



## Management Approach to Implementation of EEP-System and CBIP for Effective of Enterprises` Integration

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### Abstract

It has been proved that in the era of globalization and the development of information technologies, the need to optimize the supply chain of services increases, since the integration of participants in this chain is performed without the use of modern management information systems. In the paper, with the help of logic-cognitive, structural-functional methods, structural-logical and imitation modelling, a management approach to simulation of business interaction in the integration of enterprises with elements of ERP-system and CBIP is developed and proposed, which allows you to create a flexible, adaptive and secure IT infrastructure, which increases the efficiency of the enterprise and allows you to optimize the management of relations with other participants in the service supply chain. As a result of this application of modern supply chain management systems, a synergistic effect is achieved that allows you to minimize the number of technological operations, shorten the production cycle and reduce the cost of services both for each individual enterprise and in the service supply chain as a whole.

**Keywords:** ERP-system, Comprehensive business integration process (CBIP), Simulation modeling, Information technologies, Information systems.

## Introduction

The concept of interaction between integrated enterprises is to integrate management flows of information of these enterprises and bring them to a single standard.

Modern enterprise management is based on a process approach that determines a set of basic components – personnel, processes and technologies. Effective use of these components requires a comprehensive, detailed approach to the process of integrating management information flows, as well as the availability of technical and business skills to effectively build and support process business decisions.

The desire of a person to cope with the problems of obtaining and processing management information is currently in the interaction between integrated enterprises through comprehensive integration of applied information technologies (IT). The emergence of new approaches and technologies for creating, storing and accessing integrated information resources has been driven by the evolution of computing and cybernetic methods of managing information flows. This made it possible to increase the speed of data acquisition and the volume of effectively accessible information space at the same time, however, the situation with the use of information in the management of integrated industrial entities did not change.

Complexity of information objects of different appearance and function is equally important component with information systems (IS) focused on customer service. Heterogeneity is an important feature of such a set of information resources, in addition to distribution – the number of forms of their presentation, storage environments, as well as the variety of conditions and methods of access is virtually unlimited. Resources of various sizes relate to such objects: databases and repositories, electronic directories, full-text arrays, the availability of which is provided by embedded or external tools, redundant relative to the resource itself. The information environment is the process of changing the properties of information objects that affect the system, as well as the totality of these objects.

Theoretical aspects and practical approaches of studying the basics of process approach in business process management and research of modern technologies of development and modeling of business processes were made in paper many scientists. In the papers of scientists actively investigated the problems of integrating enterprise resource planning (Hwang & Grant, 2016), contributing to production management (Kakouris & Polychronopoulos, 2005). Business process management considered on the basis of events (Krumeich, et al., 2014). Integration processes of enterprise efficiency proposed through algorithms for the implementation of ERP system (Lee, et al., 2003), which allows for flexibility and optimization of business processes (Nawaz & Channakeshavalu, 2013; Radeschütz & Mitschang, 2009; Seethamrajua & Sundar, 2013). However, the problems of simulation modeling of business interaction processes between integrated enterprises based on the technology of ERP-system remain insufficiently investigated.

The main purpose of the integration task is to develop technology for integrating heterogeneous information resources, including databases, to improve data processing efficiency by sharing existing enterprise information resources and building a new generation of management information systems based on comprehensive business processes. For this purpose it is necessary to solve the following tasks: to carry out the analysis of the used information systems at the enterprises, to establish connections between the business architecture of the enterprises and the automation of management processes; describe the links between business processes and information resources; to develop general requirements for architecture and technology of integration of heterogeneous information resources of integrated enterprises on the basis of executed business processes. In the research, the methods of logical-cognitive, structural-functional, structural-logical and imitation modelling were used to solve this goal.

Integration of ERP systems of different companies is done as a unification of two independent systems through API or as a unification of information flows based on the unification of management information. The tools are designed to integrate platform-independent software applications implemented using state-of-the-art technologies and provide the following basic functions:

- creation of models of functioning of software applications;
- formation of design patterns of software applications;
- creation of software API for design patterns of software applications;
- automation of code generation process for software application controllers;
- saving of information in XML, CSV format for further introduction into relational database and statistical analysis of the received data.

It should be noted that the use of distributed architecture to solve the problem of integration and development of corporate information systems, different configurations, allows achieving speed of integration, reducing overhead and time costs, including the total cost of ownership of the software product.

The quality of interconnection depends largely on the volume and structure of the data being transmitted (Sishchikov, et al., 2012). The transmission of data is accompanied by a solution: on the one hand, it is necessary to provide as detailed information as possible so that the receiving party can correctly interpret the data received; on the other hand, the transmission is not subject to all available data caused by the confidentiality regime.

In this regard, the implementation of information interaction requires the preliminary preparation (conversion) of data in order to generate their presentation in a format understandable to the receiving party, but taking into account the restrictions imposed by the transmitting party. The text format is most promising for the implementation of information interaction (Kovshov, et al., 2010; Kovshov, et al., 2008; Smirnov, 2013). The main advantage of this format is the natural

integration of additional elements in the message that can be used to convey the semantics of the message. Among the standards of text format, the most common is the set of standards defined using XML (Extensible Markup Language). Unlike other languages, XML allows you to reproduce not only the structure but also the semantics of information. Particular interest is given to XML technologies in the construction of XML document exchange systems. Their most important feature is separating formatting from content. XML allows data to be manipulated and manipulated (Kovshov, et al., 2010; Kovshov, et al., 2008).

## Research methods and models

### 1. Use XML-technology in the management process of enterprises' integration

Today XML can be used in any application that needs structured output, from complex IPs with colossal amounts of transmitted information to simple software systems that use this language to describe business information. Most of the tasks involved in creating and processing structured information that can be solved using XML are presented in Table 1.

Table 1. XML-based tasks

No.	Task name
1	Use in software applications to store and process structured data in a single format
2	Possibility of splitting the contained information in parts
3	XSL Style Sheets
4	Description of data of any type, presentation of specialized information
5	A powerful addition to HTML
6	Intermediate data format in three-tier systems when searching for information in remote databases
7	The default standard for the new RDF resource description language
8	Development of complex information systems

Source: created by the authors.

Advantages of XML-technology in comparison with other methods of data integration are presented in table 2. The process of integrating data at the semantic level is quite a complex process and provides support for a single method of data visualization, taking into account their semantic properties in the context of a single ontology of the visual area, and different ontologies can be mapped to different data sources.

These principles are already being applied, including at the level of software implementations. However, the more complex tasks of semantic integration are the subject of many scientific projects.

The key concepts of the current state of affairs in the field of IT are speed and innovation, which implies the introduction of news that provides quality growth in the application area and high efficiency of business processes that are implemented (Manvelidze, 2013).

Table 2. Advantages of XML

No.	Task name
1	Easier compared to binary formats when exchanging information streams
2	Supports lots of software
3	XML parsers and schemas make it easier to parse structured documents
4	Use of HTML infrastructure, including HTTP
5	Unicode code pages support, easy to create multilingual documents
6	Text, easily documented format
7	Random layout of the stored information structure

Source: created by the authors.

The main participant in the interaction between integrated enterprises is a set of interconnected information processes. Each of the processes, in turn, contains a specific set of operations implemented in one way or another. Organizational, economic, or business activities are related to a specific product called economic information. Economic information (ECI) by its nature, on the one hand, corresponds to the concept of "information" and, on the other, reflects the peculiarities of its functioning environment, i.e. economy. Most often, this term refers to a transformed and processed set of information that reflects the state and course of economic processes. The structure of ECI is formed by a specific information set, which has a specific meaning and covers not the economic information in general, but its prominent structural units. The unit (structural element) of the highest rank can be considered the entire information set of an object (industry, region, enterprise, shop, firm, institution, etc.), its information base (IB). Such a set is subdivided into lower-rank structural units, and continues until the indivisible (atomic) units are reached. These are the ECI details. Therefore, they represent the minimum (elementary) structural entities of ECI that have meaning.

Each object (phenomenon, process, etc.) has certain features and characteristics that are unique to it and distinguish it among others.

For example, such properties of a product are its price, overall dimensions, weight, capacity, etc. Characteristics of the enterprise may be its authorized capital, number of clients, services rendered, etc. All these properties are reflected by the variables just mentioned - the so-called requisites, or elementary structural units of ECI.

A prop form is a collection of characters – characters or numbers – that reflect completely certain properties of an object. A prop is a logically indivisible element of any other more complex information set - further splitting it into smaller components breaks the link of the props with the specific property of the object it displays.

In a more formalized definition, economic information refers to the embodiment of information about the economic relations and processes of material, labour and value resources and services expected or realized in practice and eliminate the uncertainty about the outcome of these processes and services.

In the end, interactions between integrated enterprises are reduced to sharing documents - as carriers of economic information. All this has led to the heyday of the content management industry (Lomov, et al., 2010).

## 2. Forming model of information movement in the enterprise production processes

The created model (Fig. 1) consists in the contour division of information processes, that is: there is an external contour between the enterprise and its clients, partners, public services, and an internal contour performing the functions of information exchange between departments of the enterprise.

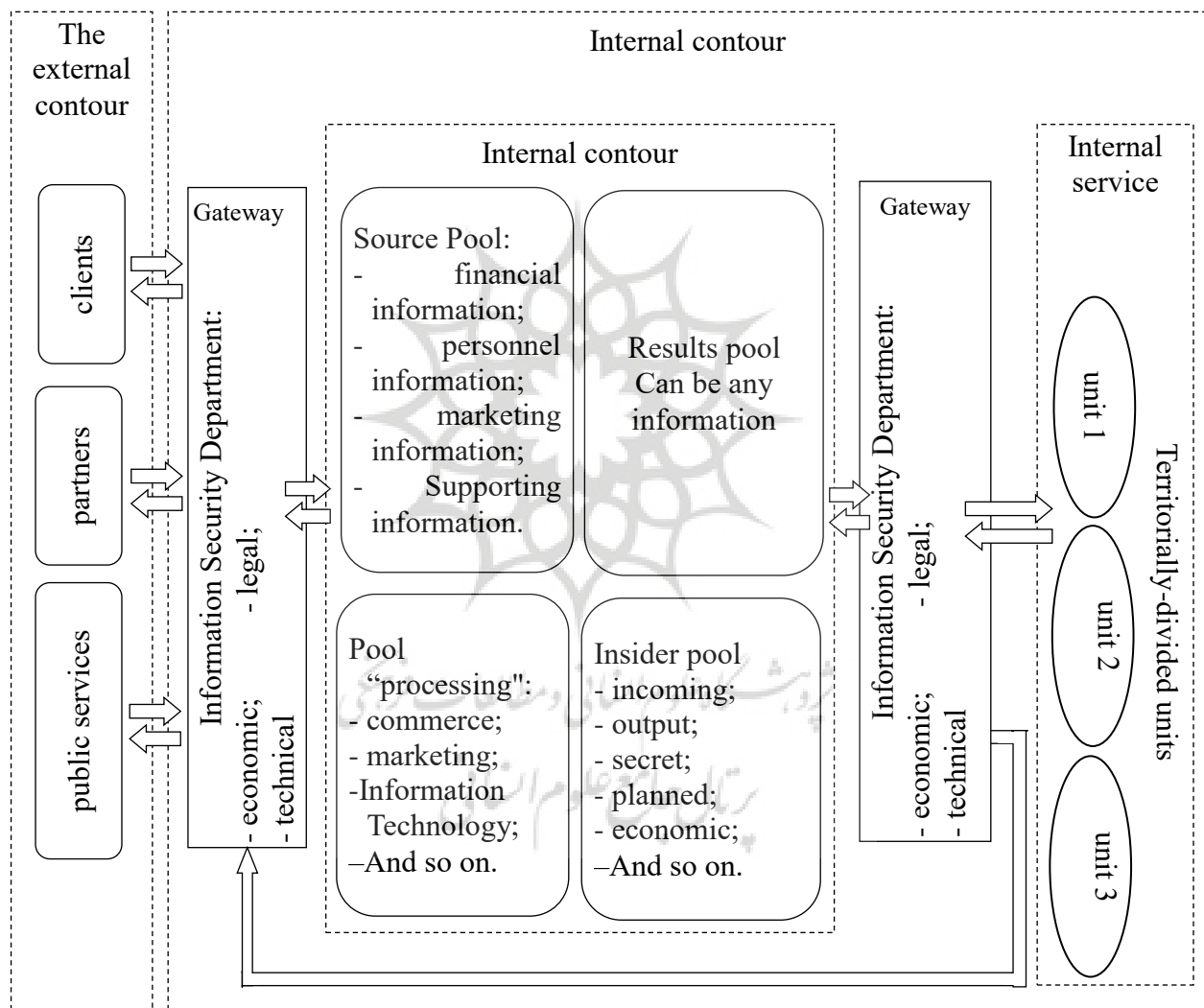


Fig. 1. Model of information movement in the enterprise production processes  
Source: created by the authors based on data (Maksimov, et al., 2018).

By multi-contour information models we mean a set of directional contours that provide meaningful groupings of information management flows. This ensures that the information is purposefully received by the consumer, which makes the management process more efficient and



the executor does not waste time on the information he does not need.

The basis for the exchange of information between the circuits is the "smart gateway", which performs conversion, filtering, and grouping and protection functions.

"Intelligent Gateway" is a mediator between heterogeneous information environments, it provides processing and adaptation of data to information systems of integrated enterprises. The gateway itself is based on streaming information (Maksimov, et al., 2018; Demianchuk, et al., 2014).

At the heart of the "smart gateway" is a service-oriented approach (SOP) to the development of information systems architecture. From a technical point of view, SOP defines software as components (services or services) that have weak relationships and are clearly defined for compatibility, increased flexibility and reusability, while the full functionality of the system is implemented as components, which are constructed in such a way, who often don't really know about each other's existence.

Business processes serve as a mechanism to ensure the alignment of services with one another. A business process can be defined as a set of related tasks related to an activity that has functional parameters. The business process manages the flow of events, calls and coordinates services, and creates the context for their interaction.

A business process is an abstract mechanism, independent of how the services are implemented and what logic they carry within themselves.

Effective management of integrated business entities requires a clear understanding of the business processes that exist in them. These business processes have a specific feature, which is conditioned by the specificity of integration, that is, business functions inherent in different components of the integrated object (IO), which are radically different, but are inseparable elements of it. We call these business processes "Comprehensive Business Integration Processes" (CBIP).

CBIP can be defined as a sustainable, targeted set of interconnected activities that, with the use of integration technologies, will transform production inputs into integration outputs that are of value to clients of integrated enterprises. We refer to the term "overarching" as the integration in the business process of tasks that are performed not only by divisions of one enterprise participating in the IS, but also by the tasks of related enterprises, using continuous (IT-only) information flows.

### 3. Forming models of operation of comprehensive business integration process and business process optimization in integration of business entities

For example, you can consider a comprehensive business integration process of three enterprises (Fig. 2) – a financial and technology company (FTC) – a bank and a provider of communications services – "Model of operation of comprehensive business process integration".

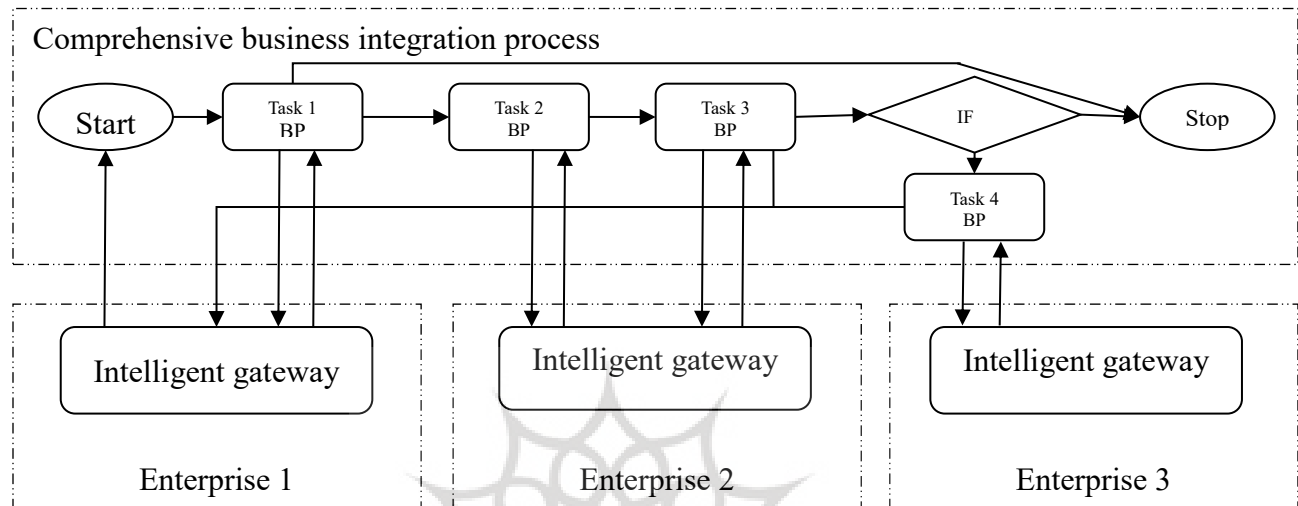


Fig. 2. Model of operation of a comprehensive business integration process

Source: created by the authors.

In this case, the bank acts as an integration link between the client using the FTC (terminal, payment portal, mobile application) interfaces and the communication service provider.

Based on the business process map in the software complex from Software AG Designer, we built a model of comprehensive business process integration model of business process optimization for integration of economic entities (Fig. 3).

The Business Process Model contains three Pools that are associated with the three enterprises involved in the Integration Business Model. In order to achieve the goal (replenishment of the client's personal account with cash), the business process combines a set of tasks that are performed at three enterprises consecutively. For the sake of clarity and reliability, we consider tasks that look like software micro services that provide a more regulated flow of all operations without errors that could be performed by a particular performer, including the so-called "human factor".

Each enterprise has its own specific ERP-system, which solves the problem of automation of its narrow branch functions. In this paper, we do not raise the issue of detailed consideration of information systems, we designate directions, technologies and tools for integration of these systems. In this example, we propose to apply the principle of multi-loop information flows



(Maksimov et al., 2018) with the addition of a new entrant into the IT landscape - the Intelligent Gateway, which is based on open systems principles, which provides maximum adaptability and maximum security.

With its open source software interface, the Intelligent Gateway provides seamless integration with any modern ERP system. Thus, CBIP, using modern approaches to integrating heterogeneous information systems, creates an efficient, adaptable and secure IT infrastructure of the integrated facility.

The key features of this approach are:

- the presence of a single integrative data model, combining information from different sources and software applications;
- the only mechanism for access to information resources of AI physically located in different sources;
- availability of mechanisms to ensure the integrity and reliability of data at the level of enterprise integration system as a whole;
- rather short terms of implementation of new functions declared by the business;
- minimal financial and human costs of introducing new technologies;
- maximum flexibility and adaptability of information technologies for the needs of the core business.

This also raises the financial issue of integrating information flows of IO. Let's compare two options for integration - the technology of integrating ERP systems and the use of comprehensive business integration processes.

Considering the changes made to the monolithic ERP system, it is safe to state the cost and temporal characteristics, which will be quite large, since it is related to changes to specific functional units of the monolithic system. Also, after the changes, it is necessary to carry out comprehensive testing of all software, both involved in the adaptation project and not activated. These circumstances will greatly increase the cost of the work.

Adaptation of AI for the use of comprehensive business integration technology will change only those software blocks that directly change, providing low cost with high reliability of adaptation.

You can also focus on determining the cost of the most comprehensive business integration process. It will consist of the cost of resources involved in the execution of specific tasks. That is, the cost of resources such as manpower, raw materials, production funds, and the like, plus the time to complete specific tasks.

Using the economic data of specific integrated entities, you can calculate the resources needed and the cost to implement and integrate comprehensive business processes.

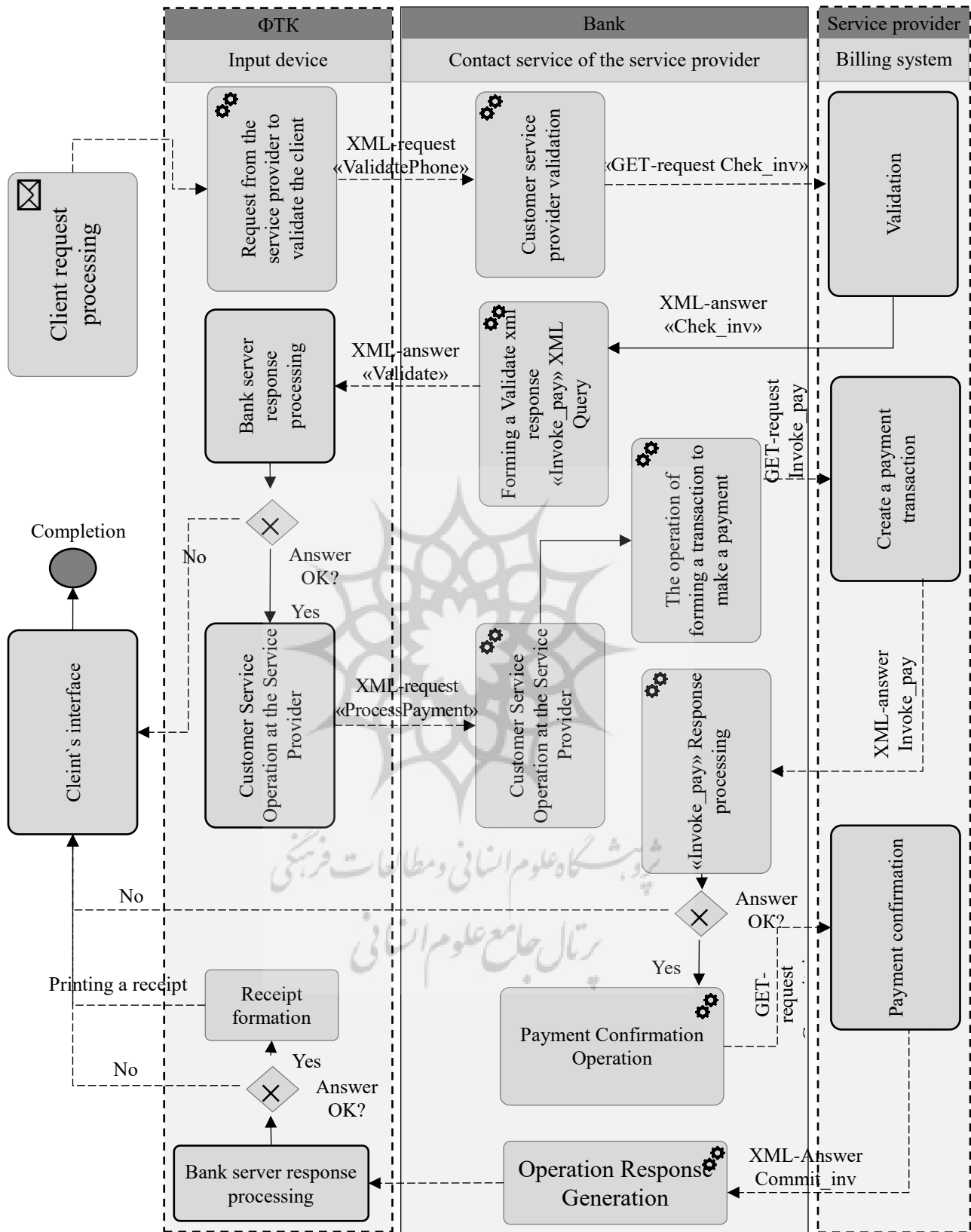


Fig. 3. Model of business process optimization in integration of business entities  
 Source: created by the author based on Software AG Designer.

## Conclusion

Based on the research, it is argued that a comprehensive business integration process is a sustainable, focused set of interrelated activities that, with the use of integration technologies, will transform production inputs into integration outputs that are of value to clients of integrated enterprises. In doing so, business processes are integrated into the business process, which performs not only the divisions of one enterprise participating in the integrated system, but also the tasks of related enterprises, with the use of continuous information flows. Such a comprehensive business integration process is considered for the integration of three enterprises: a financial-technological company, a bank and a communication service provider for the purpose of developing a process business card "Model of business process optimization in the integration of economic entities", on the basis of which the model is built. Comprehensive Business Process Integration Model "Business Process Optimization Model for Integration of Business Entities". The Business Process Model contains three Pools that are associated with the three enterprises involved in the Integration Business Model. In order to achieve this goal, the business process combines a set of tasks that are carried out in succession at three enterprises. In applying this concept, an efficient, adaptive and secure IT infrastructure of an integrated system is formed, the key features of which are the presence of a single integrative data model that integrates information from different sources and software applications; a single mechanism for accessing information resources of AI physically located in different sources; availability of mechanisms for ensuring data integrity and reliability at the level of enterprise integration system as a whole; quite short terms of implementation of new functions declared by business; minimal financial and human costs of implementing new technologies; maximum flexibility and adaptability of information technology for the needs of the core business.

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