Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Information Engineering

Bachelor Thesis

Information System Design and Analysis

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Thi Huong Diu Nguyen

Systems Engineering and Informatics
Informatics

Thesis title

Information System Design and Analysis

Objectives of thesis

The main objective of bachelor thesis is to analyse and design the information system. The design of information systems requires analysis of the current state of data flows and processes of information system and proposal their optimization through diagrams.
Therefore, the partial objectives of the bachelor thesis are such as following:
- To describe information systems, their types and development,
- To analyse the current state of data flows and processes in the selected information system or its part,
- To synthesize the results achieved and propose process optimization.

Methodology

The bachelor thesis is divided two main parts: In the first part, which is the theoretical part, will be base on the study to analysis of literature to describe clearly about the theory of information systems, UML or DFD. In the second part, it is focused on analysis and design of selected type of information system. There will be used primarily the system of management of entrance examinations at Czech University of Life and Science.

The process of design contains the following stages: to make the system actually work, to create a data model, to identity agents, objects, classes and construction of the diagrams. There will be used DFD (Data Flow Diagram) as a tool for creating a data flow diagrams, ER diagram notation as tool for creating data model, or notation UML for creating an object view on selected information system.

The proposed extent of the thesis

30 – 40 pages

Keywords

Application, UML, entrance examination, information system, analyse and design, diagram, DFD, data.

Recommended information sources

Alan W.Brown (ed), Coponent – Based Sofware Engineering, IEEE Computer Society, Los Alanmitos, CA, 1996.

Grady Booch, Jame Rumbaugh and Ivar Jaconson, The Unified Modeling Language User Case, Addition – Wesley, 1999.

Hans – Erikson, Magnus Penker, UML Toolkit, Wiley computer Publishing, 1998

Ivar Jacobson, Magus Christerson, Patrik Jonsson and Gunnar Evergaard, Object- Oriented Sofware Engineering – A Use Case Driven Approach, Workingham, England, Addition – Wesley, 1992

VRANA, I. – ČESKÁ ZEMĚDĚLSKÁ UNIVERZITA V PRAZE. PROVOZNĚ EKONOMICKÁ FAKULTA. *Projecting of information systems with UML*. Praha: Česká zemědělská univerzita v Praze, Provozně ekonomická fakulta, 2009. ISBN 978-80-213-1976-9.

VRANA, I. – ČESKÁ ZEMĚDĚLSKÁ UNIVERZITA V PRAZE. PROVOZNĚ EKONOMICKÁ FAKULTA. *Software engineering*. Praha: Česká zemědělská univerzita, 2013. ISBN 978-80-213-2349-0.

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Declaration

I declare that I have worked on my bachelor thesis titled "Information System Design and Analysis" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break the copyrights of any person.

In Prague on date of submission _____

Acknowledgment

I would like to thank my supervisor Ing. Jan Tyrychtr, Ph.D. and my colleagues for their advice and support during my work on this thesis

Information System Design and Analysis

Abstract

The thesis focuses on the analysis and design of Information System. The thesis consists of two main parts: Literature review and practical part. The literature review covers some basic theories about Information System, its analysis of requirements, and the Data Flow Diagram to understand processes of information systems and proposal their optimization through diagrams. In the practical part, based on the literature review, there will be used primarily the system of management of entrance examination at Czech University of Life and Science.

Keywords: Information System, System, analysis requirement, Data Flow Diagram, entrance examination.

Návrh a analýza informačního systému

Abstrakt

Diplomová práce se zaměřuje na analýzu a návrh informačního systému. Práce se skládá ze dvou hlavních částí: Přehled literatury a praktická část. Přehled literatury pokrývá některé základní teorie o informačním systému, jeho analýze požadavků a diagramu toku dat s cílem porozumět procesům informačních systémů a navrhnout jejich optimalizaci pomocí diagramů. V praktické části bude na základě literární rešerše použit především systém řízení přijímací zkoušky na České Zemědělské Univerzitě.

Klíčová slova: Informační systém, systém, požadavky na analýzu, diagram toku dat, vstupní zkouška.

Table of content

List of figure

Introduction

In ancient, Information System (IS) has appeared, it is just simple information from the mouth of this person to the mouth of that person. Or, it could be written on stone or wall surfaces by the person. Nowadays, IS is still around us but it is more developed with technologies. IS can be defined as an integration of components for hardware, software, database, network, and procedures. Based on IS, the people create many other systems to serve the organization and company. The combination between IS and technologies is known as Information and Communication Technology (ICT) supporting a lot of business processes. In education, the application of IS is seriously important. One of them creating the entrance examinations become easy and effective.

Every year, the entrance examination of many other universities is organized by the school to aim to select several students for each faculty of campus. Because they are organized on a large scale and require accurate information between students and school, errors are unavoidable. Therefore, we should have a system in which we can manage the amount of information.

Czech University of Life and Science is a famous school that is trusted and chosen by the domestic and foreign student to study. With a lot of different faculty, the student will have more choices for them. It is attractive to a thousand students each year to register. That is not a small number. Therefore, the system management of the entrance exam is always most important to be sure information exactly and the process goes right.

Because I write the thesis in the Covid-19 period, this period is hard for teachers, students, and everyone. The idea about Entrance Exam Online is formed and presented clearly in the practical part. I hope it can bring some helpful things to my University before finishing my academic study.

Objectives and Methodology

Objectives

The main objective of my bachelor thesis is to analyze and design the information system.

The design of an information system requires analysis of the current state of data flow and processes of the information system and proposal their optimization through diagrams. Therefore, the partial objectives of the bachelor thesis are such as following:

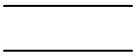
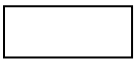
- To describe information systems, their types, and development.
- To analyze the current state of data flows and processes in the selected information system or its part.

Methodology

The theoretical part is done using a literature review of academic papers, professional books about Information System (IS), Data Flow Diagram (DFD).

In the practical part, some diagrams will be used to analyse and design the system of management of entrance examinations at Czech University of Life and Science.

The **DFD** is developed to analyse the system of management of entrance examinations. According to (Ivan Vrana, 2013), DFD depicts processes and dataflow between them. We use four items with the following rules:

- Process 
- Data flow
- Data store 
- Termination 

1. Process (the main component of the DFD)
   - symbol: circle (rectangle with rounded corners)
   - name: verb + subject
   - at least one input and one output data flow
   - numbering is possible
   - decomposition is possible

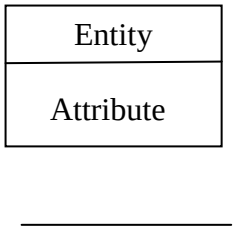
2. Data flow:
   - symbol: line, connecting a process with rest of the system (arrow – the direction of a flow)
   - usually with a name (exceptions)
   - at least one end connected with a process
   - the other end must be connected with: another process, or data store, or terminator

3. Terminator: (external entity)
   - symbol:
     rectangle (sharp-edged/shaded)
     repeating ~ line-through a corner
   - it is place of origin or consumption of system data

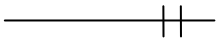
4. Data store: (logical file)
   - symbol: pair of parallel lines
   - name: noun between lines
   - it provides:
     - asynchronous data transmission
     - (de)composition of data structures
   - at least one input and one output data flow

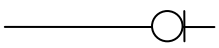
I also use **Entity Relationship Diagram (ERD)** to express the data in my program. ERD shows the type of objects (entities), about which we store data in the system (Vrana, 2013). Some symbols and formal rules:

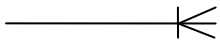
1. Symbols:
   - Entity: represent a class of an object
   - Attribute: is a property that describes a particular entity
   - Relationship: illustrates the association between two entities (Straight line)

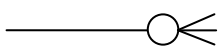


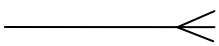
2. Formal rules of relationship:


Right one

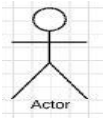

None or one


One or more

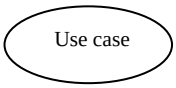

None, one or more


More than one

Besides, **Use Case Diagram** of UML as a notion for creating an object view on the selected information system.



Actor: an organization, a human being, or an external application that interacts with the system.



Use case: system function (process – automates or manual)

Literature Review

3.1Information system

3.1.1 Definition

There are many different understandings of meaning Information System, are the combination of human being, information technology and business process by hardware and software, are interrelated component working together to get business objective.

An information system is a consistent, coordinated set of components acting together toward the production, distribution, or processing of information. For generality, this definition sacrifices precision but it applies to computer Information System, networked Information Systems, biological Information System, and a variety of other intriguing contexts (Ratzan, 2004).

Another definition from (Arduin, 2015) which is given by the French Commission Centrale des Marchés that an Information System is a set of human, material, and software resources, used by a user to carry out an activity within a given environment, which must be taken into account.

According to (Ivan Vrana, 2013), we have a "building Information System" following as:

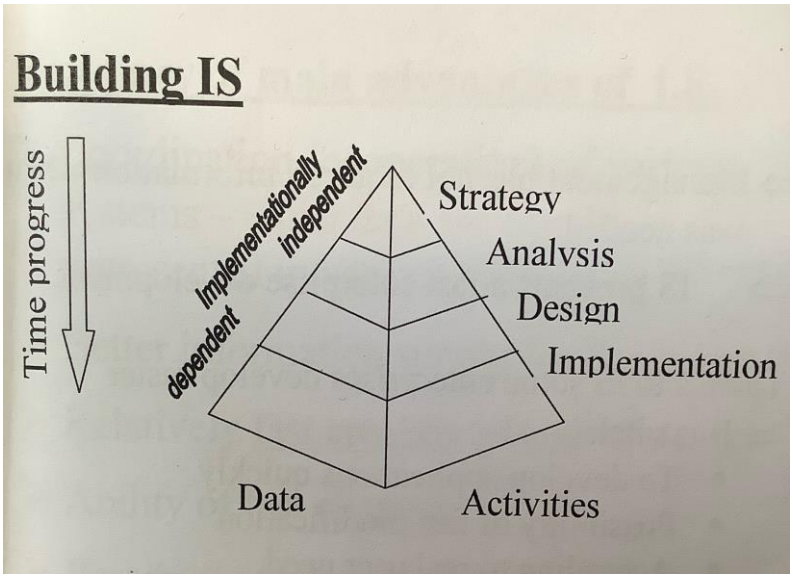


Figure 1: The building IS. Source: (Ivan Vrana, 2013)

- Engineering approaches in all life-cycle phases: event parameterization and measurability, element standardization and typing, standards transferability, structured work organization, documentation.
- Needing of formal techniques and automated tools documentation.

Thanks to IS some enterprises develop faster as it is vital to develop applications quickly, the possibility of fast modification, and for real user needs. Besides, design techniques are automated by code generators. (Ivan Vrana, 2013)

3.1.2 System

System – a set of elements so interconnected as to aid in driving toward a defined goal (Gibson, 2016). First is the existence of a set of an element that is a group of objects with some characteristics in common. Secondly, the objects must be interconnected or influence one another. Finally, the interconnected elements must have been formed to achieve some defined goal or objective (Arduin, 2015).

System – an integrated set of interoperable element or entities, each with specified and bounded capabilities, configured in various combinations that enable specific behaviors to emerge for Command & Control, C2 by Users to achieve performance-based mission outcomes in a prescribed operating environment with a probability of success (Wasson, 2015).

System development is a systematic process including phases such as planning, analysis, design, implementation, and maintenance. This thesis is focused on system design and system analysis.

- System design:

It answers the question "How to accomplish the objective of the system?"

System design – a process of planning a new business system or replacing an existing system by defining its components or modules to satisfy the specific requirements. Understanding the old system thoroughly and determining how computers can best be used before planning to operate efficiently.

The typical design needs are screen layouts, navigation tools, and a help system. The Entity Relationship Diagram (ERD) will be transformed into a physical database design. Detail specifications will be translated into program modules and manual procedures to operate the system should be documented.

- System analysis:

It answers the question "What the system should do?"

System analysis – a process of gathering and interpreting facts, identifying the problems, and decomposition of the system into its components. It is aimed to identify objectives and solve techniques to improve the system and ensure that all the components of the system work efficiently to accomplish their purpose.

Following (Gibson, 2016) suggest 10 Golden Rules of Systems Analysis:

Rule 1: There always is a client

Rule 2: Your client does not understand his problem

Rule 3: The original problem statement is too specific: you must generalize the problem to give it contextual integrity

Rule 4: The client does not understand the concept of the index of performance

Rule 5: You are the analyst, not the decision-maker
Rule 6: Meet the time deadline and the cost budget
Rule 7: Take a goal-centered approach to the problem, not a technology-centered or chronological approach
Rule 8: Non-users must be considered in the analysis and the final recommendations
Rule 9: The universal computer model is a fantasy
Rule 10: The role of decision-maker in public systems is often a confused one

3.1.3 Analysis of requirements

Requirements are the things that a software developer should discover before starting to build a software product. Without a clear specification of a set of valid user requirements, a software product cannot be developed and the effort expended on the development will be a waste. The functions of a software product must match the user requirements. Many computer-based information systems have failed because of their inability to capture correctly the user requirements. And when a completed software product is modified to incorporate lately understood user requirements, the effort spent, and consequently, the cost is extremely high. (Mohapatra, 2010)

Requirements definition is not limited to the problem analysis that yields a functional specification. Requirments definition must encompass everything necessary to lay the groundwork for the subsequent stage in system development.

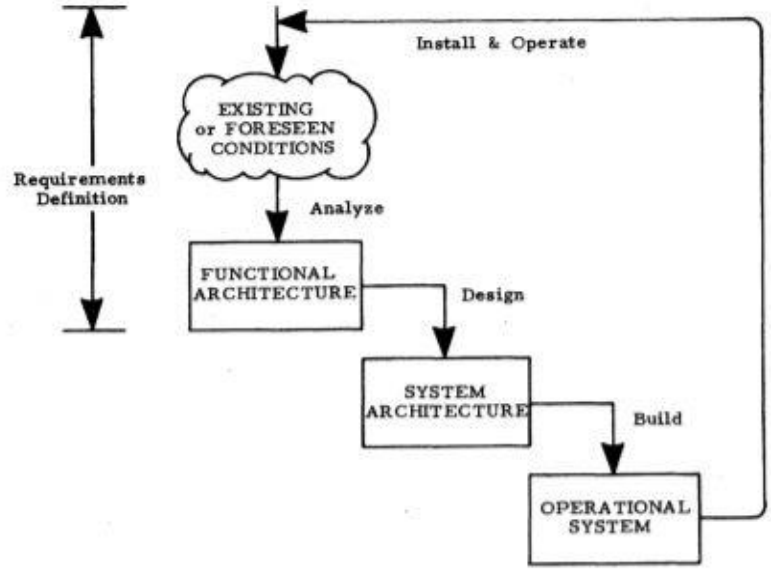


Figure 2: Simplified view of the development cycle. Source: (Douglas & Kenneth, 1997)

Within the total process, which consists largely of steps, is a solution to a problem, only once is the problem itself stated and the solution justified in requirement definition.

Requirements definition is a careful assessment of a fulfilled system. It must be Why a system is needed, based on current or foreseen conditions, which may be internal operational or an external market. It must be What system feature will serve and satisfy

this context. And it must be How the system is to be constructed. Thus, the requirements definition must deal with three subjects:

1. Context analysis: The reason Why the system is to be created and why the criteria are technical, operational, and economic feasibilities certainly forming boundary conditions for the system.
2. Functional specification: A description of What the system is to be, in terms of the functions it must accomplish. Since this is part of the problem statement, it must only present boundary conditions for considerations later to be taken up in system design.
3. Design constraints: A summary of conditions specifying How the required system is to be constructed and implemented. This does not necessarily specify which things will be in the system. Rather than it identifies boundary conditions by which those things may later be selected or created.

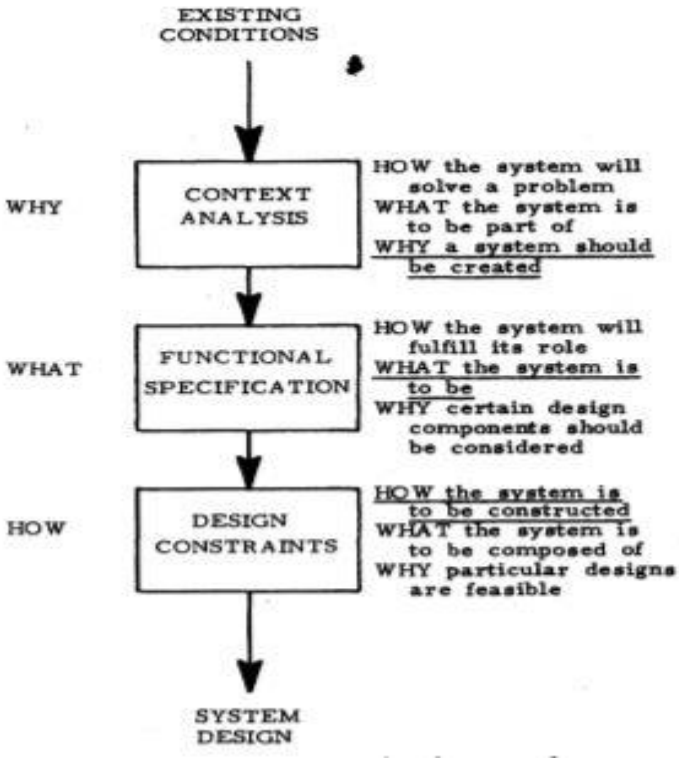


Figure 3: Each subject has a fundamental purpose. Source: (Douglas & Kenneth, 1997)

Each of the subjects has a specific and limited role in justifying the required system. Collectively, they capture on paper, at the appropriate time, all relevant knowledge about the system problem in a complete, concise, comprehensive form. Taken together, these subjects define the whole need. Separately, they say What the system is to be part of, What the system is to be, and What the system is to be composed of (Fig. 3). The process is known as “analysis” must apply to all three.

3.1.4 Structured analysis

Analysts use various tools to describe and understand the IS, using structured analysis is one of the ways.

Structured analysis is a development method allowing the analyst to understand the system and its activities logically. It is a systematic approach, which uses graphical tools that analyze and refine the objectives of an existing system and develop a new specification that can be easily understandable by the user.

The attributes following:

- The presentation of the application is specified by the graphic.
- The processes are divided to give a clear picture of system flow.
- It is logical rather than physical
- It is an approach that works from high-level overviews to low-level details.

System development has various tool and techniques during Structured analysis: (Tutorialspoint, 2021)

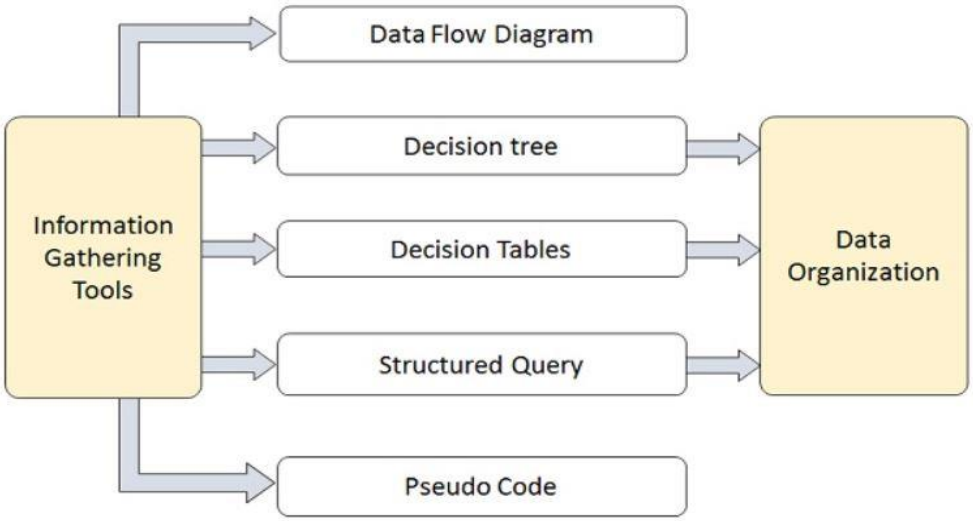


Figure 4: Structured analysis tools. Source: (Tutorialspoint, 2021)

They are Data Flow Diagram, Data Dictionary, Decision Trees, Decision Tables, Structured English, Pseudocode.

This thesis focused on Data Flow Diagram to develop IS. According to (Mohapatra, 2010), the use of structured analysis tools results in a disciplined approach to analyzing the present system and in knowing the user requirement. Therefore, an analyst can develop Data Flow Diagram to discover how an IS operates in a real system by understanding how data flow and get transformed and stored.

3.2 System Development Life Cycle (SDLC)

3.2.1 Overview of SDLC

1. Definition

SDLC is an approach to system development in an organized and disciplined manner. (Vrana, 2013). An effective SDLC should have a high-quality result in the system. Throughout their cycles, SDLC is a conceptual model including policies and procedures for developing or altering systems.

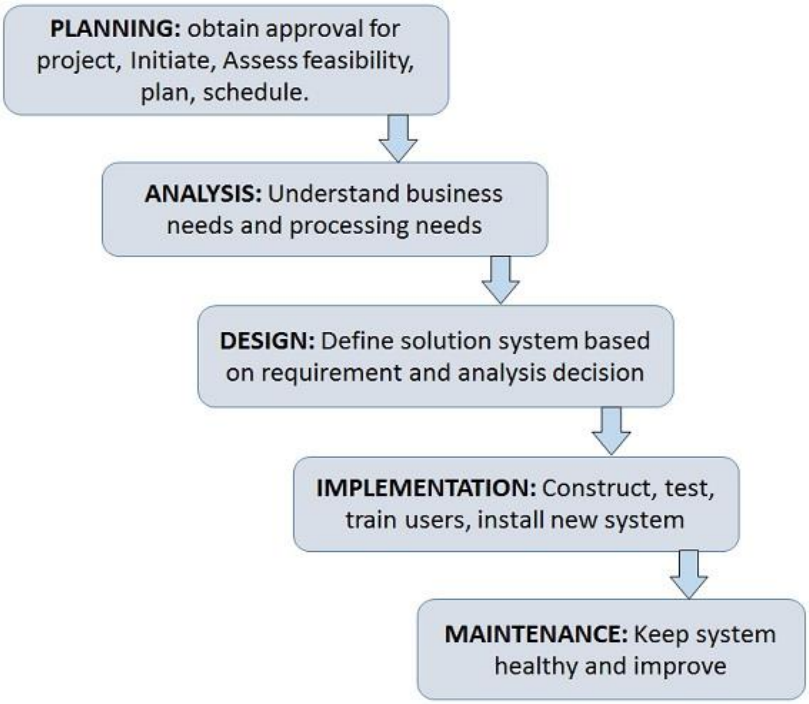


Figure 5: The common phase of SDLC. Source: (Tutorialspoint, 2021)

2. Component of the approach
   - Definition of objectives of the developed system
   - Definition of indicators of achieved objectives
   - Building alternative stragtegies
   - Selection and implementation of a strategy

The aim of SDLC is mainly that if we do not have indicators of goal achievement, we can know where we go, but we do not know if we were already there. (Vrana, 2013)

3.2.2 Waterfall

SDLC is a systematic approach working into phases that are required or modified IS, as following:

- System requirement
- Software requirement
- Analysis
- Design
- Coding
- Test
- Operation

Each consecutive phase begins after the previous phase is finished. It has many versions with different numbers of phases, it can be 3 phases to 1 phase. The waterfall is suitable for isolated small programs. Therefore, it is failed for larger projects. Because it has some problems as needing a long time from beginning to finish the project and if it does not need feedback, it is suitable. Besides, it is focused on professional IS problems that are a reason for losing track of users' needs.

3.2.3 Iterative

It is the main idea to remove long waiting and to supply something valuable every few weeks.

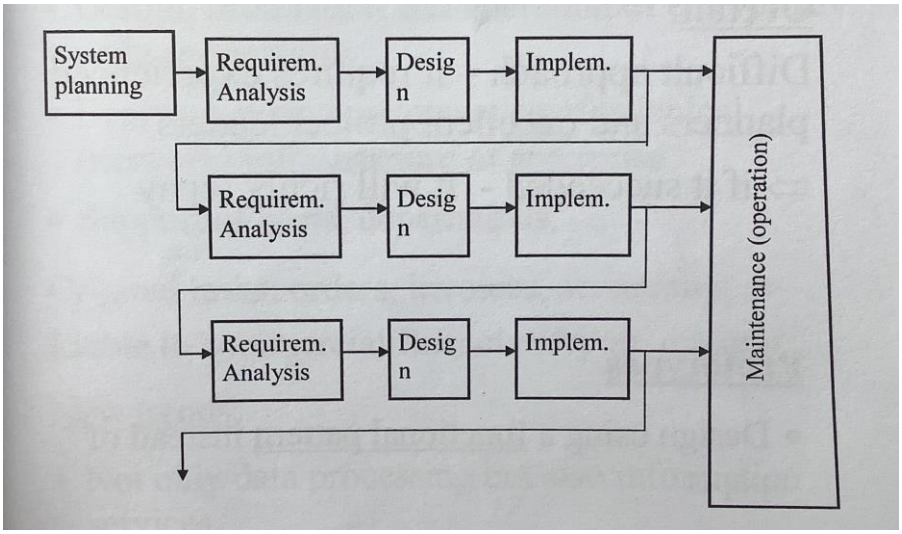


Figure 6: Picture describing the process of Iterative type. Source: (Vrana, 2013)

- Advantages:
  It is increased involvement of users and investment return and makes a shorting of average implementation time, it will be counted at half of the time.
- Disadvantage:
  It is difficult to assess the economy and the system for transaction processing. And it has many supprises which must not be “on my way”.

In summary, it will be a difficult approach because it is required an experienced pattern and an excellent project leader. And if it succeeded, it will richly repay.

3.2.4 Prototype

- Although it uses on paper it is used in design as a functional pattern.
- It is distinguishing easily between a preliminary and a detailed design.
- If a solution is every innovation, it will be designed twice.
- If the project is risky, it will be suitable for a spiral model.
- It is one of the most effective ways for innovative or risky projects.
- The usage is main in 3 fields: Simulation of performance, Checking of requirements understanding, and Interface design.

3.3 Data flow diagram (DFD)

3.3.1 Overview of DFD

The Data Flow Diagram (DFD) is a structured analysis and design method. It is a visual tool to depict logic models and expresses data transformation in a system. DFD includes a mechanism to model the data flow. It supports decomposition to illustrate details of the data flows and functions. DFD can not present information on the operation sequence. Therefore, it is not a process or procedure modeling method (Li Qing & Yu Liu Chen, 2009).

Normally, data flow diagrams are developed in four stages:

1. Physical Data Flow Diagrams of the Current System.
2. Logical Data Flow Diagrams of the Current System.
3. Logical Data Flow Diagrams of the Proposed System.
4. Physical Data Flow Diagrams of the Proposed System.

The first two diagrams are meant for the analysis of the current system while the next two diagrams are meant for the improvement and design of the new, proposed system.

A logical DFD describes how the business operates. It focuses on the function performed by the system such as data transformation, reporting. Therefore, we can ignore implementation specifics.

A physical DFD is meant to depict an implementation-dependent view of the system. Such a diagram may include, in defining data flows and data stores, the following: - names of persons - forms and document names and numbers - names of departments - master and transaction files - equipment and devices used - locations - names of procedures (Mohapatra, 2010).

Normally, the system can be physical or logical, manual or computer based. DFD symbols include four symbols which are:

- Process
- Data flow
- Data store
- Termination (External entity)

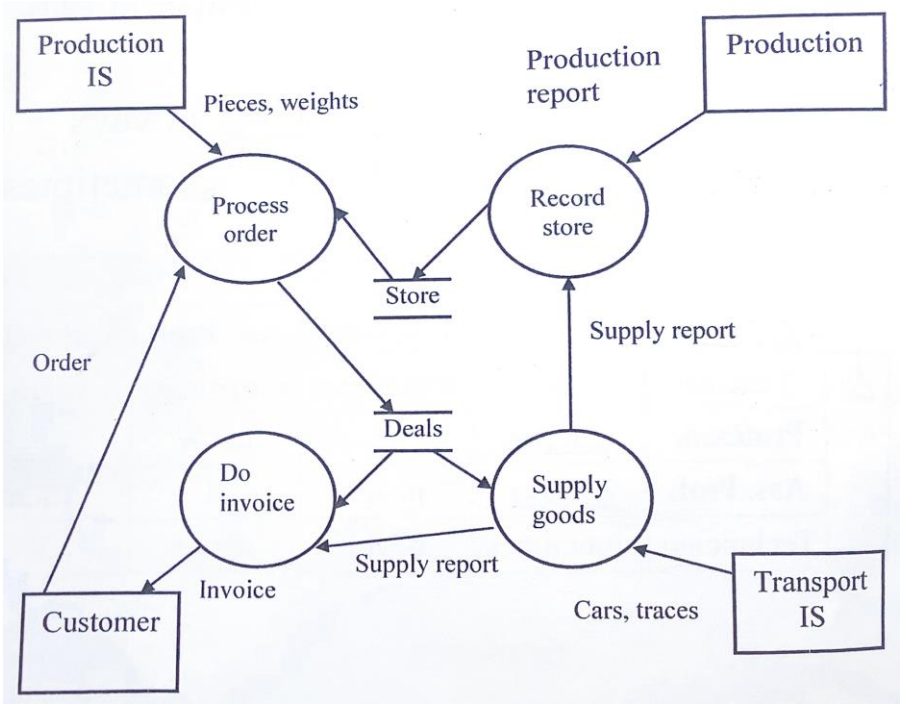


Figure 7: DFD example. Source: (Ivan Vrana, 2013)

Where

- A process is an activity or a function that is performed for some specific business reason.
- A data flow is a single piece of data or a logical collection of several pieces of information.
- A data store is a collection of data that is stored in some way.
- A termination is a person, organization, or system that is external to the system but interacts with it.

3.3.2 DFD models Organization

a. Context level Diagram

This is the highest-level diagram. The context diagram is the DFD of the scope of an organizational system that shows the system boundaries, external entities that interact with the system and the major information flows between the external entities and the system (Li Qing & Yu Liu Chen, 2009).

Rules for Context Diagram:

- One process numbered 0
- Sources and sinks (external entities) as squares
- Main data flows depicted
- No internal data stores are shown. They are inside the system
- External data stores are shown as external entities

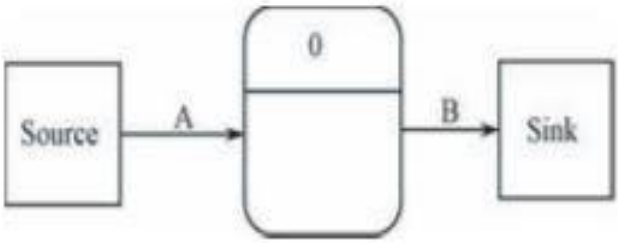


Figure 8: A simple example of a context diagram. Source: (Li Qing & Yu Liu Chen, 2009)

The Context Diagram shows the overall business process as just one process and shows the data flow to and from external entities. Data stores are not usually included on the Context Diagram. Therefore, the Context Diagram is decomposed into the lower-level diagram is a known level-0 diagram.

b. Level-0 DFD

The level-0 diagram is a DFD that represents a system's major processes, data flows and data stores at s high level of detail. For example following as:

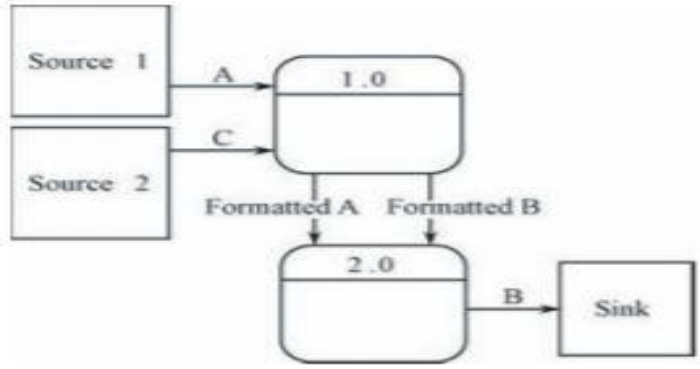


Figure 9: An example of the level-0 diagram. Source: (Li Qing & Yu Liu Chen, 2009)

Each process on the level-0 DFD can be decomposed into a more explicit DFD, called level-1 diagram, and can be further decomposed into the next lower-level diagram when it is needed.

c. Decomposed DFD child diagram

Drilling down from level-0 to the level-1 diagram, this could be continued to evolve to become level-2, 3, and so on is possible but they are not very common. Therefore, this thesis is focused on stopping in level-1 DFD.

Rules for process decomposition:

- Processes can be decomposed/ refined. That means one process can be decomposed into a complete DFD.

- Interface flows must remain consistent. When decomposing a DFD, it is necessary to conserve inputs and outputs from a process at the next level is called balancing.
- Lower-level processes, data flows and data stores can be added on
- Sources and sinks remain on level-1
- The level-0 can be used as “abstract”
- A data flow can be split into separate date flow on a lower-level diagram.

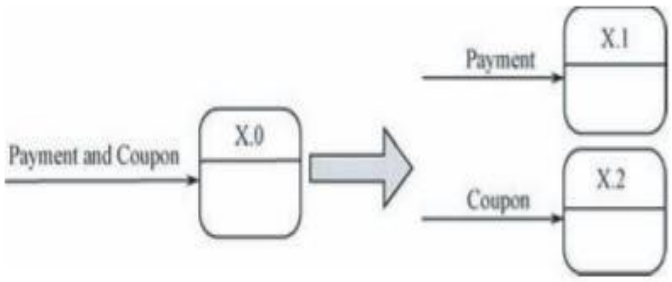


Figure 10: An example of data flow split. Source: (Li Qing & Yu Liu Chen, 2009)

Practical Part

4.1 Introduction about entrance examination online

Nowadays, studying online, take the exam online, working online, and so on are become popular and it helps society more developing. In education, studying online and online examination is also popular but entrance examination online is not.

This practical, basing on SDLC which is a basis to build system management of online examination effectively. In this research effort, the individuals under consideration were students who would be enrolling in computer. As a modern organization, the entrance online examination has some points better than the traditional entrance examination. It is automated and computers are working as human beings.

The management system of online examination is focused on creating system consists of information of student who wants to enroll to Czech University of Life and Sciences and the effective assessment question and exam's result to the student. In the paper, the presentation is pertinent to the elements of the assessment process: analysis, design, testing, and maintenance.

4.2 Analysis of requirement

4.2.1 Existing system

The existing system is a manual one in which teacher and student have to meet to take the exam, it is more difficult for student or examiner from a very far distance to go to exam place. Also, students take the exam on paper which is made from wood, that is not a good idea in future because we need to protect the forest.

Below are some disadvantages of the manual system:

- Students have to go to the exam center to take the entrance exam and in some cases due to some problems, they may not appear on time.
- Much time needed for creating the question papers.
- Wasting of paper.
- There is no system that automatically records students' result after they finish the exam.
- Students always take the entrance exam on paper. In some cases, the exam paper is lost, affects to result of students, wastes much time to solve.
- The result has to be announced manually to the student via email.

4.2.2 Proposed system

The proposed system is used to conduct online examination. The student can be at home or any places that have wifi connection to write the exam online. The system will allow students to enter the online exam portal, display the result and store it in a database as well. The administrator can add or update information about the student, exam date,

subjects, and the teacher can add, modify the question and make marks in a particular exam.

Below are some advantages of entrance exam online:

- Students can participate in the entrance exam at a very far distance.
- No wasting of paper.
- There is an available system to store the whole examination procedure of the student.
- The result is automatically displayed and stored in the database.
- Administrator, teacher, the student can easily update information.

4.3 Design of entrance examination online

In this part, the proposed system will be covered by the Use Case Diagram and Data Flow Diagram in the developing system management of entrance examination online.

4.3.1 Use case diagram

Use case diagram is a graphical depiction of the interactions among the elements of a system. A set of use cases, actors and their relationship is shown by the use case diagram as a behavioral diagram. The actors for proposed are identified and described below:

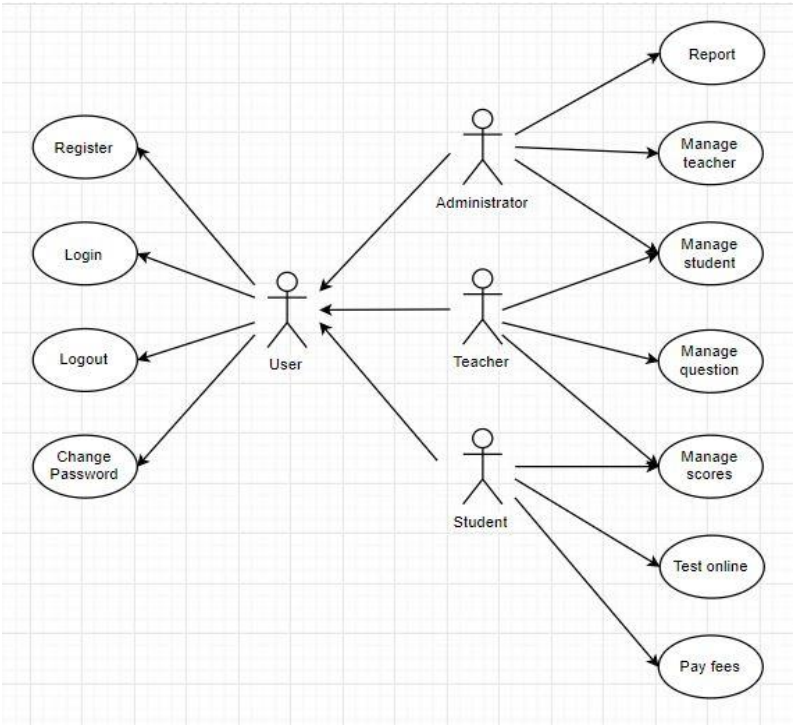


Figure 11: Use case diagram for entrance exam online. Source: own

1. Administrator:

The administrator will be able to manage all information of student, teacher and have to report, confirm information. He/she also can add, review, delete and update all

information about teachers and students to keep track of the whole examination process to avoid any entrance exam malpractice.

2. Teacher:

Teachers have to manage their student, question of exam, and score. They will know all information about the student, number of students that join the entrance examination, and set up the system of multiple-choice questions that belongs to other faculties and score to decide that the students will be passed or failed.

3. Student:

Student is also an important user of the proposed system. After registration and having an account, the students can see their profile and can pay an amount of exam fee. Then, they can join the system to take the examination, get result and save it right after finish the exam.

4.3.2 Context Diagram

The functionality entrance examination is declared as follows:

1. Checking Submit application
2. Preparing student identification number and send it to eligible applicants; then transfer the student name list to the Exam council.
3. Checking the examination result, report of the Exam council and determining students that are passed the examination under certain criteria.
4. Informing students of their examination results.
5. Analyzing examination results and preparing an analysis report by informing the result.

The context diagram is developed firstly to isolate the system from its environment and illustrate the interaction between the system and users:

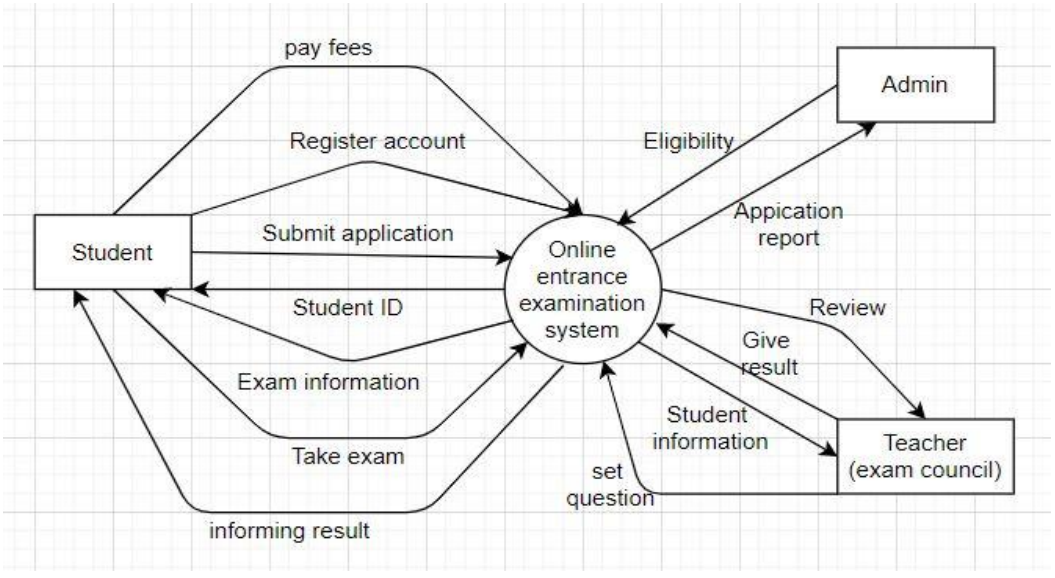


Figure 12: Context diagram of entrance exam online system. Source: own

4.3.3 Level-0 Diagram

The Level-0 Diagram shows clearly about processing system. The system will have 3 main processes: Register application sheet, Take exam online, Analysis. It also will have 3 main data stores: student list, question list and result list.

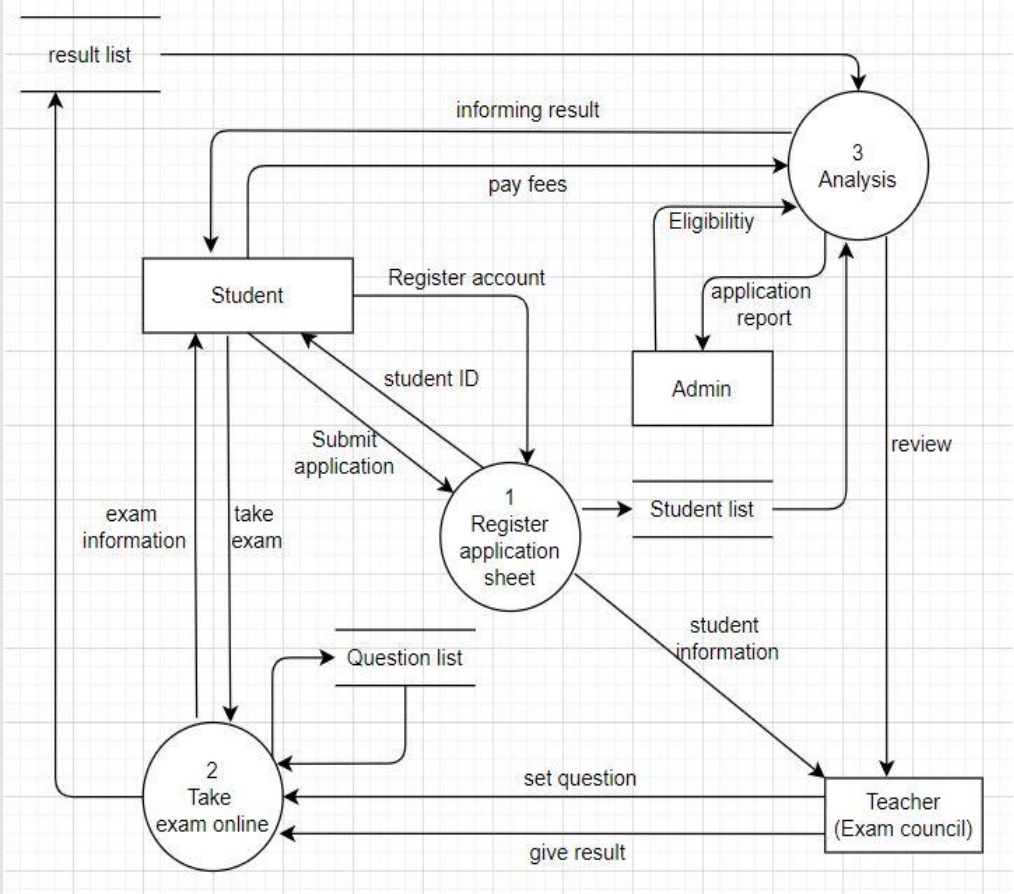


Figure 13: Level-0 DFD of system management of entrance exam online. Source: own

- Process 1 (Register application sheet):
  This process mainly receives information from “Student“ and store in “Student list“, provides “Student information“ to “Teacher“.

- Process 2 (Take exam online):
  This process seems like a place to meet between student and teacher, the exam online receives “set question“, “give result“ from “teacher“ and attendances of students. It also provides information about examination to the student, for example, like date, time from start to finish, subject, sample, and so on. From process 2, it stores in question and results automatically.

- Process 3 (Analysis):

It is an important process in the system because it verifies information between teacher and student. The goal of this process is analyzing information to review, evaluating information and reporting to them.

4.3.4 Level-1 Diagram

Level-1 Diagram is used to describe the process “Take exam online“ (Process 2). The diagram will show how it works:

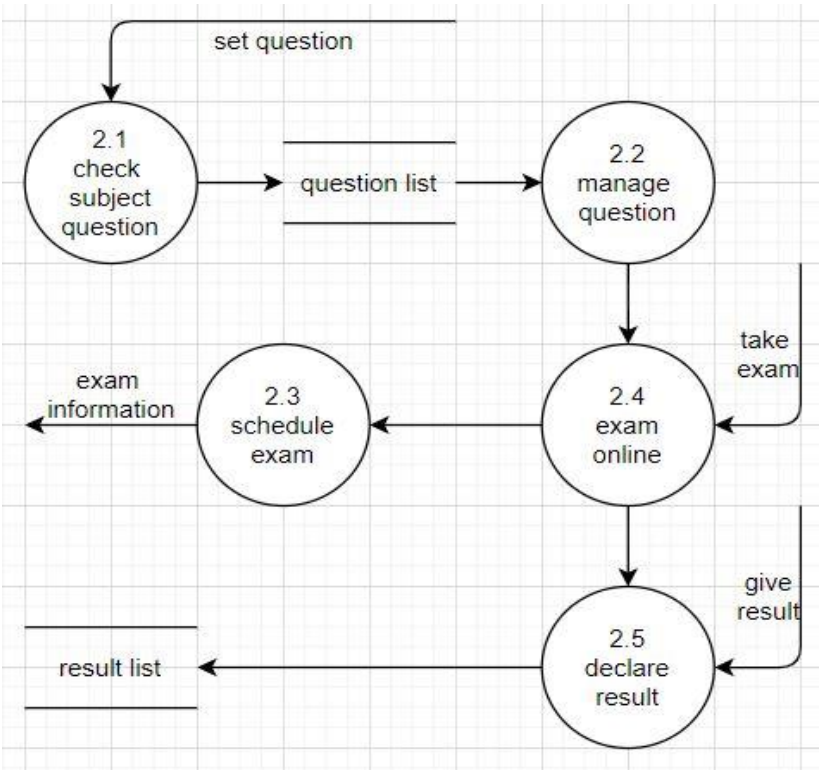


Figure 14: DFD level-1 diagram of process 2. Source: own

To describe Process 2, the system is divided into 5 small processes:

- Process 2.1: check subject question (for example Language subject, Mathematic) and build the multiple-choice questions. Then, saving information questions in the database.

- Process 2.2: from the database, the “manage question“ process receives a list of question and sends to the next process.

- Process 2.3: “Schedule exam“ contains a date, time, sample of examination and announces student about exam information.

- Process 2.4: this is an important process, a place which students can join to receive questions and start to answer.

- Process 2.5: declare the result and store it in the “result list“.

Results and Discussion

In the Practical part, the management system of entrance examination online is developed through:

- Use case diagram
- Context diagram
- DFD level-0 diagram
- DFD level-1 diagram: Take exam online (Process 2)

The diagram has shown how the system works and also the advantages of online examination. The system has been built for convenience and saving time for teachers and students.

In the first phase, there was an analysis of user requirements, followed by the creation of a data, behavioral and functional model. Then the diagram has been developed to follow the proposed system.

Although the entrance exam online is a good solution in the Covid-19 quarantine period, it still has some limitations in the exam process. Especially, “cheating” is one of a problem that needs to be handled. How can we control a number of the student taking the online exam without cheating?

My solution is “Video call”, by which the teacher can observe the examinee, make sure the student takes the exam by themself, not by other people and no cheating through a computer camera. We can also use “Video call” to perform an “Oral exam” or an interview for the students.

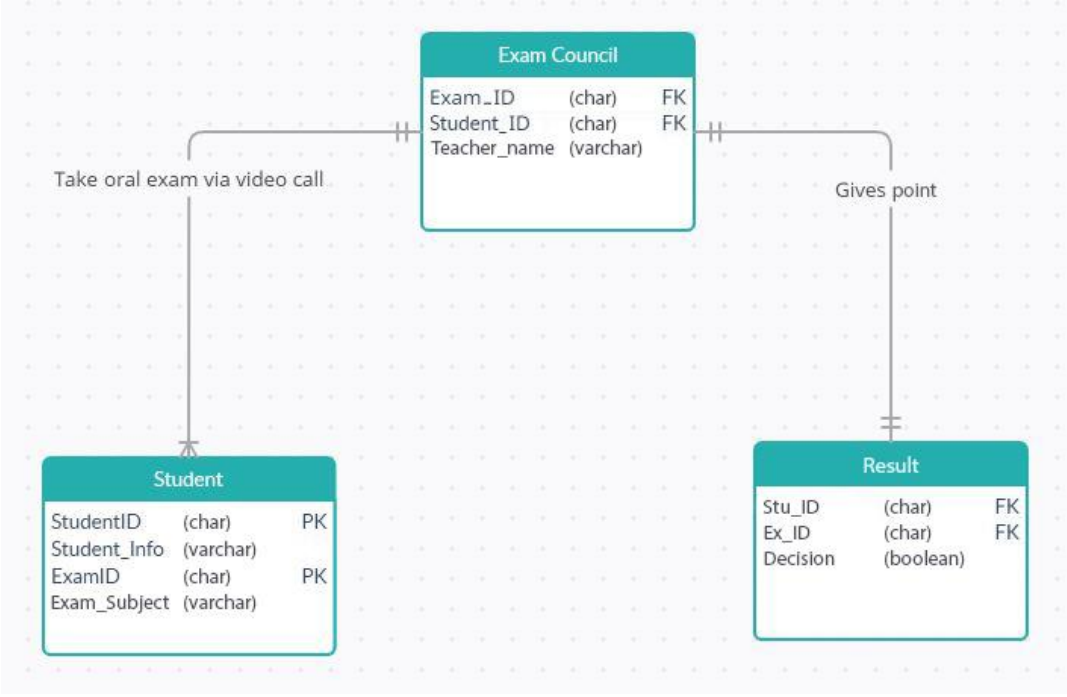


Figure 15: ERD shows process "Video call". Source: own

In fig. 15, Teacher (**Exam council**) gives point for each exam student has (based on Student_ID and Exam_ID which are referenced from **Student**). After that, the result is given for the corresponding student, with his/her ID (Stu_ID), exam ID (Ex_ID) and the decision (passed or failed).

Conclusion

In the theoretical part, this thesis has been introduced and described basically about Information System, its analysis of requirement, and Data Flow Diagram. With the theoretical part, more understanding about system and how to build system through the diagram.

In the practical part, the management system of entrance exam online was the chosen topic to practice. It was taken form based on the fact of quarantine status, the problem of school and student. It was shown clearly in disadvantage of the traditional entrance examination and advantage of entrance exam online. From that, building the system that is satisfied with the proposed system through developing diagrams.

The process of design has contained the following stages: to make a system actually work, to create a data model, to identity agents, objects, classes and construction of the diagram. DFD is used as a tool for creating a Context diagram, Level-0 Diagram, and Level-1 Diagram. Besides, ER diagram notation as a tool for creating a data model in the solution part, and Use Case Diagram of UML for describing a behavioral diagram.

Finally, the process of writing the thesis helps me to gain many skills, to work and solve the problems independently, gives me a lot of new knowledge.

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Appendix

Video call solution SQL:

```
CREATE TABLE STUDENT (
        ID CHAR(6) PRIMARY KEY,
        STUDENT_INFO VARCHAR(50),
        EXAMID CHAR(5) PRIMARY KEY,
        EXAM_SUBJECT VARCHAR(20)
        );
CREATE TABLE EXAM_COUNCIL (
        EXAM_ID CHAR(5),
        STUDENT_ID CHAR(6),
        TEACHER_NAME VARCHAR(50),
        FOREIGN KEY (EXAM_ID) REFERENCES STUDENT(EXAMID),
        FOREIGN KEY (STUDENT_ID) REFERENCES STUDENT(ID)
        );
CREATE TABLE RESULT (
        STU_ID CHAR(6),
        EX_ID CHAR(5),
        DECISION BOOLEAN,
        FOREIGN KEY (STU_ID) REFERENCES STUDENT(STUDENT_INFO),
        FOREIGN KEY (EX_ID) REFERENCES STUDENT(EXAMID)
        );
```