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Department of Science and Innovation

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METHODOLOGICAL MANUAL

The fundamentals of the Earned value management for effective project monitoring and forecasting

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In the present Methodological Manual there are descriptions of Earned value management (EVM) theory, forecasting model basics for project performance, recommended for the Project management courses in bachelors degree programs and Project planning and control courses in masters degree programs. They include fundamentals of the Earned value management to enhance practically the EVM topic, forecasting model on EVM case study taking into account the influence of project risk management strategies and forecasting model based on EVM tool.

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Introduction

Most infrastructure and investment projects are delivered behind schedule and with cost overruns; often driven by unforeseen risks and environmental uncertainty. Therefore, project-intensive industries need the proposed analytical methodology to forecast the duration and cost of projects in real time. This will help avoid the above problems or better understand the risks. This is important in light of the implementation of Initiatives 2.13, 3.27 and 5.10 of the Strategic Development Plan of the Republic of Kazakhstan until 2025, which are aimed at implementing projects in high-tech industries, improving transport and logistics infrastructure and building smart cities to ensure sustainable urbanization.

Foundation and initial data for the development of the topic. The basis for the research and writing the methodological guideline is the grant of the Ministry of Science and Higher Education of the Republic of Kazakhstan IRN AP09259049. The initial data for the topic development were obtained based on information from publications, as well as the Project Planning Control course of Dr. Narbaev.

As part of an effective project monitoring and control system, forecasting and identifying project performance using Earned Value Management (EVM) tool is critical to project management's (PM) success. Predicting project performance is a promising task and helps project managers make timely and appropriate decisions regarding the final duration and cost of projects. There are 2 methodologies presented in the EVM tool to forecast project performance: the Gompertz Growth model and the Linear growth model. These two models are the main models of non-linear regression models. They are using this EVM tool to forecast a project's performance. The Cost contingency will be considered. Their project managers need to add the percentage of the cost contingency in case of risks. Also,

there is a section about the risk. While adding risk, managers need to give more details about its descriptions, impact in case of money and time, and the most important detail is the likelihood of the risk presented.

A great benefit of the EVM technique is its ability to assist in Monitoring & Control of ongoing projects. With the tool, one can analyze project progress and performance and, based on this, provide forecasts of possible outcomes for a project. It can also assist in providing necessary project status information to internal and external stakeholders used to judge the health of a project in terms of time, cost, and scope/quality performance.

Goals and objectives of methodological guideline. The aim of the methodological guideline is to develop a methodology for forecasting project performance using the EVM tool for risk-informed project management. This analytical tool will be used to predict the risk-integrated duration and cost of infrastructure projects in real time by considering the impact of risk and the uncertainty of the external environment through the risk behavior of the project manager.

Objectives:

- Presenting the theoretical basics of EVM;
- Development of a forecasting model based on an EVM case study;
- Development of a forecasting model based on the EVM tool.

The first section of this methodological guideline presents a comprehensive overview of the EVM concepts. The second section develops a forecasting model on an EVM case study, considering the influence of project risk management strategies (PRMS). The third section presents a forecasting model based on the EVM tool, also considering the influence of risk management strategies. In conclusion, the main results and predictions are obtained and presented.

We sincerely hope that our research team, as well as professionals with extensive experience in the field of project management, will contribute to the development of the project performance forecasting process using the EVM tool in different projects.

This methodological guideline will be useful to students, project managers, and those interested in forecasting project performance and getting accurate results using EVM and PRMS.

1. Fundamentals of EVM

EVM is a technique of thoroughly quantifying the technical performance of an ongoing project and integrating it with cost and time. It is a powerful tool that allows objective monitoring of actual status, and comparing it with a plan, tracking deviations from the project baseline, and forecasting the final cost and time at completion based on the current project status (PMI 2008).

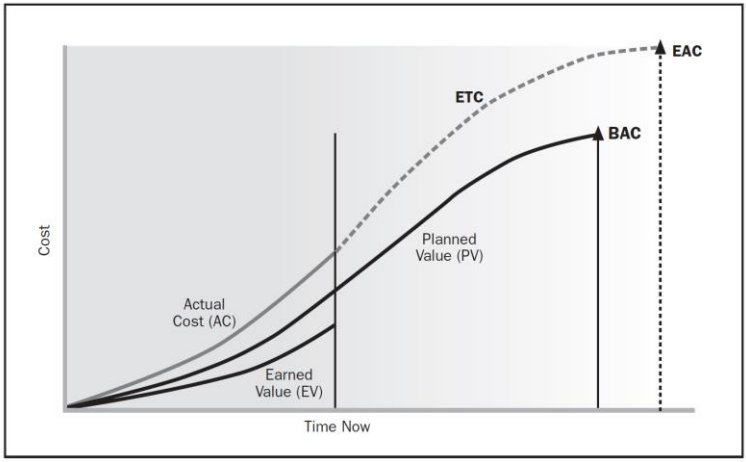


Figure 1. Graphic View of the EVM Data.
(Source: PMI (2011). Practice Standard for Earned Value Management. Second edition. PMI Publications, Newton Square.)

The basic parameters representing the basis of the analysis are the Planned Value (PV), Earned Value (EV), Actual Cost (AC) and Budget at Completion (BAC). Figure 1 is a graphical representation which shows the standard status of the construction project, i.e. Over Budget and Behind Schedule. These four indicators with corresponding Cost Performance

Index (CPI) and Schedule Performance Index (SPI) provide information on project cost, project schedule and forecast project cost and time at completion (Narbaev & De Marco, 2014).

Next, terms, abbreviations/acronyms and definitions on EVM are provided:

- *BCWS - Budgeted Cost of Work Scheduled ($):* the value of work scheduled to be accomplished in a given period of time *(= Planned Value (PV)).*
- *BCWP - Budgeted Cost of Work Performed ($):* the monetary value of the work actually performed within the control time *(= Earned Value (EV)).*
- *ACWP - Actual Cost of Work Performed ($):* the costs actually incurred in accomplishing the work performed within the control time *(= Actual Cost (AC)).*
- *ATWP - Actual Time of Work Performed (= Actual Time (AT)).*
- *STWP - Scheduled Time of Work Performed (= Planned Duration (PD)).*

Table 1. Key EVM terms and questions *(Narbaev, 2023).*

Acronym	Term	Question
PV	Planned Value	By now, what is the budgeted cost of the work planned to be done?
EV	Earned Value	By now, what is the budgeted cost of the work actually performed?
AC	Actual Cost (Total)	By now, what is the actual cost of the work actually performed?
BAC	Budget at Completion (Total Budget)	At the beginning, how much did we budget the total project?

EAC	Estimate at Completion	What is the project likely to cost at the end?
ETC	Estimate to Complete	What will the remaining work cost?
VAC	Variance at Completion	Will we be under or over budget?

In Table 1, one can refer to the key EVM terms and questions explaining the meaning of each term, respectively.

Formulae:

- Cost Performance Measures:
  - Cost Variance:

    CV = BCWP - ACWP (= EV - AC);
    (+): Underrun - Gain of Value;
    (-): Overrun - Loss of Value;
    (0): On Budget.
  - Cost Performance Index:

    CPI = BCWP/ACWP (= EV/AC)
    (>1): Underrun;
    (>1): Overrun;
    (=1): On Budget.
- Schedule Performance Measures:
  - Schedule Variance:

    SV = BCWP - BCWS (= EV - PV)
    (+): Ahead - Gain of Time;
    (-): Behind - Loss of Time;
    (0): On Schedule.
  - Schedule Performance Index:

    SPI = BCWP/BCWS (= EV/PV)
    (>1): Ahead;
    (<1): Behind;
    (=1): On Schedule.
- Integrating CPI and SPI:

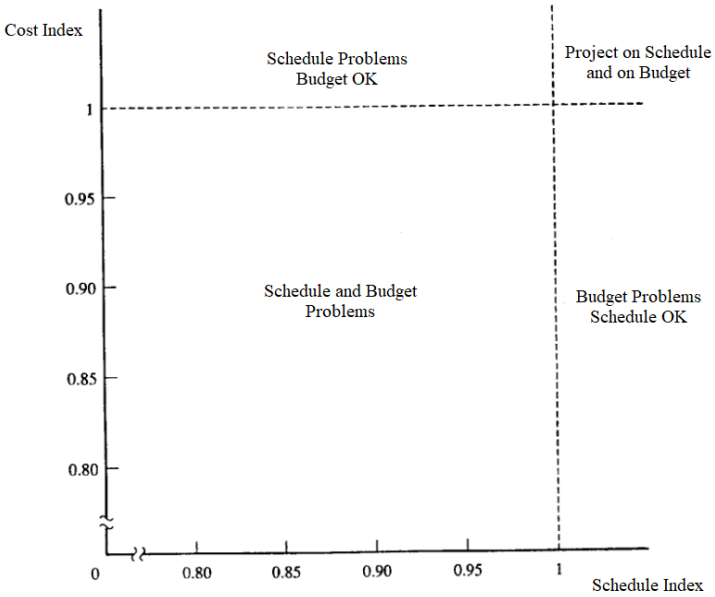


Figure 2. Integrating CPI and SPI *(Narbaev, 2023).*

In Figure 2, the project budget and schedule status can be analyzed through the combination of CPI and SPI Indices. If Both CPI and SPI are less than 1, then the project is Over Budget and Behind Schedule. If CPI is less than 1 and SPI is greater than 1, then the project is Over Budget and On Schedule. If CPI is greater than 1 and SPI is less than 1, then the project is on Budget and Behind Schedule. If Both CPI and SPI are greater than 1, then the project is on Budget and on Schedule.

- ➢ The Earned Schedule (ES) Measures:
  - ○ EV-based SV is denoted as SV($) = EV - PV
  - ○ ES-based SV is denoted as SV(t) = ES - AT (= Earned Schedule - Actual Time) (+): Ahead of Schedule;

(-): Behind Schedule;
(0): On Schedule;

- EV-based SPI is denoted as SPI($) = EV/PV
- ES-based SPI is denoted as SPI(t) = ES/AT

(>1): Ahead of Schedule;
(<1): Behind Schedule;
(=1): On Schedule.

➢ The Earned Schedule (ES) Formula:

- ES = C + $\frac{EV - PV(C)}{PV(C+1) - PV(C)}$;

C - a number of completed time increments for which EV exceeds PV.

Table 2. The EVM formulae *(Narbaev, 2023)*.

Name	Formula	Meaning
CV - Cost Variance	EV - AC	Negative – Over Budget Positive – Under Budget
SV - Schedule Variance	EV - PV	Negative – Behind Schedule Positive – Ahead of Schedule
CPI - Cost Performance Index	EV / AC	Greater than 1 – Good Performance Less than 1 – Bad Performance
SPI - Schedule Performance Index	EV / PV	Greater than 1 – Good Performance Less than 1 – Bad Performance
EAC - Estimate at Completion	AC + Bottom Up ETC	Actual Cost to Date + A New Estimate for The Remaining Work (It is used when the

		original estimate is flawed)
	$\frac{BAC}{CPI}$	Past Performance (Spending Rate) will continue to the future
	AC + (BAC - EV)	Performance to date is atypical and future performance will be the same as planned
	$AC + \frac{BAC - EV}{CPI * SPI}$	It might be used when the cumulative CPI is less than 1 and a scheduled completion date must be met
TCPI - To Complete Performance Index	$\frac{BAC - EV}{BAC - AC}$	In order to stay within budget, what rate must we use for the remaining work? Greater than 1 – Bad Performance Less than 1 – Good Performance
ETC - Estimate To Completion	EAC - AC	How much more will the project cost?
	Reestimate	Reestimate the remaining work from the bottom up
VAC - Variance at Completion	BAC - EAC	How much over/under budget will we be at the end of the project?

In Table 2, formulae, and meanings on the key EVM parameters (e.g.: CV, SV, CPI, SPI, etc.) are given.

- ➢ Cost and Time Forecasting:
  - ○ Cost Estimate at Completion (CEAC) - the expected total cost of completing a project;

- CEAC = Cost Spent + (Work Remaining × Expected Unit Cost);
- Expected Unit Cost = Cost Spent / Work Accomplished;
- CEAC Forecasting:

Table 3. Independent EAC Assumptions and Calculations *(Source: PMI (2011). Practice Standard for Earned Value Management. Second edition. PMI Publications, Newton Square.)*

Assumption	Formula
Future Cost Performance will be performed at the budgeted rate	EAC = AC + (BAC - EV) = BAC - CV
Future Cost Performance will be the same as all past cost performance	EAC = AC + (BAC - EV)/CPI = BAC/CPI
Future Cost Performance will be the same as the last three measurement periods (*i, j, k*)	$EAC = AC + \frac{(BAC - EV)}{(EV_i + EV_j + EV_k) / (AC_i + AC_j + AC_k)}$
Future Cost Performance will be influenced additionally by past schedule performance	$EAC = AC + \frac{(BAC - EV)}{(CPI \times SPI)}$
Future Cost Performance will be influenced jointly in some proportion by both schedule and cost indices	$EAC = AC + \frac{(BAC - EV)}{(0.8CPI + 0.2SPI)}$

In Table 3, formulae and assumptions on Estimate at Completion (EAC) are provided.

- Time Estimate at Completion (TEAC) - the expected duration of completing a project;
- TEAC = Actual Time + (Planned Duration - Earned Schedule);

- Original Estimate Approach (Earned Schedule):
  TEAC = AT + (PD - ES);
  Time overruns are past history and will not incur in the future;
- Revise Estimate Approach:
  TEAC = AT + (PD - ES)/SPI(t);
  Project future will, at least, reflect past behavior if no corrections!

➢ Critical Ratio and Control Limits:

Figure 3. Critical Ratio and Control Limits *(Narbaev, 2023).*

According to the Critical Ratio Index (Figure 3), one can investigate the health of the project and take appropriate steps to maintain/advance the project status. If the Critical Ratio Index is between 0.5 and 0.6, one should inform company top management and If the Critical Ratio Index is between 0.7 and 0.8, one should investigate the current situation immediately to enhance the project health and to raise the Critical Ratio Index.

If the Critical Ratio Index is between 0.9 and 1.0, one should control the situation carefully and If the Critical Ratio Index is between 1.0 and 1.1, then one should ignore the current Project Status, since it is considered to be an ideal situation. If the Critical Ratio Index is between 1.2 and 1.3, one should investigate the situation at leisure and If the Critical Ratio Index is between 1.4 and 1.5, then one should investigate the situation immediately, since this kind of situation is considered to be improbable and there is a high chance to discover some mistakes within the Project Estimates.

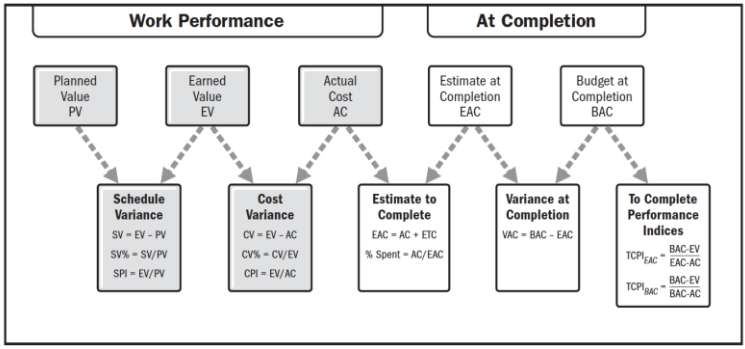


Figure 4. Basic EVM Variance and Index Calculations. *(Source: PMI (2011). Practice Standard for Earned Value Management. Second edition. PMI Publications, Newton Square.)*

In Figure 4, one can notice the formulae on Schedule Variance (SV), Cost Variance (CV), Estimate to Complete (ETC), Variance at Completion (VAC) and To Complete Performance Indices (TCPI).

Performance Measures		Schedule		
		SV > 0 & SPI > 1.0	SV = 0 & SPI = 1.0	SV < 0 & SPI < 1.0
Cost	CV > 0 & CPI > 1.0	Ahead of schedule under budget	On schedule under budget	Behind schedule under budget
	CV = 0 & CPI = 1.0	Ahead of schedule on budget	On schedule on budget	Behind schedule on budget
	CV < 0 & CPI < 1.0	Ahead of schedule over budget	On schedule over budget	Behind schedule over budget

Figure 5. Interpretations of Basic EVM Performance Measures. *(Source: PMI (2011). Practice Standard for Earned Value Management. Second edition. PMI Publications, Newton Square.)*

In Figure 5, The Project Cost and Schedule Performance can be analyzed through Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI) and Schedule Performance Index (SPI) Values. If CV > 0, CPI > 1.0, SV > 0 and SPI > 1.0, then The Project is Ahead of Schedule and Under Budget. If CV > 0, CPI > 1.0, SV = 0 and SPI = 1.0, then The Project is On Schedule and Under Budget. If CV > 0, CPI > 1.0, SV < 0 and SPI < 1.0, then The Project is Behind Schedule and Under Budget. If CV = 0, CPI = 1.0, SV > 0 and SPI > 1.0, then The Project is Ahead of Schedule and On Budget. If CV = 0, CPI = 1.0, SV = 0 and SPI = 1.0, then The Project is On Schedule and On Budget. If CV = 0, CPI = 1.0, SV < 0 and SPI < 1.0, then The Project is Behind Schedule and On Budget. If CV < 0, CPI < 1.0, SV > 0 and SPI > 1.0, then The Project is Ahead of Schedule and Over Budget. If CV < 0, CPI < 1.0, SV = 0 and SPI = 1.0, then The Project is On Schedule and Over Budget. If CV < 0, CPI < 1.0, SV < 0 and SPI < 1.0, then The Project is Behind Schedule and Over Budget.

Table 4. EVM as it relates to Project Management Situations. *(Source: PMI (2011). Practice Standard for Earned Value Management. Second edition. PMI Publications, Newton Square.)*

Project Management Question	EVM Performance Measures
How are we doing timewise?	*Schedule Analysis and Forecasting*
Are we ahead or behind Schedule?	Schedule Variance (SV)
How efficiently are we using Time?	Schedule Performance Index (SPI)
How are we doing cost-wise?	*Cost Analysis and Forecasting*
Are we under or over our Budget?	Cost Variance (CV)
How efficiently are we using our resources?	Cost Performance Index (CPI)
How efficiently must we use our remaining resources?	To-Complete Performance Index (TCPI)
What is the project likely to cost?	Estimate at Completion (EAC)
Will we be under or over Budget?	Variance at Completion (VAC)
What will the remaining work cost?	Estimate to Complete (ETC)

In Table 4, EVM Performance Measures with related Project Management Questions were provided.

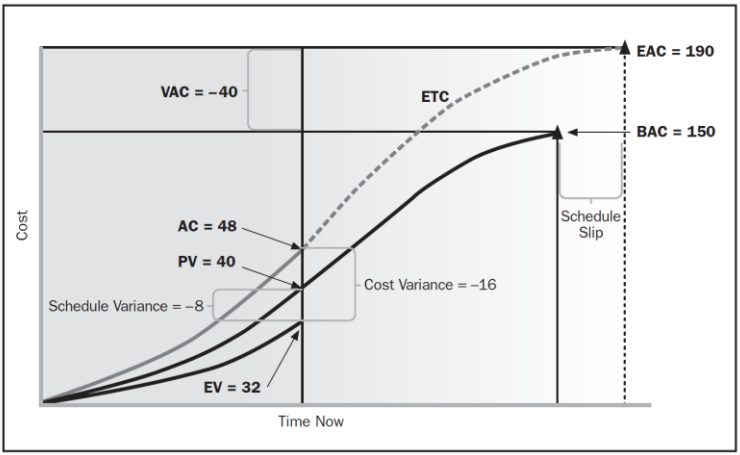


Figure 6. Graphic Summary of Project Status.
(Source: PMI (2011). Practice Standard for Earned Value Management. Second edition. PMI Publications, Newton Square.)

In Figure 6, one can see The Graphic Summary of The Project Status. According to The Graph, The Project is Behind Schedule (SV < 0) and Over Budget (CV < 0).

2. Case Study on EVM (Data from MS Excel)

EARNED VALUE MANAGEMENT APPLICATIONS
HOUSE CONSTRUCTION PROJECT - CASE GAME

Rationale:
A great benefit of the Earned Value Management (EVM) Technique is its ability to assist in Monitoring & Control of ongoing projects. With the tool, one will be able to analyze project progress and performance and based on this provide forecasts of possible outcomes for a project.
It can also assist in providing necessary project status information to both internal and external stakeholders used to judge the health of a project in terms of time, cost, and scope/quality performance.

Purpose:
To apply the EVM Tools and Concepts for monitoring and control of a project "Building of a Private House" as part of teaching Project Management (PM) related disciplines. Where appropriate the Earned Schedule (ES) Tools and Concepts have to be used.

Objectives:
To reinforce understanding of the EVM and ES and the way how these techniques relate to Project Monitoring & Control.

Intended Learning Outcomes (ILO):
By the end of the game, Learners are expected to:

1. Analyze Time, Cost, and Scope/Quality Metrics of an ongoing project;

2. Calculate and Interpret the EVM/ES Variances and Indices;
3. Provide Forecasts of Time and Cost Outcome of a Project using various formulas under various assumptions and interpret them;
4. Chart Graphs of the EVM/ES Metrics, Variances, Indices and Forecasts and visually interpret them;
5. Suggest preventive actions and detect right period to take such actions – you may want to understand the relationships between activities and work-packages from the WBS;
6. Provide Project Status (Health) reporting to various stakeholders such as project contractor, subcontractor, owner, other players and wider public.

Group Size:
A group consists of 3-4 participants.
Game Duration:

- ➢ Instructions – 10-15 minutes;
- ➢ Learners at Work – 90-120 minutes;
- ➢ Debriefing/Presentation – 30-45 minutes;
- ➢ Total Expected Time – 130-180 minutes.

Seating and Materials:
Slides, Round Tables per Group, Markers, Flip Charts for Presentation.

Way of Working:
Students are encouraged to be creative and provide as many results, analyses and findings as possible with diverse arguments, interpretations and implications using the course

materials. It is encouraged to bring laptops to class to facilitate the game.

Project and Data:

Assume, at some point in time in future, you decided to build a private 2-storey house (villa) for your family. You may act as a contractor or owner of the project. The planned duration of the project is 12 months. 5 months into the project life, you decided to check the health of your project – to see whether there will be enough investment and time to meet the agreed plan.

Below is the EVM data upon which you need to answer the points provided in Section Indented Learning Outcomes (ILO) above.

Table 5. EVM Status Report of the House Construction Project as of Month 5 (by WBS components):

	EVM Metrics	PV	EV	AC	BAC
	Project Budget Baseline				371,000
	Management Reserves				15,000
	Performance Measurement Baseline	164,000	148,900	160,200	356,000
	Undistributed: Contingency Reserves				31,000
	Components of WBS	164,000	148,900	160,200	325,000
1.1.1	Design House	5,000	5,000	5,500	5,000
1.1.2	Design Yard	2,000	2,000	1,800	2,000

1.1.3	Engineering Design Structures	9,000	9,000	11,000	9,000
1.1.4	Engineering Design Interiors	4,000	4,000	4,500	4,000
1.2.1	Procurement Structures Foundation	18,000	18,000	20,000	18,000
1.2.2	Procurement Structures Walls	18,000	15,000	17,000	30,000
1.2.3	Procurement Structures Roofing	20,000	16,000	18,000	34,000
1.2.4	Procurement Structures Interior	-	-	-	28,000
1.2.5	Procurement Building Services Engineering	-	-	-	21,000
1.3.1	Excavation	12,000	12,000	12,500	12,000
1.3.2	Construction Foundation	25,000	25,000	25,000	25,000
1.3.3	Construction Walls	16,000	14,000	14,500	34,000
1.3.4	Construction Roofing	8,000	6,500	7,400	18,000
1.3.5	Installation Structures Interior	-	-	-	12,000
1.3.6	Installation Building	-	-	-	8,000

	Services Engineering				
1.4	Integration & Testing	-	-	-	15,000
1.5.1	Site Management	12,000	9,900	10,500	20,000
1.5.2	Project Management	15,000	12,500	12,500	30,000

Table 6. EVM Monthly Report of the House Construction Project through Month 5 (aggregated):

EVM Metrics	1	2	3	4	5	6	7	8	9	10	11	12
PV	18,900	46,300	75,000	123,000	164,000	205,000	235,000	255,400	265,000	289,000	302,700	325,000
EV	23,890	52,500	74,400	115,350	148,900							
AC	20,500	63,100	79,000	129,000	160,200							

Calculate:

from Table 5 - %Complete, CPI, SPI, TCPI-BAC, CV, %CV, SV, %SV, VAC, ETC, EAC (1-5), TCPI-EAC, %Spent - BAC, %Spent - EAC.

from Table 6 - CPI - Cumulative, CPI - Monthly, SPI - Cumulative, SPI - Monthly, TCPI - BAC, CV - Cumulative, CV - Monthly, SV - Cumulative, SV - Monthly, VAC, EAC (1-4), ES, SV(t), SPI(t), TEAC (1-2).

3. The EVM tool

EVM tool

Administrator signs in tips

Login: ajay@evm.com

Password: Password#1234

Web-site: http://evm.thinkit.kz

1. To start the work with EVM tool, firstly, ask your supervisor to create a new account and request user name and password to enter.

2. By creating new accounts for users, the administrator can define a role for the user. There are 3 different roles: Administrator, Super user and User. The main differences of these differences are in the general appearance of the main page. To get to this page, you need to use the data obtained by username and password.

3. To get to this page, you need to use the data obtained by username and password. Go to the http://evm.thinkit.kz, use received user name and password to enter.

4. When you sign in you will see the Project detail page:

Table 7. Administrator view

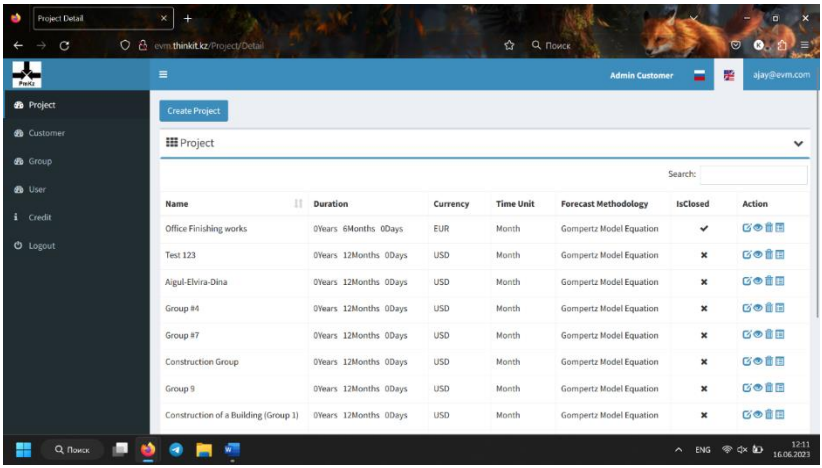


Table 8. Super user view

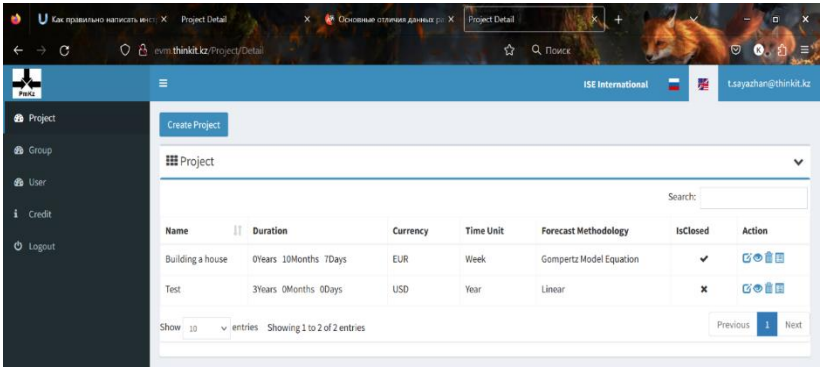
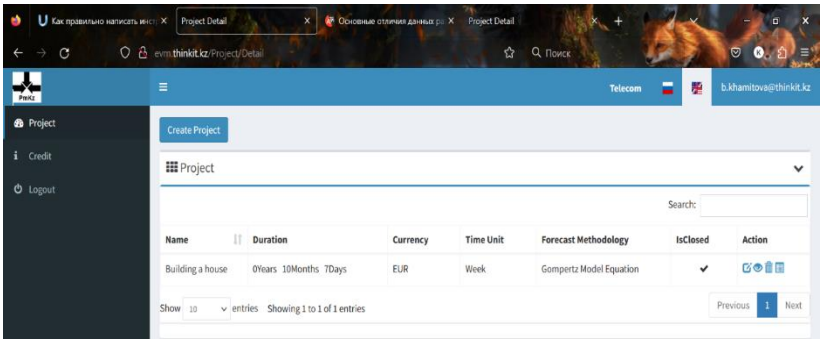


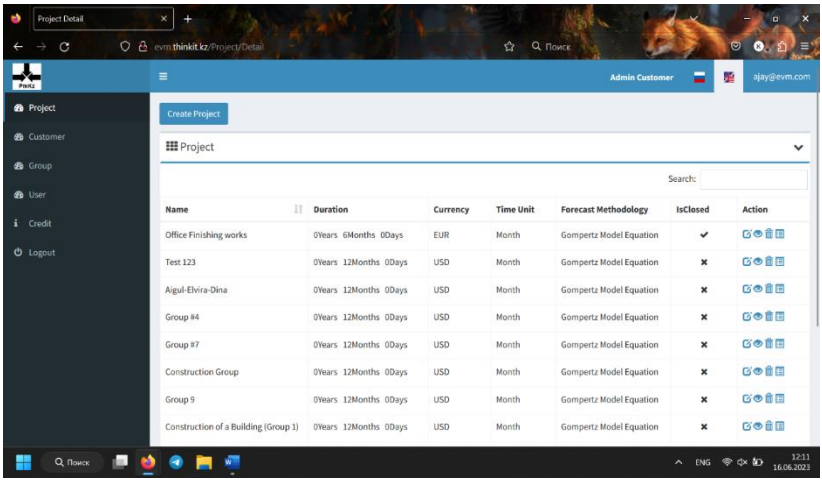
Table 9. User view



As you can see, when entering by User you will see only the projects, that were created by you.
When entering by Super user you can see all projects that was created by you and your group. Also, in menu tab you can see more details. However, when entering by Administrator, you can see all the projects that were created by any user, group in this workspace.

5. In the main page you can see the menu on the left side, you can hide it by using the following button:

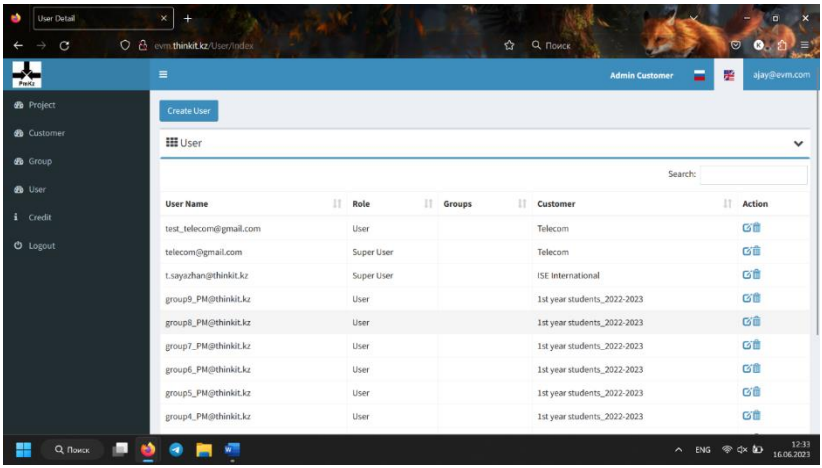
Table 10. Menu page



From the Administrator view you can see all information as said before, and you can also create new accounts and distribute the roles to the users, groups. To do that you need to go to the User page, that is highlighted by green in the picture above.

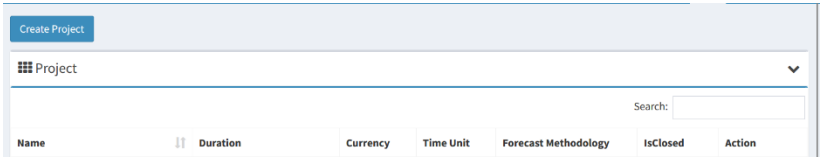
In this page, you can add information about your Users, i.e. Administrator can clarify the roles, the groups and also customers.

Table 11. Project page



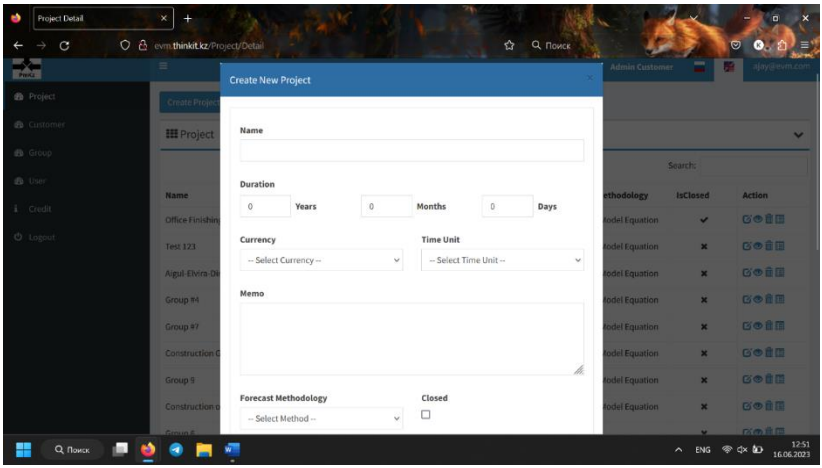
6. In the Project page you will see the main description of the projects: Name, Duration, Currency, Time unit, Forecast methodology, status and action.

Table 12. Project information page



7. Here, you can also create project by adding to the Create Project button. After clicking to the button, you will see the following window.

Table 13. Project output page



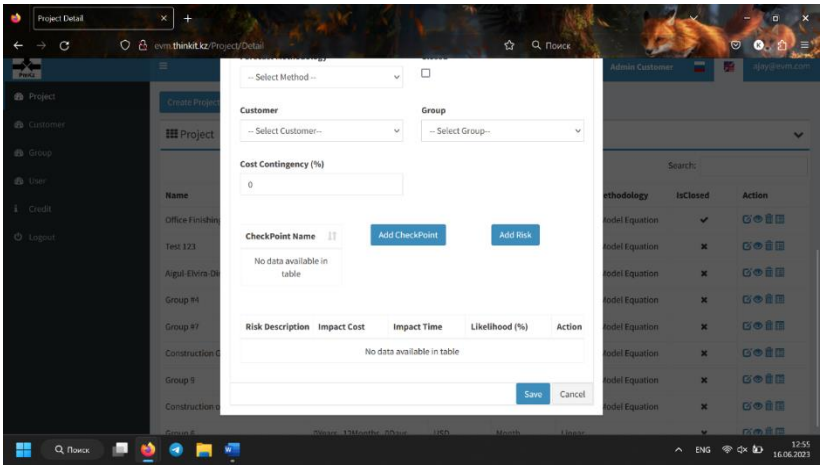
Here, you need to add all input information about the project: the name, duration of the project by years, months or days (depends on a project), currency (3 options: USD, EUR and KZT), time unit (depends on duration), into the Memo section you can add any information about the project.

The following step is to select the Forecast methodology, for now, there are only 2 methodologies presented in EVM tool: Gompertz Growth model and Linear growth model, these two models are the main models of a non-linear regression models.

The next button is responsible for the status of the project, if the project is closed or not.

The following buttons are presented below.

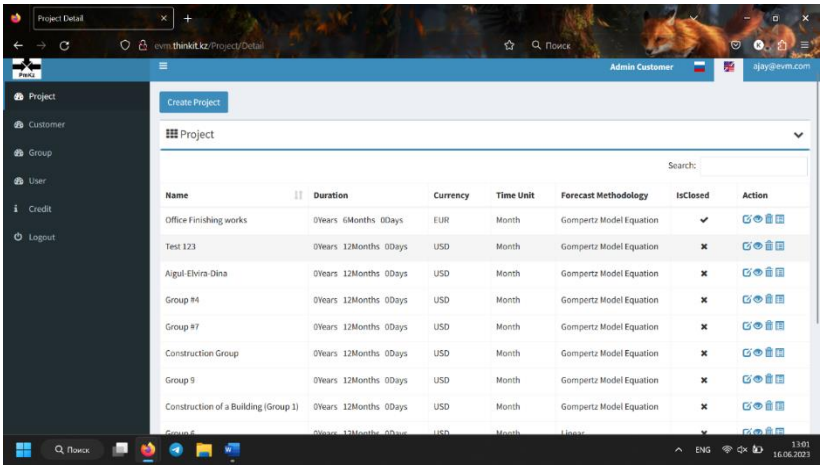
Table 14. Project output page



There you need to add information about the customer and group that are responsible for the project. The next section is Cost contingency, there you need to add the amount in % of the cost contingency in case of risks. Additionally, the following section is about the check points, or in other words, tracking periods. Also, there are the section about the risk, while adding risk you need to give more details about its descriptions, impact in case of money and time, and the most important detail is the likelihood of the risk presented.

8. When finishing all the input data of the project, click to the Save button. Then you will see your created project in the general list of the projects. Here in Action column, you can see the different buttons that has their own actions – Edit, View, Delete and Detail.

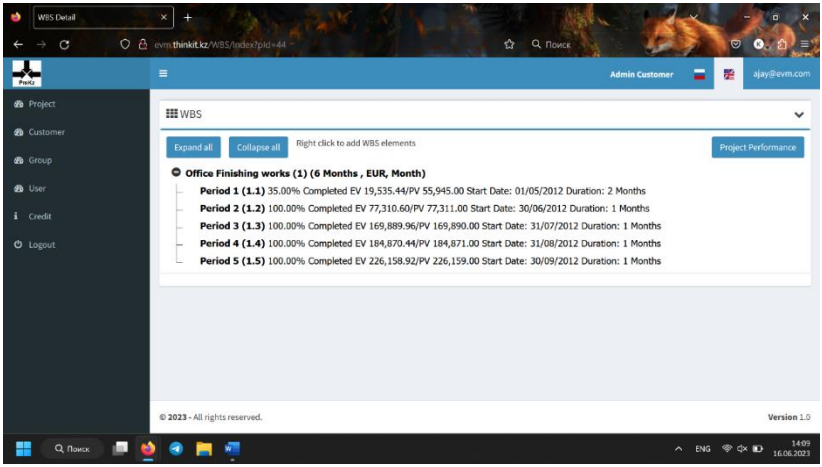
Table 15. Project archive page



9. When clicking on the "edit" action, the same window appears as when "create project" action. With this action, you can make adjustments based on the introductory data of the project.

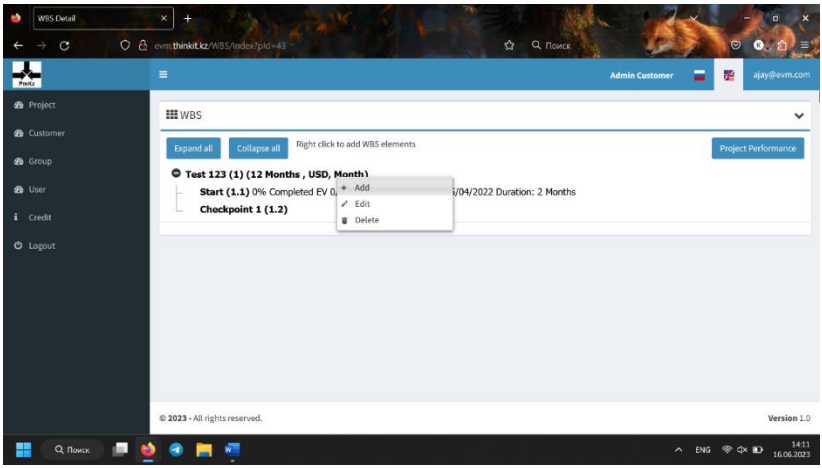
10. When clicking on the “view” action, you will see the window with WBS.

Table 16. Project tacking page



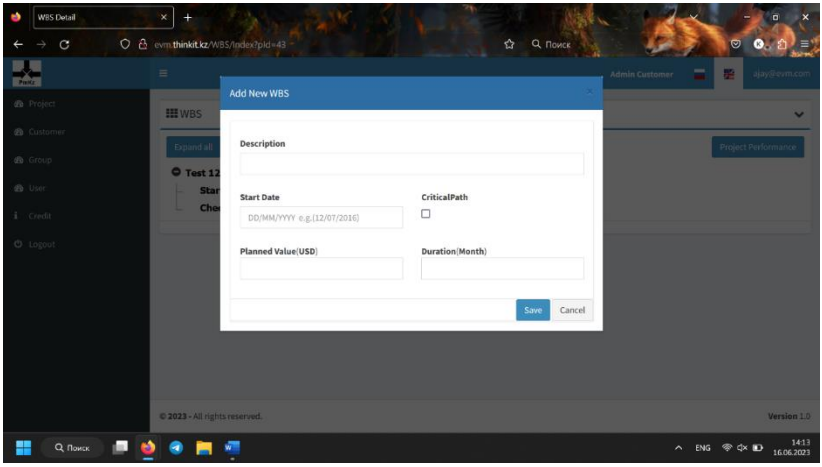
Please note that WBS will change from project to project.
In this window, by clicking on the right button of the mouse to the project name you can add new WBS line, edit existing line or delete it.

Table 17. Project WBS page



11. When clicking to the add function, you will see the new window.

Table 18. Project WBS page



In this window, you can see the main input data of the WBS line, as description, start date, planned value, duration, and status if the line is a critical pass or not. After filling all these sections press to the save and continue to add new WBS lines as was done in previous steps.

12. If the project has already started, and you need to enter the actual data of certain actions into the WBS, you must first fully prepare the WBS according to the plan, and then go through each item in the WBS again and add the actual data to those actions that have already been started or completed, depending on the project.

Table 19. Project description page

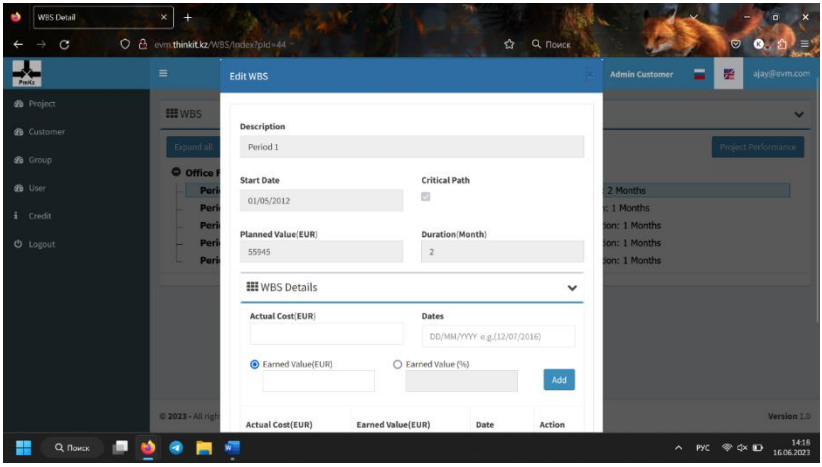
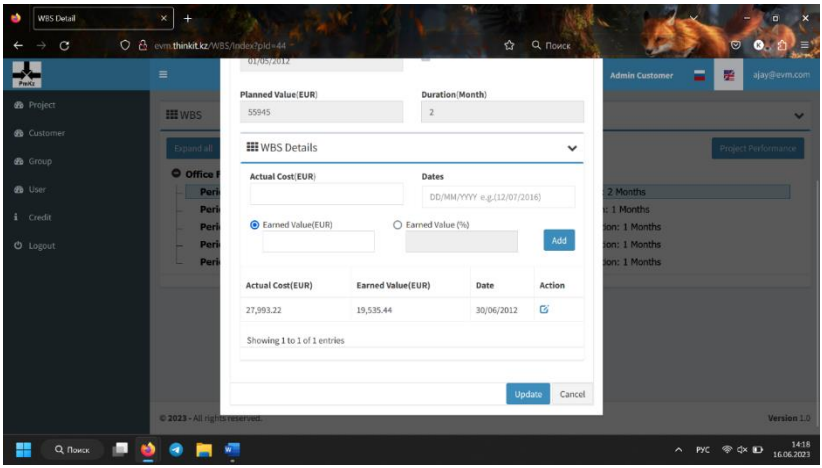


Table 20. Project description page with EVM inputs



13. When the VBS is fully ready, you can proceed to the next action - Project performance. Moving on to the project performance, the work with the instrument is finished. This action displays the final results of cost forecasting, shows the behaviour of the S-curve and risk indicators (Omega).

Table 21. Project performance report page

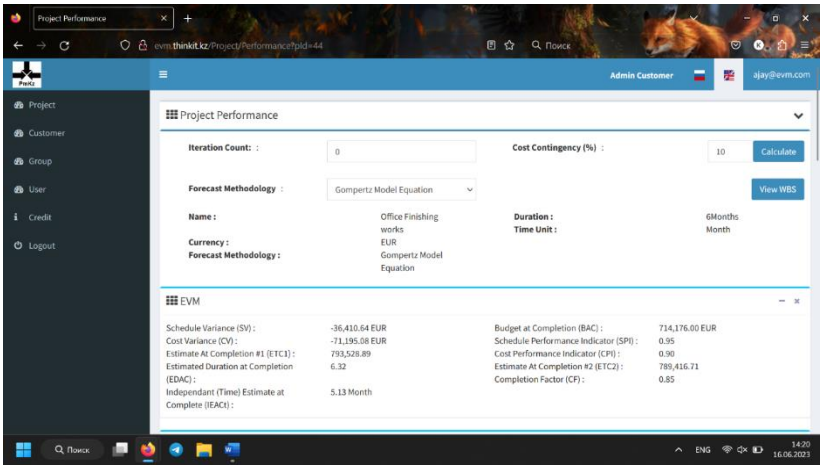


Table 22. Project performance report page 2

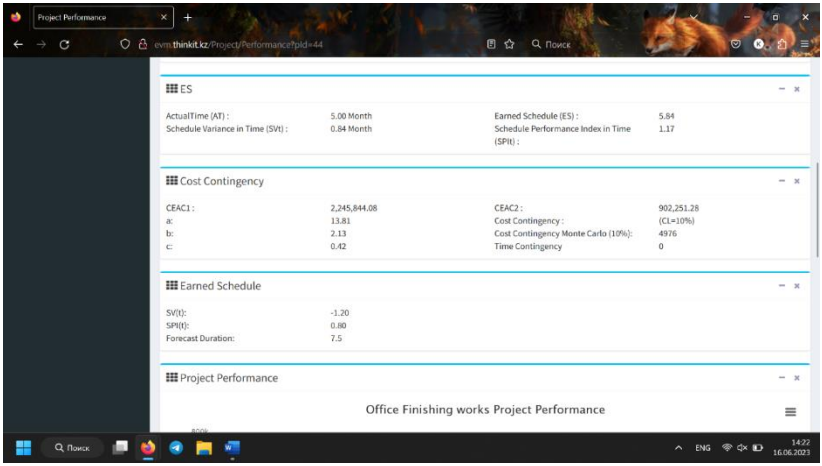


Table 23. Project performance report, graphs

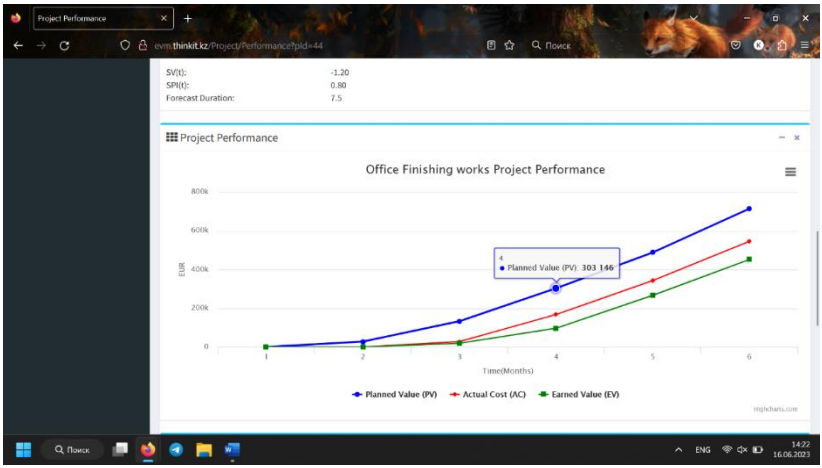
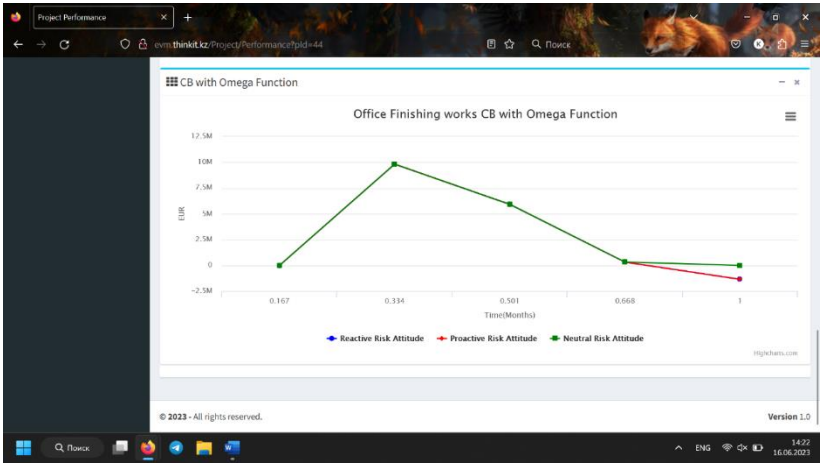


Table 24. Project performance report, graphs 2



CONCLUSION

The conclusions on recommendations for methodological manual “The fundamentals of the Earned value management for effective project monitoring and forecasting” include the following:

- in the long term, this practical guide will contribute to the development of research in project performance forecasting by using EVM tool;
- this manual contains a brief theoretical explanation of EVM, a description of EVM case study and practical use EVM software for students and guide users;
- a great benefit of this manual is with the help of EVM tool it will assist in the Monitoring and Control of ongoing projects;
- this EVM tool will analyze project progress and performance and provide forecasts of possible outcomes for a project;
- by using the manual users can provide status information to both internal and external stakeholders in terms of time, cost and scope/quality performance;
- methodological work will be useful to students, project managers, and all those who are interested in the procedure of forecasting project performance and getting accurate results by using EVM concepts.

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CONTENTS

		Page
	Introduction	3
1	Fundamentals of EVM	6
2	Case study on EVM	17
3	The EVM tool	22
	Conclusion	36
	References	37
	Appendix	40

Kazakh-British Technical University

Teaching Aid

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METHODOLOGICAL MANUAL

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Computer preparation Narbaev T.S., Kussaiyn M.Zh., Khamitova B.M., Talgat S.

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