Organizational and economic features of continuous introduction in production of innovations

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Abstract. Article is devoted to the subject which isn't losing interest – the organization of continuous introduction of innovations. She contains statement of scientific and methodical approach to creation of this type of the organization with involvement of "bank of the ideas" and accounting of temporary aspect of introduction of innovations. Orientation to accounting of temporary aspect does necessary a research of structure and structure of time expenditure on realization of an innovation. At the same time will have to methods of the direct account and correlation modeling are involved. As a result of performance of such complex of works the scientifically based base for planning of introduction of innovations and management of these processes will appear.

1. Introduction
In this work scientific and methodical approach not just to implementation of an innovation, and to the organization of continuous innovative development of the entity and management of these processes is stated.

To tell that in such foreshortening the researched questions weren't considered, likely it isn't absolutely fair. At least problems of management of implementation of innovations are reflected in works of the whole cohort of remarkable scientists-economists – L I Abalkin, I A Bayev, V P Gorshenin, G M Dobrov, I V Yershova, N Novitsky, R A Fakhrutdinov, D S Lvov, A A Rumyantsev, etc. This list can be continued … However, practically nobody researched questions of the organization of continuous innovative development of production. The matter is that the called problems, are many-sided and multidimensional and today are up to the end not solved, and each of the called scientists considered management of implementation of innovations under that corner on which it was shown by practice. According to it, the conducted research of the entities of a machine-building complex of the Republic of Bashkortostan convincingly showed lack of the system of the organization at them continuous innovative development of production that quite often involves unreasonably fast obsolescence of innovations and also problems of their "description" in the operating production process.

It is necessary to notice that the organization of implementation of innovations is complex therefore processes its accompanying and connected with direct development, creation, implementation of innovations shall be in details researched. Extent of disaggregation shall be sufficient for allocation of their certain type giving the chance to remove certain regularities. It will constitute one of prerequisites of implementation of uninterruptedness of implementation of innovations and will
predetermine need of modeling of process of adaptation of innovative solution to conditions of production.

It is established that modeling of processes of implementation of innovations requires allocation of the period of adaptation of innovative solution to production process conditions. In this regard structural components of the period of adaptation – time for mastering skills of practical application of the developed idea and time for bringing to organic unity of the mastered technical tool with the system of its functioning are determined.

It is offered, to establish adaptation time duration by means of the correlation and regression model oriented to involvement of the following factors: direction of the plan of implementation of innovations, categories of complexity, qualification of the worker, size of the production program.

The practical importance of the results received during this research is that with their help it is obviously possible to organize continuous innovative development of production at the entities and also to exercise control of these processes.

2. Structurization of costs of time for adaptation of innovative solution to conditions of production

The innovative solution or the idea passes consistently following stages: idea choice, designing, production, adaptation. According to told, duration the idea development cycle (T idea) will be determined as follows:

\[ T_{\text{idea}} = T_{\text{idea choice}} + T_{\text{designing}} + T_{\text{production}} + T_{\text{adaptation}} \]  

where:
- \( T_{\text{idea choice}} \) – time spent for the choice of the idea from "bank of the ideas" (the corresponding algorithm shall be developed and approaches to identification of costs of time for the idea choice are determined);
- \( T_{\text{designing}} \) – time spent for design study of the idea (including all stages of the check point);
- \( T_{\text{production}} \) – time for production of means of equipment of a production process of the design developed at the previous stage including time for production of the most this design;
- \( T_{\text{adaptation}} \) – idea adaptation time (developments, designs) under production conditions.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Structural representation combinations of work types on preparatory and production stages.}
\end{figure}

The most important features of time of development of the idea (T idea) it is necessary to call:
- availability of single structure of stages of preparation of the idea for all sections of the plan of implementation of innovations;
- implementation of processes of preparation of the idea in parallel with the main production process;
- coincidence in time of the beginning of the period of adaptation to the term of transfer of the developed idea in production;
- coincidence in time of a completion date over a new object with starting date of its full functioning.

From all components of a formula 1 the last has a certain novelty and this circumstance does necessary its detailed consideration. Usually, in time cost structure such component isn't allocated, considering that all work on its embodiment will be finished with idea production. However, with increase in complexity, expansion of dimensions of the developed ideas need of adaptation of the developed idea to conditions of its functioning and also acquaintance with it appears. Otherwise, production process suspensions for the solution of the called problems are possible. According to told, adaptation time (T adaptation) is determined as follows:

\[ T_{\text{adaptation}} = T_{\text{development}} + T_{\text{devices}} \]  

where: \( T_{\text{development}} \) – time for mastering skills of practical application of the developed idea (can concern only the worker operating this technical tool - the idea); \( T_{\text{devices}} \) – time for bringing to the organic unity mastered by the CU with the system of its functioning.

3. Modeling of time of adaptation of innovative solution to conditions of production

Ensuring continuous innovative development and especially management of these processes is required by developments of approach to cost determination of time for adaptation, mastering skills of work with the materialized idea, bringing the created technical tool to organic unity with the system of its functioning.

It is possible to perform the solution of the exposed task in several ways. The first and the most known – to perform regulation of the processes and procedures which are a part of \( T_{\text{development}} \) and \( T_{\text{adaptation}} \). Accepting this method for the practical embodiment, it must be kept in mind that the processes and procedures which are the making \( T_{\text{development}} \) and \( T_{\text{adaptation}} \) shall be broken into the smallest structural components. Admitting this fact, it is necessary to recognize also innovative nature of the materialized idea that can serve as a serious obstacle for disaggregation of the called processes and procedures.

It is quite possible to try to solve a problem, having addressed a method of correlation and regression modeling. Application of this method will demand allocation of structure of the factors exerting impacts on each of adaptation time components (\( T_{\text{adaptation}} \)).

Correlation and regression modeling is one of methods of the solution of tasks and information search. It allows to determine joint influence of a set of the interconnected and one-timely operating signs and also separate influence of each sign on an economic event (process). Thanks to this type of modeling it is possible to estimate interrelation degree between several signs, between signs and the received result and also to simulate the regression equation, interrelations describing a form. So far it is possible to state two assumptions:

- Development time (\( T_{\text{development}} \)) represents function from the direction of the plan of implementation of an innovation (P), category of complexity of the performed works (C), qualifications of the worker (K)), the size of the production program (PP), etc.
  \[ T_{\text{development}} = f (P; C; K; PP \ldots) \]  

- Time for bringing to organic unity of the materialized idea with the system of its functioning can be provided as function from the plan of implementation of innovations (P), degree of flexibility of production organization (G), etc. factors.
  \[ T_{\text{devices}} = f (P; G; \ldots) \]  

Having established such dependences and having gathered statistical material, obviously, it is possible to develop the correlation and regression models allowing to determine adaptation time duration (and by analogy and for all components of a formula 1).
In relation to this task for creation of correlation and regression model it is necessary to consider several ideas developed by the entity and also to allocate factors – extent of influence of which on duration of a cycle of development of the idea it is necessary to estimate. As those factors are accepted: direction of the plan of implementation of innovations (P); categories of complexity (C); qualification of the worker (K); size of the production program (PP).

It is necessary to notice that these factors are chosen proceeding from the fact that all of them are dependent from each other, and their set influences idea adaptation period duration.

To a research 10 ideas relating to various directions of the innovative plan, with different levels of complexity, performed by workers of various qualification levels and the different sizes of the production program were chosen.

In the analysis of dependences the following scales were applied:
- direction of the plan of innovative development (P): 3 – the most significant direction of the plan of innovative development; 2 – the average importance P; 1 – the smallest importance P
- category of complexity of the performed works (C) 1 – is difficult; 10 – is easy
- qualification of the worker (K) is specified the necessary category for accomplishment of the corresponding task from 1 to 6;
- quantitative change of the size of the production program (PP) due to improvement of means of equipment of attendants realization of this idea.

After that, influence of each criterion on an indicator of time of adaptation is determined and the equation allowing to determine the adaptation time duration (Adaptation t) is created. Based on calculations we will create the general table of indicators with 10 ideas and the offered scales. We will in addition assume that within the most significant direction of the plan of innovative development (3) with the greatest category of complexity (3), the maximum qualification of the worker (3) and the minimum size of the production program (1) time of adaptation will constitute 4 days and vice versa within the least significant direction of the plan of innovative development (1) with the smallest category of complexity (1), the minimum qualification of the worker (1) and the size of the production program (9) time of adaptation will constitute 9 days. Then, the created data will take the form provided in Table 1. At the same time, we will determine correlation dependences of time of adaptation on each criterion as follows. Regression modeling allows to consider influence of values of independent variables on a dependent variable. Having carried out the regression analysis of the provided data the following data (Table 3, 4) are obtained. The created report allows to analyse dependences of each criterion for the period of adaptation. The obtained data, allow to claim that:
- Value of multiple R - expresses a level of dependence of independent variables (P, S, K, PP) and dependent variable (Tadapt) and is equal to the square root from determination coefficient. It is equal in our case 0,926 that speaks about essential communication between variables

| P   | C   | K   | PP  | T adaptation, day |
|-----|-----|-----|-----|-------------------|
| Idea 1 | 1   | 1   | 6   | 1                 | 4     |
| Idea 2 | 3   | 8   | 5   | 7                 | 9     |
| Idea 3 | 2   | 6   | 5   | 6                 | 6     |
| Idea 4 | 2   | 7   | 3   | 9                 | 7     |
| Idea 5 | 1   | 4   | 4   | 9                 | 6     |
| Idea 6 | 2   | 7   | 3   | 8                 | 8     |
| Idea 7 | 2   | 4   | 5   | 2                 | 4     |
| Idea 8 | 1   | 5   | 5   | 2                 | 5     |
| Idea 9 | 2   | 9   | 3   | 6                 | 9     |
| Idea 10 | 1 | 6   | 4   | 3                 | 5     |
Table 2. Matrix of correlation dependence.

|                | T adaptation | Direction of the plan of innovative development | Category of complexity of the performed works | Qualification of the worker | Size of the production program |
|----------------|--------------|-----------------------------------------------|-----------------------------------|-----------------|------------------------------------------------|
| T adaptation   | 1            |                                               |                                   |                 |                                           |
| Direction of the plan of innovative development | 0.688625 | 1                                             |                                   |                 |                                           |
| Category of complexity of the performed works | 0.24059 | 0.02805 | 1                                             |                                   |                                           |
| Qualification of the worker | -0.33489 | -0.03904 | 0.516365 | 1                                             |                                   |
| Size of the production program | 0.714041 | 0.425439 | -0.22296 | -0.59483 | 1                                           |

Table 3. Regression Statistics.

|                        |               |               |               |               |
|------------------------|---------------|---------------|---------------|---------------|
| Multiple R             | 0.926792      |               |               |               |
| R Square               | 0.858944      |               |               |               |
| Adjusted R Square      | 0.7461        |               |               |               |
| Standard Error         | 0.951618      |               |               |               |
| Observations           | 10            |               |               |               |

Table 4. Analysis of variance.

|                | df | SS          | MS           | F             | Significance F |
|----------------|----|-------------|--------------|---------------|----------------|
| Regression     | 4  | 27,57211    | 6,893028     | 7,611746      | 0,023519       |
| Residual       | 5  | 4,527889    | 0,905578     |               |                |
| Total          | 9  | 32,1        |              |               |                |

Table 5. Dispersion analysis.

|                | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
|----------------|--------------|----------------|--------|---------|-----------|-----------|
| Intercept      | 0.779757     | 2.740642       | 0.284516 | 0.787422 | -6.26529  | 7.824801  |
| P Variable 1   | 1.33565      | 0.543367       | 2.458099 | 0.057362 | -0.06112  | 2.732419  |
| C Variable 2   | 0.776052     | 0.317959       | 2.440732 | 0.058601 | -0.04129  | 1.593391  |
| K Variable 3   | -0.68419     | 0.556089       | -1.23036 | 0.273284 | -2.11366  | 0.745281  |
| PP Variable 4  | 0.269847     | 0.150024       | 1.798688 | 0.13198  | -0.1158   | 0.655496  |

- The calculated value of coefficients 0.779757 shows what there will be Y (adaptation time) if all variables (the direction of the plan of implementation of an innovation, category of complexity of works, qualification of the worker, the size of the production program) are equal in the considered model to 0. That is the value of the analyzed parameter is influenced also by other factors which aren't described in model.
- Values of coefficients P = 1.33565; C = 0.776052; K = -0.68419; PP = 0.269847, accepted according to the given calculations.
- The carried-out correlation and regression modeling allows to create the following model of time of adaptation:
\[ T_{\text{adaptation}} = 1.33565 \times P + 0.776052 \times C - 0.68419 \times K + 0.269847 \times PP + 0.779757 \] (5)

where: \( T_{\text{adaptation}} \) – adaptation time (day); \( P \) – the directions of the plan of implementation of innovations; \( C \)– category of complexity of the performed works; \( K \) – qualification of the worker; \( PP \) – the size of the production program.

The conducted research (correlation and regression modeling) of structural components of time of adaptation convinced that time of development (\( T_{\text{development}} \)) represents function from the direction of the plan of implementation of innovations (\( P \)), categories of complexity of the performed works of the CU (\( C \)), qualifications of the worker (\( K \)), the size of the production program (\( PP \)), etc., i.e.

The realization of the stated offer is enabled at the same time in two spheres - production and on its preparatory phase that can be shown in the Figure 1.

In this drawing it is visible that the processes connected with the idea choice, its design-technology study by direct production and also can be performed by adaptation in parallel with earlier developed production.

In the Figure 1 the structure of stages of the works connected with an idea materialization is visually visible. It is necessary to allocate that this structure of stages of works, differs in coherence of stages, and stages constitute a vicious circle.

Told does possible introductions in scientific turnover of a concept – an idea implementation cycle which represents structure of the stages reflecting nature of works on a materialization of the idea and the circulation representing them during any period.

And if the concept "idea implementation cycle" is entered, then for implementation of management of implementation of innovations it will be extremely interesting to know duration of an implementation cycle of the idea which represents time period from the moment of the choice of the idea prior to full functioning. The model of determination of duration of an implementation cycle of the idea is provided by a formula 1.

The correlation and regression analysis made on the stated idea showed that in addition to the provided criteria for the period of adaptation also other factors which aren't provided in this model influence. In this connection, certainly, there are insignificant deviations of time of adaptation actual and time of adaptation planned.

Everything told confirms forecasting effectiveness of time of adaptation on a preparatory phase of production.

4. Conclusion
Ensuring sustainable development of production does more and more relevant the organization of continuous innovative development. Together with it the relevance of modeling of processes of adaptation of innovative solution to conditions of production increases.

At the same time, modeling of processes of adaptation of innovative solution to conditions of production, it is integrated to determination of time expenditure and their structural representation and also the factors influencing their duration which are up to the end not solved today.

In this regard it is offered to systematize a cost structure of time for implementation of the innovative idea as a part of which it is necessary to allocate time for idea adaptation. It is established that time of adaptation of the idea depends on such factors as the section of the plan of implementation of an innovation, category of complexity of performance of works, qualification of the worker, the size of the production program, etc.

During the research it was succeeded to establish quantitative dependence of time of adaptation on the called factors. Approbation of the offered approach on materials of the real entities showed his viability and a possibility of practical application. We consider that by means of the results received in this research the entities will have an opportunity to organize continuous innovative development of the production. Though, certainly, they should face need of the solution of a number of the private practical tasks connected with need of accounting of their organizational and economic features too. All this, certainly, moves apart the horizons and opens a way to creativity.
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