

Information System for Sewing Enterprise

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Abstract

The implementation of the project on construction of a rational model of the automated information system of complex accounting at the enterprise is described. The requirements to the project of information system and the analysis of the system functionality are given. The development of an automated information system of enterprise management is considered as a scientific project that has a certain life cycle, which is implemented in such phases as pre-investment, investment and operational. The main issues that need to be considered when developing an automated enterprise management system are outlined. Having analyzed the system, using object-oriented methodology, the boundaries of the system and the environment are separated, the actors, options for use and the relationship between them are identified.

Keywords 1

Project life cycle, business plan, Gantt chart, automated information system, critical path, human resources, material resources, project participants, sewing enterprise.

1. Introduction

The word of project is very often used in our lives. There is development of means to fight AIDS, conservation of the Chernobyl NPS, election campaign, renting and repairing a new office, etc. All these tasks have several common features that characterize them as projects. These features include a focus on achieving the goal; the presence of numerical hierarchical goals; coordinated implementation of related actions; project time frame; availability of budget; uniqueness.

It is the project that allows us to properly plan and quickly manage the implementation of tasks. The aim of the project is to create something new, non-existent at this moment. As a result of the project, a new product appears as an enterprise, a product, a production line, service. The concept of project covers a wide range of activities from minor modernization of the existing facility to the creation of an enterprise in a complex with the developed infrastructure that requires significant investment.

Project management is one of the most complex and time-consuming areas due to the large amount of information used for management decisions, as well as the fact that the structure of the project in the process of its implementation is changing.

Effective project management is impossible without the use of modern information and communication technologies and appropriate tools.

2. Analysis of recent research and publications

The paper [1] analyzes the content of the concept of project and project management; the main components of the project are given; the life cycle of the project in the form of phases is described (design, implementation, and operation), which have a certain set of works (processes) that need to be implemented as well as the main functions for effective project management are mentioned.

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The main theoretical and conceptual principles and practical examples of strategic management were studied by Tony Morden [2], Wyn Jenkins and David Williamson [3]. The use of information technology in project management of the enterprise was researched by Michael S. Zambruski [4]. The issues of organization management are studied by Hal G. Rainey [5], K. Schwalbe [6].

Data flow diagram (DFD) is one of the main tools for structural analysis and design of information systems. They are used for graphical structural analysis, which describes external sources to the system and data recipients, logical functions, data flows and data warehouses to which access is made. IDEF0 notation, based on SADT methodology, is most often used to describe business processes.

Scientific works of many domestic and foreign scientists are devoted to business process modeling, in particular works by John Jeston [7], J. Pinggera, P. Soffer, S. Zugal, B. Weber, M. Weidlich, D. Fahland, H.A. Reijers, J. Mendling [8], J. Cardoso [9], H. Gould [10] and others.

One of the methods of project planning is the Gantt chart, which is used to illustrate the plan, the work schedule for any project. The method of planning the activities of the enterprise using the Gantt chart was investigated by such scientists as J. Geraldi [11], A. Sharon [12], Olivier and Cristina Rebière [13].

A significant contribution to the study of life cycles of related fields of knowledge was made by J. Westland [14], Massimo Pica [15].

3. Project proposals for the formation of the information system

It is known that a lot of industries today do not have partial or full automated work. Therefore, employees of such enterprises are forced to perform some routine operations that could be done with computers. Thanks to new information technologies, it is possible to automate management operations, as well as to obtain information for decision-making and analytics in enterprise management.

The **purpose** of this paper is to create and implement a project to build a rational model of an automated information system of integrated accounting of material resources, production costs, sales of finished products of light industry, building an effective business management model using intelligent systems and technologies.

This task can be considered in terms of a research project, which contains a set of purposeful, consistent actions aimed at achieving the result with limited resources and timing of their beginning and end. A project is a certain enterprise with established goals, the achievement of which determines the completion of the project [15].

Each project has its own life cycle that is the period from the conception of the project (idea) to its completion (liquidation of the project). The project life cycle is defined as a set of consecutive phases of the project, their names and numbers are determined by the control needs of the organization or organizations involved in the project [16].

The following phases of the project were used to solve this goal:

Pre-investment phase includes identification that is a problem definition and proposal for its solution, preparation and evaluation of a business plan, especially an identification of investment opportunities, analysis of alternatives and preliminary project selection, namely preliminary feasibility study, analysis of analogue projects (if any), definition of time, resource (human), financial costs of the project, assessment of risks and viability of the project, selection and preliminary approval of equipment and its location (s), expertise, negotiations on the development of an automated system.

Investment phase includes establishing the legal, financial, and organizational basis for the project, detailed design and contracting, development of the most automated system and its testing, tenders for equipment supply, purchase and installation of equipment and programs, data filling system, pre-production marketing, staff training, commissioning, and launching.

Operation phase:

- in the short term, it is studied the possible occurrence of problems related to the use, operation of equipment or staff qualifications;
- in the long term, it is considered the chosen strategy and the total cost of production and marketing, as well as saving time and resources during operation, which automatically leads to an increase in profits from the manufacture of goods. This phase also includes the following works as

testing of equipment, debugging programs, correction of errors and inaccuracies in the work, closing the contract, analysis of results, development, and improvement of certain functions of the automated accounting system at the enterprise.

The point of the project is to produce a new and unique product for the company [16].

The process of managing this project can be considered as a set of some functions:

1. Subject area management. The subject area of the project (project goals, objectives, and work) in the process of its life undergoes changes, so there is a need to manage the subject area of the project.
2. Quality management. There are clearly defined and established requirements or standards of quality of results, using which it is possible to assess the degree of success of the implemented automated information system or the developed project. Defining these requirements, their control and support during all phases of the project is the essence of the quality management function.
3. Time management. It means keeping time limits, control of project development and in case of deviation from the plan, the appropriate measures for their elimination should be applied. To prevent undesirable deviations, it is necessary to predict the project development process.
4. Cost management. It is necessary to keep the established, planned budget according to the plan [17].

Effective project management is impossible without the use of modern information technologies.

At each stage of the project life cycle, the goals of automation will be different. During the pre-investment phase these is search for sponsors, ensuring effective interaction with the customer, reducing development time, concluding key documents, calculation of risks, etc. During the investment phase these are the choice of performers, staff, equipment, suppliers, etc. At the design stage it is to reduce the time of development of the project implementation schedule [18]. At the implementation stage it is to increase the reliability and efficiency of information about the status of the project to solve operational management tasks; to reduce time for preparation of documents, reports on the progress of the project; to ensure effective interaction between project participants. At the stage of delivery and completion of the project it is observed checking the efficiency of the equipment, and the formation of working documentation [19-26].

In practice of project management, it is used both universal and specialized tools or programs (software packages).

Universal software packages include spreadsheet, word processor, database management systems (DBMS), presentation programs (e.g., PowerPoint) and communication programs (e.g., Skype, Zoom, MS Teams, etc.).

Specialized programs are the tools that are specifically designed to manage the project at different stages. For example, during the concept phase, the software package ProjectExpert can be used, during the system design it can be ERWin package, if it is preparation and implementation, MS Project is proposed.

The MS Project software package is most often used for the implementation of small and medium-sized projects due to the wide capabilities of the package, and user-friendly interface. The program provides an opportunity to structure the project by dividing it into stages, tasks, and subtasks, to identify critical tasks, to obtain a schedule of project implementation, to allocate resources to project tasks, as well as to effectively control the load of resources.

The development of a project to create an automated information accounting system was implemented using the MS Project environment using the Gantt chart, which is one of the methods of project planning. All tasks performed during the project life cycle are presented in Fig.1.

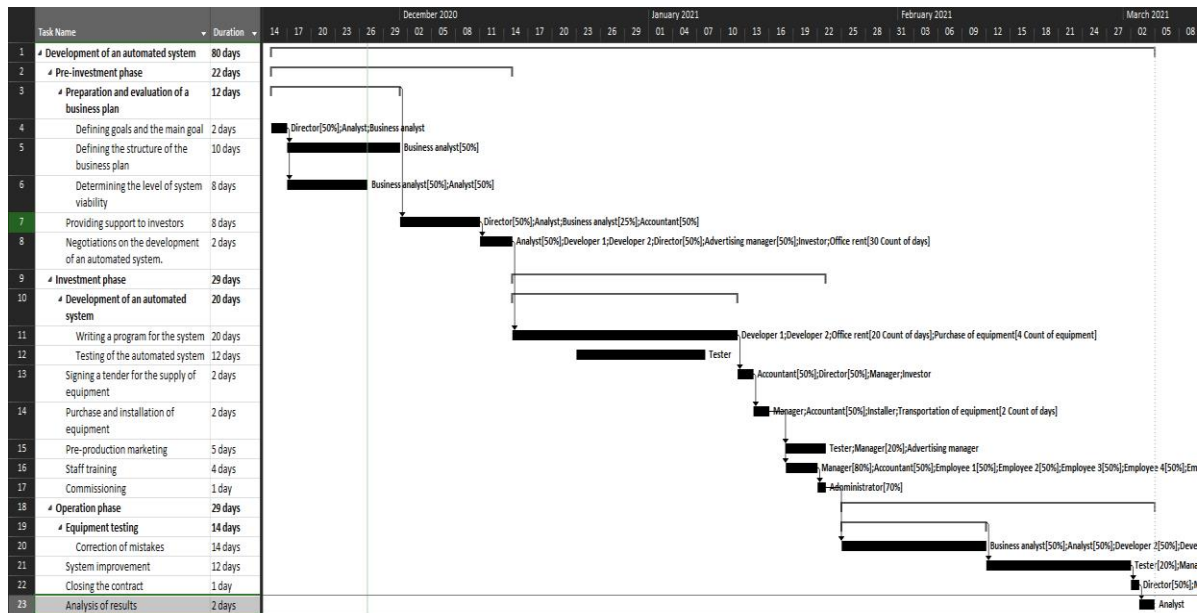


Figure 1: Project development life cycle

This diagram shows the names of tasks, their sequence, start and end dates (duration), resources (labor, material ones), which are used to perform a task, as well as their involvement (as a percentage, where 100 % is one bet). It should be noted that the composition of these subprocesses / activities may change, i.e., some activities may degenerate.

Project tasks can be performed simultaneously or sequentially. The list of tasks and the time required to complete them is displayed on the task schedule. It can be used to determine when a task should begin and end and how long it will last.

In the project it is possible to define intermediate purposes, or checkpoints (milestones) which will be used for display of intermediate results of the project. Checkpoints help to group tasks [14].

In the Resource Sheet section of the MS Project environment, it must be specified all the resources that are attached to the project. These can be labor, financial, and material resources. For material resources it is necessary to specify units of measurement. For labor resources it is necessary to set the following parameters as the maximum workload for an employee, the hourly rate, the cost of overtime work. Time of payment for the performed work could be at the beginning, during the performance or after the delivery of the finished work. Figure 2 shows all the resources that were used to implement our project.

As can be seen, the following human resources take part in the development of the project, namely developers (they write a program for the system), tester (they test software and detect errors in the work of applications), business analyst and analyst (they analyze the problem and make a business plan) , director (manages the sewing enterprise and is involved in the project development process), manager (manages the production process and assists in the development of the business plan), administrator (is responsible for training employees to use the developed product), investors (finance the project for profit), accountant (keeps accounts during the project), installer (delivers and installs the equipment which the system will work on), advertising manager (is responsible for advertising the developed system), employees (master the work of the system for further use).

Project participants realize different interests in the project implementation process, form their own requirements in accordance with the goals and motivation and influence the project based on their interests, competencies, and the degree of involvement in the project.

The project participants, their roles, distribution of functions and responsibilities depend on the type, scale, and complexity of the project, as well as on the phases of its life cycle. Project participants can be active, passive, and direct.

Material resources are office rent for work (creation of software applications), measured in days; rent of the necessary equipment for software creation and its testing; purchase of necessary equipment for system operation at the enterprise; transportation and installation of equipment.

		Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt. Rate	Cost/Use	Accrue	Base
1		Developer 1	Work		D1		100%	\$10,00/hr	\$13,00/hr	\$0,00	Prorated	Standar
2		Developer 2	Work		D2		100%	\$12,00/hr	\$15,00/hr	\$0,00	Prorated	Standar
3		Analyst	Work		A		100%	\$12,00/hr	\$15,00/hr	\$0,00	Prorated	Standar
4		Tester	Work		T		100%	\$8,00/hr	\$10,00/hr	\$0,00	Prorated	Standar
5		Project Manager	Work		P		100%	\$19,00/hr	\$23,00/hr	\$0,00	Prorated	Standar
6		Business analyst	Work		B		100%	\$15,00/hr	\$18,00/hr	\$0,00	Prorated	Standar
7		Director	Work		D		50%	\$30,00/hr	\$0,00/hr	\$0,00	Prorated	Standar
8		Manager	Work		M		100%	\$7,00/hr	\$9,00/hr	\$0,00	Prorated	Standar
9		Adnministrator	Work		A		70%	\$5,00/hr	\$8,00/hr	\$0,00	Prorated	Standar
10		Employee 1	Work		E1		50%	\$6,00/hr	\$9,00/hr	\$0,00	Prorated	Standar
11		Employee 2	Work		E2		50%	\$6,00/hr	\$9,00/hr	\$0,00	Prorated	Standar
12		Employee 3	Work		E3		50%	\$6,00/hr	\$9,00/hr	\$0,00	Prorated	Standar
13		Employee 4	Work		E4		50%	\$6,00/hr	\$9,00/hr	\$0,00	Prorated	Standar
14		Employee 5	Work		E5		50%	\$6,00/hr	\$9,00/hr	\$0,00	Prorated	Standar
15		Employee 6	Work		E6		50%	\$6,00/hr	\$9,00/hr	\$0,00	Prorated	Standar
16		Accountant	Work		AC		50%	\$7,00/hr	\$10,00/hr	\$0,00	Prorated	Standar
17		Installer	Work		I		100%	\$4,00/hr	\$6,00/hr	\$0,00	Prorated	Standar
18		Investor	Work		I		100%	\$0,00/hr	\$0,00/hr	\$0,00	Prorated	Standar
19		Advertising manager	Work		AM		100%	\$10,00/hr	\$14,00/hr	\$0,00	Prorated	Standar
20		Purchase of equipment	Material	Count of equipment	P			\$500,00		\$0,00	Prorated	
21		Office rent	Material	Count of day	O			\$15,00		\$0,00	Prorated	
22		Equipment rental	Material	Count of days	E			\$25,00		\$0,00	Prorated	
23		Transportation of equipment	Material	Count of days	TE			\$50,00		\$0,00	Prorated	
24		Finance	Cost		F						Prorated	

Figure 2: All resources involved in the project

Since resources are rarely available, this factor must be considered when developing a project. Each resource and each type of work has a certain value in monetary terms, which makes up the budget of the whole project. The MS Project environment also provides information which resources are overloaded and which tasks cannot be completed untimely.

The Task Usage section automatically calculates the cost of the project and it can be estimated the project budget (Fig. 3).

With the help of different modes of viewing information about the project and reports, it is possible to quickly identify the types of tasks, the implementation of which is delayed or the cost of which exceeds the budget [13].

Project management is about tracking the status of tasks and determining whether they are being carried out according to plan. If execution lags the plan, you should either change the plan or take measures to eliminate the delay. MS Project automatically adjusts the plan according to the changes.

		Task Mode	Task Name	Work	Duration	Start	Finish	Cost
1			Development of an automated system	1 533,6 hrs	80 days	Sun 15.11.20	Thu 04.03.21	\$20 688,80
2			Pre-investment phase	252 hrs	22 days	Sun 15.11.20	Mon 14.12.20	\$3 714,00
3			Preparation and evaluation of a business plan	128 hrs	12 days	Sun 15.11.20	Mon 30.11.20	\$1 896,00
4			Defining goals and the main goal	40 hrs	2 days	Sun 15.11.20	Mon 16.11.20	\$672,00
			Analyst	16 hrs		Sun 15.11.20	Mon 16.11.20	\$192,00

Figure 3: Costs during project implementation

The following main points should be noted when calculating the project budget:

- the project budget should be based on cost estimates and schedules;
- it should be also based on project requirements, and any assumptions should be identified and documented.

The structure of the project budget is shown in Fig.4.

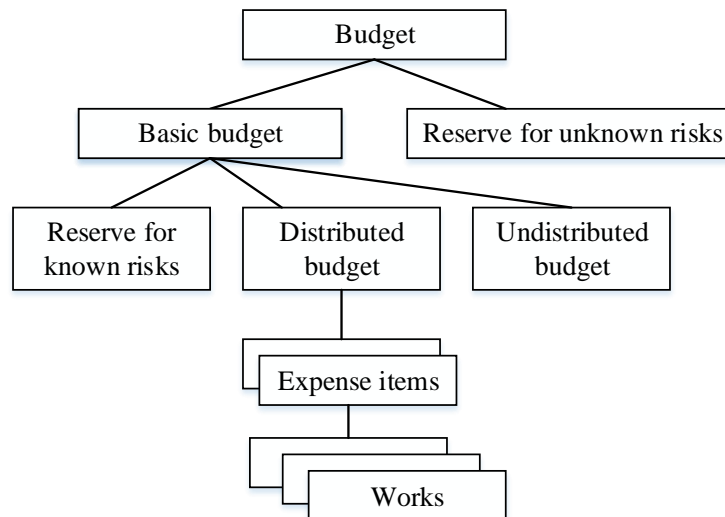


Figure 4: Project budget structure

To calculate the project budget, it is necessary to have a project estimate; approved cost items; project schedule. Graphical representation of the project budget is called the S-curve of the project.

When any complex task must be completed by a certain deadline, the important factors are time and material resources [13]. They can be managed using the critical path method. This method allows you to predict how long the project will take, which of its tasks are critical and which are the most stretched in time. Critical tasks are those whose delay may affect the completion of the project. Critical tasks form a critical path. Delays in non-critical tasks will not affect the completion date of the project [11].

The critical path method is a standard method for determining critical tasks [12]. It is based on a mathematical model that considers the relationship between the types of tasks, their duration, and the conditions of resource availability. MS Project allows you to quickly identify the critical path and focus on critical tasks. Using the critical path method, it can also be predicted and optimized labor costs [13]. MS Project provides the user with various tools for creating and maintaining a project.

Thus, according to the obtained data, it can be concluded that the selected project is small in scale because it relates to the modernization of certain functions of business (at a cost of up to 10 million dollars).

In terms of complexity, it is a mono-project that is a separate narrow-profile project of a certain type and scale.

In terms of quality, it belongs to the projects of ordinary quality, because it does not pose a threat to humanity in the case of an error.

By the nature and scope of its activities, it belongs to organizational projects aimed at reforming the management system, creating a new organization, restructuring, etc. After all, the developed system should automate the work of production due to the developed electronic systems of storage, data processing, etc.

According to the duration of the project or the terms of implementation it refers to short-term projects (up to 3 years). Figure 3 shows that the duration of the project is 80 days.

The main features of the project are:

- saving labor, and time costs;
- quantitative measurability, evaluation of all costs and benefits;
- ability to track, check the work of employees;
- ability to report on the performed work;
- low equipment requirements;
- minimal use of manual labor related to information processing;
- ease of performing operations for the user;
- ability to verify the correctness and completeness of calculations on computers;
- ensuring the protection of information from unauthorized access.

The advantages of using the Gantt chart as a method of project planning are:

- visualization of the task and all stages of the project;
- assistance in identifying critical points;
- optimization of planning and distribution of tasks;
- the ability to quickly update with software and applications;
- the ability to build even on plain paper or in Excel, etc.

Management functions of this project are:

- forecasting and planning of project activities;
- organization of work;
- coordination and regulation of project development and implementation processes;
- activation and stimulation of work of executors, developers;
- accounting, control and analysis of the progress of project development and implementation (regular meetings, inspections such as monitoring of project implementation).

Also, it should be emphasized that during the development of the project there is an important justification, which is presented in the business plan [7]. After all, it provides a detailed description of the goals and objectives that need to be solved, as well as their ways to achieve. A business plan provides an opportunity to determine the viability of the project in conditions of fierce competition; describes possible risks of the project; contains a reference point for the development of the enterprise; is an important tool for obtaining financial support from external investors, auctioneers, etc. [8].

Although the development of this project is done by a business analyst and an enterprise analyst, who make a significant contribution to its conclusion and formation, but it is primarily intended for the following categories of participants as directors or owners; investors or ordinary banks for which it is a mandatory document.

The content of the business plan and the degree of its detailization usually depend on the size of the future project and the scope to which it relates; the size of the market (demand); the presence of competitors and their number.

There are different standards of business planning [7]. The most famous are the UNIDO standard (United Nations Industrial Development Organization); KPMG standart (Klynveld Kraayenhof & Co., William Barclay Peat & Co., Marwick, Mitchell & Co., Treuhand-Gesellschaft); TACIS standard (Technical Assistance for the Commonwealth of Independent States); EBRD standard (European Bank for Reconstruction and Development).

The automated information system itself, to which the project was developed, needs to solve the following issues:

- analysis of product demand in the market;
- study of the system of indicators of accounting for production costs and sales at industrial enterprises in order to organize automated information accounting;
- examination of disadvantages and problems in the organization of the system of accounting for production costs and the organization of the sales process of finished products at the enterprise;
- development of a database of potential buyers for further communication with them;
- substantiation of the use of information technology for analysis and management decisions in commercial activities;
- analysis of the use of information systems and technologies in order to study the needs of the buyer and the organization of production of goods;
- creating a database of manufactured products to calculate the cost of their production;
- development of personal electronic accounts to obtain the necessary information by employees in accordance with their work at the enterprise.

The **object of the study** is the organizational and economic process of automation of cost accounting and sales of finished products at industrial enterprises to ensure its effective management in modern conditions of high competition using information technology and systems.

The **subject of the study** is a set of methodological, practical, and theoretical aspects of automation of the process of managing the commercial activities of light industry, which provide a rational structure and create competitiveness in the market.

The work of the automated information accounting system at the sewing enterprise, for which the project was developed, can be represented by a use case diagram, which is designed to build a conceptual model of how the system works in the environment.

The main purpose of the system is to automate the input and storage of reporting data on the receipt of orders and their processing, scheduling and workload of employees. The system allows you to change, supplement and view information about the work of the enterprise, impose restrictions on access to the system, save orders that have already been processed.

The selected system contains the following main functions:

1. Obtaining and processing the order.

This function is designed to receive and process information about the execution of the order. It describes how the order arrives at the enterprise and stores information about it and the customer as well as the characteristics of goods that are listed in the database.

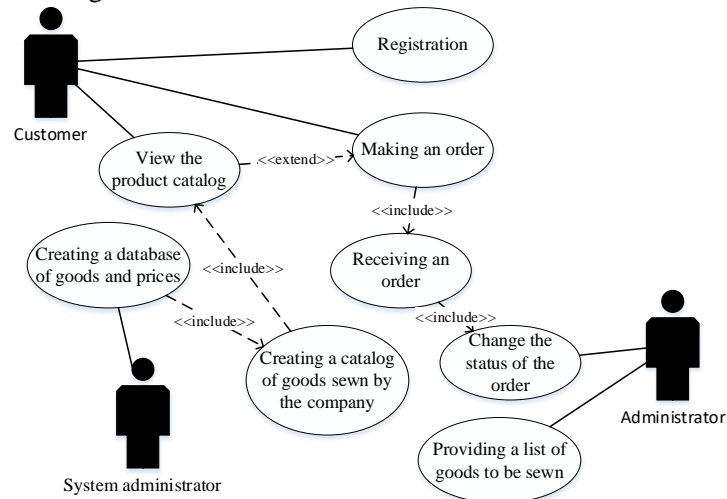


Figure 5: Obtaining and processing the order

2. Supply of materials and warehouse work.

This subsystem is responsible for the availability of materials in the warehouse, as well as for supply and communication with suppliers (Fig. 6).

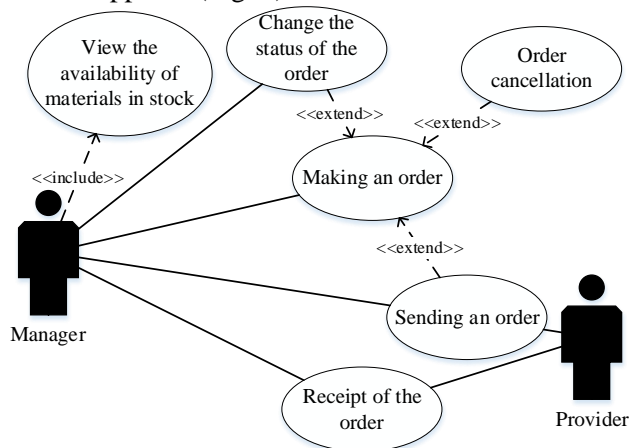


Figure 6: Supply of materials

The input data of the subsystem are receipt of materials in the warehouse, their name, number, price, date of receipt, name of the supplier and information about them. At the output, the subsystem provides this data, which is entered into the system. Also, when materials are taken from the warehouse to fulfill the order, this is also considered.

3. Execution of the order.

This feature is designed to store information about employees working in the company and the distribution of tasks between them (Fig. 7).

In this situation, the enterprise acts as an employer for employees. Employees have their own work schedule and workload, as well as a personal account, where they receive tasks and deadlines. After

completing the task, employees enter this information in their account. To ensure the effectiveness of the system, it is necessary to motivate employees with the following measures as self-development, profit sharing, career growth, professional recognition, etc. [6]. The place of application of the system is industrial enterprises for sewing. This system, for example, reflects the transition from manual, time-consuming and error-prone routine operations to the use of computer technology that quickly and accurately stores and processes the information needed to make management decisions.

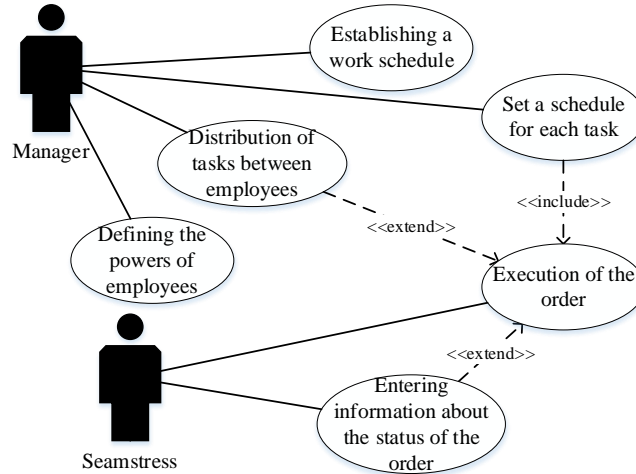


Figure 7: Execution of the order

4. Conclusions

The problem of automating the work of certain departments or even the whole enterprise is important. After all, every day there are new functions, opportunities to simplify the work, the use of which will facilitate the work of production and reduce costs. Therefore, each company must monitor new trends, functions, applications, programs, etc. and implement them to make a profit. Also, it is necessary to constantly analyze the work of production and identify weaknesses and eliminate them. One of such methods is the transition to automated work using modern technologies. The paper considers the development of an automated information enterprise management system as a research project that has a certain life cycle, which is implemented in such phases - pre-investment, investment and operational. With the help of calendar planning tools, a Gantt chart was constructed, which shows the sequence of works defined in time. And it allows you to specify the resources (labor, financial and material) and their workload, which are necessary to perform a task. After describing all the works and resources, the general budget of the project was calculated, and the main points of its conclusion were described. For systematization of the project the classification on traditional features is carried out as scale, complexity, quality, sphere of activity, duration. The main functions of the project are given. The structure of the business plan, its content, participants, and standards are analyzed. After analyzing the system, using object-oriented methodology, the boundaries of the system and the environment were separated, the actors, options for use and the relationship between them were identified. There are three main functions that reflect and characterize the operation of the automated information management system of the enterprise manufacturing goods.

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