A FRAMEWORK FOR DESIGNING PHARMACEUTICAL MANAGEMENT INFORMATION SYSTEM

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Abstract: Today, the increasing growth of science and technology in the field of software engineering and information technology has improved the performance of information systems. The health management information system consists of several subsystems, including the Pharmaceutical Management Information System, laboratory information system, Nursing Information System. In information systems, the collected information is irregular and random, and the collected data are incomplete and not properly analysed. Therefore, there is a need for a comprehensive information system. The aim of this research is to propose a framework for designing Pharmaceutical Information System, which has been applied in a real case study. The UML technique as a most used modelling language, is used to design the current management information system. The proposed framework provides a structure, the introduction of components, defined layers and each layer connection with diagrams, designed to improve Pharmaceutical management information system and with regard to the goals of the system. The proposed framework has been developed to improve the design of processes, identify the flow of data and consider the system's comprehensiveness.

Key words: Health Information System, Framework, Pharmaceutical System, Modelling.

1. INTRODUCTION

Today, in all areas of human knowledge, the impact of informatics and information technology can be seen. Healthcare structure due to its complexity, the massive amount of information generated, information management and organizational changes of this technology is not needed. The Hospital Management Information System (HMIS) is a tool for managing the correct, easy and improved performance of the health system [1, 2].

An information system is a set of interdependent elements that collects information, processes, stores and distributes information in a company or organization, and provides the information needed by managers to plan, control and direct the organization [3]. There are various information systems that have been created based on the needs of the organization [4].

Health Management Information System consists of several components, including: clinical information system, financial information system, laboratory information system, Nursing Information System, Pharmaceutical Information System, Communication and

Archiving System. The reasons for creating a management information system are: the collected information in health centres is irregular and random; and the collected data are incomplete and not properly analysed. In this paper, the Pharmaceutical management information systems has been selected. The pharmacy information system is a system that collects, stores and manages information related to medication and drug use in the patient care process [5]. The pharmacy information system is responsible the follow-up process and distribution of drug in the pharmacy management information system and other healthcare organizations [6]. This information system is one of the most widely used systems in relation to clinical information systems [7]. The aim of this research is to propose a framework for designing Pharmaceutical Information System. The framework is applied in a real case study (Vali Asr Hospital in Arak, Iran).

The rest of the paper is organized as follows: section 2 provides an overview of frameworks for designing information systems. In section 3, the research method is described. Section 4 represents the proposed framework which has been applied in the case study. For the validation of the proposed framework, it's compared with existing frameworks in section 5. A concluding discussion and review of the contributions and limitations of the study are presented in Section 6.

2. BACKGROUND AND RELATED WORK

2.1. Enterprise information system framework

The framework is composed of five sections including Project Phase, Phase of values, Benefits (structural basis), Benefits (understanding the values), and Costs. This framework is intended to understand the values of enterprise information systems in development – Figure 1 [8].

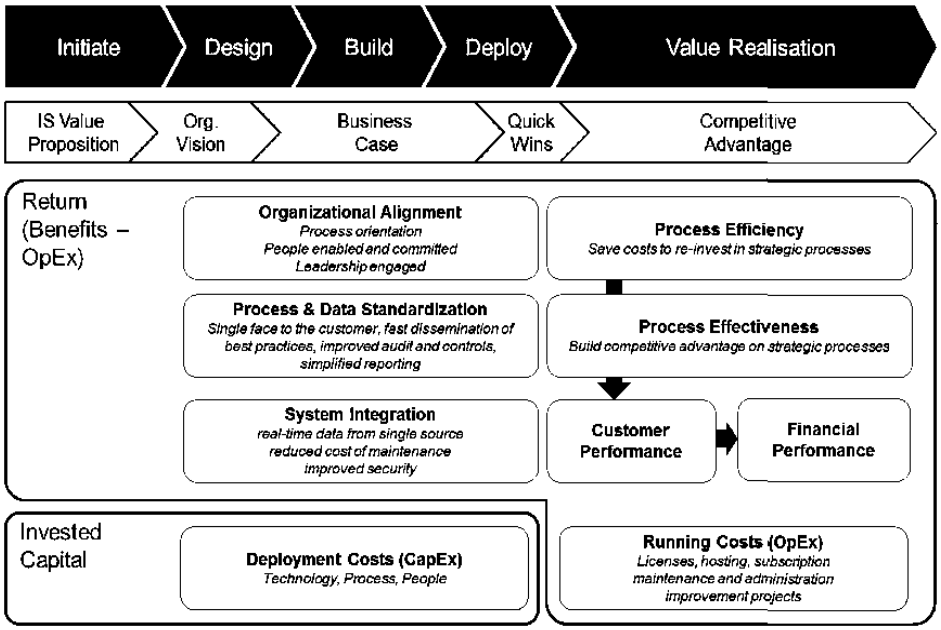

Figure 1. Organizational Information System Framework [8]

2.2. Information system framework

This part has been mentioned the overall information system. The structure of a cognitive framework to enhance the development and management of processes for an information system is examined. The framework is shown in Figure 2 [9].

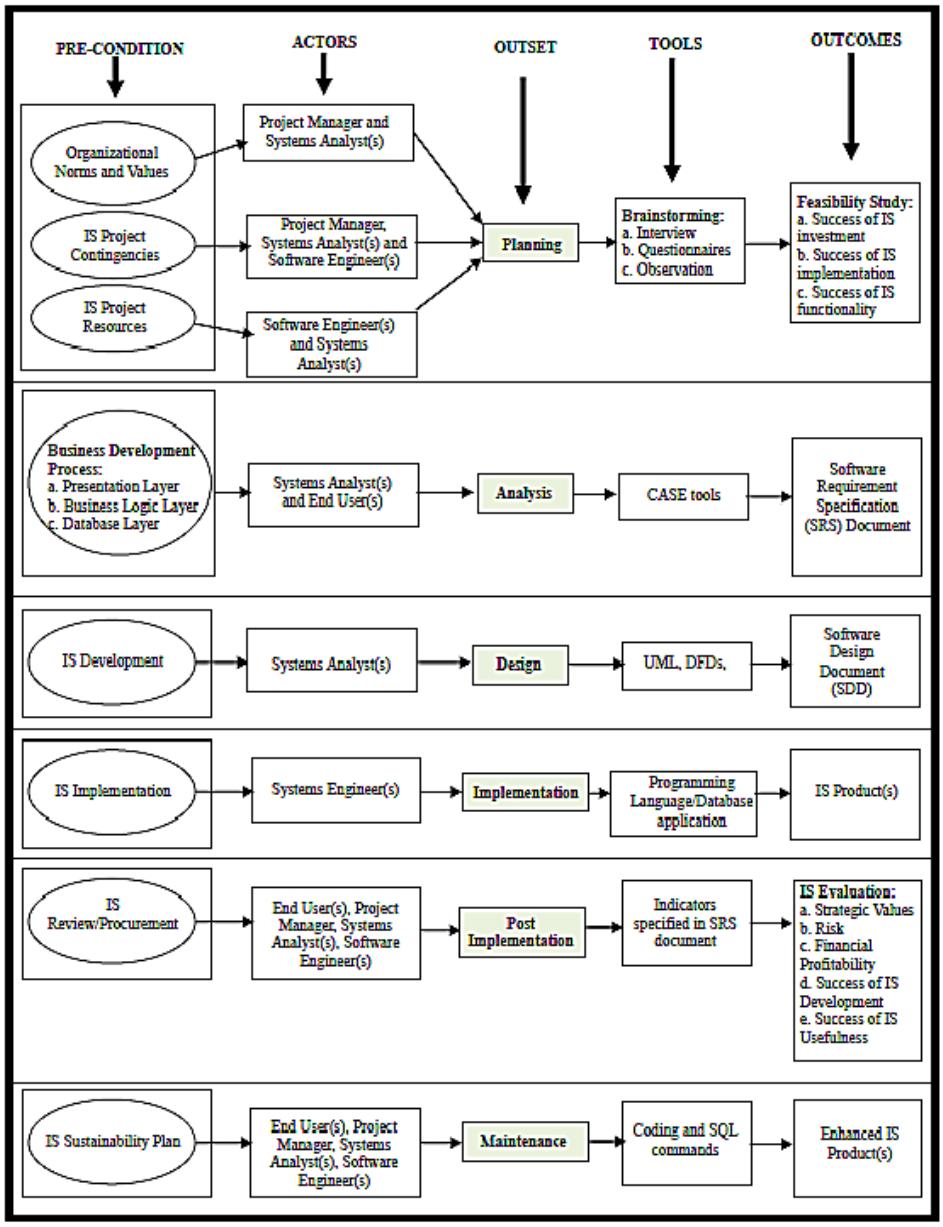

Figure 2. An administrative framework for enhancing process development [9]

2.3. Existing frameworks for health information system

2.3.1. Organizational structure framework. This framework provides a structure for better management and development of the medical knowledge process in medical research. An organizational structure based on a health system shows the interaction of components for strategic implementation in a comprehensive perspective [12]. The framework for developing and evaluating a comprehensive health system is shown in Figure 3 [10].

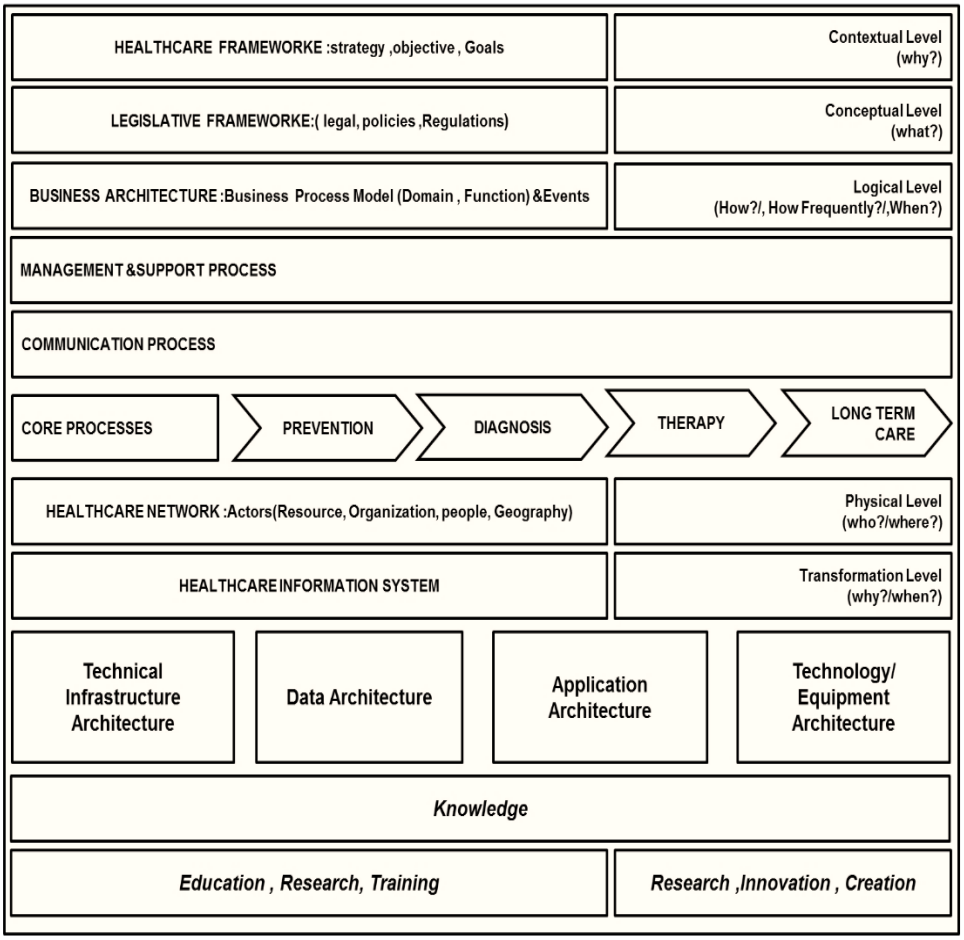

Figure 3. Healthcare system framework [10]

2.3.2. Framework for a coherent structure for the development of health information systems. The main idea for the structure of this framework is to create a coherent and consistent structure for the development and development of health information systems. This structure provides easy communication, access, and sharing of medical information. In Figure 4, you can see the framework components [11]. The Framework Components include Main staff, Personal Digital Assistant, Web Portal, Adopted Agent, Local Data, P2P network, Share Hospital Data base, User Profile, Access Control Layer [11].

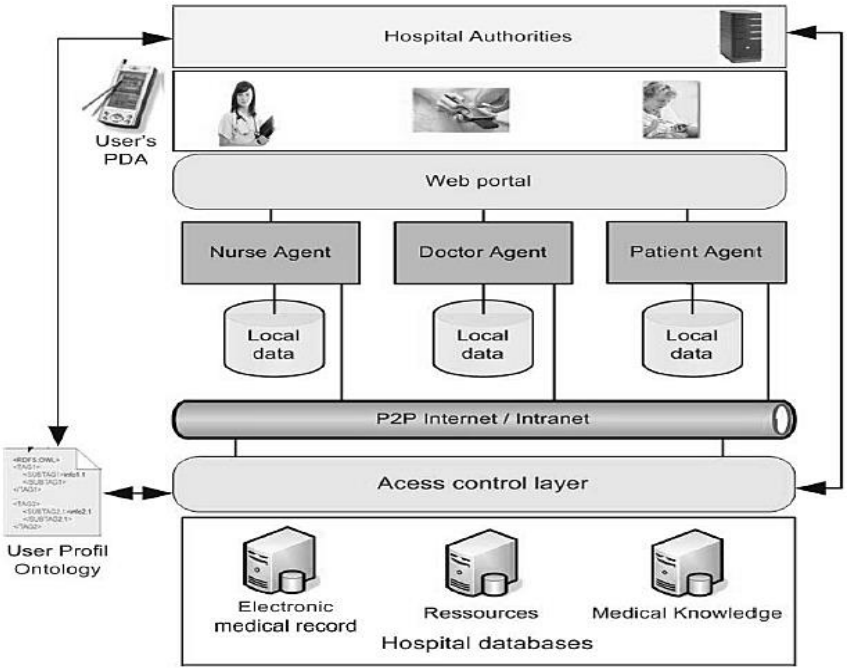

Figure 4. Complete structure of the framework for the development of the healthcare system [11]

2.3.3. Health Information System Framework. In health information systems, patient and employee data is processed to provide the necessary information. On the other hand, the information must be sorted and organized in an organized structure for managers to make necessary decisions or develop the system [12]. The health information management system also includes the components and management functions as follows [12]: System components include: data collection, data transfer, data processing, data analysis, information for planning and management.

Management in the health care system can be classified into three management functions [12]: patient and user management function, Health unit management function, Health system management function.

3. RESEARCH METHODOLOGY

In this research after reviewing the existing frameworks for optimizing the management of pharmaceutical information system, a framework has been proposed, which has been applied in a real case study. We design a management information system based on the proposed framework using the UML technique in the Rational Rose environment. The drug section consists of three parts .include: Outpatient pharmacy, Inpatient pharmacy, Pharmacy warehouse. In this research, we design the Use Case Diagram, Activity Diagram, Class Diagram and Sequence Diagram according to the proposed framework for the Pharmacy warehouse. According to the studies done in the diagrams of UML, the four diagrams are mentioned more important than the other diagrams [13, 14, 15].

4. INTRODUCTING THE PROPOSED FRAMEWORK

4.1. Elements of the proposed framework

The proposed framework is defined for the six components includes faceplates components, data collection, data flow component, process component, the component entities (objects), component output, component data interpretation. Each of the components is related to the layers of the framework, we will continue to examine each of the components.

- Component data collection: This component is intended to collect data and obtain the necessary information for analysing the system. This is the first layer, the layer defined data. Data input includes prescription patients (personal information, insurance, prescribed medication) data from pharmacy staff and warehouse staff, medications and medical equipment to be provided to the pharmacy and the medication and equipment requested by the sections to be distributed.
- Data flow component: This component is defined to identify the overall process of the system, the flow of processes, and the interaction between processes. Includes the association of the pharmacy with the warehouse and all departments to receive and send medicines and medical equipment. After identifying the system and obtaining the required information from the system analyse. This component is in the second and third layers, describes the layer and process layer.
- Process component: Once the overview of the system has been achieved, it is time to identify the system more precisely, to examine the processes, the order and the relationship between them. This component is defined to identify the processes, interactions and the order of their implementation, this component is in the third layer (process layer).
- The entity of object (object): After identifying the flow of data and processes, it is time to identify the objects. The entity of the object is for the fourth, fifth, and sixth layers.
- Output information component: The input data is logged by the staff. The data is processed and the output information is generated. The data is processed and the output information is generated. This component determines which function (including the flow of input data) by whom and what date was conducted. Output information is provided to web users. The output information component is defined for this purpose and is located in the transfer layer.
- The component of information interpretation: With the information we can monitor, evaluate, organize and manage the system. Information obtained from each unit of the drug system, including the outpatient pharmacy, hospital pharmacy and drug warehouse, are examined separately. After identifying the systems, processes, entities, classes and their interactions take turns interpreting the information. These are defined in the Comment Interpretation Component. This information is available to managers, doctors, and other people to make the necessary decisions.

The proposed framework also consider the following objectives: a general view of the system, the flow of data as well as the process, and entities.

4.2. Structure of the proposed framework

The proposed framework is designed to improve the design of the pharmaceutical management information system. Initially, for the proposed framework, a general view is

expressed, then the components for the framework are introduced. The proposed framework consists of seven layers consisting of data layer, description layer, process layer, entity layer, data warehouse layer, sequence of objects, transition layer. Four diagrams of the UML technique are proposed for designing a Pharmaceutical management information system. After defining the structure of the proposed framework, we describe the relationship between the layers and the diagrams for designing Pharmaceutical management information system.

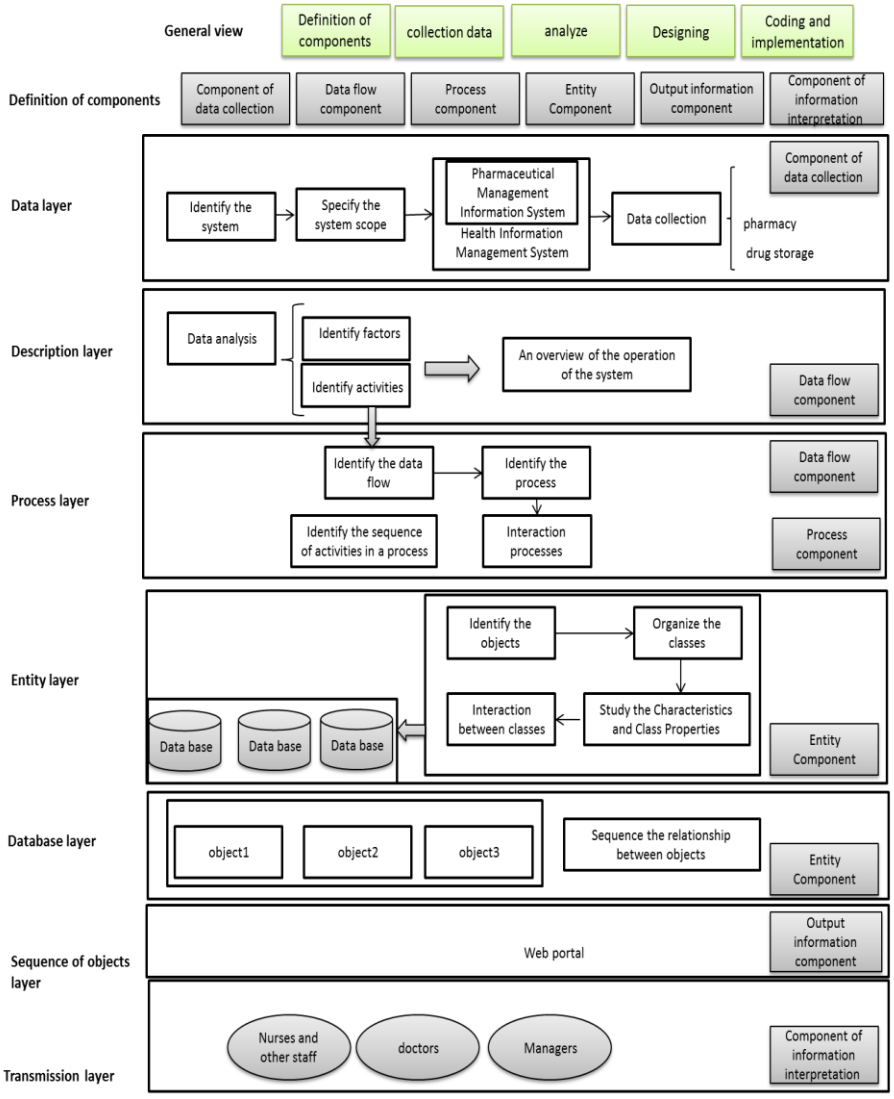

Figure 5. The proposed framework

Regarding Figure 5, "Description layer" describes the second layer of the proposed framework for analysing data. In this layer, by identifying factors and activities and obtaining

a general view of the system, it can be linked from the diagrams of the UML to use case. The "process layer", the third layer of the proposed framework, is associated with the Activity Diagram, by identifying the data stream and the sequence of the processes and the interaction of the processes. The fourth layer "Entity layer" identifies the objects in the system after identifying the data stream, processes, interaction, and process sequences. Places objects in the same property in the same class. The entity layer is associated with the Class Diagram. The fifth layer of the proposed framework (Object Sequence Layer) represents the order of the sequence of objects and is related to the UML diagrams with the Sequence of the diagram.

4.3. The framework layers

- Data layer: In this layer, we identify the information system that we are looking for, and specify the system's scope. From Health Information Management, we choose Pharmaceutical management information system for the importance of this system and is associated with all parts of the hospital. In this layer, we collect the required data from the Pharmaceutical Management Information System, which consists of three sections of outpatient pharmacy, hospital pharmacy and drug warehouse. The purpose of this section is to identify the system's needs, goals, and constraints, and provide the only function of the system.
- Description layer: Once the required data is collected, it is time to analyse the data. Identify the actions and activities of the system so that we can achieve a general view of the system. In this layer, the behaviour of the system is a reflection of the subject's identity of the person. This layer contains the component of the flow of data. The description layer is related to the use case diagram.
- Process Layer: In the earlier level of the system, we were able to identify a general view of the information system. In this layer, we examine the system more precisely. We identify the data flow that involves processes, interactions between them, and the sequence of activities in a process. This layer includes the flow and process components. This layer is related to the Activity Diagram for the design of the second diagram of the Pharmaceutical Management Information System.
- Entity layer and data warehouse: After identifying the flow of data and processes, entities are examined. The objects of the system are identified. We put a bunch of objects that have the same properties in a class. Then we put the relationship between the classes. The collected data should be stored in the data warehouse to provide information for users. This layer contains the entity (object). The entity layer is defined by the proposed framework for class diagram design.
- Object Sequence Layer: In the previous step, the entities were identified and classified according to their characteristics. But each object in the information system is arranged to communicate with other objects. This layer defines the relationship between objects. This layer contains the entity (object). Sequence of object layer with Sequence Diagram (fourth diagram) is related to the design of the pharmaceutical management information system. Entities communicate with each other by sending messages. The order and message sending time is important, which is implemented by the intended diagram.
- Transmission layer: After modifying the system, it can be implemented by programming languages to enter or call information through the web pages of the

system. Employees, including doctors, administrators, and other employees by the web portal, can view or log in to their system. But it is important that control access to data. This layer contains the output information component and the component of the information interpretation.

4.4. Structure of the proposed Framework

The structure of the proposed framework can be described in a five-step process including Identifying and collect data, Interaction and communication of the drug unit (interaction of entities), Identifying and reviewing data flow (process identification), adaptation, and Collecting, storing and managing table information. In Table 1, each step is described with regard to the aspects, components, or functions of an organization.

Table 1. Organized Structure of Pharmaceutical Management Information System

Levels	***Aspects***	***Component***	***Management function***
Identify and collect data	*-Patient, staff, medicine (entities)*	*-Input data*	*- Pharmacy management* *- Warehouse management*
Interaction and communication of the drug unit (interaction of entities)	*- Relationship between the two pharmacies together* *- Relationship of pharmacies with drug store* *- Hospital pharmacy relationship with other departments* *- The pharmacy's connection to the fund*	*- Input data* *- Data stream* *- Output information*	*-Management department*
Identifying and reviewing data flow transfer (process identification)	*- Receive medicine from the warehouse* *- Receive medications from the sections* *- Drug delivery to all departments by the pharmacy*	*- Input data* *- Data stream*	*-Management department*
Adaptation	*- Co-ordination of the pharmacy with added or reduced part of the unit of treatment*	*- Interpreting information*	*-Management unit of health*
Collect, store and manage information	*-Data classification* *- save information* *- Accessibility to information by (administrators, technical pharmacist)*	*- Output information* *- Interpretation of information*	*-Management department* *-Management unit of health*

Regarding Table 1, the framework includes four management functions:

- Pharmacy management: This department includes management of inpatient and outpatient pharmacies. The director of the unit is monitoring daily activities.

- Warehouse management: warehouse manager supervises the processes of this department, including the arrival and departure of the drug.
- Management of the drug unit: The management of the drug unit is the responsibility of the pharmacy technician and includes the management of all three departments, outpatient pharmacy, inpatient pharmacy and drug store.
- Management of unit health: management and supervision of all affairs and units of the hospital.

4.5. Communication of proposed framework with diagrams

In this sub-section, four diagrams of the UML technique are implemented with the Rational Rose tool. Then, each diagram is linked with the layers of the proposed framework.

In first part, the use case diagram of the warehouse has been designed. This layer provides an overview of the system and identifies the agents and activities of the system. Use Case Diagram (Figure 6) also gives us an overview of the system. This diagram consists of the same agents as the Use Case cases. This diagram relate with description layer.

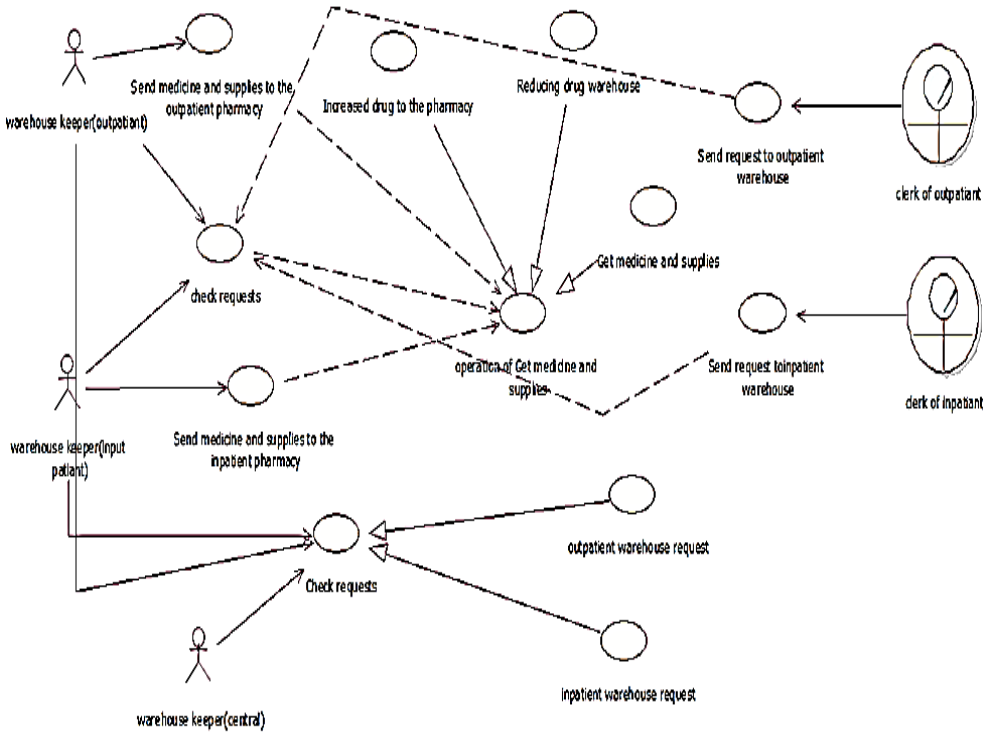

Figure 6. Use case diagram of warehouse

In second part, the Activity Diagram of the warehouse has been designed. The third layer of the proposed framework, the Description Layer related to Activity Diagram (Figure 7). The Activity Diagram is a Use Case Diagram, and is used to cover its weaknesses.

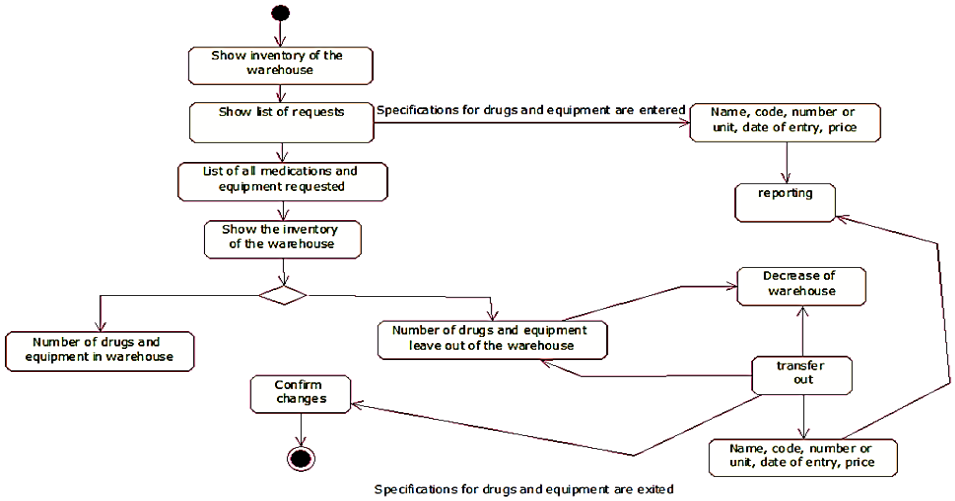

Figure 7. State diagram of warehouse

The fourth layer of the proposed framework is associated with the Class Diagram (Figure 8). After the processes are identified, it turns to identify the objects. The object of the system must identify and those having the same properties and attributes put into a category or class.

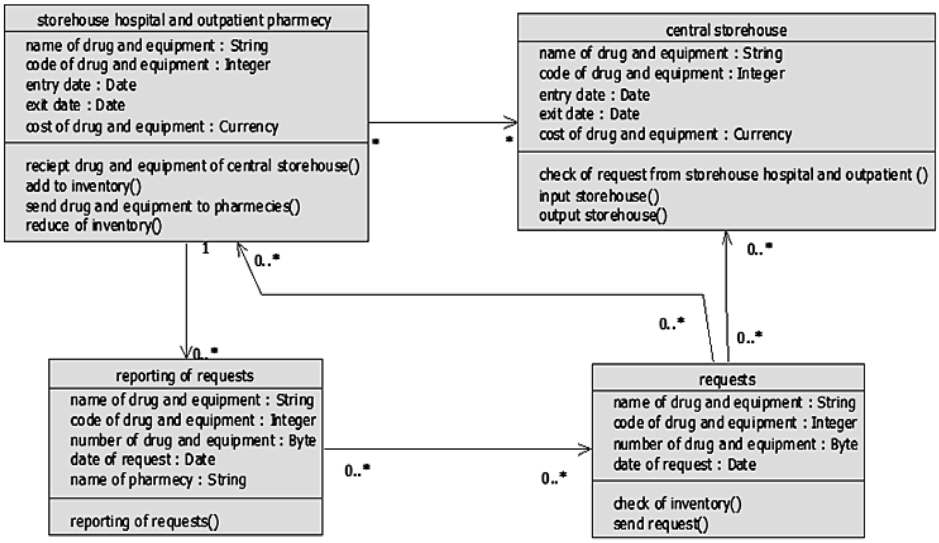

Figure 8. Class diagram of warehouse

The sixth layer of the proposed framework is the Sequence Diagram Sequence Object layer (Figure 9). After identifying the system and obtaining information from the processes, the flow of data, the entities, the interaction between them turns to identify the order of the sequence of objects.

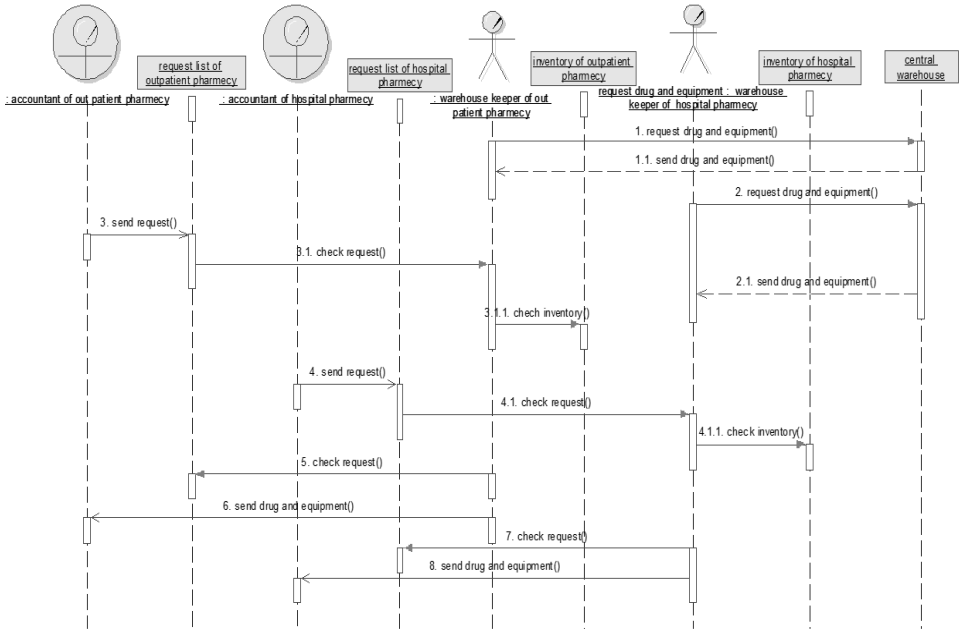

Figure 9. Sequence diagram of warehouse

5. COMPARE THE PROPOSED FRAMEWORK WITH EXISTING FRAMEWORKS

In this section, we describe the process of assessing the implementation of the health information management information system framework [16]. In the following, we review at the factors that are needed to assess the management process of the information management system framework. The factors for assessing health information systems include [16]:

- Technical factors include: complexity reporting, health information system design, software, the complexity of information technology.
- Organizational factors: Performance management and information requirements, monitoring, planning, training, quality, financial affairs, information usage, resource availability.
- Behavioural factors: the level of recognition of the health information system, the quality of the data, the task of solving problems in the health system, the components of the health system, ensuring the definition of the layers for the health information system, the motivation.

The three main factors that have been introduced the health information system process with these characteristics includes: data collection, data transfer, data processing, data analysis, display, data quality review, and reversibility.

As you can see in the table 2, the available factors evaluate the proposed framework with other introduced frameworks, including: organizational information framework [8], information system framework [9], organizational structure framework [10], A framework for a coherent structure for the development of health information systems [11], health information system framework [12]. The proposed framework supports all the factors compared with other reviewed frameworks.

Table 2 .Comparison of the proposed framework with the existing frameworks

Name of the framework	***Interaction and sequencing***	***Identify entities***	***Relationship of entities and processes***	***Performance management***	***Related to modelling diagrams***
organizational information framework [8]	√	–	–	–	–
Information system framework [9]	√	–	–	–	–
A framework with an organizational structure [10]	√	√	–	–	–
A framework for a coherent structure for the development of health information systems [11]	√	√	–	–	–
Health Information System Framework [12]	√	√	√	√	–
proposed framework	√	√	√	√	√

6. CONCLUSION

Health Management Information System Based on system performance, system processes and interaction with patients than other systems are complex and more sensitive. Therefore, the system must be properly identified and analysed. Then, considering the goals and complexity of the system, a framework is proposed to improve the design of the processes. For the proposed framework is defined six components and four management functions. The proposed framework has seven layers, including the data layer, the description layer, the process layer, the entity layer, the data warehouse layer, the object sequence layer, the transmission layer. The relationship has been established between the layers of the proposed framework and the proposed diagrams for designing the management information system. The proposed structural framework was also examined in five levels. The proposed framework provide objectives such as: designing processes and communication between them, interacting and integrating within the unit as well as interaction, coordination and integration with other entities of the organization.

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