

Evaluation of the modernization efficiency in the aerospace production sector

Miroshnikova Tatyana Konstantinovna,

Associate professor of Economics and Management Department
Vladivostok State University of Economics and Service
41, Gogolya Street, Primorsky Krai, 690014, Vladivostok, Russian Federation

Vasyukova Lyudmila Konstantinovna,

Associate professor of Department of Finances and Credit
The Far Eastern Federal University
8, Suhanova Street, Vladivostok, 690950, Russian Federation

Nedoluzhko Olga Vyacheslavovna,

Associate professor of Department of Economics and Management
Vladivostok State University of Economics and Service
41, Gogolya Street, Vladivostok, 690014, Russian Federation

Abstract

The key purpose of the study is evaluation of the economic impact of the innovative development scenario as part of value chain of the governmental aerospace company «AEROSPACE» in terms of modernization and creation of the public-private partnership. The collaboration of international management innovations' and Russian engineering technologies and solutions gives a practical effect as part of determination of innovative potential of outdated production of complex metal-working, increasing of innovative production integration of the company (as member of internal and external markets). Key methodology findings are including:

- *Evaluation of current level of the technological advancements and developments as part of the economic efficiency and expediency;*
- *Determination of integration opportunities of the innovative management;*
- *Evaluation of the direct economic benefits of the industrial modernization and integration of participants in the process of implementation of innovations.*

Keywords: innovative scenario, modernization, economic impact, production' integration.

Introduction

Analysis of the current state of production in Russian Federation' engineering sector and the authors' experience of the restructuring programs development, innovative development and creation of the stimulation models of new productions, proves the possibility of the introduction of international innovations in the management of projects, processes and organizational development in terms of efficient start of the Russian technological innovation in the small-scale production. In this study we note that companies that implement their own or acquired innovations receive effective experience of the investments impact in terms of open market with a so called positive economic effect.

The study proposes an estimating approach of economic efficiency of the modernization of a pilot production for the enterprises of the aerospace industry and the creation of public-private partnership of the governmental structures and companies with a foreign commercial organization.

The R&D based production was chosen as the object of the research. This organization operates in the aerospace sphere of market and has an experience of development, research and pilot-production products for commercial use, primary for the adjacent sectors.

Economic modeling of efficiency increasing of the modernization carried out considering two different innovative scenarios. Both of them affect: technology, business, processes, investments, organizational structure, increasing of the main production processes paradigm and social factors when considering the geographical location of the production site.

The technologies developed by the "Industrial Unit" are used for the production of components in sphere of heavy metalworking machinery in plenty of different products by different enterprises, for example: aerospace, water and railroad transport, oil and gas production, thermal equipment etc.

General methodology of the study

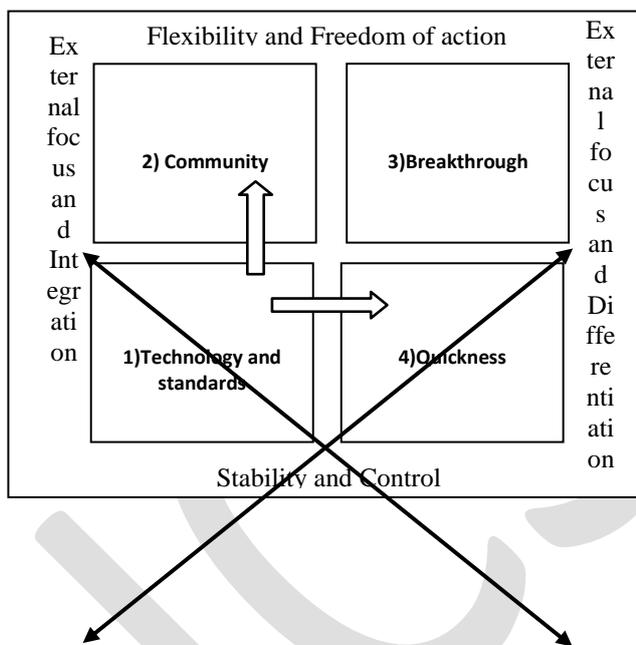
Direct economic influence.

The methodological approach to achieving this goal provides scenic estimation of the economic influence of production "AEROSPACE". Under the direct economic effect refers to the effect that receives pilot production «AEROSPACE» the introduction of new technologies in the management and production, modernization of equipment, increase capacity utilization. The direct economic effect is based on increasing productivity to fulfill larger volume orders, reduce labor intensity, cost and downtime, entering new markets, saving time on passing the order, details of the design and development of the documentation for the equipment with CNC-controlled (computer numerical control). The effect is calculated on the basis of return on investment in the modernization of equipment, enhancing the composition of executives and technologists. The magnitude of the economic effect depends on the selected scenario of innovation and scope of its implementation in the enterprise.

The hypothesis of innovative development

To select the main direction of efficiency' increasing, we consider four scenarios for innovative models competing for the resources innovative development of values. An innovative model allows take in count features of the existing pilot-production

“AEROSPACE” and “Industrial Unit” practices like: corporate culture, competence of personnel and processes. For each of the innovative scenarios were defined key performance indicators (efficiency markers), plans of the priority projects, and different financial parameters.



In line with this model, the emphasis in the creation of production can be placed on the internal and external, flexible of stable development. Combinations of options allow to define four scenarios for innovative pilot production:

1)“Technology and standards” combines a focus on the internal processes and integration of resources with the priority of stability and control with the principal target setting - “produce better, cheaper, more reliable”;

2)“Community” (“Sustainable development”) combines a focus on internal processes and integration of resources with the priority of flexibility and freedom of action with the principal target setting - “support the development with relying on the culture and people”;

3)“Breakthrough” combines a focus on the external processes and service differentiation with the priority of flexibility and freedom of action, with the principal setting - “invent the future”;

4)“Quickness” (“Quick wins”) combines a focus on the external processes and service differentiation with the priority of stability and control, with the principal target setting - “Create value now and every day”.

Based on the current objectives, pilot production “AEROSPACE” operates within existing governmental restrictions by the scenario of “Technologies and standards”. Following the methodology of changing related innovative scenarios, we have formulated hypothesis for the

modeling the economic effects of modernization:

-The first innovative scenario “Sustainable development” (“Community”) is focused on balance and continuity of the development of a pilot production “AEROSPACE” through the implementation of new technologies, standards and continuous improvement of professional competence. From the perspective of the development of new technologies, this scenario involves the systematic implementation of the collaboration between “AEROSPACE” and “Industrial Unit” technologists with new and existing orders on existing pilot production facilities.

-The second innovative scenario is so called “Quick wins” (“Quickness”) and this scenario is focused on the most rapid solution of actual problems of the “AEROSPACE” through the introduction of the new technologies, complete modernization of the equipment and re-engineering management standards.

Stages of the study

The methodology of this analysis assumes the implementation of the following basic steps. On the first stage all indispensable data was collected and processed. In a series of seven individual and group interviews attended by: Director of production, lead technologists, senior economists and lawyers. Requested and analyzed all financial and accounting information, reports on economic activity, public certificates, approvals that required for production process and plan of production activities. We analyzed market competitiveness and made a technological audit of all spheres of pilot production.

The second stage provides the analysis of data required for the creation of the SWOT-analysis and examination of choice for the innovative scenarios for pilot-production. Analysis and complex modernization plans drawn up by the methodical recommendations for the evaluation of investment projects UNIDO (United Nations Industrial Development Organization), and designed in a financial model based on the raw data, a number of assumptions and preconditions.

On the third stage, on the basis of forecast data on sales, technological and investment opportunities was modeled an economic impact of each scenario of modernization, sales plan, production plan, procurement plan, organizational plan, financial plan, a plan of priority projects, project risk map as well as the scheme of legal cooperation between the two participants of the modernization project.

Basic principles of calculation of the economic model and financial plan

economic model

The economic model is built for two innovative scenarios: “Sustainable development” - the first scenario and “Quick wins” - the second scenario. For the analysis of the investment project and the reorganization was set in the calculation of the horizon of 3,5 years. Conventional project starts date July 1, 2015.

The following tax rates are used in the calculation model: VAT (Value-added tax) (18%); Income tax (20%); Property tax (2.2%); Local tax (0.3%); Social contributions on wages (30%); Personal income tax (13%).

The model uses the following indicators of inflation: Annual inflation of income (sales) and expenditure (purchases) assumed equal to the annual inflation forecast of Economic Development of Russia in the 2015-2018 years. Annual inflation of wages is taken to be the annual index of real wages, Russian Ministry of Economic Development forecasted for 2015 and experts estimate for 2016 - 2018.

The size of fixed costs (administrative and management and production (operational)) adopted at the level of current expenditures «AEROSPACE» for the maintenance of pilot production, adjusted for inflation.

The cost of the equipment purchased by “Industrial Unit” in terms of “Quick Wins” scenario is determined on the commercial offer of the company-supplier. Dates of depreciation of purchased equipment are defined on the basis of RF Government Decree of 01.01.2002 N 1 “Classification of fixed assets, included in depreciation groups”. This equipment belongs to the 5th depreciation group (assets with useful life of more than 7-10 years inclusive) (140 001 010 “CNC machines, including processing centers”). The new equipment is put into operational process during October – December 2015. The cost of fixed assets to be made to the project by the «AEROSPACE», and the amount of depreciation on them is determined on the basis of accounting data. Fixed assets that are made to the project, used since the beginning of the innovation process.

In addition to the economic model we are using the following assumptions:

- Since the production is carried out upon request, its implementation is carried out in the month in which it was produced, i.e., stock is not formed in inventories of finished products;
- When paying by buyers of finished products is used the system of the advance payments, the remaining debt is repaid upon shipment of finished products;
- Payment to suppliers of purchased raw materials and services is carried out in the period in which they were acquired, i.e. not formed payable for delivered raw materials, materials and services, as well as not formed receivables prepayment of raw materials and services;
- Financing the modernization carried out by «Industrial Unit», external borrowings are not involved.

Basic methods of calculation

We use linear (straight-line) method of depreciation for the equipment. In accordance with paragraph 4 of article №259 of Tax Code of Russian Federation, linear depreciation method charges cost evenly throughout the useful life of a fixed asset.

For the calculation of the product we apply the method of direct calculation, which involves determining the unit cost by dividing the total cost by the number of produced products. This method is optimal for our research, because mainly used in the facilities that producer homogeneous products. In American and European practice this method is called – Calculation of unit costs.

To present the information about cash-flow from operating activities, in accordance with

IFRS (International Financial Reporting Standards), we used two methods:

- a) Straight-line which is based on the disclosure of the main types of gross cash payments
- b) Indirect which is based on the adjustment of the net-profit before taxing and indexation, with eliminating the impact of non-cash transactions, accruals and deferrals, investing or financing cash-flows.

Financial plan

Income and expense plan reflects operating activities of the projects (process of production and sales) for the certain periods of time (month, quarter, year). As part of the financial model, we formed a plan of income and expenditure on an accrual basis, the essence of which is that revenues are taken into account "for shipping" and expenses are recognized when they are actually incurred, regardless of when they will actually be paid.

Cash receipts and payments plan, as opposed to the plan of income and expenditure shall be prepared "to pay" and reflects the actual cash flows of the project. In contrast to the plan of income and expenses, cash receipts and payments plan has two additional sections: cash-flow from investing activities (on the resources of the costs for generating future income); cash-flow from financing activities (cash flows associated with the formation of the company's capital), of which we can find out the amount and timing of investment, the form of project financing.

The consolidated balance sheet reflects the structure of assets, liabilities and equity at a specific reporting date. Consolidated balance sheets play an important role in assessing the financial condition of the company, its solvency in the short and long term.

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Funding Strategy (revenue sources and uses of funds) project carries on the funds of «Industrial Unit». The need for funding in the innovation scenario "Quick wins" appears in the first two months of the project, when purchased new equipment in the amount of 178 million rubles, including: The cost of purchased equipment – 168,19 million rubles and replenishment of working capital – 9.81 million rubles. In the first scenario, the innovative "Sustainable development" does not appear in the additional financing needs of the project participants, as derived from operating activities income fully cover the project costs.

Analysis of industrial activity

Positioning of pilot production

The concept of "pilot production" covers various production units: experimental workshops enterprises of mass and serial production of the types of experimental production at industrial research institutes, experimental plots for debugging of new technological processes. Experienced management is the link between science and industry.

Testing of the product in the pilot production is carried out in parallel with the stages of

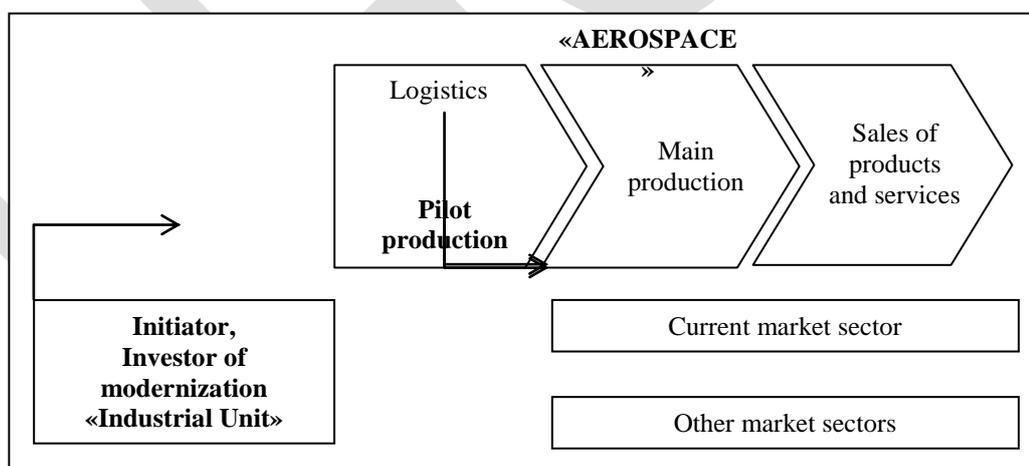
technical preparation of production, and it is the final stage of scientific research and experimental development.

Comprehensive experience of our researches of different industrial enterprises in different sectors shows that the rapidly changing concepts such as physical and chemical, circuit engineering, design, and other technologies not only justifies the creation of pilot production, but contribute it as well.

The key features of the pilot production "AEROSPACE" are:

- A large product range;
- Uniqueness and the frequent change of production facilities;
- Frequent changeover of the equipment;
- Deadlines for the prototypes production;
- Large number of design and technical changes.

In accordance with this approach, the current pilot production «AEROSPACE» has a special and versatile low-productive equipment, which allows for a full processing cycle of products for various usage, from the development of design documentation in its own design office to production to finished products. All production sites are located in a single management unit, equipped with overhead cranes and self-propelled rail platforms, which is reflected positively on the productivity and the timing of orders.



Current positioning of the pilot production is made by the chain-value method of M. Porter.

Also, the authors determined the area of the main competitive advantages of pilot-production and concluded that the possibility of changing the basic competitive «focuses" strategy to "differentiation" after the modernization of the equipment. Promising markets products modernized pilot production will not only domestic customers, but also the entire enterprise sector, as well as other basic industries. The ability to process the introduction of development «Industrial Unit» for complex metal processing and launch their serial production on the basis of pilot production of components aerospace enterprise «AEROSPACE» caused by highly

qualified scientific and technological competencies of staff of experienced production, demanding internal customer, external civil and defense customers. However, at the time of innovation and modernization of the production pilot plant «AEROSPACE» is a complex of stable management, investment and economic problems caused by the constant under-utilization of production capacity, lack of cycle production, low productivity, single and small batch orders.

Results of the production research

According to the results of a complex research of the strategic analysis activities and technological audit, authors have made a SWOT-analysis:

◆ Strengths:

- Availability of high-skilled and well educated technologists, specialists in metal engineering;
- New high-productive equipment;
- The project is funded entirely by one of the participants, there is no dependence on banks;
- Short payback period. The project pays for itself in 7 months;
- Activities parties complement each other;
- Complete authorization of production.

◆ Weaknesses:

- Having a risk of increasing the financing needs of the project in case of delay in commissioning of the equipment or the incomplete implementation of the sales plan;
- The lack of a transparent system of economic management of production;
- Low automation of the management;
- Among other shortcomings of the low speed drawing quality of the process according to an insufficient number of technicians;
- Technologist' labor is not automated in the compilation of the list of parts machining operations.

◆ Opportunities:

- Regular financing by the governmental programs;
- Recovering from the crisis situation of the project in 2017-18.

◆ Threats:

- Continued decline in industrial sector of Russian economy;
- Delay of the military and aerospace state funding programs;
- The increase of the cost of metallurgical raw materials for the production needs.

Qualitative assessment of innovative scenarios

According to the results of the SWOT-analysis the possibility of changing the current scenario may be considered as confirmed hypothesis. Current scenario “Technologies and standards” can be replaced with an adjacent scenario with the appropriate economic assessment.

I. Innovative scenario “Sustainable Development” provides a set of activities arranged in a logical chain of the progressive realization of the strategic and innovative purposes «AEROSPACE» from top to bottom. Set of plans with different level of implementation will be developed, it will help in comprehensive assessment of potential of operation and will provide the opportunity to launch a pilot production and to set a number of interrelated technological measures that will increase a production efficiency in terms of long-living producing infrastructure. Investments and entering the new high-performance equipment are not foreseen in this scenario.

II. As part of the second innovative scenario which is called “Quick Wins” to be implemented a set of innovative advancements that are aimed at the rapid modernization of the existing pilot production, as we as set of measures of the efficiency enhancing of plenty of different functional areas such as business processes, economics, human resource management. Automation control system will continue until 2016. As part of the technological development of products will be implemented a pilot project component production series "X" using the acquired new equipment. The condition for this scenario are the large-scale investments and commissioning of the new high-performance equipment.

Modernization plan

Phases of modernization	1 st innovative scenario “Sustainable Development”	2 st innovative scenario “Quick Wins”
Pre-investments phase	Evaluation of contributions in the joint venture and determining the distribution of interests. Signing of collaboration contact. Determining of the property labor and material resources usage for participants of production.	

Investments phase		Development and implementation of a cost-accounting system of tracing and calculation of the costs accounting (3-4 month). Purchase of equipment (1 month)
Exploitation phase		Commissioning and production of the pilot batches on new hardware (3 month). Introduction of production orders management system - ADEM (Automated Design Engineering Manufacturing) (1-2 month)
		Development and introduction of the system of budgeting activities (4-5 mo.). The regulation of business processes (2 mo.). Determining duties of people who will combine their activities (1 month.). Development and implementation of a system of key performance indicators of the following areas: economic efficiency and technical condition of manufacture (3-4 mo.).

Evaluation of the economic effects of innovative scenarios

Evaluation of the effect by using business-indicators

Sales plan and production program formed by the initiator of modernization «Industrial Unit» on the basis of pre-orders from its existing and new customers in the four groups of finished products:

- (a) Products with high processing complexity;
- (b) High production complexity equipment (“X” series);
- (c) Primary products of “AEROSPACE” and industry-specific demand;
- (d) Other products (steel + products with low processing complexity).

In the first scenario, existing equipment is able to produce: (a), (c) and (d) groups of products, in the second scenario all four groups can be produced (because of the new equipment that can be implemented in this scenario). Five times increase the volume of sales of products with high processing complexity is due to the growth of production, and because of the transition to more complex products with high sales prices.

Intra-industry consumption remains unchanged.

	Units of	2015	2016	2017	2018
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Index	measuring								
Innovative scenario		(1) «SD»	(2) «QW»	(1) «SD»	(2) «QW»	(1) «SD»	(2) «QW»	(1) «SD»	(2) «QW»
Sales revenue	Million. USD.	4,18	7,17	15,68	46,34	22,10	60,98	30,54	86,41
Depreciable value	Million. USD.	0,79	3,48	0,73	3,02	0,66	2,56	0,59	2,10
Number of employees	Per.	85	121	85	121	85	121	85	121

Implementation of this plan of sales and production program requires the following types of fixed assets and materials (some of them will be supplied by "AEROSPACE" and "Industrial Unit"):

- buildings;
- transmission devices;
- heavy machinery;
- power machines;
- CNC equipment;
- Measuring and control devices;
- Vehicles;
- Household equipment;
- etc.

The scenario "Sustainable Development" will be implemented on the existing «AEROSPACE» machine working stock. At the same time the production efficiency will be achieved in the management innovation of the organization of production processes, application of new technologies for processing, increasing the mass of orders, as well as accelerated raw materials procurement procedures and additional funds as a commodity crediting «Industrial Unit» for the pilot production of «AEROSPACE».

Scenario "Quick Wins" requires implementation of the new park of the equipment. «Industrial Unit» plans to purchase and use the new equipment in the amount of not less than 10 high-performance and high-tech foreign machines totaling up to 3.48 million USD. The total net book value of pilot production equipment in the near horizon of the project will fall to 2.10 million USD.

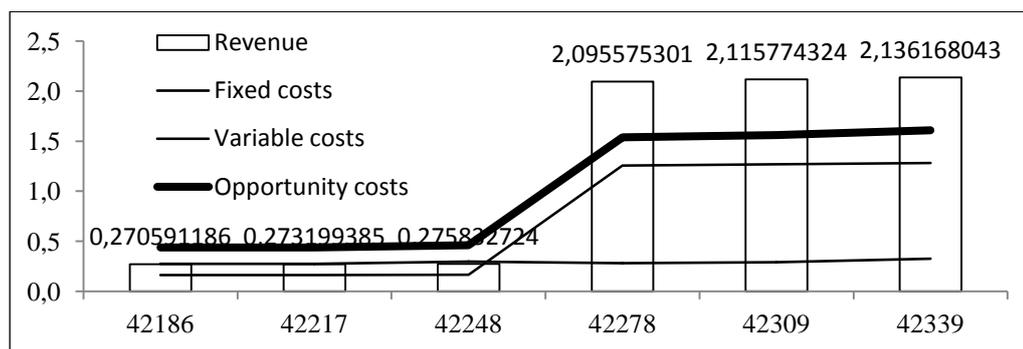
Organizational modernization plan calls for an increase in staffing levels in the first scenario, up to 85 full-time employees and the second up to 121 full-time employees, of which 21 employees - Administrative and managerial staff and 100 people - production staff. This will create new jobs for highly qualified personnel. The number of employees in the project consists of the current staff number of pilot production and additional staff provided by the «Industrial Unit». The level of staff salaries determined based on the average salary in the city.

Evaluation of the effect by using financial indicators.

Index	Units of measuring	2015		2016		2017		2018	
		(1) «SD»	(2) «QW»	(1) «SD»	(2) «QW»	(1) «SD»	(2) «QW»	(1) «SD»	(2) «QW»
Innovative scenario									
Net income	Million. USD.	0,23	0,79	2,79	11,81	4,79	16,45	7,43	24,52
Profit margin (margin on net sales)	%	6%	11%	18%	25%	22%	27%	24%	28%
EBITDA	Million. USD.	0,36	1,25	3,63	15,30	6,13	21,09	9,43	31,18
BCF (Budget Cash Flow)	Million. USD.	0,49	0,47	2,13	6,69	3,08	8,93	4,32	12,70
Funding needs	Million. USD.		3,42						
Pay-off period	Month.		7						

The graph below shows the breakeven point of the project and the minimum production volume that required. Breakeven means that the revenue derived from project completely compensates both variable and fixed costs (expenses). Graphs is built only for the “Quick Wins” innovative scenario. In this scenario project reaches breakeven point in October 2015, when production based on new equipment starts. Until October 2015 the fixed costs of the project exceed the revenue from product' sales.

According to the “Sustainable development” scenario there is no need in building of a graph, because projects starts from the breakeven point and revenue received in the first period of the project fully compensates for both variable and fixed costs (expenses).



Results

The main result of study, we can consider the possibility collaboration between proven international methods and management techniques and Russian technical solutions and advancements for the industrial needs. The results of calculation of the modernization of the financial indicators in the models show a high cost-effectiveness of such innovative measures, particularly when replacing the fleet of obsolete equipment with the high-performance, as well as carrying out the process of re-engineering. Natural performance indicators modernization of the second scenario, the innovative "Quick wins" exceed the performance scenario "Sustainable development" is 2.5 - 3 times, relative to 1.5 times. Only in the third year of the modernization of the profitability of sales net profit scenario "Sustainable development" overcomes a significant gap, but never close to the scenario "Quick wins".

In this article we focus primarily on innovative development and the economic effect detailed sales plan was not considered production, procurement and organizational plans as well as scheme of legal interaction between the project participants and the public regulation of their activities. However, as a result it can be stated a number of significant effects of the modernization of the pilot production «AEROSPACE». Activities of pilot production goes into the sphere of cutting-edge technologies as well as high-performance management. Complete modernization of equipment creates a possibility of fulfilling orders that were previously unrealizable. As a result of innovative activities and modernization decreases the load on maintenance of infrastructure: utilities and maintenance expenses for the maintenance of pilot production, part of the labor costs of personnel and depreciation of fixed assets covered by the joint venture with the initiator of «Industrial Unit». It is important that decreases the size of government subsidies from the federal budget for the maintenance of underutilized capacities of pilot production.

References

Gordon, M. J., 1982. The Investment, Financing and Valuation of a Corporation, Westport, Conn.: Greenwood Pr., p. 128.

Federal State Statistics Service (Rosstat). Electronic resource // [<http://www.gks.ru>]

Ministry of Chemical Industry of the Russia., 1978. Method of determining the annual economic effect on the creation and implementation of new technology, inventions and innovations in the chemical industry. Moscow.

Damodaran, A. 2011. Investment valuation. Tools and methods for the evaluation of any assets. Textbook. Alpina Publisher. Moscow. - p. 1324.

Fisher I., 1930. The Theory of Interest, Macmillan. New York.

Denzin NK, Lincoln YS (eds.). 2000. Handbook of Qualitative Research. London: Sage Publications.

Fang zhad Information Technology Entrepreneurship and Innovation Section VI innovation process 2008 by I Globa

Technological Innovation and the Dutch financial sector DeNederlandscheBank Eurosystem
http://www.dnb.nl/en/binaries/Themaonderzoek%20%20uk_tcm47-336322.PDF

Manufacturing the future: The next era of global growth and innovation By James Manyika, Jeff Sinclair, Richard Dobbs, Gernot Strube, Louis Rasse, Jan Mischke, Jaana Remes, Charles Roxburgh, Katy George, David O'Halloran and Sreenivas Ramaswam

<http://www.mckinsey.com/business-functions/operations/our-insights/the-future-of-manufacturing>

Jeremy Carter, Menno van Dijk and Ken Gibson. "Capital investment; How not to build the Titanic". The McKinsey Quarterly 1996 Number 4.

Karim Benammar Innovation Through Clean Sheet Redesign. Innovation Management.se
<http://www.innovationmanagement.se/2015/11/11/innovation-through-clean-sheet-redesign/>

A New Approach to Manage Disruptive Innovation in an Environment of High Uncertainty. Jose A. Briones. <http://www.innovationmanagement.se/2012/03/19/a-new-approach-to-manage-disruptive-innovation-in-an-environment-of-high-uncertainty/>

Innovation Support in Latin America and Europe: Theory, Practice and Policy in Innovation and Innovation Systems. February 17, 2014 | By: Traducción por Jesus Mascareño. Edited by Mark Anderson, David Edgar, Kevin Grant, Keith Halcro, Julio Mario Rodriguez Devis and Lautaro Guera Genskowsky.

Publisher: Gower Publishing Co. Publication Date: December 28, 2013

Reverse Innovation. Jeffrey Phillips. June 28, 2012

Winning at New Products –Creating Value through Innovation Paul Hobcraft. September 29, 2011

Four Tools to Support Creativity and Innovation Jun 02, 2015 | By: Langdon Morris | In: The Innovation Formula

Michael J. Gelb. How to Think Like Leonardo da Vinci. Dell, 1998. P. 138.

Karl Sabbagh. Twenty-First-Century Jet: The Making and Marketing of the Boeing 777. Scribner, 1996. p. 70.

Thomas J. Allen and Gunter W. Henn. The Organization and Architecture of Innovation. Elsevier, 2008. P. 2.

Innovation Governance: Delivering on the Growth Promise Sep 11, 2014 | By: InnovationManagement | In: Roundtable Discussion, Videos.

<http://www.innovationmanagement.se/2014/09/11/innovation-governance-delivering-on-the-growth-promise/>

Best Board Practices on Innovation Governance – How Proactive is your Board? Oct 19, 2015 | By: Jean-Philippe Deschamps | In: Strategies

Innovation Governance: How Top Management Organizes and Mobilizes for Innovation, by Jean-Philippe Deschamps and Beebe Nelson, Wiley/Jossey-Bass, 2014.

Harold R. Kerzner Project Management: A Systems Approach to Planning, Scheduling, and Controlling. Aug 14, 2016

A Guide to the Project Management Body of knowledge PMBOK Guide fourth ed.... Jenson Books Inc, Project Management.