing the initial objectives thus looking to identify the minimum additional resources needed which allows harmonizing the resources with the minimum level of the objectives, or to associate tolerances only to the objectives looking to identify the minimum quantity/value to reduce the objectives as so to fully capitalize the available resources. If the 2 restriction categories will be relaxed simultaneously we will seek for the smallest deviation from the objectives while supplementing the resources with the smallest possible amounts.

Stage 2. The right member of the harmonization model of objectives with the resources is actualized with the optimal values resulted from the optimization process from the previous stage and the optimization process resumes with the initial objective function. The optimal solution will point out the updated objectives for the remaining timeframe until the end of the initial forecast horizon.

Version 2. **The manufacturing classification is changed partially or totally**

The harmonization model of the objectives with the resources is reconfigured and the 2 stage optimization process from above resumes.

Observation 3. Flexible optimization procedures are at the base of the harmonization model. In a near future, these will be extended with robust optimization models.

6. CONCLUSIONS

In times of economic instability a prudent and adaptive forecast management is more than needed. There is the risk of consuming the resources for achieving objectives that have no market, thus leading to bankruptcy. Practically, in any given time the decision-makers need to have alternative strategies of evolution for different hypotheses regarding the business environment (Andreica et al., 2013; Popescu et al., 2014). The authors tried to meet the decision-makers needs by developing an interactive system to assist the economic enterprises adaptive forecast management. This system was experimented on several economic organizations and will be extended to a higher number of instances than it has been until now.

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