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DEVELOPMENT OF BUSINESS PROCESS DESIGN METHODS

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ABSTRACT

In all economic and production-technological areas (or processes), business processes are the main objects that unite everything that is related to the achievement of the goal.

There are many models of business processes that do not sufficiently reflect the features of the business process and the needs of a person in the business process. In other words, all kinds of model are functionally incomplete.

Business process analysis is becoming extremely important for manufacturing and logistics systems as it plays a vital role in the successful improvement of business processes. The goal of process analysis is to unlock new knowledge to solve problems and optimize processes to create core competencies. A large amount of research and development has been carried out to optimize the performance of business processes in this complex and dynamic environment. Several methodologies, techniques and tools have been developed to analyze and optimize business processes in the field of production and logistics.

Therefore, more and more new approaches to the description of business processes appear. In this work , we offered universally th business process model, which is called the base. Since, all other views of business processes are derived from the basic business process representation by the model.

Keywords: *Business Process, Design Methods, Modeling, Knowledge Analysis*

1. INTRODUCTION

This guide provides details to assist authors in preparing a paper for publication in JATIT so that there is a consistency among papers. These instructions give guidance on layout, style, illustrations and references and serve as a model for authors to emulate. Please follow these specifications closely as papers which do not meet the standards laid down, will not be published.

On the occasion of the 40th anniversary of Computers in Industry, the world has become dynamic. On this basis, a trend also affects the activities of the subjects of the national economy, its processes and business processes. Under those circumstances, it becomes relevant to constantly improve the activities of companies depending on changes in the outside world, including changes taking into account the dynamics of the surrounding space.

An effective solution in this case is the design of business processes and their automation.

This article discusses in more detail the features of the following aspects:

· Presentation of the activities of companies in the form of a set of processes;

· Determination of the stages of process design;

· Development of a design model for the software of the system;

· Creation of automation systems based on an architectural approach.

We represent the entire business process design cycle as an interval that begins with the types of processes for achieving or fulfilling a business goal and ends with the formation of a complete business process that ensures the fulfillment of the business mission or business case.

A business process is defined not only by a metamodel or a flow diagram of business operations and business procedures for each business operation, but also by resources, which, in addition to resources, include infrastructure.

Organizing local models into a team, it is important not only to combine functions, but also to organize the structure, in other words, the nature of the connection between the models and the type of protocol (universal or unique), the issues of how the integration takes place are also important, such organizational features as the type of integration technologies are especially important data, information, knowledge and rules, service or agents, also type of technology tools and interfaces. For integration, standard integration tools can be used, for example, such as methods and integration tools: ESB, EAI, EII, ETL, where ESB (Enterprise Service Bus) literally translates as "enterprise service bus", EAI - enterprise application integration - enterprise application integration , EII - enterprise information integration - integration of corporate information, ETL - extract, transform and load - software for extracting, transforming and loading data [1].

Furthermore, the base model is a composite of local models. At the same time, the organization of local models into basic models depends on the features of local models and the environment, as well as on the features of business processes and the problem being solved in the business process.

Before presenting the main idea of the article, first introduce and give a number of concepts.

Definition 1

Model representation of a business process:

• is an object of the external (or rather real or virtual) world;

• performs the function and role of a labor tool that performs tasks assigned or coming from the production plan (operational-calendar or schedule), the business process.

At the same time, the business process is a labor tool that performs tasks for a certain subject of labor and on the basis of the available means of labor.

Definition 2

A complete business process is a process with all components, i.e.

• the logic of the scheme (metamodel) for performing business process operations from abstract classes;

• business process infrastructure

In this case, the infrastructure includes types, means of labor, including systems for automating the business process

Definition 3

The concept of "object" is used in two ways:

• The object (or object of research) is equal to the entire space of the subject or problem area (or space), i.e. objects or subjects of research is the entire space of objects (both general and local) of the problem area.

• An object, on the other hand, is equated with separate objects or components, things (i.e., in fact, objects) or processes, business processes, or their components, objects and objects of a large object of the local space of the problem area.

In particular, an object is both a business process and its components.

Definition 4

The concept of space and area presupposes the same subject of research.

Subject space is all objects or objects belonging to the space that is of particular interest to ektor.

A problem area is a subject area and tasks or problems that have arisen on it.

Problems that arise in the problem area arise as a result of the connection of objects (from the subject space) and the goal from the target space of the ektor. The target space exists only in the head of the ektor.

Thus, it can be argued that the basis and content of the problem area is the subject space, i.e. many objects of labor, means of labor, production environment, i.e. unified information space (UIS) and target space of the actor.

Definition 5

Technological and model foundations of business processes.

Building, operating, and running complex processes without a model (i.e. no MDA) is a difficult task. Therefore, the process of building business processes is important, conducting on the basis of a model as a factor regulating the process of building and maintaining operational processes of business processes. Moreover, due to the multifaceted nature of business processes, many models are required, but they are interconnected according to a certain criterion. The technological and model foundations of logistics processes have the following features:

- the business process acts as an object of the external world, therefore, we accept the business process as an object of the external world. He, like any object suitable for human activity, must be observable;

- the business process plays the role of a unifying one, is a unifying tool of the means of labor, a methodology for completing a task with a subject of labor;

- during the execution of production orders, the business process is used to fulfill the production order (or plan) as a labor tool that links the plan and operational management in the production environment, i.e. the process of executing the plan. Hence it is clear that the business

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process itself as a method or technology of labor must be observable and controllable;

- an automation system refers to the business process infrastructure as one of its components.

As a production (production-technological) link and instrument of labor for fulfilling the production task from the plan, it must accept and process the object of labor, perform processing operations for the object of labor and have various means of labor.

All these features of the business process should be reflected in the model. Thus, a business process is a complex object. Therefore, due to its complexity, no model can fully reflect its properties. But each local BP model reflects only separate aspects of BP and their properties.

In other words, the business process is a formalized process and is like a tool of labor, working at the junction of the production plan with the production and technological infrastructure or processes. The latter constitutes the scope of the plan execution and the execution of the plan implementation processes. Therefore, they include elements from both strategic management (planning and strategic processes) and production processes.

There are many models of business processes, but they (types of model) do not sufficiently reflect the features of the business process and the needs of a person in the business (business process). In other words, all kinds of model are functionally incomplete.

In order to systematically present the entire range of processes that are needed to implement ideas and technologies, as well as to reveal the features of business processes in warehousing, the entire cycle will be presented as a generalized model or conceptual structure of activities and technologies of warehousing in the following form (Figure 1) [2].

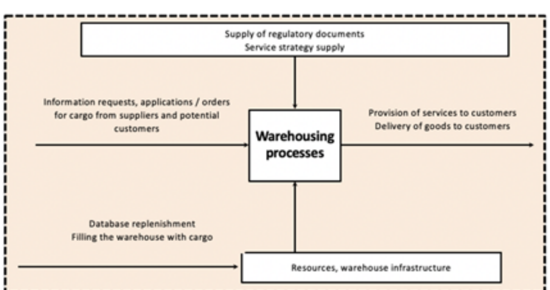

Figure 1: The Process Of Building A Platform For A Specific Problem Area

The activity of a warehouse, like the activity of any enterprise, consists of a set of external (supply, work with customers and suppliers) and internal (marketing, technological process, etc.) processes.

The main warehouse processes are:

- Acceptance of cargo to the warehouse;
- Placement and storage of cargo;
- Complete set of cargo;
- Shipment of sets of cargo.

Each of these processes can be investigated and solved as a separate problem. To solve the division of the process into tasks, the plan of the warehouse was considered in Figure 2. The movement of cargo is carried out in five zones: unloading, forwarding, storage, cargo picking and shipment.

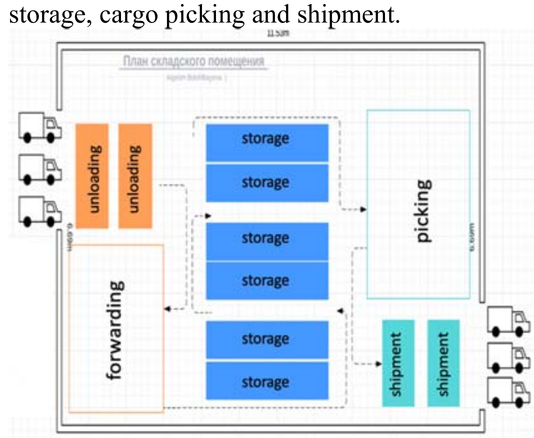

Figure 2: Warehouse Plan

This paper proposes a methodology for automating business tasks of business processes for fulfilling applications, processes for receiving, placing, picking and shipping goods to customers.

2. METHODOLOGY FOR DESIGNING BUSINESS-PROCESSES

The popularity of various approaches to process management, such as Lean Management by Womack J.P., Action-based Costing by Tunney P.B., Business Process Reengineering by Hammer M., Process Innovation, Workflow Management and Supply Chain Management, have implications that relate to the requirements for process models. Today, the number and variety of purposes for which process models are used is growing. In addition to the "traditional" use of process models in software development, these models are increasingly used for purely organizational purposes such as reorganization, certification, activity costing, or human resource planning. Process modeling should be a tool to deal with the complexity of planning and controlling processes. However, existing models also show significant complexity. Consequently, the design of process models is often very problematic. Developing integrated process models can be challenging, especially in enterprise-wide process management projects. The following describes modeling guidelines for workflow control and modeling.

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So, the design cycle consists of the following sections:

1. Building a problem area;
2. Construction of special processes;
3. Building business processes;
4. Building software.

These sections consist of stages:

- Stage 1: designing the problem area by separating it from the company's activities;
- Stage 2: design of the power supply unit as it is, i.e. as "as-is";
- Stage 3: design, BP in the form as it should be, i.e. in the form of "to-be";
- Stage 4: design, extended power supply in the form of "to-be-EXT".
- Stage 5: designing a complete BP in the form of a set of classes of object-oriented representation, i.e. as "to-be-OOV";
- Stage 6: designing a component-service representation of a BP in the form of "to-be-WS" - representing a BP in the form of a set of service classes;
- Stage 7: designing a component-service representation of a BP into a complete business process in the form of "to-be-AS" - a BP with an automation system.

The business process model for the design purpose consists of concatenating the life cycle models of the design process of a complete business process.

Hence, the step-by-step general model of the results of the stages of designing a business process is as follows:

$$M = \langle MC, M_{pr}, M_{AS\text{-}IS}, M_{TO\text{-}BE}, M_{TO\text{-}BE\text{-}EXT}, M_{TO\text{-}BE\text{-}P\text{-}OOV}, M_{TO\text{-}BE\text{-}WS}, M_{TO\text{-}BE\text{-}AS}\rangle \quad (1)$$

Where

M - business process model or business process structure model, which consists of the sum of the object model and the model of the subject of management. It includes structures of private models, which consist of structures:

MC - model of general or complete problem area;

M_{pr} – homogeneous problem area model;

$M_{AS\text{-}IS}$ - is a process of the "as-is" type;

$M_{TO\text{-}BE}$ - "to-be" business process;

$M_{TO\text{-}BE\text{-}EXT}$ – extended "to-be" business process;

$M_{TO\text{-}BE\text{-}OOV}$– object-oriented representation of the business process;

$M_{TO\text{-}BE\text{-}WS}$ – a model of software development and information support for a business process management system;

$M_{TO\text{-}BE\text{-}AS}$ – a model for developing a business process management system from software and information support;

Where each model shows what should be the results of the design phase in the model.

In the design cycle, each stage corresponds to the level of maturity of the processes or business processes that ensure the fulfillment of the business mission.

A more complete version of the model than the version of the model in the form (1) has the form:

$$M = \langle [F_1(*), Mpr]; [F_2(*), M_{AS\text{-}IS}]; [F_3(*), M_{TO\text{-}BE}]; [F_4(*), M_{TO\text{-}BE\text{-}EXT}];[F_5(*), M_{TO\text{-}BE\text{-}OOV}]; [F_6(*), M_{TO\text{-}BE\text{-}WS}]; [F_7(*), M_{TO\text{-}BE\text{-}AS}]\rangle \quad (2)$$

Where

$F_i(*)$ - means algorithms for designing or transforming the input, which is the result of the previous design stage to the output;

M_{xx}- design results at the design life cycle stages.

Next, we will stop at each stage in order to reveal the essence of the stages.

2.1 Designing the problem area by separating it from the company

One of the first concepts on which business processes are based is the "problem area".

The problem area is the unification of the subject space of the actor's research with the actor's goal. In this case, the actor-researcher and the actor-decision maker can be either the same person or different persons.

The subject space is the infrastructure and institutional support (resources) of the company.

The goal of the actor is the formalized goals of the company. The actor is a person - an employee of this company or from the outside who conducts research and / or makes decisions [3-4].

When examining a problem area, it is necessary to establish the directions in the series of the problem area that are most unstable or changeable in different instances of the problem area class. This is only when examining a problem area to build a platform. Usually, instability manifests itself in the subject of labor. Certain characteristics require a separate business process that differs from business processes with different characteristic values.

The first, initial stage is the design of the problem area by separating it from the company's activities.

The design phase model shows the specification of the result obtained at this phase, as well as the design algorithm.

The problem area in the context of processes or business processes (for design processes), ensuring the achievement of the goal, primarily consists of the business goal and the processes that ensure the achievement of this goal.

Business goal as a response to the presented business requirements for the project. It is determined by choosing from a variety of company goals that are most important to our requirement.

The structure of the goals and objectives of companies is shown in Figure 4.

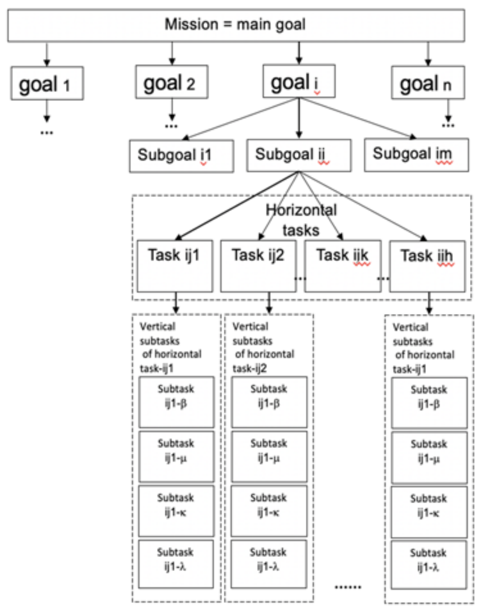

Figure 4: The Structure Of Goals And Objectives Of The Company

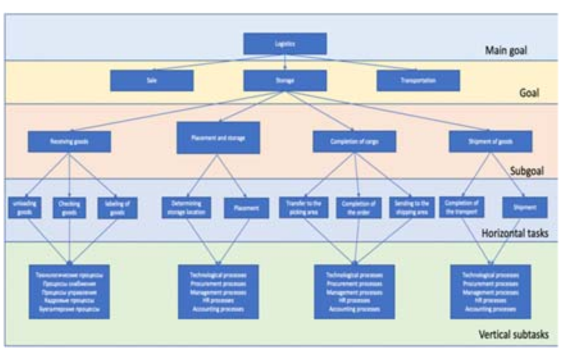

Figure 5: The Structure Of Goals And Objectives Of The Logistics Company (Storage Branch)

In relation to the studied area, the identification of the problem area was also carried out by isolating from the company's activities, which are presented in Figure 5.

This tree of the structure of the goals and objectives of the company, including the industry - logistics (problem area) can be symbolically represented in this way:

$$Z = \{Z1, Z2, Z3, \ldots, Zi, \ldots, ZI\},$$
$$Zi = \{Zi1, Zi2, Zi3, \ldots, Zij, \ldots, ZiJ\}, \quad (3)$$
$$\ldots\ldots\ldots$$
$$Zdij = \{Zdij1, Zdij2, Zdij3, \ldots, Zdijk, \ldots, ZdijK\},$$

Where,

Z – the goals of the company are equivalent to the mission of the company;

Zi – subgoals of goal Z of the company, $Zi \in Z$,

Zdij – tasks of subgoal Zij of the company, $Zij \in Zi$.

Further it is necessary to establish the levels of process control systems, providing the selected target. This establishes all levels of the management system that are needed to achieve the selected business goal Zj. It is assumed that at each level there is one process allowing the achievement of the goal. We will call this kind of processes special processes.

The general design model MC consists only of model views, i.e. MC contains information that a given problem area contains which models, i.e. what are the local models and how they are connected as part of the general model of business processes. Thus, the problem domain model, i.e. MC reflects the peculiarity of the problem area, for the business process of which it is planned to automate.

A model or a model representation of a process management system (processes or business processes (sequence of operations), which we consider to be means or tools to achieve the goal), the identified processes of the first stage in the problem area of the company's activities, processes for business has the form:

$$MC = \boxed{\bigcup_{i=1}^{7} KM_i} \quad (4)$$

or

$$MC^j = \boxed{\bigcup_{i=1}^{7} KMj_i} = KMOBP^j \cup KMLBP^j \cup LMBP^j \cup \{\cup KLSP^j i\} \cup \{\cup LLSP^j i\} \cup \{\cup MMSP^j{}_i\} \cup \{\cup SM^j{}_{hijk}\} \quad (5)$$

Where,

MC - Model of specifications of business processes, resulting from the first design stage;

1. KM1 - External conceptual model of the business process of the general problem area;

2. KM2– Internal or local conceptual model of the business process of the local problem area of the general problem area;

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3. KM3– A logical model of a business process, which consists of special processes as part of a business process of a local problem area;

4. KM4 - Conceptual model of the i-th special-process of the local problem area;

5. KM5 - Logical model of the i-th special-process of the local problem area;

6. KM6– metamodel or operator model of the i-th special process;

7. KM7– service model or from the service model h-th service (service model.

The business process consists of specific processes that generate the levels of the management management system. Special processes consist of operations or elementary processes, which are then decomposed.

2.2 Design processes as they are, i.e. as "as-is"

If platform is built on the top level of the hierarchy, the services need to be more complete, heavy, and vice versa. The result of the process description is presented in the form of diagrams as it is. The declarative presentation of the diagram is a paradigm and it expresses the logic of work without describing their control. This is the as-is diagram[5].

The first path is the process path, i.e. building a process and its operations through decomposition of processes and ordering the results of decomposition. Building a process through modeling processes on IDEF0, DFD, etc. and select operations from the processes.

1. Let's build a process model in the form of diagrams IDEF0, DFD, etc.

2. Then build specific tasks for business problems (for each operation / node of the DFD diagram), and then a metamodel solution for each specific problem of the business problem.

3. Further, from the metamodel, the process of performing this task is built, the implementation of which ensures the fulfillment / achievement of the task goal.

4. Further, in the resulting process (s), select individual operations and then represent them in the form of DFD special processes.

5. Further, we will collect (combine) all the special processes that allow achieving one business goal into a single one. And then everything instead makes up as-is processes for one business goal.

We synchronize and harmonize process operations of all special tasks with each other. This can be done in the process itself or in the DFD diagrams of these processes.

The operations of each level form processes that we will call special.

The level of detail of operations, i.e. there can be as many levels of the hierarchy as there are feedback loops of the multi-loop operations itself. But we represent the hierarchy in three levels. At the top level, only the sequence of operations is specified, as shown in Figure 5. This can be done with an IDEF3 diagram. At the second level, the composition of operations and the feedback loop are revealed, taking into account recursion, as shown in Figure 6. The third and further levels are further details of business operations (Figure 7). There are contradictions between the highlighted operations in the form of a diagram as is and the highlighted services. The deeper the operations are highlighted (diagrams as they are), the weaker the requirements for services. The level of detail envy is what level of granularity of services for solving the problem of automation by this business process.

Thus, at the second design stage, the formation of special processes takes place. We will assume that there is one process at each level of the control system, therefore, we will consider only one at each level.

Special processes based on existing operations, prior to design, by decomposition and establishment of operations, by bringing into a single system using the IDEF0 toolkit. Therefore, the established processes will be called as-is processes. Moreover, these processes can be set at different levels.

Decomposition of each business operation, taking into account or observing the sequence of their execution, is carried out on the basis of IDEF0 tools. This is achieved by the fact that the relationship is set at the first level, and the subsequent levels, each business operation is separately decomposed.

The business process model of the "as-is" type by levels is set in this way.

Each special process is presented at different levels of development and completeness of accounting for all operations. This is the local operator model of special processes.

Thus, the diagram is hierarchical as is.

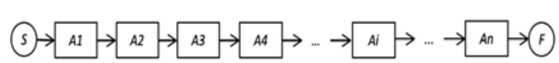

Figure 6: Sibling diagram "as-is" of the process. The chain consists only of a linear sequence of operations

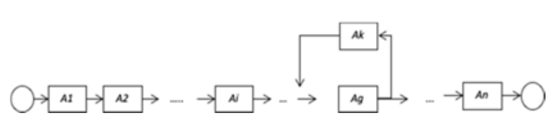

Figure 7: Two-level diagram "as-is" of the process, taking into account the recursion of operations and branching of operations

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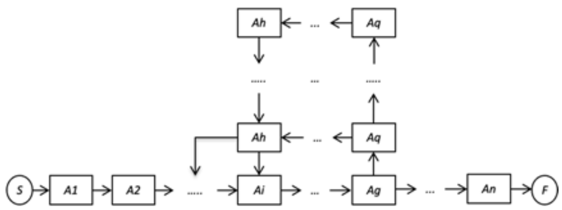

Figure 8: Multilevel Diagram Of The "As-Is" Process, Where A Double And Further Recursion Operations Are Taken, And The Recursion Loop Can Consist Of Two Or More Operations

The complete model of this stage for each level can be set in this way

$$MP1 = (F_2(*), MC) \quad (6)$$

Where ,

models F0 (*) - specification of the model design algorithm: an algorithm for separating processes from activities.

MP1 - the result of designing or transforming MC with the F2 algorithm (*).

In this version, as part of the model of the type MS, special processes are listed, and they are revealed as actions - a group of operations.

At this stage, the integration procedure is not needed.

The organization of logistics processes can be organized in various ways. This paper describes one of the options for a generalized abstract algorithm for organizing a step-by-step process from receiving cargo to unloading it. In this case, the duration of the stage can be measured in days, weeks, months.

Representation of business processes in the form Pr = <Pr (A1), Pr (A2), Pr (A3),…, Pr (Ai),…, Pr (An)>, corresponds to the second equation of the diagram as is the process.

The second path is the task path, i.e. building a process and its operations through production goals.

The second alternative is to build processes from operations or build as-is processes. According to this option, tasks are immediately highlighted that more fully reflects the features of processes and their operations.

After defining the problem area and its goal Z, we define / set sub-goals {Zi} of this problem area, which will become the goals of homogeneous problem areas identified from the problem area.

The goal (or the same subgoal of the goal of the problem area) of the homogeneous problem area Zi ∈ Z consists of a set of business tasks (TDB). For example, the purpose of a warehouse consists of solving problems:

<«Ts1 - tasks 1 (task of receiving goods)»;
«Ts2 - task 2 (tasks of sorting goods)»;
«Ts3 – task 3 (cargo placement tasks) "- etc...>

If we consider that in order to fulfill / achieve the goal Zi ∈ Z it is necessary to complete or solve tasks (TDB). Thus, the task representation of the process looks like:

$$TDB = \{TDB_1, TDB_2, TDB_3, \dots, TDB_j, \dots, TDB_m\} \quad (7)$$

The solution to the TDB problem consists of a sequence of business tasks:

$$TDB = <TDB_1 \rightarrow TDB_2 \rightarrow TDB_3 \rightarrow \dots \rightarrow TDB_j \rightarrow \dots \rightarrow TDB_m>, \quad (8)$$

This sequence is represented in the form of a diagram or a meta-model business processes. Then the process for the i-th homogeneous area of concern (homogeneous problem area - HPA) for the purpose of Zi ∈ Z consists of the concatenation process of the list of tasks

$$Pr(TDB) = <Pr(TDB_1), Pr(TDB_2), Pr(TDB_3), \dots, Pr(TDB_i), \dots, Pr(TDB_n)>, \quad (9)$$

Where,

Pr(TDB) – process resulting from the concatenation of problem solving processes $\{Pr(TDB_i)\}$, i=1,m. In other words, Pr (TDB) is a process for solving all problems $\{TDB_i\}$;

$Pr(TDB_i)$, process Pr_i – reflects the scheme (sequence of operations) for solving the problem TDB_i, of subgoal Zi ∈ Z,

In turn, each business-task (TDBj) consists of a number of special tasks {STsj}:

$$\{STs_j\} = \{STs_{j1}, STs_{j2}, STs_{j3}, \dots, STs_{jh}, \dots, STs_{jn}\}, \quad (10)$$

Where,

$\{STs_j\}$ – list of special tasks as part of {TDBj} ∈ Zi, Zi ∈ Z.

STs_{jh} - h –th special task in the composition $\{STs_j\}$.

These tasks should be solved simultaneously, the coordination of the implementation of each step of special tasks among themselves is regulated by internal signs.

Summing up, we give the following table 1.

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Table 1: Business Tasks Of The Business Process, With A List Of Special Tasks

	TDB_1	TDB_2	TDB_3	…	TDB_j	…	TDB_m	TDB
special processes	$\{STs_1\}$	$\{STs_2\}$	$\{STs_3\}$		$\{STs_j\}$		$\{STs_m\}$	STs}
	STs_{11}	STs_{21}	STs_{31}		STs_{j1}		STs_{m1}	$SSTs_1$
	STs_{12}	STs_{22}	STs_{32}		STs_{j2}		STs_{m2}	$SSTs_2$
	STs_{13}	STs_{23}	STs_{33}		STs_{j3}		STs_{m3}	$SSTs_3$
	…	…	…		…		…	…
	STs_{1h}	STs_{2h}	STs_{3h}		STs_{jh}		STs_{mh}	$SSTs_h$
	…,	…,	…,		…,		…,	…
	STs_{1n}	STs_{2n}	STs_{3n}		STs_{jn}		STs_{mn}	STs_n
	The overall process or summary process							SS

The structure of each individual special task (STsjh) business task (TDBj), i.e. {STsj} is formulated as follows:

$$STs_{jh} \rightarrow \langle Sst, Mp, Sfn, W\rangle \quad (11)$$

Where,
STs_{jh} – task;
Sst – starting conditions of the problem;
Mp – a method for transforming the initial state and condition of the problem Sst into the final state Sst, i.e. the method of reaching from the initial state to the final state or metamodel of the problem solving process;
Sfn – final state of the task;
W – criterion or requirements for reaching the final state Sfn from the initial Sst.

Special tasks { STs_{jh} }, in turn, constitute special processes $\{Pr(Mp_i)\}$, $i=1,m_i$ from problem solving methods or from a metamodel of the problem solving process.

Assembly phase of processes and their operations.

The general process Pr (TDBi) can be formed in various ways.

1) The first option, when only technological processes are integrated.

2) The second option, when not only technological processes are integrated, but at the same time a special control process is being built.

3) The third option is when all special processes are integrated with each other.

4) The fourth option, when the corresponding operations of special processes are integrated into the general operation, which constitutes a process of the "to-be" type. Thus, one generalized process of the "as-is" type is formed.

2.3 Designing a business process as it should be, i.e. as "to-be"

In "to-be" diagrams, the integration of operations between special processes is taken into account, while the metamodel of special processes remains independent. In this case, on the basis of many special processes, one process is created, which consists of many special operations and constitutes business operations [6].

But the metamodels of special processes will work harmoniously among themselves.

Their harmonization is carried out on the basis of an automaton model (Figure 9).

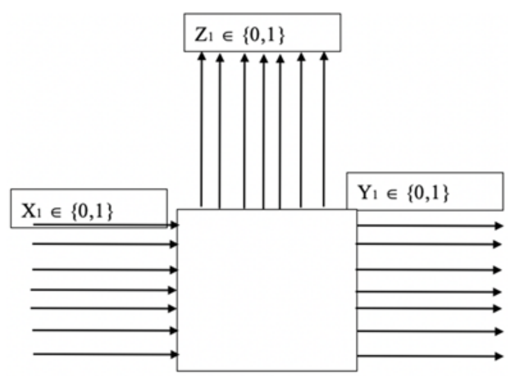

Figure 9: Automatic Model Of Harmonization Of Special Processes

Where,

X_1 is a team to start a business process. If $X_1 = 1$ at the input of the automaton, then this means that a command has been received from the outside that the business process should be launched (or started).

Y_1 - executing the signal for submitting to the first business operation of the business process by the command $Y_1 = 1$.

Z_1 - the state of the business process, if $Z_1 = 1$ this corresponds to the state that the business process is running, i.e. $Z_1 = 1$.

That is, if the input is $X_1 \in \{0,1\}$, $X_1 = 1$ and the state is equal to $Z_1 \in \{0,1\}$ $Z_1 = 0$, then the output

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will be $Y_1 = 1$, $Y_1 \in \{0,1\}$ and in this case, the states will pass to the states $Z_1 = 1$, $Z_1 \in \{0,1\}$.

If at the stage as is "as-is" those processes are defined that ensure the achievement of the business goal (each process allows the fulfillment of tasks or sub-goals of the selected business goal of the problem area.), Then at the stage as it should be "to-be" we collect all those processes that have a common leadership, so as to optimize.

Each process allows you to accomplish the objectives or subgoals of the selected problem area business goal. For example, if the goal Z_1 is chosen, then to achieve it, you need to solve the following tasks:

- ϕ - the task of organizing the management process;
- λ is the task of the process (s) for managing technological (executing) operations (processes);
- μ - the task of supplying resources;
- κ - the task of selecting personnel to perform performing operations.

Each subgoal corresponds to a set of tasks: κ, μ, κ, λ, ϕ which form a separate subgoal of the general goal of the problem area.

For example, in a homogeneous problem area of "storage" different means of labor and different methods for different sub-goals will be considered different processes such sub-goals are or these sub-goals are the following processes:

• transport control in the cargo unloading area - κ, μ, κ, λ, ϕ
• freight forwarding - κ, μ, κ, λ, ϕ
• storage of cargo in the storage area of the warehouse - κ, μ, κ, λ, ϕ
• order picking in the picking area - κ, μ, κ, λ, ϕ
• shipment of cargo - κ, μ, κ, λ, ϕ

Starting from this stage of design, the business process is presented in an object-oriented form, therefore, the connecting links between classes and objects are the integration procedures, the integration process. However, the business goals of these classes can be both general and different.

The pattern of transition from individual processes of business tasks to a business process from business operations can be different.

1) Combining processes of only one horizontal task with each other along one specialized task x, for example, task process β.

2) Combining processes first of only one horizontal task among themselves along one specialized task x, for example, task process β, then for all other specialized tasks: ϕ, λ, κ, μ.

3) Combining the processes of all tasks of one subtask.

4) Integration of milestone tasks with each other.

These special tasks will also be called verticals of each business task (horizontal task) of the subgoal of the problem area or the goal of a homogeneous problem area.

Each business task can be solved by performing these special tasks / processes, but their operations, for example, task x in different business tasks, differ from each other both in structure and (at least) in parameter values.

In the form of a table of compositions of business tasks and the differences in them of special tasks, we demonstrate in the following table 2.

Table 2: The Composition Of The Business Task And The Differences In Them Special Tasks

Vertical specific tasks of special processes of subgoal	Horizontal business tasks (business tasks or subtasks) of a homogeneous problem area					
	Subtask 1	Subtask 2	Subtask 3	Subtask 4	Subtask …	Subtask N
β - task of processes (execution) technological processes;	β_1	β_2	β_3	β_4	…	βn
ϕ - task, organization of the management process;	ϕ_1	ϕ_2	ϕ_3	ϕ_4	…	ϕn
λ - tasks, process (s) for managing technological (executing) operations (processes);	λ_1	λ_2	λ_3	λ_4	…	λn
μ - the task of supplying resources;	μ_1	μ_2	μ_3	μ_4	…	μn
κ - the task of selecting personnel to perform performing operations.	κ_1	κ_1	κ_3	κ_4	…	κn

Based on the given task processes, a business process of the form as it should be is compiled by integrating the task processes. But before that, we compose an intermediate view of the process by simple unification, not integration.

In the intermediate version, only technological operations are combined (partial integration), and during integration, all special processes are combined with each other, and then their operations are integrated (full integration) or synthesized into business operations.

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An intermediate version of business processes is already a systemic representation of all processes of "business processes" in a homogeneous problem area, where sub-goals act as goals. One of the options for formal setting the sequence of operations is the Lyapunov-Shestopal scheme. Further, these processes can be integrated and a full-fledged business process can be built as it should be.

There are two ways to automate business processes.

In the first case, it is possible to automate each special process of a business task vertically and then integrate them into a general business task automation system, and then integrate the business task systems of a homogeneous problem area horizontally.

Thus, in order to obtain a system of a homogeneous problem area, a two-tier integration is necessary: at the application level and obtain a system for a business task and at the system level of a business task in order to obtain a system for a homogeneous problem area.

In the second option, we first obtain a business process for individual business tasks from the special processes of a special task by vertical integration, then from the business processes of a business task, by integration, we will obtain a business process of the entire homogeneous problem area, by horizontal integration.

It is possible that each special process of a business task is automated by a separate application individually, based on individual design technologies. Then a business task process automation system will be obtained by integrating applications of special business task processes. In this case, the vertical processes of one business task or the horizontal of several business tasks.

In this case, the automation of an entire business process in a homogeneous problem area is achieved by integrating process automation systems for individual business tasks.

Thus, the creation of a monolithic automation system for all processes is ignored.

Therefore, an integrated system for automating processes or business processes is being built.

1. Preliminarily, from the special processes of the business task, business processes are compiled for the corresponding business task. And then business processes of different (selectively, the decision maker selects based on certain considerations) business tasks for (sub-goal) a homogeneous problem area are integrated.

The business process of business tasks is integrated with each other into a single business process of a homogeneous problem area. Integration of business processes from business task processes into a single business process of the entire homogeneous problem area.

2. Special processes of business tasks are integrated into the corresponding general special processes of a subsystem of a homogeneous problem area.

A system for automating business processes of a homogeneous problem area is obtained by integrating systems for automating business processes of a business task horizontally.

A system for automating business processes of a business task is obtained by integrating applications of special processes of this business task vertically.

A set of business tasks that are tasks of one subgoal (one homogeneous problem area) constitutes a homogeneous problem area. There can be several options for obtaining a b]usiness process of a homogeneous problem area, as well as a system for automating this business process through integration.

2.4 Designing an extended business process in the form of "to-be extended"

With different performers, infrastructure, objects of work and work environment, it presents different business challenges. Each business task has a range of special tasks, but for different business tasks the composition and parameters of special tasks may be different.

We assume that the solution of these tasks is achieved by one process or one business process, which includes special processes.

These are tasks of one goal Z. The formulation of each task is as follows:

$$ZD \rightarrow <Sst, Mp, Sfn, W> \qquad (12)$$

where task semantics have components:

ZD - task;

Sst - starting conditions of the problem;

Mp is a method for converting an initial condition into a final condition, i.e. method of reaching from the initial state to the final state;

Sfn is the final state of the task;

W - criterion or requirements for reaching the final state from the initial one.

In the interval along the paths from Sst to Sfn by the Mp method, there are cross-links between the tasks. For example, the task of organizing the management process influences the management process.

An example in logistics is such a case. For example, organizational operations can provide such management (and executive) personnel for the process of loading and unloading cargo that the warehouse process becomes more efficient.

It is assumed that the cargo was brought to the unloading area regardless of how, it does not matter (railway, car, etc.). These issues are not considered in this work.

All aspects of the organization of warehouse processes and their implementation in practice are considered from a systemic standpoint. All these processes are considered in interrelation within the framework of business processes of the "as-is" and "to-be" types, ensuring the fulfillment / achievement of the business objectives and goals. In this case, the business goal in logistics is the formation of cargo for shipment.

In logistics, processes (sub-goals of the company) consist of:

• Acceptance of cargo;
• Placement and storage;
• Equipment;
• Cargo shipment.

All these processes together constitute a business process, they must be included in the overall business process.

Note that the level of maturity of processes to achieve a business goal:

• can be at a low level, when business processes are presented as “as-is”;

• but it can be at the middle level, when business processes are presented in the form of a “to-be” business process;

• but it can be at a high level, when business processes are presented as a complete business process, when the business process as an infrastructure also includes an automation system.

Our goal is to achieve a high level of presentation of the business process of the warehouse process.

2.5 Designing a complete business process as a set of classes of object-oriented representation, i.e. as "to-be-OOV"

In the previous paragraph, special processes were defined. The execution of these processes can be automated using RPA and WebService technologies.

All business - processes are formalized, so that on their basis to build a service-oriented formalized model of the complete business process of the warehouse. Service-oriented formalized model allows programming a complete business process based on WebService programming technologies [7-8].

The first and prerequisite for software development is its adaptability depending on the production situation.

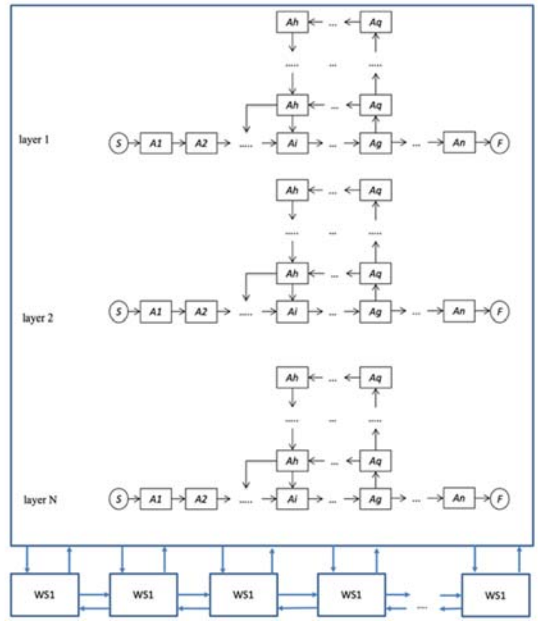

Figure 10: The Structure Of The Webservice Model

WebService is a software technology for building loosely coupled software systems that provides interaction regardless of the platform of reusable software modules - services, decorated with an interface that ensures compatibility. This technology (WebService) is based on open standards and protocols[9-10]:

• SOAP (Simple Object Access Protocol) - a messaging protocol between a consumer and a web service provider;

• WSDL (Web Services Description Language) - a language for describing the external interfaces of a web service;

• UDDI (Universal Discovery, Description and Integration) is a universal interface for recognition, description and integration, used to form a catalog of web services and access it.

Since some resource, material, financial and personnel tasks are reusable software modules, a decision may be made to arrange them into separate web services. The structure of the model is shown in Figure 10.

2.6 Designing a component-service representation of a business process into a complete business process in the form of "to-be-WS" - representing a business process as a set of service classes

At this stage, it is necessary to consider the integration of services in a composite web service [11].

Let's consider the structure of a composite web service. Today, as a rule, composite web services are performed manually, in the process of developing applications. Often times, the use of a single service is not sufficient to perform a specific business function. In this case, we talk about the composition of services, i.e. services are executed not independently of each other, but in a certain sequence, coordinated through the business process. A business process describes a logical and temporal sequence in which a series of actions must be performed to achieve a given goal. There are two types of coordination models, choreography and orchestration, which define two different approaches to service composition (Figure 11).

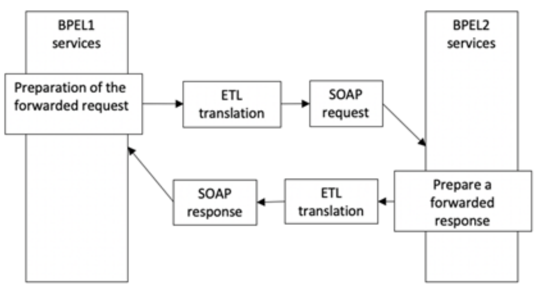

Figure 11: Integration Of Two Services

The terms orchestration and choreography describe two aspects of business process development based on Web services federation.

From the moment a web service is created, a company must be able to make it available and vice versa, developers must be able to find it. Discovery of web services is an important step, because it is in this case that we can restore the WSDL contract, without which nothing would be possible. As a result of this need, Ariba, IBM and Microsoft began to develop a Universal Description, Discovery and Integration (UDDI) standard, which is widely adopted and then rejected by OASIS, with the goal of providing a standard way to publish and request web services. The UDDI specification uses a distributed virtual directory approach that allows a user, through a web interface, to publish or search for web services.

Since in the study, web services were on the same machine, the need for UDDI disappeared, in subsequent studies it is planned to use web services on different remote machines.

The choreography model (Figure 12) describes a global business process that encompasses all interacting participants.

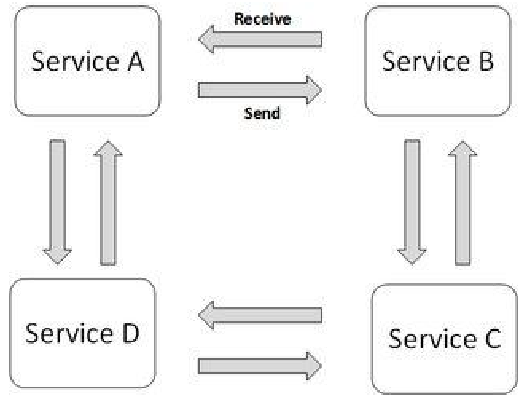

Figure 12: Choreography Model

The orchestration model is a projection of the choreography onto a single participant - it describes the order in which various service operations (required functions) need to be invoked from the perspective of a specific participant. Orchestration refers to an executable business process that can interact with external and internal Web services. Messaging-based interactions include business logic and order in which tasks are performed. They can transcend application and enterprise boundaries by defining a multi-step transactional business model (Figure 13).

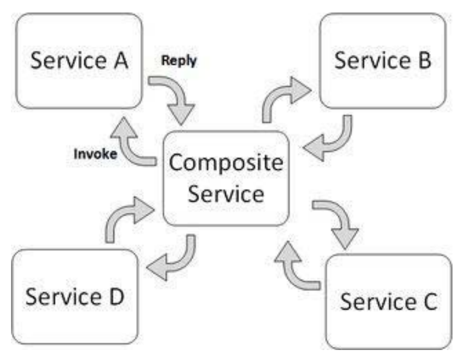

Figure 13: Orchestration Model

In addition, while the choreography model describes only the general order of actions, the orchestration model also requires that the internal actions necessary to create or use the messages exchanged by a particular participant be specified.

Given the orchestration, the structure of the model can be built using composite web services of the form in Figure 13.

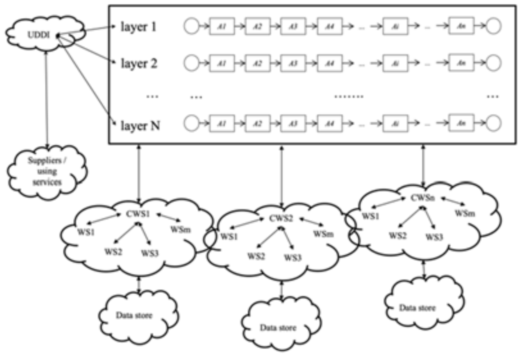

Figure 13: Model Structure Using Composite Web Services

At this stage, it is necessary to determine which services will be atomic and which composite. To do this, using the first stage, where we have defined horizontal and vertical (special) tasks of the business process, we will define the types of services used. Special tasks that include planning, management, resource provision tasks, as well as transformation tasks, hypothetically, we will refer to composite services, and those tasks that are performed without integration will refer to simple ones [12].

2.7 Designing a component-service representation of a business process into a complete business process in the form of "to-be-CWS" - a business process with an automation system

Each of the enterprise systems requires the organization of interaction with the warehouse system at the main points of cargo movement. In practice, the number of points of contact between systems and the complexity of integration largely depends on the specifics of the enterprise's industry, the organization of its business processes and the principles of working with cargo in the system [13].

Let's say a warehouse has a cargo picking area where the goods are assembled. Various integration options are possible, depending on how the system takes into account the loads and whether it takes them into account in principle. Let's say that the system reflects the fact that the cargo was assembled. In this case, the integration of systems will have to reflect the movement of components and kits at all stages of the warehouse technological process.

When designing an integration between systems, it is also important to know how the unit of measure is taken into account in the system. Often in the system, all work is carried out in terms of minimum units - for example, pieces. At the same time, for a warehouse system, you need to know the remainder of the cargo exactly in the context of all available units - boxes, boxes, packages, etc. This allows you to significantly optimize warehouse operations. Despite the possible discrepancy in the principles of cargo accounting, the interests of both systems should be taken into account in the development of integration [14].

Despite the diversity of companies and their specifics, there are several main points of contact between systems that should be present in any integration scheme. These include the acceptance of cargo, selection and shipment of cargo, inventory (or arbitrary reconciliation of balances).

The system can transfer all its functionality via web services. Web service definitions are defined in the configuration tree and made available to other systems by publishing them to the server.

Any system can turn to the service, just as the proposed system can turn to web services from other manufacturers (Figure 14).

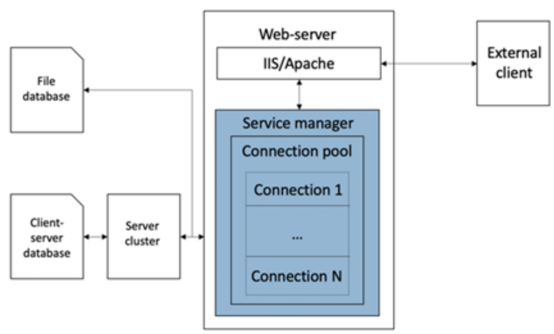

Figure 14: Service Architecture

As shown in Figure 14, the SOA architecture is based on a service manager that performs the following functions:

- Management of connections with infobases;
- Support for WSDL service;
- SOAP protocol implementation, message serialization, corresponding service call.

The integration of a warehouse management system and an enterprise system can be done in different ways [15].

The following integration mechanisms exist:

• Integration through the OLE mechanism, which allows the corporate database and the warehouse management system to embed or link data created in one of the databases into a document and / or reference created by another database.

• Integration through the use of SQL capabilities.

• Integration on the principle of "one window", when the functionality of the corporate system and the system of accounting and warehouse management is combined into a common information base.

• Integration on the basis of file exchange between the office of the enterprise and the warehouse.

The decision on the choice of one or another method of integrating the accounting and warehouse management automation system should be made based on the specifics of the information system of the enterprise, the territorial location of the integrated objects, the characteristics of the business processes of the enterprise, the stored cargo, warehouse personnel.

3. CONCLUSIONS

As a result of applying this methodology in a case study, we obtained a set of generalizable elements considered as a concept and solution for this particular proposal.

It is expected that the adoption of such methodologies will have a significant positive impact on the efficiency of resource use in the development and use of information systems. The use of lifecycle optimization solutions additionally allows the creation of new BMs based on integration mechanisms. Since the literature on this type of BM is scarce, this article provides a framework for developing theoretical and methodological foundations, it would be very useful to scale the methodology towards the model, taking into account the integration solutions learned by performing a specific but redesigned logistics process.

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