

Раздел 2. «Информационно-коммуникационные технологии»

УДК 658.56
МРНТИ 20.15.05

V.A. Kunaev, A.B. Bekish, A.D. Taisagatov

*Karaganda industrial university, Temirtau, Kazakhstan
(E-mail: kunaev91@list.ru)*

Analytical review of the software (PLM systems) used for the product lifecycle management

The article defines the main purposes of PLM systems, offers a set of functional capabilities for their objective comparison. An analytical review of the software used for product lifecycle management was performed. The following PLM systems were considered: Siemens Teamcenter, Autodesk Fusion Lifesplan, Oracle Agile, Aras PLM, Omnify Empower, Upchain PLM, PTC Windchill, SAP PLM, QA Wolf, TESTMO, Testsigma, BugBug, ClickUP. The most important functions of each software were highlighted. Based on a comparative evaluation of the software, the most multifunctional PLM systems are determined, recommendations on the choice of software for solving specific tasks of product lifecycle management are described.

Key words: PLM system, product lifecycle management, software, quality management, specification management, project management.

Introduction

PLM-system is an application software for product lifecycle management (PLM) [1]. PLM technologies combine methods and means of information support of product throughout all stages of its life cycle. A characteristic feature is the provision of interaction between automation tools of different manufacturers and various automated systems of many enterprises [1].

The main purposes of the PLM systems implementation are:

- improving employee productivity;
- reduction of production preparation time;
- improving product quality and customer satisfaction;
- cost reduction;
- support of the intellectual property of the enterprise;
- provision of ERP systems data;
- ensuring compliance of the enterprise with the requirements of ISO 9000.

Methods and materials

To achieve the implementation aims listed above, PLM systems can have the following functions:

- management of data and information about the product: about its configuration and environment (content & context);
- management of the design sequence (design chain);
- document management (of all necessary types and formats);
- requirements management;
- product line management, product portfolio and project management;
- asset management;
- operational information management (data collection after product sale);
- program and project management;
- visualization and collaboration;

Раздел 2. «Информационно-коммуникационные технологии»

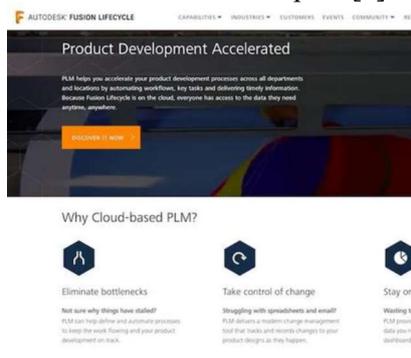
- management of component suppliers;
- production management;
- development of product descriptions;
- product analysis, validation and simulation;
- development of technical descriptions (instructions, manuals, etc.) [1].

The listed functionality was used as a basis for comparing PLM systems from different vendors (Figure 1).

Siemens Teamcenter [2]



Autodesk Fusion Lifesplan [3]



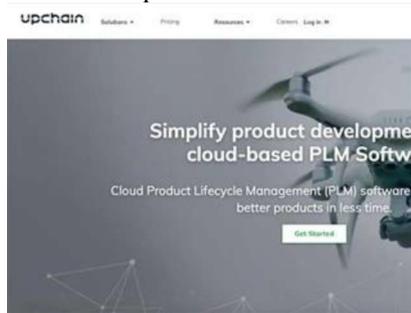
Oracle Agile [4]



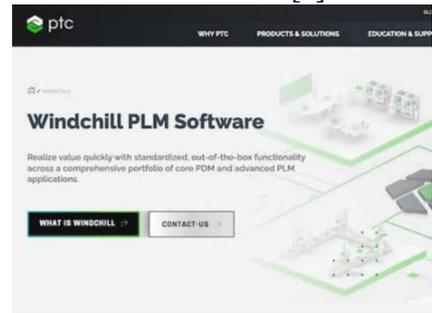
Aras PLM [5]



Upchain PLM



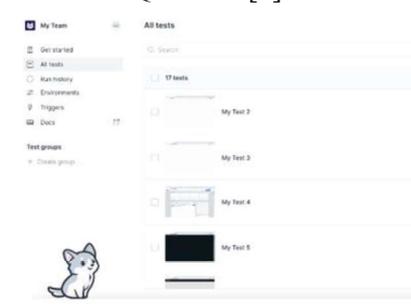
PTC Windchill [6]



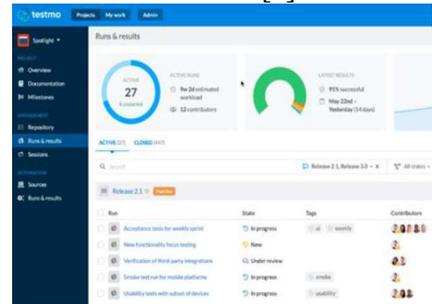
SAP PLM [7]



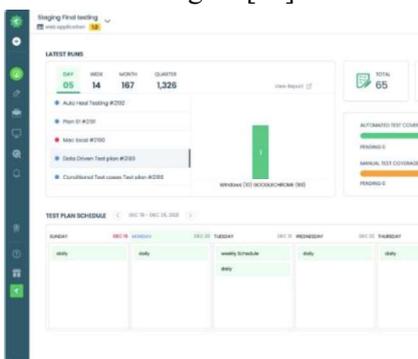
QA Wolf [8]



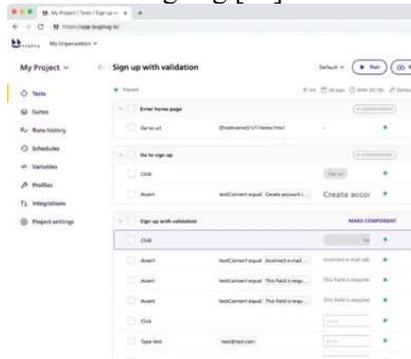
TESTMO [9]



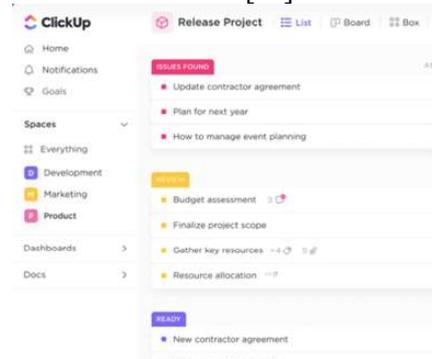
Testsigma [10]



BugBug [11]



ClickUP [12]



Раздел 2. «Информационно-коммуникационные технологии»

Figure 1. PLM systems from different vendors

The following PLM systems were selected for the analytical review (Figure 1):

- Arena PLM;
- Siemens Teamcenter;
- Autodesk Fusion Lifespan;
- Oracle Agile;
- Aras PLM;
- Omnify Empower;
- Upchain PLM;
- PTC Windchill;
- SAP PLM;
- PROPEL PLM;
- QA Wolf;
- Testmo;
- Testsigma;
- BugBug;
- ClickUp.

Results and discussion

Below are the main features of the software presented in this review.

1. Arena PLM

Arena PLM combines information about products, people and processes into a single corporate platform to accelerate product design and development using cloud-based software that can be used anytime and from anywhere [13].

Software features:

- management of engineering changes, specifications and documents;
- cooperation with suppliers;
- requirements management;
- compliance management (FDA, ISO, ITAR, EAR and environmental regulations)
- quality control.

2. Siemens Teamcenter

Siemens Teamcenter serves a variety of industries, including the aerospace and defense industries, medical device manufacturing, pharmaceuticals, etc. [14].

Software Features:

- integration with NX CAD;
- management of specifications (lists of materials) and document flow;
- management of electrical and mechanical design;
- change management and workflow;
- management of materials, data, life cycle, processes;
- support for visualization, digital layout [14].

3. Autodesk fusion lifespan

Autodesk Fusion Lifespan is a product lifecycle management platform that helps in creating and automating procedures, maintaining the workflow [13].

Software features:

- Quality management and cooperation with suppliers;
- version, revision and release management;
- product data management (PDM);
- setting up and managing the bill of materials (BOM);
- access to all important data in real time;

Раздел 2. «Информационно-коммуникационные технологии»

- graphical dashboards for quick interpretation;
- change management tool for tracking all versions of the product design.

4. Oracle Agile

Oracle Agile is a product lifecycle management tool that helps manage product value chains, as well as develop and launch new products. It also integrates with computer-aided design (CAD) systems to manage elements, parts, products, documents, requirements, technical change orders and work-flows. The software supports the following key functions:

- innovation management;
- product development management;
- portfolio management;
- cost management;
- product master data management;
- simulation configurator;
- working with a closed cycle of quality management [4].

5. Aras PLM

Aras PLM is an open source product lifecycle management software system. Thanks to this, the user can adapt it to meet their specific needs. Even if the code is changed, system updates are available.

Key features of Aras PLM:

- document management, requirements and specifications;
- self-reporting;
- configuration management;
- project engineering;
- planning of the production process;
- automatic and bidirectional data synchronization;
- assessment and quality management [1].

6. Omnify Empower

Omnify Software offers a scalable and adaptable product lifecycle management system. Omnify Empower has the ability to deploy the system locally or in the cloud.

Main features of Omnify Empower:

- opportunities for quality management, changes, problems and compliance;
- document and item management capabilities;
- specification management;
- ability to import and export data from current business applications using the system integration function;
- availability of various training tools, such as official documents, seminars, webinars and live demonstrations [1].

7. Upchain PLM

Unchain PLM is a cloud-based PLM system that allows small and medium-sized enterprises to jointly engage in design, production, and maintenance throughout the value chain[1].

The most important functions of Upchain PLM are:

- specification management;
- using Microsoft Office plugins;
- change management;
- view CAD files in 3D/2D;
- flexible project management;
- built-in workflow management;
- collaboration on a single project management panel.

8.PTC Windchill

Раздел 2. «Информационно-коммуникационные технологии»

PTC Windchill is a PLM software that helps to distribute, transmit, publish, exchange information in real time and visualize product data.

Some key solutions implemented in PTC Windchill:

- data visualization;
- CAD & MCAD models;
- cost estimation and analysis;
- outsourcing and project management;
- data management of multiple systems;
- augmented reality (AR) and 3D visualization;
- monitoring of the "Always On" system based on the Internet of Things;
- tools for converting the list of materials;

One of its most unique features of PTC Windchill is the ability to customize the user interface. Customizing the user interface includes the placement of frequently used modules in the upper part of the working window for quick access [4].

9. PROPEL PLM

PROPEL PLM is a software that helps users optimize and collect information about a new product. PROPEL PLM encourages collaboration at the company level by offering a variety of ways to communicate, discuss product differences, and develop model plans. The software allows groups of companies to create reliable databases and custom tools for monitoring and storing data. As a tool designed for every employee of the company, PROPEL PLM even has a mobile version that employees can download as an application [3].

10. SAP PLM

SAP PLM software provides comprehensive support for all operations related to the product. Here is a list of some of its main functions:

- product development management;
- approval of the project plan;
- task and problem management;
- control of project documentation;
- project portfolio management;
- management of commercial projects;
- calculation and modeling of the product cost;
- requirements collection and management;
- joint work on products and visualization of the enterprise.

Features such as optimizing project proposals, progress, tasks, and deadlines allow you to track all data from one place. The function of calculating the cost of a product in real time helps to determine costs, target price and profitability. SAP PLM also supports interdisciplinary product development that integrates all relevant data on mechanical, electrical and electronic structures. The software also supports built-in analytics for status reports, automated key processes, a shared workspace, a three-dimensional viewer, and much more.

11. QA Wolf

QA Wolf is a multifunctional system that helps production teams with multiple branches to control and bring their products to market readiness faster. QA Wolf offers many features such as online testing, automatic documentation, trigger systems, document storage and step-by-step guides that allow teams to prepare their product from anywhere [3].

The main functions of QA Wolf:

- generation of Javascript code based on the actions of the tester on the site;
- - ability to run parallel tests in Netlify or Vercel deployments;
- integration with Slack, Vercel and GitHub;
- ability to re-run certain lines of code;
- logs and videos for documentation of failures after failed tests;
- integration into the CI/CD process;

Раздел 2. «Информационно-коммуникационные технологии»

- automation of test planning, activity tracking;
- data import and export, flexible reports, analytics and data visualization in real time;
- Unicode compatibility.

12. Testmo

Testmo is a unified software with which user can manage all the activities of the IT team for quality control and testing. Testmo allows to configure and scale the management of test cases, supports research testing and session management. The software integrates with a variety of automation and reporting tools.

The main functions of the software:

- management of test suites and test cases;
- control of research testing, taking notes;
- full integration with Jira, GitHub, GitLab, Jenkins, Bitbucket and other tools;
- integration with test automation tools, CI/CD pipeline, DevOps tools;
- flexible reporting system, wide selection of metrics, real-time updating of dashboards and graphs;
- high level of customization with the ability to create processes and artifacts in the required format;
- scalability for different team sizes [2].

13. Testsigma

Testsigma is a cloud-based testing automation platform that allows Agile teams to simplify and speed up quality control of web applications, mobile applications and APIs without configuration and framework [2].

Features of Testsigma:

- personalization of dashboards for each role;
- quick access to the results of the last run and to the list of recent actions;
- a single platform for managing testing of web applications, Android Web, Android Native, iOS Web, iOS Native applications and web services;
- user management;
- creation of specialized artifacts, for example, categories of requirements, types and priorities of test suites;
- one-click test management and migration;
- planning of tests and their parallel passage;
- customizable dynamic and context-sensitive reports;
- automatic error reporting;
- integration with Jenkins, Circle CI, Jira, YouTrack, Slack, Browserstack, etc.

The PLM systems presented in the analytical review were compared by the functions performed. The results of the comparative assessment are presented in table 1. In this table, the "+" sign indicates that the software supports this function, and the "-" sign indicates that it does not.

Table 1. Comparison of the PLM system by the performed functions

Functions	Software												
	Arena PLM	Siemens Teamcenter	Autodesk Fusion Lifespan	Oracle Agile	Aras PLM	Omnify Empower	Upchain PLM	PTC Windchill	Propel PLM	SAP PLM	QA Wolf	Testmo	Testsigma
Specifications management	+	+	-	-	+	+	+	-	+	+	-	-	-
Documents management	+	+	-	-	+	+	-	-	+	-	-	-	-

Раздел 2. «Информационно-коммуникационные технологии»

Requirements management	-	-	-	-	+	+	-	-	+	-	-	+	+
Projects management	-	-	+	-	+	-	+	+	+	-	-	-	-
Portfolio management	-	-	-	-	-	-	+	-	-	+	-	-	-
Data visualization	-	-	-	-	-	-	-	+	-	-	-	-	-
Visualization	-	+	-	-	-	-	-	+	-	-	-	-	-
Cost management	-	-	-	-	+	-	-	-	-	-	-	-	-
Quality management	+	-	+	+	-	+	-	-	+	-	-	-	-
Test Management	-	-	-	-	-	-	-	-	-	-	+	+	+

Based on the results of the analysis of the supported functions, a histogram is developed (Figure 2), clearly demonstrating the number of the main, most important functions supported by each PLM system.

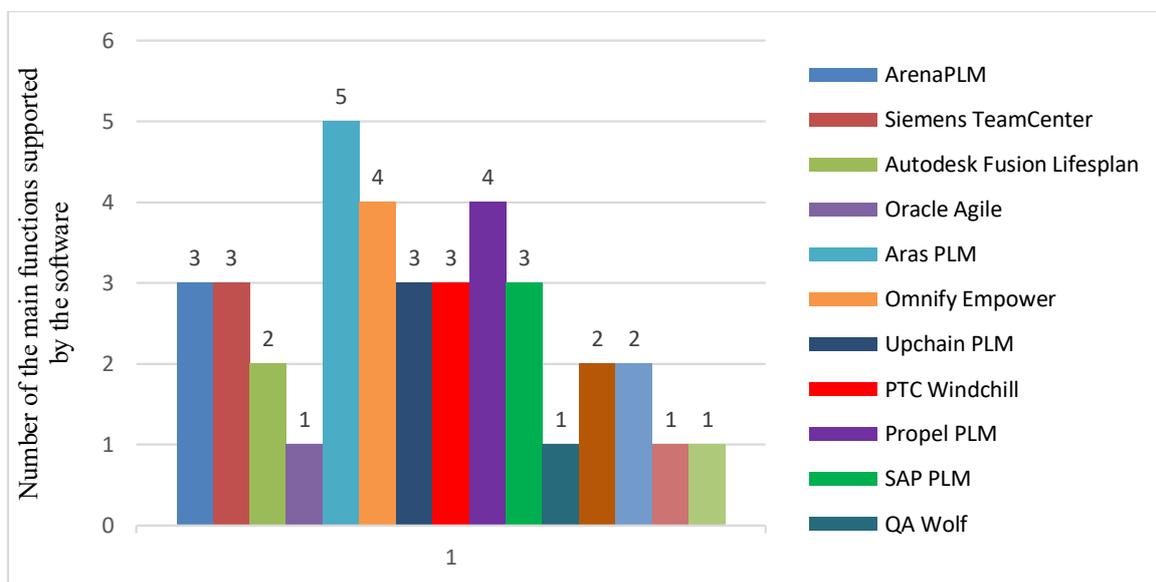


Figure 2. Number of functions supported by the software

Conclusions

Based on the results of the literature review of existing software for product lifecycle management, the main tasks of PLM systems are identified, a set of functionality for comparing PLM systems is proposed. The comparative evaluation of existing PLM systems by the functions performed allowed us to determine the most multi-functional software for lifecycle management (Aras PLM). The advantage of Aras PLM also lies in the open source of this software. Thanks to this, the user can adapt this PLM system to solve specific tasks. At the same time, it is necessary to understand that this assessment is purely informational in nature. The choice of a PLM system should be based on the specific life cycle management tasks being solved at the enterprise.

References

1 PLM системы (Системы управления жизненным циклом продукции) [Electronic resource]. – Access mode: <https://kazgisa.kz/plm-sistemy-sistemy-upravleniya-zhiznennym-cziklom-produkczii/?ysclid=likryr0ni120622788> (Date of request:05.06.2023).
 2 Siemens Teamcenter [Electronic resource]. – Access mode: <https://plm.sw.siemens.com/en-US/teamcenter/> (Date of request:05.06.2023).

Раздел 2. «Информационно-коммуникационные технологии»

- 3 Autodesk Fusion Lifesplan [Electronic resource]. – Access mode: <https://forums.autodesk.com/t5/fusion-360-support/lifetime-simulation/td-p/8693073> (Date of request:05.06.2023).
- 4 Oracle Agile [Electronic resource]. – Access mode: <https://www.oracle.com/scm/product-lifecycle-management/> (Date of request:05.06.2023).
- 5 Aras PLM [Electronic resource]. – Access mode: <https://www.aras.com/en> (Date of request:05.06.2023).
- 6 PTC Windchill [Electronic resource]. – Access mode: <https://www.ptc.com/en/products/windchill> (Date of request:05.06.2023).
- 7 SAP PLM [Electronic resource]. – Access mode: <https://www.sap.com/cis/products/scm/plm-r-d-engineering.html> (Date of request:05.06.2023).
- 8 QA Wolf: [Electronic resource]. – Access mode: <https://www.qawolf.com> (Date of request:05.06.2023).
- 9 TESTMO [Electronic resource]. – Access mode: <https://www.testmo.com> (Date of request:05.06.2023).
- 10 Testsigma [Electronic resource]. – Access mode: <https://testsigma.com> (Date of request:05.06.2023).
- 11 BugBug [Electronic resource]. – Access mode: <https://bugbug.io> (Date of request:05.06.2023).
- 12 ClickUP [Electronic resource]. – Access mode: <https://clickup.com> (Date of request:05.06.2023).
- 13 Программное обеспечение PLM: обзоры и сравнения лучшего программного обеспечения для управления жизненным циклом продукта. [Electronic resource]. – Access mode: <https://businessyield.com/ru/business-branding/plm-software/> (Date of request:05.06.2023).
- 14 7 лучших программ PLM. [Electronic resource]. – Access mode: <https://www.affde.com/ru/best-plm-software.html> (Date of request:05.06.2023).

В.А. Кунаев, А.Б. Бекіш, А.Д. Тайсагатов

Өнімнің өмірлік циклін басқару үшін қолданылатын бағдарламалық жасақтамаға (PLM жүйелеріне) аналитикалық шолу

Мақалада PLM жүйелерінің негізгі міндеттері анықталған, оларды объективті салыстыру үшін функционалдық мүмкіндіктер кешені ұсынылған. Өнімнің өмірлік циклін басқару үшін қолданылатын бағдарламалық жасақтамаға аналитикалық шолу жасалды. Келесі PLM жүйелері қарастырылды: Siemens Teamcenter, Autodesk Fusion Lifesplan, Oracle Agile, Aras PLM, Omnify Empower, Upchain PLM, PTC Windchill, SAP PLM, QA Wolf, TESTMO, Testsigma, BugBug, ClickUP. Әр бағдарламалық жасақтаманың маңызды функциялары. Салыстырмалы бағалау негізінде ең көп функционалды PLM жүйелері орнатылды, өнімнің өмірлік циклін басқарудың нақты міндеттерін шешу үшін бағдарламалық жасақтаманы таңдау бойынша ұсыныстар сипатталды.

Кілт сөздер: PLM жүйесі, product lifecycle management, бағдарламалық қамтамасыз ету, сапа менеджменті, спецификацияны басқару, жобаны басқару.

Раздел 2. «Информационно-коммуникационные технологии»

В.А. Кунаев, А.Б. Бекіш, А.Д. Тайсагатов

Аналитический обзор программного обеспечения (PLM-систем), используемого для управления жизненным циклом продукции

В статье определены основные задачи PLM-систем, предложен комплекс функциональных возможностей для их объективного сравнения. Выполнен аналитический обзор программного обеспечения, используемого для управления жизненным циклом продукции. Были рассмотрены следующие PLM системы: Siemens Teamcenter, Autodesk Fusion Lifesplan, Oracle Agile, Aras PLM, Omnify Empower, Upchain PLM, PTC Windchill, SAP PLM, QA Wolf, TESTMO, Testsigma, BugBug, ClickUP. Выделены наиболее важные функции каждого программного обеспечения. На основании сравнительной оценки ПО установлены наиболее многофункциональные PLM-системы, описаны рекомендации по выбору программного обеспечения для решения конкретных задач по управлению жизненным циклом продукции.

Ключевые слова: PLM-система, product lifecycle management, программное обеспечение, управление качеством, управление спецификациями, управление проектами.

References

- 1 PLM sistemy (Sistemy upravleniya zhiznennym ciklom produkci) [Electronic resource]. – Access mode: <https://kazgisa.kz/plm-sistemy-sistemy-upravleniya-zhiznennym-cziklom-produkczii/?ysclid=liikryr0ni120622788> (Date of request:05.06.2023).
- 2 Siemens Teamcenter [Electronic resource]. – Access mode: <https://plm.sw.siemens.com/en-US/teamcenter/> (Date of request:05.06.2023).
- 3 Autodesk Fusion Lifesplan [Electronic resource]. – Access mode: <https://forums.autodesk.com/t5/fusion-360-support/lifetime-simulation/td-p/8693073> (Date of request:05.06.2023).
- 4 Oracle Agile [Electronic resource]. – Access mode: <https://www.oracle.com/scm/product-lifecycle-management/> (Date of request:05.06.2023).
- 5 Aras PLM [Electronic resource]. – Access mode: <https://www.aras.com/en> (Date of request:05.06.2023).
- 6 PTC Windchill [Electronic resource]. – Access mode: <https://www.ptc.com/en/products/windchill> (Date of request:05.06.2023).
- 7 SAP PLM [Electronic resource]. – Access mode: <https://www.sap.com/cis/products/scm/plm-r-d-engineering.html> (Date of request:05.06.2023).
- 8 QA Wolf: [Electronic resource]. – Access mode: <https://www.qawolf.com> (Date of request:05.06.2023).
- 9 TESTMO [Electronic resource]. – Access mode: <https://www.testmo.com> (Date of request:05.06.2023).
- 10 Testsigma [Electronic resource]. – Access mode: <https://testsigma.com> (Date of request:05.06.2023).
- 11 BugBug [Electronic resource]. – Access mode: <https://bugbug.io> (Date of request:05.06.2023).
- 12 ClickUP [Electronic resource]. – Access mode: <https://clickup.com> (Date of request:05.06.2023).
- 13 Programmnoe obespechenie PLM: obzory i sravneniya luchshego programmnoego obespecheniya dlya upravleniya zhiznennym ciklom produkta. [Electronic resource]. – Access mode: <https://businessyield.com/ru/business-branding/plm-software/> (Date of request:05.06.2023).
- 14 7 luchshih programm PLM. [Electronic resource]. – Access mode: <https://www.affde.com/ru/best-plm-software.html> (Date of request:05.06.2023).