



AUTOMATIC CONTROL SYSTEMS IN THE DEVELOPMENT OF DOCUMENT MANAGEMENT COMPONENTS BASED ON SAAS SOLUTIONS

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ABSTRACT

Small businesses face unique challenges in operating their own IT infrastructure. Among them is the ability to have and maintain data centers capable of supporting business. Even IT services companies may not have the expertise to manage an IT infrastructure. As a result, small businesses tend to use Internet resources to meet business needs. An increase in the efficiency of small businesses with the help of SaaS solutions is presented in terms of resource costs for the deployment and maintenance of infrastructure in the field of document management. When the developed system components are introduced to the enterprise, its overall efficiency will increase due to organized work with documented information and reduce the use of company resources associated with the costs of deploying a document management system.

Keywords: document management, SaaS solutions, automatic control systems system, management.

INTRODUCTION

Technology is changing the way companies achieve business goals, especially in small and medium-sized businesses.

The most popular option for small businesses is the cloud, which can help alleviate resource and expertise gaps. Possible benefits of cloud solutions include lower costs, lower maintenance costs, and the ability to redirect resources to core activities.

SaaS (Software as a service) delivers business applications online instead of installing and running software. Small businesses typically benefit from lower deployment and IT infrastructure costs.

The relevance of the research topic lies in improving the efficiency of small businesses using SaaS solutions in terms of resource costs for deploying and maintaining infrastructure in the field of document management.

The practical significance of the work: when the developed system components are introduced to the enterprise, its overall efficiency will increase due to organized work with documented information and reduce the use of company resources associated with the costs of deploying a workflow system.

To process economic and financial information, as well as to maintain continuous accounting at enterprises, the 1C: Enterprise system is used.

However, this system does not allow generating the following documents and reports:

- application for the issuance of equipment from the warehouse;
- application log;
- reporting documents for the installation and installation of equipment.

All of the above documents are drawn up manually, and their transfer between departments is carried out in printed form, which takes approximately 30% of the employees' working time.

To optimize production processes and support the competitiveness of the enterprise, the organization of information resources, their systematization and storage are in place. The effectiveness of enterprise management as a whole depends on how clearly the process of passing various documents is organized.

A document management system (DMS) is the use of a computer system and software for storing, managing and tracking electronic documents and electronic images of paper information obtained using a document scanner [1].

SaaS transforms IT resources into ongoing services. SaaS provides the application with functionality over the Internet as a service and thus eliminates the need to install and run software on the client's computer. Hence, customers only pay for the use of the software due to the lack of license fees. This unique feature of SaaS has allowed the market to grow six times faster than the out-of-the-box software market. SaaS is predicted to become increasingly important in most enterprise application software markets, according to Gartner research.

As a result, companies using SaaS applications are not charged with installing and maintaining software. Users simply pay a subscription fee to access the software, which is a turnkey solution. SaaS companies simply host the software on their servers and deliver it to subscribed end users over the Internet, and are responsible for providing access, security features, IT support, and performance in the course of their work.

SaaS applications and services typically use a multitenant approach, which means that host servers will run one instance of the SaaS application, and that single



instance will serve each subscribed client or cloud client. The app will run in the same version and configuration for all customers or tenants. Although different subscribers will run on the same cloud instance with a common infrastructure and platform, data from different tenants will still be separated.

The typical multi-tenant SaaS application architecture means that the cloud service provider can manage maintenance, updates, and bug fixes faster, easier, and more efficiently. Instead of making changes in multiple instances, engineers can make the necessary changes for all clients while maintaining one shared instance.

In addition, the multi-tenant approach allows more people to access more resources without sacrificing critical cloud features such as security, speed, and privacy.

Benefits of SaaS

SaaS removes the need for organizations to install and run applications on their own computers or in their own data centers. This excludes the cost of acquiring, providing, and maintaining hardware, as well as licensing, installing, and supporting software. Other benefits of the SaaS model include:

- a) Ready-made solutions. One of the main operational advantages of SaaS is the fact that it offers out-of-the-box functionality. Simply put, you can get started almost immediately because the software is installed and configured ahead of time in the cloud, and you don't have to go through a lengthy deployment process as is often the case with on-premises software.
- b) Price - Because SaaS is subscription-based and often doesn't require any upfront licensing fees, the initial cost will be much less. This ensures that your business has more liquidity, freeing up cash flow to use in other areas of your business.
- c) Scalability. One of the most significant benefits of SaaS for customers is its scalability. Compared to traditional software models, SaaS can scale up and down to meet rapidly changing business requirements and also provides integration with other SaaS offerings. So, if you get a sudden influx of new users, SaaS offers the flexibility you need to increase your capacity immediately.
- d) Easy Upgrade - Some businesses choose SaaS because of regular product upgrades, making this one of the key operational benefits of SaaS subscriptions. Instead of buying an upgrade package and going through a lengthy installation process, your provider will simply update the solution and make it available to you.

Problems and Risks of SaaS

SaaS also poses some potential risks and challenges as businesses have to rely on external vendors to provide software, keep it running, track and report accurate billing, and create a secure environment for business data [2]:

- a. Questions beyond the control of the client. Problems can arise when providers experience service outages, make unwanted changes to their service offerings, or encounter a security breach, all of which can greatly impact customers' ability to use the SaaS offering. To proactively address these issues, customers must understand and enforce their SaaS provider's SLA.
- b. Clients lose control of version control. If a provider accepts a new version of the application, it will be distributed to all of its customers, whether or not the customer wants the newer version. This may require the organization to allocate additional time and resources for training.
- c. Difficulty in changing suppliers. As with any cloud service provider, switching providers can be difficult. To switch vendors, customers must migrate very large amounts of data. In addition, some providers use proprietary technologies and data types, which can further complicate the transfer of customer data between different cloud providers. Provider lock-in is when a customer cannot easily switch between service providers due to these conditions.
- d. Safety. Cloud security is often seen as a major issue for SaaS applications.

SaaS Security and Privacy

The security risks associated with software as a service are different from those associated with traditional software. In the case of traditional software, the software vendor is responsible for fixing code-based vulnerabilities, while the user is responsible for running the software on a secure infrastructure and network. As a result, security is more the responsibility of the ISV and the third-party cloud provider.

Despite the rapid adoption of cloud models for fully serviced software products, organizations still have certain reservations about SaaS products when it comes to security and privacy. These concerns include:

- encryption and key management;
- identity and access management (IAM);
- security monitoring;
- response to incidents;
- poor integration into the company's broader security environment;



- fulfillment of data residency requirements (physical or geographical location of data or information);
- data confidentiality;
- the cost of investing in third-party tools to offset the SaaS security risk;
- lack of communication with technical and security specialists in the sales process.

Language and Software Features

1C: Enterprise

1C: Enterprise is a universal cloud and local software package for automating the financial and operational activities of the company as a whole. 1C:Enterprise has a lot of possibilities for solving various problems of modern business. This is achieved through the ability to adapt the system to the specific needs of companies and their business processes [3].

1C: Enterprise is more than just a solution for automating fixed business rules. Rather, it is a set of software tools used by developers and users. The system can be logically divided into two main components that are closely related: the application and the platform on which the application runs.

The 1C: Enterprise platform has the following advantages:

- significantly reduces the technological complexity, ergonomics and productivity of corporate software systems;
- allows experienced users to implement specific business processes;
- accelerates and standardizes the development, configuration and support of business applications;
- provides complete openness of the user interface and solution code, which allows you to better understand and change business processes;
- integrates with existing 1C applications and third-party systems;
- supports web services, ODBC, COM, etc.;
- supports various architectures: Windows / Linux, MS SQL, PostgreSQL, IBM DB2 and Oracle DB;
- includes local or managed hosting with web delivery, as well as a web client, tablet or Windows client.

The 1C: Enterprise application system is used daily by millions of corporate users to automate operations, accounting, finance, personnel management and management. 1C provides a range of vertical solutions for production, sales and service. Thanks to an innovative technological platform and a number of applied solutions, 1C has become widely known for its openness, speed of editing and software updates [2].

"1C: Accounting" is a universal accounting program designed for synthetic and analytical accounting in various sections. Analytical accounting is maintained for objects of analytical accounting in natural and value terms. This system can be used to maintain almost any part of accounting:

- cash accounting and banking operations;

- accounting of currency transactions;
- accounting of fixed assets and intangible assets;
- accounting of materials, goods, services, production;
- maintaining mutual settlements with debtors, creditors, organizations and responsible persons;
- Payroll calculation.

The program has a mode for generating arbitrary messages. With the help of this mode, reports submitted to the tax authorities are implemented, in addition, this mode is used to create internal reports to analyze the financial activities of the organization in any form [3].

Benefits of this Program:

- a. With the help of "1C: Accounting" you can keep all existing types of accounting and tax accounting.
- b. To date, "1C: Accounting" is one of the most versatile accounting programs that can be used in various organizations. This program is based on the 1C:Enterprise platform, which can be customized to meet the needs of a particular business. Such flexibility of 1C:Accounting allows you to solve many different tasks with its help.
- c. "1C: Accounting" is ideally adapted to Russian legislation and makes it easy to adapt to the laws and requirements of officials, which regularly change in our country. 1C developers track all changes in tax legislation and promptly update reporting forms in the program.
- d. The program "1C: Accounting" is characterized by high performance, allowing you to solve even the most complex tasks.

The 1C platform consists of several parts and can work in a file or server version. In the file version, the entire database is contained in one file (with the "1cd" extension) - the platform is installed on each computer and directly reads / writes to the database.

In the server version, the database storage platform uses a SQL server (usually MS SQL, but from version 8.2.14 - use such as Firebird PostgreSQL, IBM DB2, Oracle Database), and the platform itself works with a three-tier architecture.

A common plus is the versatility of the configuration code: with a few exceptions, a configuration designed for a file database will work in a server database and vice versa.

Instruments

- The 1C platform has the ability to upload and download a configuration, compare a configuration with another, and partially upload changes[4].



- It is possible to release the texts of the modules for batch processing and load them back into the configuration.
- It is also possible to unload and reload the entire database (including data).
- Configuration storage is used for collective work on one configuration.
- There are also a number of rules for making changes to standard configurations, there is even a 1C document describing methods and standards for changing standard configurations (and any others).

Each 1C SaaS application works in multi-tenancy mode with the most important areas of customer interest. Each customer using a SaaS application can have multiple users (e.g. employees, vendors) [3]. Each client can work with several applications at the same time.

The use of cloud technologies facilitates work in cases where potential application solutions are not used in a local network, have heterogeneous equipment and are

not disposed to follow mandatory recommendations on the composition of hardware and software [7].

Customers using a SaaS application can only see their own data, while on the service provider side; all customers use the same application instance and database. To do this, the SaaS representative must perform fast and simultaneous updates for all clients [8].

KOMPAS-3D

KOMPAS-3D is a flexible 3D modeling system that allows you to create models in several ways:

- bottom-up modeling using ready-made components;
- top-down modeling by developing components in accordance with specific projects;
- modeling based on layout drawings, such as kinematic diagrams;
- any combination of these modeling methods.

These approaches make it easy to create editable associative models (Figure-1).

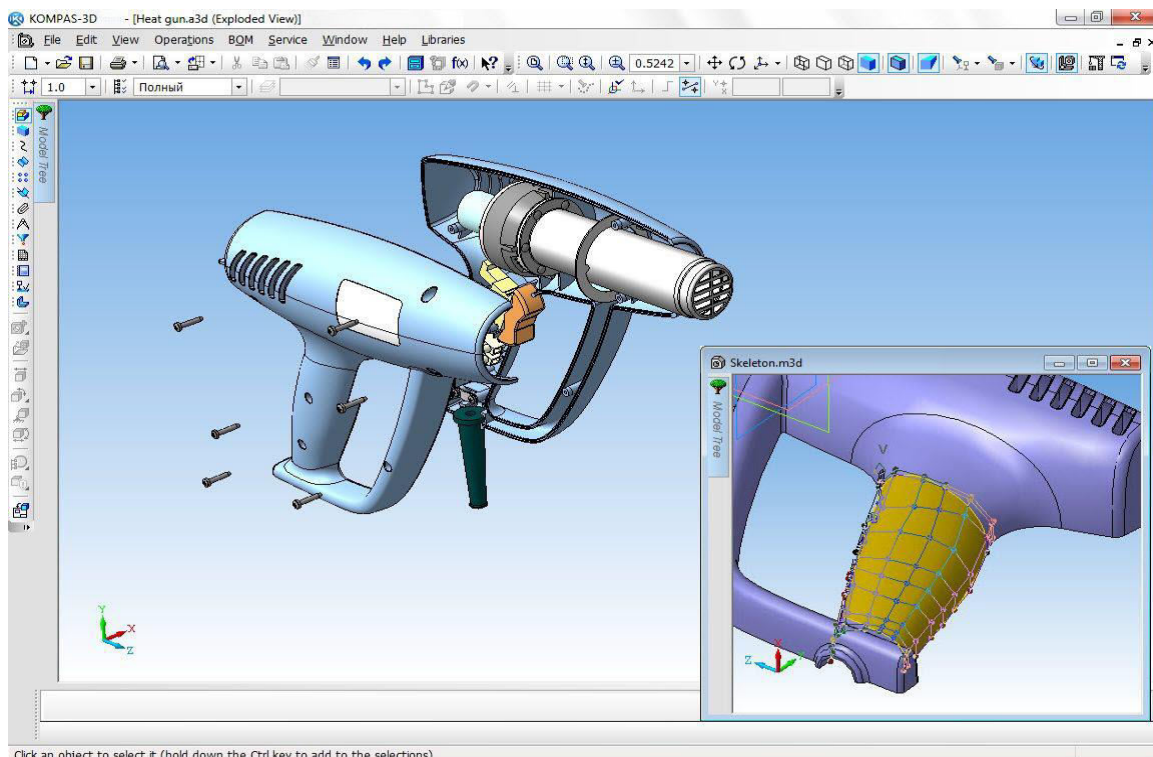


Figure-1. KOMPAS-3D program interface.

The KOMPAS-3D system has powerful functions for project management of thousands of assemblies, parts and standard library products. It supports all the 3D modeling and surface modeling capabilities that have become the standard among mid-range CAD/CAM programs.

AutoCAD

AutoCAD is a CAD-type software focused on drawing and modeling in 2D and 3D. It allows you to create and modify geometric models with almost unlimited

possibilities for the development of all types of structures and objects.

This ability to work in various fields has led AutoCAD to move beyond its traditional use in the world of architecture and engineering and enter the world of graphic design and interior design (Figure-2).

Nowadays, AutoCAD has many specialized support tools that cover all kinds of industrial fields related to 2D design and 3D modeling.

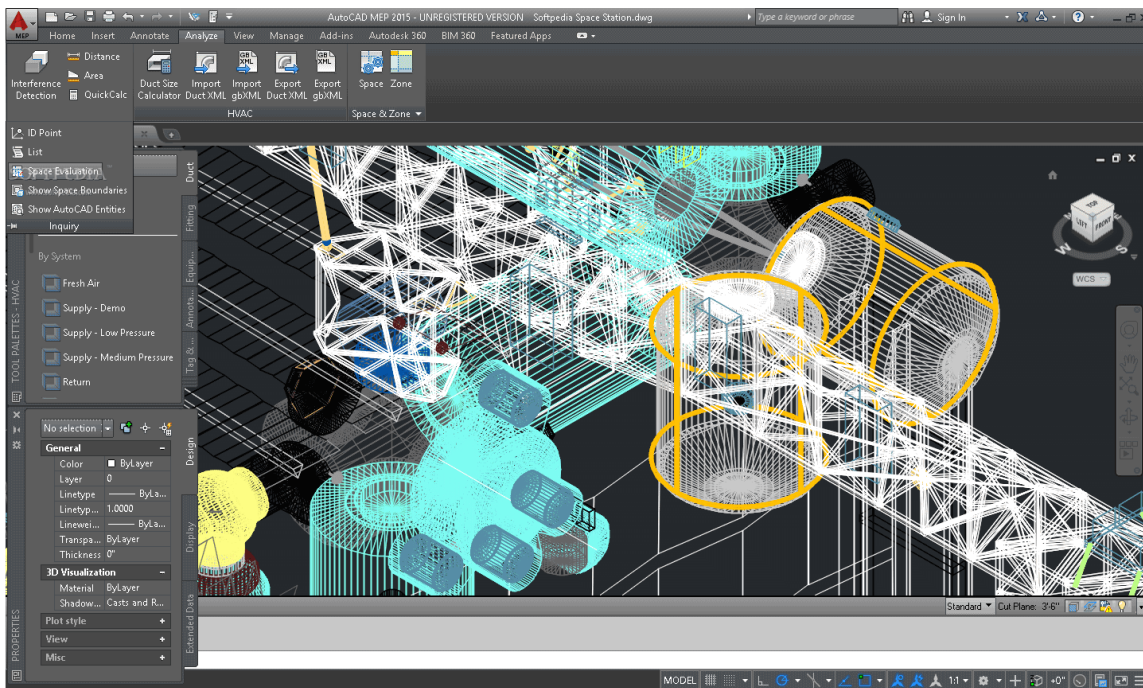


Figure-2. AutoCAD program interface

In terms of 3D modeling, Autodesk has focused on improving rendering and compatibility with other programs that complement AutoCAD.

- More realistic 3D modeling.
- Application of realistic lighting in renderings.
- Creation of cross-sectional drawings.
- Rendering directly in the cloud.

METHODOLOGY

Business process modeling is a reflection of the subjective vision of the processes that really exist in the organization using graphical, tabular, textual representations.

At the moment, there are many methodologies for describing business processes (IDEF0, IDEF3, DFD, WORKFLOW, UML, ARIS, and others) and tools (BPWin, ERWin, Power Designer, and others) [4].

Each method provides the user with a specific language for describing real-world objects using a specially designed syntax. Each method offers its own way of describing the activities of the organization. Since any organization is a complex, multifaceted system, there is no one single method.

Formalization and description of business processes of any enterprise is carried out on the basis of the IDEF methodology. Its distinctive feature is the emphasis on the subordination of objects.

The set of structural components of the language, their characteristics and the rules that define the relationships between the components are the syntax of the language.

To describe a function, IDEF0 considers it as an activity or sub-process that transforms incoming objects into outgoing objects through mechanisms corresponding

to materials, software, or human means (resources, tools, participants, etc.). It is also contemplated that its behavior may be influenced or triggered by a set of conditions that form its control directives. Indeed, IDEF0 describes each function as a block, expresses its purpose in plain text, and presents its interface using arrows indicating its inputs, outputs, mechanisms, and controls.

A distinctive feature of IDEF0 is its emphasis on object subordination. The description looks like a "black box" with inputs, outputs, controls and mechanism, which is gradually detailed to the required level. Diagramming begins with the representation of the entire system in the form of a single block and arcs depicting interfaces with functions outside the system. Then the block that represents the system as a single module is detailed in another diagram using several blocks connected by interface arcs. Each detailed diagram is block decomposition from the diagram of the previous level. At each decomposition step, the diagram of the previous level is called the parent diagram for the more detailed diagram [5].

Such diagrams do not explicitly indicate either sequence or time. The method has a number of disadvantages: the complexity of perception (a large number of arcs in the diagrams and a large number of decomposition levels), the difficulty of linking several processes.

The main operation is work in the service for storage and work in the document management system. The following are used as initial data:

- accounting inquiries, applications, etc.;
- various types of documents;
- information about employees, contractors.



The result is an individual configuration for working in a document management system. The rules that guide this service are applied solutions and program code, that is, compliance is depicted using control arrows.

Management and necessary resources are common to each allocated block. Relationships between individual blocks, represented as arrows, show that the functions of adding material can be performed in parallel, and each block is mandatory for the final solution [6].

The IDEF3 methodology (Integrated Definition Process Description Capture Method) was developed to more conveniently display workflows (Work Flow) that

require a more detailed reflection of the logical sequence of procedures. Unlike the IDEF0 methodology, IDEF3 is not standardized.

Information processing - clustering - leads to clusters similar to those produced by the IDEF0 method. In the system being developed, there is one user role: administrator. It performs specific functions and interacts with the system.

The behavior of a system is described using a functional model that displays system use cases, the system environment, and the relationships between them.

Table-1. Calculations for evaluating document management systems according to the specified criteria.

Evaluation Criteria	Ki	1C-Fresh		SAP		Sail Online		Microsoft Dynamics 365		Circuit Elbe	
		i	Zi-Ki	i	Zi-Ki	i	Zi-Ki	i	Zi-Ki	i	Zi-Ki
Functional	0,4	4	1,6	4	1,6	2	0,8	3	1,2	2	0,8
Availability of a free (test) period and its features	0,1	3	0,3	2	0,2	1	0,1	4	0,4	3	0,3
Availability of industry solutions and ease of use	0,2	3	0,6	4	0,8	2	0,4	2	0,4	3	0,6
Price	0,3	3	0,9	1	0,3	3	0,9	2	0,6	3	0,9
Integral estimate: Q		3,4		2,9		2,2		2,6		2,6	

RESULTS AND DISCUSSIONS

To successfully complete the task, it is also necessary to analyze and draw up a specific set of requirements for each stage of the development and implementation of the components of the document management system.

The input data for the analysis are the characteristics of LLC NPF Inzher, the current situation at the enterprise, the results of a survey of company employees, as well as the capabilities of an EDMS based on SaaS solutions.

The system must support the following modes of operation:

- main mode, in which all main functions are performed;
- prophylactic mode, in which the main functions are not performed.

In the main mode of operation, the system must provide:

- users work 24 hours a day, 7 days a week;
- performance of their functions - collection, processing and loading of data; data storage, reporting.

In preventive mode, the system should provide the ability to carry out the following work:

- maintenance;
- modernization of the hardware and software complex;
- elimination of emergencies.

One of the main requirements from the employees of the enterprise is to create a similar interface to the programs used by the employees before. This requirement is due to a reduction in the time of personnel training with the software product [7].

Also an important function in the development of components is the rapid exchange of data between employees of the enterprise. The software product must be able to both upload and download the received data. One of the types of data is specifications from KOMPAS-3D in the ".spw" format. The information obtained from the specification is necessary for the creation of reports and requests for the quantity of goods [8].

Connecting to a service based on SaaS solutions is necessary with the help of a service provider. He offers an cation solution for business and implements and maintains the product, and also solves problems with configuration errors and other issues.

Applied solutions are used to organize work and expand the configuration. Such solutions perform standard



functions for document management. Among them, the main one is loading data from an external source.

CSV is a universal text format designed for typing tabular data. In this format, columns are separated by special characters - delimiters. The separators are most often the characters ";" (semicolon), "," (comma) or tab (system value "Symbols. Tab" in 1C 8). Loading from CSV to 1C

is most often needed to load data into the system from an external source, such as a website or other accounting system.

CSV, in fact, is an ordinary text in which data is indicated. Usually, the first line contains the names of the column, the second and further - the data (Figure-3).

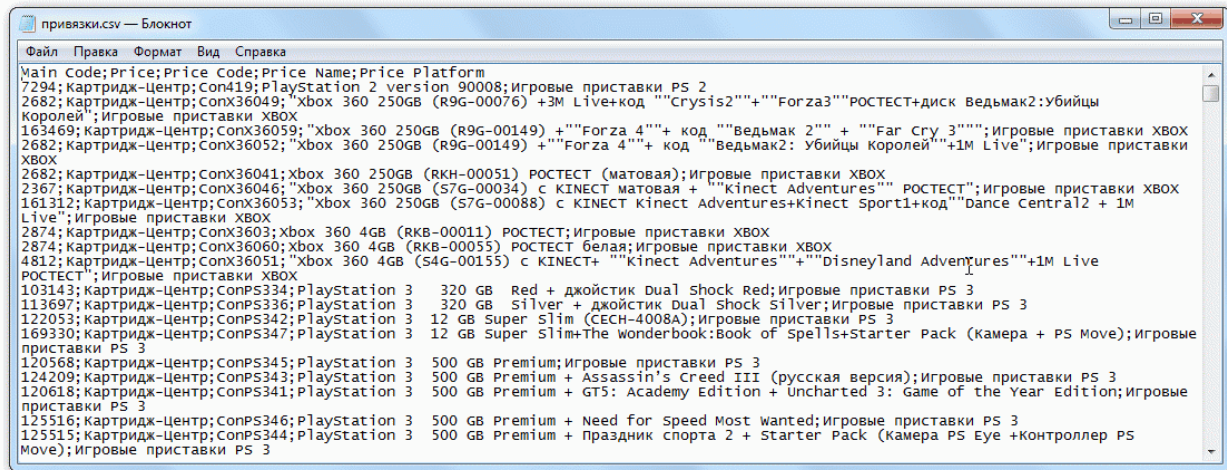


Figure-3. An example of a CSV file

To create this external processing, you need to create a new external processing in the configurator menu.

When you click on the file search, you must display a file selection dialog in the OS.

After finding the file, you need to process it. Before processing, you need to clear the past information in the table, and then read it.

After receiving the data, the first line is read and columns are formed on the form with the name of the "header" (the first line).

After the header is formed, you can start processing the loading of the data itself:

All lines are processed line by line and transferred to the table field. After loading, the data can be used to implement various tasks: loading a price list, loading an item, loading counterparties, loading a balance.

CONCLUSIONS

SaaS is a software licensing and distribution model in which hosted software is provided to customers through a licensed subscription over the Internet.

SaaS works through a cloud delivery model. The software provider either hosts the application and associated data using its own servers, databases, networking and computing resources, or it can be an independent software vendor that contracts with a cloud service provider to host the application in the provider's data center.

Various SaaS scenarios are being applied to achieve small business advantage.

The tool for developing system components is the 1C Fresh cloud system service.

A functional model of the program was developed, analogues of SaaS solutions for the document management system were analyzed, and the requests of the company's employees were taken into account.

In accordance with the goal, the following tasks were performed:

- analysis of the literature, description of the main concepts and terms of the study;
- description of the main characteristics of the language and software used in the study;
- development and description of the architecture of the system components, its functional model;
- development of technical specifications from the enterprise, a comparative analysis of document management systems based on SaaS solutions;
- development and description of the software tool, its structure and user interface.

The practical significance of the work: when the developed system components are introduced to the enterprise, its overall efficiency will increase due to organized work with documented information and reduce the use of company resources associated with the costs of deploying a workflow system.



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