NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

DECISION SUPPORT SYSTEM FOR MANAGEMENT OF MILITARY CONSTRUCTIONS

by

Adel Boukraa

March 2004

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13. ABSTRACT (maximum 200 words)

This thesis is primarily concerned with automation support for an organization in charge of the construction and modification of buildings for military bases and civilian construction during disaster relief.

The first issue at hand is the need to know how this organization functions manually and the participation of each department in daily work. Use Case Analysis was applied to understand the business process and an UML model was created to appraise the domain concepts. Architecture for a decision support system was then developed to provide the necessary automation support and a prototype for the user interface of the proposed system was constructed to evaluate the architectural design.

The proposal software will improve the decision-making ability of the leader of this organization and the heads of each department. It will make the routine tasks easier, and provide the necessary and accurate data in a timely manner.

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DECISION SUPPORT SYSTEM FOR MANAGEMENT OF MILITARY CONSTRUCTIONS

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Submitted in partial fulfillment of the
requirements for the degree of

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This thesis is primarily concerned with automation support for an organization in charge of the construction and modification of buildings for military bases and civilian construction during disaster relief.

The first issue at hand is the need to know how this organization functions manually and the participation of each department in daily work. Use Case Analysis was applied to understand the business process and an UML model was created to appraise the domain concepts. Architecture for a decision support system was then developed to provide the necessary automation support and a prototype for the user interface of the proposed system was constructed to evaluate the architectural design.

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ACKNOWLEDGMENTS

My deepest thanks to God for everything, including the opportunity to study in the United States. Thanks to Dr. Man-Tak Shing, and to Professor Richard Riehle for their many hours and constant dedication to the completion of this thesis. I dedicate my work to my parents Taib and Saida Boukraa, my wife Imen, and my daughter Safaa for their encouragement, and for their never-ending patience and love.

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I. INTRODUCTION

The primary goal of this thesis is to automate the business processes for an organization in charge of the construction and modification of buildings for military bases, and civilian construction during disaster relief. In recent years, the organization hired a contractor to automate the business processes but the organization did not receive the value paid for the supply contracts.

Armed with the rudimentary knowledge received at the Naval Postgraduate School, an attempt is made to address these issues and improve the process by developing a business application that improves the decision-making ability of the leader of this organization and the heads of each department.

The results of this thesis will free up personnel for more interesting and useful work, and provide the leader with a more timely and accurate picture of the organization in question. Routine tasks will be simplified and the necessary and accurate data received in a timely manner.

The first issue at hand is the need to understand how this organization functions manually and the participation of each department in the daily work. Chapter II presents a clear idea of the capacity of the organization to accomplish this project, the intended customers and the necessity for such a system. Next, the requirements are refined in order to have an accurate design of the system by taking into consideration the hardware and software already in place. To achieve this goal, object oriented methodology with UML models are was used to capture the knowledge of the business process for a basis for understanding the elements involved in finding a solution. The process of developing the requirements specification is the focus of Chapter III. Chapter IV shows the architecture developed for the system that matches the requirements. The prototype was developed in Chapter V by using Microsoft Access to have a clear idea about the user interfaces and the functionality of the entire system.

The sequence diagrams appear in Appendix A and the data dictionary in Appendix B provides a programmer's guide to developing reliable software.

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II. SOFTWARE REQUIREMENTS SPECIFICATIONS

A. GOALS

The major goal of this thesis is to develop an automated support tool for the leader of an organization in charge of the construction and modification of buildings for military bases and civilian construction during disaster relief. Such software will improve the decision-making ability of the leader of this organization and the heads of each department. Routine tasks will be simplified and the necessary and accurate data received in a timely manner.

B. DOMAIN

This organization is composed of approximately 2,000 civilians and 500 military personnel. The military and civilians of different specialties work together to design and manage the construction of military facilities for the Army, Navy, Air Force and other assigned government agencies. This organization stands ready to meet national security, emergency and other national requirements.

C. ORGANIZATION

Figure 1 shows the diagram of the organization, which consists of two major departments (financial and technical) under the oversight of the director and other services. Their specific functions are described as follows.

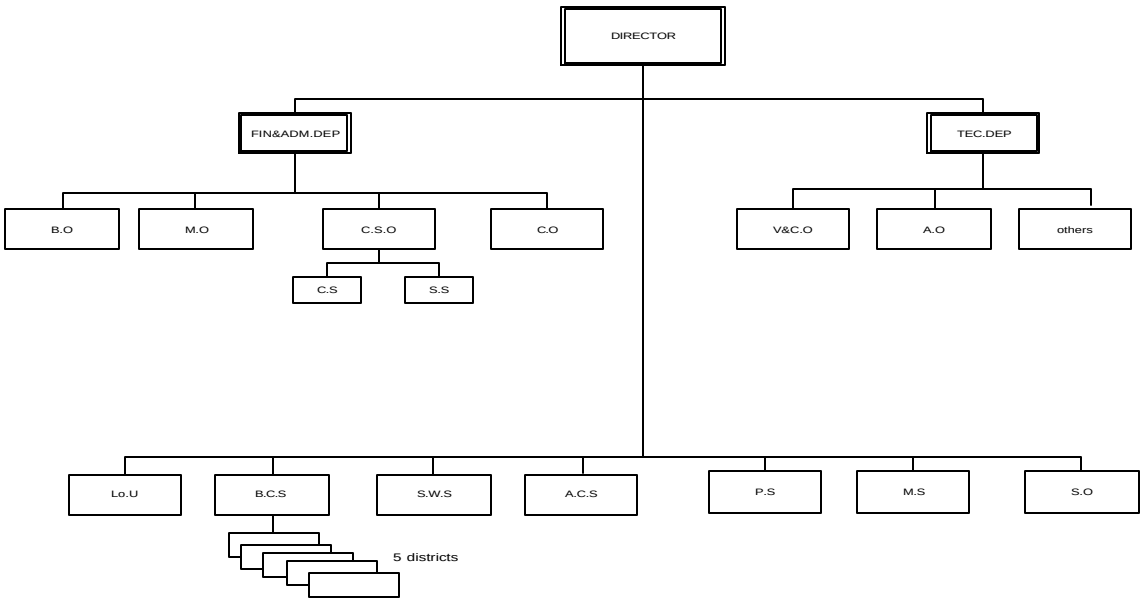

Figure 1. Organization Diagram

1. Director

This position provides leadership and oversight of a major, function program, as well as overseeing the financial aspects of unit management, including controlling the budget and allocating resources. It keeps abreast of the progress of the projects, and also interfaces with the Minister and the other heads of the ministry when appropriate.

2. Technical Department (TEC-DEP)

This department designs and manages the construction of military facilities for the Army, Navy and Air Force (Military Construction), and other government agencies.

This department is composed of several technical offices.

a. Verification and Control Office (V.C.O)

This office controls all projects and verifies that the project is completed in accordance with the agreement.

b. Architecture Office (A.O)

This office provides the designs necessary for the realization of the projects.

c. The Other Technical Offices (Others)

The design and management of projects is conducted by this office.

3. Administrative and Financier Department (FIN&ADM.DEP)

This department manages the budget of this organization and is responsible for the recruitment of the necessary civilian workers. It is composed of several administrative offices.

a. Civilian Staff Office (C.S.O)

This office is responsible for the management of the civilian personnel (Recruitment, Payroll, Promotion...)

b. Budget Office (B.O)

This office controls the budget and its distribution among projects.

c. Market Office (M.O)

Different types of markets with the supplier and control over their execution are established by this office.

4. Production Service (P.S)

This service makes the necessary materials to be used in the buildings, such as the windows, doors, furniture, and so forth, and helps to fix said materials.

5. Air-Conditioning Service (A.C.S)

The main function of this service is to install and fix the air conditioning, kitchens and bakery.

6. Logistic Unit (Lo.U)

The Logistic Unit is a military unit that provides the logistic means for the other departments as well as service for the execution of projects and manages the military personnel.

7. Maintenance Service (M.S)

This service is responsible for the management and maintenance of trucks, bulldozers and other equipment needed for the completion of the construction.

8. Supply Office (S.O)

This office contains four warehouses in which the different types of items used for construction are stored.

9. Special Works Service (S.W.S)

This service executes the urgent projects and those of a secure nature.

10. Big Construction Service (B.C.S)

This service is composed of five districts that execute the non-contractor projects.

D. AVAILABLE HARDWARE

The proposal software must run on the hardware setup shown in Figure 2, which consists of a centralized server connected to computers in various department offices via a local area network and to remote offices via phone lines.

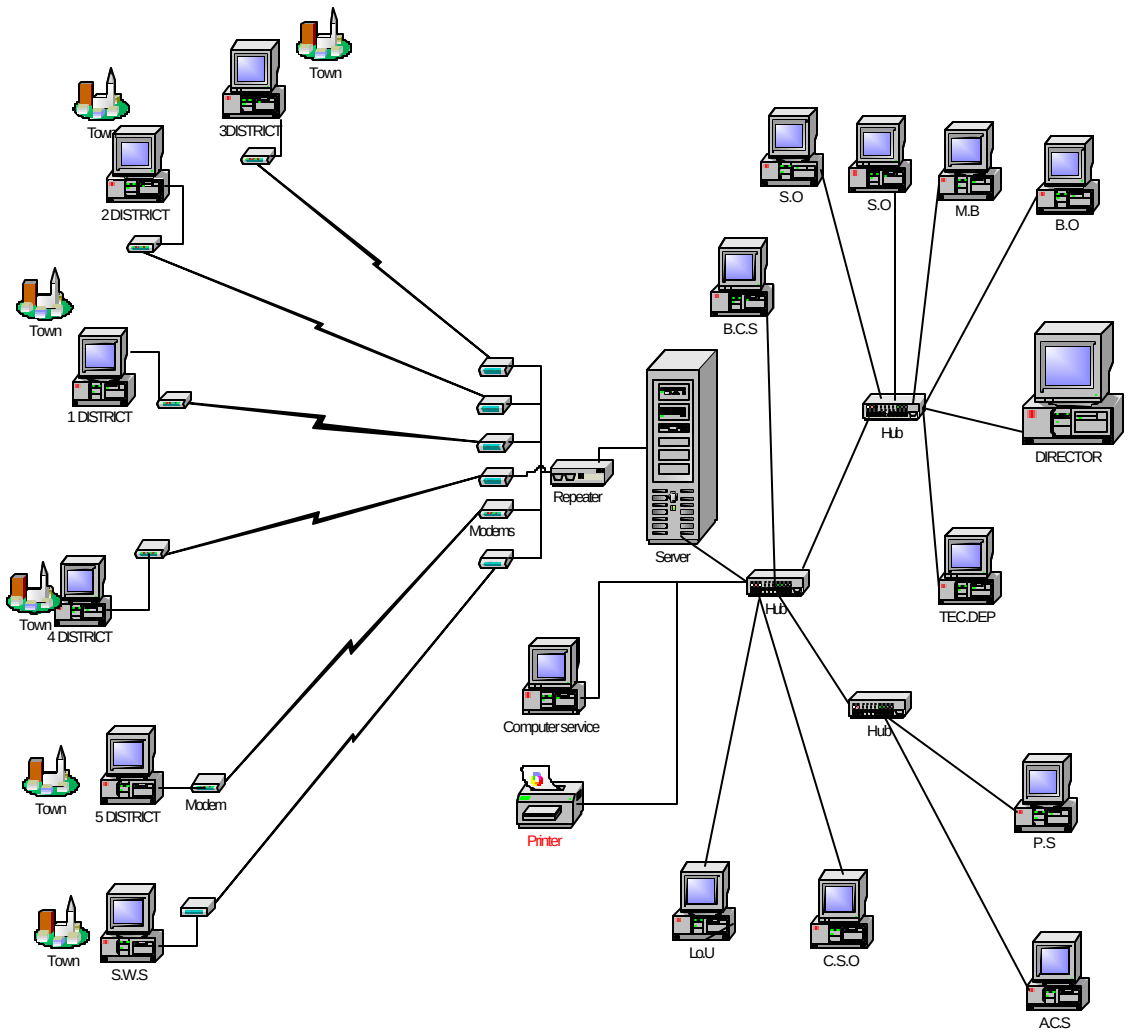

Figure 2. Available Network

E. AVAILABLE SOFTWARE

1. Civilian Office (Payroll)

This software is written in COBOL to compute civilian staff payroll and their promotion in rank or category. This software does not provide statistics about expenses. A historical file does not exist to verify mistakes.

2. Supply Office (Stock Management)

This software is written in COBOL to keep track of stock (consumables, construction truck, machine parts). This software is not reliable and cannot ensure that the main function to keep track of stock occurs due to management rules.

3. Logistic Unit

This software is used to manage military personnel but it cannot accomplish much functionality such as keeping track of historical data and providing accurate data on personnel.

4. Budget Bureau

This software is written in FOX-PRO. Its goal is to manage the budget. This goal was reached but has a disadvantage. Its output cannot be used with other software.

F. PROBLEMS WITH EXISTING SYSTEMS

A plan to automate the organization that takes into consideration the available sources such as computer personnel staff and money does not exist.

A complete solution for automation also does not exist to help the commanders take action. The existing hardware configuration does not take into consideration what the software architecture will be. Manual information is still the main source for daily work. The maintenance of the existing software is expensive as no documentation or source code is available. The existent software solution is not reliable in that there is no back-up system. It is not possible to ensure payroll is met for the next month. Sharing data between departments is not trustworthy due to inconsistency in data from different sources. Individual decisions are still the main source for taking action. Making decisions are based on experience and analyzing data. Many in this staff's organization prefer to work manually. The budget to automate this organization is not available and also depends on the general policy of the Ministry of Defense.

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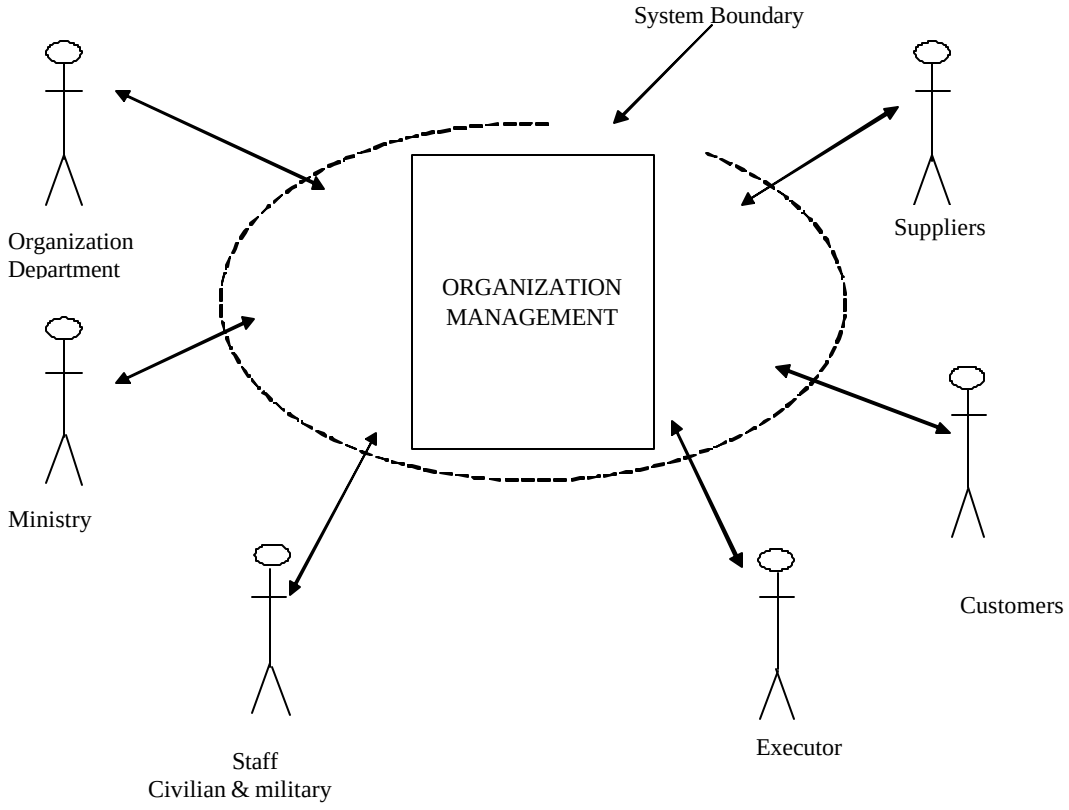
III. SYSTEM REQUIREMENTS

A. SOLUTION SYSTEM BOUNDARY

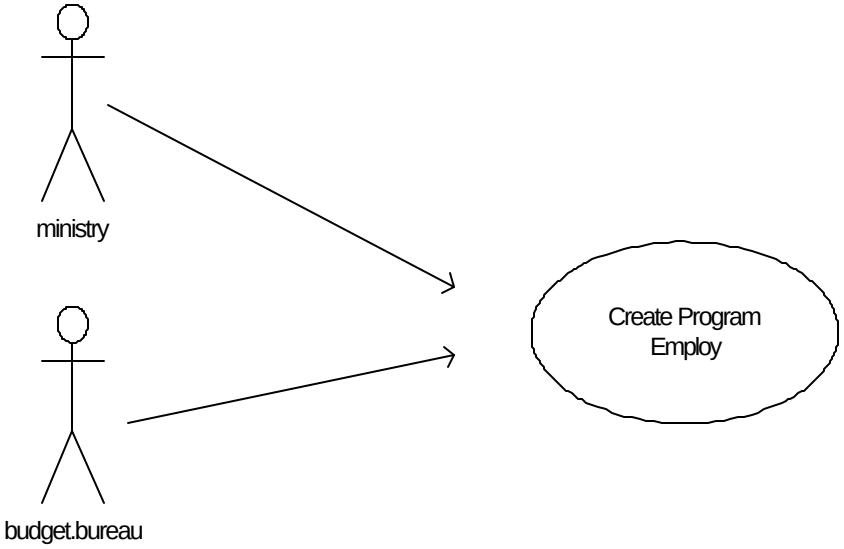
The figure below shows the system boundary with the main users who contribute the most to this organization.



B. USE CASES

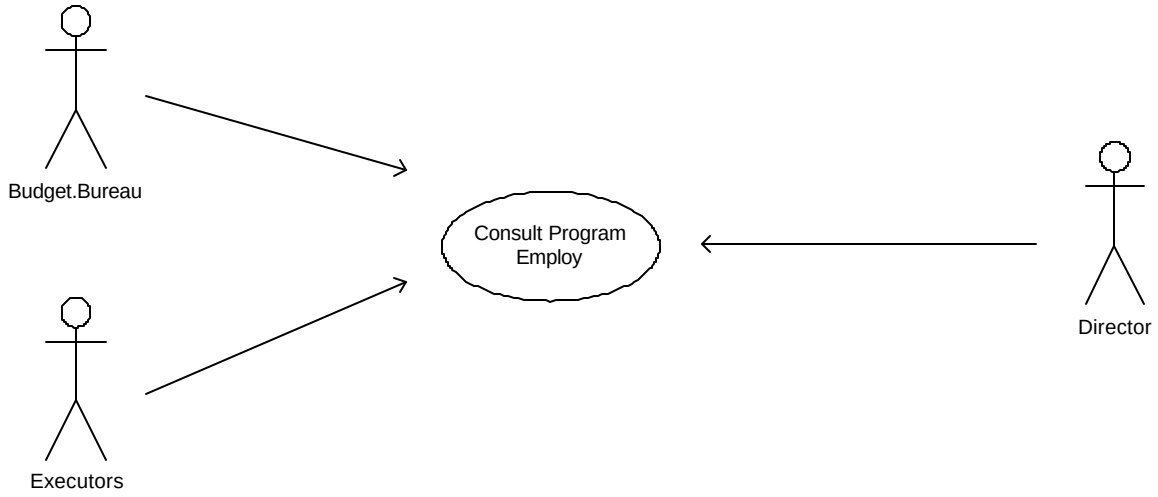
This section presents 18 use cases to analyze the business process of the organization. They describe the problem domain in unambiguous terms for communication with the potential users of a system, so as to ensure that the correct product will be built. The use cases are presented into the focused step of iteration that describes from a business perspective how to use cases that share functionality and assist one another in reaching an understood goal.

1. Create Program Employ



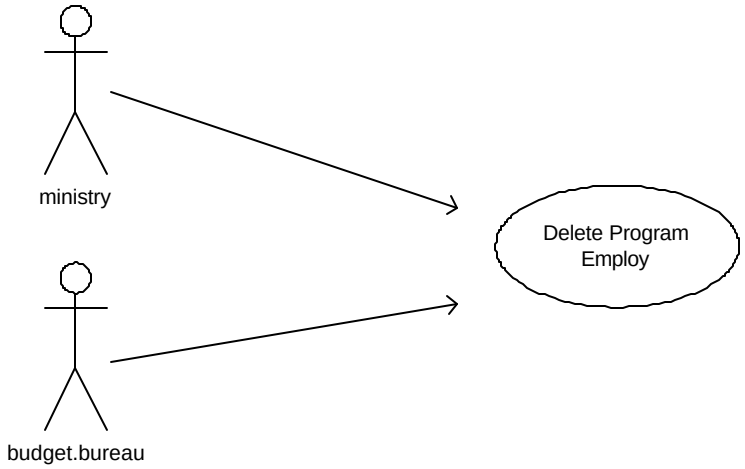
Use case name	Create Program Employ (Scheduled projects)
Iteration	Focused
Summary	The ministry sends the current projects to the organization. The Budget Bureau takes this program and enters the necessary information into a computer.
Basic Course of events	1. The Ministry sends the current Employ Program 2. The Budget Bureau enters the code for each item 3 The operator introduces the code into the computer 4. Code invalid check with the Bureau 5. Code valid introduces the remaining data
Related Business Role	- Each title contains many items - Each item must exist only in one title - The item can be executed for more than one year
Author	Boukraa, Adel
Date	

2. Consult Program Employ



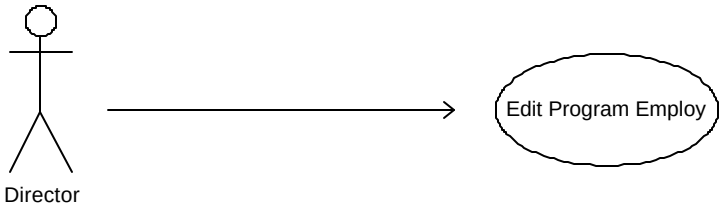
Use case name	Consult Program Employ
Iteration	Focused
Summary	The Budget Bureau and the director introduce the code to consult each item. The executor enters the code to consult the items that he is allowed to consult.
Basic Course of events	1. The operator introduces the choice for consultation 2. The operator introduces the necessary code to consult 3. The system displays the information 4. The operator's choice to continue or exit the consultation
Related Business Role	- Each item must be consulted by the allowed user
Author	Boukraa, Adel
Date	

3. Delete Program Employ



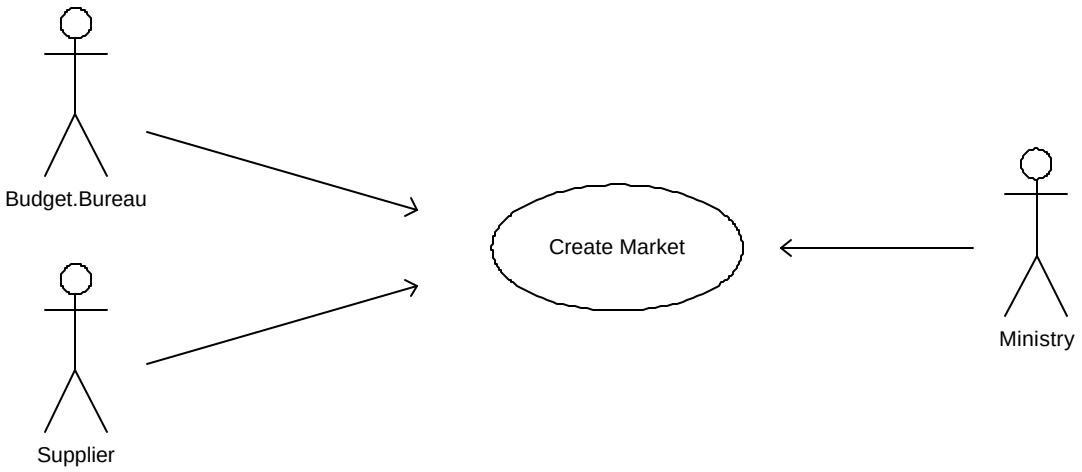
Use case name	Delete Program Employ
Iteration	Focused
Summary	The Ministry sends a decision to delete Item from Program employ. The Budget Bureau obtains the right code for this Item and deletes it.
Basic Course of events	1. The Ministry sends the decision to delete item 2. Budget Bureau picks the code 3. Operator enters the code 4. System displays the message 5. Operator chooses to delete or not delete
Related Business Role	- To delete item, the Budget Bureau makes a ministry decision
Author	Boukraa, Adel
Date	

4. Edit Program Employ



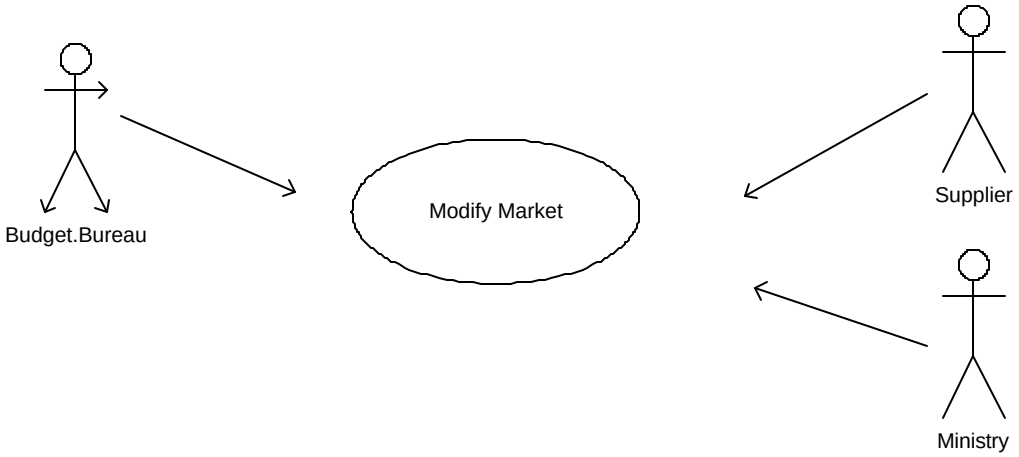
Use case name	Edit Program Employ
Iteration	Focused
Summary	The Director needs to know the global situation of the Employ Program. Then he uses the application to have an global edit for this program
Basic Course of events	1. Director needs to know the program 2 The operator enters the choice 3. The system edits the program
Related Business Role	- Only the director is allowed to have this function
Author	Boukraa, Adel
Date	

5. Create Market



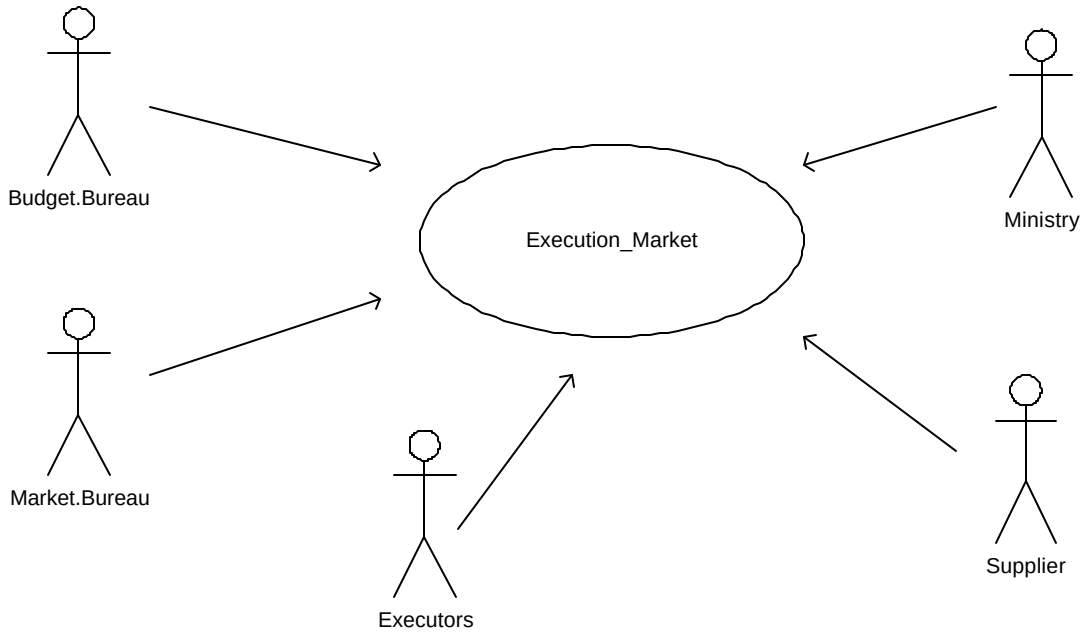
Use case name	Create Market
Iteration	Focused
Summary	The ministry sends the approved market to B.B. The B.B creates a code for each market and introduces the global data for the market.
Basic Course of events	1. Ministry sends the approved market 2. B.B receives the market 3. B.B creates the code and introduces global information of market 4. If new supplier, B.B creates a new supplier record
Related Business Role	- Market can only have one program employ - The market is valid only if it is approved by the ministry
Author	Boukraa, Adel
Date	

6. Modify Market



Use case name	Modify Market
Iteration	Focused
Summary	The supplier sends request to modify market. The ministry approves this request and sends the modification of market to B.B. The B.B introduces the data into the computer.
Basic Course of events	1. Supplier sends request 2. Request approved by ministry 3. B.B receives modification market 4. B.B checks the type modification 5. B.B enters global data for this modification
Related Business Role	- Market has zero or more modifications - The modification is valid only if it is approved by Ministry
Author	Boukraa, Adel
Date	

7. Execution Market

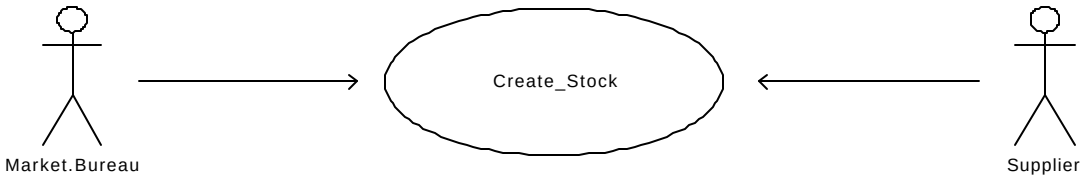


Use case name	Execution Market
Iteration	Focused
Summary	The B.B sends a copy to the supplier, executors and market bureau. The Executors send the reports that contain the supplier's bills to the market bureau that checks these reports and send them to B.B. These reports will be sent to the ministry from whom the suppliers receive their money.
Basic Course of events	1. B.B sends copy to supplier, market bureau and executor 2. Executor sends report market to M.B 3. M.B Check report market 4. M.B updates market 5. M.B sends report to B.B 6. B.B sends report to ministry 7. Supplier obtains money from ministry
Related Business Role	- Report contains one or more bills - The bills must match the market clauses. - The market contains one or more reports
Author	Boukraa, Adel
Date	

8. Consultation Market

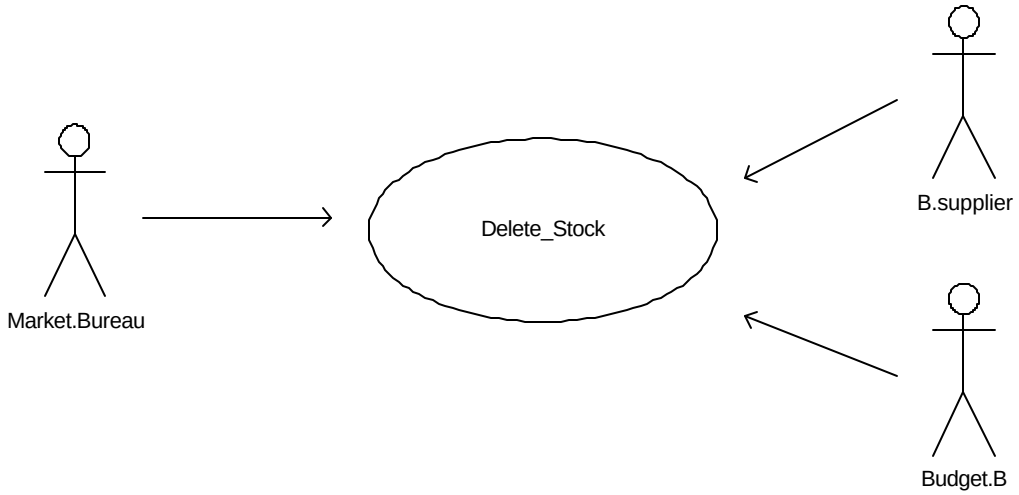
Use case name	Consultation Market
Iteration	Focused
Summary	The Bureau market checks the situation of all markets or a specific market each week. The director consults the situation of each specific market.
Basic Course of events	1. M.B introduces choice 2. Choice = all markets 3. System edits situation 4. Choice = specific market 5. System edits situation with reports and bills market 6. Director enters code for specific market 7. System edits the situation with reports and bills market
Related Business Role	- The consultation must be 100% accurate at the end of the week
Author	Boukraa, Adel
Date	

9. Create Stock



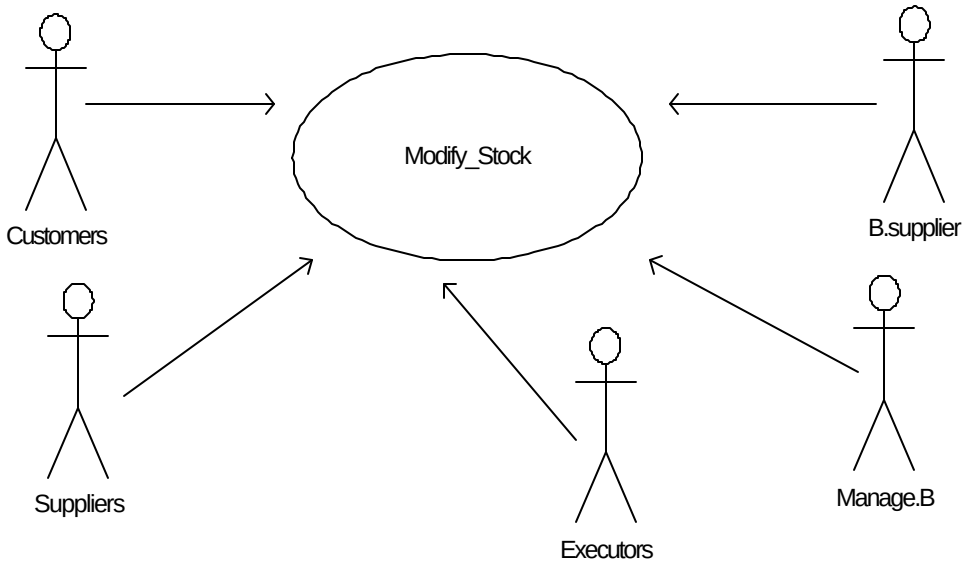
Use case name	Create Stock
Iteration	Focused
Summary	The Suppliers send bills. The M.B introduces code item, if item does not exist then introduces remaining data for the new article
Basic Course of events	1. M.B get bills 2. Verifies code 3. Code does not exist 4. Creation of new item
Related Business Role	- Be sure that this item has the right code - Verification of stock each month to avoid duplication of item - Manual records match automated records
Author	Boukraa, Adel
Date	

10. Delete Stock



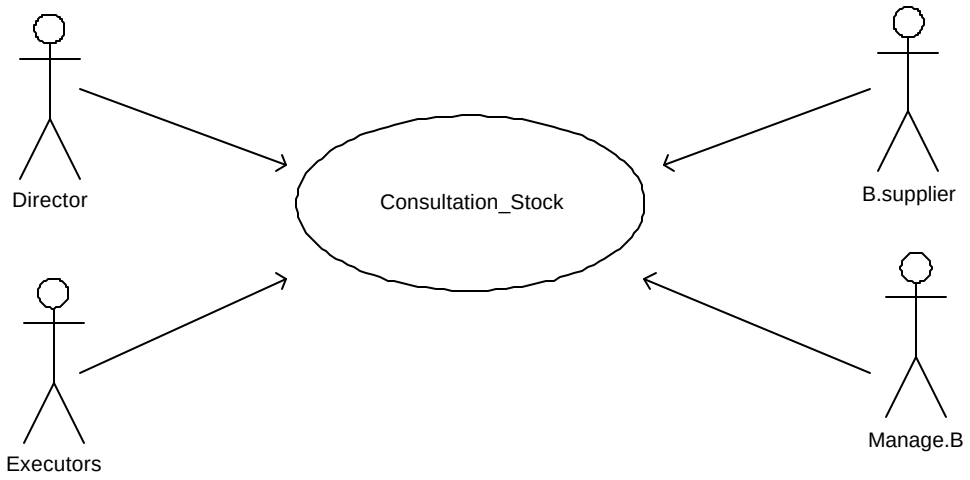
Use case name	Delete Stock
Iteration	Focused
Summary	When the market bureau finds an error during the execution of Market in collaboration with B.B and B.S., the market bureau erases the item for this market and replaces it with the creation of a new article.
Basic Course of events	1. B.B or B.M or B.S find code article that does not match 2. M.B verifies that this code is for this market 3. Deletes code
Related Business Role	- To delete the item you must have Boss authorization
Author	Boukraa, Adel
Date	

11. Modify Stock



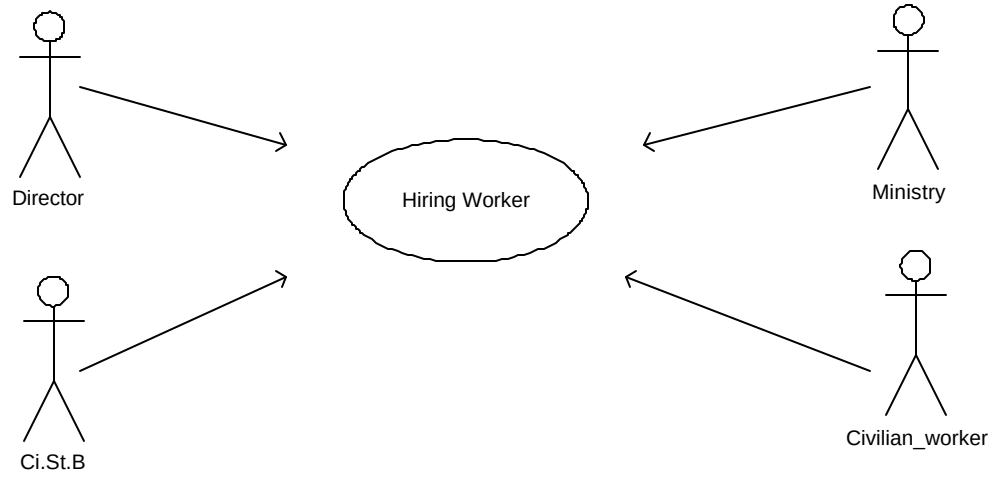
Use case name	Modify Stock
Iteration	Focused
Summary	The Manage Bureau receives request from suppliers or executors or customers. M.B processes the request and modifies the stock. The supply bureau performs the physical operation.
Basic Course of events	1. Customer or executor or supplier applies query. 2. Manage Bureau takes this query 3. M.B enters type query 4. M.B introduces code item 5. M.B valid dates items 6. Stock to be modified dependent on the type of query
Related Business Role	- Take in consideration the minimum quantity in stock only if the query signed by authority is performed
Author	Boukraa, Adel
Date	

12. Consultation Stock



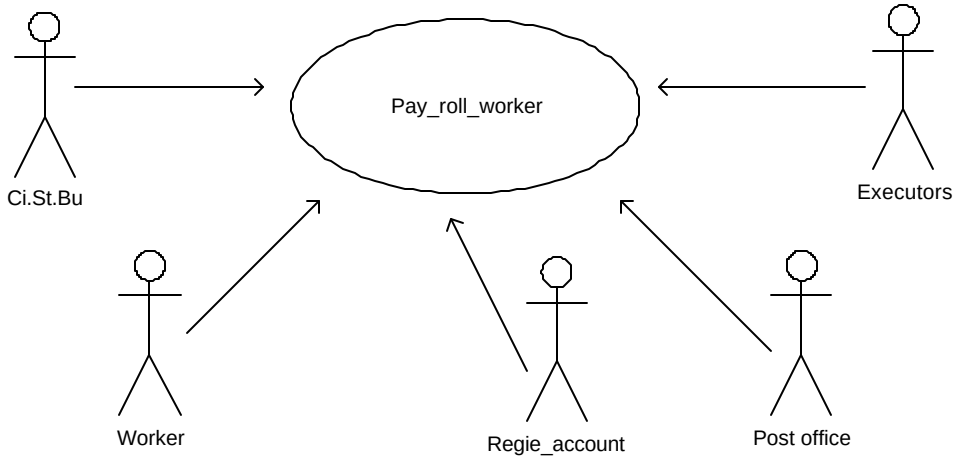
Use case name	Consultation Stock
Iteration	Focused
Summary	The Director, B.S and M.B can consult all the stock. The executors consult only the item that is used.
Basic Course of events	1. Users enter their code 2. System displays screen 3. Users enter code choice item to consult 4. System displays data about item
Related Business Role	- Each executor consults the item in his field
Author	Boukraa, Adel
Date	

13. Hiring Worker



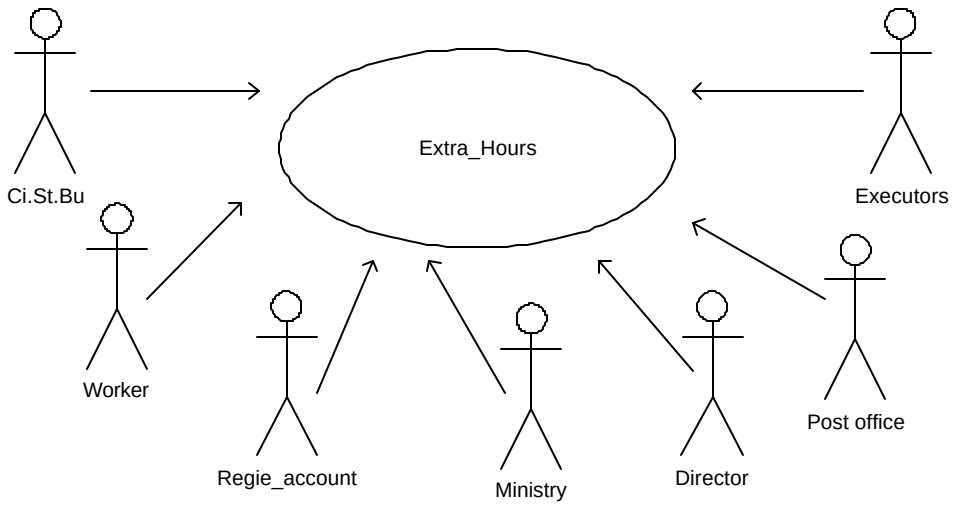
Use case name	Hiring worker
Iteration	Focused
Summary	The person applies for a job in the C.S.O. The bureau sends this application to the director that signs it and sends it to the Ministry. If the Ministry approves this application, the C.S.O introduces the new worker record into the computer.
Basic Course of events	1. Person applies for job 2. C.S.O sends application to director for signature 3. Director sends application to Ministry for approval 4. Application approved will be received by C.S.O 5. C.S.O gets the ID for the worker 6. The operator introduces the complete data for the worker in the computer
Related Business Role	- Verify the type of application (contractor, temporary) - Verify if the worker has old ID (Unique identification) - The recruitment is final only if the application is approved
Author	Boukraa, Adel
Date	

14. Worker Payroll



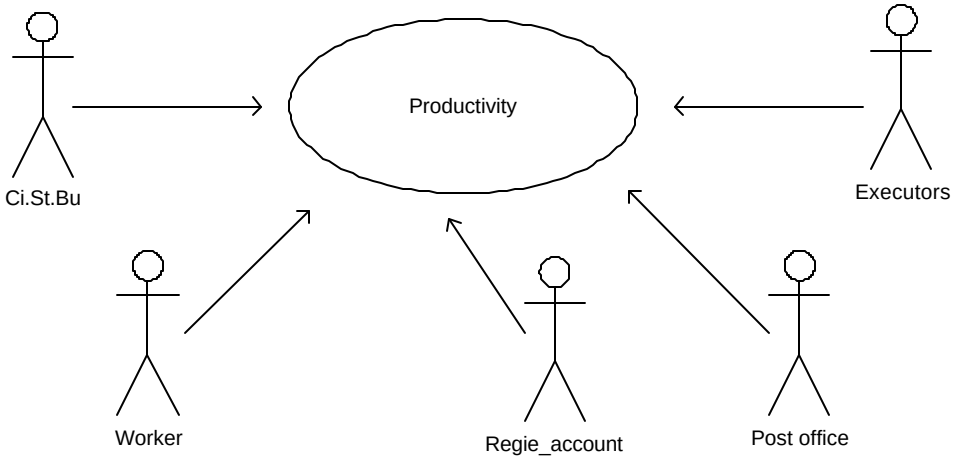
Use case name	Pay_roll_worker
Iteration	Focused
Summary	At the end of each month, the executors send the number of hours to the contractor, the temporary workers to the C.S.O. The office verifies these hours and the system computes the payroll and generates a copy. The operator checks the copy with the manual records and corrects if there are errors or validates this step and sends the payroll to the post office where the worker obtains wages.
Basic Course of events	1. Executors send number of hours to C.S.O 2. C.S.O checks hours 3. System computes payroll 4. System generates a copy of payroll 5. C.S.O checks copy and corrects if there are mistakes 6. System does final computation of payroll and edits three copies of payroll and docket 7. C.S.O sends two copies to the *accounting service* and keeps one for historical data. 8. The *accounting service* sends one copy to the post office 9. Workers obtain wages from post office
Related Business Role	- The number of hours: 104 <= hours <= 208 - The number of hours can be sent manually or automatically by executors
Author	Boukraa, Adel
Date	

15. Worker Extra Hours



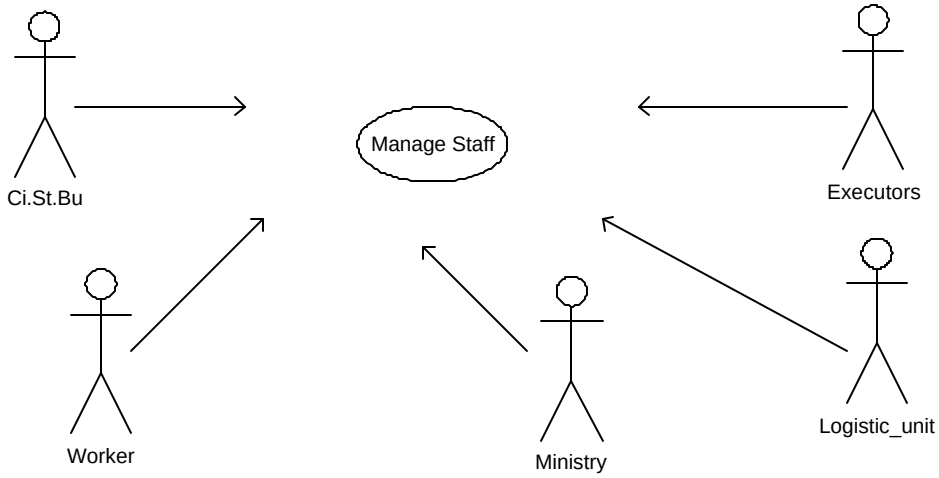
Use case name	Extra hours
Iteration	Filled
Summary	The executors send the extra hours to the C.S.O Then the bureau send these hours to the director to be signed and approved by the Ministry. They then introduce these hours into the computer and the computer computes these hours and generates three copies. The same operation of as that of payroll is used.
Basic Course of events	1. Executors send number of hours to C.S. O 2. C.S.O checks hours 3. Hours signed by director 4. Hours approved by ministry 5. Computer computes extra hours 6. Hours checked by operator 7. System does final computation of extra hours and generates three copies of extra hours and docket 8. C.S.O sends two copies to the *accounting service* and one is for historical purposes. 9. The *accounting service* sends one copy to the post office 10. Workers obtain their extra hours from the post office
Related Business Role	- extra hours <=104 /month - The number of hours can be sent manually or automatically by executors - Extra hours must be approved by the Ministry
Author	Boukraa, Adel
Date	

16. Worker Productivity



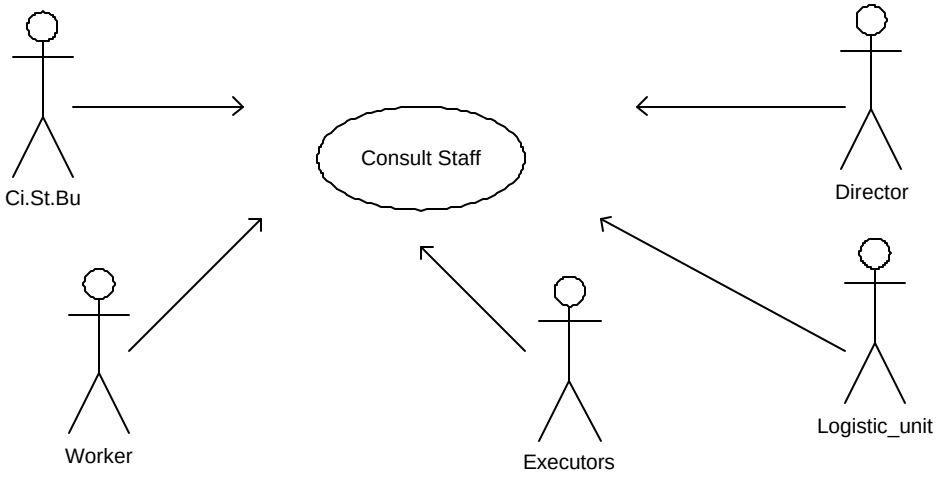
Use case name	Productivity
Iteration	Focused
Summary	Each six months, the executors send the contractor's and temporary worker's grade and days present to the C.S.O. The office verifies the grade and presence. The system computes the productivity and generates a copy for the operator to check against the manual copy and correct it if there are errors. The validated report sent to the post office where the worker obtains his productivity.
Basic Course of events	1. Executors send grade and days present to C.S.O 2. C.S.O checks days present 3. System computes productivity 4. System generates a copy of productivity 5. C.S.O checks copy and corrects all mistakes 6. System does final computation of productivity and generates three copies of productivity and docket 7. C.S.O sends two copies to the *accounting service* and one is for historical purposes. 8. The *accounting service* sends one copy to the post office 9. Workers obtain their productivity from the post office
Related Business Role	- Grade <= 20 - Presence day <= 180 - Presence day < 140 day =>productivity = 0
Author	Boukraa, Adel
Date	

17. Manage Staff



Use case name	Manage Staff
Iteration	Focused
Summary	When the organization receives the authorization to employ a worker (civilian or military),the C.S.O is responsible for managing civilians, the placements of workers (districts) and their promotion and familial situation and salary, but for military personnel, the logistic unit is responsible only for their number and their place of employment (districts, services…).
Basic Course of events	1. The executors send needs for workers 2. The S.C.O or logistic unit does the detachment decision 3. Introduces the decision into the computer 4. Each time a change occurs in the administrative situation of a worker, the executors send the necessary papers 5. C.S.O introduces the type of decision and remaining data 6. The logistic unit sends these papers to the Ministry
Related Business Role	- Age for civilian when recruited <=40 - For single: children = 0 - Promotion of civilian worker must approved by the Ministry - Change in the type of worker must be approved by the Ministry
Author	Boukraa, Adel
Date	

18. Consult Staff

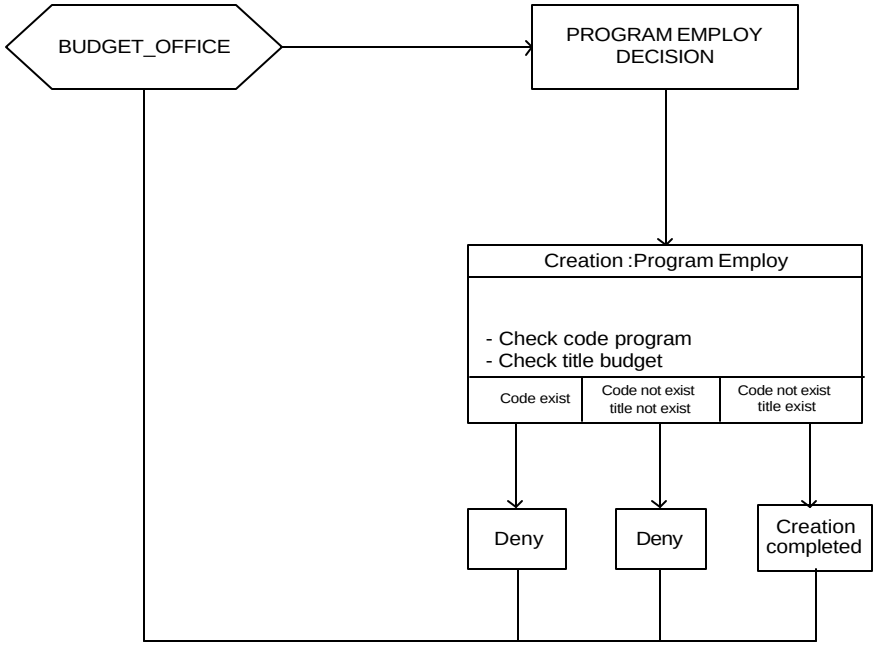


Use case name	Consult Staff
Iteration	Focused
Summary	When the director receives a claim from executors or workers, he consults the system to understand and become knowledgeable about the situation and the executors or logistic unit or S.C.O have to verify the situation of the worker when it is required.
Basic Course of events	1. The executors or worker send a claim to the director 2. The director enters the type of consultation 3. The system displays the contents of the consultation 4. The executors or logistic unit or S.C.O introduce the type of consultation when needed. 5. System displays or edits the information
Related Business Role	- Director consults all workers - S.C.O consults only civilian workers - Logistic unit consult only military personnel - Executors consult only people that belong to them.
Author	Boukraa, Adel
Date	

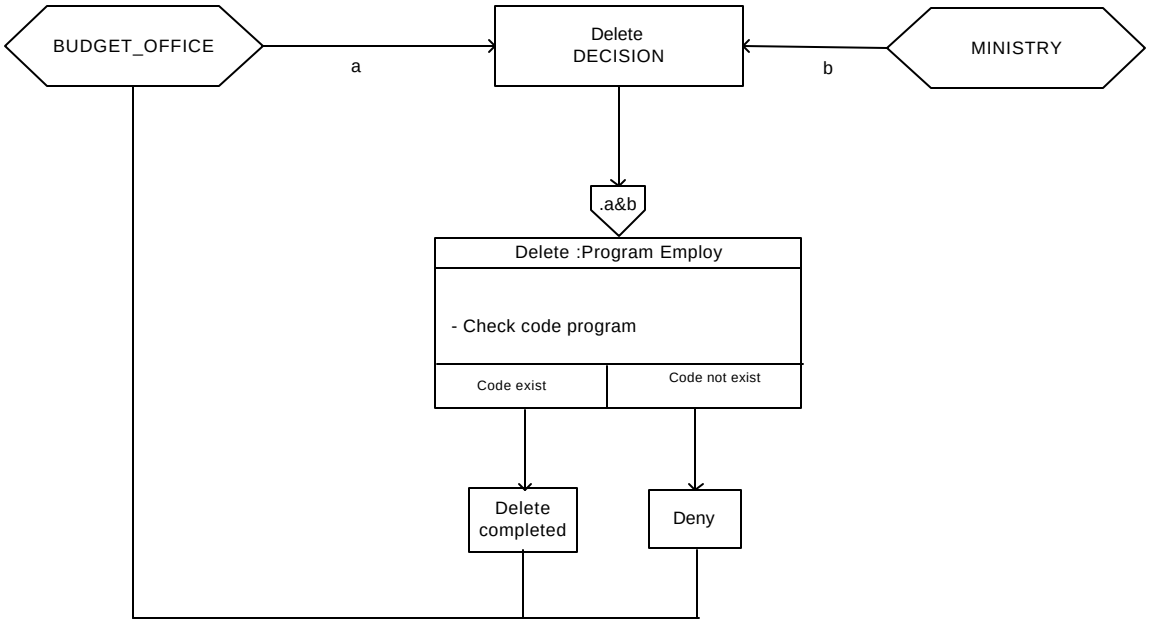
C. SYSTEM OPERATIONS

The system operation was developed using the graphical tools provided by the MERISE method to describe the operations of the system as shown below.

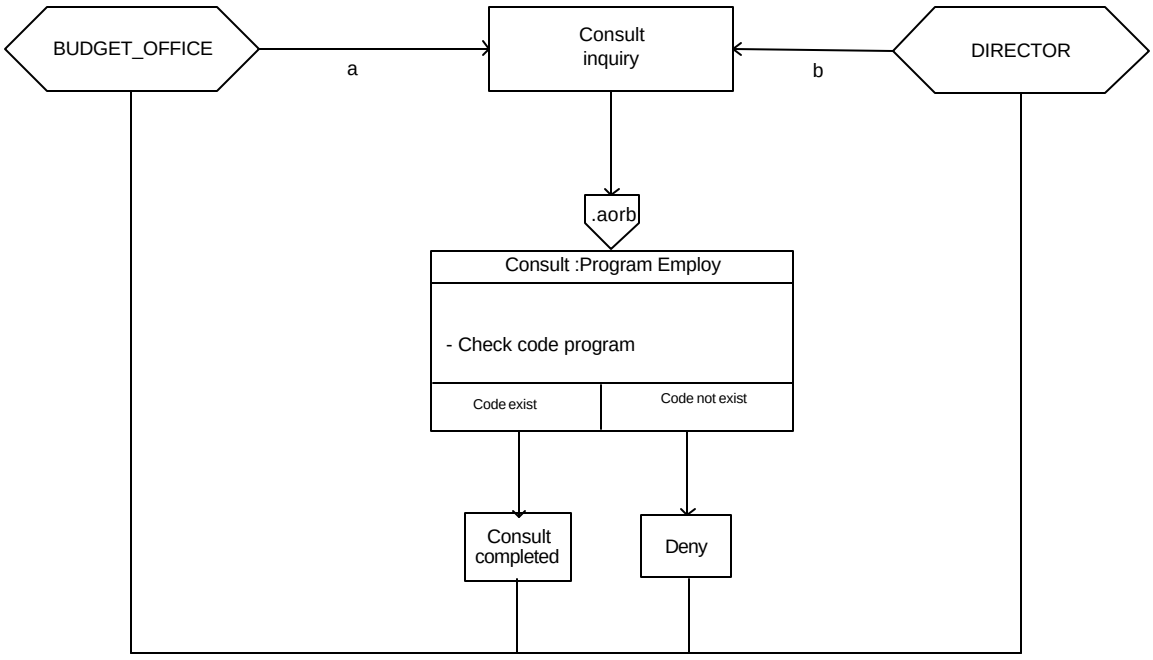
1. Program Employ



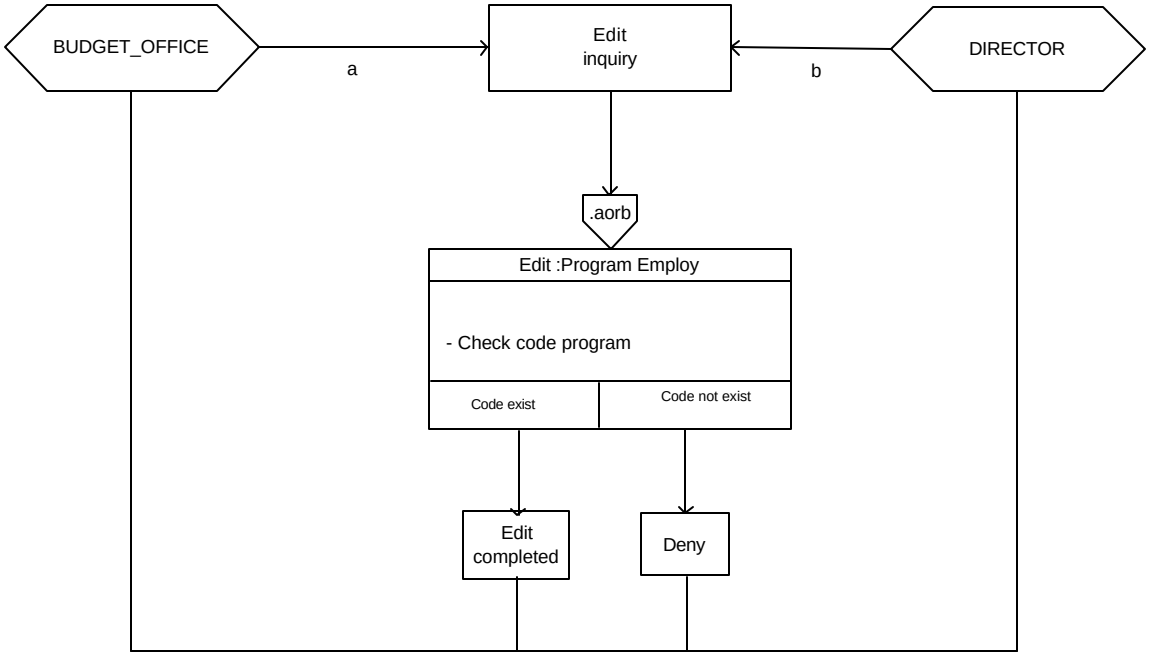
2. Delete Program Employ



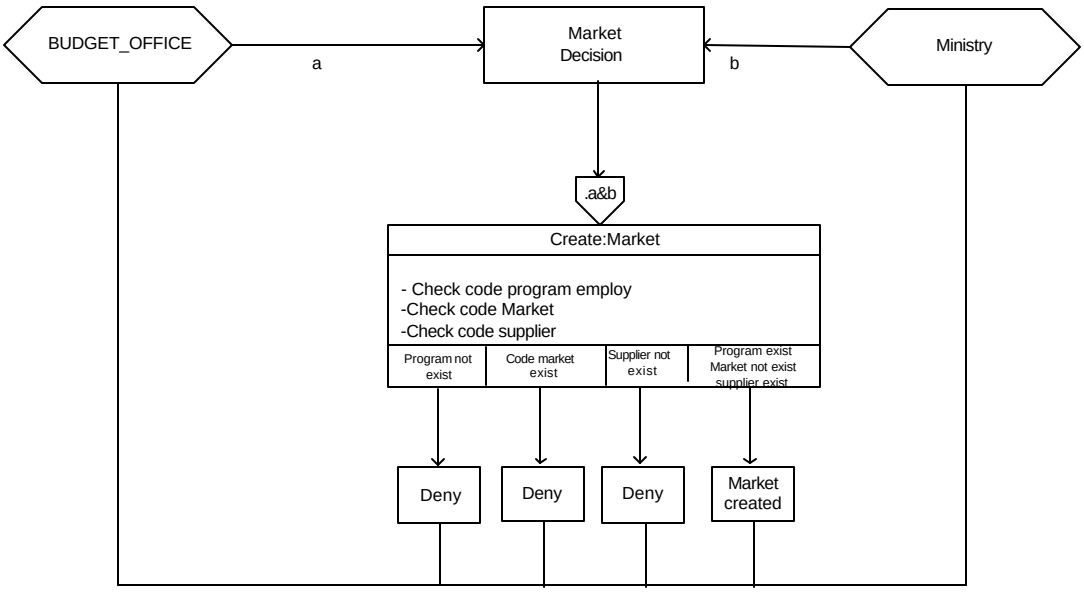
3. Consult Program Employ



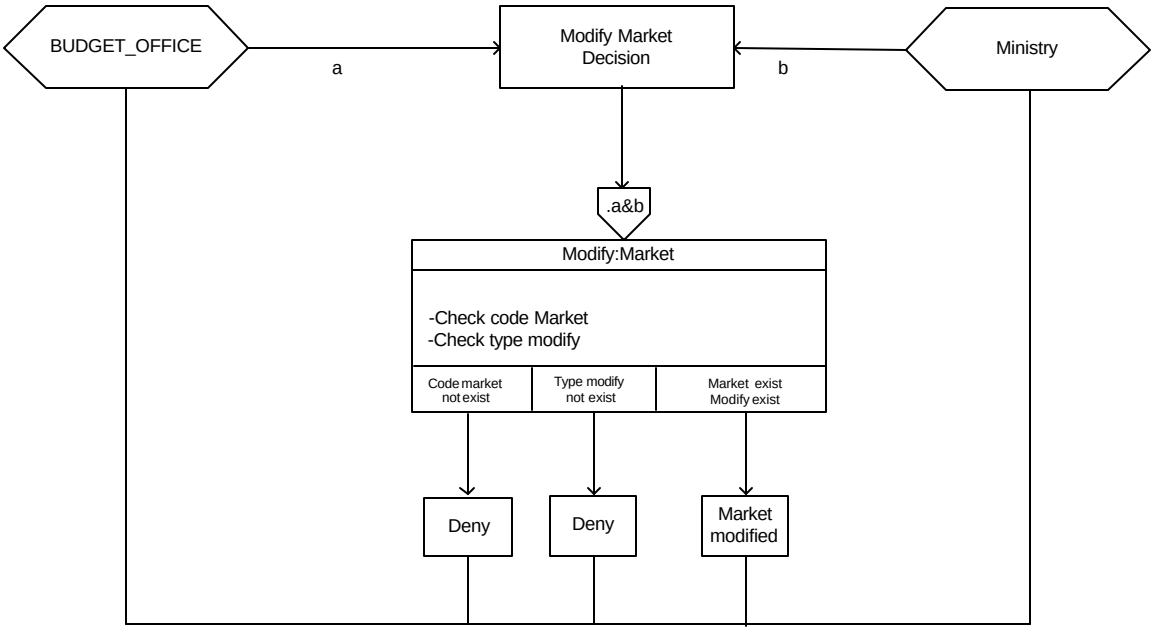
4. Edit Program



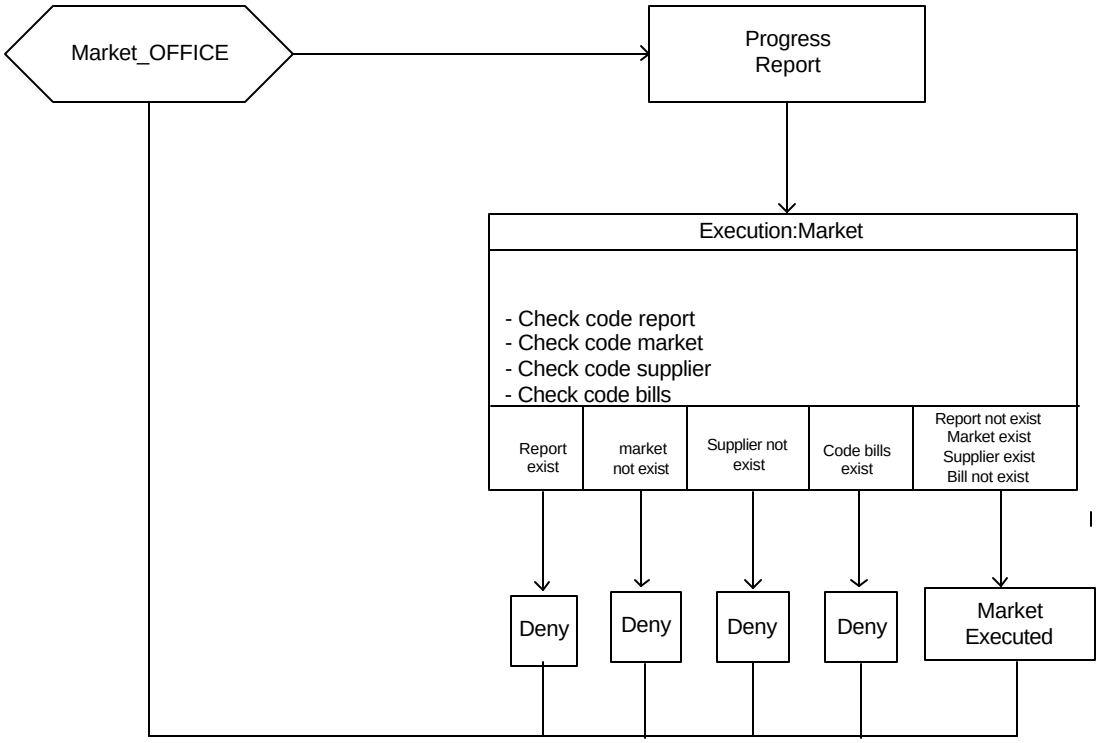
5. Create Market



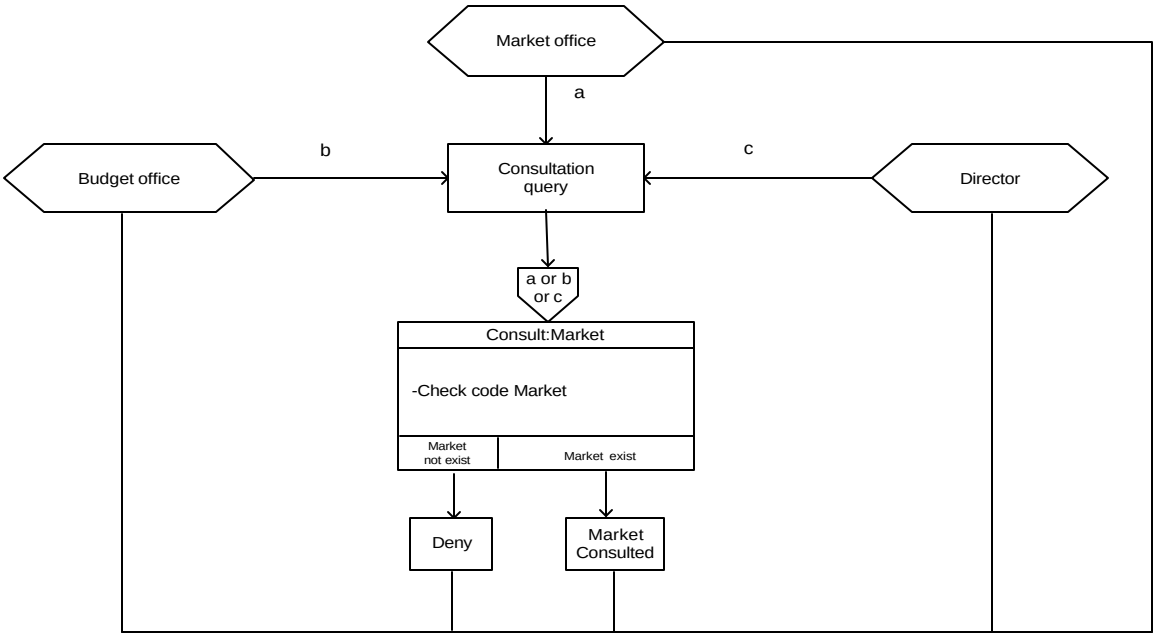
6. Modify Market



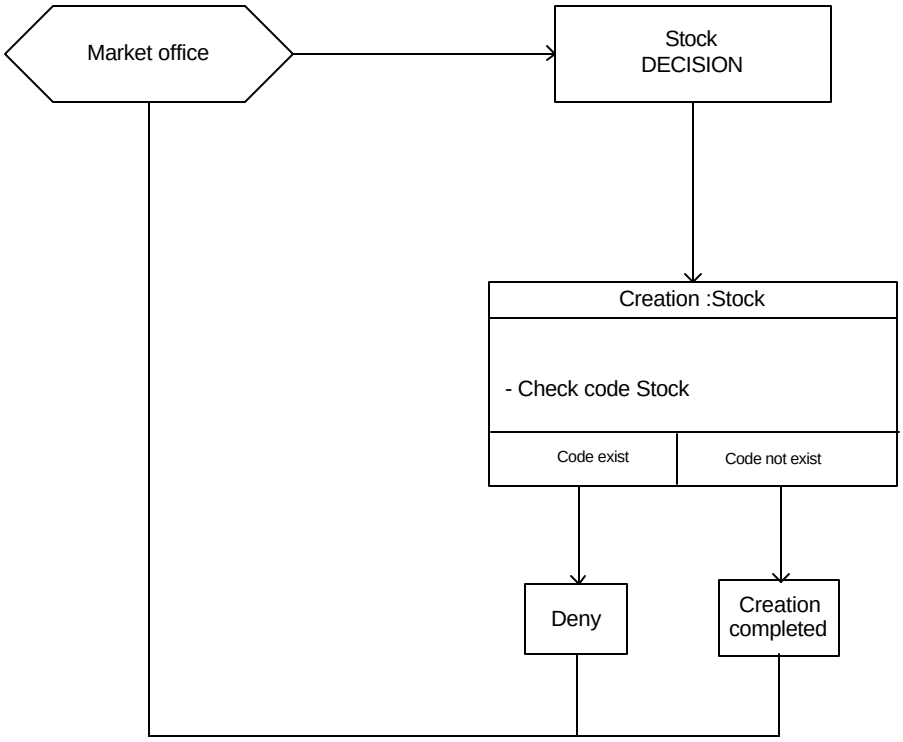
7. Execution Market



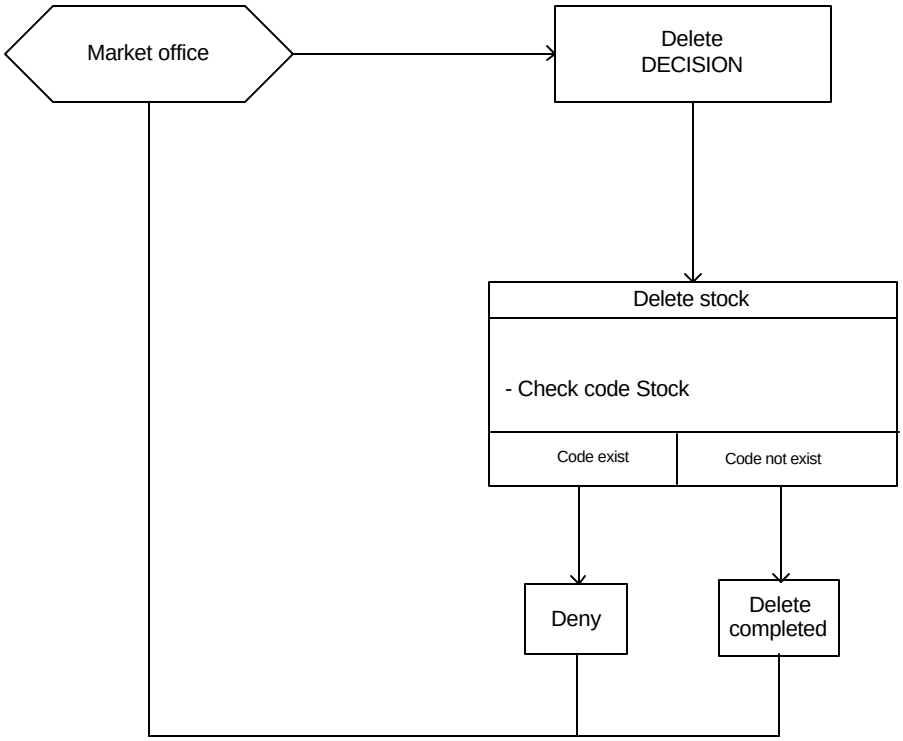
8. Consult Market



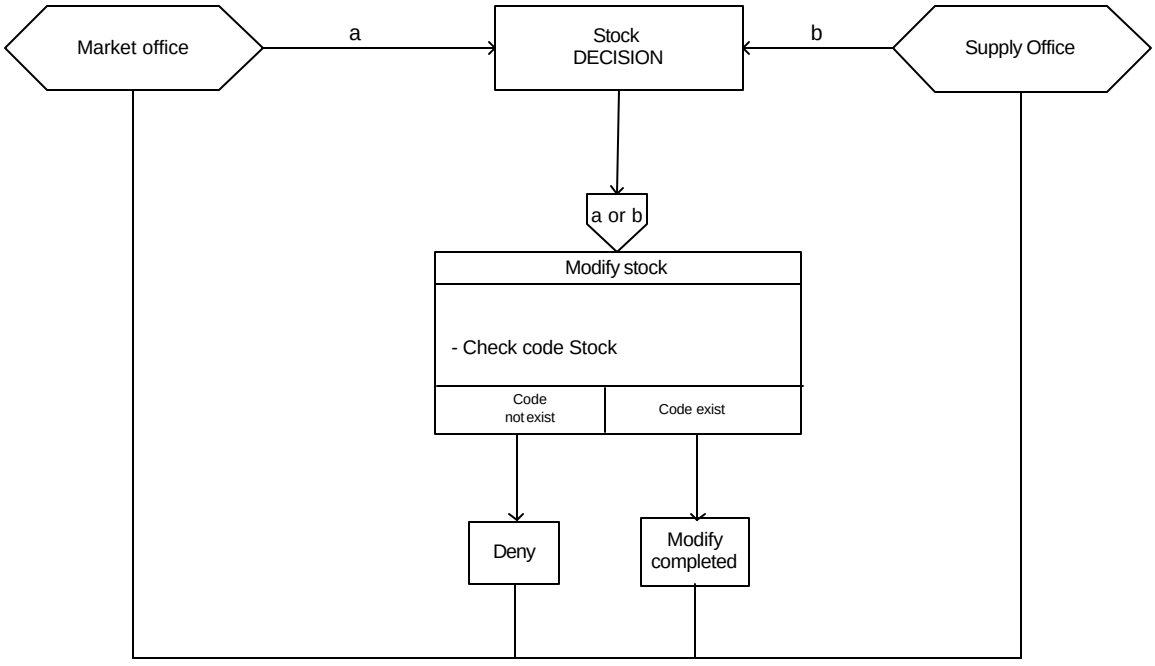
9. Create Stock



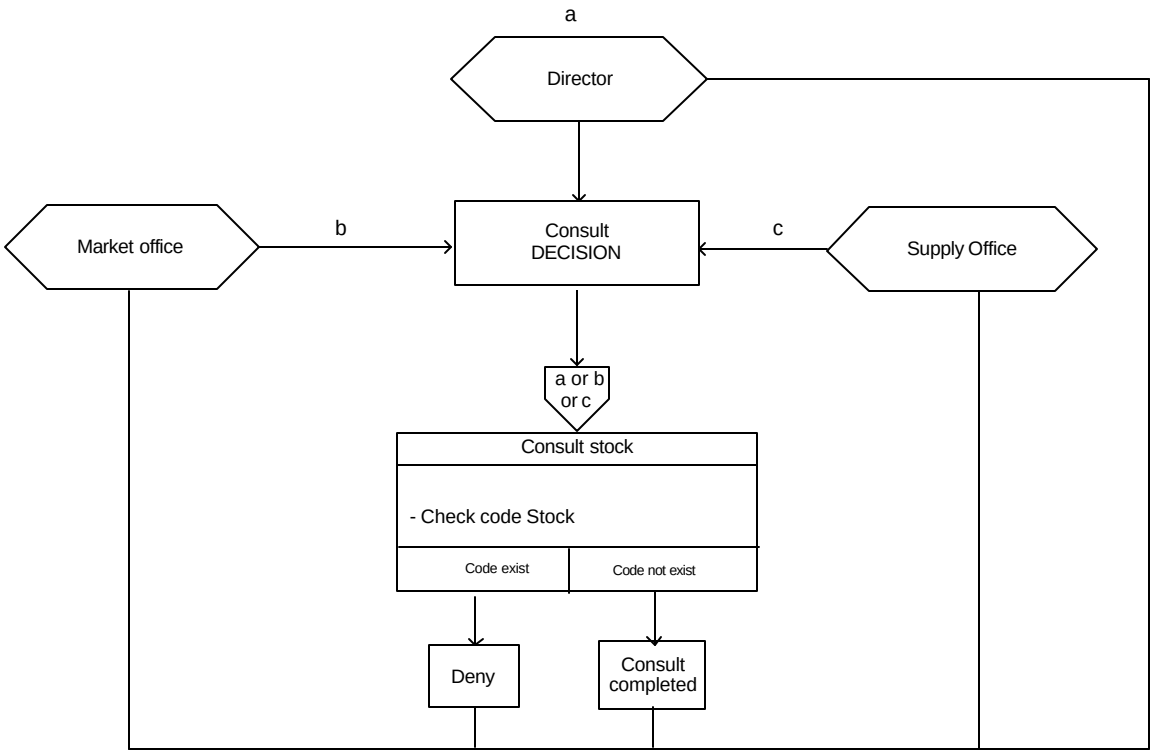
10. Delete Stock



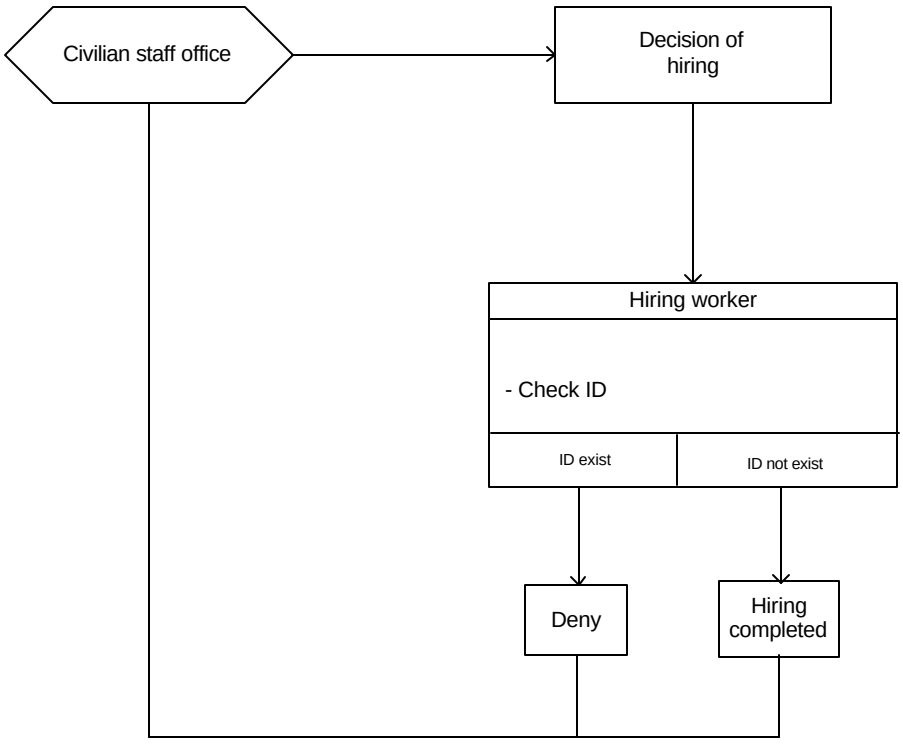
11. Modify Stock



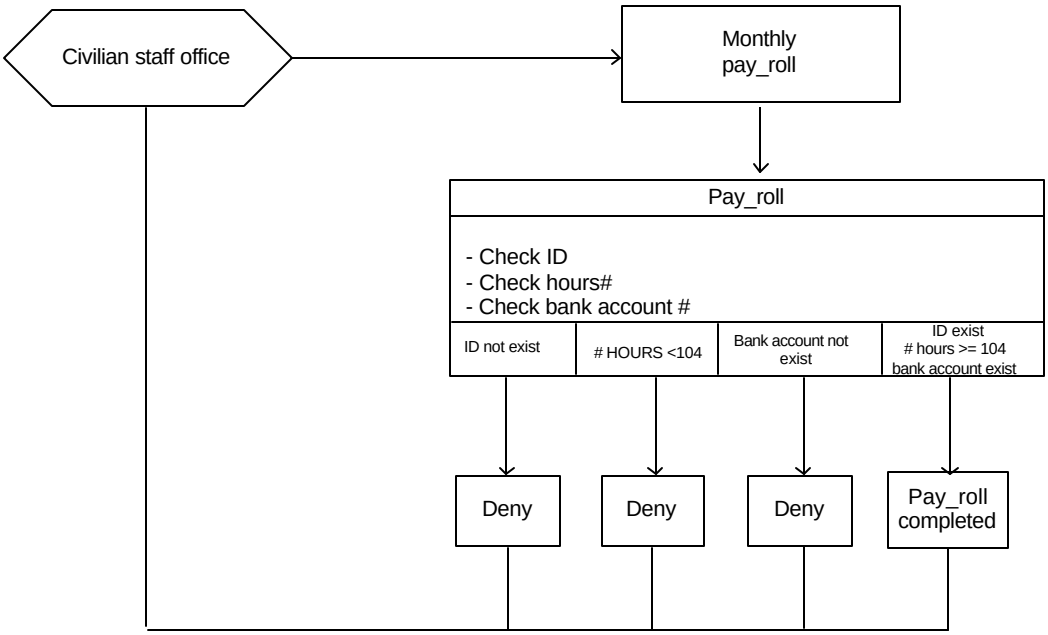
12. Consult Stock



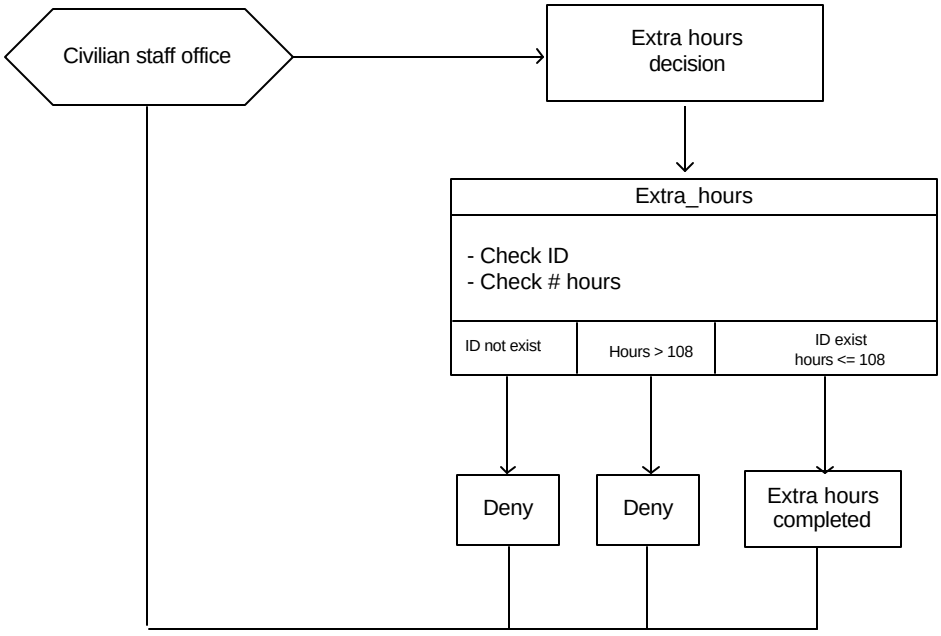
13. Hiring Worker



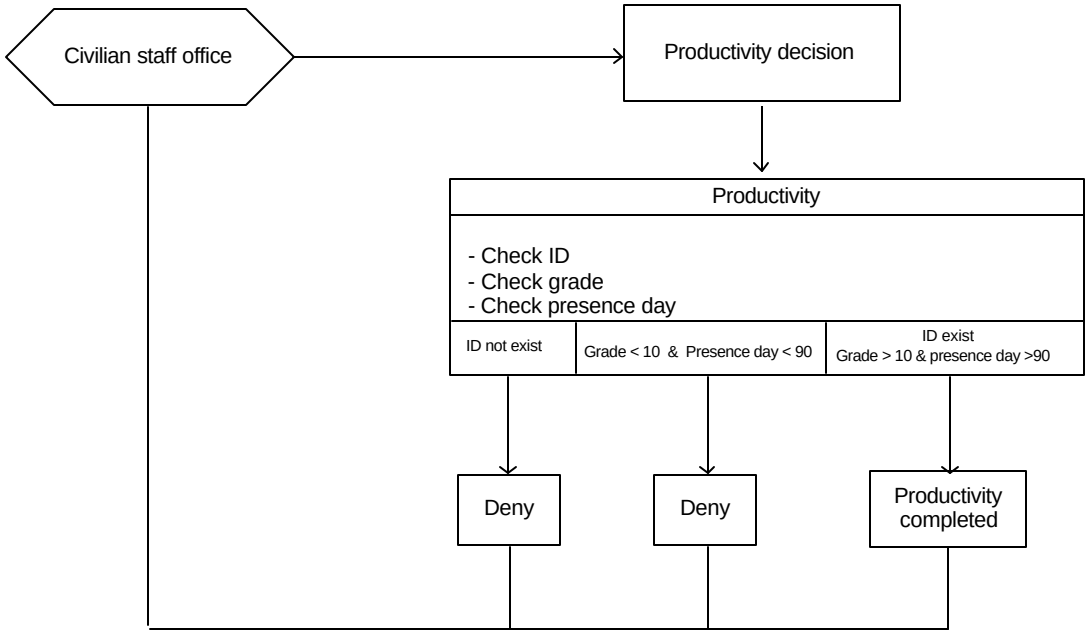
14. Staff Payroll



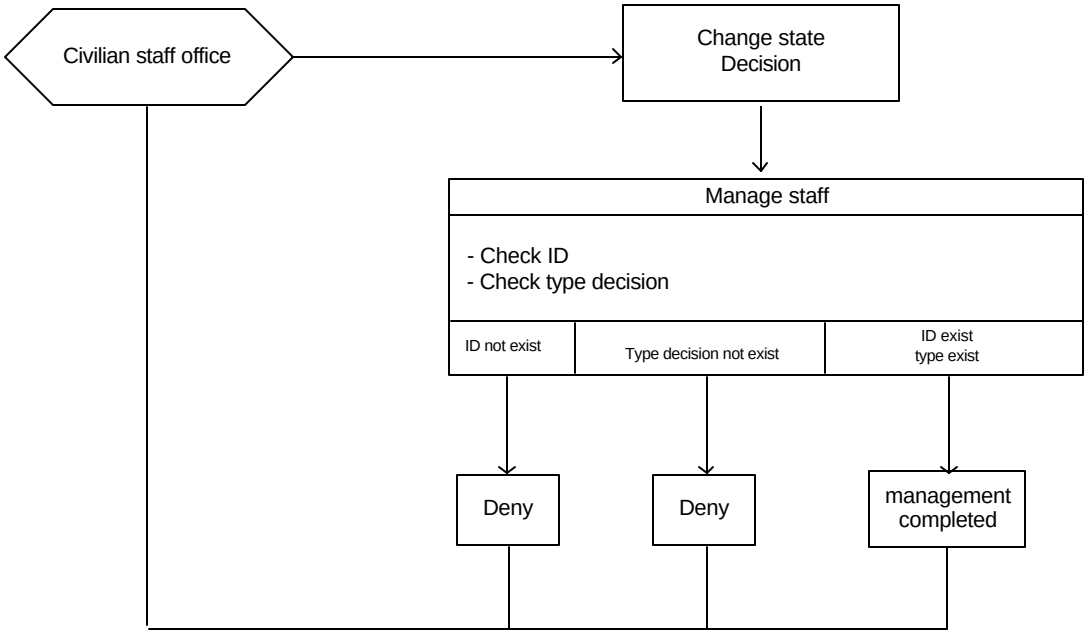
15. Worker Extra Hours



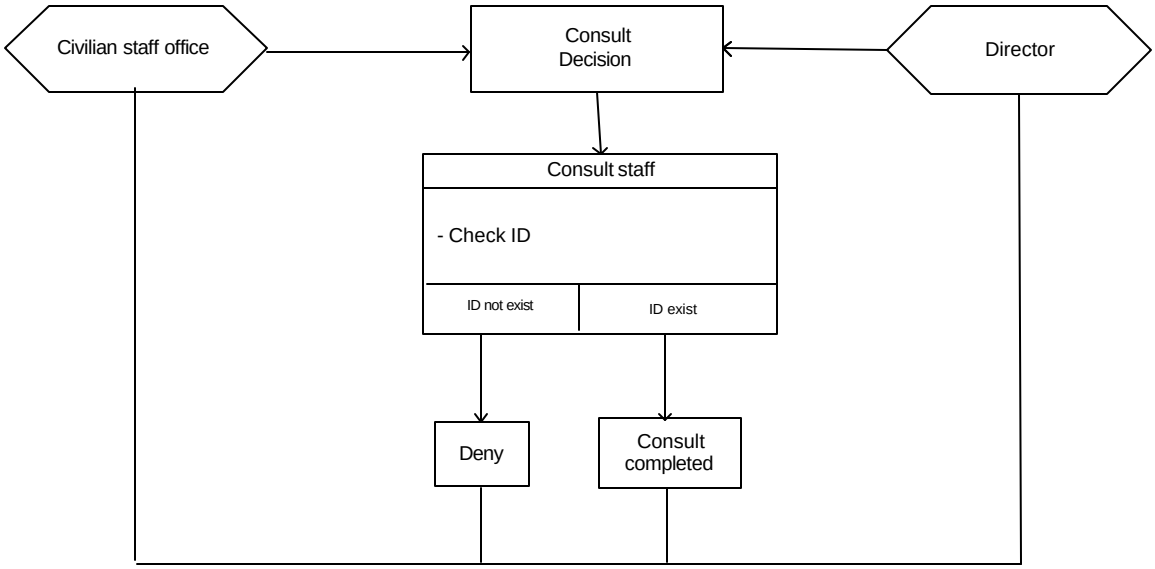
16. Worker Productivity



17. Manage Staff



18. Consult Staff



D. CONSTRAINTS

1. Why Cobol

Many factors contributed to the need to use COBOL to develop this software.

This organization bought a COBOL compiler four years ago and the programmers only know this software language. Therefore, legacy is the main factor for the choice.

COBOL makes it possible to leverage modern IS technologies, while being free of hardware. COBOL delivers the best performance, flexibility, scalability, and platform independence.

COBOL is capable of running applications on hundreds of platforms in every type of client/server environment, without recompilation. Therefore, it is possible to use SCO.UNIX without any problems in implementing the software. It is easy to migrate the code from one machine to another.

The goal is to move the legacy data to a relational database and access it from the COBOL program, without having to embed SQL or recode the COBOL application in any way. Industry claims that 70% of the world's active business applications are still running COBOL It will be the same in the case of this thesis as the system being developed is a business application. COBOL is the best computer language to use for this

type of software. COBOL will interfere to a large degree in the phase design of the software. COBOL only uses global data and the maximum number of files used is eight.

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IV. SYSTEM DESIGN

A. SYSTEM ARCHITECTURE

At the highest level, the system architecture is driven by the business goals and objectives to be accomplished. The financial and administrative department is clearly the principal management department and its different offices contribute in the best manner possible to the management of this institute. The department looks to the other department to provide it with updated and accurate data.

The main goal in developing this software is to provide the leadership with tools to make the correct decisions.

The architecture developed in Figure 3 takes into consideration these two main points. The system is divided into six subsystems, and is designed such that these subsystems barely communicate to avoid coupling problems. They also share the same database.

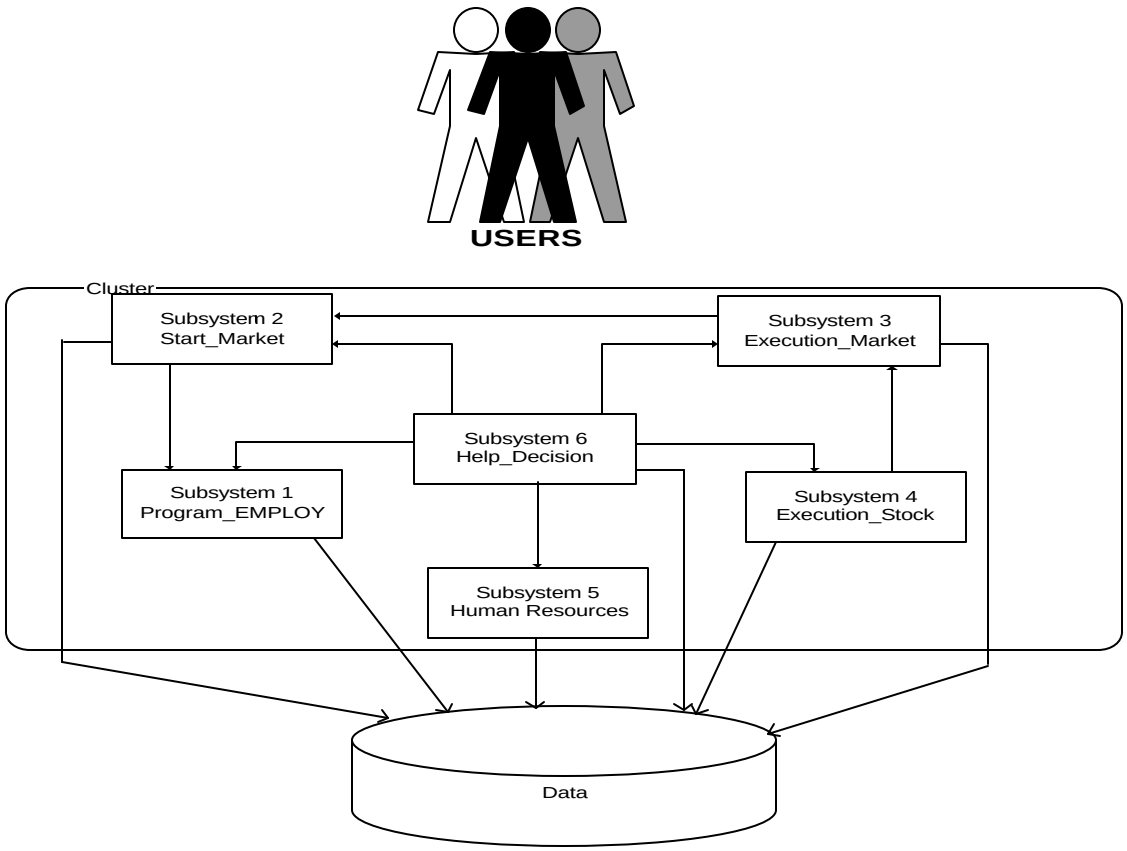

Figure 3. System Architecture.

B. CLASS DIAGRAM

Architecture provides concurrent multiple views that should be the basis for the design. This design verifies that all requirements are captured and represented. They must be traced down to the classes that satisfy them. Figure 4 identifies the data and processes underlying the classes of objects for the system.

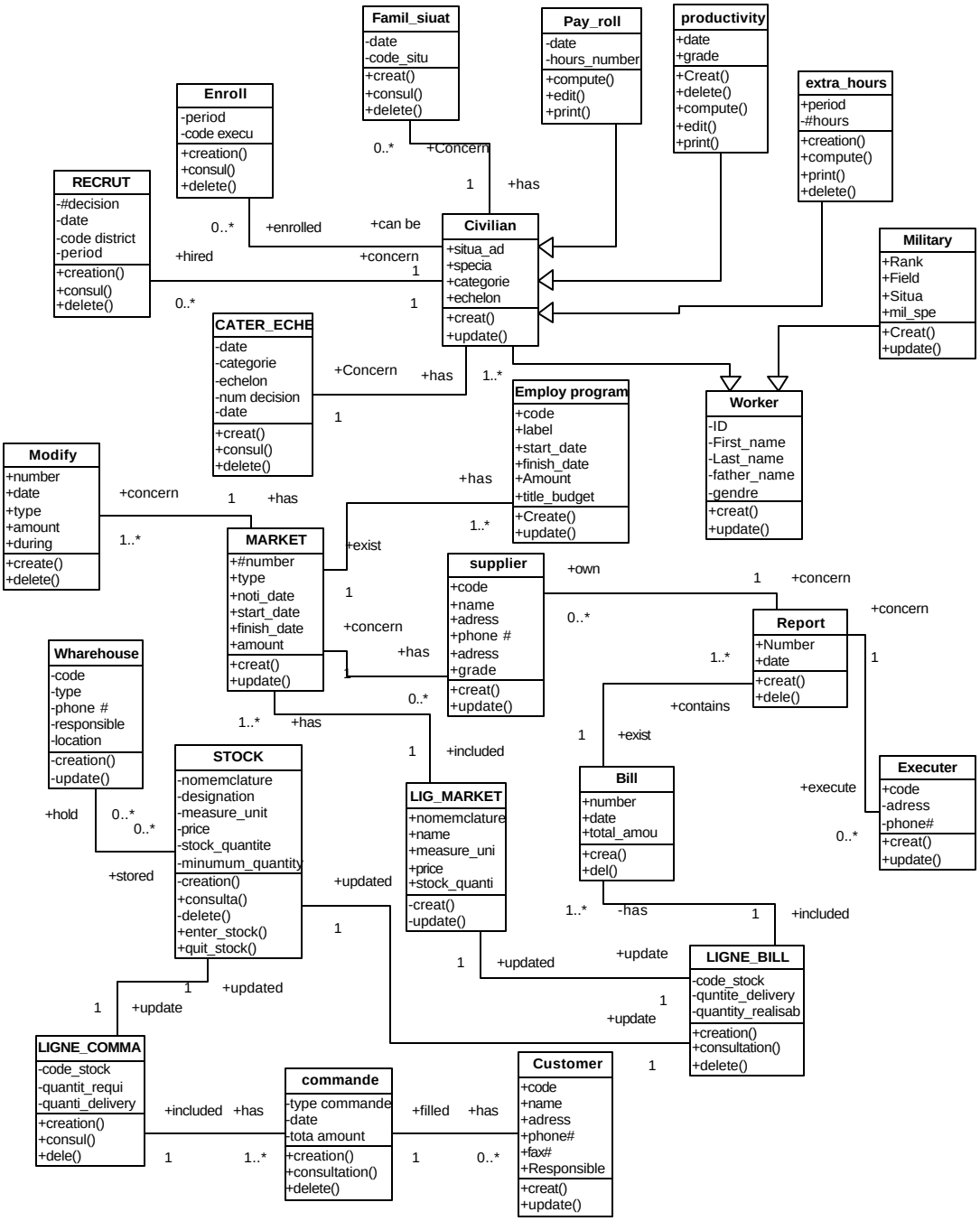

Figure 4. Class Diagram.

C. FILES DESCRIPTION

After the design of the class diagram and the study of system constraints are completed, the files are created. COBOL is used to develop this software. The translation of classes in classic files is shown in the tables that follow.

1. Program

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Proemp #	4	Numeric	Subsystem 1	*	*	*
Year	4	Date	Subsystem 6	*		*
Despre	50	Text				
Stapro	8	Date				
Endpro	8	Date				
Budget	12	Numeric				
titbud	6	Text				

2. Market

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
market#	4	Numeric	Subsystem 2	*	*	*
martyp	4	Text	Subsystem 3	*	*	*
stamar	8	Date	Subsystem 6	*		*
endmar	8	Date				
desmar	50	Text				
amomar	12	Numeric				
appmar	3	Text				
daapma	8	Date				

3. Item Market

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Coditm	12	Text	Subsystem 2	*		*
market#	4	Text	Subsystem 3	*	*	*
quaitm	12	Numeric	Subsystem 6	*		*
priitm	12	Numeric				

4. Modify Market

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
market#	4	Numeric	Subsystem 2	*	*	*
modmar	4	Numeric	Subsystem 6	*		*
moornu	4	Numeric				
typmod	1	Text				
permod	8	Date				
amomod	9	Numeric				

5. Invoice

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Invoic#	4	Numeric	Subsystem 3	*	*	*
market#	4	Numeric	Subsystem 6	*		*
Report #	4	Numeric				
Invamo	12	Numeric				
Invdat	8	Numeric				

6. Item Invoice

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Coditi	12	Text	Subsystem 2	*	*	*
invoic#	4	Text	Subsystem 6	*		*
quaiti	12	Numeric				

7. Report

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Report#	4	Numeric	Subsystem 3	*	*	*
market#	4	Numeric	Subsystem 6	*		*
repmon	12	Numeric				
repdat	8	Date				

8. Supplier

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
codsup	4	Text	Subsystem 2	*	*	*
clasup	50	Text	Subsystem 3	*	*	*
addsup	50	Text	Subsystem 4	*		*
phosup	8	Text	Subsystem 6	*		*
faxsup	8	Numeric				

9. Customer

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
codcus	4	Text	Subsystem 4	*	*	*
clacus	50	Text	Subsystem 6	*		*
addcus	50	Text				
phocus	8	Text				
faxcus	8	Numeric				

10. Stock

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
itecod	12	Text	Subsystem 3	*	*	*
desite	50	Text	Subsystem 4	*	*	*
priite	12	Numeric	Subsystem 6	*		*
uniite	2	Text				
thrite	12	Numeric				

11. Purchase Order

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
purord #	4	Numeric	Subsystem 4	*	*	*
typpur	2	Text	Subsystem 6	*		*
datpur	8	Date				
totpur	12	Numeric				

12. Item Purchase Order

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Codite	12	Text	Subsystem 4	*	*	*
purord #	4	Numeric	Subsystem 6	*		*
purreq	12	Numeric				
purdel	12	Numeric				

13. Staff

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
id #	8	Numeric	Subsystem 5	*	*	*
pernam	30	Text	Subsystem 6	*		*
fatnam	30	Text				
lasnam	30	Text				
famsit	1	Numeric				
birday	8	Date				
echelo	2	Numeric				
catego	2	Numeric				
codspe	4	Text				
address	50	Text				
codatt	2	Numeric				
acbank#	20	Text				

14. Decision

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Id #	8	Numeric	Subsystem 5	*	*	*
Decisio #	4	Numeric	Subsystem 6	*		*
Decdat	4	Numeric				

15. Family Situation

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Id #	8	Numeric	Subsystem 5	*	*	*
Decla #	4	Numeric	Subsystem 6	*		
dectyp	4	Numeric				
decdat	8	Date				

16. Change Situation

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Id #	8	Numeric	Subsystem 5	*	*	*
situa #	4	Numeric		*		
sittyp	4	Numeric				
sitdat	8	Date				
oldsit	2	Numeric				
newsit	2	Numeric				

17. Pay Roll

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Id #	8	Numeric	Subsystem 5	*	*	*
hours#	3	Numeric		*		

18. Productivity

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Id #	8	Numeric	Subsystem 5	*	*	*
grade	3	Numeric		*		
preday	3	Numeric				

19. Extra Hours

Attributes	Length	Type	Users	Access mode		
				Read	Write	Execute
Id #	8	Numeric	Subsystem 5	*	*	*
hours#	3	Numeric		*		

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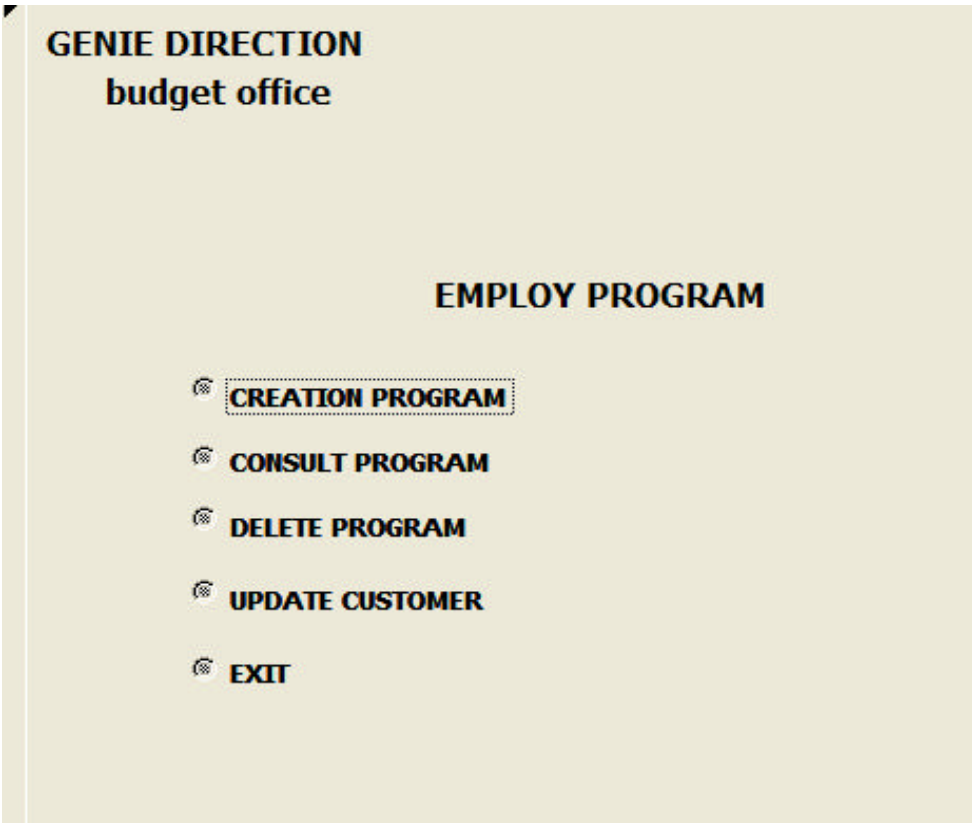
V. PROTOTYPE

As a first step to validate the design, Microsoft Access was used to create a prototype for the user interface. Views of screens and the output results presented by forms follow. This prototype is concerned with each of the subsystems of the six subsystems.

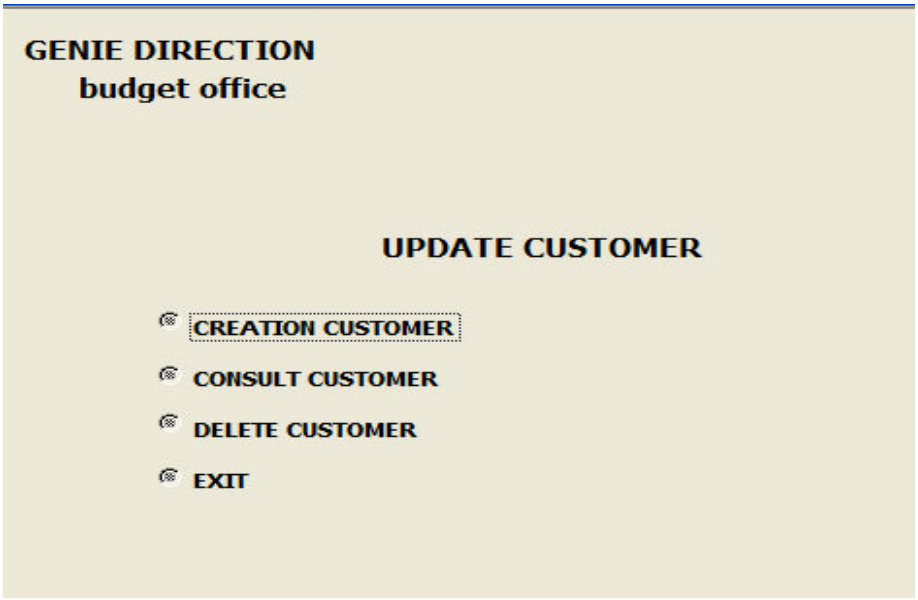
A. SUBSYSTEM 1: PROGRAM EMPLOY

This subsystem ensures that the scheduled projects are tracked. The main user of this subsystem is the budget office as mentioned in the screen shots.

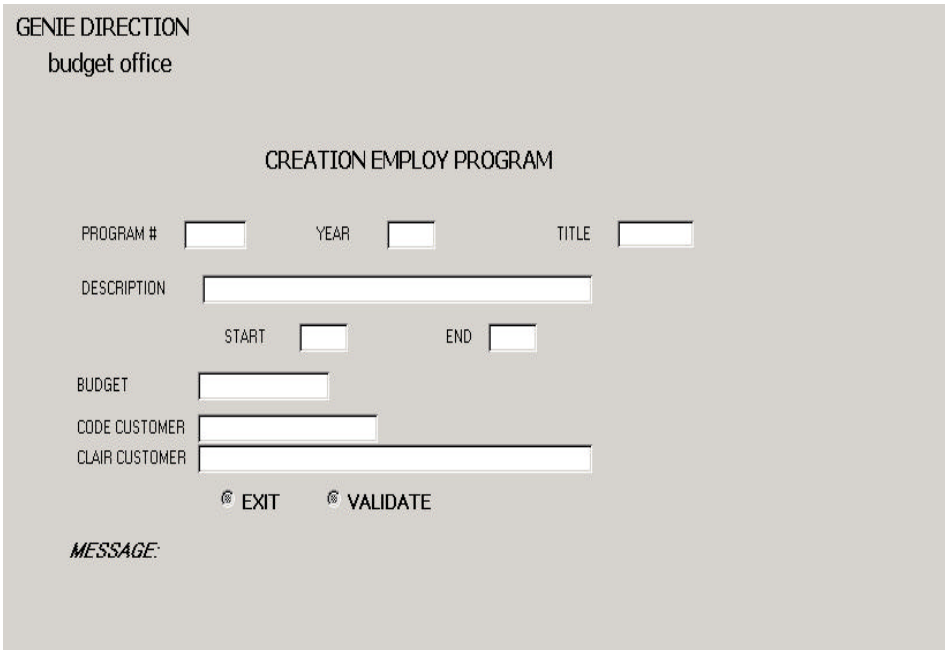
1. Screen # 1



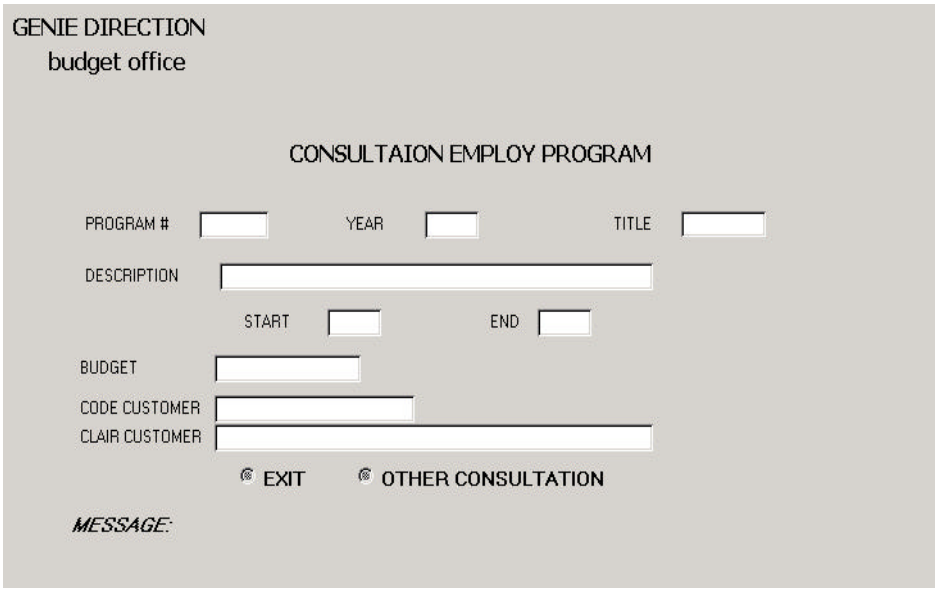
2. Screen # 2



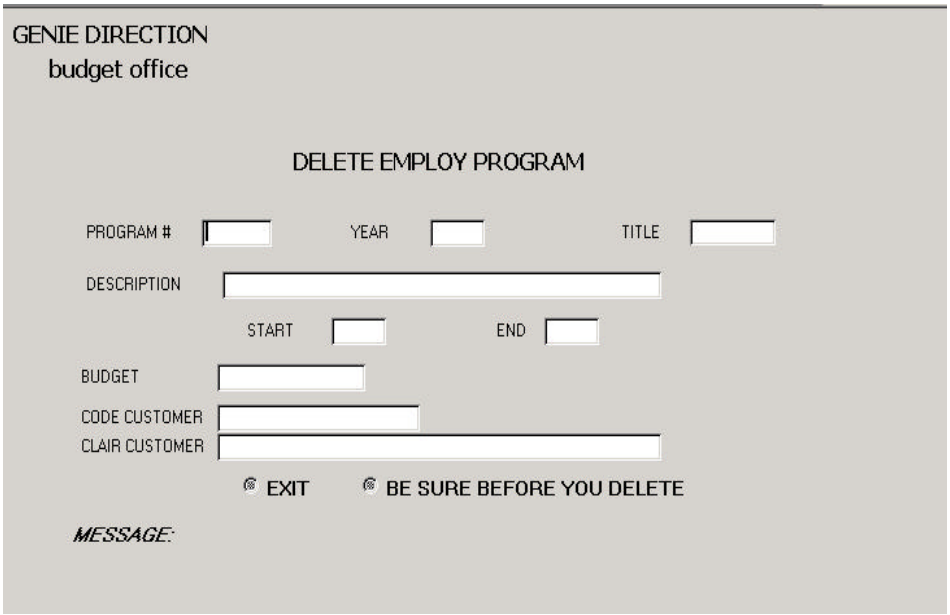
3. Screen # 3



4. Screen # 4



5. Screen # 5

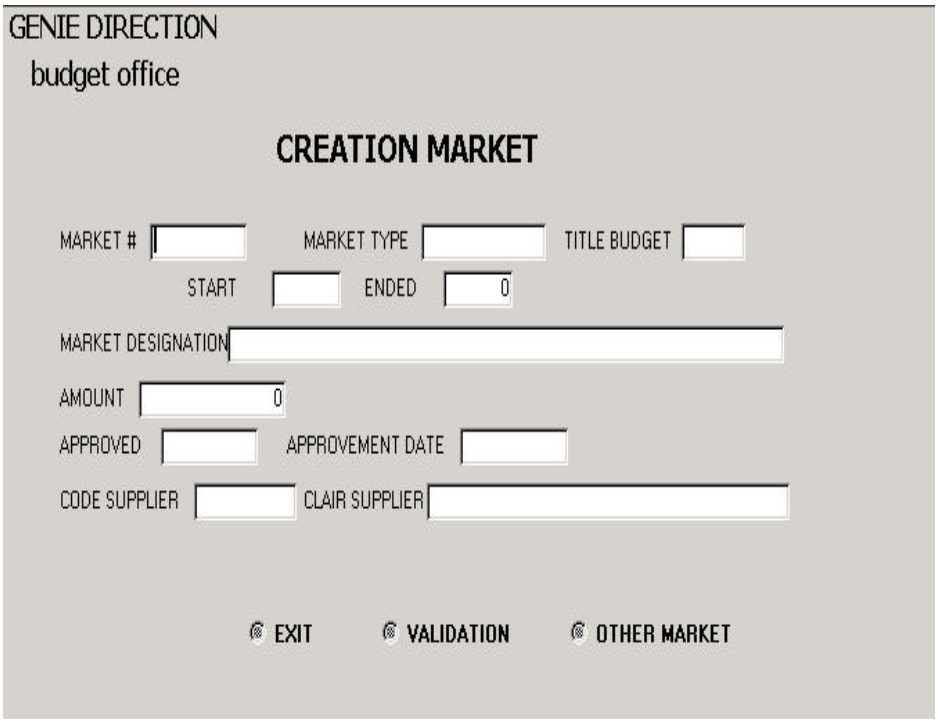


B. SUBSYSTEM 2: START MARKET

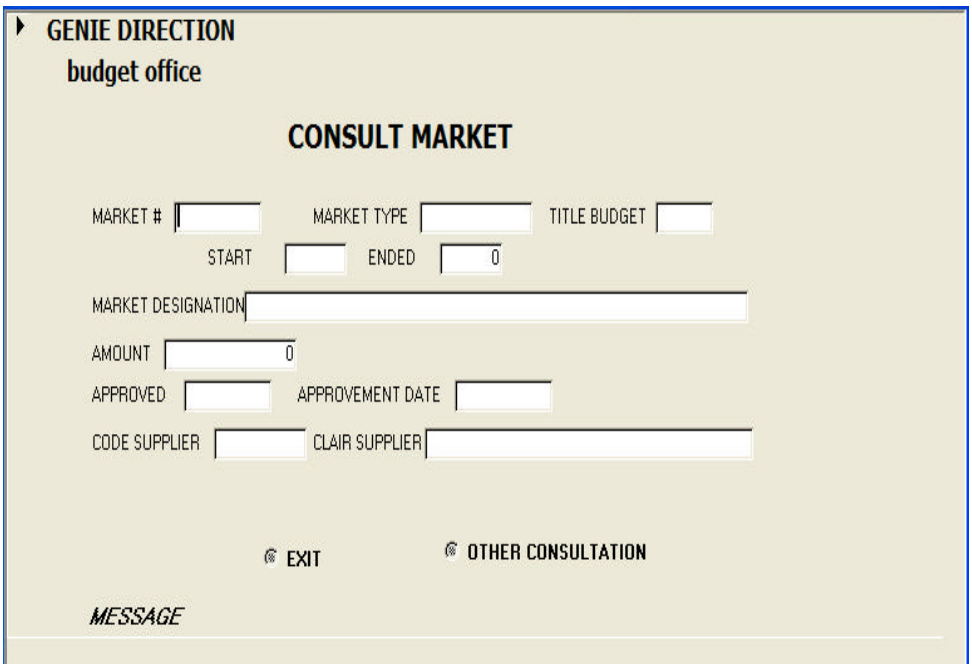
This subsystem starts the first step of the project's execution. The budget office establishes the markets that will be executed later by the other subsystems. The screens used by this subsystem are shown below.

1. **Screen # 6**

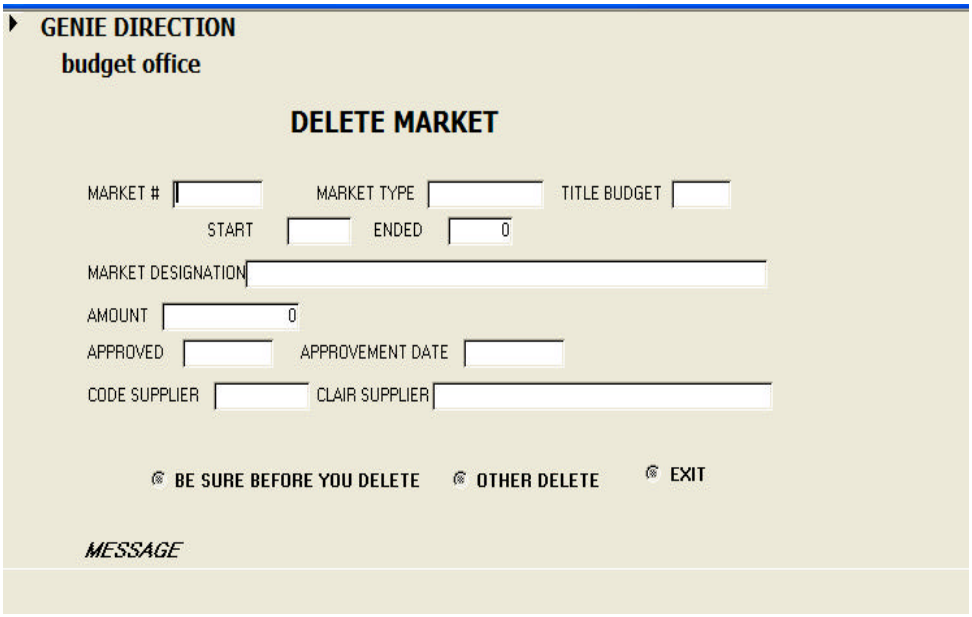
2. **Screen # 7**



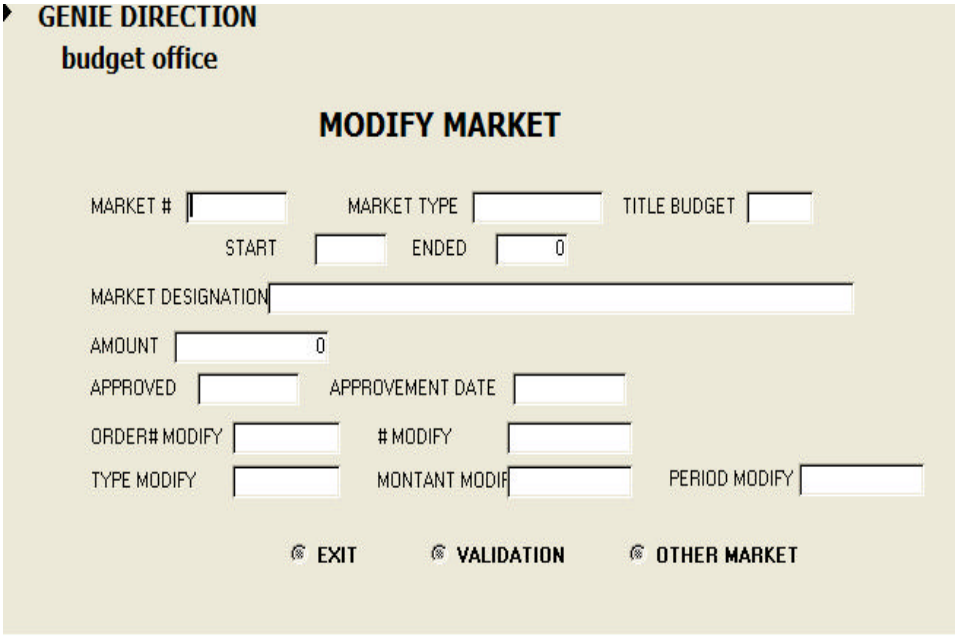
3. Screen # 8



4. Screen # 9



5. Screen # 10

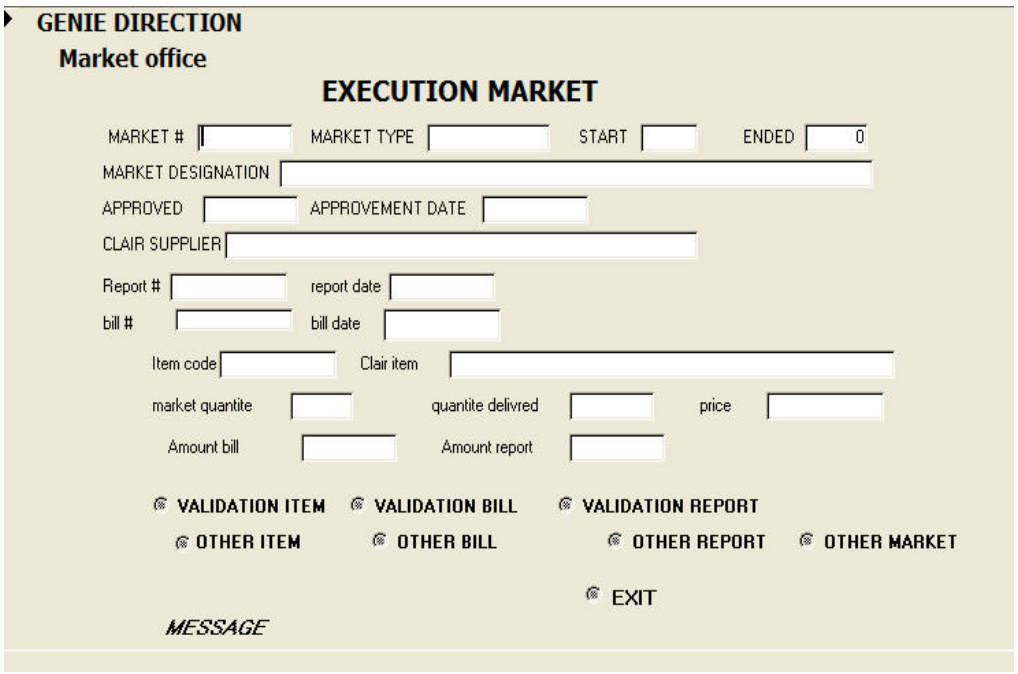


C. SUBSYSTEM 3: EXECUTION MARKET

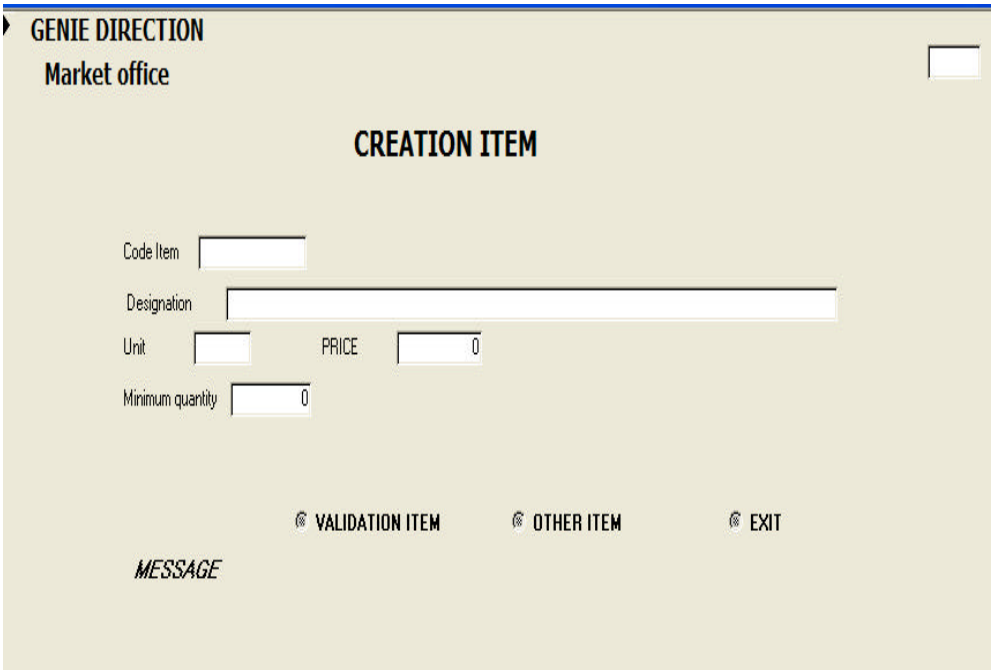
The market office starts the execution of the market established by the budget office. The screens below will help the user to accomplish this function.

1. Screen # 11

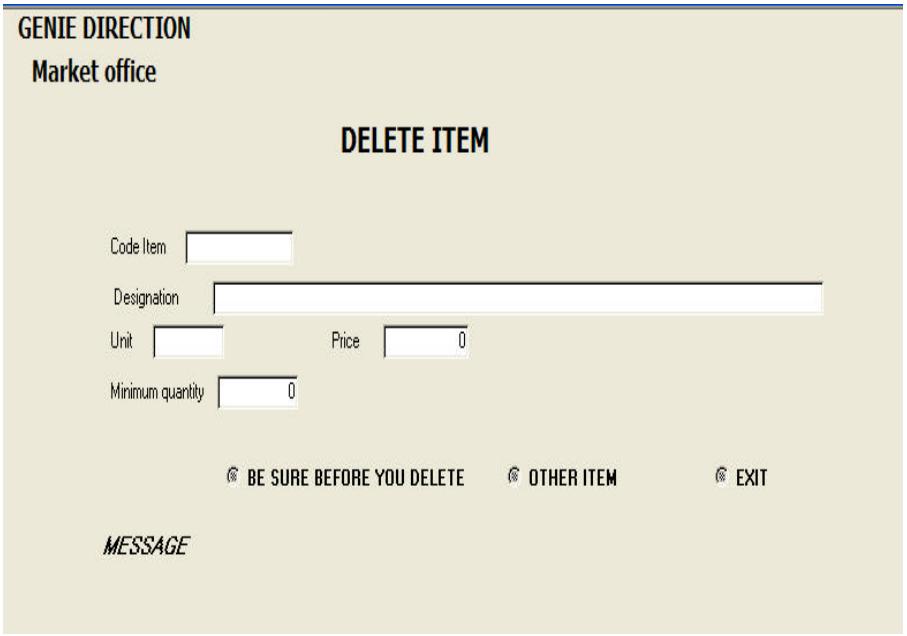
2. Screen # 12



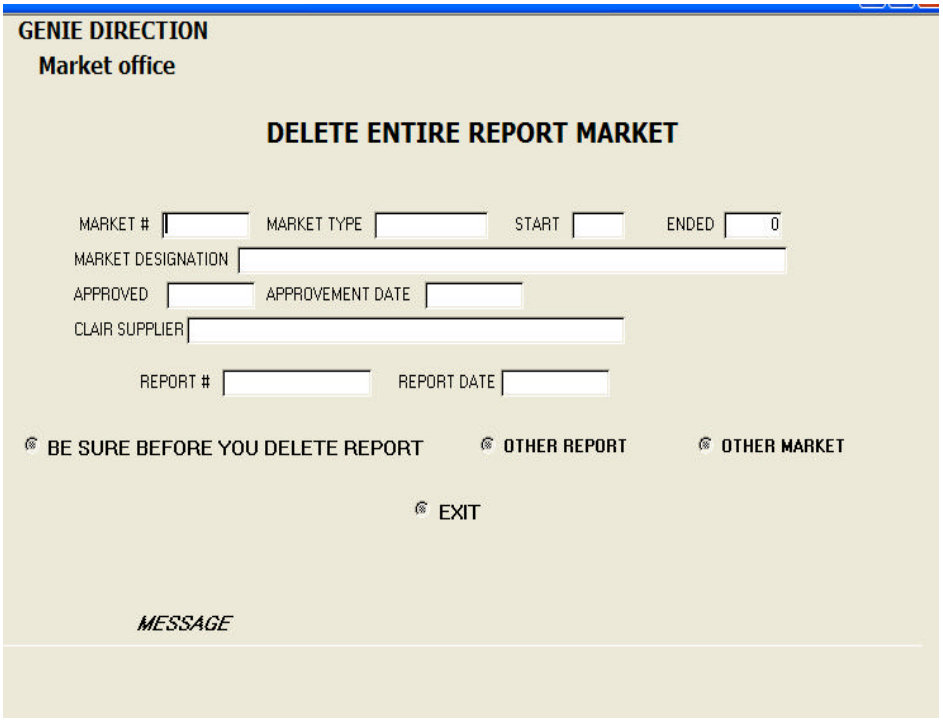
3. Screen # 13



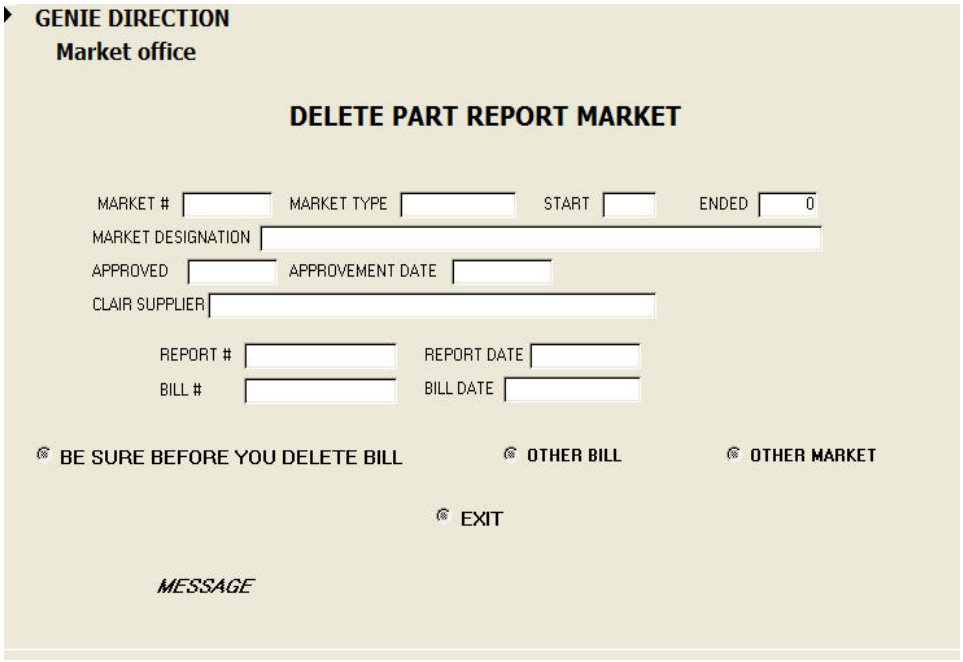
4. Screen # 14



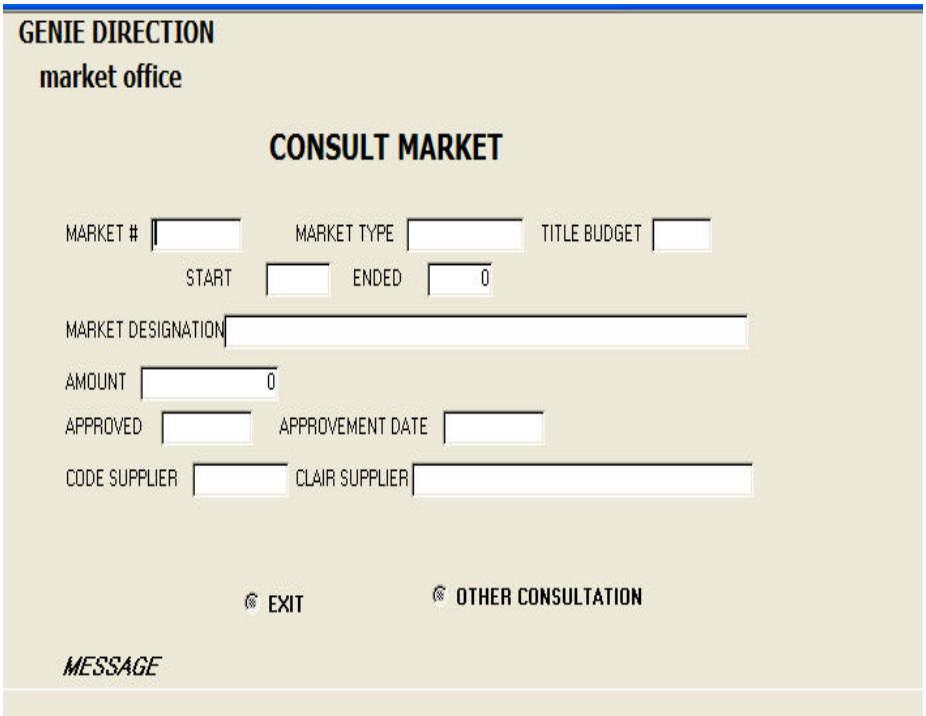
5. Screen # 15



6. Screen # 16



7. Screen # 17

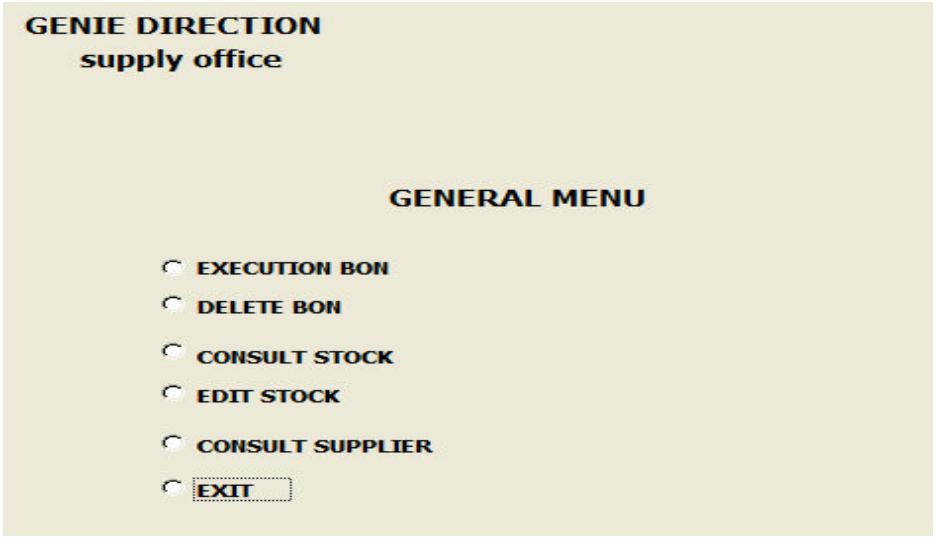


8. Screen # 18

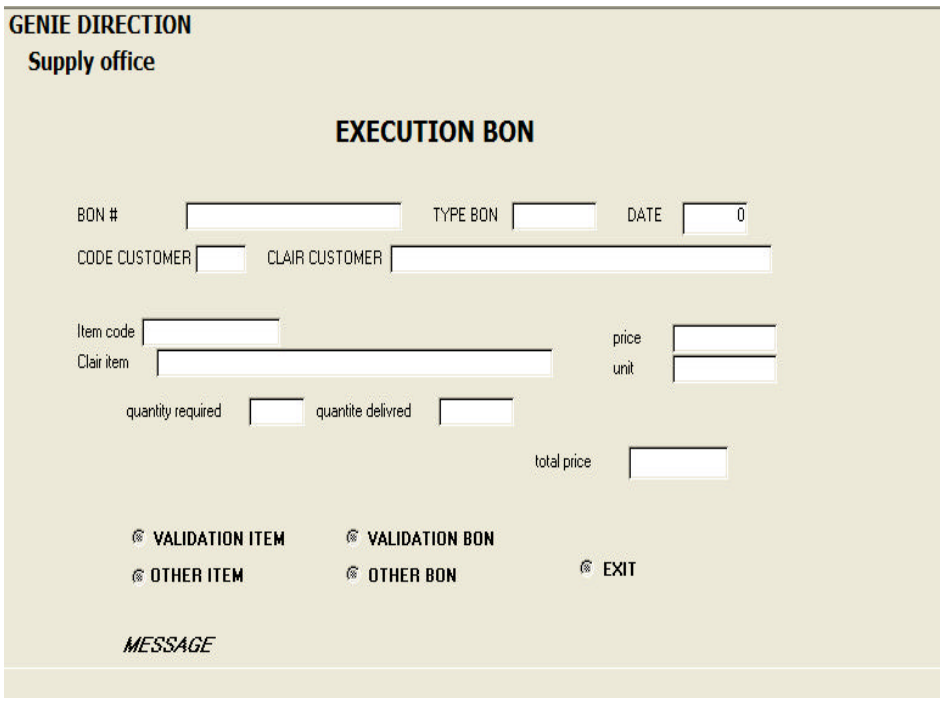
D. SUBSYSTEM 4: EXECUTION STOCK

The execution of stock is the purview of the supply office. The screens and the forms below will help the user to enhance the reliability of this software.

1. Screen # 19

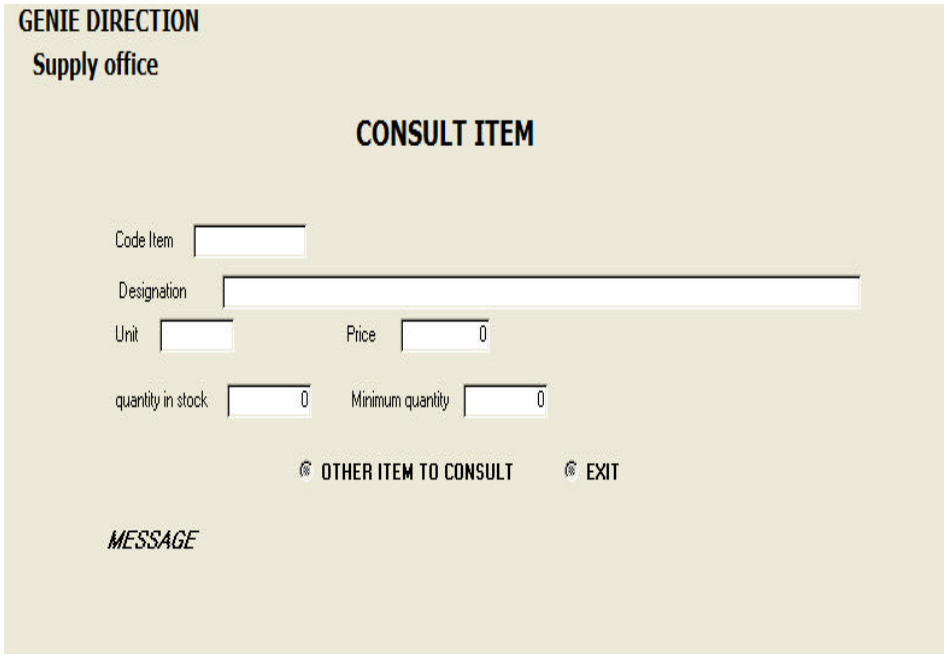


2. Screen # 20

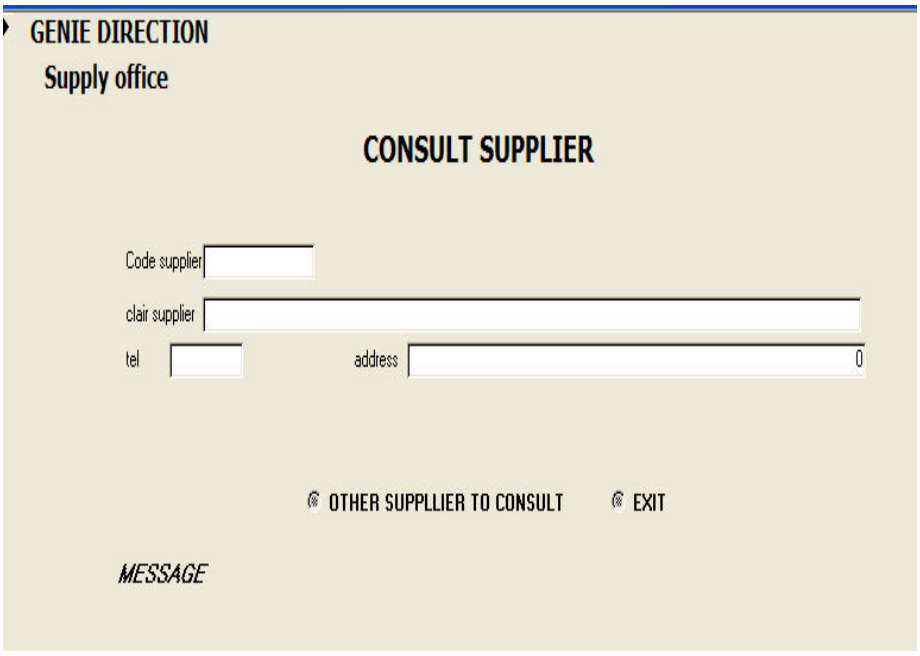


3. Screen # 21

4. Screen # 22



5. Screen # 23



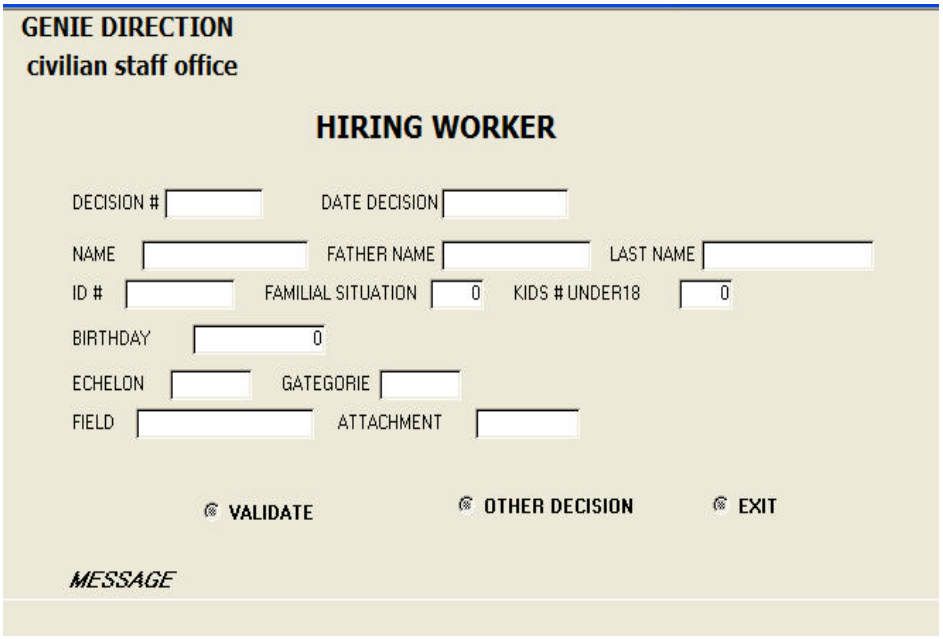
6. Form # 1

E. SUBSYSTEM 5: HUMAN RESOURCES

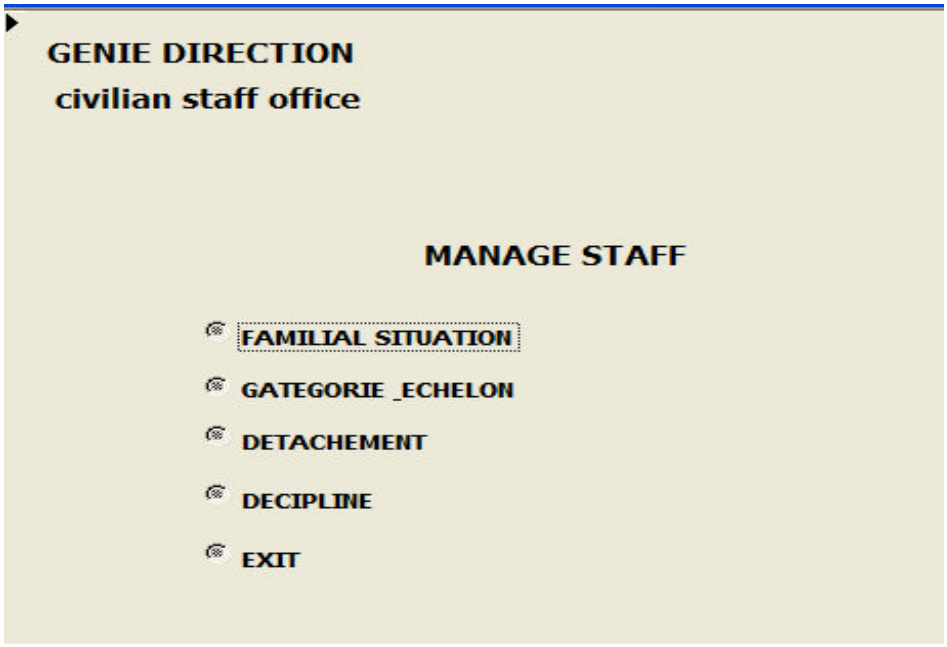
If this subsystem is reliable, the software will be successful. Dealing with human resources is a huge task and ensuring that it is managed properly will assist in the management of the entire organization. The screens below were developed by taking in consideration all the small requirements details to provide the user with the best possible interface for using this subsystem.

1. Screen # 24

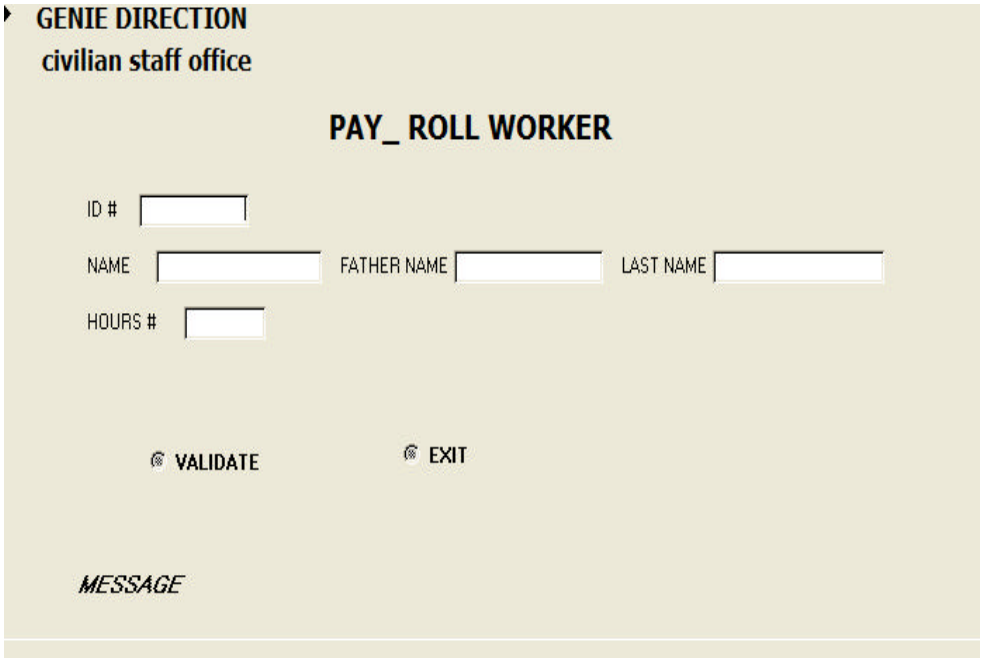
2. Screen # 25



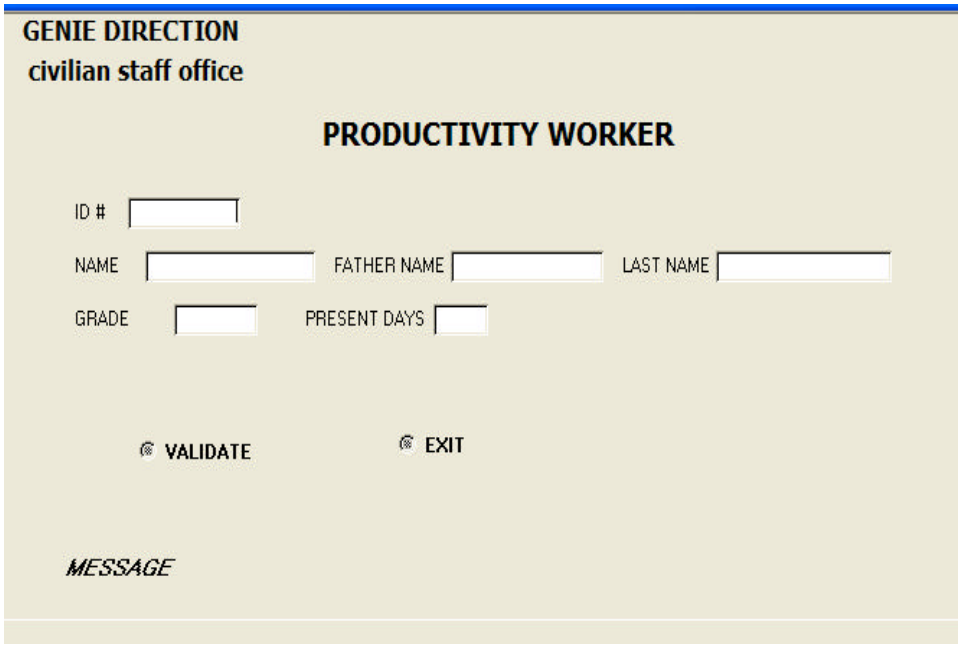
3. Screen # 26



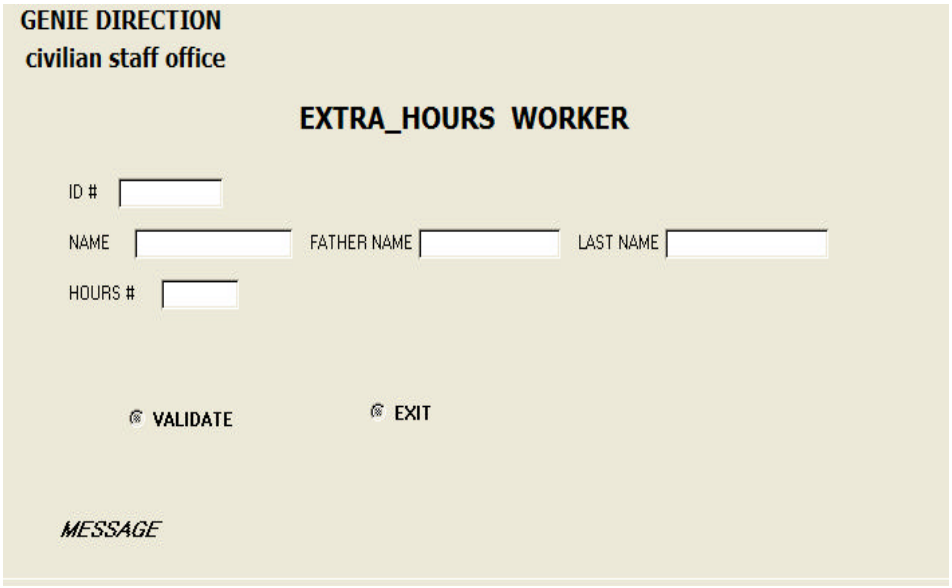
4. Screen # 27



5. Screen # 28



6. Screen # 29

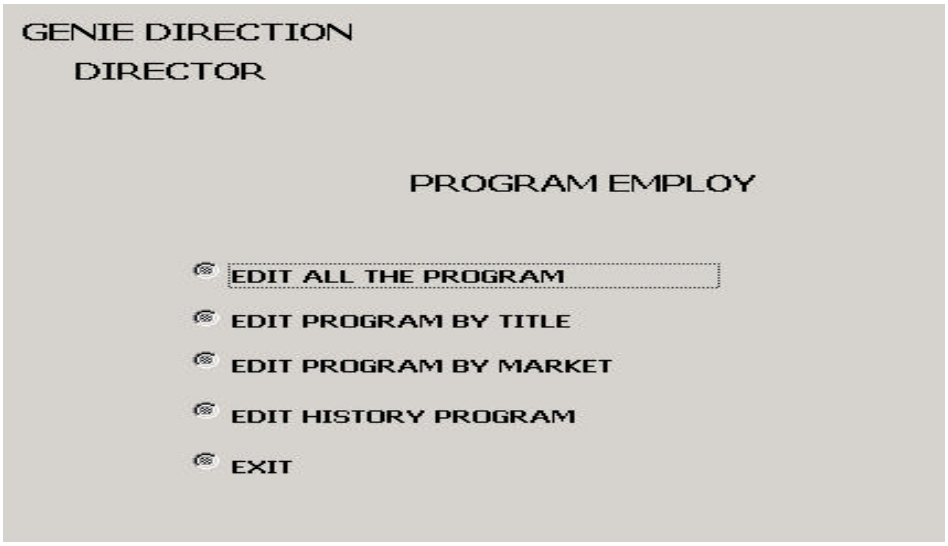


F. SUBSYSTEM 6: DECISION HELP

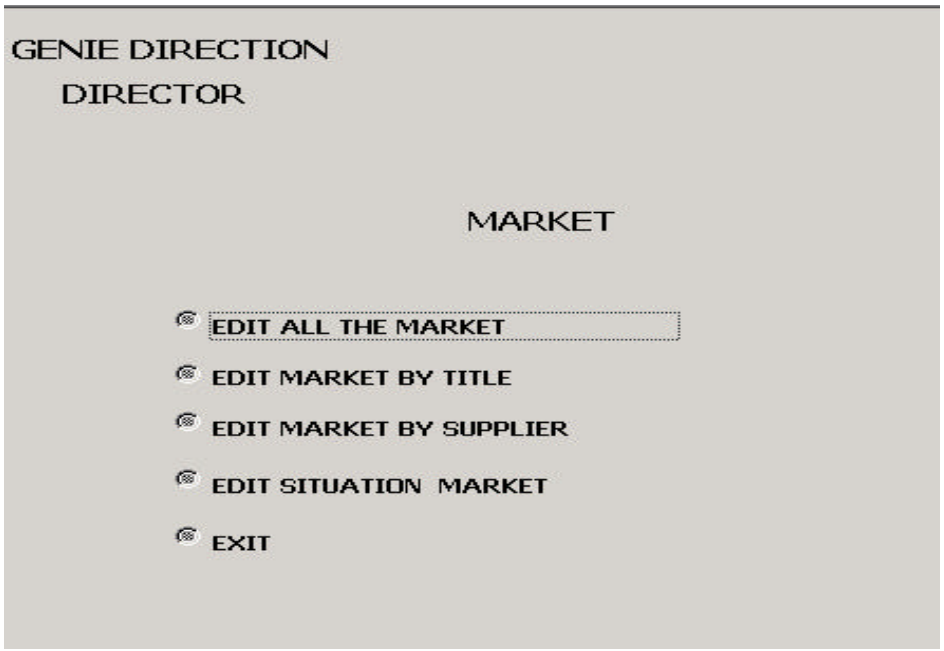
The main goal of this thesis is to provide the leader of the organization with tools to make the best decision. This subsystem is a compilation of all the subsystems and provides the interface necessary for the director to consult any data shown in the forms below.

1. Screen # 30

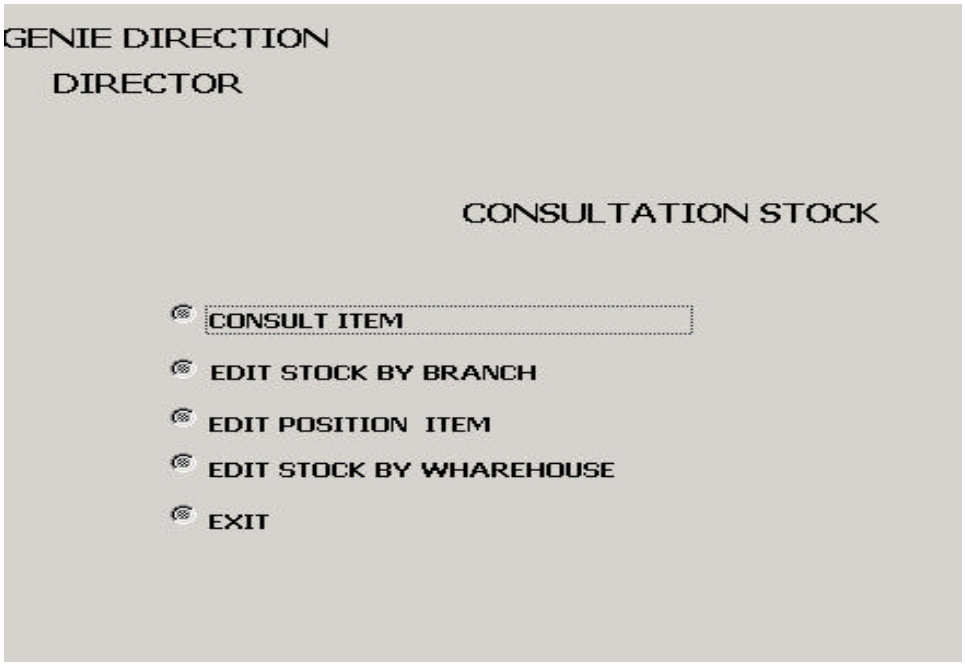
2. Screen # 31



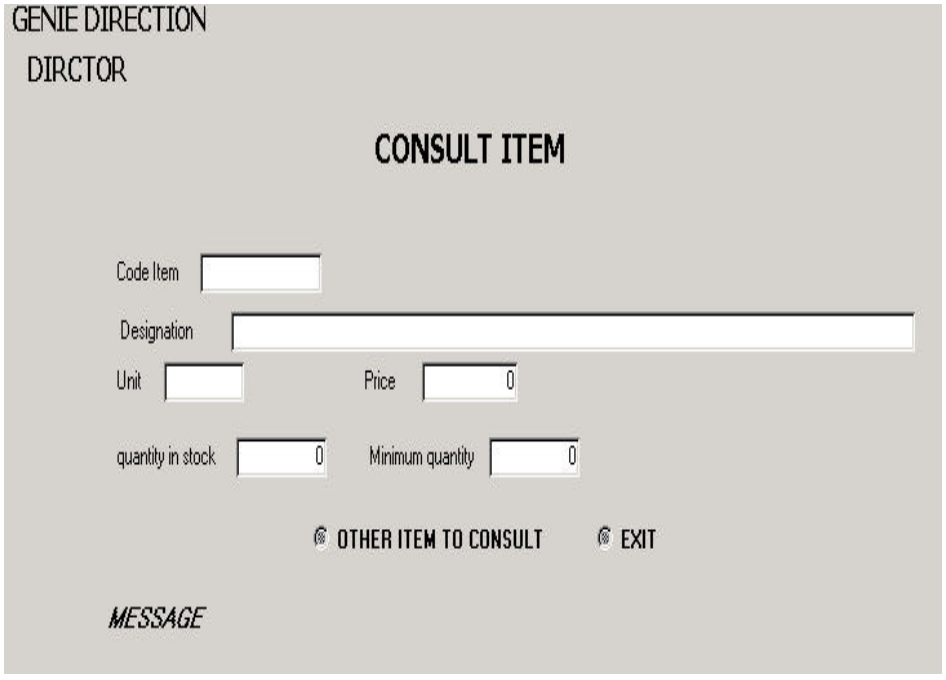
3. Screen # 32



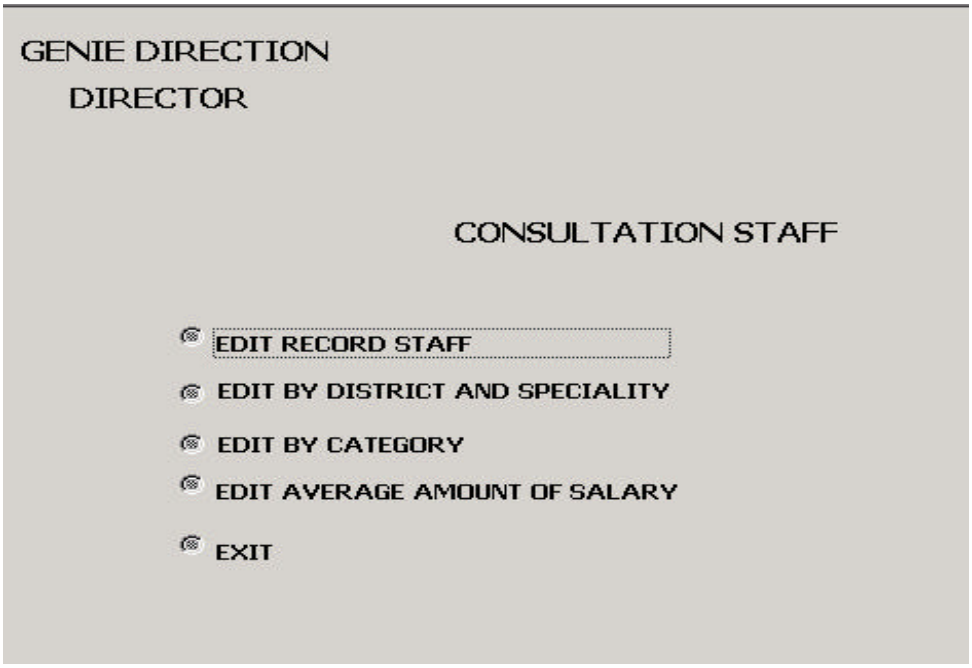
4. Screen # 33



5. Screen # 34

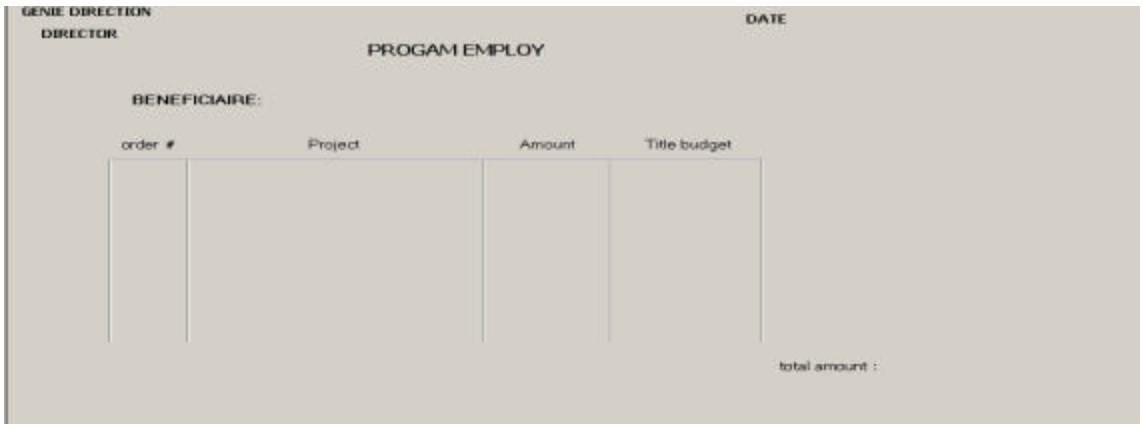


6. Screen # 35

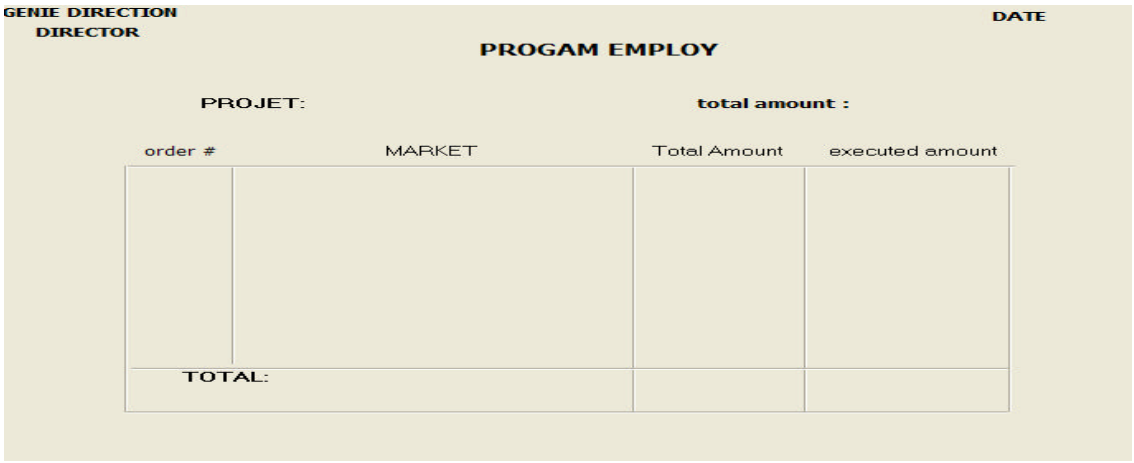


7. Form# 2

8. Form# 3



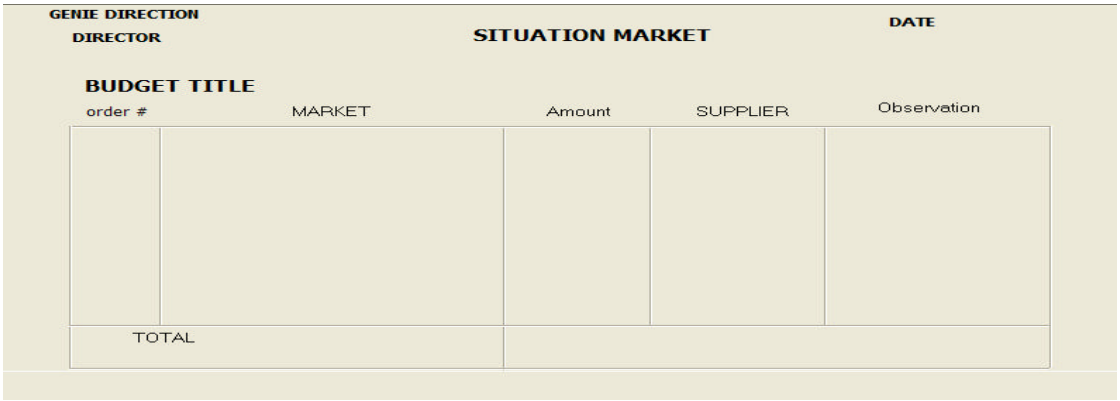
9. Form# 4



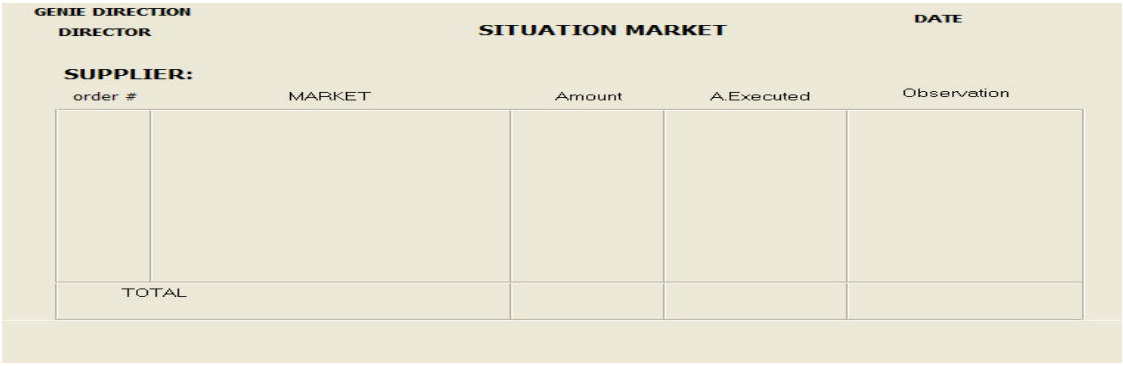
10. Form# 5

11. Form# 6

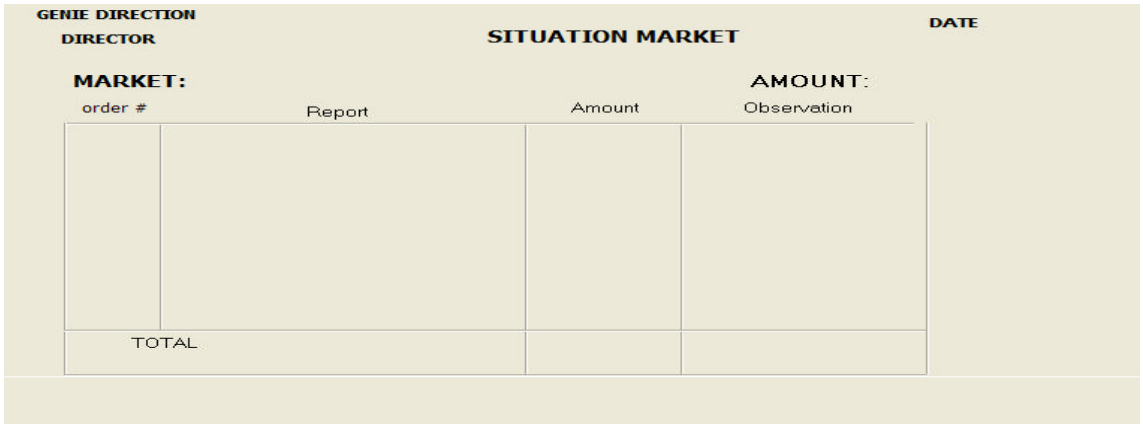
12. Form# 7



13. Form# 9



14. Form# 9

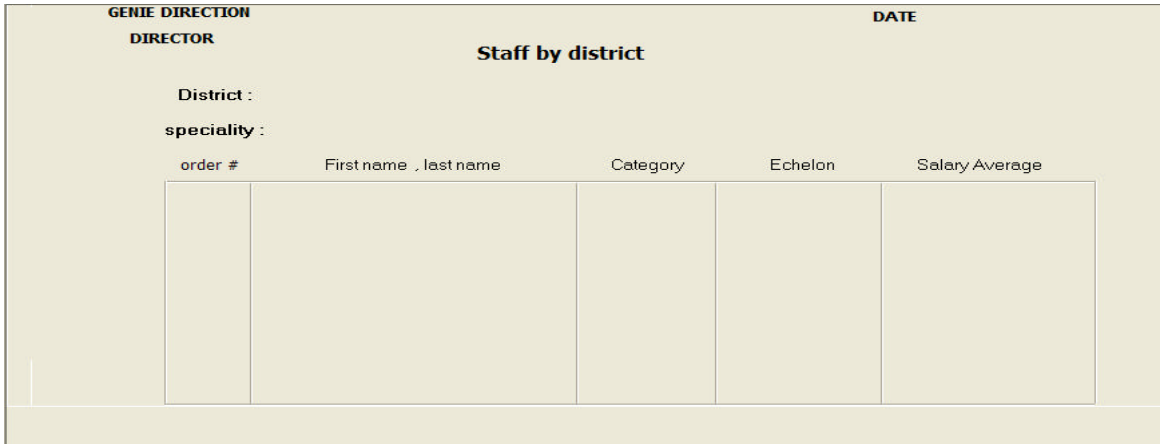


15. Form# 10

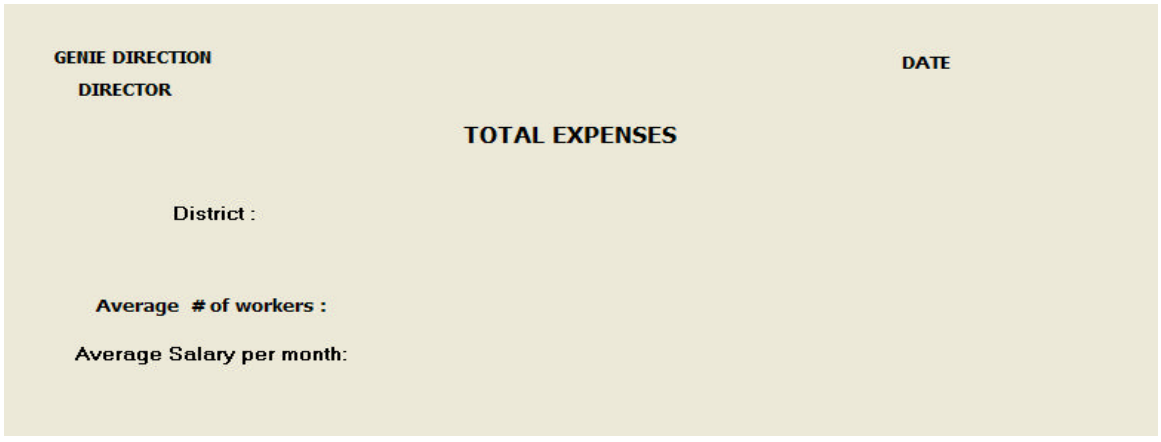
16. Form# 11

17. Form# 12

18. Form# 13



19. Form# 14



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VI. CONCLUSION

A. SUMMARY

This thesis develops the requirements and an architecture for a software system that helps leadership make decisions and specifically focuses on three aspects of projects planning: requirements, design and prototype.

Chapters II and III clearly state the functionality of the organization and the system requirements. Chapter IV analyzes these requirements, and transforms them into an accurate design using tools provided by the UML models. Chapter V provides the necessary interfaces for the users to enhance the benefits of this software making it easy to understand the functionality of this software. This study will improve the decision-making ability of the leader of this organization and the heads of each department. It will make the routine tasks easier, and provide the necessary and accurate data in a timely manner.

While working on this thesis, it became clear that collecting enough information for the requirements was a greater task than anticipated. Very little is written about the organization, and what is written, is largely limited to facts. Face-to-face discussions are necessary as well as are observations over time so that opinions and impressions can be gleaned from users. Once a more solid foundation of requirements is built, then it will be possible to analyze information using UML models. By using this methodology, it was possible to model the system and its architecture.

B. RECOMMENDATIONS

Several future tasks that need to be completed are listed as follows:

- Divide the available programmers into two teams
- Start to develop the code for the high priority subsystems
- Train the users to use the system correctly
- Test each subsystem before its implementation
- Test the entire system and verify the behavior of each subsystem
- Start the deployment of the software by implementing the subsystems during different periods.
- The maintenance phase will determine the success of this project.

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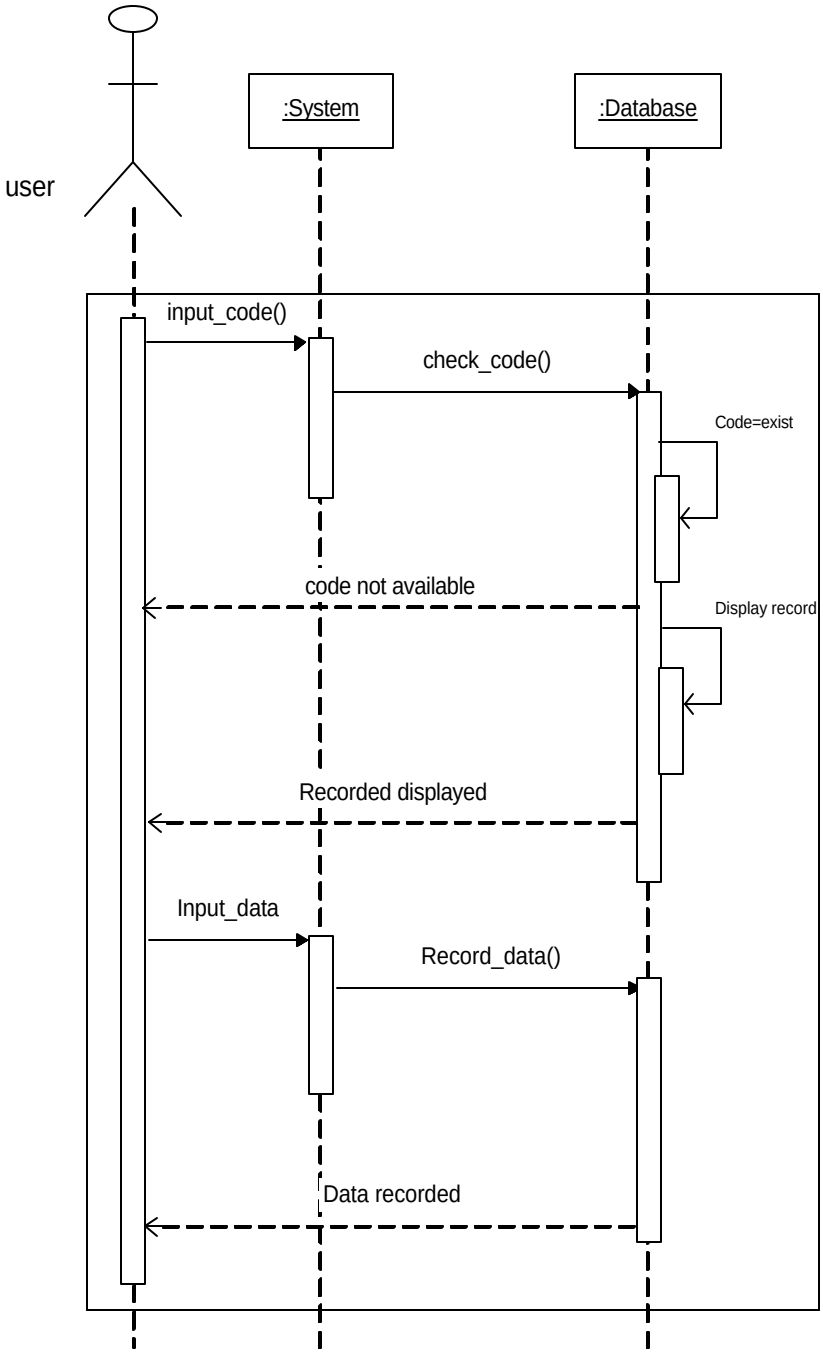
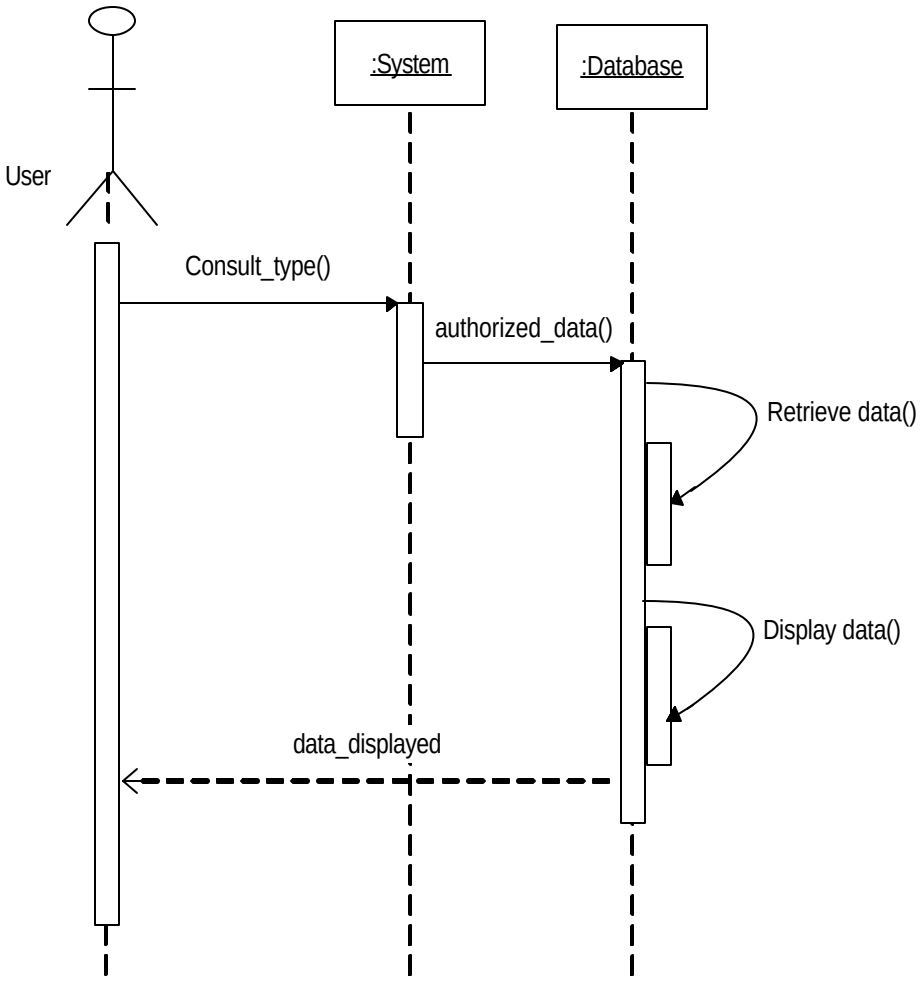
APPENDIX A. SEQUENCE DIAGRAMS

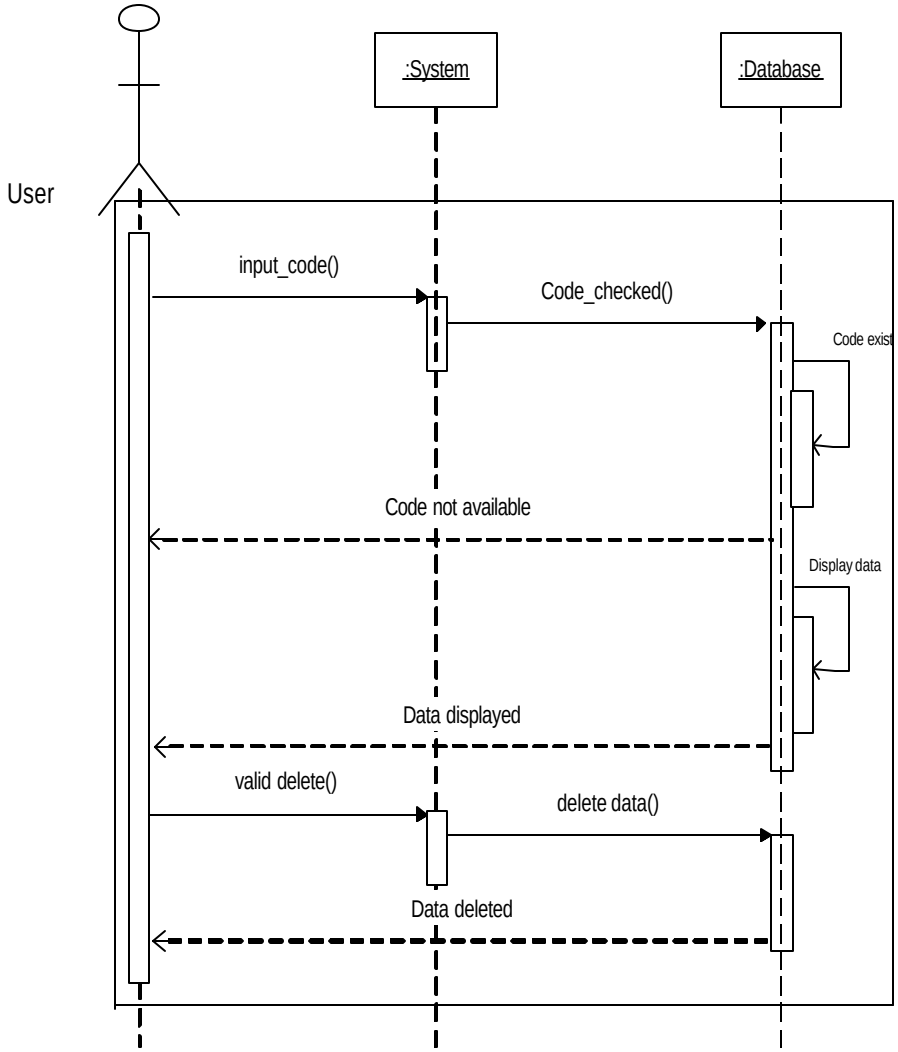
A. CREATE PROGRAM EMPLOY



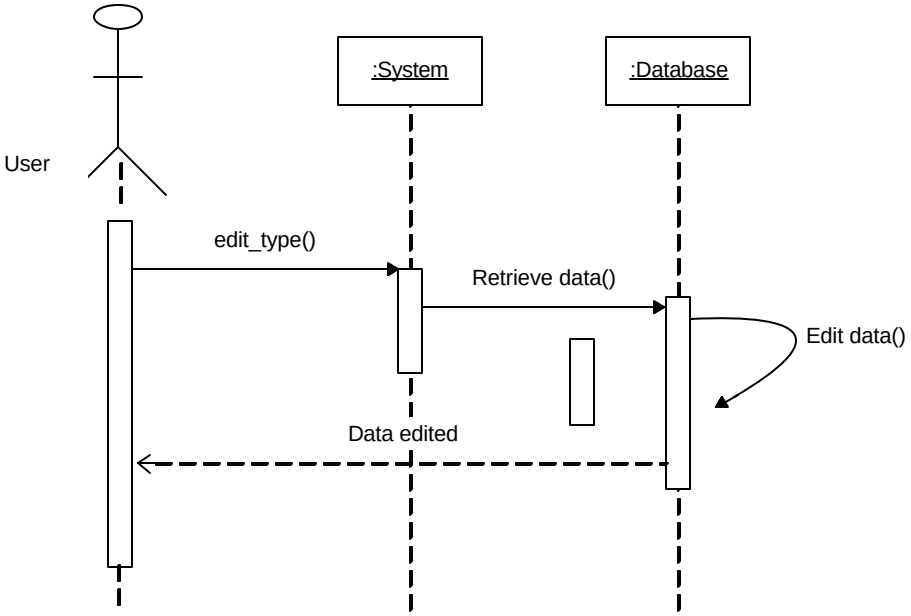
B. CONSULT PROGRAM EMPLOY



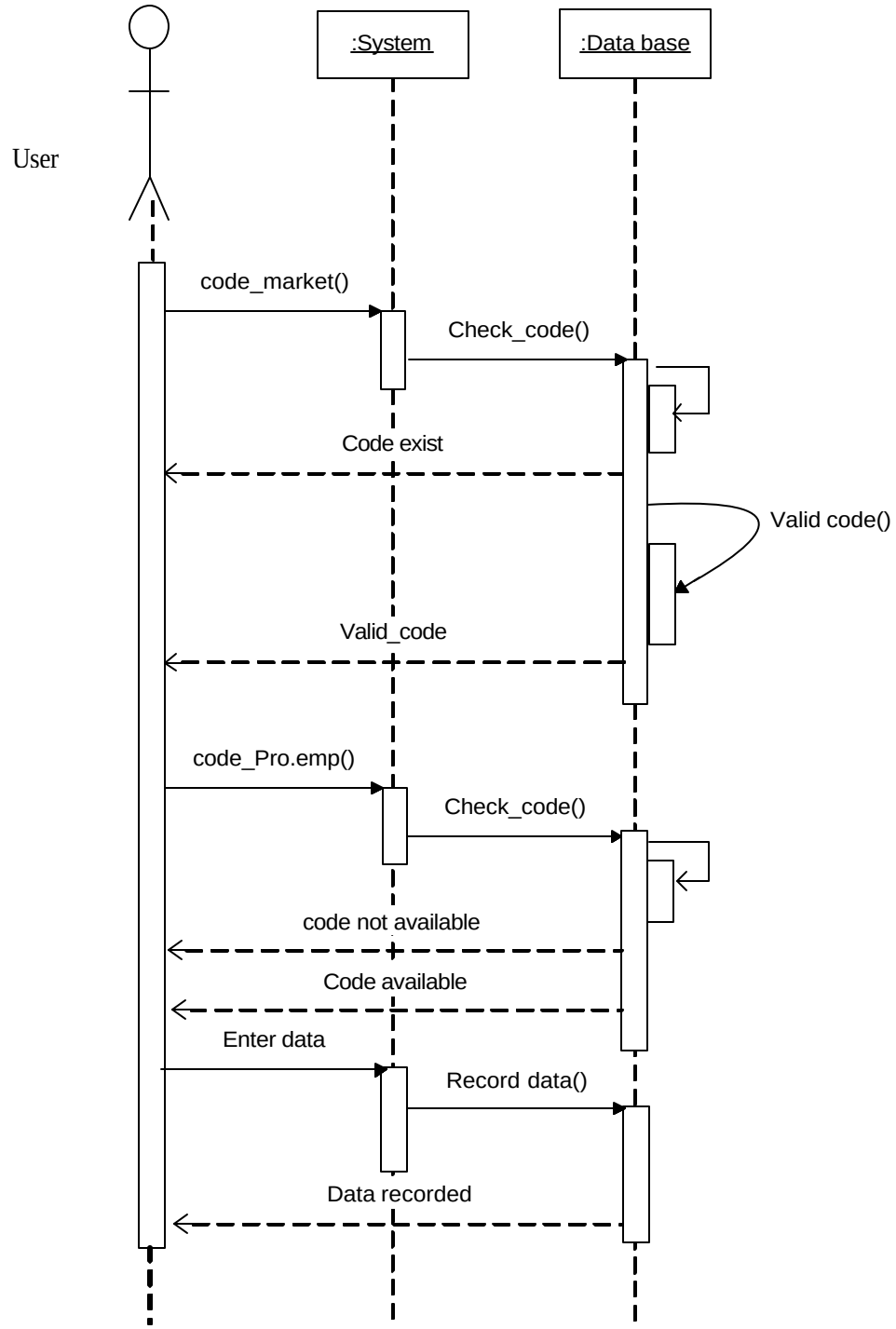
C. DELETE PROGRAM EMPLOY



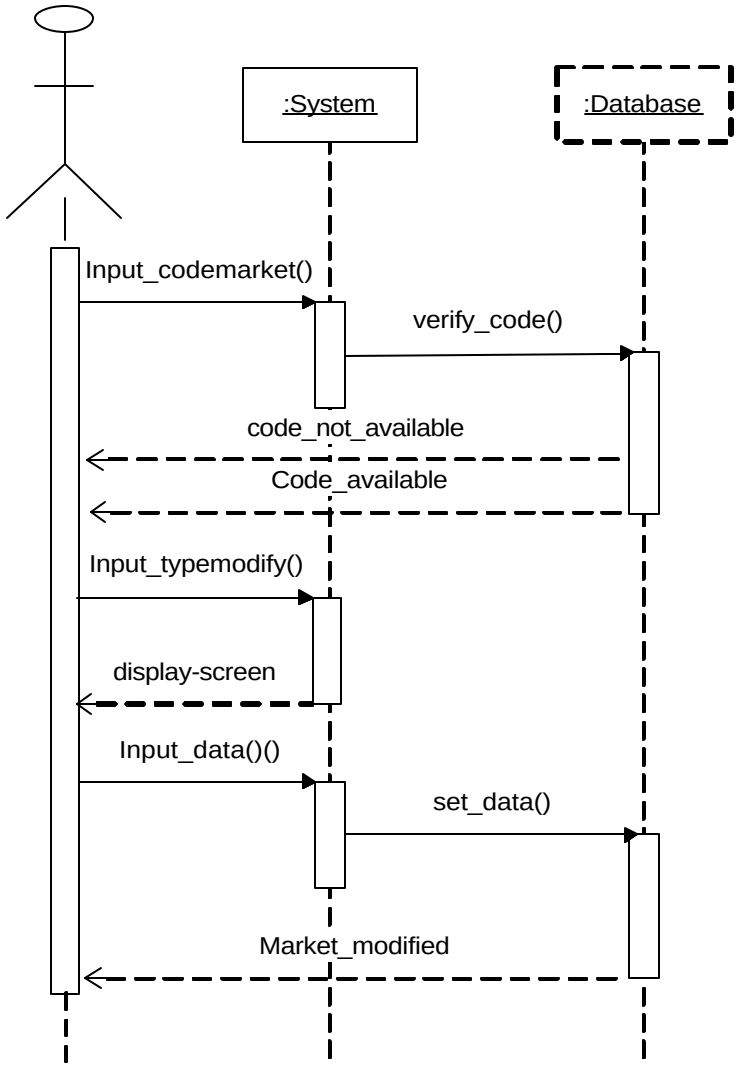
D. EDIT PROGRAM EMPLOY



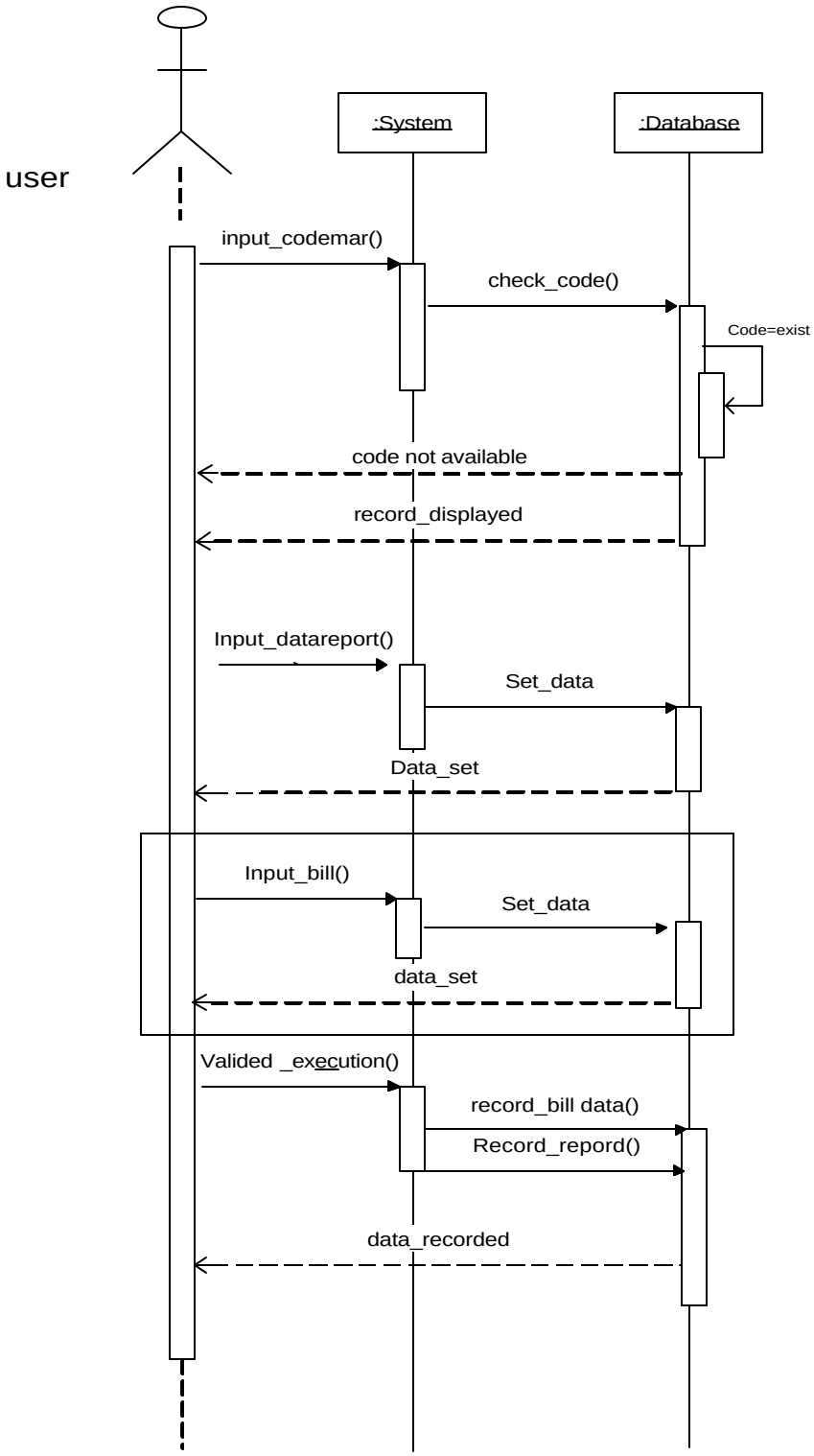
E. CREATE MARKET



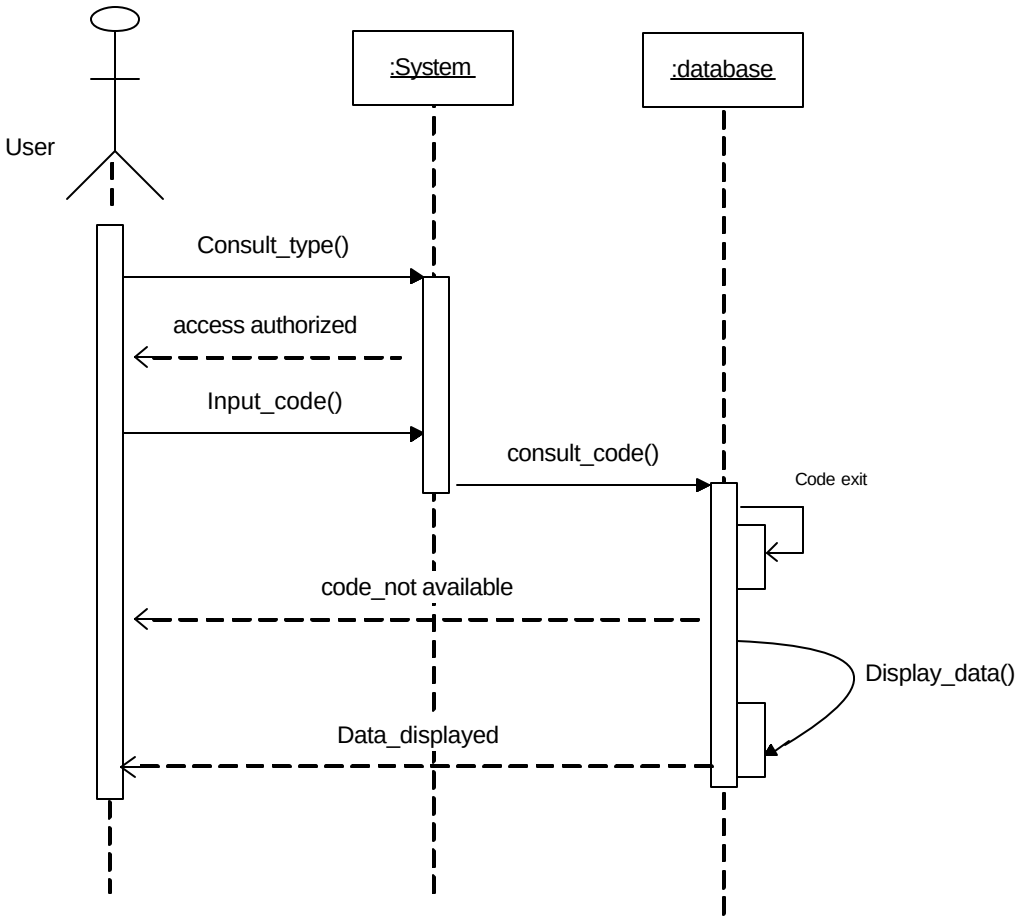
F. MODIFY MARKET



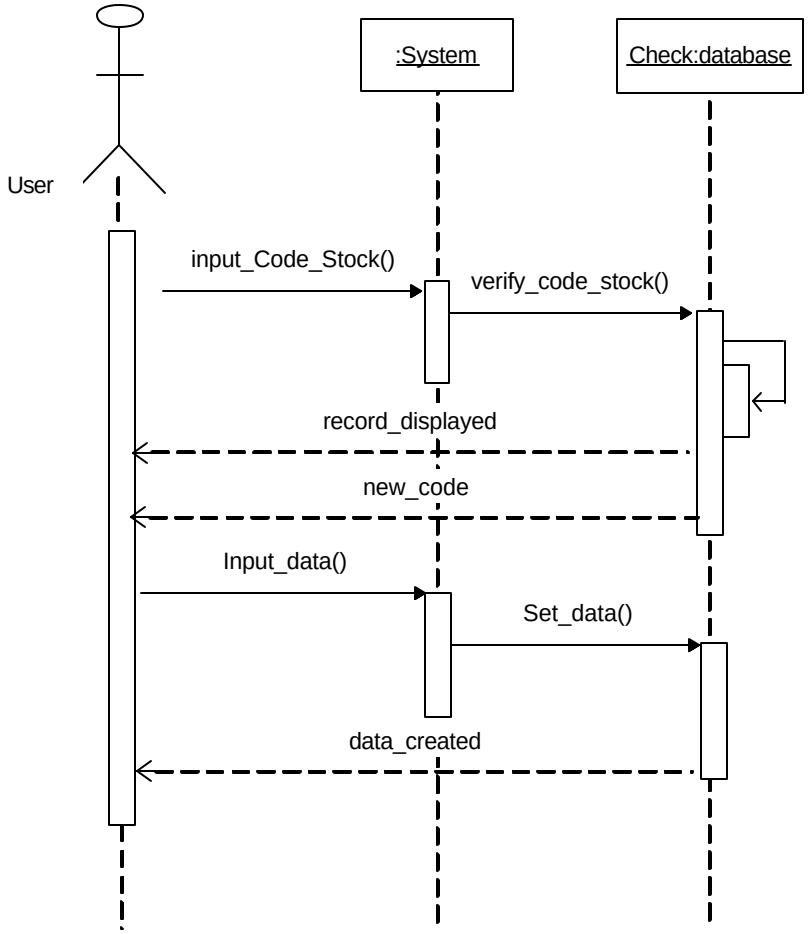
G. EXECUTION MARKET



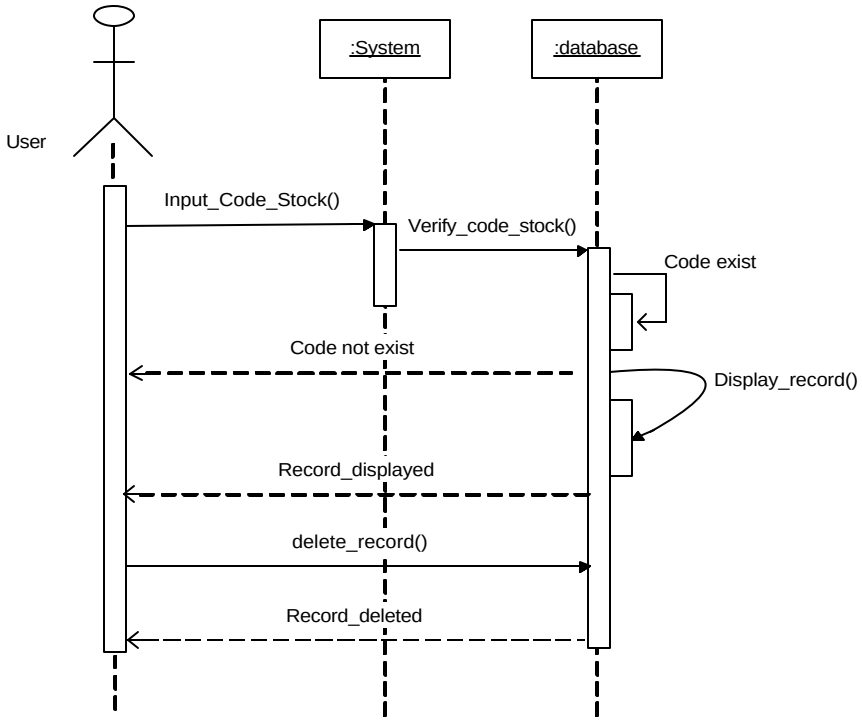
H. CONSULT MARKET



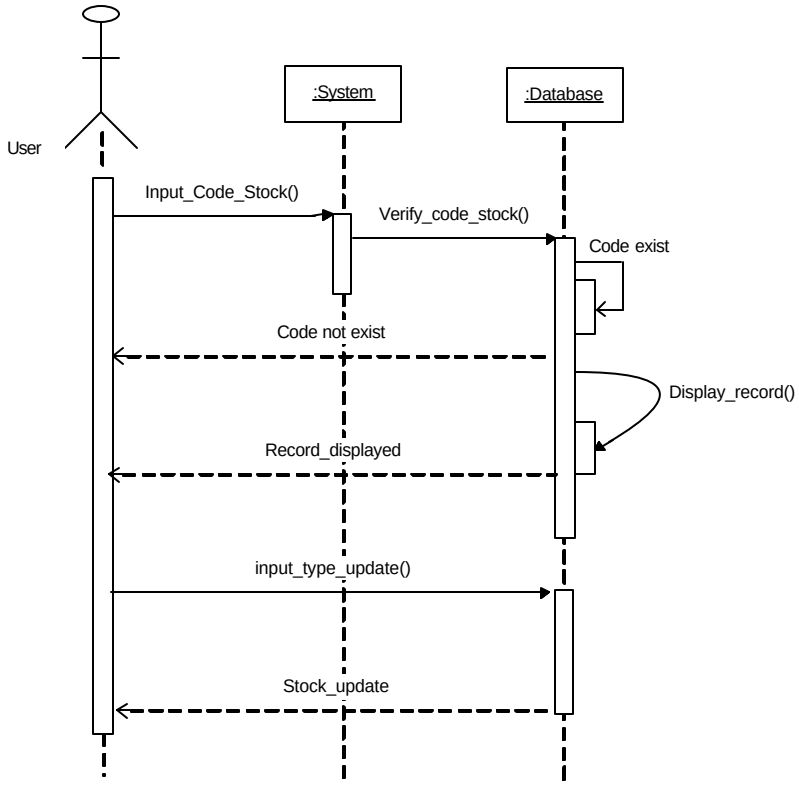
I. CREATE STOCK



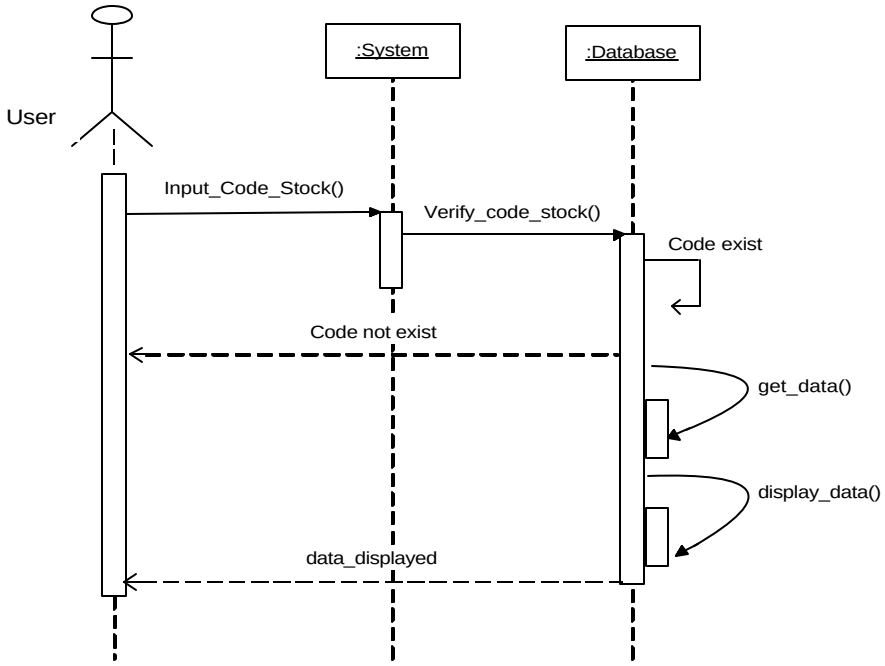
J. DELETE STOCK



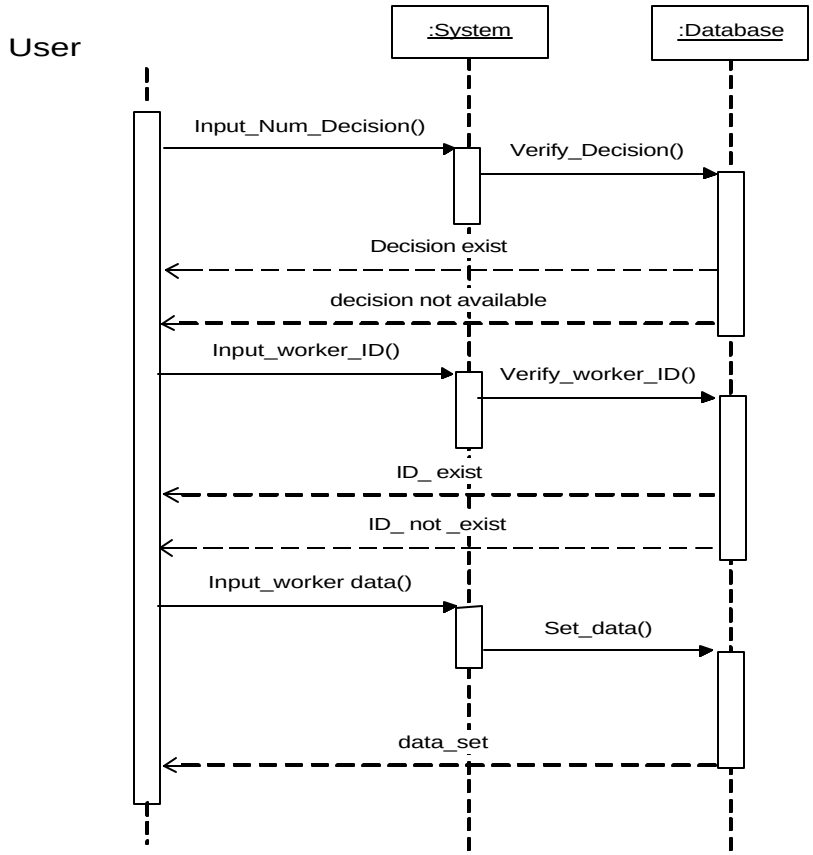
K. MODIFY STOCK



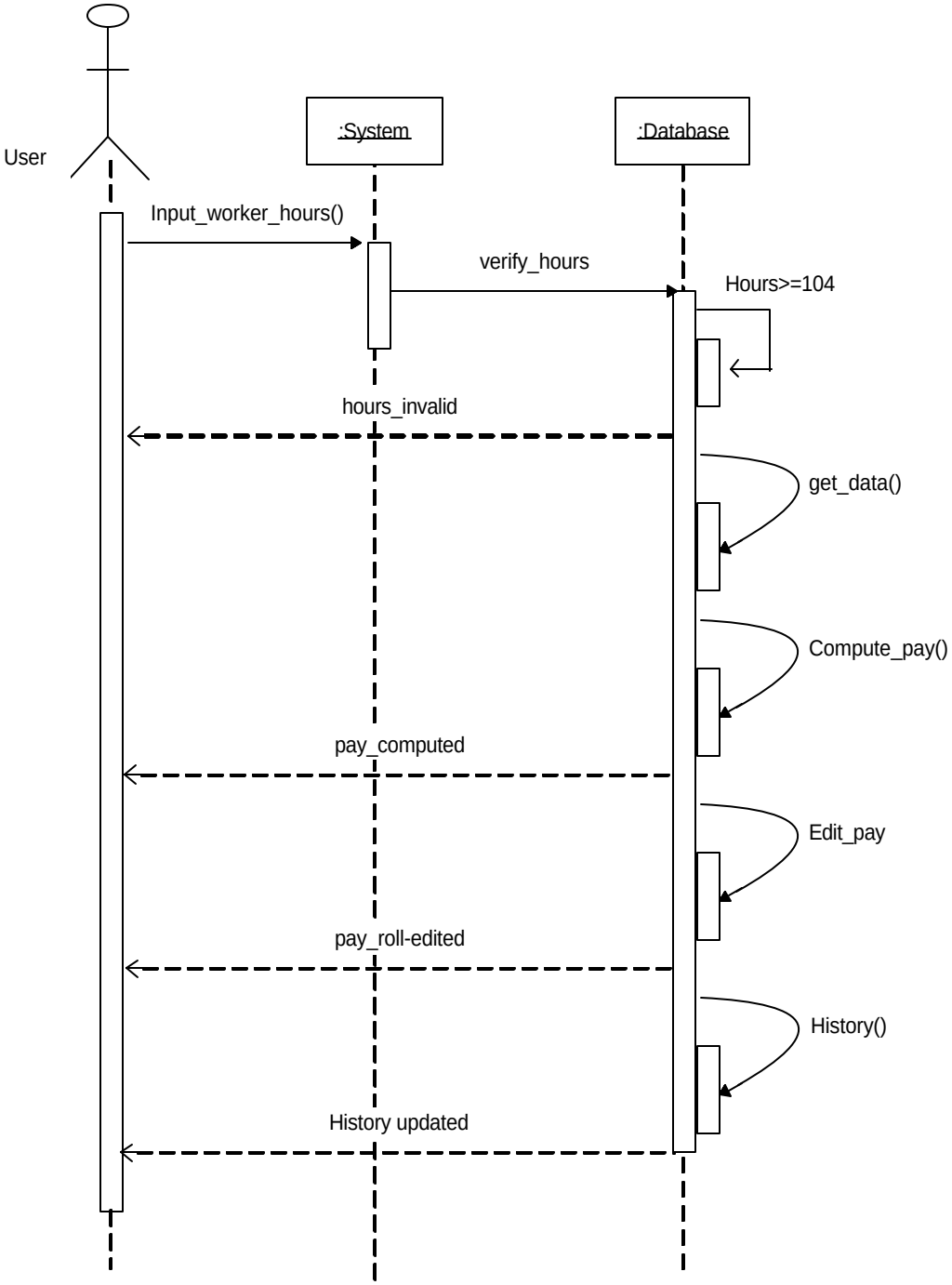
L. CONSULT STOCK



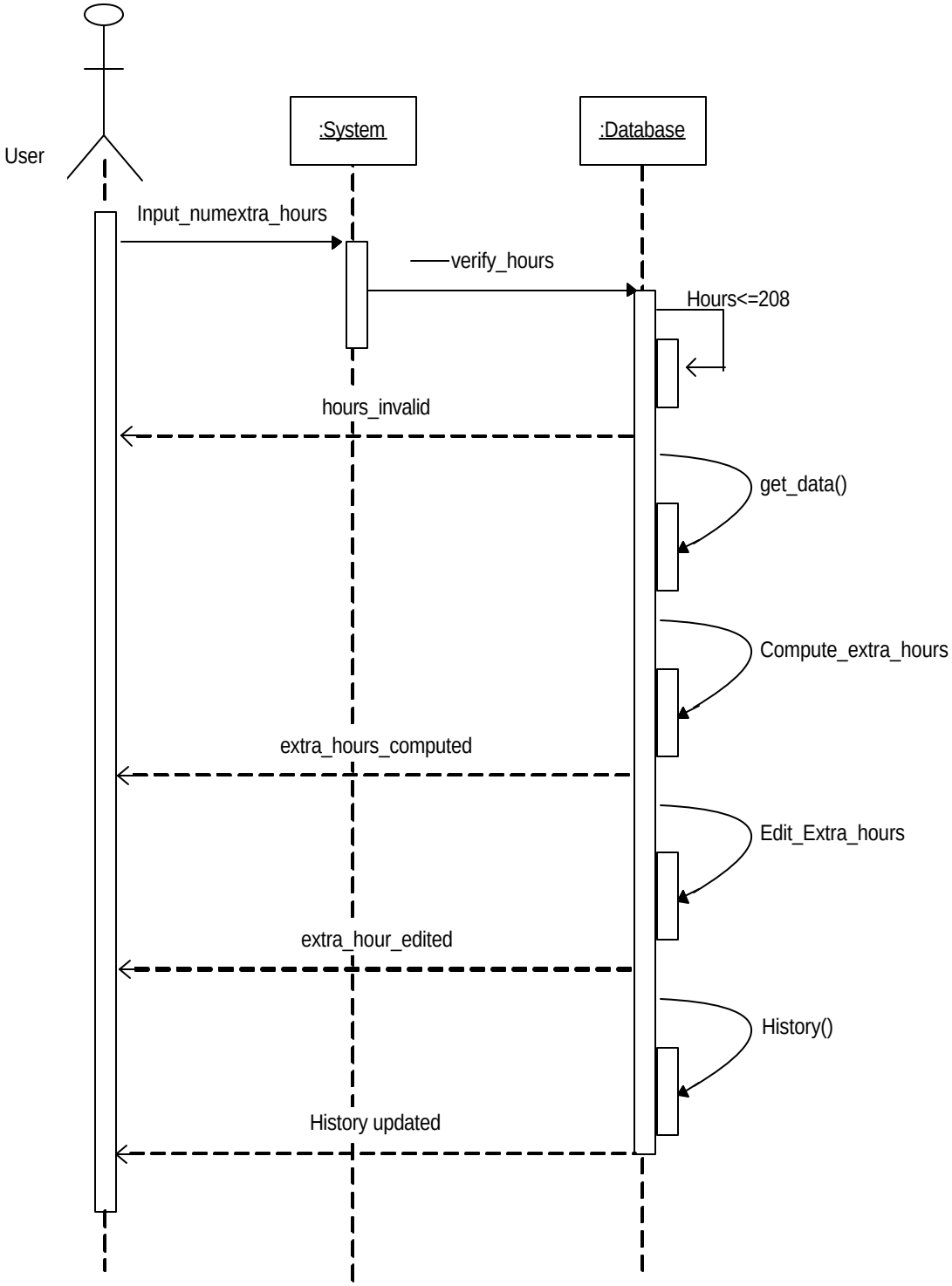
M. HIRING WORKER



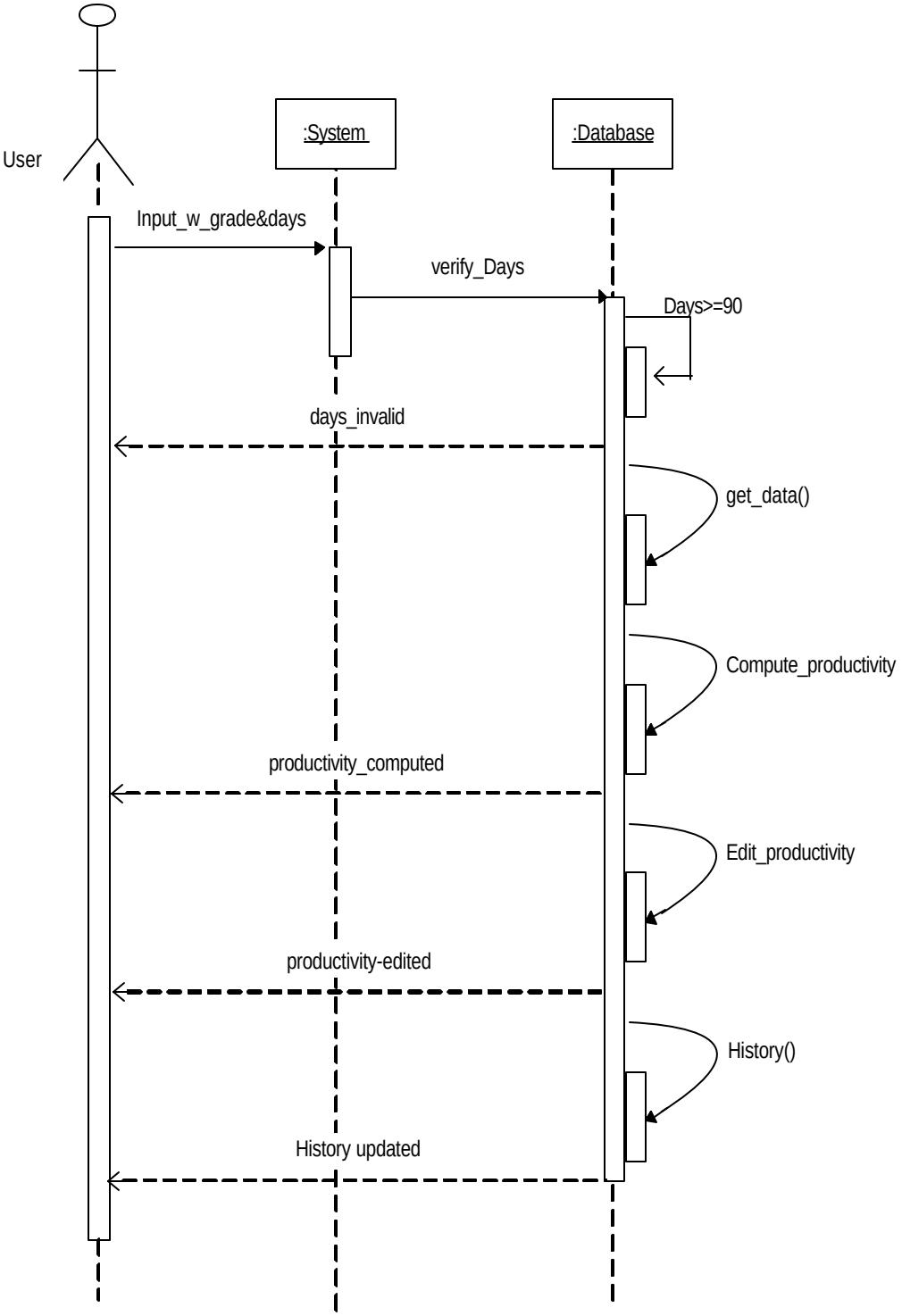
N. WORKER PAY_ROLL



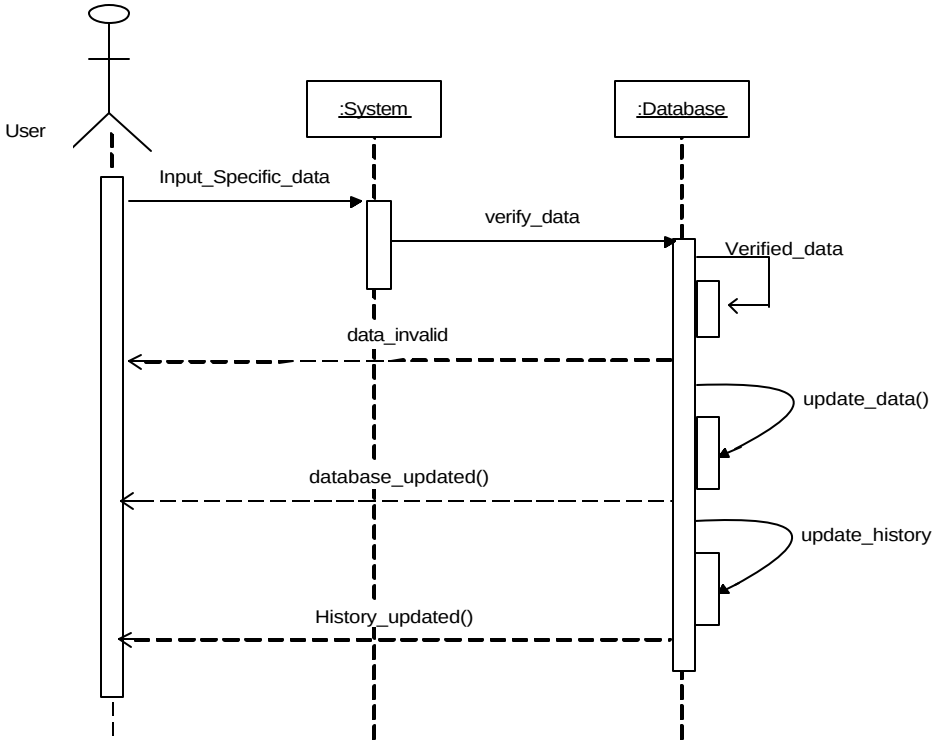
O. WORKER EXTRA HOURS



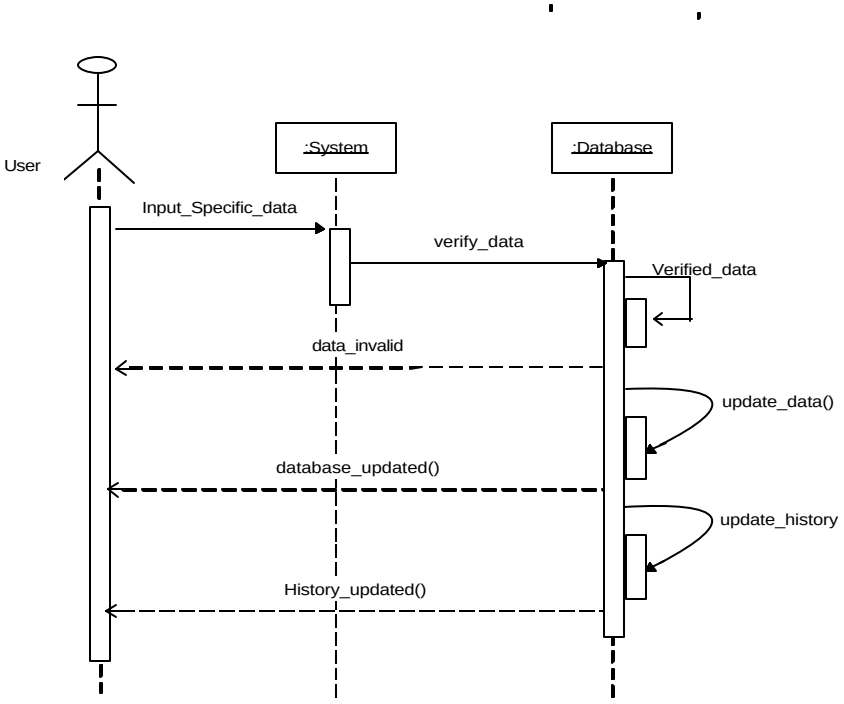
P. WORKER PRODUCTIVITY



Q. MANAGE STAFF



R. CONSULT STAFF



APPENDIX B. DATA DICTIONARY

ORDER#	NAME	ABBREVIATION	LENGTH	TYPE
01	Program employ #	Proemp#	4	Numeric
02	Year	Year	4	Date
03	Description program employ	Despre	50	Text
04	Start program	Stapro	8	Date
05	End program	Endpro	8	Date
06	Budget	Budget	12	Numeric
07	Title budget	titbud	6	Text
08	Market #	market#	4	Numeric
09	Market type	martyp	4	Text
10	Start market	stamar	8	Date
11	End market	endmar	8	Date
12	Description market	desmar	50	Text
13	Amount market	amomar	12	Numeric
14	Approved market	appmar	3	Text
15	Date approved market	daapma	8	Date
16	Order # modify market	modmar	4	Numeric
17	Modify market #	moornu	4	Numeric
18	Type modify	typmod	1	Text
19	Period modify	permod	8	Date
20	Amount modify	amomod	9	Numeric
21	Report #	report #	4	Numeric
22	Report date	repdat	8	Date
23	Invoice #	invoice #	4	Text
24	Invoice date	invdat	8	Date
25	Item code	itecod	12	Text
26	Description item	desite	50	Text
27	Market quantity	marqua	12	Numeric
28	Market delivery	mardel	12	Numeric
29	Price item	priite	12	Numeric
30	Invoice amount	invamo	12	Numeric
31	Report amount	repamo	12	Numeric
32	Unit item	uniite	2	Text
33	Threshold item	thrite	12	Numeric
34	Purchase order #	purord #	4	Numeric
35	Type purchase order	typpur	2	Text
36	Purchase order date	datpur	8	Date
37	Total purchase	totpur	12	Numeric
38	Purchase required	purreq	12	Numeric
39	Purchase delivery	purdel	12	Numeric
40	Item stock quantity	itstqu	12	Numeric
41	Code supplier	codsup	4	Text
42	Clair supplier	clasup	50	Text

ORDER#	NAME	ABBREVIATION	LENGTH	TYPE
43	Address supplier	addsup	50	Text
44	Phone supplier	phosup	8	Text
45	Fax supplier	faxsup	8	Numeric
46	Code customer	codcus	4	Numeric
47	Clair customer	clacus	50	Text
48	Address customer	addcus	50	Text
49	Phone customer	phocus	8	Text
50	Fax customer	faxcus	8	Numeric
51	Type customer	typcus	4	Numeric
52	Decision #	decisi#	4	Text
53	Data decision	decdat	8	Numeric
54	Person name	pernam	30	Date
55	Father name	fatnam	30	Text
56	Last name	lasnam	30	Text
57	Id #	id #	8	Text
58	Family situation	famsit	1	Numeric
59	Number of kids	kids#	1	Text
60	Birthday	birday	8	Numeric
61	Echelon	echelo	2	Date
62	Category	catego	2	Numeric
63	Code specialty	codspe	4	Numeric
64	Clair specialty	claspe	50	Text
65	Code attachment	codatt	2	Text
66	Grade	grade	2	Numeric
67	Presence days	preday	3	Numeric
68	Hours#	hours#	3	Numeric
69	Account bank #	acbank	12	Numeric

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