COMPUTER SCIENCE

КОМП'ЮТЕРНІ НАУКИ

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CREATION OF AN IDEF0 FUNCTIONAL MODEL FOR THE INFORMATION SYSTEM OF THE INTERNATIONAL STUDENT YOUTH MEETING CENTER

Introduction

Project Goal and Rationale. The International Student Youth Meeting Center (IMC) is a unique, highly complex environment designed to foster cultural, educational, scientific, and innovative cooperation between student youth from Ukraine and the Republic of Poland. Managing such a multifaceted facility — which integrates accommodation, catering, modern scientific laboratories, virtual reality halls, and large-scale youth projects — is impossible without a robust, modern IT infrastructure. The lack of a unified, automated Management Information System (MIS) can lead to inefficiencies in resource allocation, communication breakdowns, and a reduced capacity to support joint start-ups and international dialogue.

The primary goal of this project is to justify the necessity of implementing advanced Information Systems and Technologies at the IMC and to develop a clear functional model of its business processes. By utilizing the IDEF0 methodology, this study maps the interactions between various center departments, demonstrating how an integrated software environment can optimize operations, ensure security, and support the center's core mission of facilitating international research and innovation projects.

IT Infrastructure and Core Processes. To design an effective Information System, it is crucial to understand and structure the core functional areas of the IMC. The facility operates not only as a research organization but also provides comprehensive accommodation and event services. Instead of viewing these as isolated hotel departments, the system architecture models them as interconnected data-processing nodes:

• administrative and financial modules: requires ERP (enterprise resource planning) solutions to manage HR, accounting, and compliance with national regulations;

• property management system (PMS) / front desk: the software module designed to perform room reservation functions must operate in real-time within a general reservation system. It handles guest registration, financial settlements, and tracks room availability dynamically;

• housekeeping and catering logistics: relies on inventory tracking algorithms and scheduling software to maintain facility standards and manage food and beverage operations, ensuring continuous supply chains without manual tracking;

• security integration: the IT system must synchronize with access control, video surveillance, and automated fire safety networks to ensure the safety of youth participants, especially during mass events;

• IT Service Core: the central backbone ensuring the operability of computer systems, local networks, telecommunications, and access to international educational databases.

The problems that will be solved as a result of the investment project implementation include:

• the lack of an active, stable dialogue between student youth from Ukraine and the Republic of Poland as a foundation for the stability of developing relations between the countries;

• the lack of awareness regarding opportunities for effective cooperation between students of both countries in developing educational activities in higher education within strategically important directions of Ukraine's development;

• the lack of awareness regarding opportunities for effective cooperation between student youth of both countries in undertaking and developing project-based, cultural, innovative, and research activities;

• the lack of practice in creating joint start-ups, implementing innovative ideas, and conducting joint research between students of both countries.

The activities of the International Student Youth Meeting Center aim to provide the following services:

• organization of international youth scientific and practical conferences, seminars, symposia, exhibitions, and forums;

• organization of thematic summer schools in the fields of history, politics, and culture (economic, political, customs);

• assistance in organizing various youth events for students from our country and other countries;

• organization of open lectures and seminars on history, politics, culture, and domestic studies for school and university students from Ukraine and other countries, especially EU countries;

• searching for and facilitating the establishment of new contacts to create partnerships between youth from different countries in the implementation of youth projects and programs;

• searching for sources of co-financing for socio-cultural, innovative projects, and youth exchange programs;

• organizational assistance for the stay of young people from other countries in Ukraine (at the IMC);

• maintaining tourist flows for the Bukovel tourist complex during the busiest periods (from December 1 to March 1) [1].

Business process analysis for IT integration

To analyze and reorganize these business processes for IT integration, the high-level CASE tool AllFusion Process Modeler (BPwin) was used, supporting the IDEF0 functional modeling methodology. The main advantages of this methodology are its simplicity, accuracy, and intuitive graphical representation of complex IT interactionsIn this project, the International Student Youth Meeting Center of Ukraine and Poland is considered a research organization. However, the Center provides the following services:
• provision of accommodation (rooms),
• room service,
• provision of food/catering,
• provision of conference rooms,
• provision of computer laboratories,
• organization of leisure and recreation,
• organization of the enterprise's accounting and financial work,
• organization of the security service work in the hotel.

Hotel Services and Departments. Hotel services and departments can be classified according to various operating methods. According to one method, hotel services and departments are divided as follows:

• revenue centers: these are units that generate direct profit by directly selling services and goods to guests; they include rooms, restaurants, bars, and others;

• support centers: these include the economic department, accounting, planning department, personnel department (HR), engineering, and technical service; i.e., units that generate indirect profits.

A widely used method is the classification of hotel services into front of the house and back of the house, which is based on the degree of contact between employees of a given department and the customers. The reception and restaurant belong to the front of the house, while the kitchen and accounting belong to the back of the house. Employees of the latter group do not have direct contact

with customers. Training for employees of these two groups is conducted according to different programs, and their offices are clearly separated. Even their uniforms are different [2].

Administrative and Management Services. The administrative service is responsible for the organization and management of all services of the hotel complex. It resolves financial problems and personnel issues, creates appropriate working conditions for hotel staff, and monitors compliance with relevant standards and rules regarding occupational safety, fire safety, and environmental protection. Most often, this service includes: a secretary, financial service, personnel service, an ecologist, and fire safety inspectors.

Reception and Accommodation Service. The Reception and Accommodation Service (RAS) is called the "face of the hotel" because the first impression a guest receives of the hotel complex depends on this service. The service includes: administrators, receptionists, cashiers, doormen, porters, bellhops, and concierges. The main task of the RAS is to ensure the smooth operation of customer service from the hotel door to the room door. The main functions of the RAS include: meeting and greeting the guest; guest registration; processing settlement documents; primary calculations; luggage delivery and escorting the customer to the room; assistance in moving to the room; tracking and accounting for changes in the number of rooms.

The function of client registration and check-in is performed by the reception. An administrator, receptionist, and cashier, or a person performing these functions, work here. Currently, two basic principles of organizing the reception service work are common:

• the American principle: based on the interchangeability of employees. If necessary, any employee can replace a colleague and perform their functions. This allows the registration process not to slow down in the absence of one of the employees;

• the European principle: based on a clear division of functions between employees and forbids the replacement of one employee by another [3].

Reservation Service. The customer service process begins with reservation, which means ordering places and rooms. Reservation functions are performed by hotel reservation managers or directly by the Reception and Accommodation Service. As a rule, a tourist or businessman who does not want to deal with the difficulties of renting temporary housing will necessarily contact such a service and submit a request for booking a place or room.

The software module designed to perform hotel room reservation functions operates in a "confirmation/rejection" mode regarding time within the general hotel chain reservation system or autonomous operation. The functions of the reservation service include:

• accepting applications and processing them;

• preparation of necessary documentation – arrival schedule for each day (week, month, quarter, year), room status charts;

• applications are accepted by phone, fax, mail, and using computer reservation systems.

Every order must contain the following information: date and time of arrival; approximate date and time of departure; number of guests:

• room category (suite, class);

• room amenities (bath, shower, TV, fridge, safe, mini-bar, etc.);

• catering services (breakfast only, half board, full board);

• price (when determining the price, it must be precisely specified what the guest pays for – for the entire stay, for one day, for each resident, accommodation only, accommodation and board, accommodation and breakfast, etc.);

• name and initials of the person paying the bill (or name of the organization);

• type of payment (cash, cashless, credit card);

• special requests (advance booking of a restaurant table, transfer, possibility of keeping an animal in the room, etc.).

The organization applying for the reservation also provides its details (name, address, telephone, fax, bank account number, etc.). In the event that the hotel can provide the requested accommodation services, the organization must receive a confirmation of the application.

Otherwise, it must send a refusal. Confirmation of the application is a special notification that the guest will receive accommodation at the hotel. The message usually contains the confirmation number, the date of the guest's expected arrival and departure, the category of the reserved room, the number of guests, the number of beds, and other specially agreed requirements. To clarify all accommodation details and exclude disputes, it is desirable for the guest to have the message upon arrival at the hotel.

Every reservation request and cancellation must be registered. If a cancelled order is not registered on time, there is a high probability that the room will remain unsold. One of the characteristics of the hotel product as a service is the inability to store it. If a room remains unsold, potential revenue from such a service is lost. In their operations, hotel companies often resort to guaranteed confirmation of applications. This means they confirm the reservation only after receiving appropriate payment guarantees from the client in case the client is late or does not arrive at all. Such guarantees are primarily a prepayment of 50 or 100% of the daily accommodation cost or accommodation for the entire period, as well as information about the client's credit card number [4].

Hotel Support and Housekeeping Service. The housekeeping service can be called the most important unit of the reception and accommodation service. It is the part of the hotel team that creates the atmosphere of hospitality in the hotel. This unit employs the maximum number of employees compared to other services (up to 50% of the staff). These employees service various premises (rooms, public areas, special purpose rooms: entertainment centers, fitness centers, etc.), ensuring appropriate sanitary and hygienic standards, and providing laundry and dry cleaning services. This unit may include a repair department, laundry, etc.

The head of the economic support service (Executive Housekeeper) reports to the General Manager or Chief Engineer. The manager is responsible for the effective work of their unit, i.e., teaching, ensuring motivation, and controlling employees. They must have appropriate training and be able to organize the unit's work, recruit staff, and control costs and orders. The deputy head develops the staff work schedule, prepares a report on the status of rooms, and is responsible for cleaning and the condition of the room fund [5].

Room Service (Room Attendants). The most important function of room service is maintaining the required level of comfort and sanitary conditions in hotel rooms, as well as in public spaces (halls, lobbies, arcades, corridors). The room operations service is led by a manager; subordinates, floor maids, supervisors, stewards, and some other categories of employees report to him.

Maids perform cleaning. This is their main duty. Rooms are cleaned regardless of whether they are occupied or vacant. Rooms are cleaned daily, and after a guest's departure – general (deep) cleaning is performed. Every day, the maid performs current and (if necessary) intermediate cleaning of rooms. When cleaning a room after a guest's departure, in addition to standard functions, the maid's duties include checking the room, changing bed linen and towels, and replacing information materials available in the room. General cleaning of rooms and the entire residential part of the hotel takes place at least once every 10 days. Depending on the type of hotel, each maid cleans and arranges from 16 to 20 rooms a day. The time spent on cleaning depends on the proportion of vacant and occupied rooms (cleaning vacated rooms takes more time).

If a suite consists of several rooms, the cleaning process always starts in the bedroom, then continues in the living room and other rooms. Work ends with cleaning the bathroom. Daily intermediate cleaning in rooms is done if necessary and if conditions for cleaning exist. When cleaning a room after a guest's departure, additional functions of the maid include: checking the room, changing bed linen and towels, and replacing information available in the room [6].

Catering Services (Food and Beverage). This unit is an integral part of the hotel business because without a table there is no hospitality. Hotel restaurants represent not only the prestige and face of the hotel but also a main source of income (about one-third of the hotel complex's income). A hotel without a restaurant is just a "bed"; a person must first eat well and only then sleep. When organizing services in restaurants (cafes) of hotel complexes, the following meal plans are usually

offered: full board (three meals a day – breakfast, lunch, and dinner); half board (two meals a day – breakfast plus lunch or dinner); breakfast only (one meal).

Security Service. The security service ensures the maintenance of order and the safety of hotel customers. In recent years, the problem of security has become very relevant, especially in the hospitality industry. International conflicts, the wave of crime and terrorism, illegal arms and explosives trade – all these factors can affect the safety of guests and hotel staff in all countries.

The hotel complex is characterized by threats of a natural, man-made, and environmental nature, as well as terrorism and crime. Currently, the most dangerous is the threat of a terrorist act, which can lead to a large number of victims, creating an atmosphere of fear, disrupting the normal functioning of the hotel, and causing the loss of the positive tourist image of the hotel or the region as a whole. Particular attention should be paid to the professionalism of security personnel, as well as technical security measures on site. To have a constant influx of tourists and run a successful business, it is necessary to improve the hotel's security system, i.e., regularly carry out a range of organizational, methodological, technical, and other activities that ensure the hotel's full autonomy in solving security problems, including terrorist threats.

The daily work of security officers includes a thorough inspection of the protected area (every 2 hours), constant contact with all regular services of the hotel complex, exchange of information about suspicious persons and objects, etc. It is also important to establish active cooperation with territorial law enforcement agencies. When conducting mass events, an inspection of the premises by a cynologist with a dog trained to search for explosives is necessarily carried out.

It is necessary to constantly improve technical security means. It is desirable that video surveillance be organized in the central lobby as well as on the hotel floors. Instructions regarding fire safety measures should be developed. All employees should be allowed to work only after passing fire safety training (which is marked by their signature in a special log). Equipped smoking areas, the procedure for disconnecting electrical appliances, people evacuation plans, fire alarm systems, etc. – all these are elements of the fire safety system. It is also necessary to know the features of fire safety in facilities with a large number of people. In particular, 50 or more people cannot be at one emergency exit at the same time. It is forbidden to block escape routes and exits.

Instructions on how to act on duty when receiving a fire signal and failure of fire automation systems should be placed in the hotel control rooms. Recently, requirements have been introduced for the installation of thermal sensors reacting to temperature increase (up to 30-35 °C) and smoke. Any kind of production and storage rooms containing explosives and flammable materials can be organized in hotel rooms. All hotel customers must know the fire regulations. The security system in the hotel will be effective only if all employees take part in this work, and the specific features of the enterprise are taken into account [7].

IT Service. The IT service ensures the operability of computer systems that support the work of all hotel departments, including reception and accommodation, catering, food and material storage, the business center, boutiques, accounting, the secretariat, the telephone exchange, the marketing department, etc. The IT service typically deals with the maintenance of the computer system that ensures the operation of the hotel's engineering and technological equipment. It should be noted that modern computer systems cover all points of sale and enable immediate settlement for the client upon their departure from the hotel. The hotel's computer network should have access to other computer systems, including international ones for hotel reservations, transport, excursions, theater tickets, etc. Currently, the computer system serves as an operational form of telecommunication for the hotel's internal operations and interaction with the external environment [8].

Creation of an IDEF0 functional model for the information system

To analyze and reorganize business processes, the high-level CASE tool AllFusion Process Modeler (BPwin) was used, which supports the following methodologies:
• IDEF0 (functional model);

- DFD (Data Flow Diagram);
- IDEF3 (Workflow Diagram).

AS-IS Model. IDEF0 Diagram. The functional model aims to describe the existing business processes within the enterprise (the so-called AS-IS Model) as well as the ideal state—the target to be achieved (the TO-BE Model). The main advantages of this methodology are its simplicity, accuracy, and intuitive graphical representation. In IDEF0, the modeled system is represented as a set of interdependent activities (tasks or functions) that interact with the environment as a whole. A model in IDEF0 notation is a system of hierarchically organized and interconnected diagrams, comprising a context diagram and child (decomposition) diagrams at various levels. The context diagram provides a general description of the system and its links to the external environment; child diagrams describe fragments of the system (from general to specific).

The process of providing IMC services is quite diverse, encompassing a set of basic accommodation and catering services for guests staying at the hotel, as well as various additional services, such as modern projects, leisure, and recreation. The scope of additional services depends on the specifics of the projects to be implemented at the IMC, its own conceptual approach to service provision, and the requirements established by the Vasyl Stefanyk Precarpathian National University. Local conditions allow for organizing activities on the outskirts of the center, and the available infrastructure facilitates travel and hiking in the high mountains, as Ukraine's largest mountain ranges, the Gorgany and the Chornohora ridge, are located nearby.

Today, basic services include hotel security, which satisfies a crucial guest need: peace of mind and safety regarding both their person and their belongings. Hotel operations, like those of any company, are impossible without well-established accounting and financial work. At the same time, for the operation of a hotel enterprise to be stable under market conditions, its results must be competitive; therefore, market research activities regarding hotel services are essential.

Building the information system model begins with a description of the enterprise's (system's) functioning as a whole in the form of a context diagram. The activities of the IMC are regulated by a range of legislative, executive, regulatory, statutory, organizational, and methodological documentation, as well as the Statute of the Vasyl Stefanyk Precarpathian National University. The following are used as controls for the "Provision of IMC Services" process (Fig. 1) (control arrows):

1. Legislative and executive regulations of Ukraine (legislation, standards, and rules applicable to the country's tourism industry);

2. Orders and regulations of administrative bodies reflecting the regional specifics of the hotel industry;

3. Standards of ethics, aesthetics, and psychology: IMC employees must adhere to the rules of ethics, aesthetics, and psychology when interacting with the center's clients;

4. Internal rules and methods of IMC work: specific to particular hotel services, the so-called corporate culture;

5. Orders and regulations of the Vasyl Stefanyk Precarpathian National University.

To carry out service activities, the following are necessary (process inputs):

1. Consumers (Clients): those wishing to stay at the hotel;

2. Payment methods for provided services, ensuring the profitability (profit) of the operation – the goal and essence of the activity;

3. Information on the service market, allowing for the maintenance of a specific level of service quality and operational improvement;

4. Logistics providers;

5. Ideas for project implementation.

Service activities in the hotel are realized by (process mechanisms):

1. Existing infrastructure (a set of facilities, premises, management systems, communications, etc., supporting the activity);

2. Materials and technical resources (technological equipment, furniture, bed linen, tablecloths, household and technical appliances, office equipment, etc.);

3. Personnel of various structural units (services) of the hotel;
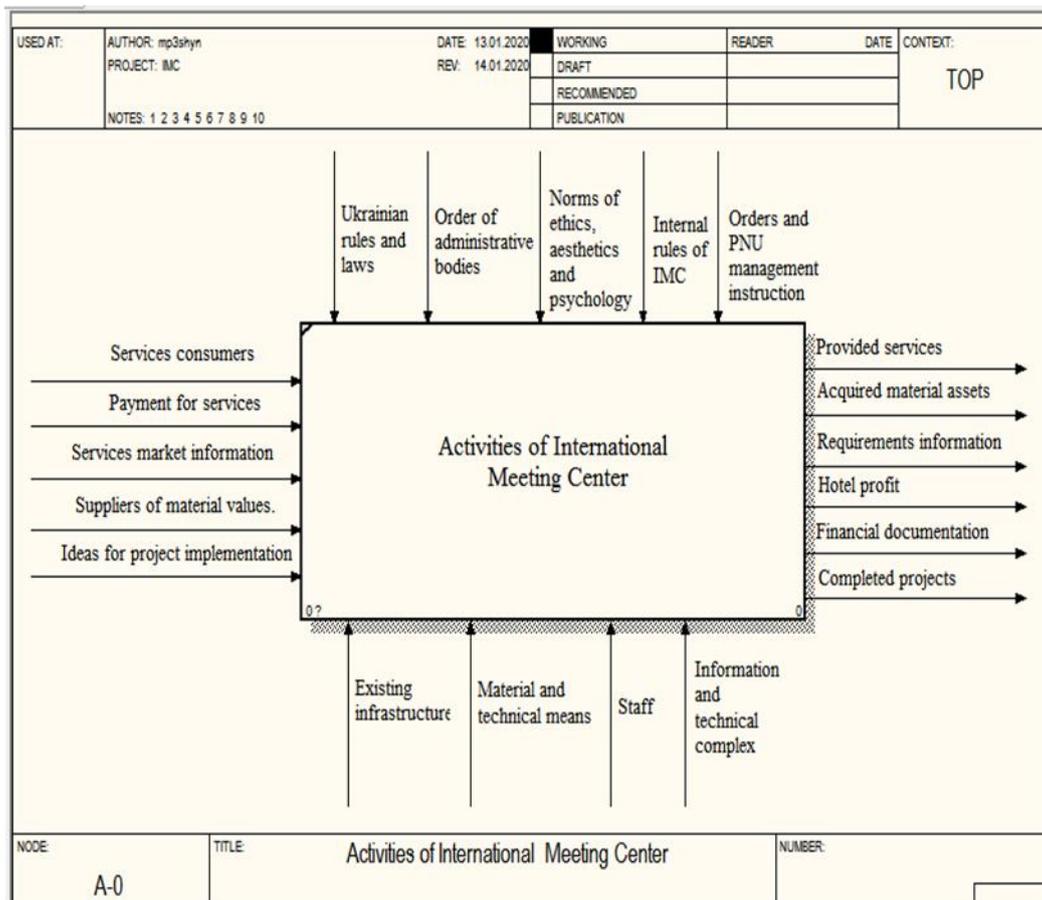4. Information-technical complex (computer labs, electronic library).

Fig. 1. IDEF0 Context Diagram. Functioning of the IMC

In this case, the results or outputs of the process of providing hotel services at the IMC will be:
1. Provided services;
2. Acquired material assets;
3. Information on consumer and market requirements regarding hotel services;
4. Hotel income (Profit);
5. Financial documentation (invoices);
6. Implemented projects.

Fig. 2 presents the A0 decomposition diagram covering the same modeling domain. In this diagram, each function is represented by corresponding rectangular blocks arranged in order of priority (from the top-left corner to the bottom-right corner). Each block (performed function) possesses appropriate interfaces, consisting of boundary elements presented in the context diagram and internal arrows connecting specific functions. As can be observed, functions (blocks) 1, 2, and 3 are interconnected; that is, the output of the previous function feeds into the subsequent function. Functions (blocks) 4-7 are independent of blocks 1-3; that is, they can be executed in an autonomous mode. At this stage, their inputs and outputs are described only by boundary arrows that separate the modeled object from the environment.

The input for the first block "Provide Rooms" (Fig. 3) is the "client's need for this service." As a result of executing this function, the client is assigned a room for which they pay; that is, they transition from the status of seeking accommodation to being settled in a specific hotel room. The execution of this function is carried out using the following mechanisms: personnel, material and technical resources, and available infrastructure.
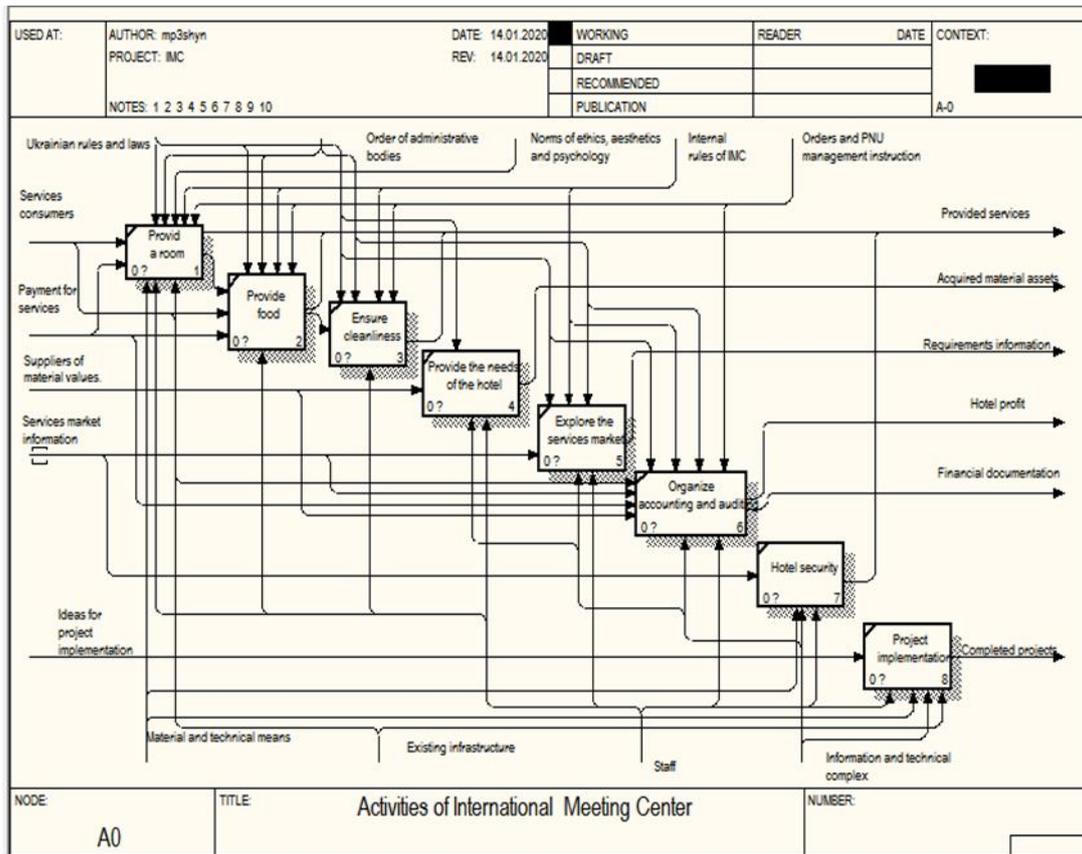
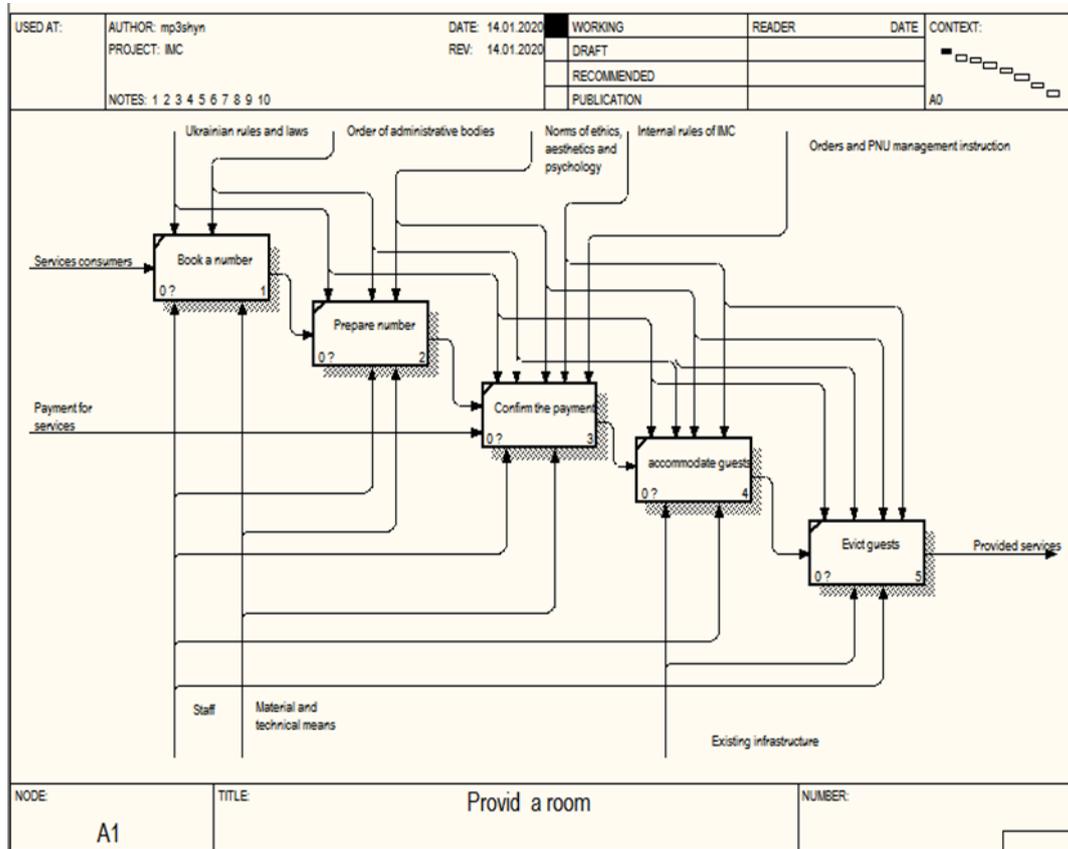Fig. 2. Extended diagram of the "Provision of Hotel Services" business process

Fig. 3. Extended diagram of the "Room Reservation" business process

A detailed description of the processing process is shown in Figure 3.

The room assignment process can be accomplished by performing the following activities:

1. Room reservation;
2. Room preparation;
3. Payment confirmation;
4. Guest settlement (Check-in);
5. Guest departure (Check-out);
6. The "Food Service Provision" process can be presented as the realization of five functions: 1 – "Purchase raw materials"; 2 – "Prepare the dish"; 3 – "Accept the order"; 4 – "Prepare the order"; 5 – "Accept payment";
7. All these processes are interconnected and carried out in the sequence shown in the diagram (Fig. 4), as the result of one process is necessary for the realization of the next (the output of the previous one is the input for the next).
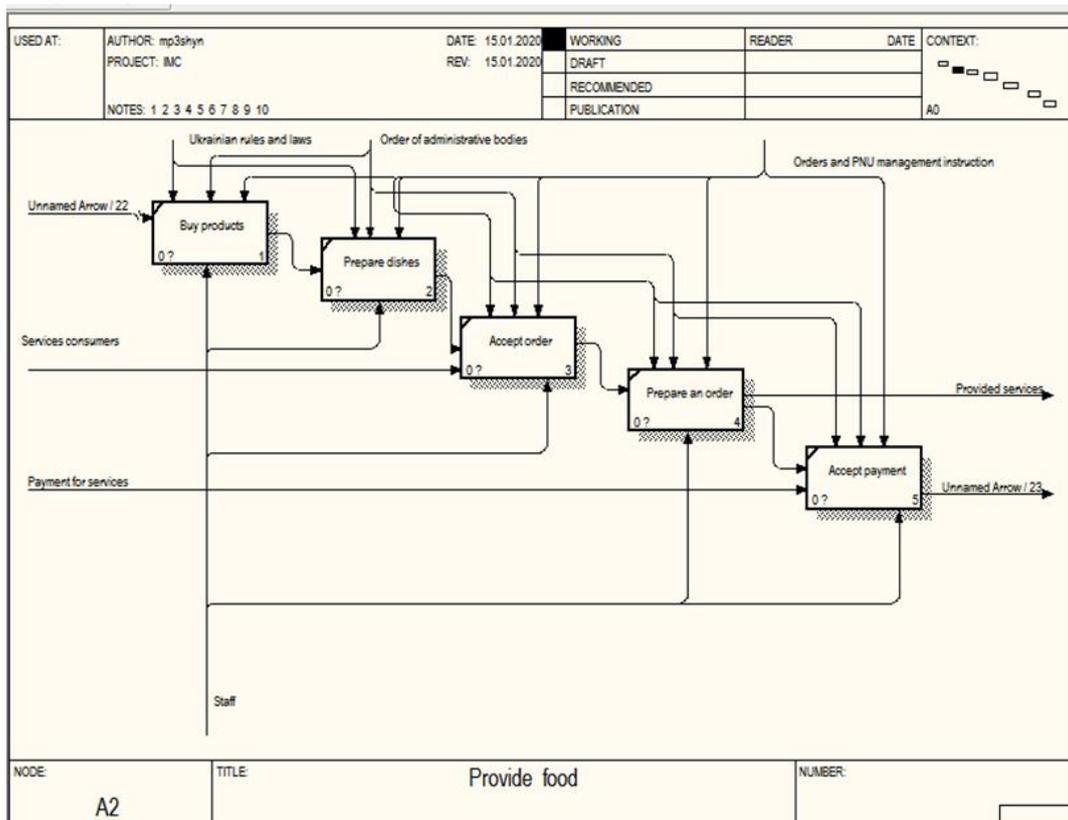

Fig. 4. Extended diagram of the "Food Service Provision" business process

Fig. 5 presents the child diagram of parent unit 3 (from diagram A0), the process "Maintaining Cleanliness of Premises." It includes three functional blocks:

1. Maintaining cleanliness in public areas – lobby, corridors, etc.;
2. Inside the premises – hotel rooms;
3. Maintaining order and cleanliness on the hotel complex grounds – access roads, parking, recreation zone, and other adjacent areas that require systematic cleaning of both debris left by tourists staying at the hotel and debris resulting from natural processes (fallen leaves, snow, etc.).

Cleaning of all facilities is carried out in accordance with the orders and instructions of the hotel management, regulations, methods, and recommendations developed in the hotel, and in compliance with ethics, aesthetics, and ergonomics.
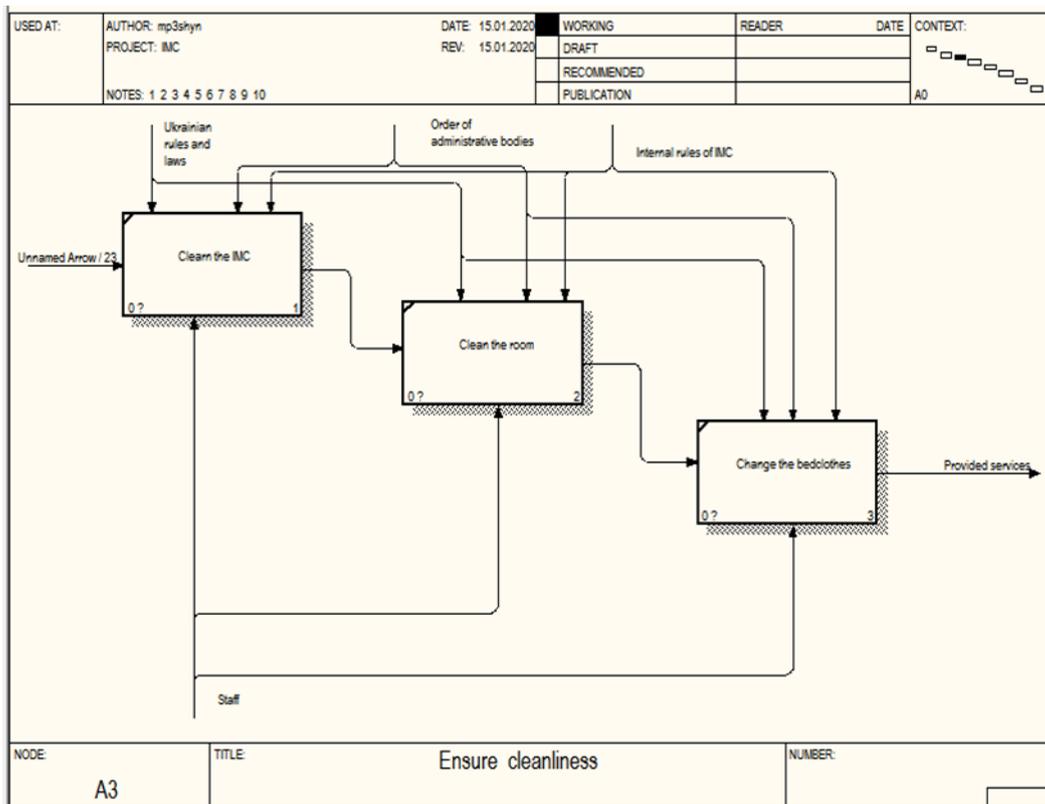
Fig. 5. Functional block diagram "Ensure Cleanliness"

Fig. 6 presents the child diagram of the fourth function of the business process (Fig. 2, diagram A0) – "Ensure Hotel Supplies" (Node A4).

This function is divided into four sub-functions:

1. "Check stock availability";
2. "Create a list of necessary goods and services";
3. "Pay bills for services and goods";
4. "Warehousing".

The function "Organize Accounting and Financial Work" (Fig. 7) in the hotel is performed by the accounting staff. The input to this function involves various types of payments for services provided, as well as purchased materials and technical assets. The result of successful activity is income ensuring financial profit.

The function "Organize Hotel Security" (Fig. 8) is performed by the security service personnel. The inputs to the block are: the need to ensure the guest's peace of mind and the safety of their person and belongings, as well as the property and the entire accommodation infrastructure; and information on scientific and technological progress in this area of activity within the hotel services market. Of particular importance for the performance of this function as a control mechanism is the ethics of interaction with consumers, as was typical for functions 1-3, especially in emergency situations.

The last and most important function is "Project Implementation," since the main idea of the IMC is establishing contacts between the youth of neighboring countries. Therefore, information and technical support, namely 2 modern computer laboratories, an electronic library, and virtual reality halls, provide the opportunity to implement various interesting international youth projects: sports competitions, e-sports championships, etc.
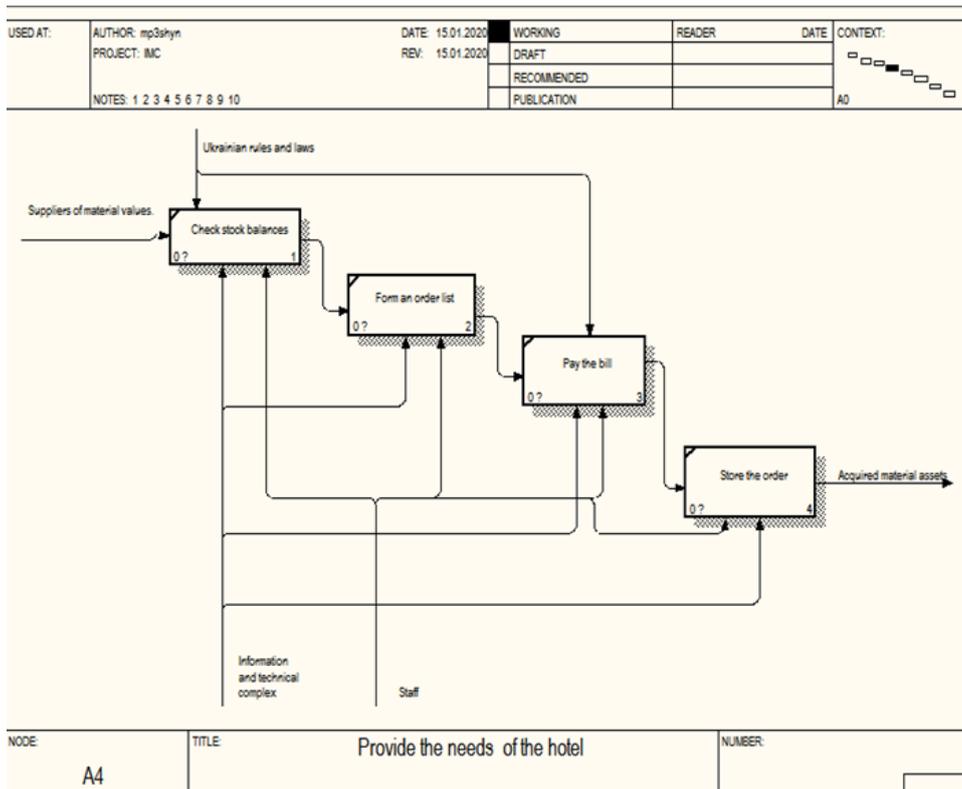
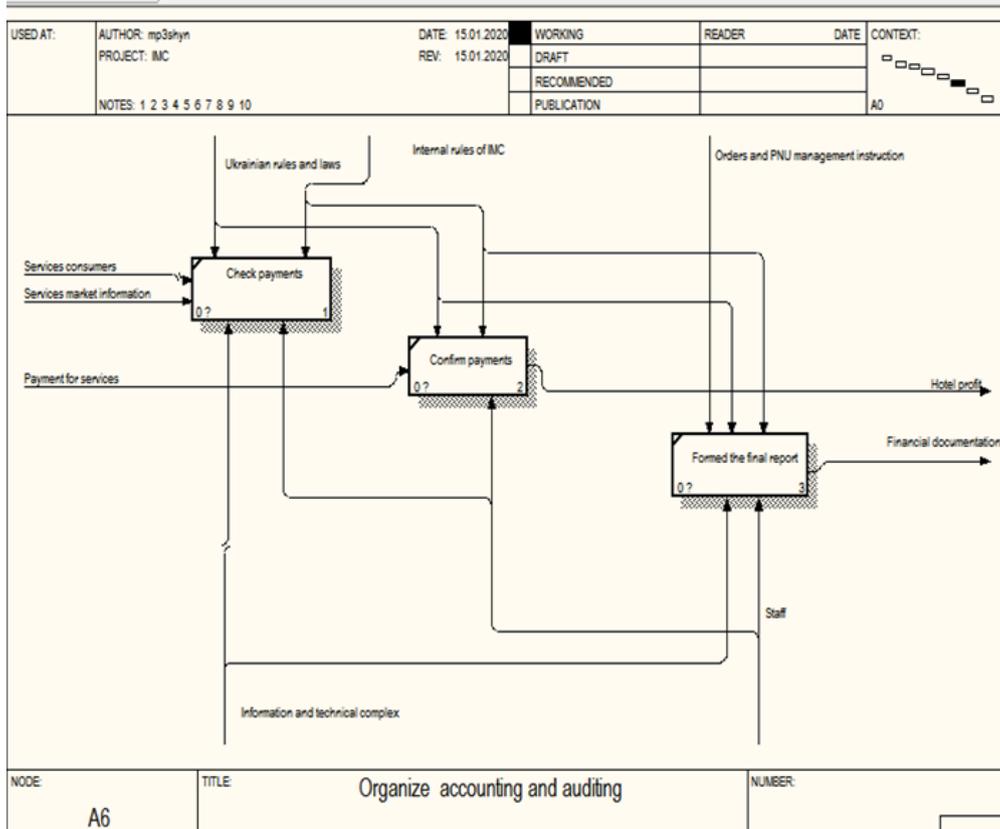Fig. 6. Functional block diagram "Ensure Hotel Supply Delivery"

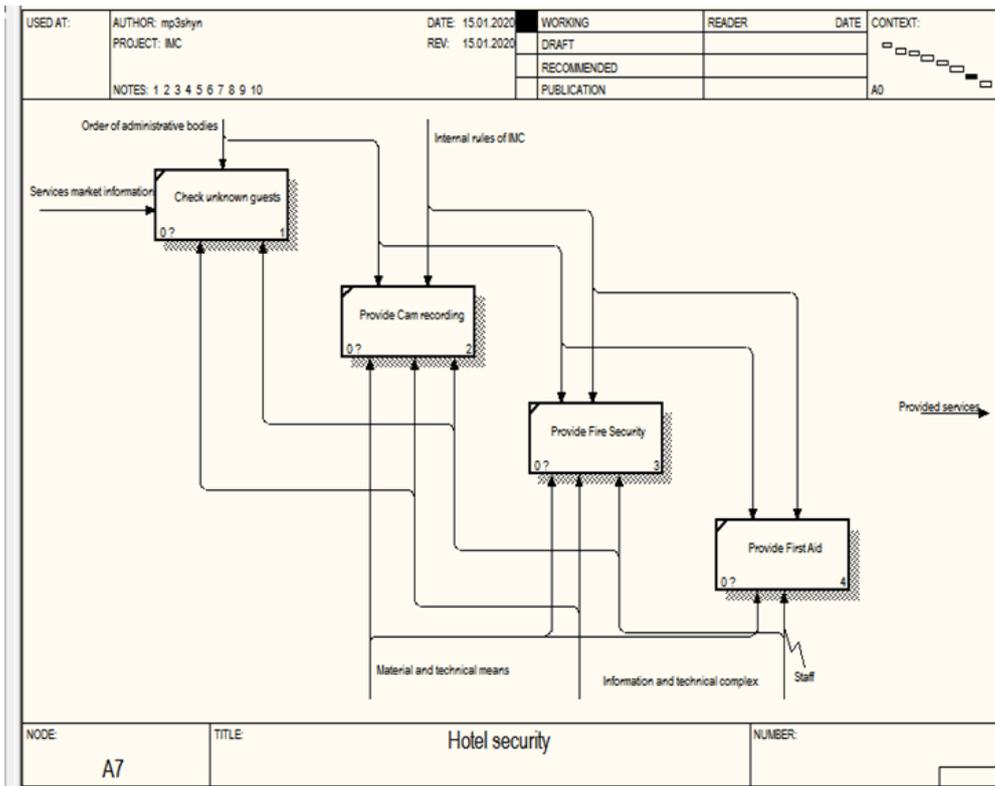Fig. 7. Functional block diagram of Accounting and Audit

Fig. 8. Functional block diagram of Hotel Security

Conclusions

The study presented the conceptual framework and functional modeling of the International Student Youth Meeting Center (IMC), a strategic project designed to strengthen cooperation between the youth of Ukraine and the Republic of Poland. The IMC is not merely a hospitality facility but a multifunctional environment fostering educational, cultural, and innovative development.

The application of the IDEF0 methodology allowed for a detailed analysis of the center's business processes. By decomposing the system into key functional blocks—ranging from standard hotel operations (accommodation, catering, housekeeping) to complex administrative and security functions – we established a clear structural model for the center's management. The distinction between front-of-house and back-of-house operations, along with the detailed mapping of inputs, outputs, controls, and mechanisms, provides a solid foundation for the efficient organization of the enterprise.

A critical component of the IMC highlighted in the model is the "Project Implementation" function. Unlike standard hotel complexes, the IMC integrates advanced IT infrastructure, including computer laboratories and virtual reality halls. These facilities are essential for the center's core mission: facilitating international youth projects, startups, and e-sports competitions.

In summary, the creation of the IMC, supported by a robust information system and clearly defined business processes, will significantly contribute to:

1. cross-border integration: establishing a stable dialogue between Ukrainian and Polish students;

2. regional development: supporting the tourism potential of the Bukovel region during peak and off-peak seasons;

3. innovation and Education: providing the technical resources necessary for modern scientific and creative collaboration.

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