

“Case Study: DFD &UML Diagrams through ABC Printing Press”

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Abstract: A technical comparative of a case study based on Structured System Analysis & Design and Object Oriented Analysis & Design is presented here for understanding the approach and individual implementation aspects of system development life cycle's initial phases of analysis and design with the help of working of the printing press. The case study presents various data flow diagrams defined by Yourdon and System Analysis and Design by I. Hawryskiewicz and unified modeling language diagrams defined by Grady Booch, Ivar Jacobson and James Rumbaugh. This case study also presents the use of the various notations to understand the logical and physical processes from the point of view of working of a process and its aspects in case of SSAD along with understanding the OOAD approach with the actor, its use cases and sequencing of situation.

Case Description

ABC Printing Press, a part of a University undertakes printing jobs from different departments of the University. The press can take printing related orders from other organizations or individuals also, but this is a rare practice. Orders once placed cannot be canceled. Any financial transactions of the various departments with the printing press are done through the University Office only. The University Office maintains the accounts of the press and the various departments of the University.

The press acquires its inventory from outside suppliers. This is done by accepting the quotations from various suppliers and placing orders respectively. They maintain information of vendors / suppliers for the raw materials. A supplier can supply more than one item and an item can be supplied by more than one supplier. The supplier may supply the item in parts. Stock for a particular item can be acquired more than once in a year. The suppliers send two copies of invoice to the printing press, of which one is forwarded to the University Office. The press makes payment to the suppliers after obtaining approval from the University Office.

The department places printing related order with the press and depending on the inventory, the press is entitled to give a response specifying whether the order will be fulfilled immediately or in the near future. Each department is assigned a budget at the beginning of the year, which becomes an important factor while getting any concession or discount from the press.

Once the order is accepted, it has to go through various printing processes for its completion. However, these processes or the sequencing are not mandatory as a job or task may need different processing or handling. The various processes are:

- Composing
- Pasting
- Plate making
- Printing
- Binding

At the completion of the first copy, it is sent to the department for approval, which when received initiates the completion of the order. For the completion of the order, the press maintains a document known as costing sheet which specifies what all processes were applied and the inventory used for the completion of a particular order. This document is important in generating the bill.

3 delivery chalangans are sent along with the items; one being kept in the press, second being given to the department and the third being sent to the University Office by the press. The invoice is not sent with the items, but it is sent at a later date due to complexity involved in preparing it. Two invoices are sent to the department; of which one is forwarded to the University Office by the department.

Summary of transactions as well as reports related to the printing press, are sent to the University Office on a regular basis. These reports or summary is useful to the management for analyzing their current budget and planning accordingly for future budget.

Understanding the environment

The press under consideration is a very old press set up to cater to the specific needs of the university. Employees of this press have worked on the age old techniques of printing and are new to the concept of using computers for their purpose. The use of computers is basic related mostly to the Office automation tools for the purpose of record keeping and printing of hand calculated invoice. The job of completing the printing related orders is carried out on old and heavy machines.

Flaws with the existing system

1. **Dependency** – The existing system functions with the authorization of the manager only. The data is first authenticated by the manager for each activity and its process before sent to the next activity or process. From the SSAD view or the data and process oriented view, the flow of data is heavily dependent on the manager of the printing press for all communications with the other external entities and managing the work flow between the internal entities so as to complete the orders and other activities. This flaw in the system is taken care in the OOAD methodology, where the situation is analyzed as per the various users of the system and their role and responsibility.
2. **Complexity and time involved in preparing the invoice** – The information regarding papers and their costs as well as the various processes involved in the completion of any order, is complicated. Many parameters related to the type, ink, colours etc have to be taken care of while preparing the invoice to be sent to the departments. In the existing manual system, the user has to retrace all the various processes and their costs maintained in various registers to calculate the total amount for the completion of the order.
3. **Large amount of paperwork** – Maintenance of different registers related to various printing processes like order register, stock register, daily issue register, costing sheet details and bill register, is required in the existing system. Any query from the departments requires the user to refer several such registers.

Purpose of automation

1. Provide better customer services by reducing process complexity and time involved in preparing the bill.
2. Improves effectiveness by analyzing the data.
3. Generation of different reports to help in understanding and analyzing the allocation of various funds to different departments.
4. Creating history files for future purpose of data mining.

Implementation issues

1. Training of press personnel.
2. Installation
3. Parallel runs
4. Maintenance

Software Quality considerations

1. A minimum stand alone machine which should be enough to provide the automation of various processes from the SSAD point of view. A network of computers and the internet facility is ideal for the implementation of the software system developed using the OOAD methodology.
2. The press personnel have basic computer literacy, so the new envisaged software system should be easy to use and understand as well as provide error recovery and better help.
3. Investment for this system will be done by the university, so there is a need to incorporate minimum expenses.
4. Maintenance of the software system needs to be easy and simple.

Considering all these issues for the existing system of printing press and the expected software system to be developed for it, we have focused our case study on two analysis and development methodologies ie Structured System Analysis & Design (SSAD) and Object Oriented Analysis & Design (OOAD). SSAD has a process / data flow oriented view whereas OOAD has object oriented view. Here, objects refer to the various entities involved in the functioning of the system.

The various diagrams related to the SSAD and OOAD approach are presented in the following sections so as to understand the approach of the methodology and implement one as suitable to customized software system needs, objectives and situations.

SSAD Methodology

The entities considered here are the external entities which interact with the system but are not a part of the system. The initial view of the system is known as the context diagram of the system which shows the system in its entirety and shows the data interactions between the external entities and the system. The next view is known as the top level diagram that expands the single system representation into detailed process level representation and the data flows between the processes.

Context Diagram

1. The context diagram depicts the entire system as a single process. It is also known as the 0 level DFD.
2. The context diagram shows
 - a. All external entities like department, supplier and university office of the system.
 - b. All data entering / leaving the system which is useful for collecting input / output documents.
 - c. The interaction between Department and University ie related to the forwarding of the invoice is not shown here for technical considerations; but it is taken care by mentioning the acknowledgement for invoice by the university to the system.

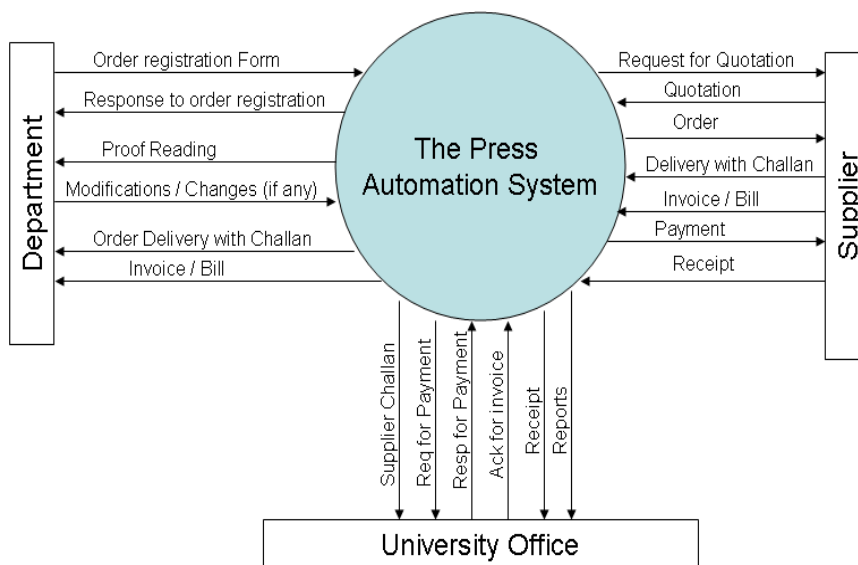


Figure 1. Context Diagrams

Existing First Level DFD

1. Keep the external entities unchanged.
2. Prepare the list of processes and data stores.
3. The logical DFD consists of 5 main processes like order registration, the actual printing process, inventory process, billing and authorization. The manager being a part of the system and also the user, is not shown as an external entity, but the role is taken care of by the use of the authorization process.
4. The costing sheet generated at the end of the press production process contains information about the order and the material ie the inventory required for processing the order.

5. A sample of the order placed by the department is first prepared for verification and sent to the department by the order registration process. This sample is given by the press production process, which being a physical entity is not shown on the DFD.

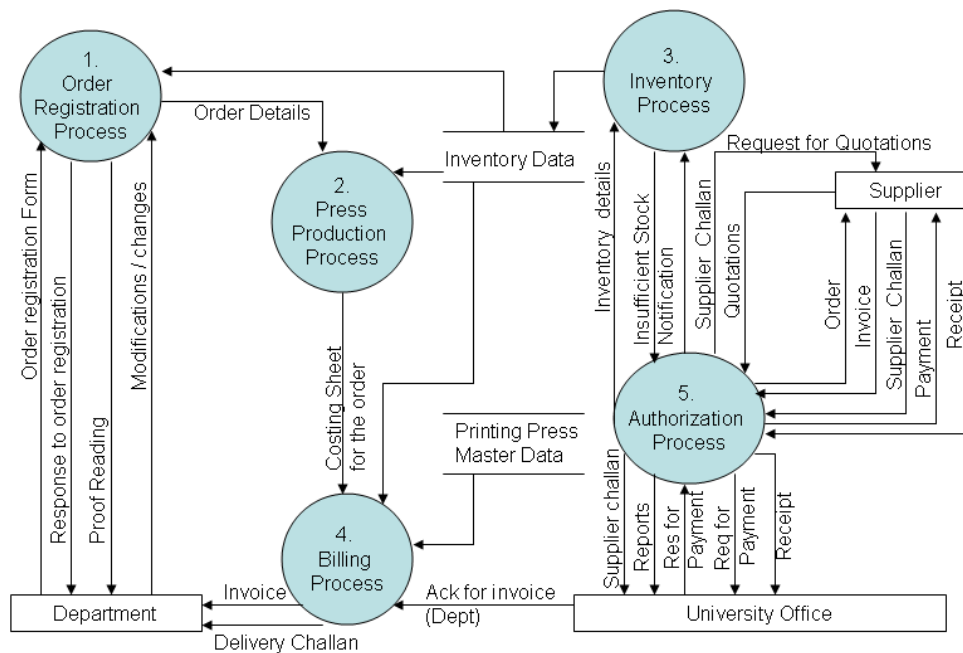


Figure 2. Existing First Level DFD

Proposed System : First Level DFD

1. The First Level DFD represents the system in detail with its processes that together constitute the entire system. Each individual process is numbered from 1 to n where n ideally should be between 5 to 9.
2. The printing press is a part of the University and is basically catering to the various departments of the University. Hence handling the other entity like individuals and organizations is out of scope of this system.
3. The new automated system can be improved by doing away with the authorization process as it can be taken care by assigning a different user role.
4. The corresponding data flows change accordingly and the execution of order can be done at a faster pace.
5. The logical DFD talks of the previously mentioned external entities along with the 2 important internal data stores ie inventory data and the printing press master data. The press master data store is related to the equipment and material that is required for the completion of any printing job for eg blocks, inks, letters etc.

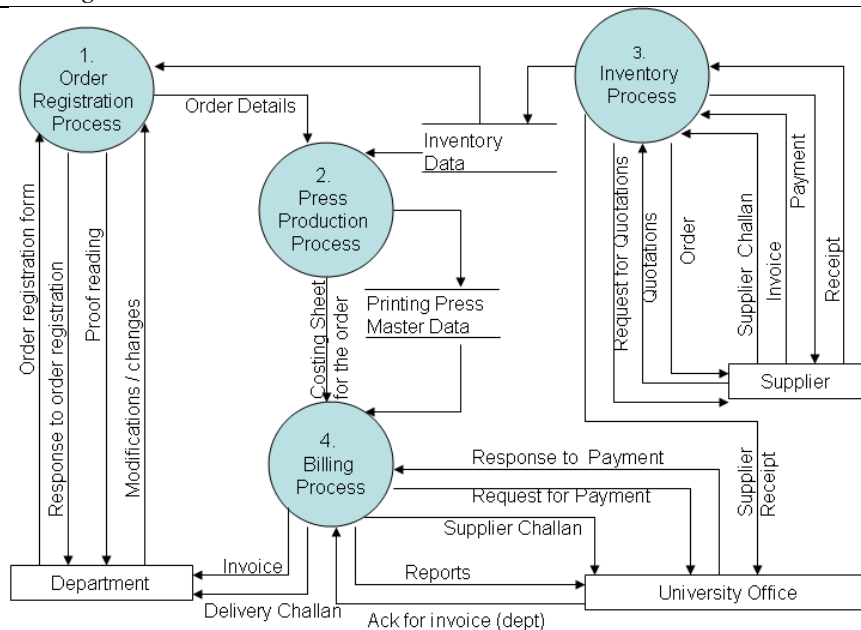


Figure 3. First Level DFD

First Level DFD (Physical)

1. The above DFDs were logical in nature where interaction between processes was shown considering that a process sending information to another process does so only after processing the information received from the external entity.
2. The given diagram is based on the actual situation where information once received by a process is stored in the data store. Any process now requiring this information will take it from the data store.

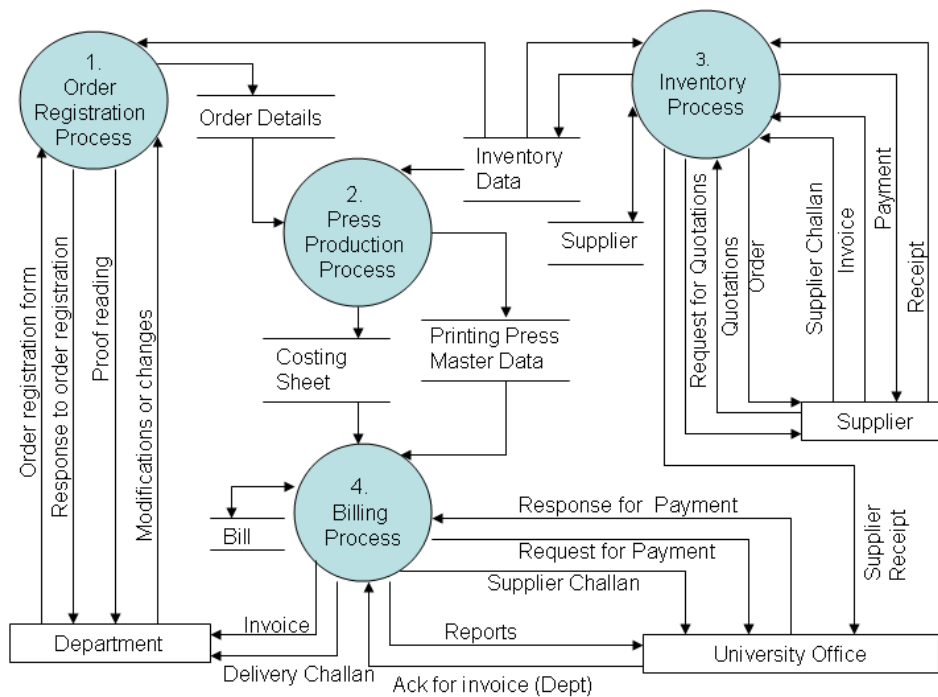


Figure 4. First Level DFD (Physical)

Second Level DFDs

The Second Level DFD represents the details of individual processes that have been defined in the First Level DFD. The sub processes are numbered from 1.1, 1.2, ... and so on. Such detailed data flow at times defines from the logical working to the physical working of a system. Internal data stores additionally may be mentioned so as to complete the data input, storage and output.

In the printing press system, the following processes have been considered for further expanding as sub processes.

Second Level DFD for the Order Registration Process

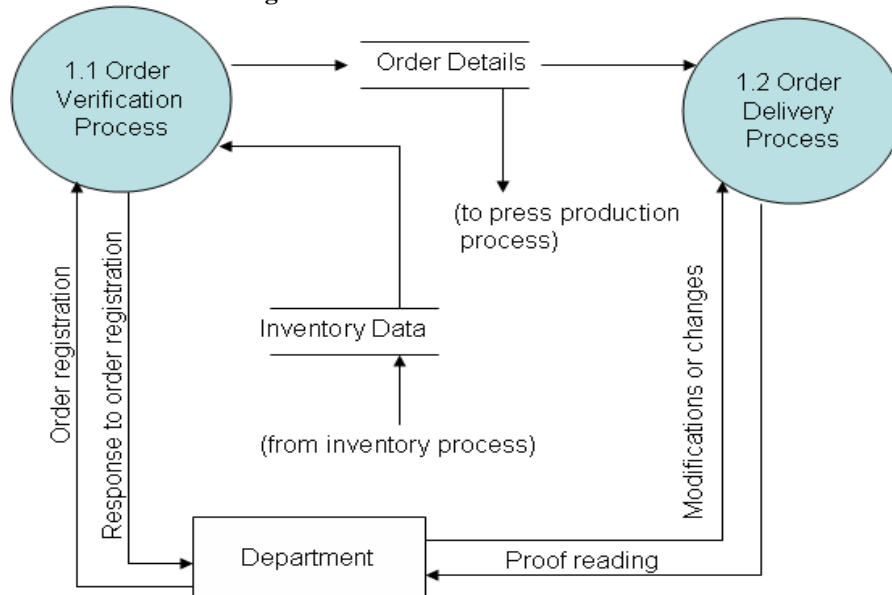


Figure 5. Second Level DFD for the Order Registration Process

Second Level DFD for the Press Production Process

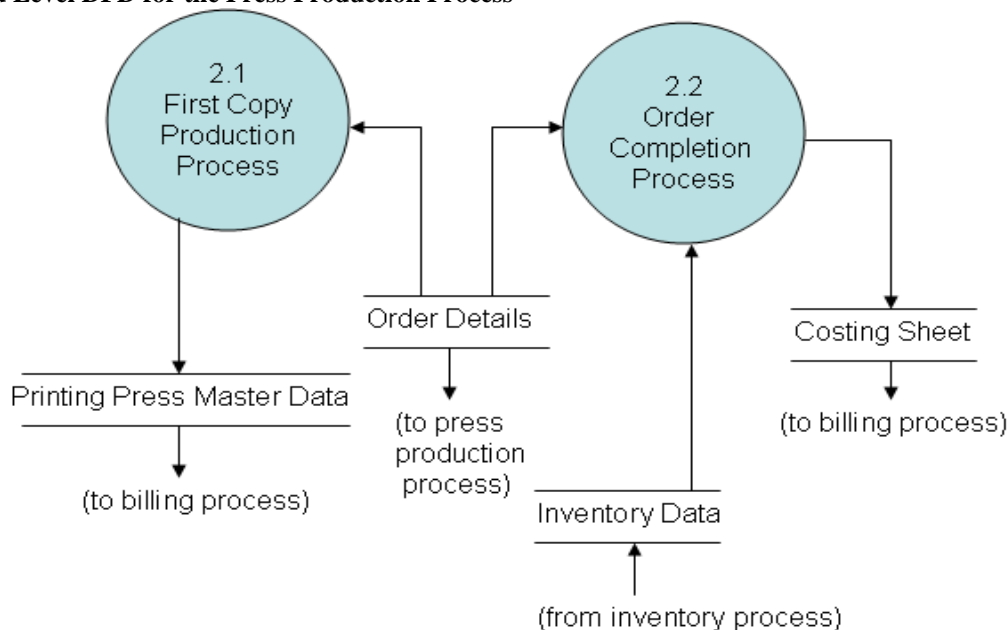


Figure 6. Second Level DFD for the Press Production Process

Second Level DFD for the Inventory Process

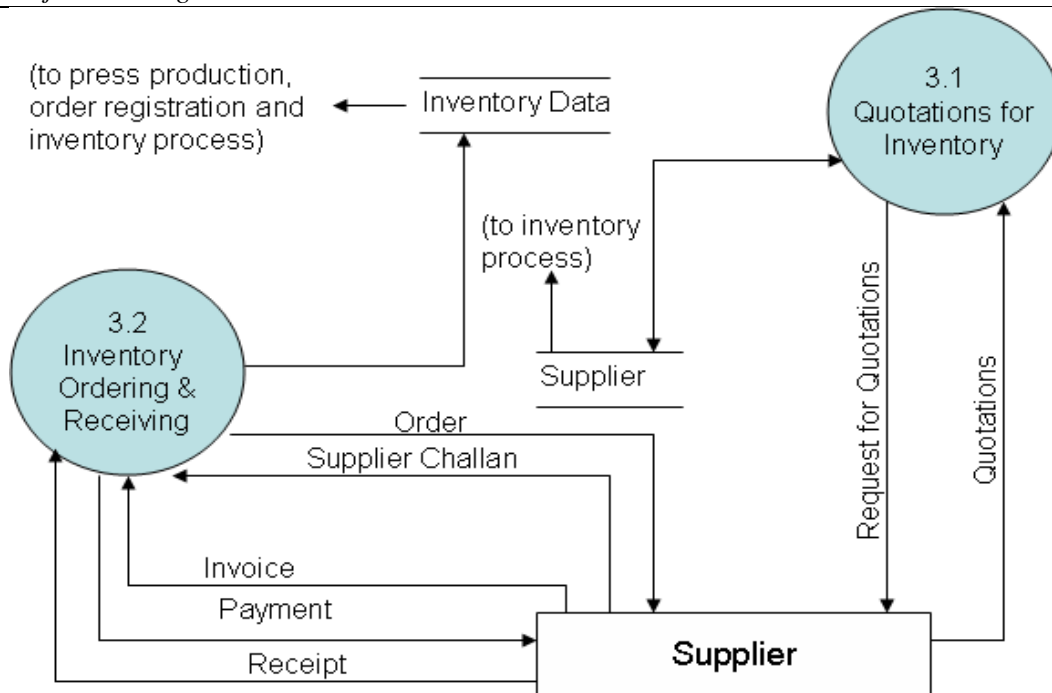


Figure 7. Second Level DFD for the Inventory Process

Second Level DFD for the Billing Process

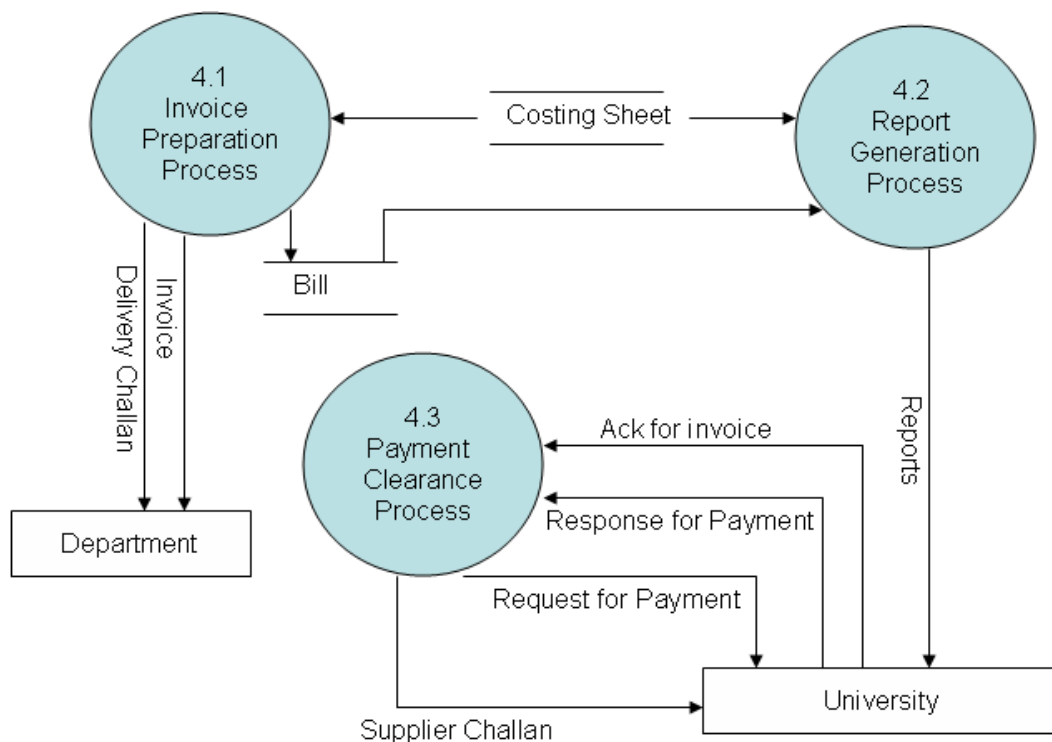


Figure 8. Second Level DFD for the Billing Process

OOAD Methodology

After the above discussion on DFDs, the case study now looks into the UML diagrams which are object oriented in nature and easy to maintain and understand. The UML diagrams are based on the object oriented analysis and design methodology. In this methodology, various scenarios are considered for their analysis and design as given by the use case diagram.

Use Case Diagram

This diagram shows various entities as actors participating in and with the system. The use cases are represented with the ovals to show the procedure or activity of the system.

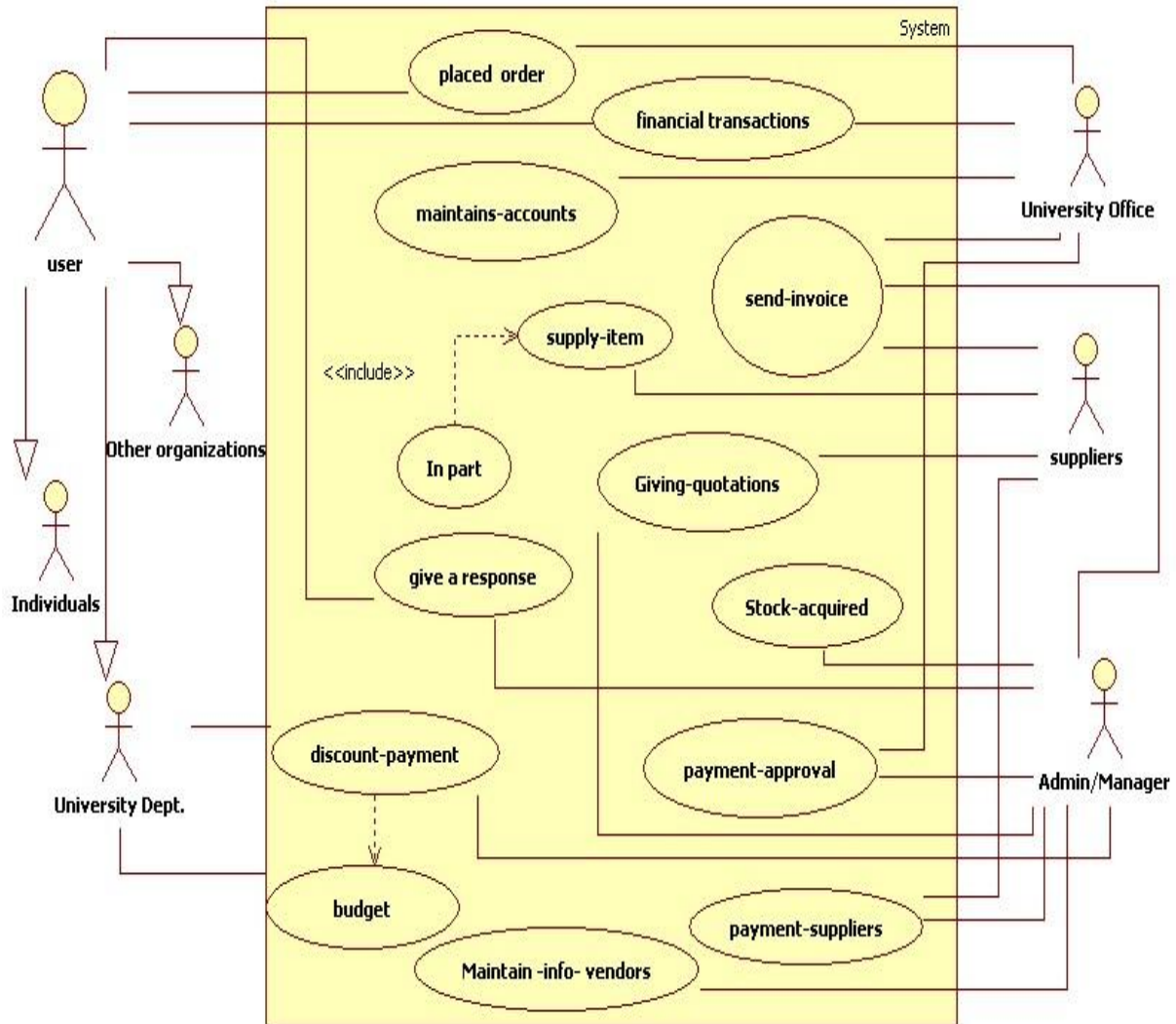


Figure 9. Use Case Diagram

Class Diagram

The class diagram shows the various classes in the system that will be directly implemented as code in any object oriented programming language. These classes will be instantiated to real world object ie the actual data.

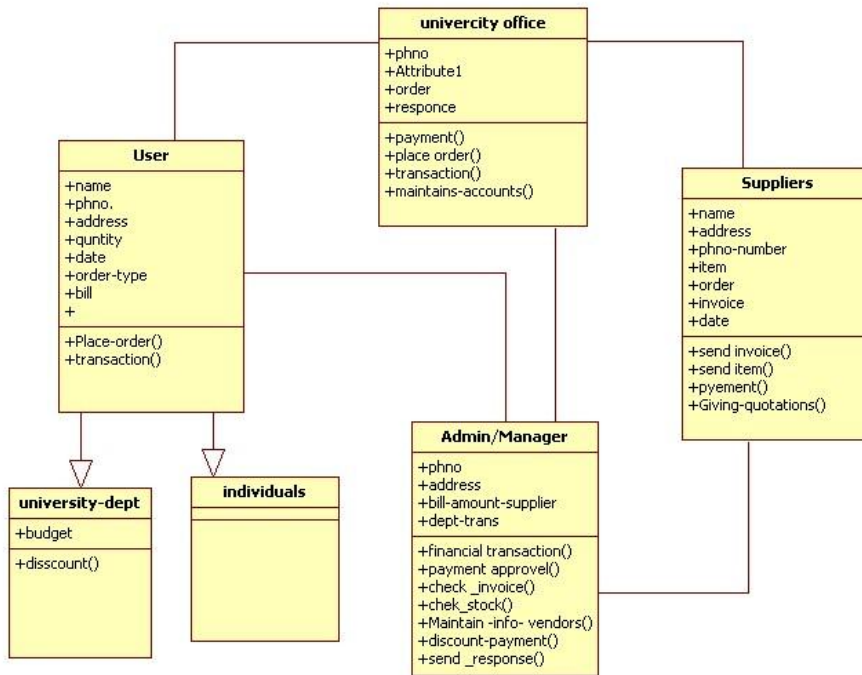


Figure 10. Class Diagram

Sequence Diagram

A Sequence diagram is an interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams or event scenarios. In figure 10, the sequence of activity is shown with respect to the suppliers.

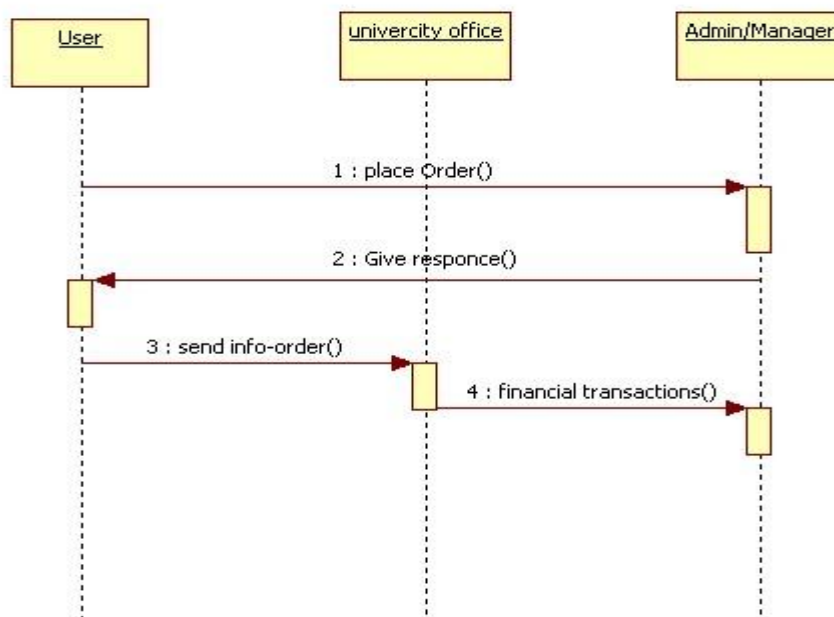


Figure 11. Sequence Diagram for user

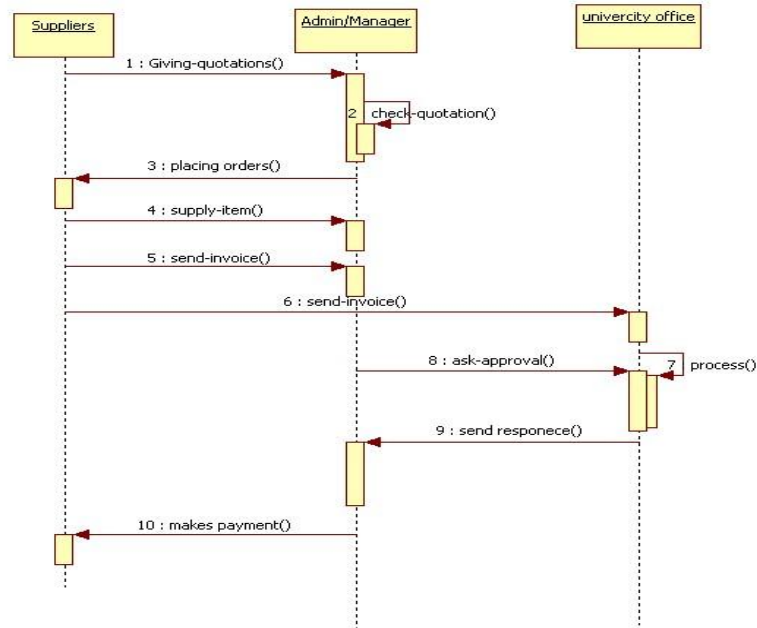


Figure 12. Sequence Diagram for supplier

Activity diagram

Activity diagrams are graphical representations of work flows of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modeling Language, activity diagrams are intended to model both computational and organizational processes (i.e. work flows). Activity diagrams show the overall flow of control. Activity diagrams may be regarded as a form of flowchart. Typical flowchart techniques lack constructs for expressing concurrency. However, the join and split symbols in activity diagrams only resolve this for simple cases; the meaning of the model is not clear when they are arbitrarily combined with decisions or loops.

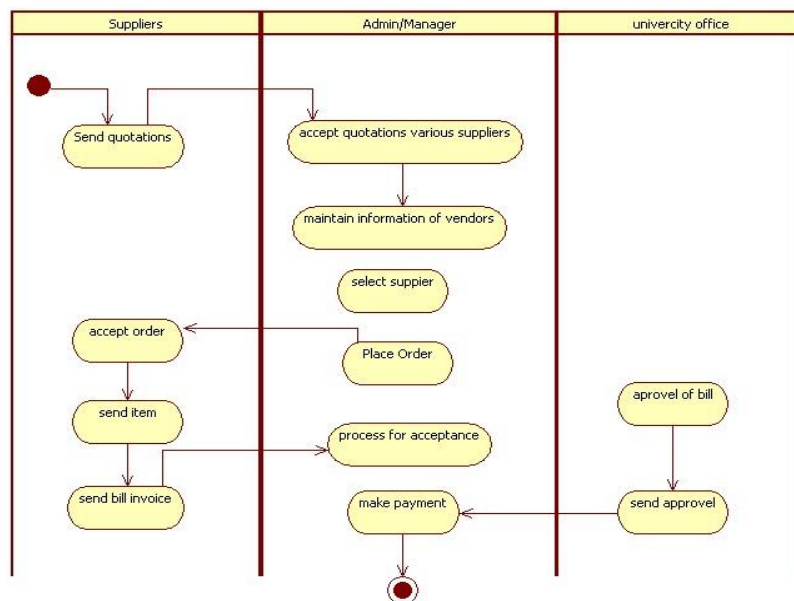


Figure 13. Activity Diagram for supplier

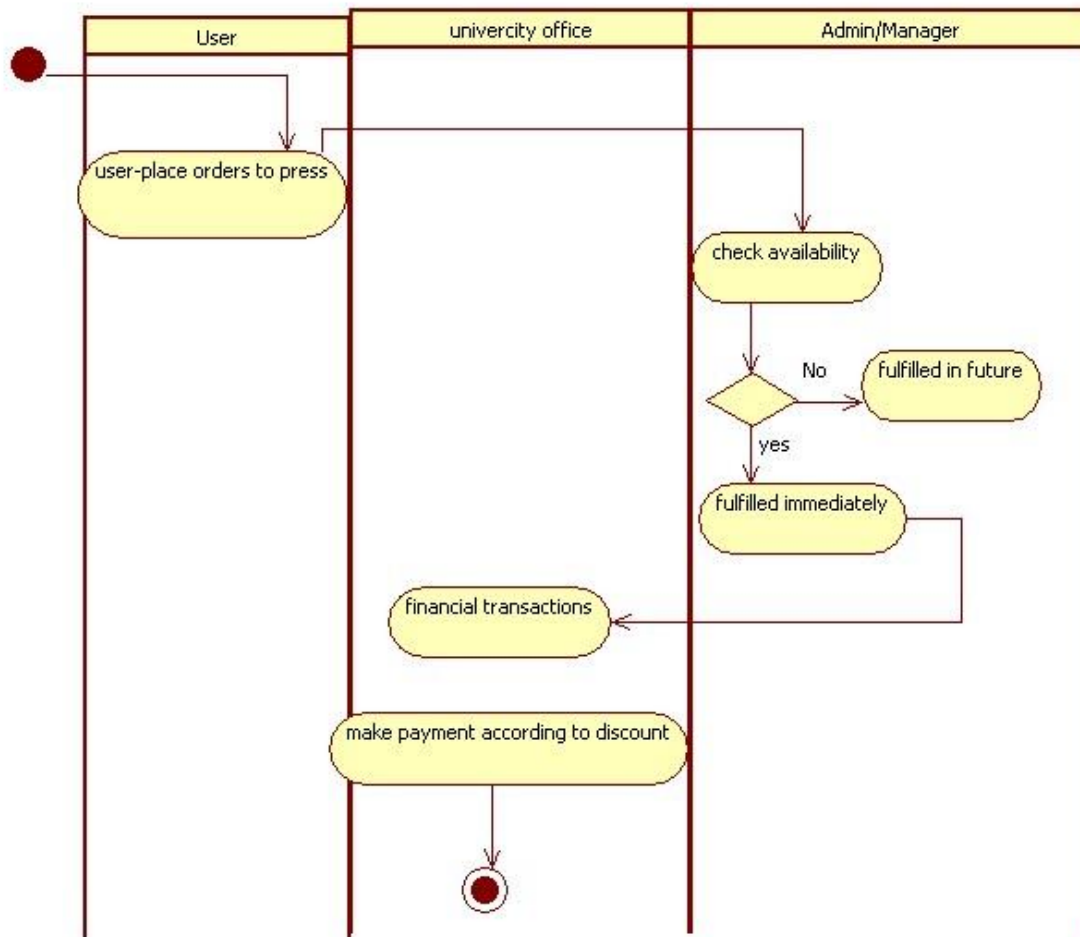


Figure 14. Sequence Diagram for user

In this way, the various diagrams related to SSAD and OOAD methodology can be constructed to understand the system in clarity of thought and communication.