Project Design Implementation And Evaluation

PROJECT IMPLEMENTATION, EVALUATION AND PRESENTATION OF THE PROJECT OUTCOMES

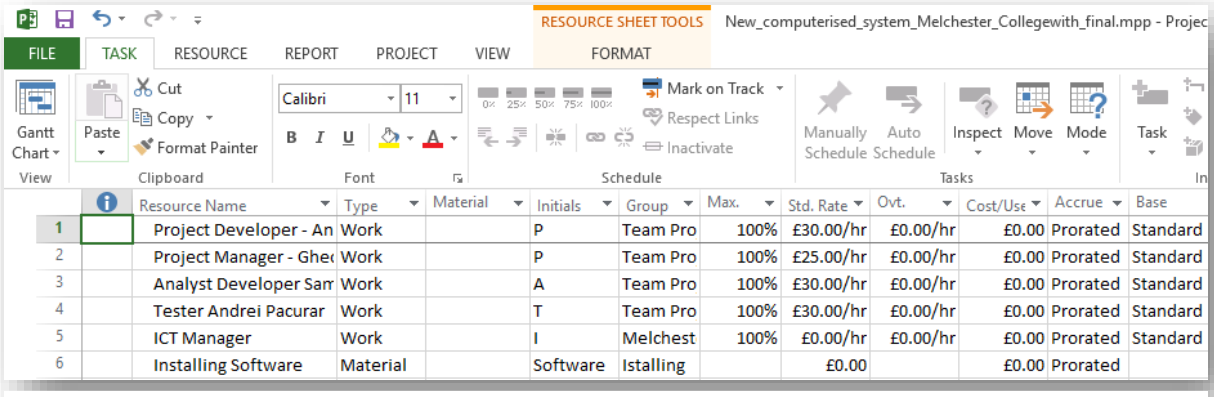
Gheorghe Mitrea

TOWER HAMLETS COLLEGE 2017

1 Contents

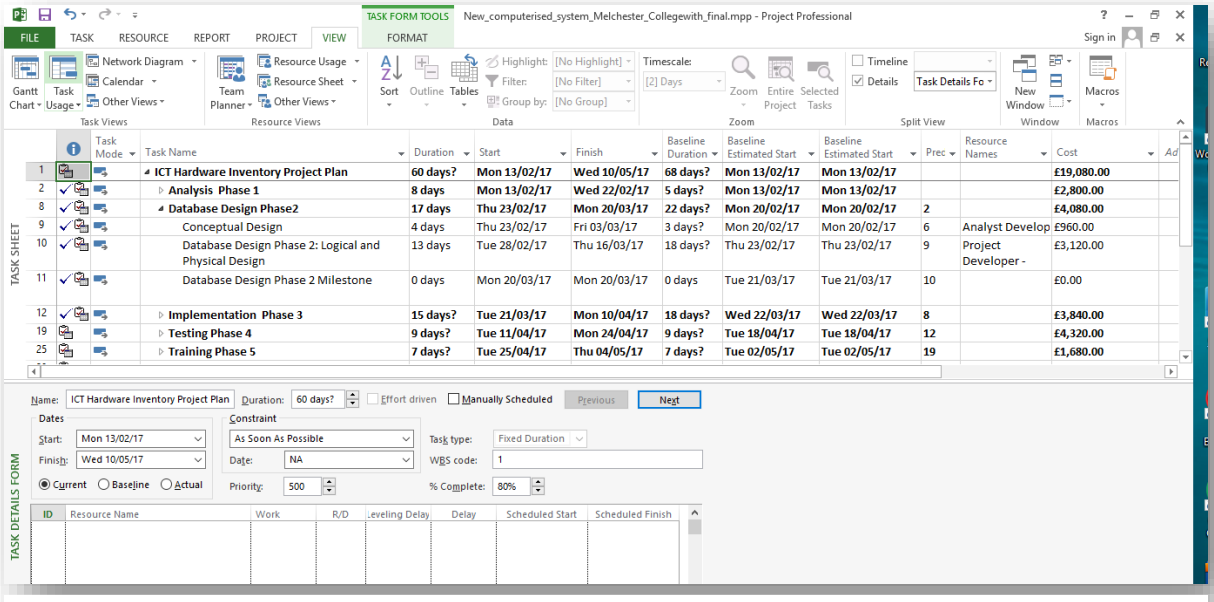
Table of Figures

1. Task 1 A Gantt chart clearly showing the resource allocation



	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base
1	Project Developer - An	Work		P	Team Pro	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
2	Project Manager - Ghe	Work		P	Team Pro	100%	£25.00/hr	£0.00/hr	£0.00	Prorated	Standard
3	Analyst Developer Sam	Work		A	Team Pro	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
4	Tester Andrei Pacurar	Work		T	Team Pro	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
5	ICT Manager	Work		I	Melchest	100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard
6	Installing Software	Material		Software	Istalling		£0.00		£0.00	Prorated	

Figure 1 Allocating the resources for the implementation of the project



	Task Mode	Task Name	Duration	Start	Finish	Baseline Duration	Baseline Estimated Start	Baseline Estimated Start	Prec	Resource Names	Cost
1		ICT Hardware Inventory Project Plan	60 days?	Mon 13/02/17	Wed 10/05/17	68 days?	Mon 13/02/17	Mon 13/02/17			£19,080.00
2		Analysis Phase 1	8 days	Mon 13/02/17	Wed 22/02/17	5 days?	Mon 13/02/17	Mon 13/02/17			£2,800.00
8		Database Design Phase2	17 days	Thu 23/02/17	Mon 20/03/17	22 days?	Mon 20/02/17	Mon 20/02/17	2		£4,080.00
9		Conceptual Design	4 days	Thu 23/02/17	Fri 03/03/17	3 days?	Mon 20/02/17	Mon 20/02/17	6	Analyst Develop	£960.00
10		Database Design Phase 2: Logical and Physical Design	13 days	Tue 28/02/17	Thu 16/03/17	18 days?	Thu 23/02/17	Thu 23/02/17	9	Project Developer -	£3,120.00
11		Database Design Phase 2 Milestone	0 days	Mon 20/03/17	Mon 20/03/17	0 days	Tue 21/03/17	Tue 21/03/17	10		£0.00
12		Implementation Phase 3	15 days?	Tue 21/03/17	Mon 10/04/17	18 days?	Wed 22/03/17	Wed 22/03/17	8		£3,840.00
19		Testing Phase 4	9 days?	Tue 11/04/17	Mon 24/04/17	9 days?	Tue 18/04/17	Tue 18/04/17	12		£4,320.00
25		Training Phase 5	7 days?	Tue 25/04/17	Thu 04/05/17	7 days?	Tue 02/05/17	Tue 02/05/17	19		£1,680.00

Figure 2 Differences between the original project and the current stage of it

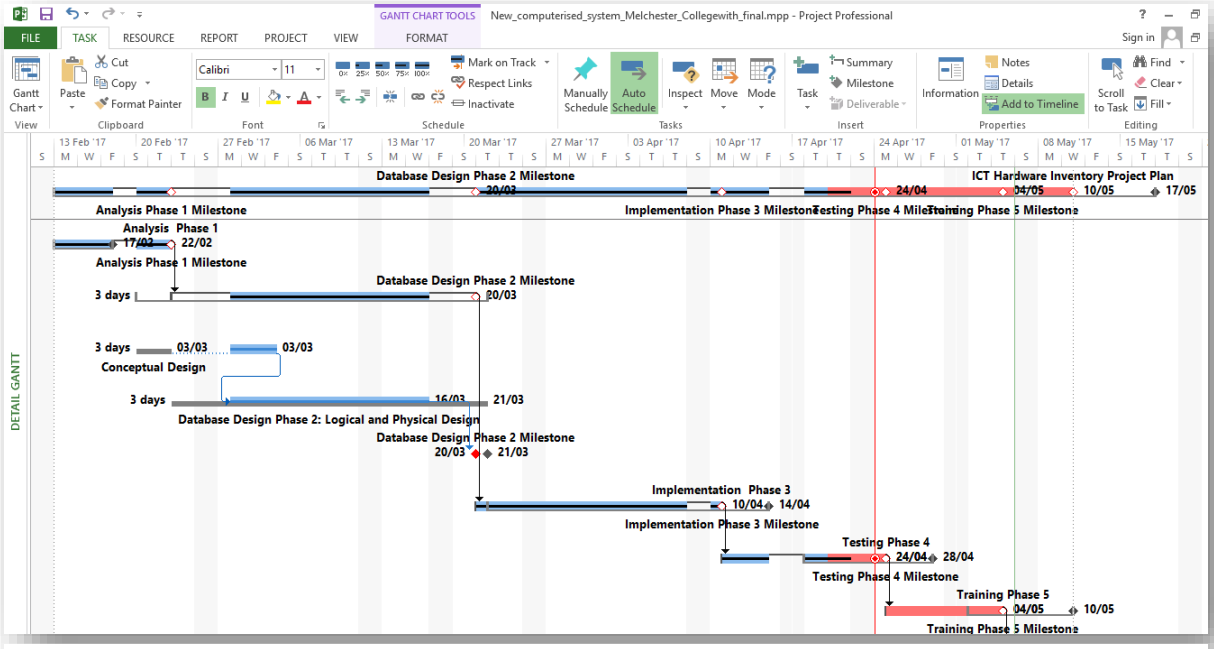


Figure 3 Milestones of the project

2. Task 2 Undertake the proposed project in accordance with the agreed specification

Introduction

The project related to the implementation of the new computer system in the Melchester College for securing the information. While purchasing the new system, its specifications must be considered and evaluation must be done at the time of making the payment to develop this application for data record keeping. The college is offering various resources in order to facilitate the system specifications.

2.1 Initial Phase

The initial phase of the project was when the ICT Department's Manager of Melchester College selected and invited the Project Manager for this implementation of a new hardware inventory system to a meeting in which to discuss the terms and specifications of the project.

Meeting Note

To: Project Manager – Gheorghe Mitrea

From: ICT Manager Department, Melchester College

Date: March 02, 2017

Subject: Installation of new hardware inventory system

Due to extensive ICT staff feedback, we Melchester College would like to demonstrate our commitment in making the installation of a new the hardware inventory system in the ICT department. It provides an advanced system to our system inventory and college for maintaining the record of digital equipment.

The enthusiasm, product knowledge, and implementation strategy were impressive and a specific deal is signed with the company for maintenance and training of staff.

The letter is only to develop an obeisance that makes you aware that credit exists and you need to verify the specific records that are in agreement.

Thank you for the outstanding work and commitment.

Thank you and regard, ICT Department!

2.2 Brief Details

In essence, the present project is an IT project of a system application, which provides the conceptual framework for addressing the plan of analysis, design, implementation and operation of an information system to inventory all the hardware equipment within Melchester College.

The issues have to be checked and later on discussed with the team for an early redress. The decisions have to be related to the project development and it must to be stated in the brief of the project (Mishra and Mishra, 2011).

The project plan has been segregated according to the specification of the project. Each task of the project will provide a major description required to implement the project.

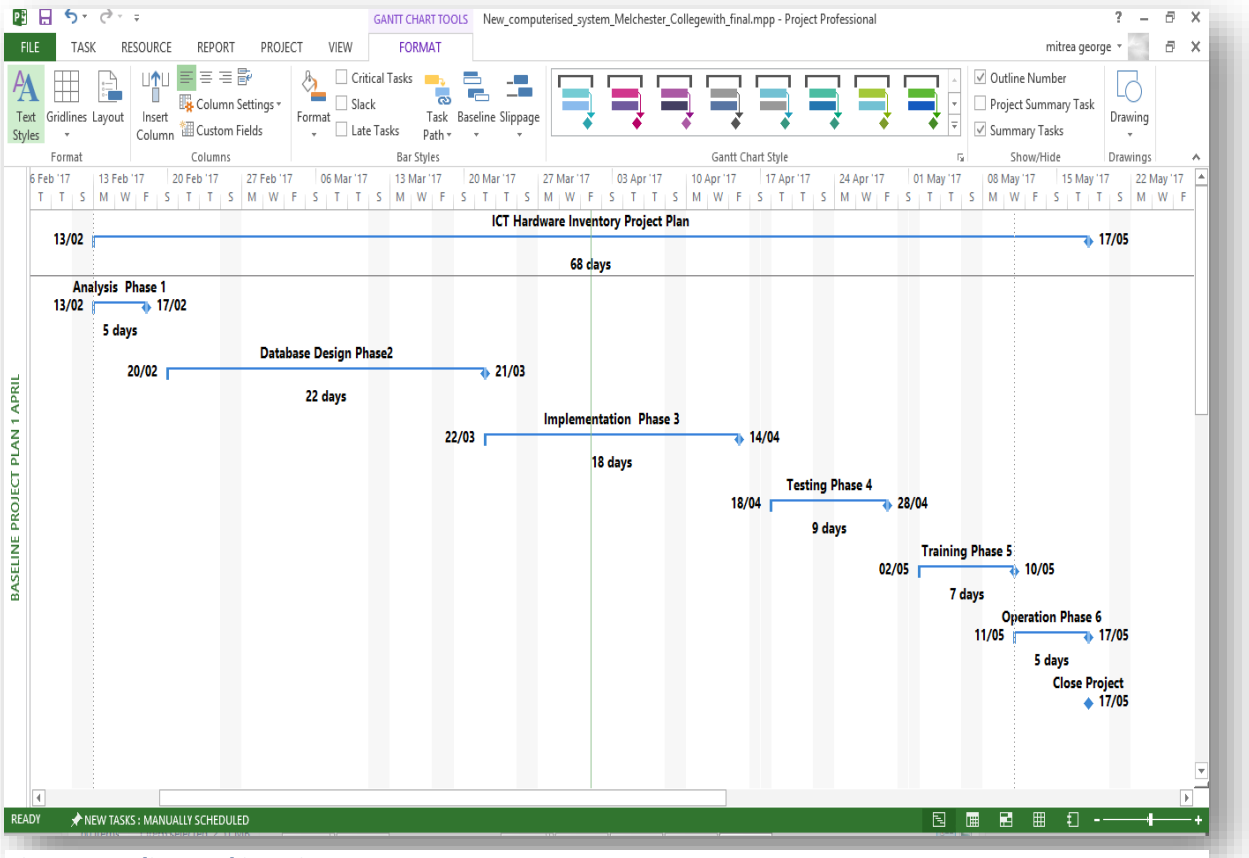


Figure 4 Baseline graphic project

The tasks described are not the specific tasks but are considered as the general tasks necessary to install the hardware, software and includes the verification of the system (Larson et. al., 2011). It will contain the necessary information:

- When the tasks will be accomplished?

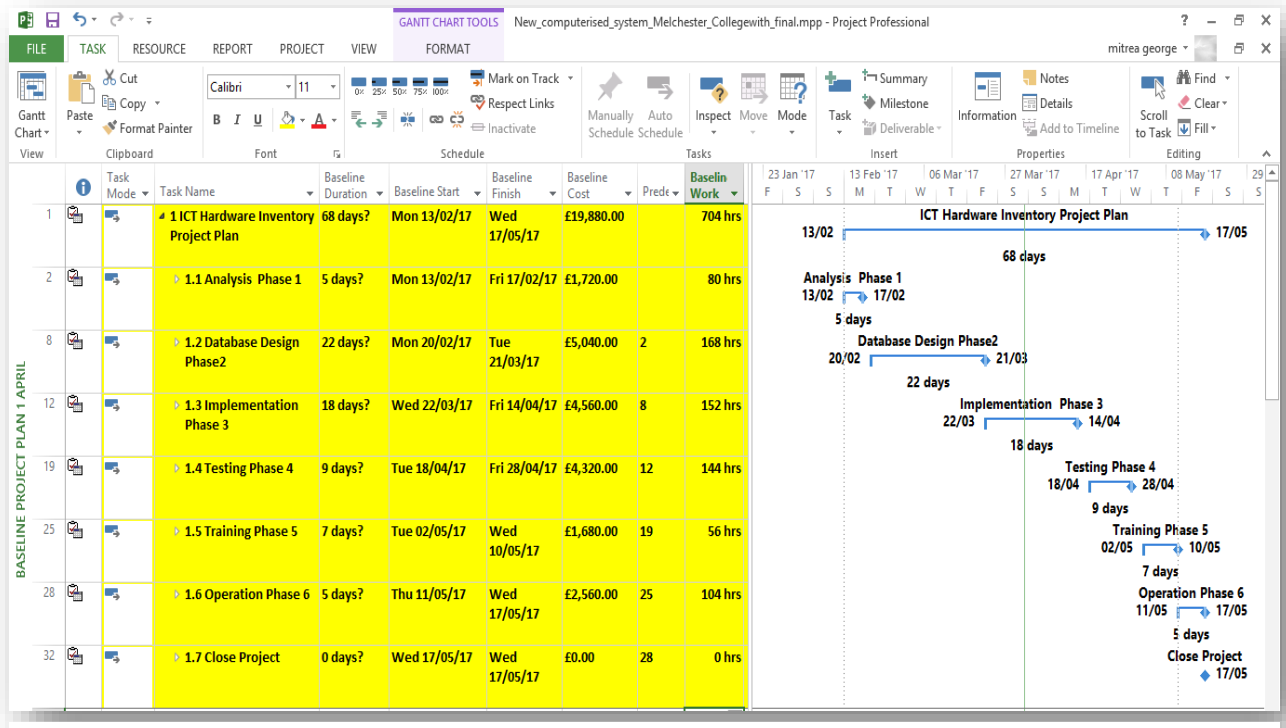
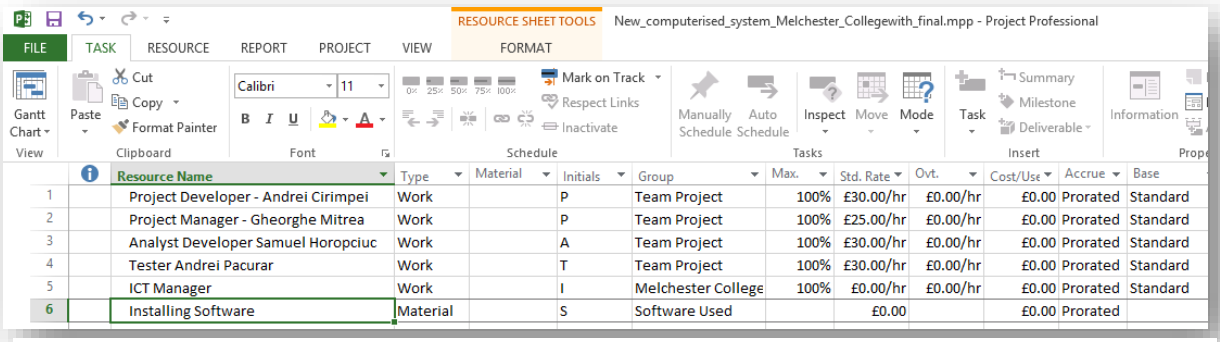


Figure 5 The date when the baseline project's tasks will be accomplished

Project brief is used to set the specifications for each task and subtask undertaken. The Project Manager said that the project has to comply with the new regulations that will help in avoiding the fines. It will cover the number of persons required to handle the operations to have more efficient and effective operation in the project development (Mishra and Mishra, 2011).

2.3 Defining the Resources of the Project

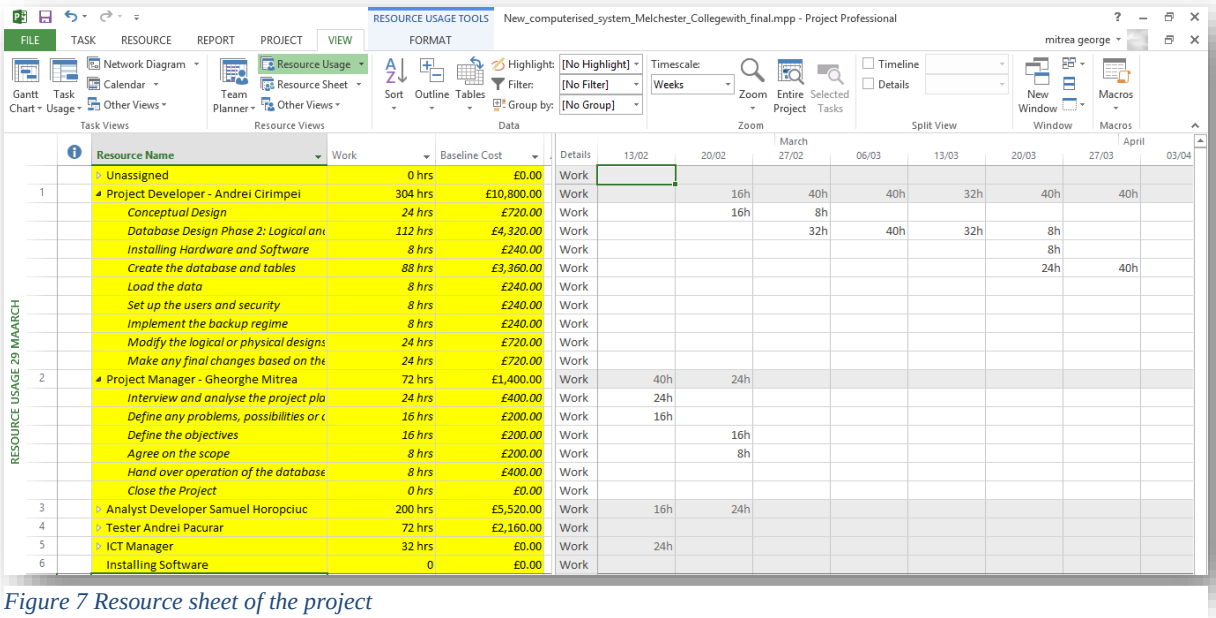
The college defined the resources as the team's project and the materials (software and hardware) needed for the project's implementation. The image below shows the entire resources for this project:



	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base
1	Project Developer - Andrei Cirimpei	Work		P	Team Project	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
2	Project Manager - Gheorghe Mitrea	Work		P	Team Project	100%	£25.00/hr	£0.00/hr	£0.00	Prorated	Standard
3	Analyst Developer Samuel Horopciuc	Work		A	Team Project	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
4	Tester Andrei Pacurar	Work		T	Team Project	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
5	ICT Manager	Work		I	Melchester College	100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard
6	Installing Software	Material		S	Software Used		£0.00		£0.00	Prorated	

Figure 6 Resources of the project

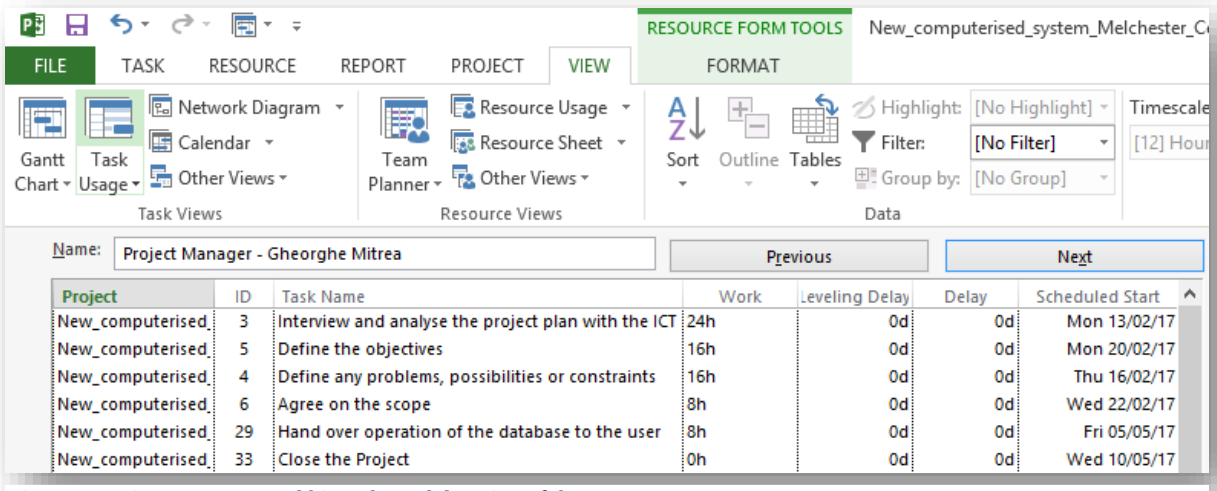
- Various resources required to accomplish the task:



	Resource Name	Work	Baseline Cost	Details
	Unassigned	0 hrs	£0.00	Work
1	Project Developer - Andrei Cirimpei	304 hrs	£10,800.00	Work
	Conceptual Design	*24 hrs*	*£720.00*	Work
	Database Design Phase 2: Logical an	*112 hrs*	*£4,320.00*	Work
	Installing Hardware and Software	*8 hrs*	*£240.00*	Work
	Create the database and tables	*88 hrs*	*£3,360.00*	Work
	Load the data	*8 hrs*	*£240.00*	Work
	Set up the users and security	*8 hrs*	*£240.00*	Work
	Implement the backup regime	*8 hrs*	*£240.00*	Work
	Modify the logical or physical designs	*24 hrs*	*£720.00*	Work
	Make any final changes based on the	*24 hrs*	*£720.00*	Work
2	Project Manager - Gheorghe Mitrea	72 hrs	£1,400.00	Work
	Interview and analyse the project pla	*24 hrs*	*£400.00*	Work
	Define any problems, possibilities or	*16 hrs*	*£200.00*	Work
	Define the objectives	*16 hrs*	*£200.00*	Work
	Agree on the scope	*8 hrs*	*£200.00*	Work
	Hand over operation of the database	*8 hrs*	*£400.00*	Work
	Close the Project	*0 hrs*	*£0.00*	Work
3	Analyst Developer Samuel Horopciuc	200 hrs	£5,520.00	Work
4	Tester Andrei Pacurar	72 hrs	£2,160.00	Work
5	ICT Manager	32 hrs	£0.00	Work
6	Installing Software	0	£0.00	Work

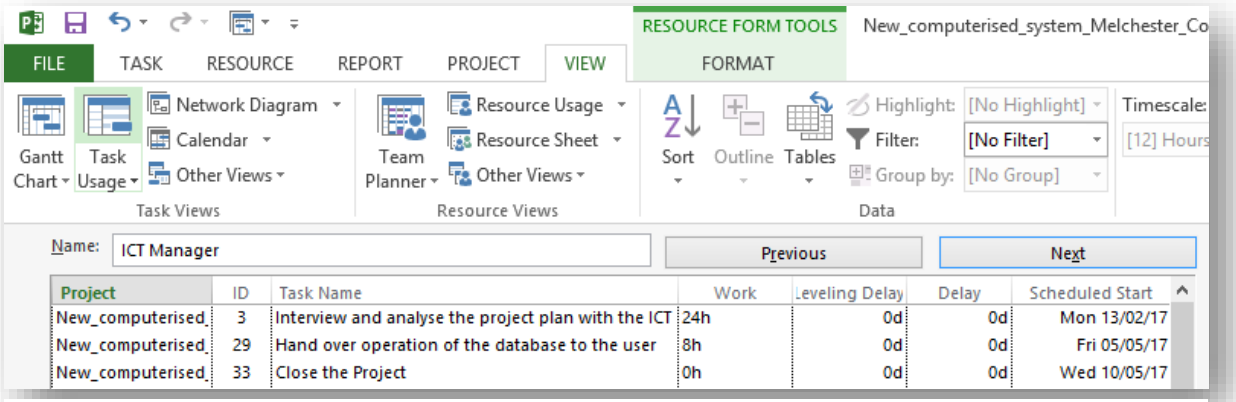
Figure 7 Resource sheet of the project

As it can be seen in the above picture the project manager was appointed in the person of **Gheorghe Mitrea** who will lead the team for the implementation of the project, then **ICT Manager** as an employee of the college to help the team project with the details related to the specifications of the new desired computerised system requirements.



Project	ID	Task Name	Work	Leveling Delay	Delay	Scheduled Start
New_computerised	3	Interview and analyse the project plan with the ICT	24h	0d	0d	Mon 13/02/17
New_computerised	5	Define the objectives	16h	0d	0d	Mon 20/02/17
New_computerised	4	Define any problems, possibilities or constraints	16h	0d	0d	Thu 16/02/17
New_computerised	6	Agree on the scope	8h	0d	0d	Wed 22/02/17
New_computerised	29	Hand over operation of the database to the user	8h	0d	0d	Fri 05/05/17
New_computerised	33	Close the Project	0h	0d	0d	Wed 10/05/17

Figure 9 Project Manager and his tasks and duration of them



Project	ID	Task Name	Work	Leveling Delay	Delay	Scheduled Start
New_computerised	3	Interview and analyse the project plan with the ICT	24h	0d	0d	Mon 13/02/17
New_computerised	29	Hand over operation of the database to the user	8h	0d	0d	Fri 05/05/17
New_computerised	33	Close the Project	0h	0d	0d	Wed 10/05/17

Figure 8 ICT Manager and his tasks and duration of them

Samuel Horopciuc was appointed for the post of Analyst Developer. His role is to collect and analyse fairly and consistently the developed database, implementation of the database system or support the strategic decisions related to current computerised system.

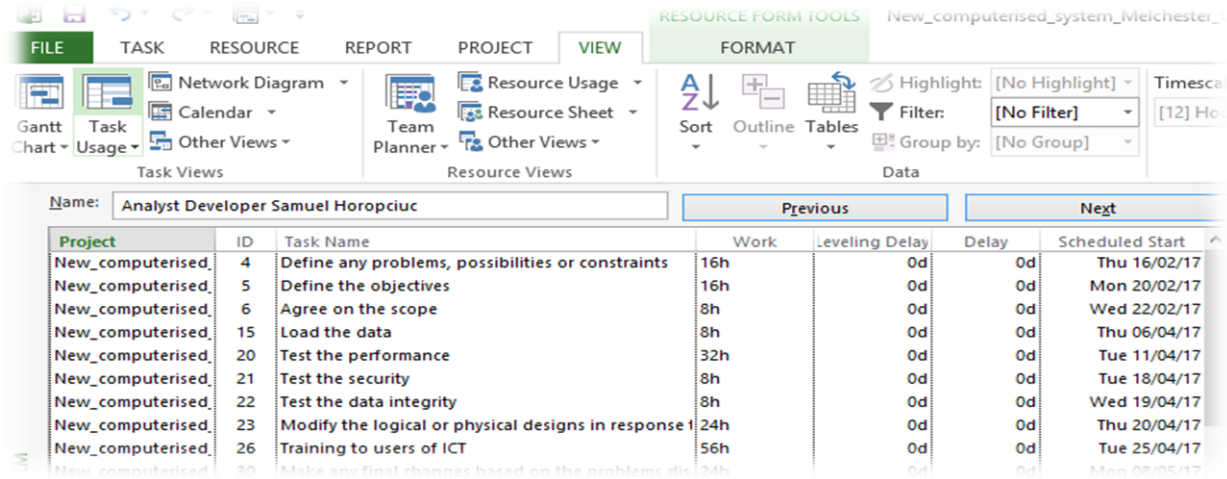


Figure 10 Samuel Horopciuc and his tasks with their duration

Andrei Cirimpei was appointed for the post of ***Project Developer***. He will work on the project to identify the challenges for such a computerised system database. Then, he will design the program and prepare the functions for the end user. Once designed, the developer will write the code for such a program.

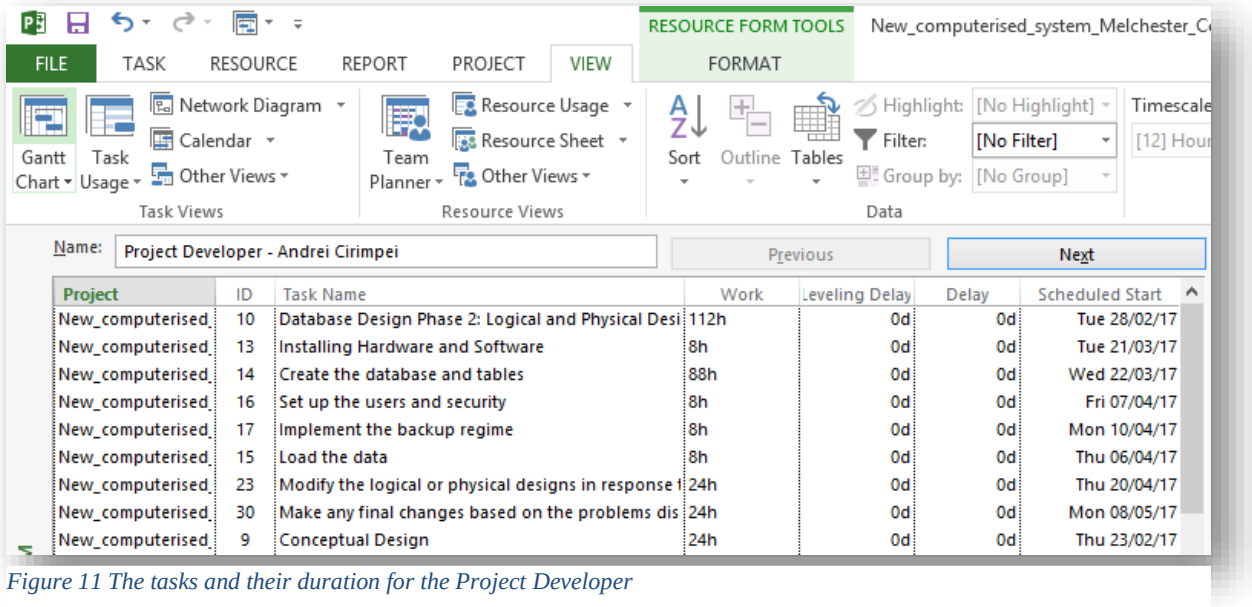


Figure 11 The tasks and their duration for the Project Developer

As a ***Program Tester*** was appointed **Andrei Pacurar**. The computerised system tester will test the final product before it is sent to the client for use. He will deal with the information related to the quality of the product or service being tested.

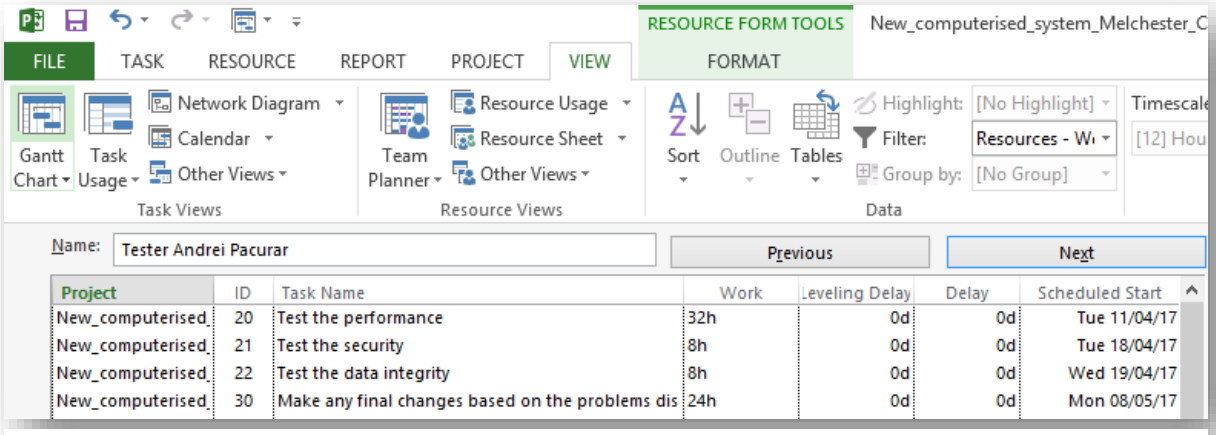


Figure 12 The tasks and their duration for the Tester

2.3.1 Defining the Software Used to Develop the New Computerised System

The resources used as ***software*** needed to implement the new computerised system for hardware inventory (record keeping) are an interaction between a created database using ***MySQL Workbench*** and ***Xampp*** (a PHP development environment), communication between the user and the system. This will form an automated system showing the details of each device in the hardware inventory of Melchester College.

2.4 Project Plan

The initial project with resources allocated to each tasks and subtasks to lead to the fulfilment of project will look like figure 10 below:

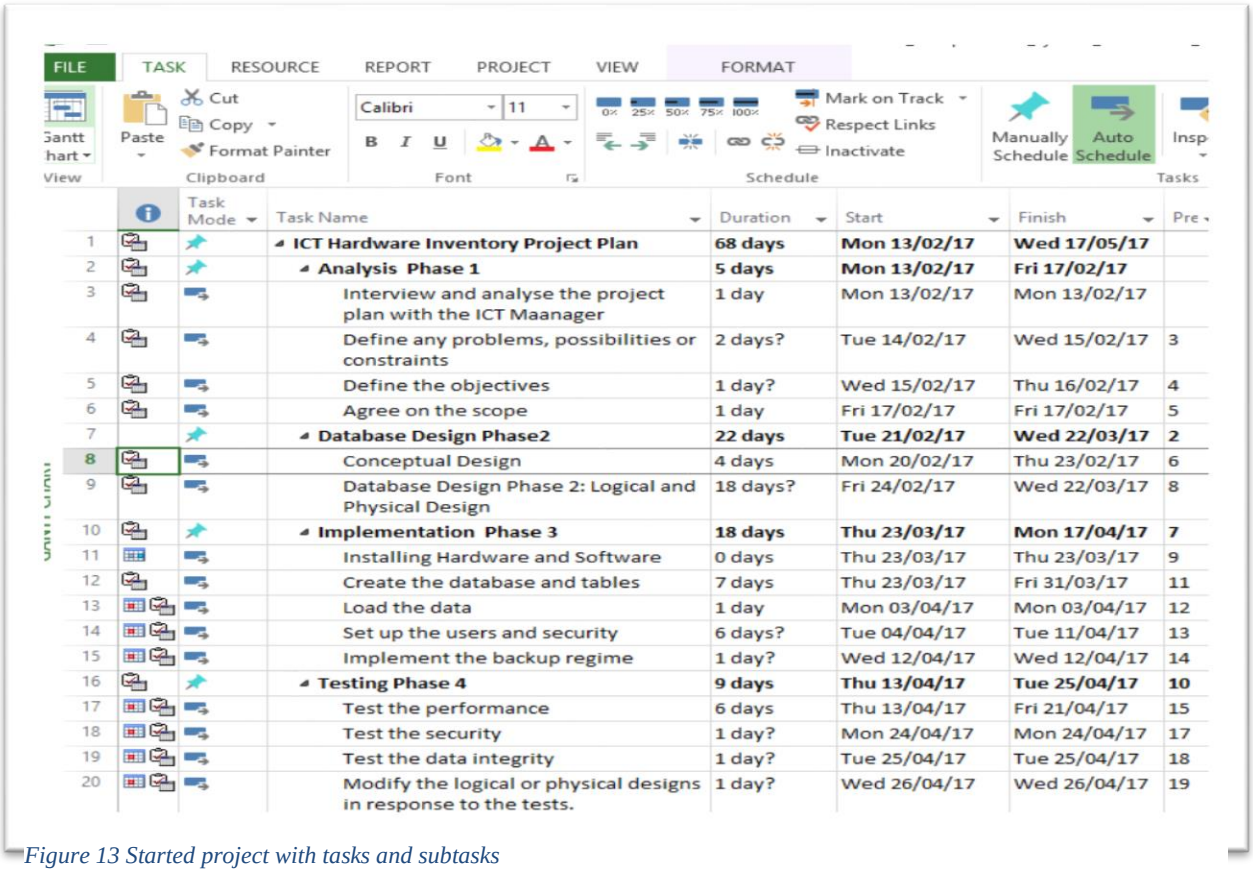


Figure 13 Started project with tasks and subtasks

Each task of the project will provide a major description required to implement the project. The tasks describe are not the specific tasks but are considered as the general tasks necessary to install the hardware, software and includes the verification of the system (Larson et. al., 2011). It will contain the necessary information:

- When will the task accomplished?
- Various resources required to accomplish the task
- Key authorities responsible for the task (Wysocki, 2011).
- What are the criteria involved for successful completion of the task?
- Planning process and coordination for its implementation
- Training must be provided to the staff for its use and implementation
- Technical assistance must be provided according to the said requirements
- Make sure that all the necessary prerequisites have been completed before the date of implementation

- Purchase the adequate hardware and software required
- Conversion of data need to be done before loading the system (Courtois, 2014)
- Facilitation of site needs to be done before implementing the project.

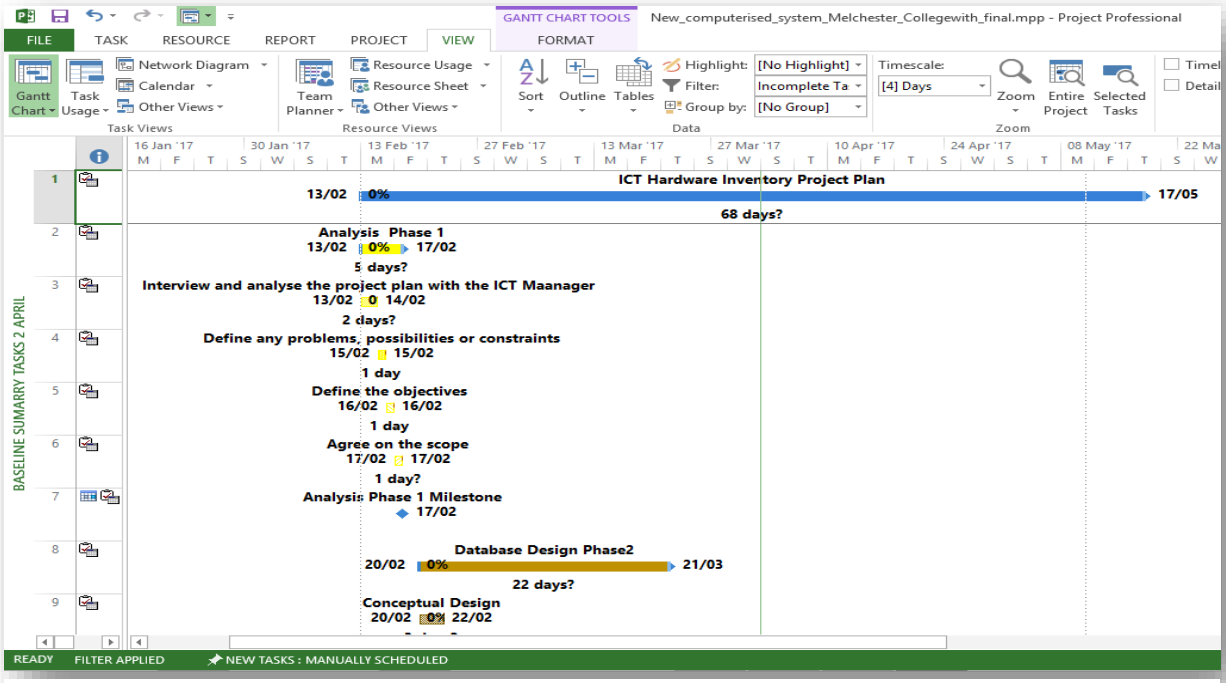


Figure 14 Analyse the tasks and the milestone of them

2.5 Planning Process and Coordination for its Implementation

What are the criteria involved for successful completion of the task?

Project progress is viewed by achieving the milestones of each task leading to the fulfilment of database implementation in the approved term project, see figure 12 below:

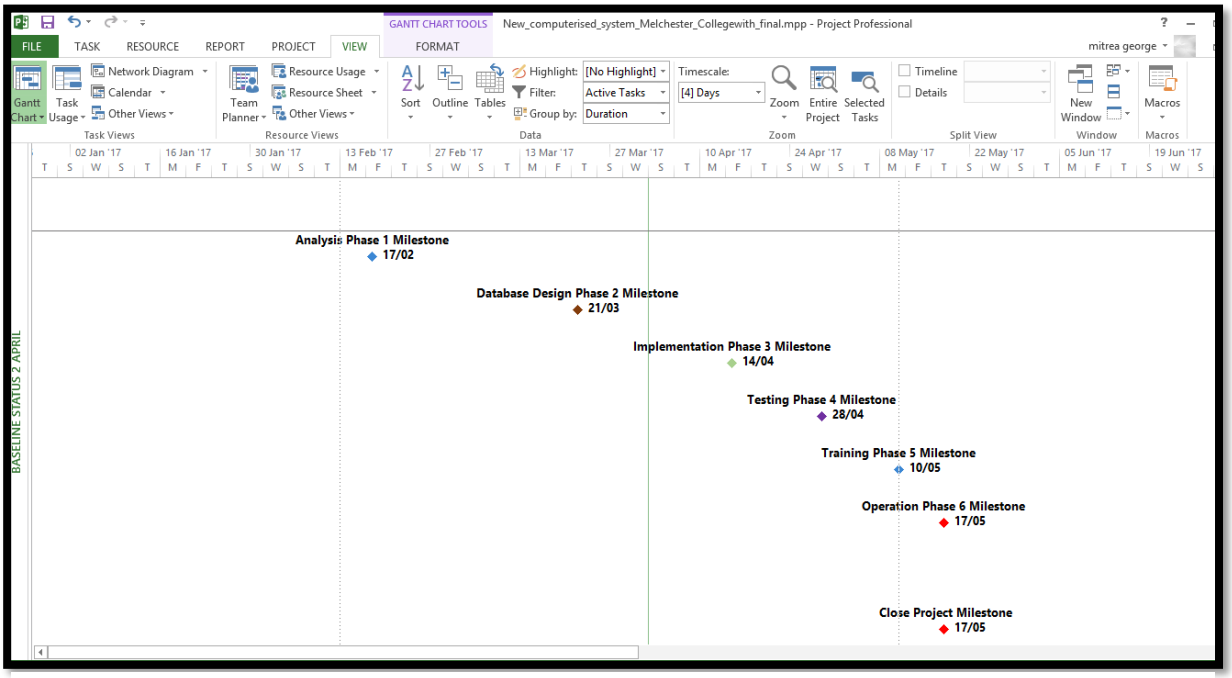


Figure 15 Agreed of milestone deadlines of each phase of the project in the Baseline Project

Progress of the project at the date of 3 April 2017 which demonstrates that there are delays of the tasks and subtasks related to Baseline Project:

GANTT CHART

	Task Mode	Task Name	Duration	Start	Finish	Baseline Duration	Baseline Estimated Start	Baseline Estimated Start	Prec	Resource Names	Cost
1		**1 ICT Hardware Inventory Project Plan**	**60 days?**	**Mon 13/02/17**	**Wed 10/05/17**	**68 days?**	**Mon 13/02/17**	**Mon 13/02/17**			**£19,080.00**
2		**1.1 Analysis Phase 1**	**8 days?**	**Mon 13/02/17**	**Wed 22/02/17**	**5 days?**	**Mon 13/02/17**	**Mon 13/02/17**			**£2,800.00**
3		1.1.1 Interview and analyse the project plan with the ICT Maanager	3 days	Mon 13/02/17	Wed 15/02/17	2 days?	Mon 13/02/17	Mon 13/02/17		ICT Manager, Project	£600.00
4		1.1.2 Define any problems, possibilities or constraints	2 days	Thu 16/02/17	Fri 17/02/17	1 day	Wed 15/02/17	Wed 15/02/17	3	Analyst Developer	£880.00
5		1.1.3 Define the objectives	2 days	Mon 20/02/17	Tue 21/02/17	1 day	Thu 16/02/17	Thu 16/02/17	4	Analyst Develop	£880.00
6		1.1.4 Agree on the scope	1 day?	Wed 22/02/17	Wed 22/02/17	1 day?	Fri 17/02/17	Fri 17/02/17	5	Analyst Develop	£440.00
7		1.1.5 Analysis Phase 1 Milestone	0 days	Wed 22/02/17	Wed 22/02/17	0 days	Fri 17/02/17	Fri 17/02/17	6		£0.00
8		**1.2 Database Design Phase2**	**17 days?**	**Thu 23/02/17**	**Mon 20/03/17**	**22 days?**	**Mon 20/02/17**	**Mon 20/02/17**	**2**		**£4,080.00**
9		1.2.1 Conceptual Design	3 days?	Thu 23/02/17	Mon 27/02/17	3 days?	Mon 20/02/17	Mon 20/02/17	6	Project Develop	£720.00
10		1.2.2 Database Design Phase 2: Logical and Physical Design	14 days	Tue 28/02/17	Mon 20/03/17	18 days?	Thu 23/02/17	Thu 23/02/17	9	Project Developer -	£3,360.00
11		1.2.3 Database Design Phase 2 Milestone	0 days	Mon 20/03/17	Mon 20/03/17	0 days	Tue 21/03/17	Tue 21/03/17	10		£0.00
12		**1.3 Implementation Phase 3**	**15 days?**	**Tue 21/03/17**	**Mon 10/04/17**	**18 days?**	**Wed 22/03/17**	**Wed 22/03/17**	**8**		**£3,840.00**
13		1.3.1 Installing Hardware and Software	1 day	Tue 21/03/17	Tue 21/03/17	0 days	Wed 22/03/17	Wed 22/03/17	10	Project Develop	£240.00

Figure 16 Progress of the project at the date of 3April 2017

The next diagram (figure 14) shows how the tasks and the subtask for the first part of the project is going to delay the project implementation because some of the tasks needed more preparation time and need it to be ready for the next step of the project:

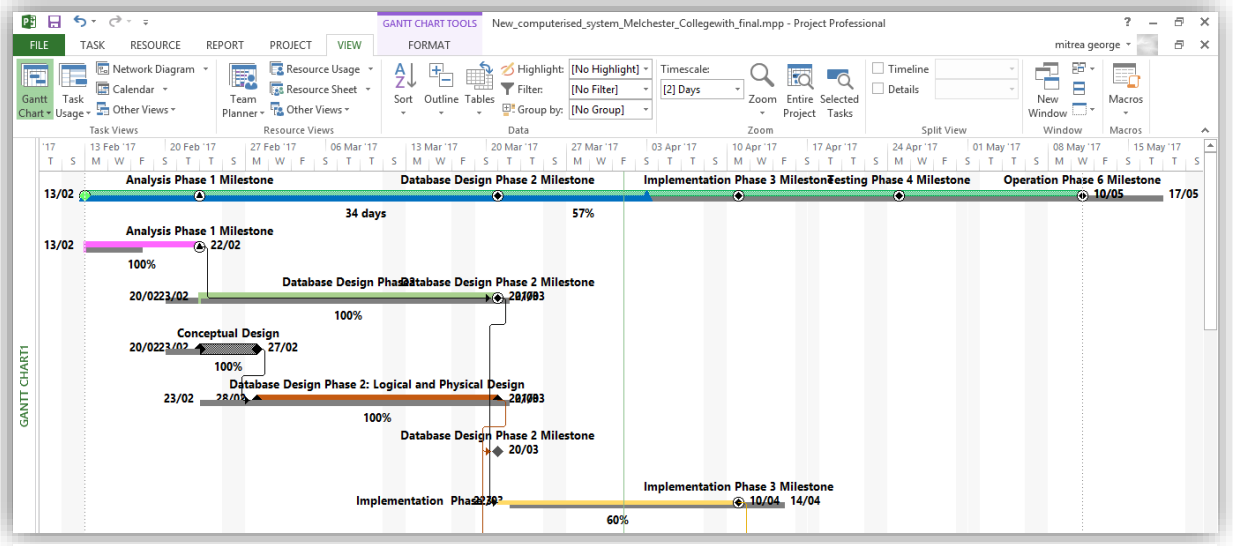


Figure 17 Diagram progress of the Project on 3 April 2017

As it can be seen from the above picture there is a difference of the duration for each task if it is compared to the initial proejct plan. A comparison of the Curent Project plan to the baseline project plan, which is represented in the diagram with a grey bar, is reflecting the delays of each task related to the initial set up duration in the plan.

In the next diagram (figure 15) it shows the completed tasks (blue bars) with both the current project plan dates and also with the baseline project plan dates (the gray bars under the current project plan bars). The diagram shows also the milestone in red diamonds for current plan project and in gray diamonds the propoesed initial ones:

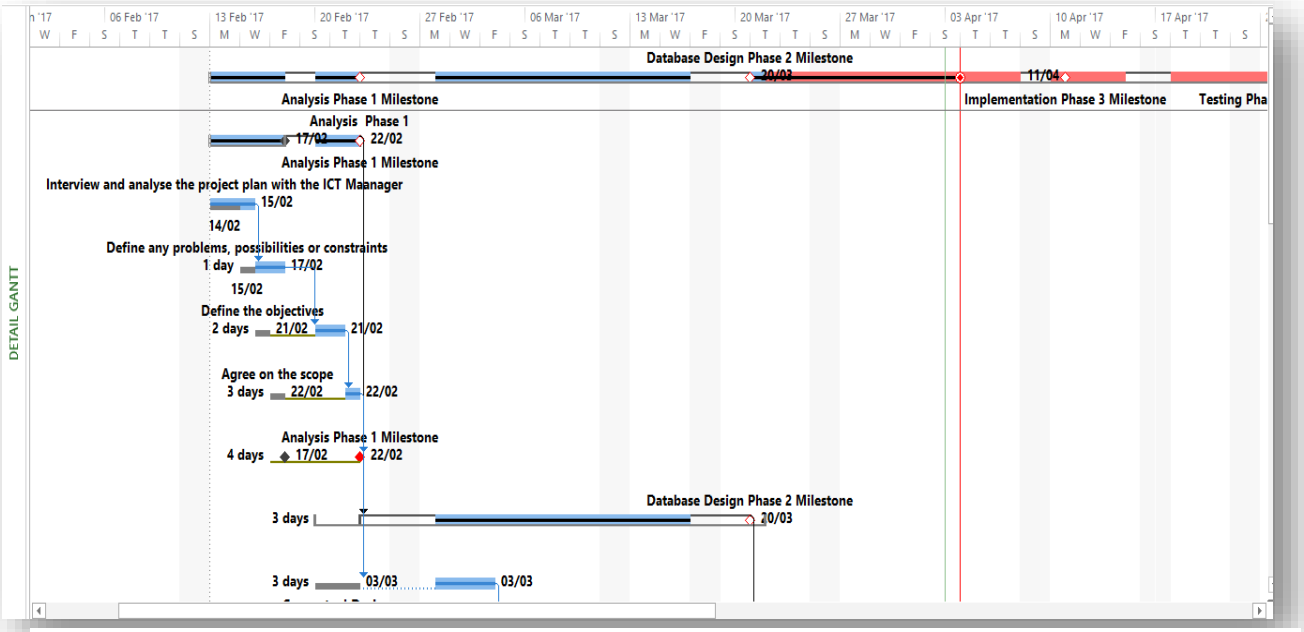


Figure 18 Diagram with the completed tasks on 3 April 2017, which contains the comparison to the baseline project and also the milestones on each task

The below diagram will show the current progress of the project related to the baseline grey bars on 3 April 2017:

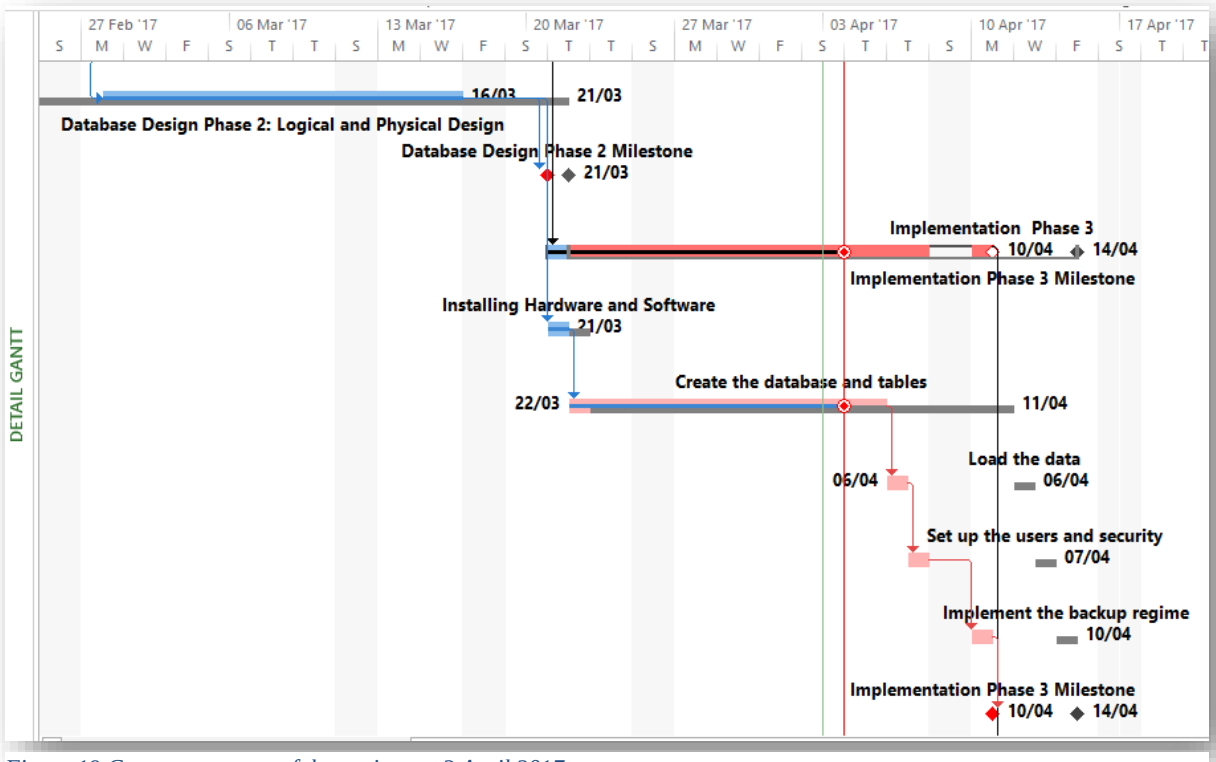


Figure 19 Current progress of the project on 3 April 2017

The next image will show the compared statistics between the current situation of the project:

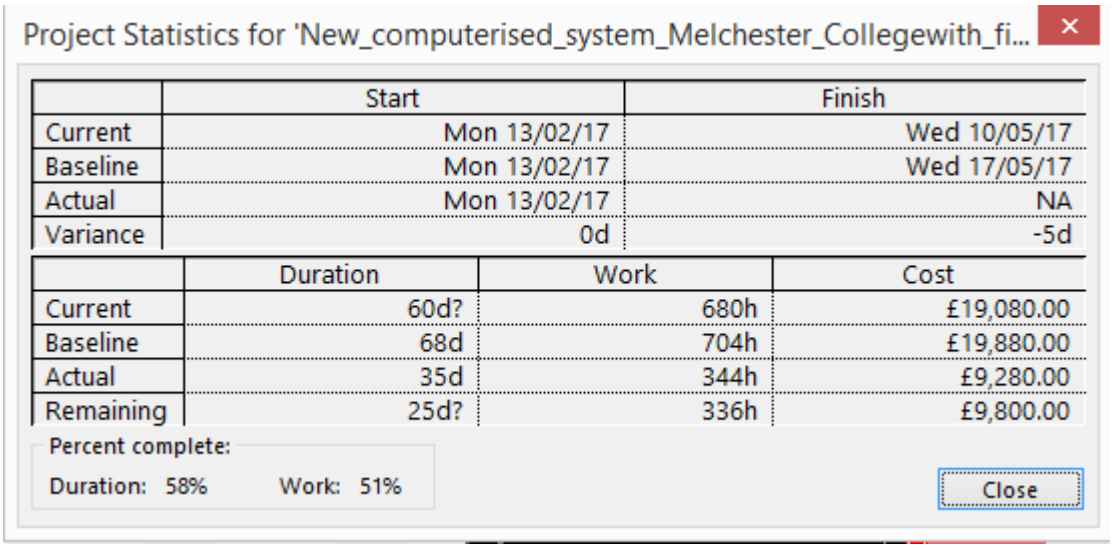


Figure 20 Statistics on the current plan and the baseline one

The conclusion until the date of 3 April is that the project plan is behind by five working days compared to the initial plan.

For a better understanding to see if the terms of fulfilment phases of the project fit the specifications of the initial plan project there is a need for a comparison. The comparison between the deadlines of baseline milestone project and the current one shows that the first phase of the project (Analyse phase) pushed the end date of the project back four days. The expectation for the fulfilment of the other milestones of the critical tasks is a more realistic expectation of the duration of the project in comparison with the initially proposed one.

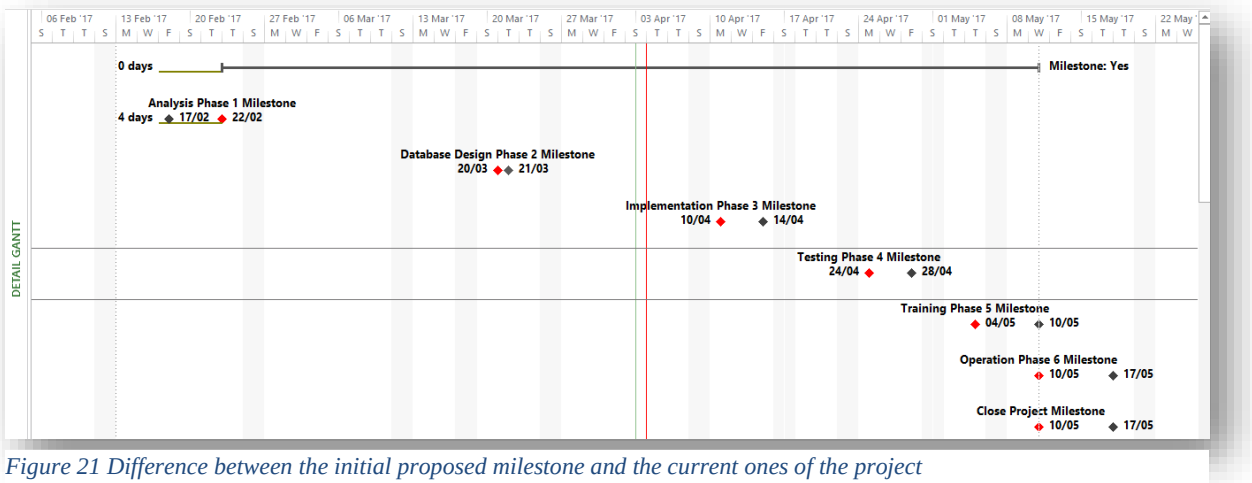


Figure 21 Difference between the initial proposed milestone and the current ones of the project

2.6 Tasks and Subtasks of the Project

2.6.1 Phase 1: Analyses

The next image is showing the details of the first phase of the project with its subtasks and their allocated resources:

2	**Analysis Phase 1**	**8 days**	**Mon 13/02/17**	**Wed 22/02/17**	**8**		**£2,800.00**
3	Interview and analyse the project plan with the ICT Maanager	3 days	Mon 13/02/17	Wed 15/02/17	4	ICT Manager, Project Manager -	£600.00
4	Define any problems, possibilities or constraints	2 days	Thu 16/02/17	Fri 17/02/17	5	Analyst Developer Samuel	£880.00
5	Define the objectives	2 days	Mon 20/02/17	Tue 21/02/17	6	Analyst Developer Samuel	£880.00
6	Agree on the scope	1 day	Wed 22/02/17	Wed 22/02/17	9,7	Analyst Developer Samuel	£440.00
7	Analysis Phase 1 Milestone	0 days	Wed 22/02/17	Wed 22/02/17			£0.00

Figure 22 Phase one with its details

2.6.2 Phase 2: Database Design

The next image is showing the details of the Design phase of the database implementation with its subtasks and their allocated resources:

8	**Database Design Phase2**	**17 days**	**Thu 23/02/17**	**Mon 20/03/17**	**12**		**£4,080.00**
9	Conceptual Design	4 days	Thu 23/02/17	Fri 03/03/17	10	Analyst Developer Samuel	£960.00
10	Database Design Phase 2: Logical and Physical Design	13 days	Tue 28/02/17	Thu 16/03/17	13,11	Project Developer - Andrei	£3,120.00
11	Database Design Phase 2 Milestone	0 days	Mon 20/03/17	Mon 20/03/17			£0.00

Figure 23 Phase 2 of the project

2.6.3 Phase 3: Implementation

The next image is showing the details of the Implementation phase of the project with its subtasks and their allocated resources:

DETAIL GANTT

12		**Implementation Phase 3**	**15 days?**	**Tue 21/03/17**	**Mon 10/04/17**	**19**		**£3,840.00**
13		Installing Hardware and Software	1 day	Tue 21/03/17	Tue 21/03/17	14	Project Developer - Andrei	£240.00
14		Create the database and tables	11 days	Wed 22/03/17	Wed 05/04/17	15	Project Developer - Andrei	£2,640.00
15		Load the data	1 day	Thu 06/04/17	Thu 06/04/17	16	Analyst Developer Samuel	£480.00
16		Set up the users and security	1 day?	Fri 07/04/17	Fri 07/04/17	17	Project Developer - Andrei	£240.00
17		Implement the backup regime	1 day?	Mon 10/04/17	Mon 10/04/17	20,18	Project Developer - Andrei	£240.00
18		Implementation Phase 3 Milestone	0 days	Mon 10/04/17	Mon 10/04/17			£0.00

Figure 24 Phase 3 Implementation

2.6.4 Phase 4: Testing Phase

The next image is showing the details of the Testing phase of the project with its subtasks and their allocated resources:

DETAIL GANTT

19		**Testing Phase 4**	**9 days?**	**Tue 11/04/17**	**Mon 24/04/17**	**25**		**£4,320.00**
20		Test the performance	4 days?	Tue 11/04/17	Fri 14/04/17	21	Analyst Developer Samuel	£1,920.00
21		Test the security	1 day	Tue 18/04/17	Tue 18/04/17	22	Analyst Developer Samuel	£480.00
22		Test the data integrity	1 day?	Wed 19/04/17	Wed 19/04/17	23	Analyst Developer Samuel	£480.00
23		Modify the logical or physical designs in response to the tests	3 days?	Thu 20/04/17	Mon 24/04/17	26,24	Analyst Developer Samuel	£1,440.00
24		Testing Phase 4 Milestone	0 days	Mon 24/04/17	Mon 24/04/17			£0.00

Figure 25 Phase 4 Testing and its resources

2.6.5 Phase 5: Training Phase

The next image is showing the details of the Training phase of the project with its subtasks and their allocated resources:

25		**Training Phase 5**	**7 days?**	**Tue 25/04/17**	**Thu 04/05/17**	**28**		**£1,680.00**
26		Training to users of ICT	7 days?	Tue 25/04/17	Thu 04/05/17	29,27	Analyst Developer Samuel	£1,680.00
27		Training Phase 5 Milestone	0 days	Thu 04/05/17	Thu 04/05/17			£0.00

Figure 26 Phase 5 of the project by have a training phase with the users of the database

2.6.6 Phase 6: Operation or Handover Phase

The next image is showing the details of the Handover phase of the project with its subtasks and their allocated resources:

28		**Operation Phase 6**	**4 days?**	**Fri 05/05/17**	**Wed 10/05/17**	**32**		**£2,360.00**
29		Hand over operation of the database to the user	1 day	Fri 05/05/17	Fri 05/05/17	30	ICT Manager, Project Manager -	£200.00
30		Make any final changes based on the problems discovered by users	3 days?	Mon 08/05/17	Wed 10/05/17	33,31	Analyst Developer Samuel	£2,160.00
31		Operation Phase 6 Milestone	0 days	Wed 10/05/17	Wed 10/05/17			£0.00

DETAIL GANTT

Figure 27 Phase 6 of the project

2.6.7 Phase 6: Close Project Phase

The next image is showing the details of the second phase of the project with its subtasks and their allocated resources

32		**Close Project**	**0 days?**	**Wed 10/05/17**	**Wed 10/05/17**			**£0.00**
33		Close the Project	0 days?	Wed 10/05/17	Wed 10/05/17	34	ICT Manager, Project Manager -	£0.00
34		Close Project Milestone	0 days	Wed 10/05/17	Wed 10/05/17			£0.00

DETAIL GANTT

Figure 28 Last phase of the project

3. Task 3 Organise, Analyse and Interpret Relevant Outcomes

Introduction

Melchester College has around 450 PCs and the related peripherals like printers and the scanners across the overall campus. All the other staff of Melchester College are equipped with the necessary terminals required. The equipment of ICT has been purchased from the recommended suppliers. Each site of the college has been provided with the unique four-digit code of the respective college.
The new integrated computer system will provide better services to ICT Department in regards to storage of the information of hardware inventory. This new computerised system must record all the entries of the devices, suppliers, users, job card which shows a history maintenance of each device, departments and the department location for each device.

When the necessary hardware item is repaired according to the said specifications, the job of the technician is fulfilled according to the details of the job and then carries out the necessary work in accordance with the requirement and signs it. The ICT manager will store all the hardware and other related records on the ICT manager's computer. All the equipment in the college will undergo the necessary annual check so they will have a Health and Safety check to ensure that they are safe to use and offer a good performance for the users.

3.1 The Life-Cycle of the New System of Hardware Inventory

The life-cycle of the database of hardware inventory is a set of steps, techniques, methods and tools used for transferring the data model into a physical model.

3.1.1 Defining the Scope

The main goal is to implement a new computerised system of hardware inventory. This system is used by ICT department of Melchester College, exploiting facilities provided by the "ict_hardware_inventory" database. The service can be accessed using both MySQL Workbench GUI interface together with Xampp, which is using MySQL as a server for the database or it can be accessed through Xampp and the interface is going to be PhpMyAdmin.

This method of accessing data in the inventory can be obtained easier and faster than the old system used, where the inventory data were handwritten into an inventory register.

Knowing that the implementation of such systems is very beneficial in all aspects, a systematic approach to this issue is required and involves the construction of new database hardware inventory system. Long term benefits are expected by using this approach.

The ICT manager is thinking that the new computerised system will serve the following specifications:

- offer quick access to hardware and supplier details
- provide maintenance history on individual items of hardware
- provide records of hardware allocated to subject areas
- offer inventory details of hardware in each room
- deal with government returns on the number of PCs allocated to Admin v Curriculum

The system is a combination of elements (components) interconnected between them, establishing a dynamic interaction based on predetermined rules to achieve a common goal.

The development of database involves several steps, which can be summarised as follows:

3.1.2 Analysis and system definition phase

The analyses to implement the new database hardware inventory is defining the purpose of the new database system, its users and its applications by which is implemented the new system. The necessary action plan to achieve its objectives will be decided at this phase.

In this stage, various expectations engaged with the project are tested in accordance with the outcomes. The information with regards to how much result is to be achieved within the stated time period. It is necessary to identify the requirement of the project as early as possible that will involve preconditions, functional requirements, operational requirements and design limitations (Sinha and Labi, 2011).

During this phase, it will require developing a web-based consortium. The consortium will be developed in Microsoft Explorer as everybody knows how to work on it. It is necessary that all the parties involved in the project need to collaborate with each other in the implementation of the project. The project benefits most when it complies with the future requirements. In order to avoid any disparities, various meetings must be conducted from time to time with all the parties involved during this phase (Sinha and Labi, 2011).

This phase will have the next tasks:

3.1.2.1 Analyse the project plan with the ICT Manager department

Meeting with ICT Manager department to set up the objectives of this inventory system hardware and discussions regarding the locations of each device found in the inventory; discussions related to the details of the suppliers; details of each hardware; the details of each job card which define the maintenance of hardware components; the locations for each department and detail as regards the Health and Safety checks.

Also, this phase contains discussions related to the users of the hardware equipment, reviewing existing documentation on the desired database. Alongside, the required documentation it is studying also other documentation (diagrams showing the inventory suppliers, existing data entry forms, reports used in controlling that activity, etc.) to decide if this influences the database requirements.

Define any problems, possibilities or constraints related to the implementation of the database. For this task, the Project Manager and The Data Analyst will be involved to find how to develop the system. Thus, the project team can understand better when to prioritise the database design, the importance of various applications and the desired performance from them.

3.1.2.2 Define any problems, possibilities or constraints

In this phase of the implementation, must be made the evaluation of the existing situation, by identifying any major problems and objectives found. This will result in a list of the problems which must be ranked to separate the problems of 'primary" of those "secondary", so that it is possible to identify the relations of cause-effect.

The most suitable methods and techniques will be used to achieve the objectives. Therefore, discussions held by the project team at that moment must be subordinate to the pragmatism, because they want to solve primarily the practical problems. Understandably, there are always several ways and are therefore important dialogue and discussion, not confrontation must take place to reach the goals. The purpose of these discussions is to adopt a single decision to reach the most effective solution that addresses the problems identified in the first stage.

3.1.2.2.1 Risk assessment methods

Various issues have been seen in the implementation of the project like earthquakes and floods could occur that might destroy the integrated computer's system. The issues may include the staff that regulates the system might be late due to some traffic issues. Could be a problem with the power supply in the college's building for which one needs the backup of the system. For handling such type of risks:

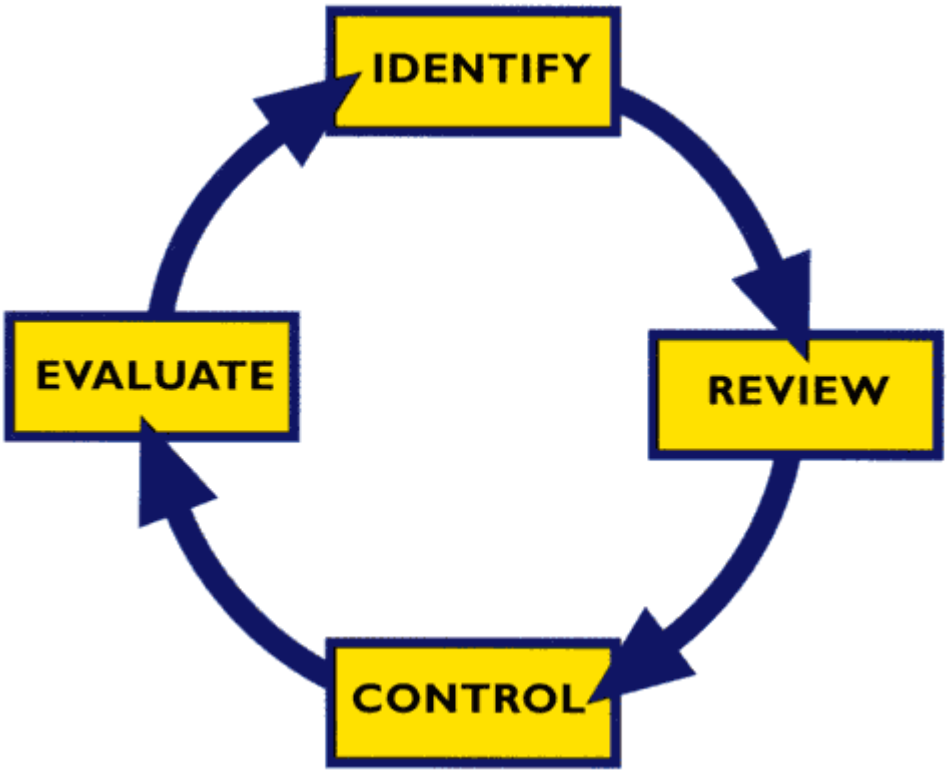


Figure 29 Risk assessment diagram of the project

A risk management plan needs to be prepared which can help to minimize the losses and helps in the identification of ascertaining the business functions and equipment that is required in order to store the necessary information. The practical strategy that needs to be followed may include the identification and prevention of the risk wherever it arises, handling of the risk which is not in the control, ascertaining the information that is required in the event of the quick recovery of the information in case of any emergency issues.

3.1.2.3 Define the objectives of the implementation

From this perspective, defining the project objectives is a major importance, because according to this the project team can set the strategy and the methods. According to management theory, such objectives must be SMART:

- Specific - to define clearly what will be done

- Measurable - the result must be able to be measured
- Accepted - by all team members
- Realistic - to be met
- Specified time - setting a realistic time frame to achieve the

The DBMS must provide full software support for developing the schema of the new system.

It should ensure:

• Minimise the cost of data processing

• Reduce response time

• Flexible application and

• Data protection.

Digital equipment is very important in the College Melchester. Therefore, in this project proposes easing and improving the work of the department ICT hardware inventory, the main aim of improving management of maintenance and repair work of digital equipment in the college.

Derived sub-objectives:

- IT service management intervention orders:
- track of the purchased and the registered devices y the college;
- orders addressed.
- Records maintenance of hardware equipment:

- Evidence providers with the maintenance of the devices;
- Evidence necessary maintenance consumables purchased by the college;
- Evidence repair hardware equipment:
- Evidence to deal with the repair of the devices;

To facilitate their use should be defined:

- who is the end user who ask questions and transact;
- what type of GUI is used: MySQL Workbench
  - Graphics;
  - will be based on forms;

- will be a SQL database type;

- generating reports;

- will use menus;

- methods and techniques for the recovery and the archiving:
    - restoration is performed during system operation;
    - the size of the backup;
    - archiving strategy;
- aspects of system security:
- use of passwords;
- grants.

The main objectives plan for the Project Team of implementation of the new hardware inventory system:

To meet the performance listed above the DBMS must ensure the main objectives.

1. Ensuring data independence - should be viewed in two ways:
    - logical independence - add refers to the possibility of new types of data records or extension conceptual structure without causing rewriting the program.
    - Physical independence - modification techniques without causing physical memory by rewriting the program.
2. Ensure minimum redundancy and data control - store the information of the database without duplicating the data. However, to improve performance related to the response time, accepting some redundancy data controlled to ensure database consistency and efficient use of hardware resources
3. Ensuring data usage facilities - supposedly DBMS's have some specialised components for:
    - Use of data by multiple users in the scheme - data the application must be used in other databases
    - Easiest possible access of users to the data - without let them know the structure of the entire database; this task is part of database administrator duties
    - The existence of efficient retrieval languages - allowing expression of interactive data retrieval requests

- The management system should offer a multi-criteria access to the information in the database - as opposed to the classical processing on files where there is only one criterion addressing, who underlying file organisation

4. Securing data from unauthorised access.
5. Ensure consistency and integrity of data against intentional or accidental deletions - is achieved through processes validation of concurrency control protocols and procedures to restore the database.
6. Ensure the segregation of data - opportunity to develop the scheme without modifying the database structure.
7. Ensure links between data - Any table from the scheme must allow defining and describing the data structure and the links between them, according to a data model (e.g., relational model).
8. Manage and control data - are provided by the DBMS, meaning that data can be used by multiple users simultaneously and users can have different requirements that may be incompatible. DBMS must solve competition problems in data problem that occurs mostly in the work environment of computer network.

    - Implemented application pilot tested and used according to the specifications (use assurance processes, administration, and maintenance);
    - Appropriate training for ICT Manager related to the newly implemented system;
    - Funding provided for implementation of the project;
    - Increase customer loyalty.

Secondary objectives:

- Gain experience for future projects;
- Future development cooperation relations with the supplier.

3.1.3 Agree on the scope

All the project team accepted the specifications, the timetable and the roles of each member of the team project. Now remain just to start the conceptual design of the project.

3.1.4 Database Design Phase 2

3.1.4.1 Conceptual Design

Creating local conceptual model for users

Describes the data stored in the database and the relationships between them.

The objective:

Creating a local conceptual model for ICT Manager views.

- The first step in database design is to collect the data necessary to carry out the system, which can collect, talk to the future user of the database.
- This discussion involves a split in views, database views that can work separately.

The conceptual model is then projected on a logic model that will later influence the data model which will be implemented.

Separation in views can be achieved in several ways:

- One global way data analysis and finding relatively independent tables.
- Another way would be considering the reports, required procedures and observation from the manager of ICT department.

Local conceptual models must contain:

- types of entities
- types of relationships
- attributes
- attributes fields
- candidate keys
- primary keys

3.1.4.2 Logical Design

Conceptual Design was created to communicate, that is to represent the system to be designed in a way more clearly. To achieve effective implementation of this, the conceptual scheme must be converted into a lower-level structure. Therefore, for some given application, choose a suitable logical model of data (e.g., relational model, how will be the database for the new inventory system). It says that conceptual schema is transformed into a logic schema expressed using abstract data structures and operations provided by the data model respectively. For example, the facts are stored in the relational model entities, the constraints are expressed using primary or foreign keys, etc.

Description of the design methodology for hardware inventory Melchester College database:

Steps in designing the implementation:

Step 1. Design the logical relational database:

- Creating a local conceptual model for views users

Step 2. Create and validate the logical local

Step 3. Create and validate global logical data model

Step 4. Physical design and implementation of relational database

Step 5. The design and implementation of the physical representation

Step 6. Design and implement a security mechanism

Step 7. Check the operating system

Logical design of the database is divided in three steps:

1. The first step is aimed at breaking down the design of information systems in order
2. The data thus created, validated by normalisation and transactions in step two.
3. Finally, it generates global model new inventory system, then is validated and verified it.

Critical factors for logical success design:

- ✓ Interactive working with the system user
- ✓ Using a structured methodology for process design database
- ✓ Incorporate rules of integrity in logical data model

- ✓ Combining conceptual validation by normalisation and transactions, the design of the logical database
- ✓ Creating a data dictionary as a supplement to the data model

3.1.4.2.1 The Entities

The first step in database design is identification of data entity provided by users. The next image will show the tables, columns and constrains of ICT Department's database:

DeviceRegistration entity

```
DeviceRegistration Table
--------Start Table------------
In this table we register the devices, each one with unique a code.
One can register two identical devices but purchased into two different dates
--------Start Columns----------
- ID (device registration ID, primary key);
- Code(device registration code, UK column);
- DeviceID (device id, FK to Device table ID column);
- Date (the date to which a purchased device was registred);
--------End Columns------------
EX:

ID      Code        DeviceID    Date
1       I897        2           2016/10/01
2       F302        4           2016/09/01
3       I898        2           2015/12/01
4       C908        6           2015/20/20

--------End table--------------
```

Figure 30 DeviceRegistration Table

DeviceType entity

```
DeviceType Table
--------Start Table------------
Define all possible device types, all device categories
--------Start Columns----------
- ID (device type ID, primary key)
- Type(type of device, UK column)
--------End Columns------------
EX:

ID      TYPE
1       Laptop
2       Base Unit
3       Monitor
4       Printer
---------End table-------
```

Figure 31 DeviceType table

Device entity

```
Device Table
--------Start Table------------
Records the details of a unique device model made by a manufacturer.
--------Start Columns----------
- ID (device ID, primary key);
- SerialNo (unique key, device serial noumber);
- Manufacturer ( producer of device );
- Model ( the model of device);
- DeviceTypeID (the device type ID, FK to DeviceType table ID column);
--------End Columns------------
EX:

ID      SerialNo    Manufacturer    Model       DeviceTypeID
1       111         Lenovo          M1          1
2       561         Toshiba         M2          1
3       801         Asus            M3          2
4       1001        Canon           M10         4
5       130         Canon           M20         5
6       170         Asus            M1          1

---------End table-------
```

Figure 32 Device table

Department entity

```
Department
--------Start Table------------
Defines all existing departments within college
--------Start Columns----------
- ID (the department / subject ID, primary key)
- Name (the department name)
--------End Columns------------
EX:

ID      Name

2       Admin
3       ICT
1       Science


---------End table-------
```

Figure 33 Department table

User entity

```
User
--------Start Table------------
Register the college users
--------Start Columns----------
- ID (the colleage user ID, primary key)
- Username (a unique alias for a user, UK column; I.e. lastname + father initial + lastname initial)
- FirstName
- LastName
- DepartmentID (the department in which the user is working, FK to Department table ID column)
--------End Columns------------
EX:

ID      Username    FirstName   LastName    DepartmentID
1       mitreaggh   Gheorghe    Mitrea      2

---------End table-------
```

Figure 34 User table

DepartmentLocation entity

```
DepartmentLocation
--------Start Table------------
This table keeps the relations between a department and a location college
--------Start Columns----------
- ID (Department Location ID, primary key)
- DepartmentID (the department ID to which location was assigned, 1st UK column, FK to Department table ID column)
- LocationID (the location assigned to the department, 2nd UK column, FK to Location table ID column)
--------End Columns------------
EX:

ID      Department_ID       Location_ID

5       1                   4
6       1                   5
7       1                   7

---------End table-------
```

Figure 35DepartmentLocation table

Location entity

```
Location
--------Start Table------------
Records all the locations (builing, floor, room) accross college
--------Start Columns----------
- ID (Location ID)
- BuildingNo (the no. which identifiy one of the college building, 1st UK column)
- FloorNo (the room floor number, 2nd UK column)
- RoomNo (the room number, 3rd UK column)
--------End Columns------------
EX:

ID      BuildingNo      FloorNo         RoomNo

1       A1              1               122
2       A2              1               122
3       A3              1               123
4       B3              1               123
5       C3              2               223
7       C3              2               Library
6       C3              3               ICT room

---------End table--------
```

Figure 36 Location table

Supplier entity

```
Supplier
--------Start Table------------
Register all the suppliers the college is provisioned by with the devices
--------Start Columns----------
- ID - (Supplier ID, primary key)
- Code - (the supplier abreviation code; i.e: RM, UK column)
- Name - (the name of the supplier)
--------End Columns------------
EX:

ID      Code        Name

1       LFT         Limited Firm Technology
2       RM          Random Manufacturer

---------End table-------
```

Figure 37 Supplier table

DeviceInventory entity

```
DeviceInventory
--------Start Table------------
Records all the registered devices within the college inventory
Note: We can add a registered device status, which can refere to as ACTIVE or INACTIVE
--------Start Columns----------
- ID (Device inventory ID, primary key);
- DeviceRegistrationID (the ID of registration device, UK column, FK to DeviceRegistration table ID column)
- PurchaseDate (the date when the product was bought)
- Guarantee (the registred device guarantee in years)
- DepartmentLocationID (the department and the location assigned to the registred device, FK to DepartmentLocation table ID column)
- SupplierID (the supplier's name of the registered device, FK to Supplier table ID column)
- UserID (the user of the device, FK to User table ID column)
--------End Columns------------
EX:

ID  DeviceRegistrationID    PurchaseDate            Guarantee   DepartmentLocationID    SupplierID  UserID

1   22                      2017-03-27 16:17:15     3           2                       1           2
2   23                      2017-03-27 16:17:15     3           3                       2           3
3   24                      2016-12-15 12:36:00     3           1                       2           4

---------End table-------
```

Figure 38 DeviceInventory table

DeviceJob entity

```
DeviceJob
--------Start Table------------
Keep the records for the maintenance history of each device that is part of college inventory
--------Start Columns----------
- ID (Device Job history ID)
- Description (the description of the job)
- DeviceInventoryID (UK first column,FK to DeviceInventory table ID column)
- IssueDate (the date when the issue was reported, UK second column)
- CloseDate (the date when the job was done)
- DeviceJobTypeID (the device job type identifier, FK to DeviceJobType ID column)
- NextCheckDate (the next periodic check date to which the device should be verified)
- Status (the current status of job)
- UserID (the assigned user job, FK to User tabble column ID)
--------End Columns------------
EX:

ID  Description                              DeviceInventoryID   IssueDate           CloseDate   DeviceJobTypeID     NextCheckDate   Status  UserID

1   This device has a problem with the video card   1           2017-01-20          2017-01-22  1               2017-11-16      close   2
2   This printer has a problem with the cartridge   2           2016-12-19          2016-12-22  2               2017-11-16      close   3
12  This device has a problem with the motherboard  3           2017-03-27          2017-03-27  3               2017-11-16      close   4

---------End table-------
```

Figure 39 DeviceJob table

DeviceJobTpe entity

```
DeviceJobType
--------Start Table------------
Defines all type of jobs related to maintenance of a device
--------Start Columns----------
- ID (the job device type ID, primary key)
- Type (the type of the job; i.e.: repaire, upgrade, return, periodic_check, UK column)
--------End Columns------------
EX:

ID      Type

1       repair
2       upgrade
3       return
4       periodic_check

---------End table-------
```

Figure 40 DeviceJobTpe table

Documentation types of entities

After identification of the entity, give them a name, and these names it was highlight in the data dictionary with explanations about entities and possible aliases.

3.1.4.2.2 Normalisation

The key objective of a developing a database management system is to create a reliable solution to the current situation and to ensure its durability with time for a hassle-less experience. The database system can be vulnerable to some special problems that can easily be resolved with the use of normalization techniques.

In the developed database system, the team project has used normalization techniques to prevent the occurrence of following problems:

Update anomaly: The team project may regularly need to update the values in their tables. If they have a database where this same value is stored in multiple places repeatedly, all these values have to be changed every time of updating. There is a chance of ambiguity if they forget to update even a single value. The database then will become inconsistent and unreliable.

Insert anomaly: There can be a case, where the members of the project team need to insert a new row in the table, but the value of some of its attributes is initially null. It is not allowed in a relational database system where one table can be related to other tables.

Delete anomaly: Sometimes they may need to delete some values of an attribute from the database, such situation may lead to force deletion of some other data which is linked to these values. Also, the developers cannot allow null values of any attribute, so it has to be resolved by changing the schema of the database.

Implementation of the normalization techniques:

To overcome above anomalies, the project team have used the normalization techniques in their developed database. Following are the normalization techniques that they have implemented:

1NF: According to the law of first normal form, a column (attribute) of a table cannot hold multiple values. It is only allowed to hold atomic values. Their solution is in 1NF because all the attributes have atomic values, i.e. there is no such column in the database table which allows multiple values to be stored for a single row.

2NF: A table is considered to be in 2NF if it satisfies both the following conditions:

- Table is in First normal form (1NF)
- No non-prime attribute is uniquely identified by the proper subset of any candidate key in developers table.

An attribute which is not part of any candidate key is known as a non-prime attribute.

The solution database system that they have developed is in 2NF because it is already in 1NF and there is no such non-prime attribute which can be identified uniquely with a subset of the candidate key, i.e. all non-prime attributes are dependent on the entire candidate key to be determined uniquely.

3NF: A table design is bound to satisfy both the following conditions for being in 3NF:

- It is in 2NF
- There is no transitive functional dependency of all non-prime attributes on the super key.

It can be saying that: A table is said to be in 3NF if it is in 2NF and for each functional dependency A→ B, it satisfies at least one of the following conditions:

- A is a super key of table
- B is a prime attribute of the table

An attribute is said to be prime if it is a part of one of the candidate keys.

The project team's resultant database is in 3NF because it is already in 2NF and there is no such non-prime attribute which can be identified uniquely by any other non-prime attribute.

3.1.4.2.3 Modelling Using Entity Relationship Diagram (ERD)

For the conceptual design the scheme identifies its essential elements: the types of entities and their attributes and associations between these types. This high-level conceptual design is based on the requirements defined in the first stage of design and is generally an Entity Relationship Diagram (ERD). This is independent of any specific data model (hierarchical, network, relational, etc.), and any system management that can be used for creating the database.

To visualise this new system, the team project will use ER diagram, because it is much easier to have all the information.

ER diagram is recommended for better data visualising.

At this point, the team project team can present a complete diagram of the model based on views about the new system.

The next image will show the ER Diagram created by Analyst Developer and the Project Developer to reach the right implementation of the project:

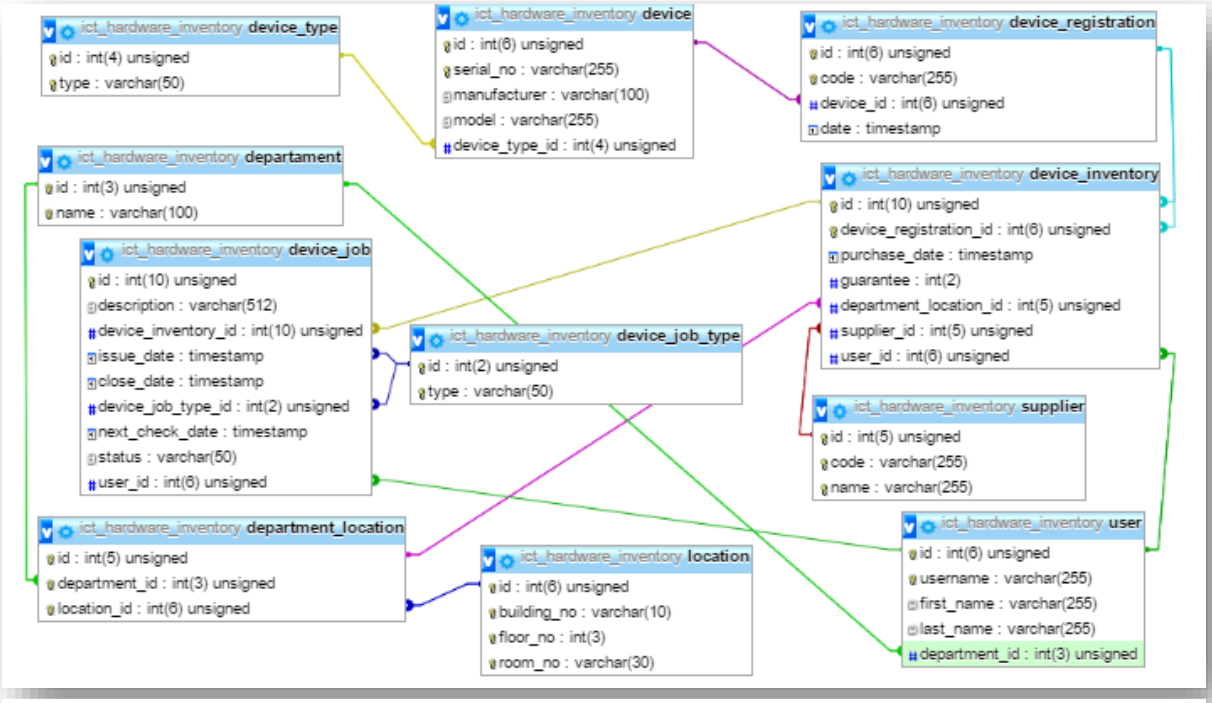


Figure 41 ER diagram of the scheme of new system hardware inventory

Also, the queries of the scheme will show the requirements of the ICT Manager:

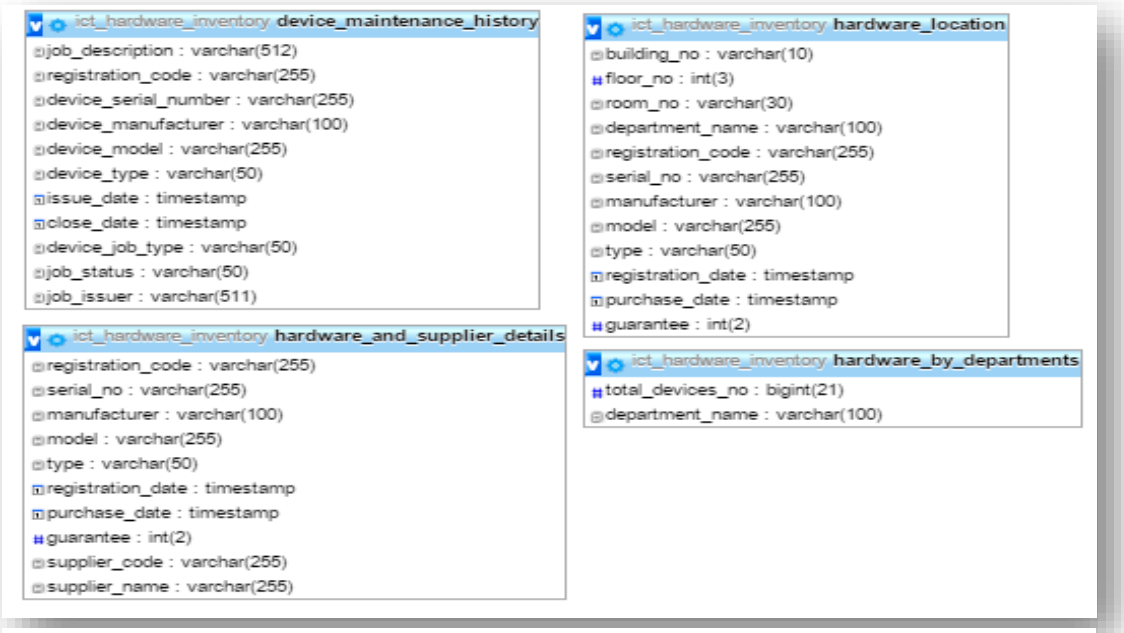


Figure 42 Queries of the schema

3.1.4.3 Physical Design

Describes how data is stored (files and indexes). Physical design is that where the designer decides how to implement the logical structure of the database management system (DBMS).

Specific details about storing data (type, size, file structure, way of organizing them)

A graphical method of viewing at the distinctions between logical and physical designs is:

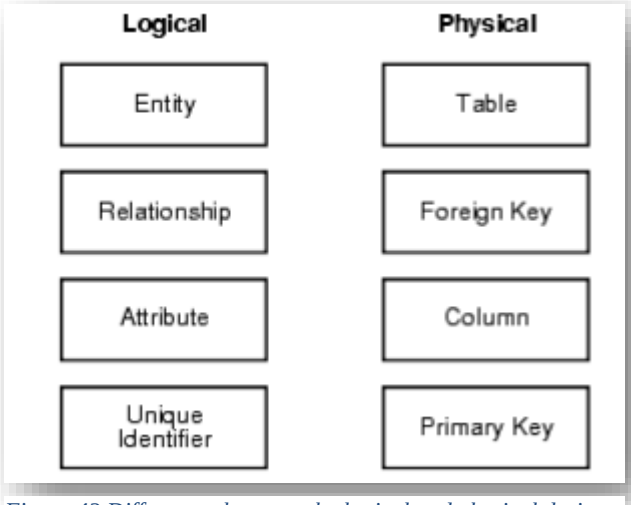


Figure 43 Differences between the logical and physical design

Physical design will create the following database structure:

Tablespaces

Tables should be segregated from their indexes and small tables should be taken away from the large tables. In the new system hardware inventor's requirements, there is an example of how to create the tables for the database:

College	Code Serial	Number Type	Make	Model
1309	X3894281G	Laptop	Toshiba	Satellite Pro A10
1310	E61891H4S135748	Printer	Brother	HL 2700CN
1808	WO44942479	Base Unit	RM	Celeron 2.4Ghz 512MB
1809	DMW4ZC802479	Monitor	RM	17"

Purchase Date	Location	Supplier	Guarantee	Subject	Use
01/04/2005	D3	LFT	1 year	Science	Admin
01/04/2005	General Office	RM	2 year	Admin	Admin
05/11/2005	D4	RM	1 year	ICT	Curric
18/11/2005	D4	RM	1 year	ICT	Curric

Figure 44 Example of creating the tables from the ICT department

After a design analyse the developers choose to separate some columns into tables, like for example ***Location*** column from the above image in a separate table which contains the following columns: id, building_no, floor_no and room_no.:

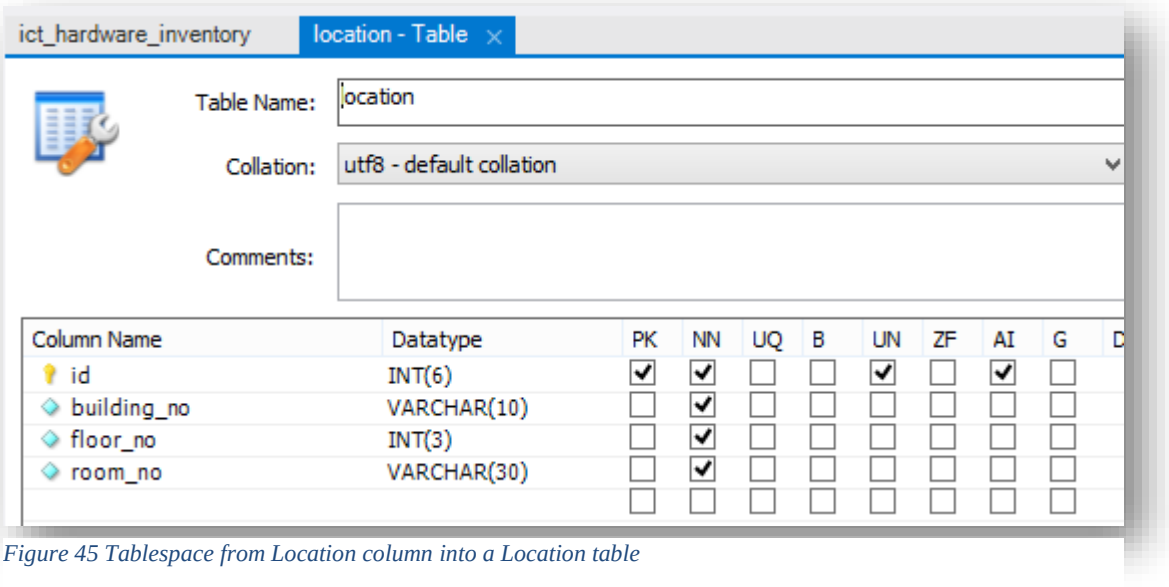
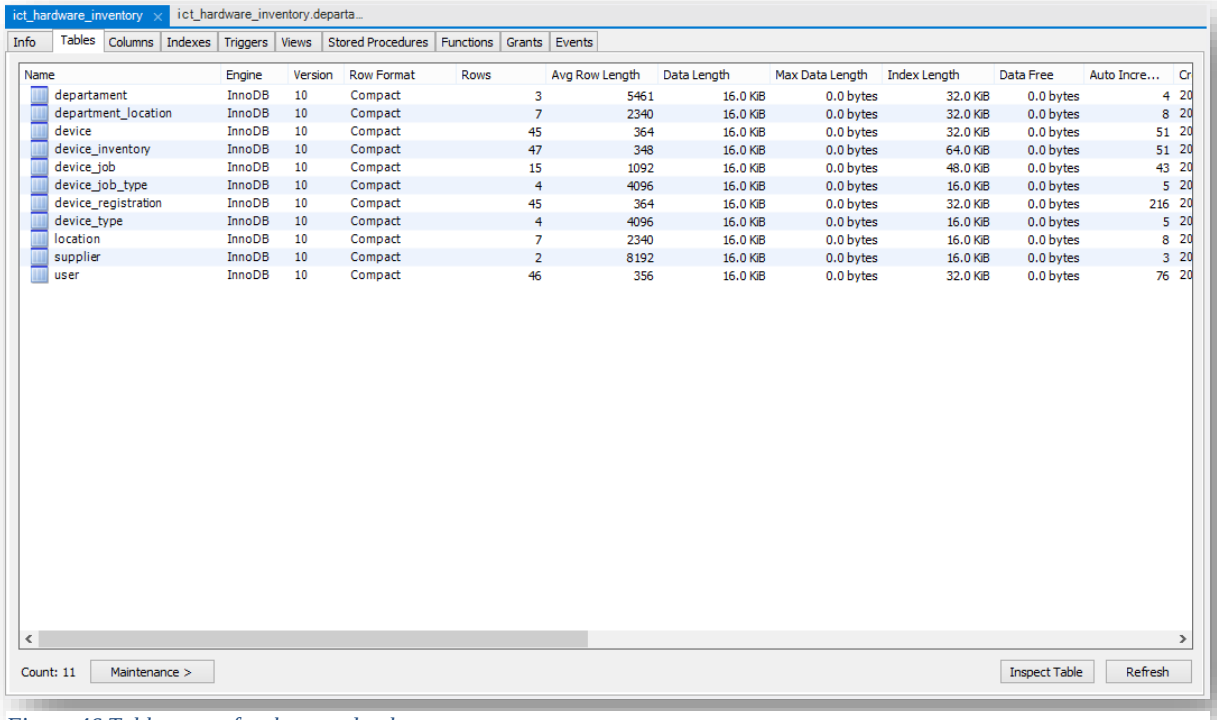


Figure 45 Tablespace from Location column into a Location table

In the same way was created the physical design for the rest of the tables:



Name	Engine	Version	Row Format	Rows	Avg Row Length	Data Length	Max Data Length	Index Length	Data Free	Auto Incre...	Cr
departament	InnoDB	10	Compact	3	5461	16.0 KiB	0.0 bytes	32.0 KiB	0.0 bytes	4	20
department_location	InnoDB	10	Compact	7	2340	16.0 KiB	0.0 bytes	32.0 KiB	0.0 bytes	8	20
device	InnoDB	10	Compact	45	364	16.0 KiB	0.0 bytes	32.0 KiB	0.0 bytes	51	20
device_inventory	InnoDB	10	Compact	47	348	16.0 KiB	0.0 bytes	64.0 KiB	0.0 bytes	51	20
device_job	InnoDB	10	Compact	15	1092	16.0 KiB	0.0 bytes	48.0 KiB	0.0 bytes	43	20
device_job_type	InnoDB	10	Compact	4	4096	16.0 KiB	0.0 bytes	16.0 KiB	0.0 bytes	5	20
device_registration	InnoDB	10	Compact	45	364	16.0 KiB	0.0 bytes	32.0 KiB	0.0 bytes	216	20
device_type	InnoDB	10	Compact	4	4096	16.0 KiB	0.0 bytes	16.0 KiB	0.0 bytes	5	20
location	InnoDB	10	Compact	7	2340	16.0 KiB	0.0 bytes	16.0 KiB	0.0 bytes	8	20
supplier	InnoDB	10	Compact	2	8192	16.0 KiB	0.0 bytes	16.0 KiB	0.0 bytes	3	20
user	InnoDB	10	Compact	46	356	16.0 KiB	0.0 bytes	32.0 KiB	0.0 bytes	76	20

Figure 46 Tablespaces for the new database

Indexes

An index of a database is a list of significant values with references to entries in the database table that is the appropriate data. It is possible to read a less number generally than the index entries, entries indicating the data to satisfy the request made.

The new database will have the constrains (foreign keys) and indexes (unique keys and primary keys).

Foreign Keys of the physical design for the new hardware inventory schema are:

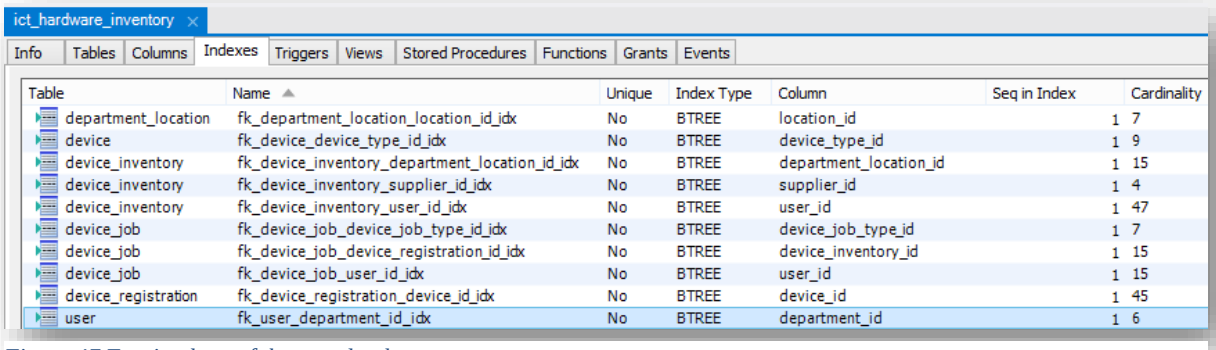


Table	Name	Unique	Index Type	Column	Seq in Index	Cardinality
department_location	fk_department_location_location_id_idx	No	BTREE	location_id	1	7
device	fk_device_device_type_id_idx	No	BTREE	device_type_id	1	9
device_inventory	fk_device_inventory_department_location_id_idx	No	BTREE	department_location_id	1	15
device_inventory	fk_device_inventory_supplier_id_idx	No	BTREE	supplier_id	1	4
device_inventory	fk_device_inventory_user_id_idx	No	BTREE	user_id	1	47
device_job	fk_device_job_device_job_type_id_idx	No	BTREE	device_job_type_id	1	7
device_job	fk_device_job_device_registration_id_idx	No	BTREE	device_inventory_id	1	15
device_job	fk_device_job_user_id_idx	No	BTREE	user_id	1	15
device_registration	fk_device_registration_device_id_idx	No	BTREE	device_id	1	45
user	fk_user_department_id_idx	No	BTREE	department_id	1	6

Figure 47 Foreign keys of the new database

Unique Keys of the physical design for the new hardware inventory schema are:

departament	uk_departament_name	Yes	BTREE	name	1	3
department_location	uk_department_location_deprtment_id_location_id	Yes	BTREE	location_id	2	7
department_location	uk_department_location_deprtment_id_location_id	Yes	BTREE	department_id	1	7
device_inventory	uk_device_inventory_device_registration_id	Yes	BTREE	device_registration_id	1	47
device_job_type	uk_device_job_type_type	Yes	BTREE	type	1	4
device_registration	uk_device_registration_code	Yes	BTREE	code	1	45
device	uk_device_serial_no	Yes	BTREE	serial_no	1	45
device_type	uk_device_type_type	Yes	BTREE	type	1	4
location	uk_location_building_no	Yes	BTREE	room_no	3	7
location	uk_location_building_no	Yes	BTREE	floor_no	2	7
location	uk_location_building_no	Yes	BTREE	building_no	1	7
supplier	uk_supplier_code_name	Yes	BTREE	name	2	2
supplier	uk_supplier_code_name	Yes	BTREE	code	1	2
user	uk_user_username	Yes	BTREE	username	1	46

Figure 48 Unique keys

Primary Keys of the physical design for the new hardware inventory schema are:

device_registration	PRIMARY	Yes	BTREE	id	1	45
device	PRIMARY	Yes	BTREE	id	1	45
supplier	PRIMARY	Yes	BTREE	id	1	2
departament	PRIMARY	Yes	BTREE	id	1	3
location	PRIMARY	Yes	BTREE	id	1	7
device_type	PRIMARY	Yes	BTREE	id	1	4
device_inventory	PRIMARY	Yes	BTREE	id	1	47
device_job	PRIMARY	Yes	BTREE	id	1	15
device_job_type	PRIMARY	Yes	BTREE	id	1	4
department_location	PRIMARY	Yes	BTREE	id	1	7
user	PRIMARY	Yes	BTREE	id	1	46

Figure 49 Primary keys of the new schema

3.1.5 Implementation Phase

3.1.5.1 Installing Hardware and Software

It was developed the ICT Hardware Inventory application that contains a database in MySQL and it was used a PHP interface technology. This application is useful for hardware inventory products for Mellchester College. The application was created using XAMPP, MySQL Workbench 6.0 and Notepad ++.

3.1.5.2 Choosing a database management system

The installation of MySQL toolset Workbench

MySQL Workbench applications must run on the same computer as well as MySQL server. This is an easy tool to use and easy to install.

MySQL Workbench is a free version and a capable software development for relational databases. MySQL Workbench is easy to install and easy to use.

It has an easy to use interface that provides:

• Database administration

• Create tables, views and other database objects

• Is running queries and SQL scripts

• Generate reports

Step 1:

MySQL Workbench is downloaded from the Internet. This executable application a is a free toolset does not need to purchase a license. The download is on the website: http://wb.mysql.com/. Install MySQL Workbench 6.3:

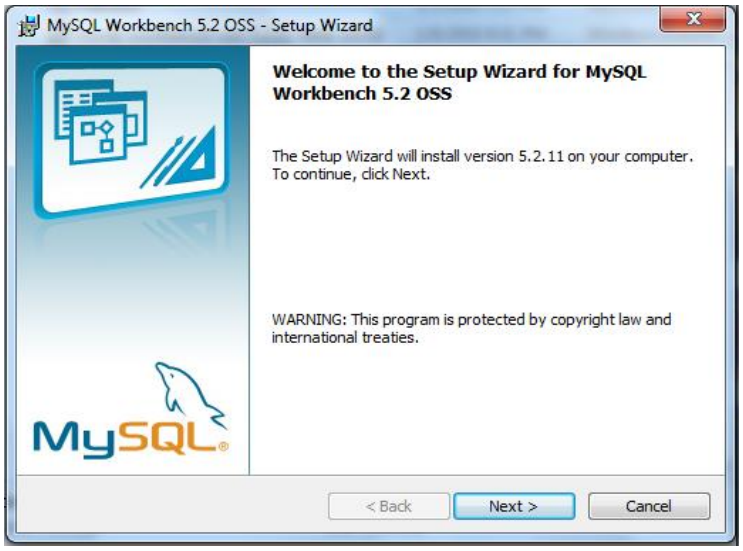


Figure 50 Install MySQL Workbench

Source: Internet

Step 2:

After the installation, the executable starts:

Figure 51 Start the executable

Source: Internet

Step 3:

Using the GUI program can create tables and relationships between them:

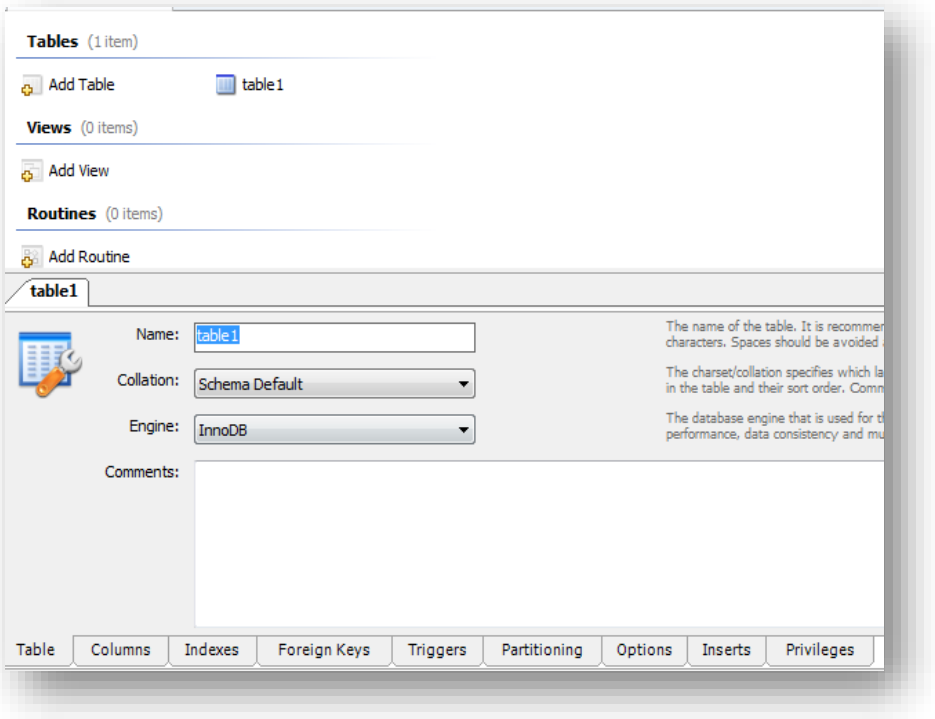


Figure 52 Create the tales and the relations of it, the views and the queries of the database

Installation and configuration of XAMPP

Xampp makes it easier to install the Apache server and contains MySQL, PHP and Perl. XAMPP is very easy to use and install - Just download, extract and starts. There are many other similar programs with XAMPP (WAMPP, Easy PHP) but it was selected as it seems the easiest and simple to use.

Step I

Download

XAMPP is available for free download from the web link of the producer: https://www.apachefriends.org/index.html

Select the operating system you have: It choose Windows

Next, choose the EXE. Download the executable and double-click it.

Step 2:

Installing downloaded Xampp:

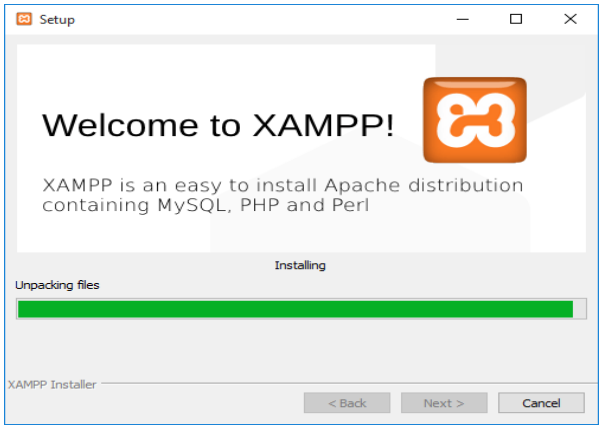


Figure 53 Installing Xampp

The use of Xampp by the project team

It was used to have MySQL as a database server.

The installation of Notepad++

Download:

Web site download is http://notepad-plus-plus.org/. Select the Download

It will appear a download window, press the save file to download the installation file.

The installation will be as follows:

An installation window will appear. From this point the installation is very simple: Run-> Please select a language-> Next-> I Agree-> Finish.

Benefits:

- it is free
- possibility to access files remotely (remote, from a server) through FTP
- the ability to preview documents HTML Browser
- autocomplete option
- line numbering program

Use of Notepad++ by the project team

The project team used it for the conceptual and logical design of the new database system.

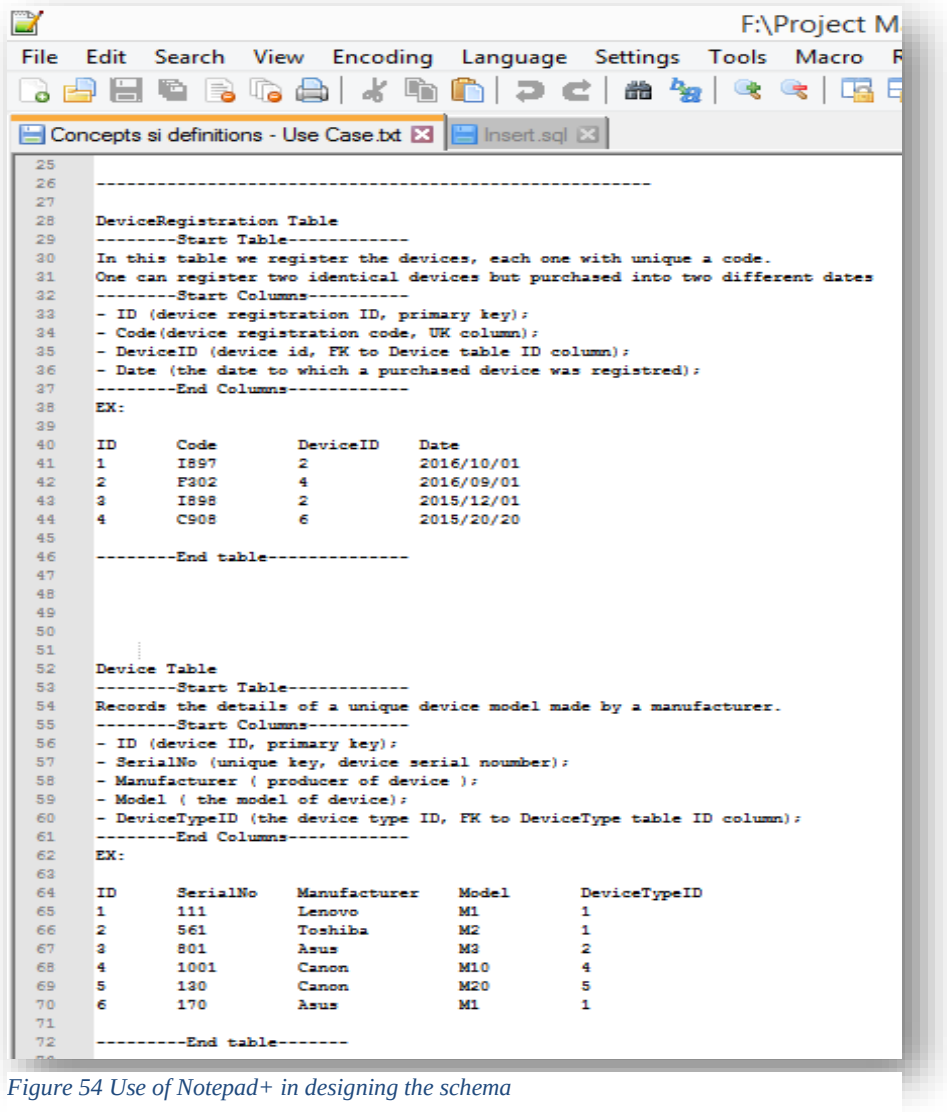


Figure 54 Use of Notepad+ in designing the schema

Hardware to be used for implementation

The college has made available to the implementation team a laptop for each member of it, which they will use them for whole implementation duration of the new computerised hardware inventory. All the computers of the project team will run on Windows platforms.

Properties of relational databases

a. A relational database appears as a collection of relations (tables) by the user.

b. The format of the column/row is familiar and easy for data visualisation.

c. There are plenty of operators for partitioning and combining relations (selection, projection, product, join, union, intersection, difference).

d. There are no explicit pointers; connections are made on the sole basis.

e. The user does not specify the gateway and does not need to know how is the information physically arranged.

f. Orders for data recovery and for making those changes in the database are included in a single SQL.

g. There is a total independence of the data.

3.1.5.3 Create the database and tables

The most common type of database is the relational data, which is applied and stored in the tables of the new system of hardware inventory. Besides tables, the relational database of the new system also contains indexes, stored procedures, triggers, users, types of data, security mechanisms and management devices.

The new database ict_hardware_inventory contains 11 tables, each recording a set of data.

Characteristics for relations of the tables

One table has the following properties:

- No duplicate rows
- No duplicate column names
- The order of rows is unimportant

- column order is unimportant
- The values are atomic.

Creating a table

The name that the project team choose for a table must follow the standard rules for naming an object of a MySQL Workbench database.

- The name must begin with a letter, A-Z or a-z.
- Can contain letters, numbers and special characters' underscore (_).
- The name is the same whether using uppercase or lowercase letters, for example, EMP, emp and eMp are all the same table.
- Can be up to 30 characters in length.
- The name must not duplicate the name of another object in the database.
- Name must not be a keyword (reserved word) of SQL reserved word.

When the developer of the project team created a new table, he used the CREATE TABLE statement. One of the simplest forms of this command is when the basic information for each type of column is defined with its time and size.

Syntax: CREATE TABLE table name

(Column name type (size) Column type (size) ...);

Column types

When the developer is creating a table, he must specify each time the type of the column data.

Type of data may be followed by one or more numbers in brackets give information about the column width. Column width determines the maximum width of column values which can have.

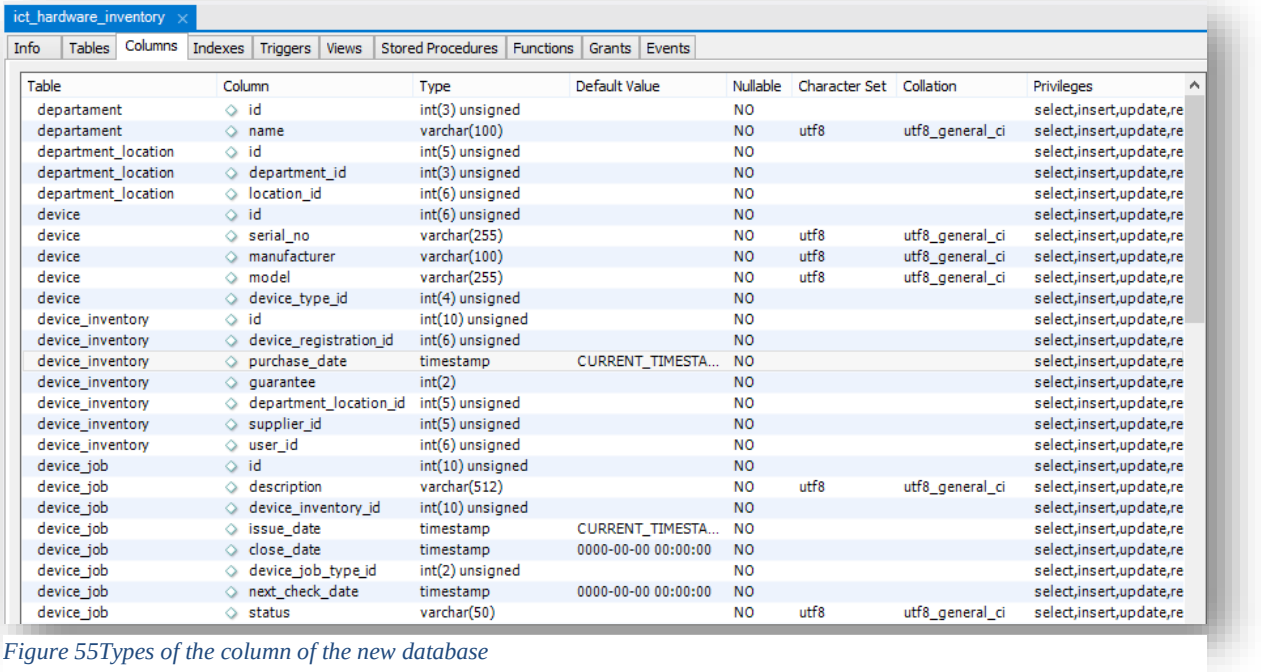


Table	Column	Type	Default Value	Nullable	Character Set	Collation	Privileges
departament	id	int(3) unsigned		NO			select,insert,update,re
departament	name	varchar(100)		NO	utf8	utf8_general_ci	select,insert,update,re
department_location	id	int(5) unsigned		NO			select,insert,update,re
department_location	department_id	int(3) unsigned		NO			select,insert,update,re
department_location	location_id	int(6) unsigned		NO			select,insert,update,re
device	id	int(6) unsigned		NO			select,insert,update,re
device	serial_no	varchar(255)		NO	utf8	utf8_general_ci	select,insert,update,re
device	manufacturer	varchar(100)		NO	utf8	utf8_general_ci	select,insert,update,re
device	model	varchar(255)		NO	utf8	utf8_general_ci	select,insert,update,re
device	device_type_id	int(4) unsigned		NO			select,insert,update,re
device_inventory	id	int(10) unsigned		NO			select,insert,update,re
device_inventory	device_registration_id	int(6) unsigned		NO			select,insert,update,re
device_inventory	purchase_date	timestamp	CURRENT_TIMESTA...	NO			select,insert,update,re
device_inventory	guarantee	int(2)		NO			select,insert,update,re
device_inventory	department_location_id	int(5) unsigned		NO			select,insert,update,re
device_inventory	supplier_id	int(5) unsigned		NO			select,insert,update,re
device_inventory	user_id	int(6) unsigned		NO			select,insert,update,re
device_job	id	int(10) unsigned		NO			select,insert,update,re
device_job	description	varchar(512)		NO	utf8	utf8_general_ci	select,insert,update,re
device_job	device_inventory_id	int(10) unsigned		NO			select,insert,update,re
device_job	issue_date	timestamp	CURRENT_TIMESTA...	NO			select,insert,update,re
device_job	close_date	timestamp	0000-00-00 00:00:00	NO			select,insert,update,re
device_job	device_job_type_id	int(2) unsigned		NO			select,insert,update,re
device_job	next_check_date	timestamp	0000-00-00 00:00:00	NO			select,insert,update,re
device_job	status	varchar(50)		NO	utf8	utf8_general_ci	select,insert,update,re

Figure 55Types of the column of the new database

Constraint types in ict_hardware_inventory schema

A Primary Key of the new hardware inventory system meet two conditions:

- primary key values must be unique;

- a primary key should not appear with null values

The next image will show a Primary Key *id* column from *device* table which doesn't have null values and is a Unique Key:

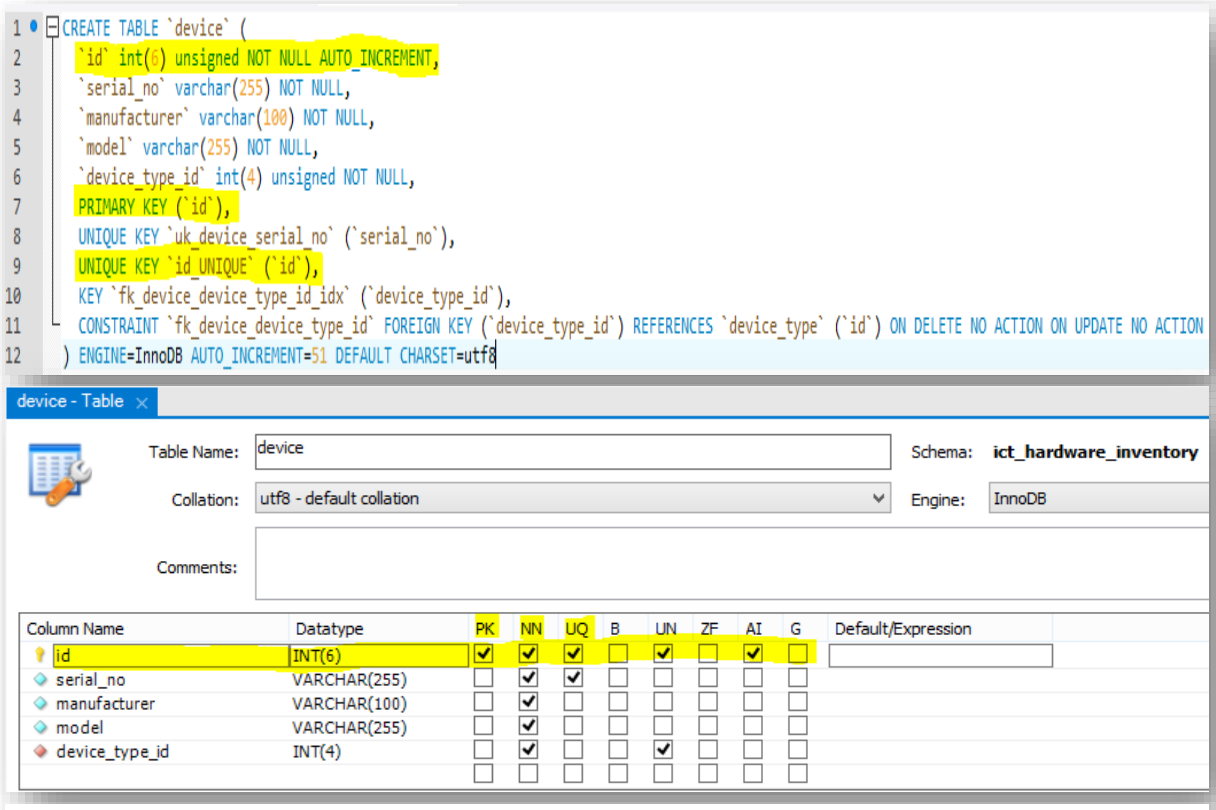
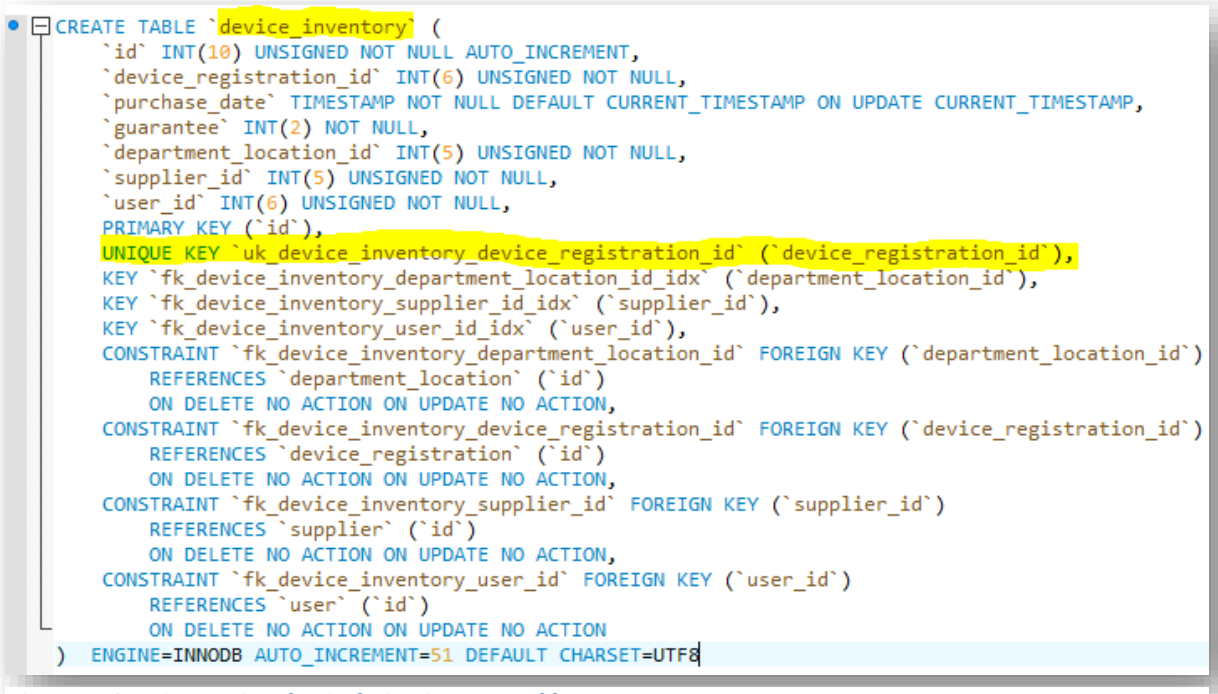


Figure 56 Primary Key id column of device table

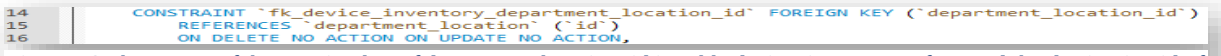
The ***Unique Key*** constraints type of database *ict_hardware_inventory* must follow this format, it must first specify the type of the constraint followed by the table name and the column name of table source which is forming the unique key. The below image shows how the database developer created the unique keys of the schema. The image is showing the table *device_inventory table* in which was created the unique key of *device_registration_id*.



```
CREATE TABLE `device_inventory` (
    `id` INT(10) UNSIGNED NOT NULL AUTO_INCREMENT,
    `device_registration_id` INT(6) UNSIGNED NOT NULL,
    `purchase_date` TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
    `guarantee` INT(2) NOT NULL,
    `department_location_id` INT(5) UNSIGNED NOT NULL,
    `supplier_id` INT(5) UNSIGNED NOT NULL,
    `user_id` INT(6) UNSIGNED NOT NULL,
    PRIMARY KEY (`id`),
    UNIQUE KEY `uk_device_inventory_device_registration_id` (`device_registration_id`),
    KEY `fk_device_inventory_department_location_id_idx` (`department_location_id`),
    KEY `fk_device_inventory_supplier_id_idx` (`supplier_id`),
    KEY `fk_device_inventory_user_id_idx` (`user_id`),
    CONSTRAINT `fk_device_inventory_department_location_id` FOREIGN KEY (`department_location_id`)
        REFERENCES `department_location` (`id`)
        ON DELETE NO ACTION ON UPDATE NO ACTION,
    CONSTRAINT `fk_device_inventory_device_registration_id` FOREIGN KEY (`device_registration_id`)
        REFERENCES `device_registration` (`id`)
        ON DELETE NO ACTION ON UPDATE NO ACTION,
    CONSTRAINT `fk_device_inventory_supplier_id` FOREIGN KEY (`supplier_id`)
        REFERENCES `supplier` (`id`)
        ON DELETE NO ACTION ON UPDATE NO ACTION,
    CONSTRAINT `fk_device_inventory_user_id` FOREIGN KEY (`user_id`)
        REFERENCES `user` (`id`)
        ON DELETE NO ACTION ON UPDATE NO ACTION
) ENGINE=INNODB AUTO_INCREMENT=51 DEFAULT CHARSET=UTF8
```

Figure 57 Creating a unique key in device_inventory table

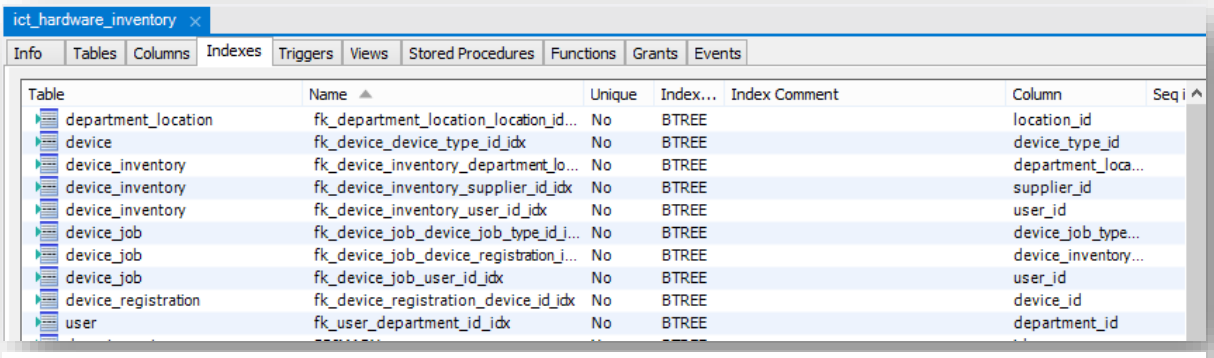
The ***Foreign key*** constraints type of database *ict_hardware_inventory* must follow this format, it must first specify the name of the constrain, then the type of the constraint in this case is a *Foreign Key*, followed by the column name of the table source and then specify on which table is referencing and in the round brackets it is specified the name of the sourced column of the referenced table. The below image shows how the database developer created the foreign keys of the schema. The image is showing the table *device_inventory table* in which was created the foreign key of *device_location_id* column referencing the destination column of the referenced table:



```
14      CONSTRAINT `fk_device_inventory_department_location_id` FOREIGN KEY (`department_location_id`)
15          REFERENCES `department_location` (`id`)
16          ON DELETE NO ACTION ON UPDATE NO ACTION,
```

Figure 58 The source of the Foreign key of department location_id in table device_inventory referenced the destination id of the referenced table which is department_location

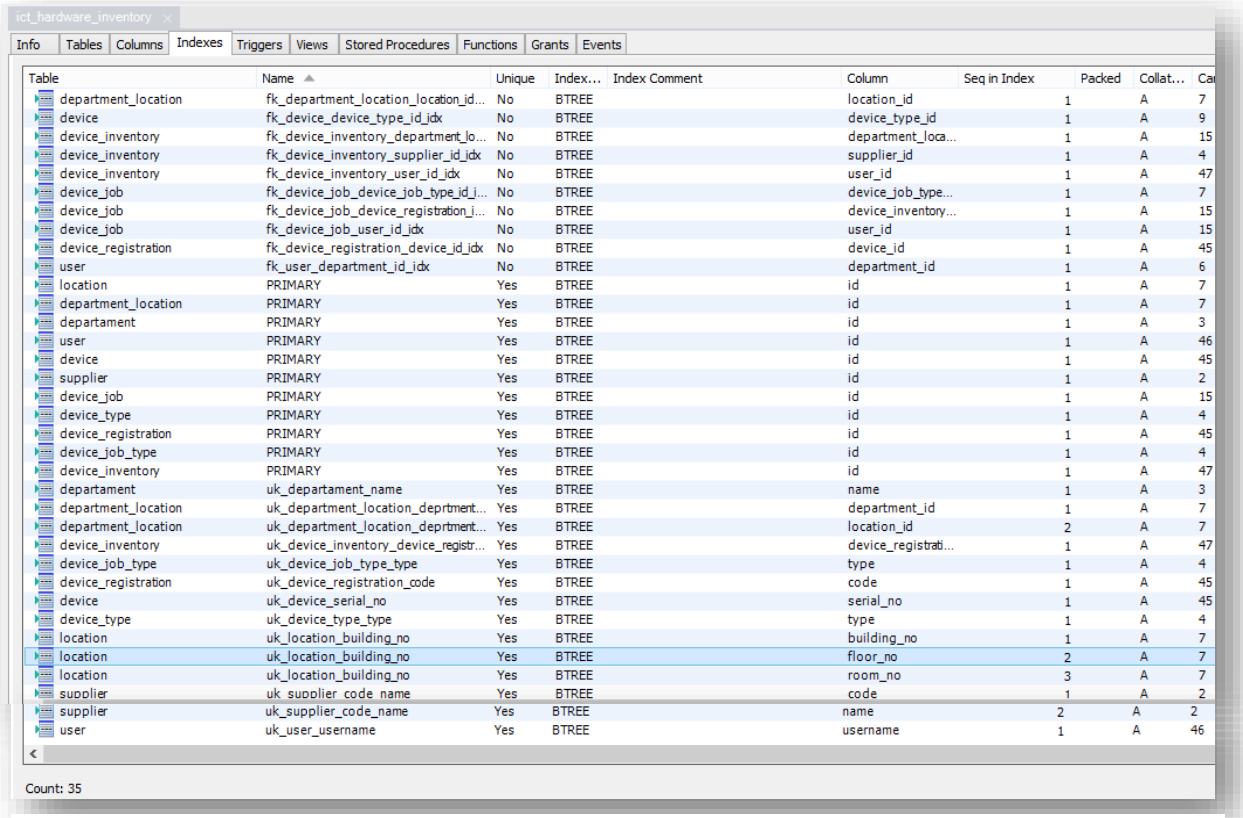
The next image will show all the foreign keys of ict_hardware_inventory schema:


ict_hardware_inventory

Info | Tables | Columns | Indexes | Triggers | Views | Stored Procedures | Functions | Grants | Events

Table	Name	Unique	Index...	Index Comment	Column	Seq i
department_location	fk_department_location_location_id...	No	BTREE		location_id	
device	fk_device_device_type_id_idx	No	BTREE		device_type_id	
device_inventory	fk_device_inventory_department_lo...	No	BTREE		department_loca...	
device_inventory	fk_device_inventory_supplier_id_idx	No	BTREE		supplier_id	
device_inventory	fk_device_inventory_user_id_idx	No	BTREE		user_id	
device_job	fk_device_job_device_job_type_id_i...	No	BTREE		device_job_type...	
device_job	fk_device_job_device_registration_i...	No	BTREE		device_inventory...	
device_job	fk_device_job_user_id_idx	No	BTREE		user_id	
device_registration	fk_device_registration_device_id_idx	No	BTREE		device_id	
user	fk_user_department_id_idx	No	BTREE		department_id	

Figure 59 All foreign keys of schema


ict_hardware_inventory

Info | Tables | Columns | Indexes | Triggers | Views | Stored Procedures | Functions | Grants | Events

Table	Name	Unique	Index...	Index Comment	Column	Seq in Index	Packed	Collat...	Ca
department_location	fk_department_location_location_id...	No	BTREE		location_id	1		A	7
device	fk_device_device_type_id_idx	No	BTREE		device_type_id	1		A	9
device_inventory	fk_device_inventory_department_lo...	No	BTREE		department_loca...	1		A	15
device_inventory	fk_device_inventory_supplier_id_idx	No	BTREE		supplier_id	1		A	4
device_inventory	fk_device_inventory_user_id_idx	No	BTREE		user_id	1		A	47
device_job	fk_device_job_device_job_type_id_i...	No	BTREE		device_job_type...	1		A	7
device_job	fk_device_job_device_registration_i...	No	BTREE		device_inventory...	1		A	15
device_job	fk_device_job_user_id_idx	No	BTREE		user_id	1		A	15
device_registration	fk_device_registration_device_id_idx	No	BTREE		device_id	1		A	45
user	fk_user_department_id_idx	No	BTREE		department_id	1		A	6
location	PRIMARY	Yes	BTREE		id	1		A	7
department_location	PRIMARY	Yes	BTREE		id	1		A	7
departament	PRIMARY	Yes	BTREE		id	1		A	3
user	PRIMARY	Yes	BTREE		id	1		A	46
device	PRIMARY	Yes	BTREE		id	1		A	45
supplier	PRIMARY	Yes	BTREE		id	1		A	2
device_job	PRIMARY	Yes	BTREE		id	1		A	15
device_type	PRIMARY	Yes	BTREE		id	1		A	4
device_registration	PRIMARY	Yes	BTREE		id	1		A	45
device_job_type	PRIMARY	Yes	BTREE		id	1		A	4
device_inventory	PRIMARY	Yes	BTREE		id	1		A	47
departament	uk_departament_name	Yes	BTREE		name	1		A	3
department_location	uk_department_location_deprtment...	Yes	BTREE		department_id	1		A	7
department_location	uk_department_location_deprtment...	Yes	BTREE		location_id	2		A	7
device_inventory	uk_device_inventory_device_registr...	Yes	BTREE		device_registrati...	1		A	47
device_job_type	uk_device_job_type_type	Yes	BTREE		type	1		A	4
device_registration	uk_device_registration_code	Yes	BTREE		code	1		A	45
device	uk_device_serial_no	Yes	BTREE		serial_no	1		A	45
device_type	uk_device_type_type	Yes	BTREE		type	1		A	4
location	uk_location_building_no	Yes	BTREE		building_no	1		A	7
location	uk_location_building_no	Yes	BTREE		floor_no	2		A	7
location	uk_location_building_no	Yes	BTREE		room_no	3		A	7
supplier	uk_supplier_code_name	Yes	BTREE		code	1		A	2
supplier	uk_supplier_code_name	Yes	BTREE		name	2		A	2
user	uk_user_username	Yes	BTREE		username	1		A	46

Count: 35

Figure 60 Indexes of the schema

✓ Presentation of the tables:

Departament table

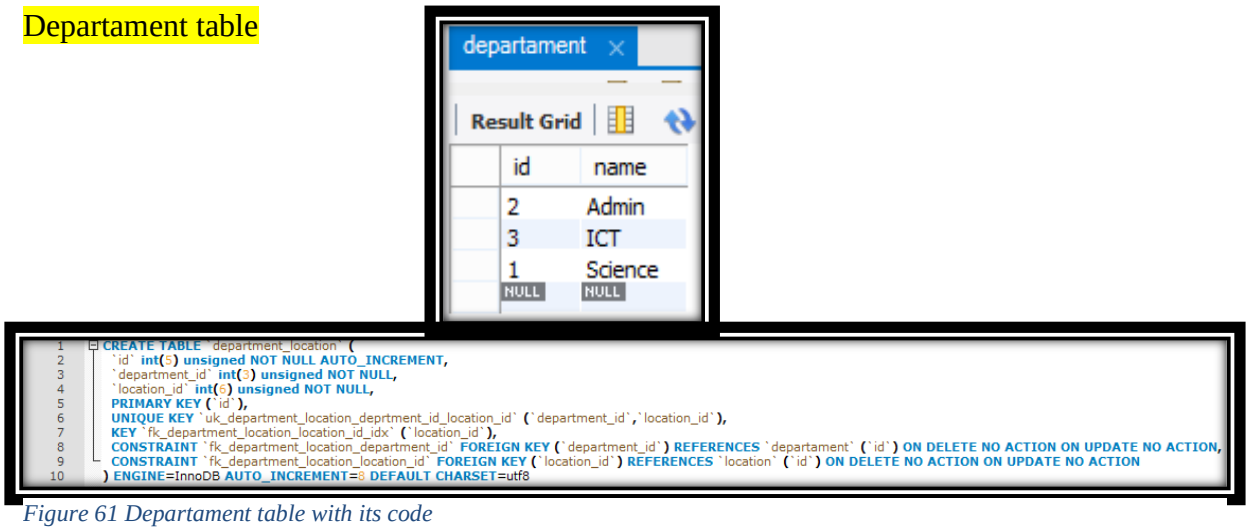


Figure 61 Departament table with its code

Department_location table

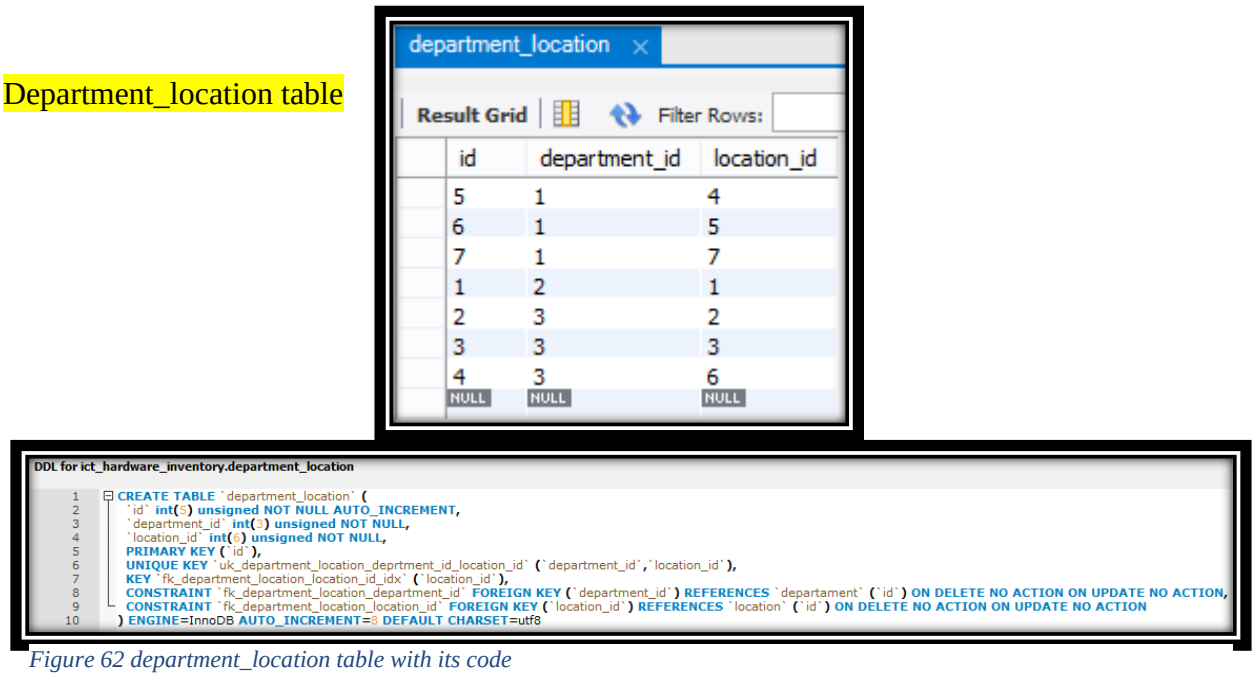


Figure 62 department_location table with its code

Device table

departament | department_location | device

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap C

id	serial_no	manufacturer	model	device_type_id
1	X3894281G	Toshiba	Satellite Pro A10	1
2	E61891H4S135748	Brother	HL 2700CN	2
3	WO44942479	RM	Celeron 2.4Ghz 512MB	3
4	DMW4ZC802479	RM	17"	4
5	u3894281G	Dell	Inspiron 15 3000	1
6	A61891H4S135748	HP	DesignJet T120 24-in Printer	2
7	BO44942479	Asus	ASUS VivoPC K20CD	3
8	AO44942479	Asus	ASUS VivoPC K20CD	3
9	DOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	4
10	AOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	4
11	T3894281G	Lenovo	Thinkpad T430	1
12	Y3894281G	Lenovo	Thinkpad T430	1
13	EO44942479	HP	280 G2 Small Form Factor PC	3
14	Z3894281G	Toshiba	Satellite Pro A10	1
15	W3894281G	Asus	X751SA	1
16	CO44942479	HP	280 G2 Small Form Factor PC	3
17	X3894281A	Toshiba	Satellite Pro A10	1
18	CMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	4
19	EMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	4
20	F61891H4S135748	EPSON	WorkForce WF-2750 All-in-One Inkjet Print...	2
21	S3894281G	LENOVO	IdeaPad 510 15.6" Laptop - Black	1
22	R3894281G	LENOVO	IdeaPad 510 15.6" Laptop - Black	1
23	YO44942479	ACER	Aspire XC-780	3
24	ZO44942479	ACER	Aspire XC-780	3
25	IMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	4
26	JMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	4
27	X3894281C	Toshiba	Satellite Pro A10	1
28	X3894281B	Toshiba	Satellite Pro A10	1
29	G61891H4S135748	SAMSUNG	Xpress M2070W Wireless All-in-One Monoc...	2
30	P3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	1
31	O3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	1

```
CREATE TABLE `device` (
  `id` int(8) unsigned NOT NULL AUTO_INCREMENT,
  `serial_no` varchar(255) NOT NULL,
  `manufacturer` varchar(100) NOT NULL,
  `model` varchar(255) NOT NULL,
  `device_type_id` int(4) unsigned NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `uk_device_serial_no` (`serial_no`),
  KEY `fk_device_device_type_id_idx` (`device_type_id`),
  CONSTRAINT `fk_device_device_type_id` FOREIGN KEY (`device_type_id`) REFERENCES `device_type` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION
) ENGINE=InnoDB AUTO_INCREMENT=51 DEFAULT CHARSET=utf8
```

Figure 63 device table with its code

Device_inventory table

departament | department_location | device | device_inventory

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content

id	device_registration_id	purchase_date	guarantee	department_location_id	supplier_id	user_id
1	22	2017-03-27 16:17:15	3	2	1	2
2	23	2017-03-27 16:17:15	3	3	2	3
3	24	2016-12-15 12:36:00	3	1	2	4
4	25	2017-03-27 16:17:15	3	2	2	5
5	35	2017-03-27 16:17:15	3	1	1	12
6	38	2017-03-27 16:17:15	3	1	1	10
7	41	2017-03-27 16:17:15	3	1	1	11
8	42	2015-11-29 17:28:23	3	1	1	13
9	43	2015-12-07 14:19:33	2	1	1	14
10	44	2015-12-20 06:28:00	3	1	1	15
11	45	2017-03-27 16:17:55	3	1	2	16
12	46	2017-03-27 16:17:55	3	2	1	17
13	47	2016-01-01 12:19:00	2	2	2	18
14	48	2017-03-27 16:17:55	3	2	2	19
15	49	2015-10-14 14:27:00	2	2	2	20
16	50	2016-03-08 13:27:00	3	2	1	21
17	51	2017-03-27 16:17:15	3	3	2	22
18	52	2017-03-27 16:17:15	3	3	1	23
19	53	2015-12-06 13:11:25	1	3	1	24
20	54	2017-03-27 16:17:15	3	3	2	25
21	55	2016-04-11 18:15:00	3	3	2	26
22	56	2014-10-05 10:21:00	1	3	2	27
23	67	2016-04-10 15:24:00	3	4	1	28
24	68	2016-09-14 13:29:00	2	4	2	29
25	69	2015-09-14 12:23:00	2	4	2	30
26	190	2015-10-12 11:20:00	2	4	1	31
27	191	2015-11-19 11:22:00	2	4	1	52
28	192	2015-06-20 14:29:00	3	4	1	53
29	193	2015-06-15 11:18:00	1	4	1	54
30	194	2015-11-24 11:25:00	3	5	2	55
31	195	2017-03-26 09:18:00	2	5	2	56

```
CREATE TABLE `device_inventory` (
  `id` int(10) unsigned NOT NULL AUTO_INCREMENT,
  `device_registration_id` int(6) unsigned NOT NULL,
  `purchase_date` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  `guarantee` int(2) NOT NULL,
  `department_location_id` int(3) unsigned NOT NULL,
  `supplier_id` int(5) unsigned NOT NULL,
  `user_id` int(6) unsigned NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `uk_device_inventory_device_registration_id` (`device_registration_id`),
  KEY `fk_device_inventory_department_location_id_idx` (`department_location_id`),
  KEY `fk_device_inventory_supplier_id_idx` (`supplier_id`),
  KEY `fk_device_inventory_user_id_idx` (`user_id`),
  CONSTRAINT `fk_device_inventory_department_location_id` FOREIGN KEY (`department_location_id`) REFERENCES `department_location` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION,
  CONSTRAINT `fk_device_inventory_device_registration_id` FOREIGN KEY (`device_registration_id`) REFERENCES `device_registration` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION,
  CONSTRAINT `fk_device_inventory_supplier_id` FOREIGN KEY (`supplier_id`) REFERENCES `supplier` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION,
  CONSTRAINT `fk_device_inventory_user_id` FOREIGN KEY (`user_id`) REFERENCES `user` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION
) ENGINE=InnoDB AUTO_INCREMENT=51 DEFAULT CHARSET=utf8
```

Figure 64 device_inventory table and its code

Device_job table

departament | department_location | device | device_inventory | device_job

Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Content:

id	description	device_inventory_id	issue_date	close_date	device_job_type_id	next_check_date	status	user_id
1	This device has a problem with the video card	1	2017-01-20 11:50:00	2017-01-22 11:50:00	1	2017-11-16 00:00:00	close	2
2	This printer has a problem with the cartridge	2	2016-12-19 10:00:00	2016-12-22 16:01:00	2	2017-11-16 00:00:00	close	3
12	This device has a problem with the motherboard	3	2017-03-27 15:07:02	2017-03-27 14:55:49	3	2017-11-16 00:00:00	close	4
15	This device has a problem with the power cable	1	2017-03-02 11:21:32	2017-03-02 12:21:32	3	2017-11-16 00:00:00	close	2
17	This device has a problem with the power cable	22	2017-04-02 18:47:57	2017-03-26 13:19:22	3	2017-11-16 00:00:00	close	4
19	This device has a problem with the power cable	4	2017-03-27 15:54:05	2016-05-01 12:50:00	3	2017-11-16 00:00:00	close	5
25	This device has a problem with the video card	1	2016-09-19 12:36:00	2016-09-25 12:36:00	1	2017-11-16 00:00:00	close	2
27	This printer has a problem with the cartridge	2	2016-11-11 10:00:00	2016-11-11 11:00:00	2	2017-11-16 00:00:00	close	3
28	This device has a problem with the motherboard	3	2017-03-27 16:09:03	2017-02-02 12:36:00	4	2017-11-16 00:00:00	close	4
29	This device has a problem with the power cable	4	2016-03-27 15:57:38	2016-03-09 12:36:00	1	2017-11-16 00:00:00	close	5
30	This device has a problem with the power cable	5	2015-12-20 13:19:22	2015-12-20 14:19:22	3	2017-11-16 00:00:00	close	10
39	This device has a problem with the video card	6	2017-02-14 08:42:00	2017-02-24 08:42:00	1	2017-11-16 00:00:00	close	11
40	This printer has a problem with the cartridge	7	2016-12-23 12:36:00	2016-12-23 14:36:00	2	2017-11-16 00:00:00	close	12
41	This device has a problem with the motherboard	28	2017-03-27 16:07:35	2016-06-22 14:50:00	2	2017-11-16 00:00:00	close	29
42	This device has a problem with the power cable	47	2016-11-26 10:29:00	2016-11-09 12:36:00	1	2017-11-16 00:00:00	close	72
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE `device_job` (
  `id` int(10) unsigned NOT NULL AUTO_INCREMENT,
  `description` varchar(512) NOT NULL,
  `device_inventory_id` int(10) unsigned NOT NULL,
  `issue_date` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  `close_date` timestamp NOT NULL DEFAULT '0000-00-00 00:00:00',
  `device_job_type_id` int(2) unsigned NOT NULL,
  `next_check_date` timestamp NOT NULL DEFAULT '0000-00-00 00:00:00',
  `status` varchar(50) NOT NULL,
  `user_id` int(6) unsigned NOT NULL,
  PRIMARY KEY (`id`),
  KEY `fk_device_job_device_job_type_id_idx` (`device_job_type_id`),
  KEY `fk_device_job_user_id_idx` (`user_id`),
  KEY `fk_device_job_device_registration_id_idx` (`device_inventory_id`),
  CONSTRAINT `fk_device_job_device_inventory_id` FOREIGN KEY (`device_inventory_id`) REFERENCES `device_inventory` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION,
  CONSTRAINT `fk_device_job_device_job_type_id` FOREIGN KEY (`device_job_type_id`) REFERENCES `device_job_type` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION,
  CONSTRAINT `fk_device_job_user_id` FOREIGN KEY (`user_id`) REFERENCES `user` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION
) ENGINE=InnoDB AUTO_INCREMENT=43 DEFAULT CHARSET=utf8
```

Figure 65 device_job tabble and its code

Device_job table

device_job_type

Result Grid | Filter

id	type
4	Periodic check
1	Repair
3	Return
2	Upgrade
NULL	NULL

```
CREATE TABLE `device_job_type` (
  `id` int(2) unsigned NOT NULL AUTO_INCREMENT,
  `type` varchar(50) NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `uk_device_job_type_type` (`type`)
) ENGINE=InnoDB AUTO_INCREMENT=5 DEFAULT CHARSET=utf8
```

Figure 66 device_job_type and its code

Device_registration table

device_registration

Result Grid | Filter Rows:

id	code	device_id	date
22	1309	1	2016-03-15 12:36:00
23	1310	2	2016-03-15 12:36:00
24	1808	3	2016-12-15 12:36:00
25	1809	4	2016-12-22 12:36:00
35	1311	5	2015-05-18 11:19:41
38	1313	6	2015-10-15 08:42:00
41	1811	7	2015-12-24 12:36:00
42	1810	8	2015-11-30 17:28:23
43	1812	9	2015-12-08 14:19:33
44	1813	10	2015-12-21 06:28:00
45	1315	11	2016-01-20 13:32:14
46	1316	12	2016-03-22 14:26:22
47	1814	13	2016-01-04 12:19:00
48	1317	14	2016-06-16 13:19:00
49	1318	15	2015-10-15 14:27:00
50	1815	16	2016-03-10 13:27:00
51	1816	18	2016-01-12 14:25:00
52	1817	19	2016-02-09 13:36:00
53	1319	20	2015-12-07 13:11:25
54	1320	21	2016-07-20 13:10:00
55	1322	22	2016-04-12 18:15:00
56	1818	23	2014-10-06 10:21:00
67	1819	24	2016-04-11 15:24:00
68	1820	25	2016-09-15 13:29:00
69	1821	26	2015-09-15 12:23:00
190	1335	29	2015-10-13 11:20:00
191	1336	30	2015-11-20 11:22:00
192	1337	31	2015-06-21 14:29:00
193	1835	32	2015-06-18 11:18:00
194	1826	33	2015-11-25 11:25:00
195	1827	34	2017-03-27 09:18:00

```
CREATE TABLE `device_registration` (
  `id` int(6) unsigned NOT NULL AUTO_INCREMENT,
  `code` varchar(255) NOT NULL,
  `device_id` int(6) unsigned NOT NULL,
  `date` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (`id`),
  UNIQUE KEY `uk_device_registration_code` (`code`),
  KEY `fk_device_registration_device_id_idx` (`device_id`),
  CONSTRAINT `fk_device_registration_device_id` FOREIGN KEY (`device_id`) REFERENCES `device` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION
) ENGINE=InnoDB AUTO_INCREMENT=216 DEFAULT CHARSET=utf8
```

Figure 67 device_registration table and its code

Device_type table

device_type

Result Grid

id	type
3	Base Unit
1	Laptop
4	Monitor
2	Printer
NULL	NULL

```
CREATE TABLE `device_type` (
  `id` int(4) unsigned NOT NULL AUTO_INCREMENT,
  `type` varchar(50) NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `uk_device_type_type` (`type`)
) ENGINE=InnoDB AUTO_INCREMENT=5 DEFAULT CHARSET=utf8
```

Figure 68 device_type table and its code

Location table

location

Result Grid Filter Rows:

id	building_no	floor_no	room_no
1	A1	1	122
2	A2	1	122
3	A3	1	123
4	B3	1	123
5	C3	2	223
7	C3	2	Library
6	C3	3	ICT room
NULL	NULL	NULL	NULL

```
CREATE TABLE `location` (
  `id` int(6) unsigned NOT NULL AUTO_INCREMENT,
  `building_no` varchar(10) NOT NULL,
  `floor_no` int(3) NOT NULL,
  `room_no` varchar(30) NOT NULL,
  PRIMARY KEY (`id`),
  UNIQUE KEY `uk_location_building_no` (`building_no`,`floor_no`,`room_no`)
) ENGINE=InnoDB AUTO_INCREMENT=8 DEFAULT CHARSET=utf8
```

Figure 69 location table and its code

Supplier table

supplier

Result Grid | Filter Rows:

id	code	name
1	LFT	Limited Firm Technology
2	RM	Random Manufacturer
NULL	NULL	NULL

```
1  CREATE TABLE `supplier` (
2    `id` int(5) unsigned NOT NULL AUTO_INCREMENT,
3    `code` varchar(255) NOT NULL,
4    `name` varchar(255) NOT NULL,
5    PRIMARY KEY (`id`),
6    UNIQUE KEY `uk_supplier_code_name` (`code`,`name`)
7  ) ENGINE=InnoDB AUTO_INCREMENT=3 DEFAULT CHARSET=utf8
```

Figure 70 supplier table and its code

User table

user

Result Grid | Filter Rows: | Edit:

id	username	first_name	last_name	department_id
2	mitreaogh	Gheorghe	Mitrea	2
3	mitreaga	Alex	Mitrea	3
4	cirimpeiac	Andrei	Cirimpei	1
5	mitreaaa	Alex	Mitrea	3
10	Chituff	Florin	Chitu	3
11	AlvezEE	Eric	Alvez	3
12	FernandezGG	Gabriel	Fernandez	3
13	CurcaAA	Andrei	Curca	3
14	ChristacheAA	Adrian	Christache	3
15	HoropociucSS	Samuel	Horopciuc	3
16	PacurarAA	Andrei	Pacurar	3
17	BiticaCC	Catalin	Bitica	3

```
1  CREATE TABLE `user` (
2    `id` int(6) unsigned NOT NULL AUTO_INCREMENT,
3    `username` varchar(255) NOT NULL,
4    `first_name` varchar(255) NOT NULL,
5    `last_name` varchar(255) NOT NULL,
6    `department_id` int(3) unsigned NOT NULL,
7    PRIMARY KEY (`id`),
8    UNIQUE KEY `uk_user_username` (`username`),
9    KEY `fk_user_department_id_idx` (`department_id`),
10   CONSTRAINT `fk_user_department_id` FOREIGN KEY (`department_id`) REFERENCES `departament` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION
11 ) ENGINE=InnoDB AUTO_INCREMENT=76 DEFAULT CHARSET=utf8
```

Figure 71 user table and its code

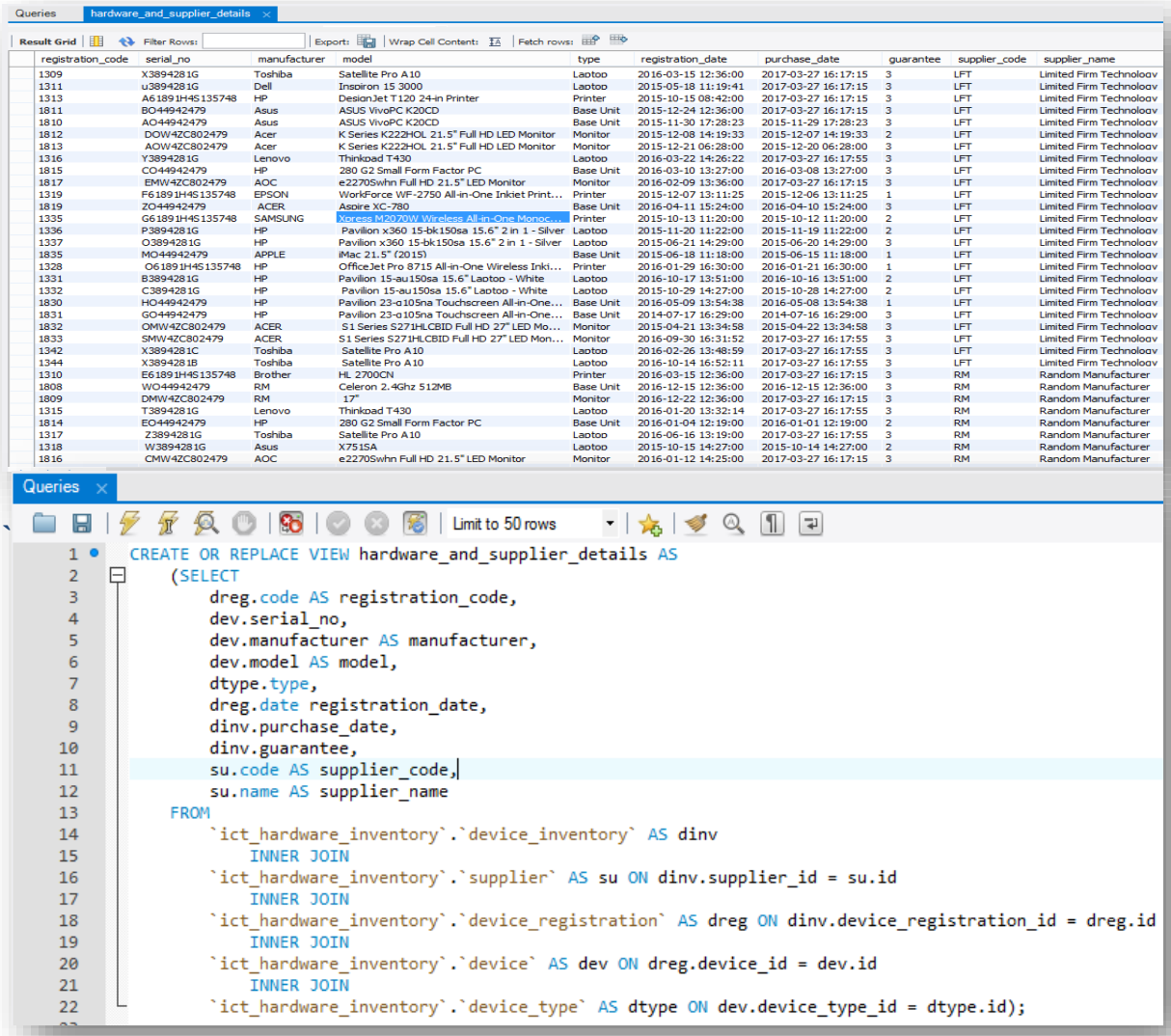
Presentation of the Queries/Requirements and the Views of the new system:

Data Model Language (DML)

DML is the language to access and manipulate the organised data according to a certain pattern data (known as query language or query data).

The Views describes how users of ICT Department will the see data of the schema. The details of the type of data and specific security information are hidden from the users.

hardware_and_supplier_details- The code and the output (view) of the query



Queries | hardware_and_supplier_details

Result Grid | Filter Rows: | Export: | Wrap Cell Content: | Fetch rows:

registration_code	serial_no	manufacturer	model	type	registration_date	purchase_date	guarantee	supplier_code	supplier_name
1309	X3894281G	Toshiba	Satellite Pro A10	Laptop	2016-03-15 12:36:00	2017-03-27 16:17:15	3	LFT	Limited Firm Technology
1311	u3894281G	Dell	Inspiron 15 3000	Laptop	2015-05-18 11:19:41	2017-03-27 16:17:15	3	LFT	Limited Firm Technology
1313	A61891H4S135748	HP	DesignJet T120 24-in Printer	Printer	2015-10-15 08:42:00	2017-03-27 16:17:15	3	LFT	Limited Firm Technology
1811	BO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-12-24 12:36:00	2017-03-27 16:17:15	3	LFT	Limited Firm Technology
1810	AO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-11-30 17:28:23	2015-11-29 17:28:23	3	LFT	Limited Firm Technology
1812	DOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	Monitor	2015-12-08 14:19:33	2015-12-07 14:19:33	2	LFT	Limited Firm Technology
1813	AOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	Monitor	2015-12-21 06:28:00	2015-12-20 06:28:00	3	LFT	Limited Firm Technology
1316	Y3894281G	Lenovo	Thinkpad T430	Laptop	2016-03-22 14:26:22	2017-03-27 16:17:55	3	LFT	Limited Firm Technology
1815	CO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-03-10 13:27:00	2016-03-08 13:27:00	3	LFT	Limited Firm Technology
1817	EMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-02-09 13:36:00	2017-03-27 16:17:15	3	LFT	Limited Firm Technology
1319	F61891H4S135748	EPSON	WorkForce WF-2750 All-in-One Inkjet Print...	Printer	2015-12-07 13:11:25	2015-12-06 13:11:25	1	LFT	Limited Firm Technology
1819	ZO44942479	ACER	Aspire XC-780	Base Unit	2016-04-11 15:24:00	2016-04-10 15:24:00	3	LFT	Limited Firm Technology
1335	G61891H4S135748	SAMSUNG	Xpress M2070W Wireless All-in-One Monoc...	Printer	2015-10-13 11:20:00	2015-10-12 11:20:00	2	LFT	Limited Firm Technology
1336	P3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	Laptop	2015-11-20 11:22:00	2015-11-19 11:22:00	2	LFT	Limited Firm Technology
1337	O3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	Laptop	2015-06-21 14:29:00	2015-06-20 14:29:00	3	LFT	Limited Firm Technology
1835	MO44942479	APPLE	iMac 21.5" (2015)	Base Unit	2015-06-18 11:18:00	2015-06-15 11:18:00	1	LFT	Limited Firm Technology
1328	O61891H4S135748	HP	OfficeJet Pro 8715 All-in-One Wireless Inki...	Printer	2016-01-29 16:30:00	2016-01-21 16:30:00	1	LFT	Limited Firm Technology
1331	B3894281G	HP	Pavilion 15-au150sa 15.6" Laptop - White	Laptop	2016-10-17 13:51:00	2016-10-16 13:51:00	2	LFT	Limited Firm Technology
1332	C3894281G	HP	Pavilion 15-au150sa 15.6" Laptop - White	Laptop	2015-10-29 14:27:00	2015-10-28 14:27:00	2	LFT	Limited Firm Technology
1830	HO44942479	HP	Pavilion 23-q105na Touchscreen All-in-One...	Base Unit	2016-05-09 13:54:38	2016-05-08 13:54:38	1	LFT	Limited Firm Technology
1831	GO44942479	HP	Pavilion 23-q105na Touchscreen All-in-One...	Base Unit	2014-07-17 16:29:00	2014-07-16 16:29:00	3	LFT	Limited Firm Technology
1832	OMW4ZC802479	ACER	S1 Series S271HLCBID Full HD 27" LED Mo...	Monitor	2015-04-21 13:34:58	2015-04-22 13:34:58	3	LFT	Limited Firm Technology
1833	SMW4ZC802479	ACER	S1 Series S271HLCBID Full HD 27" LED Mon...	Monitor	2016-09-30 16:31:52	2017-03-27 16:17:55	3	LFT	Limited Firm Technology
1342	X3894281C	Toshiba	Satellite Pro A10	Laptop	2016-02-26 13:48:59	2017-03-27 16:17:55	3	LFT	Limited Firm Technology
1344	X3894281B	Toshiba	Satellite Pro A10	Laptop	2016-10-14 16:52:11	2017-03-27 16:17:55	3	LFT	Limited Firm Technology
1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-03-15 12:36:00	2017-03-27 16:17:15	3	RM	Random Manufacturer
1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2016-12-15 12:36:00	2016-12-15 12:36:00	3	RM	Random Manufacturer
1809	DMW4ZC802479	RM	17"	Monitor	2016-12-22 12:36:00	2017-03-27 16:17:15	3	RM	Random Manufacturer
1315	T3894281G	Lenovo	Thinkpad T430	Laptop	2016-01-20 13:32:14	2017-03-27 16:17:55	3	RM	Random Manufacturer
1814	EO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-01-04 12:19:00	2016-01-01 12:19:00	2	RM	Random Manufacturer
1317	Z3894281G	Toshiba	Satellite Pro A10	Laptop	2016-06-16 13:19:00	2017-03-27 16:17:55	3	RM	Random Manufacturer
1318	W3894281G	Asus	X751SA	Laptop	2015-10-15 14:27:00	2015-10-14 14:27:00	2	RM	Random Manufacturer
1816	CMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-01-12 14:25:00	2017-03-27 16:17:15	3	RM	Random Manufacturer

Queries | Limit to 50 rows

```
1  CREATE OR REPLACE VIEW hardware_and_supplier_details AS
2      (SELECT
3          dreg.code AS registration_code,
4          dev.serial_no,
5          dev.manufacturer AS manufacturer,
6          dev.model AS model,
7          dtype.type,
8          dreg.date registration_date,
9          dinv.purchase_date,
10         dinv.guarantee,
11         su.code AS supplier_code,
12         su.name AS supplier_name
13     FROM
14         `ict_hardware_inventory`.`device_inventory` AS dinv
15             INNER JOIN
16         `ict_hardware_inventory`.`supplier` AS su ON dinv.supplier_id = su.id
17             INNER JOIN
18         `ict_hardware_inventory`.`device_registration` AS dreg ON dinv.device_registration_id = dreg.id
19             INNER JOIN
20         `ict_hardware_inventory`.`device` AS dev ON dreg.device_id = dev.id
21             INNER JOIN
22         `ict_hardware_inventory`.`device_type` AS dtype ON dev.device_type_id = dtype.id);
```

Figure 72 hardware_and_supplier_details`- The code and the output of the query

device_maintenance_history - the code and the output of the query

Queries | device_maintenance_history

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

job_description	registration_code	device_serial_number	device_manufacturer	device_model	device_type	issue_date	close_date	device_job_type	job_status	job_issuer
This device has a problem with the video card	1309	X3894281G	Toshiba	Satellite Pro A10	Laptop	2017-01-20 11:50:00	2017-01-22 11:50:00	Repair	close	Gheorghe Mitrea
This printer has a problem with the cartridge	1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-12-19 10:00:00	2016-12-22 16:01:00	Upgrade	close	Alex Mitrea
This device has a problem with the motherboard	1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2017-03-27 15:07:02	2017-03-27 14:55:49	Return	close	Andrei Cirimpei
This device has a problem with the power cable	1309	X3894281G	Toshiba	Satellite Pro A10	Laptop	2017-03-02 11:21:32	2017-03-02 12:21:32	Return	close	Gheorghe Mitrea
This device has a problem with the power cable	1818	YO44942479	ACER	Aspire XC-780	Base Unit	2017-04-02 18:47:57	2017-03-26 13:19:22	Return	close	Andrei Cirimpei
This device has a problem with the power cable	1809	DMW4ZC802479	RM	17"	Monitor	2017-03-27 15:54:05	2016-05-01 12:50:00	Return	close	Alex Mitrea
This device has a problem with the video card	1309	X3894281G	Toshiba	Satellite Pro A10	Laptop	2016-09-19 12:36:00	2016-09-25 12:36:00	Repair	close	Gheorghe Mitrea
This printer has a problem with the cartridge	1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-11-11 10:00:00	2016-11-11 11:00:00	Upgrade	close	Alex Mitrea
This device has a problem with the motherboard	1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2017-03-27 16:09:03	2017-02-02 12:36:00	Periodic check	close	Andrei Cirimpei
This device has a problem with the power cable	1809	DMW4ZC802479	RM	17"	Monitor	2016-03-27 15:57:38	2016-03-09 12:36:00	Repair	close	Alex Mitrea
This device has a problem with the power cable	1311	u3894281G	Dell	Inspiron 15 3000	Laptop	2015-12-20 13:19:22	2015-12-20 14:19:22	Return	close	Florin Chitu
This device has a problem with the video card	1313	A61891H4S135748	HP	DesignJet T120 24-in ...	Printer	2017-02-14 08:42:00	2017-02-24 08:42:00	Repair	close	Eric Alvez
This printer has a problem with the cartridge	1811	BO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2016-12-23 12:36:00	2016-12-23 14:36:00	Upgrade	close	Gabriel Fernandez
This device has a problem with the motherboard	1337	O3894281G	HP	Pavilion x360 15-bk15...	Laptop	2017-03-27 16:07:35	2016-06-22 14:50:00	Upgrade	close	Diana Mitrea
This device has a problem with the power cable	1340	W61891H4S135748	HP	LaserJet Pro MFP M27...	Printer	2016-11-26 10:29:00	2016-11-09 12:36:00	Repair	close	Ciudad Mehico

```
24  CREATE OR REPLACE VIEW device_maintenance_history AS
25      SELECT
26          djob.description job_description,
27          dreg.code AS registration_code,
28          dev.serial_no AS device_serial_number,
29          dev.manufacturer AS device_manufacturer,
30          dev.model AS device_model,
31          dtype.type device_type,
32          djob.issue_date,
33          djob.close_date,
34          djobtype.type AS device_job_type,
35          djob.status AS job_status,
36          CONCAT(usr.first_name, ' ', usr.last_name) AS job_issuer
37      FROM
38          `ict_hardware_inventory`.`device_job` AS djob
39              INNER JOIN
40          `ict_hardware_inventory`.`device_job_type` AS djobtype ON djob.device_job_type_id = djobtype.id
41              INNER JOIN
42          `ict_hardware_inventory`.`device_inventory` AS dinv ON djob.device_inventory_id = dinv.id
43              INNER JOIN
44          `ict_hardware_inventory`.`device_registration` AS dreg ON dinv.device_registration_id = dreg.id
45              INNER JOIN
46          `ict_hardware_inventory`.`device` AS dev ON dreg.device_id = dev.id
47              INNER JOIN
48          `ict_hardware_inventory`.`device_type` AS dtype ON dev.device_type_id = dtype.id
49              INNER JOIN
50          `ict_hardware_inventory`.`user` AS usr ON djob.user_id = usr.id;
51  SELECT
52      *
53  FROM
54      device_maintenance_history
55  WHERE
56      registration_code = '1808'
57  ORDER BY issue_date DESC;
```

Figure 73 device_maintenance_history - the code and the output of the query

hardware_by_departments - the code and the output of the query

Queries* hardware_by_departments

Result Grid | Filter Rows:

total_devices_no	department_name
8	Admin
21	ICT
21	Science

```
59  CREATE OR REPLACE VIEW hardware_by_departments AS
60      SELECT
61          COUNT(dinv.id) AS total_devices_no,
62          depart.name department_name
63      FROM
64          `ict_hardware_inventory`.`device_inventory` AS dinv
65              INNER JOIN
66          `ict_hardware_inventory`.`department_location` AS dloc ON dinv.department_location_id = dloc.id
67              INNER JOIN
68          `ict_hardware_inventory`.`departament` AS depart ON dloc.department_id = depart.id
69      GROUP BY depart.name;
```

Figure 74 hardware_by_departments - the code and the output of the query

hardware_location - the code and the output of the query

Queries* | hardware_location

Result Grid | Filter Rows: | Export: | Wrap Cell Content: | Fetch rows:

building_no	floor_no	room_no	department_name	registration_code	serial_no	manufacturer	model	type	registration_date	purchase_date	guarantee
A1	1	122	Admin	1813	AOW4ZC802479	Acer	K Series K222HOL 21.5" Full HD LED Monitor	Monitor	2015-12-21 06:28:00	2015-12-20 06:28:00	3
A3	1	123	ICT	1816	CMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-01-12 14:25:00	2017-03-27 16:17:15	3
A1	1	122	Admin	1812	DOW4ZC802479	Acer	K Series K222HOL 21.5" Full HD LED Monitor	Monitor	2015-12-08 14:19:33	2015-12-07 14:19:33	2
A3	1	123	ICT	1817	EMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-02-09 13:36:00	2017-03-27 16:17:15	3
C3	3	ICT room	ICT	1820	IMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	Monitor	2016-09-15 13:29:00	2016-09-14 13:29:00	2
C3	3	ICT room	ICT	1821	JMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	Monitor	2015-09-15 12:23:00	2015-09-14 12:23:00	2
B3	1	123	Science	1328	O61891H4S135748	HP	OfficeJet Pro 8715 All-in-One Wireless Inki...	Printer	2016-01-29 16:30:00	2016-01-21 16:30:00	1
B3	1	123	Science	1329	P61891H4S135748	HP	OfficeJet Pro 8715 All-in-One Wireless Inki...	Printer	2015-11-02 17:30:00	2015-11-01 17:30:00	3
A2	1	122	ICT	1318	W3894281G	Asus	X751SA	Laptop	2015-10-15 14:27:00	2015-10-14 14:27:00	2
A2	1	122	ICT	1317	Z3894281G	Toshiba	Satellite Pro A10	Laptop	2016-06-16 13:19:00	2017-03-27 16:17:55	3
B3	1	123	Science	1330	A3894281G	HP	Pavilion 15-au150sa 15.6" Laptop - White	Laptop	2016-11-23 11:16:00	2016-11-22 11:16:00	2
A1	1	122	Admin	1313	A61891H4S135748	HP	DesignJet T120 24-in Printer	Printer	2015-10-15 08:42:00	2017-03-27 16:17:15	3
A1	1	122	Admin	1810	AO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-11-30 17:28:23	2015-11-29 17:28:23	3
B3	1	123	Science	1331	B3894281G	HP	Pavilion 15-au150sa 15.6" Laptop - White	Laptop	2016-10-17 13:51:00	2016-10-16 13:51:00	2
A1	1	122	Admin	1811	BO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-12-24 12:36:00	2017-03-27 16:17:15	3
C3	2	223	Science	1332	C3894281G	HP	Pavilion 15-au150sa 15.6" Laptop - White	Laptop	2015-10-29 14:27:00	2015-10-28 14:27:00	2

```
71  CREATE OR REPLACE VIEW hardware_location AS
72      SELECT
73          loc.building_no,
74          loc.floor_no,
75          loc.room_no,
76          depart.name department_name,
77          dreg.code AS registration_code,
78          dev.serial_no,
79          dev.manufacturer AS manufacturer,
80          dev.model AS model,
81          dtype.type,
82          dreg.date registration_date,
83          dinv.purchase_date,
84          dinv.guarantee
85      FROM
86          `ict_hardware_inventory`.`device_inventory` AS dinv
87              INNER JOIN
88          `ict_hardware_inventory`.`device_registration` AS dreg ON dinv.device_registration_id = dreg.id
89              INNER JOIN
90          `ict_hardware_inventory`.`device` AS dev ON dreg.device_id = dev.id
91              INNER JOIN
92          `ict_hardware_inventory`.`device_type` AS dtype ON dev.device_type_id = dtype.id
93              INNER JOIN
94          `ict_hardware_inventory`.`department_location` AS dloc ON dinv.department_location_id = dloc.id
95              INNER JOIN
96          `ict_hardware_inventory`.`departament` AS depart ON dloc.department_id = depart.id
97              INNER JOIN
98          `ict_hardware_inventory`.`location` AS loc ON dloc.location_id = loc.id
99      ORDER BY loc.building_no , loc.floor_no , loc.room_no;
```

Figure 75 hardware_location - the code and the output of the query

admin_returned_pc_no - **the code and the output of the query**

Queries*

Result Grid | Filter Rows: | Export: | Wrap Cell Co

SUM(result.admin_returned_pc_no)	SUM(result.curriculum_returned_pc_no)
1	1

Queries*

Limit to 50 rows

```
-- pc admin vs curriculum
SELECT
    SUM(result.admin_returned_pc_no),
    SUM(result.curriculum_returned_pc_no)
FROM
    (SELECT
        COUNT(djob.id) AS admin_returned_pc_no,
        0 AS curriculum_returned_pc_no
    FROM `ict_hardware_inventory`.`device_job` AS djob
    INNER JOIN `ict_hardware_inventory`.`device_job_type` AS djobtype ON djob.device_job_type_id = djobtype.id
    INNER JOIN `ict_hardware_inventory`.`device_inventory` AS dinv ON djob.device_inventory_id = dinv.id
    INNER JOIN `ict_hardware_inventory`.`device_registration` AS dreg ON dinv.device_registration_id = dreg.id
    INNER JOIN `ict_hardware_inventory`.`device` AS dev ON dreg.device_id = dev.id
    INNER JOIN `ict_hardware_inventory`.`device_type` AS dtype ON dev.device_type_id = dtype.id
    INNER JOIN `ict_hardware_inventory`.`department_location` AS dloc ON dinv.department_location_id = dloc.id
    INNER JOIN `ict_hardware_inventory`.`departament` AS depart ON dloc.department_id = depart.id
    WHERE
        dtype.type = 'Base Unit'
            AND djobtype.type = 'Return'
            AND depart.name = 'Admin'

    UNION

    SELECT 0 AS admin_returned_pc_no,
    COUNT(djob.id) AS curriculum_returned_pc_no
    FROM `ict_hardware_inventory`.`device_job` AS djob
    INNER JOIN `ict_hardware_inventory`.`device_job_type` AS djobtype ON djob.device_job_type_id = djobtype.id
    INNER JOIN `ict_hardware_inventory`.`device_inventory` AS dinv ON djob.device_inventory_id = dinv.id
    INNER JOIN `ict_hardware_inventory`.`device_registration` AS dreg ON dinv.device_registration_id = dreg.id
    INNER JOIN `ict_hardware_inventory`.`device` AS dev ON dreg.device_id = dev.id
    INNER JOIN `ict_hardware_inventory`.`device_type` AS dtype ON dev.device_type_id = dtype.id
    INNER JOIN `ict_hardware_inventory`.`department_location` AS dloc ON dinv.department_location_id = dloc.id
    INNER JOIN `ict_hardware_inventory`.`departament` AS depart ON dloc.department_id = depart.id
    WHERE
        dtype.type = 'Base Unit'
            AND djobtype.type = 'Return'
            AND depart.name <> 'Admin') result
```

Figure 76 admin_returned_pc_no - the code and the output of the query

3.1.5.4 Load the data in phpMyyAdmin for the user interface

Once the implementation phase is completed the next step is to transfer the scheme ict_hardware_inventory on ICT Department Manager computer.

It was agreed that the users of this new hardware inventory system would use phpMyAdmin with Xampp which provides MySQL database server, for an easy and quick data processing of this graphical interface (GUI). This is a set of PHP scripts that will help the manager of ICT department to open and manage the database using a web interface.

3.1.5.4.1 Install MySQL Workbench and Xampp on the user's computer

The installation of MySQL Workbench and Xampp on ICT Manager's computer will follow the same steps as were done early when was necessary for the project team to install and run them to implement this new hardware inventory system. Now is necessary to show how to load the scheme of the new system on the client's computer.

3.1.5.4.2 Exporting the scheme

The ict_hardware_inventory scheme is exported by going to the Server menu from the Main Menu of MySQL Workbench tool. After this click on Data Export, it will appear a window for exportting the scheme, then select export as "Export to Self-Contained File" to a USB (portable storage device) and rename the scheme with ict_hardware_inventory.sql name otherwise will export it by default with dump.sql.

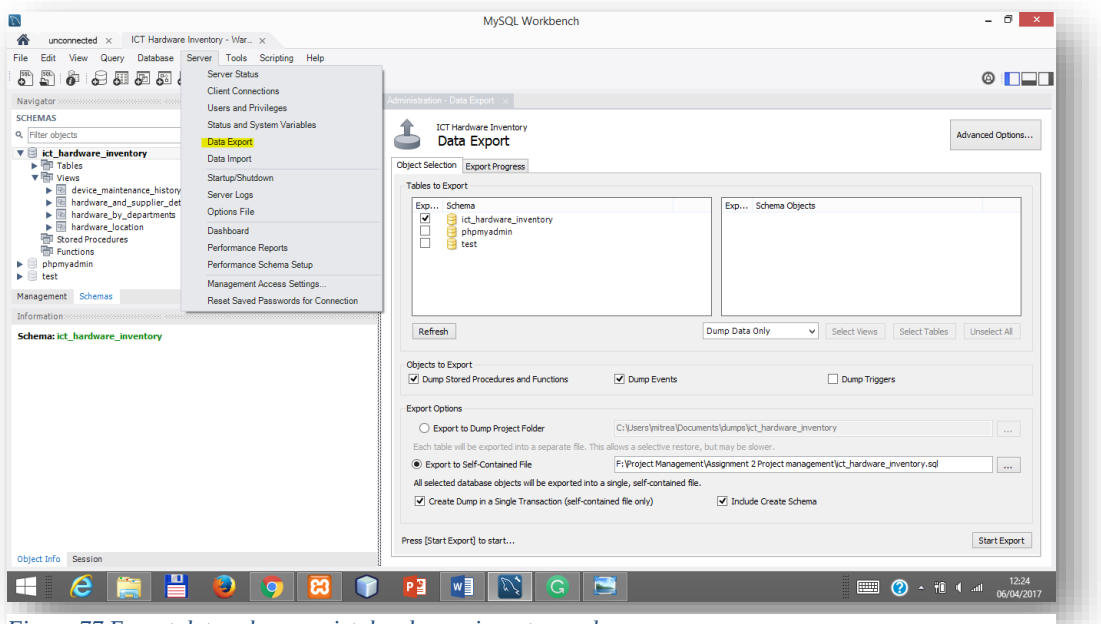


Figure 77 Export data scheme as ict_hardware_inventory.sql

3.1.5.4.3 Loading the schema

The next step is to load the schema on ICT Manager computer.

Step 1

Run Xampp application by starting Apache and MySQL database servers like in the next image:

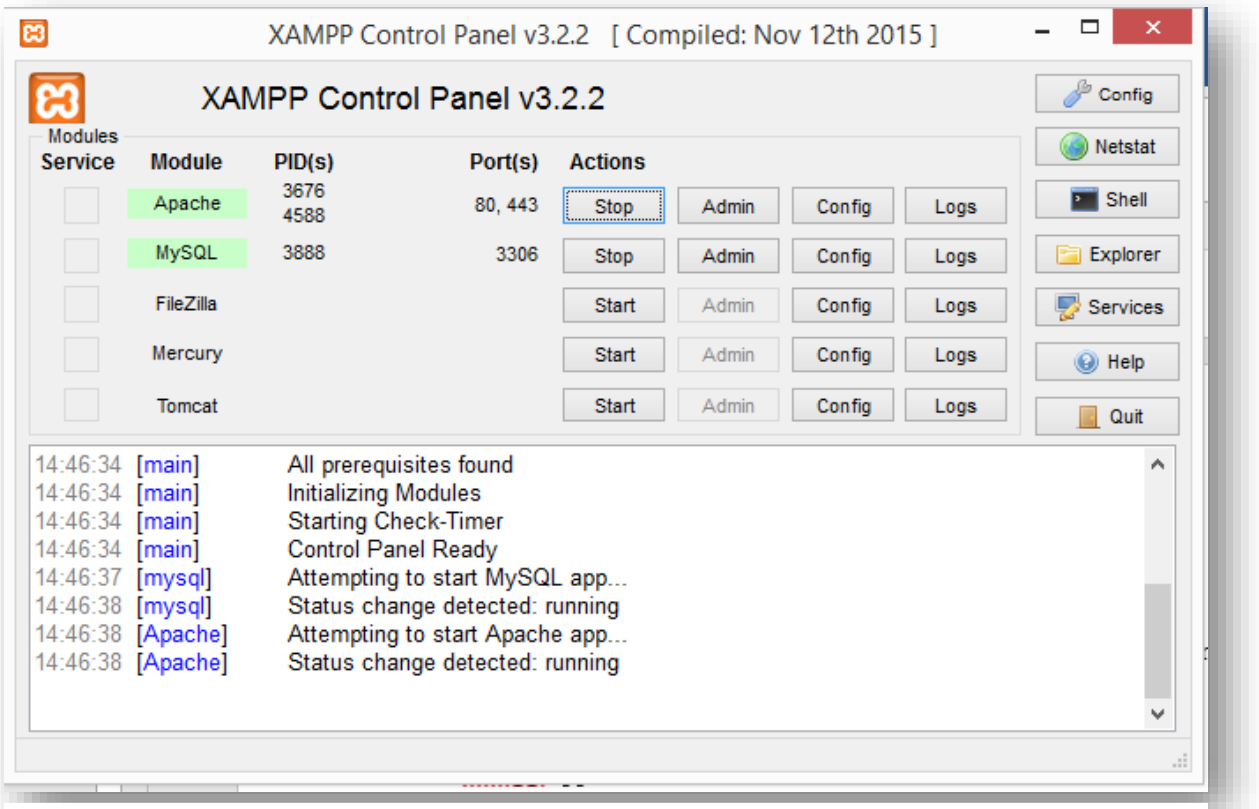


Figure 78 Running Xampp tool by starting the MySQL and Apache services

Step 2

Run MySQL Workbench tool by click on the icon of the tool placed on the desktop of the user after installation.

3.1.5.4.4 Load the data into MySQL Workbench

Step 3

To load the schema from the USB into the ***MySQL Workbench*** database have been done by click Import link from the Main Menu:

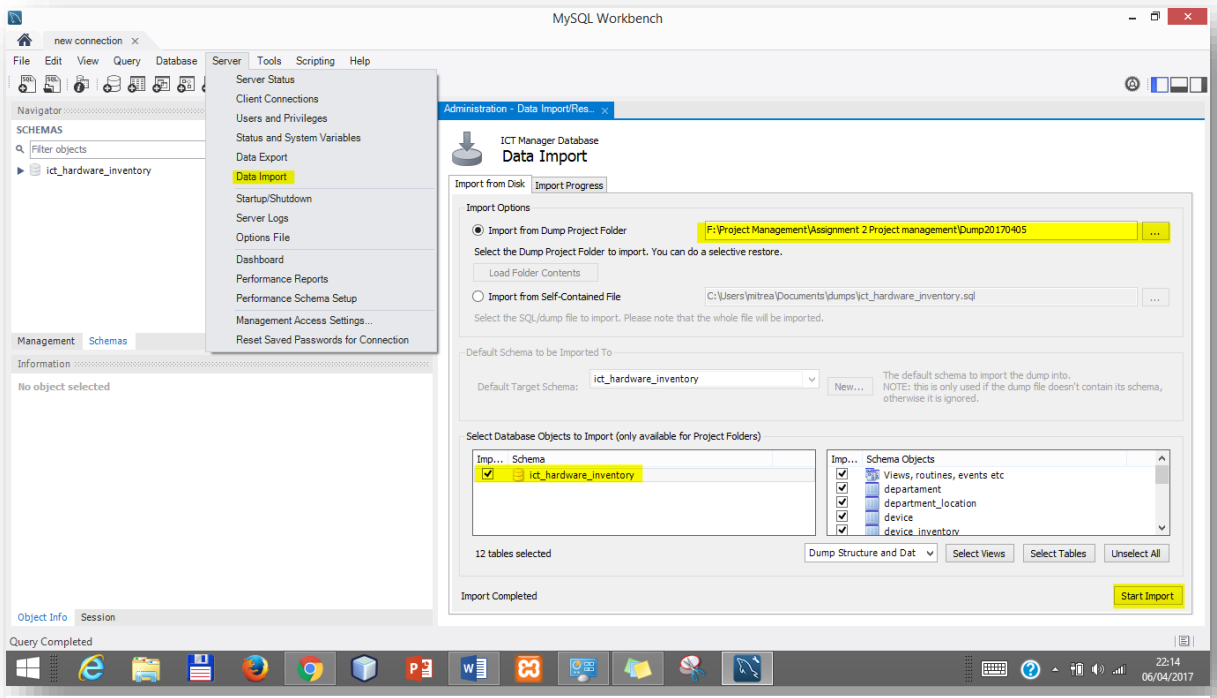


Figure 79 Load schema with Import Data from Server Menu

The next image is showing that the scheme was completed load without any errors:

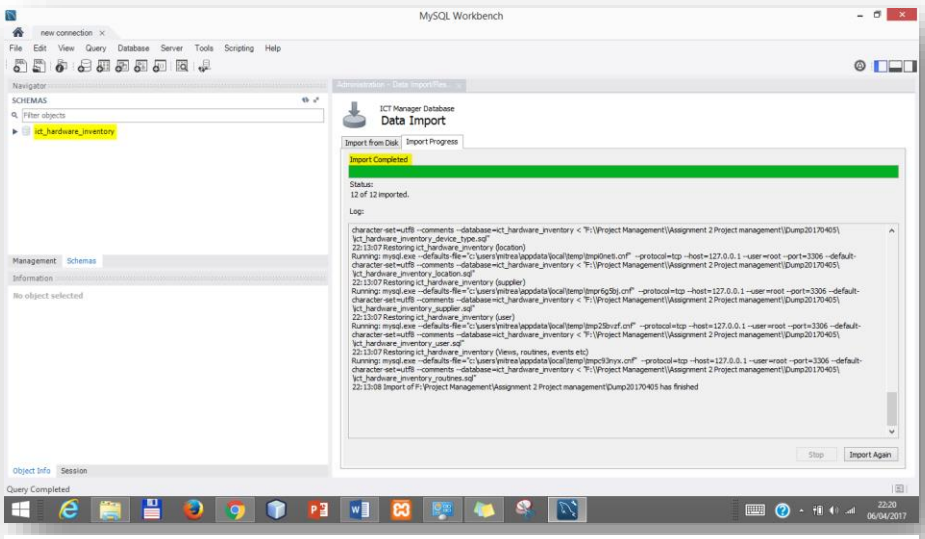


Figure 80 The import of the scheme was successfully without any errors

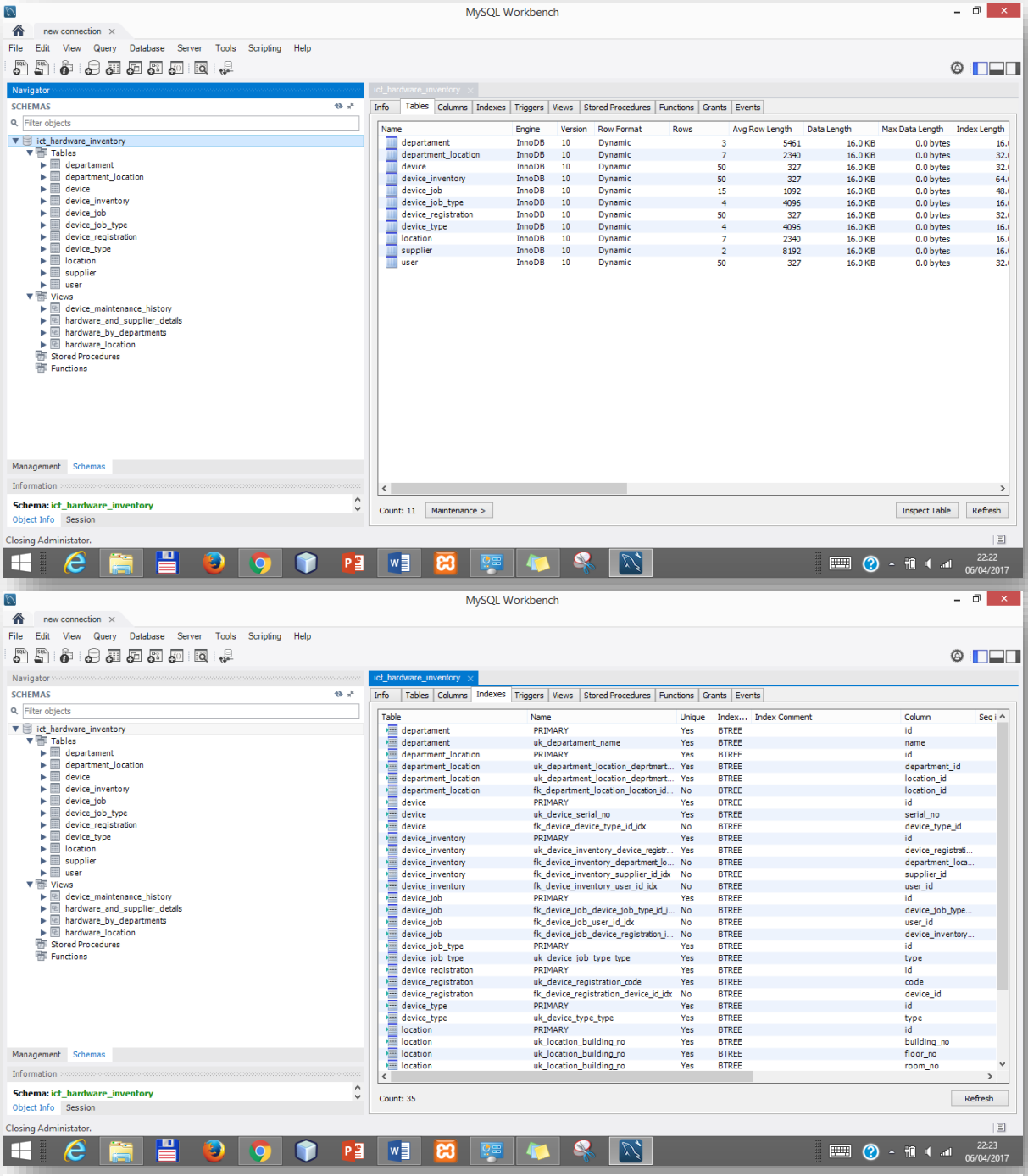


Figure 81 The import of the scheme was successfully without any errors

3.1.5.5 Set up the users and security

3.1.5.5.1 The of users of the database

• **The database administrator** (DBA) is the authorised person who will be responsible for the resource management, admission to the database, coordination and monitoring of users of that database. DBA is carry out the regular operations of data backups and restore them when it is necessary. The person with these privileges is the Manager of ICT Department and has all the privileges:

• Database Supervisor - is the creator and owner of the database objects that are used in applications. It has unlimited access to all schema objects and is responsible for control of access to other user accounts and this is the Supervisor of the department.

• Regular users - are those users who will access the database via the new scheme of hardware inventory. These users have limited rights of access to data in the database, they will have knowledge of the structure and data from this database.

In the next figure will show how is set up a new user account:

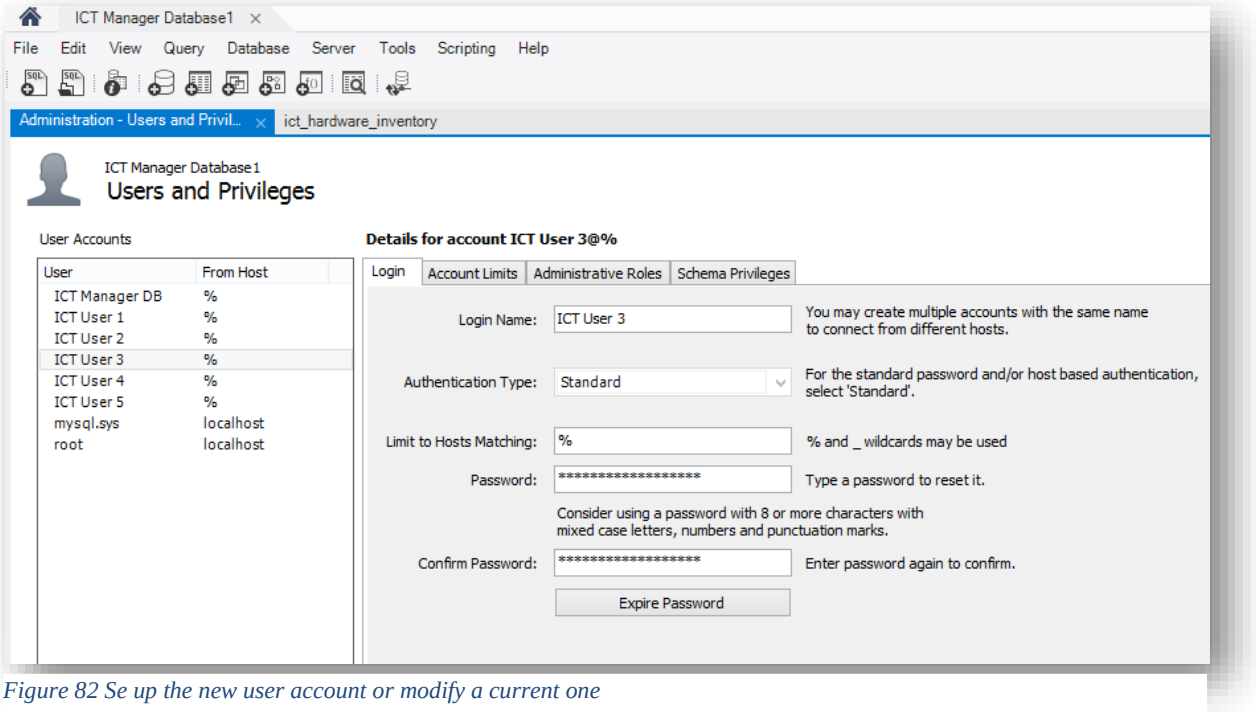


Figure 82 Se up the new user account or modify a current one

The system administrator (DBA) and Database Security officer are responsible for assigning user access to the new database by creating individual user accounts. Each user has a unique identifier that is used by operating systems to determine identity. This procedure allows authorised the use of a computational system, but not necessarily authorises the right to use a DBMS.

The DBA or the Database Security officer of ICT Department are providing a right or a privilege that allows a user to the legitimately access of the scheme or database objects.

The bellow image will show to set up the privileges of a user:

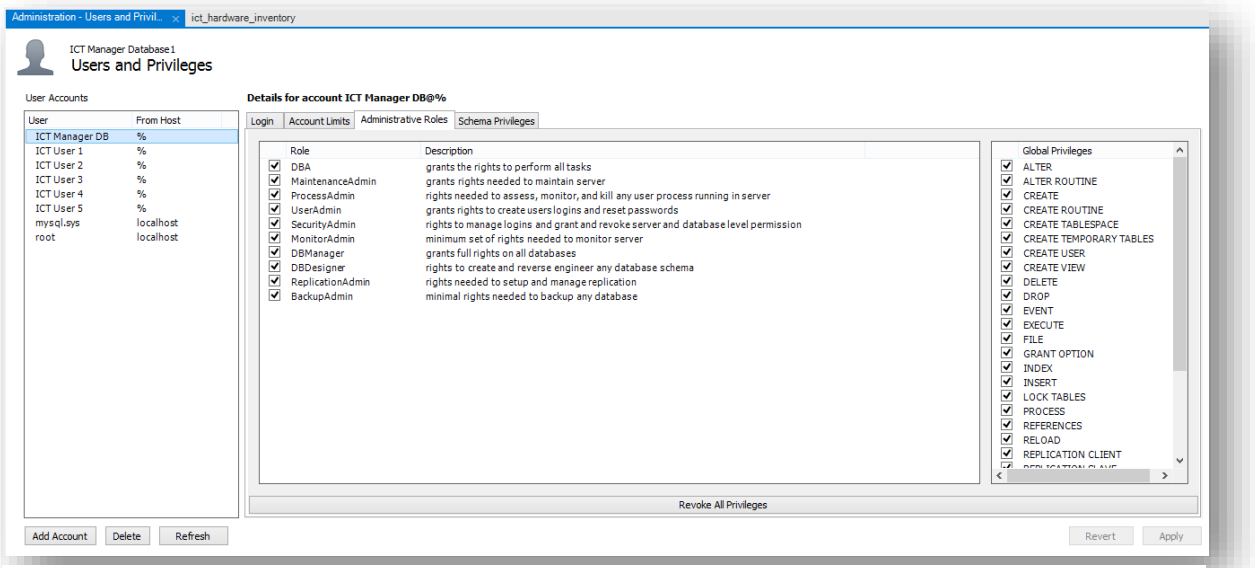


Figure 83 Set up the privileges of a user

The next image will show all the grants of the ICT department's employees, called each of them ICT Manager (DBA), ICT User 1 (Database Supervisor) and the rest of the staff called *User*:

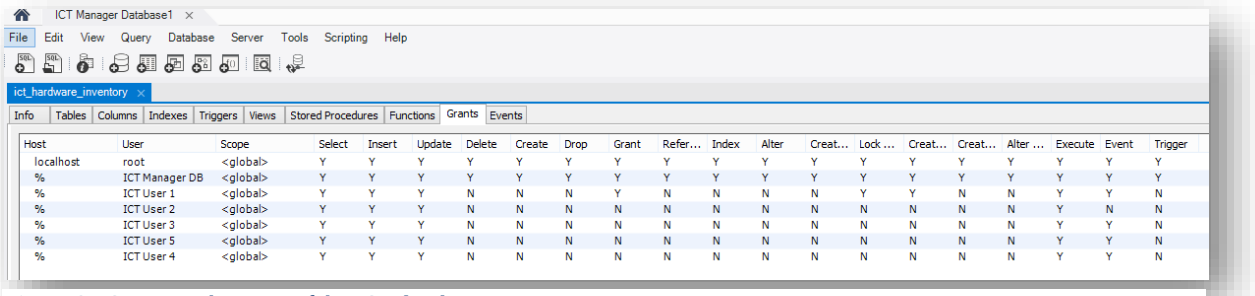


Figure 84 Grants to the users of the ICT database

3.1.5.5.2 Security of the database

Definition - involves sets of measures aiming to avoid security attacks intentional and unintentional.

Security measures aimed at avoiding:

- Data theft or fraud

- Loss of privacy
- Loss of integrity
- Data loss

The security of the new hardware inventory system must cover the following:

- Confidentiality data - the information must not become accessible to unauthorised users
- Content data privacy - Protection of personal data
- Integrity results in invalid or corrupted data.
- Availability - loss of data availability requires that the data/system cannot be accessed which affects financial performance.

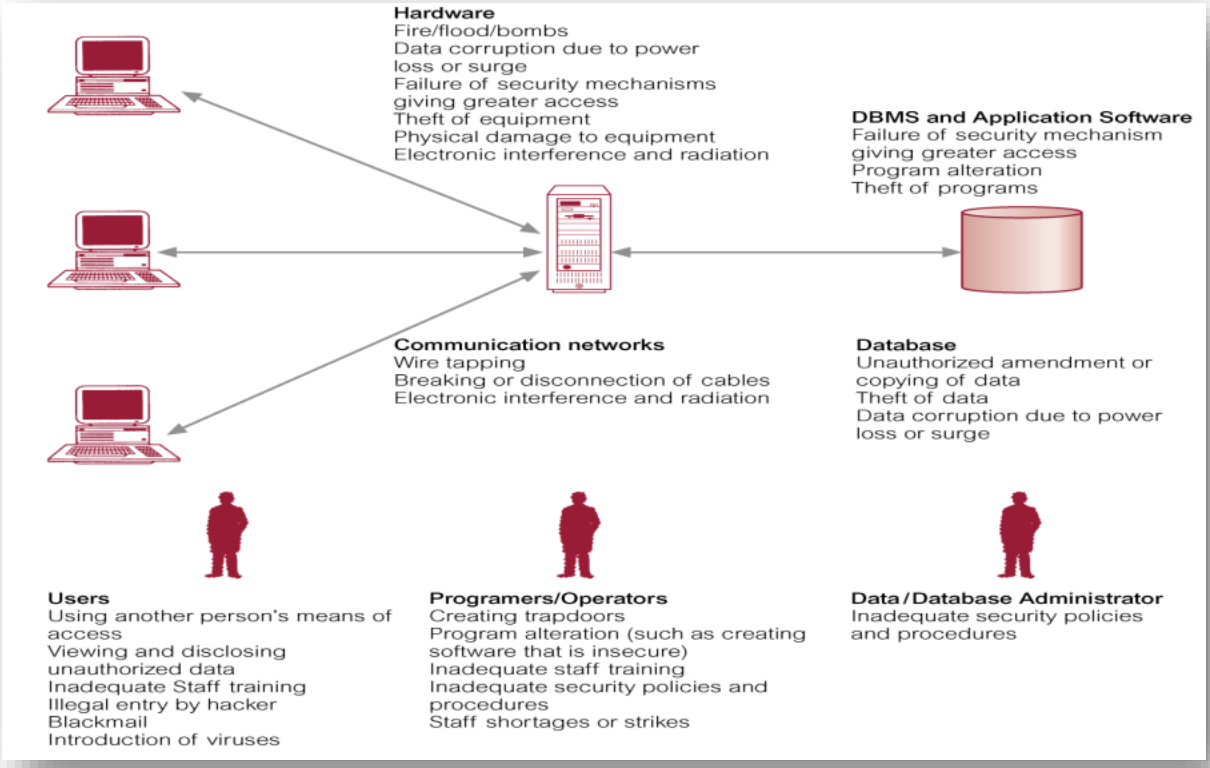


Figure 85 Database security issues

Source: Internet

Security measures

The way to which a system is affected by a certain type of risk depends on several factors such as the existence of countermeasures and settlement plans.

- For example, if there is a hardware problem, all actions must be stopped to fix it.
- Recovering data depends on the last backup performed and the time required for the system restoration.
- In designing a database should identify the types of risks that may be subject and to create plans and countermeasures.

The most important safety measures controlled by implementation of the new schema

(DBMS) refers to:

- ✓ Authorized access
- ✓ Access Control
- ✓ Implementation of views on data
- ✓ Backup and recovery Periodicals clear procedures specified in
- ✓ Integrity (the specific mechanisms)
- ✓ Data encryption

Data encryption

Data encryption is a process from which data cannot be read without having a decryption key.

The database contains private information, it is necessary that the ICT Manager to encrypt the database as a precaution against external risks, but this reduces query execution speed because decryption algorithm. Encryption is useful when the data is transmitted on other networks

RAID

- The hardware that use the new hardware inventory system must be tolerant to errors and failures, which means that the DBMS must work even if one of the components of the system fails.
- This means the use of redundant components that can be integrated into the system. The most important components are memories, controller, CPU, power supplies and coolers. Memories are most susceptible to errors and failures, so that a solution is the use of RAID technology.
- It uses an array of independent storage disks organized so as to improve performance and reliability.
-

3.1.5.5.3 Backup and Recovery

Back-up and restore (data recovery) refers to restoring a database after a failure.

- Any DBMS maintains a log of processed data (inserting data, updates, deletes data, changing tables, etc.) that shows all the operations of the scheme.
- It is recommended to perform a backup database periodically. In this way, the malfunction can restore a previous version of the database, minimizing data loss.
- Integrity of determined constraints help to maintain the database security by preventing incorrect data entry.

The Manager of ICT Department of Melchester College can do the backup of the scheme every week and should have at least two copies of it, one should remain with him, stored on an external disk (USB, CD-ROM) and do another backup to be kept be the Administrative Department of the college.

The backup restore scheme implies Data Export as this operation was described earlier when it was exported the scheme on ICT Manager's USB to be transferred on his computer. The same way with the Data Import, was discussed earlier in the project when it was necessary to import data from the manager's USB device, to load the scheme into his MySQL Workbench.

3.1.6 Software Testing and Quality Assurance

Software testing is an investigation conducted in order to obtain information about the quality of software developed in earlier stages. Testing is running the program in order to discover software errors.

Why must it be tested and validated the new system?

- To find defects
- To reduce the impact of customer defects in order not to affect costs and profits
- To increase system reliability
- To increase product quality
- To ensure that a product is in line with customer requests

After testing may or may not it is confirmed that the tested software meets the requirements that led to the creation of the new hardware inventory system and it's working as expected.

This part of the project implementation describes the most popular techniques that are used to complete Database Testing.

The methods of testing the new system are:

3.1.6.1 Black box tests

This method tests the functionality of the application and is not addressed the internal code and internal processes of the application at all. The tester should only know what the program should do, not how it does. The transfer function of the program follows: input data are given and output data is checked, without knowing how to process them.

This method is testing:

- The requirements and specifications functionality

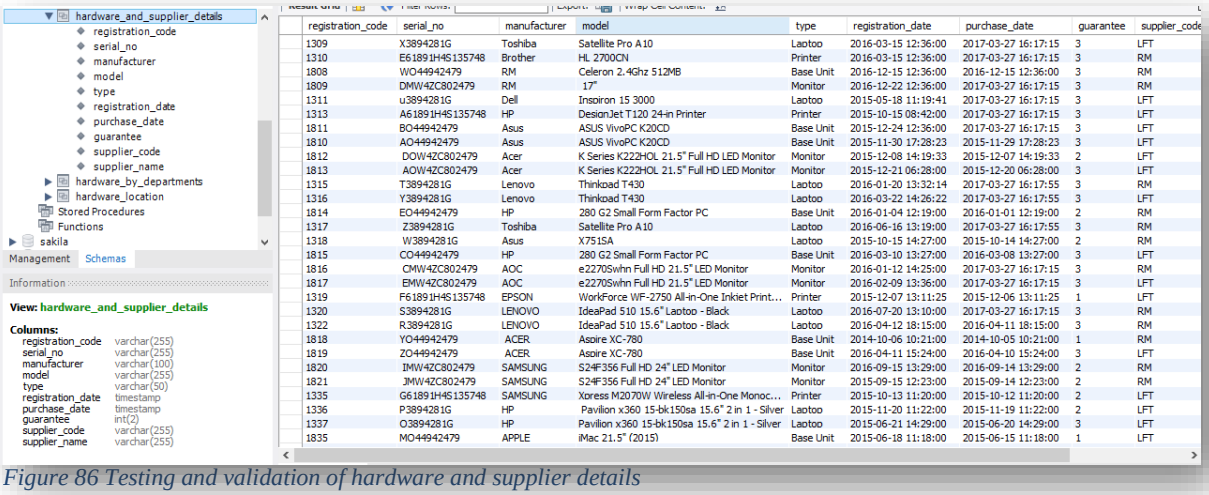
- Validate input data

- Output data

Test cases are built around requirements and specifications of the hardware inventory system:

3.1.6.1.1 Testing the functionality of the new system requirements

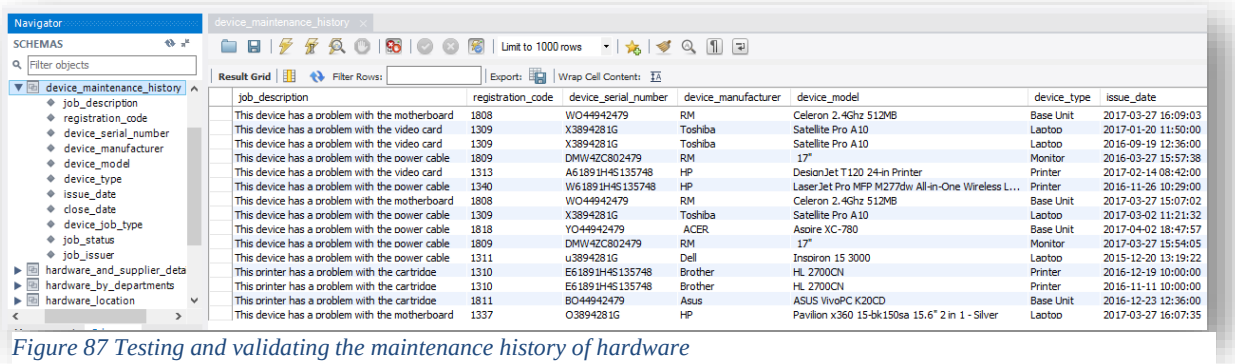
1. The first test is related to offer a quick access to the hardware and the supplier details. This was made by came with the output of ***hardware_and_supplier__details*** view where it can be see the details of the device, type of the device, registration of the devices and details of the suppliers of the devices:



registration_code	serial_no	manufacturer	model	type	registration_date	purchase_date	guarantee	supplier_code
1309	X3894281G	Toshiba	Satellite Pro A10	Laotoo	2016-03-15 12:36:00	2017-03-27 16:17:15	3	LFT
1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-03-15 12:36:00	2017-03-27 16:17:15	3	RM
1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2016-12-15 12:36:00	2016-12-15 12:36:00	3	RM
1809	DMW4ZC802479	RM	17"	Monitor	2016-12-22 12:36:00	2017-03-27 16:17:15	3	RM
1311	u3894281G	Dell	Inspiron 15 3000	Laotoo	2015-05-18 11:19:41	2017-03-27 16:17:15	3	LFT
1313	A61891H4S135748	HP	DesionJet T120 24-in Printer	Printer	2015-10-15 08:42:00	2017-03-27 16:17:15	3	LFT
1811	BO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-12-24 12:36:00	2017-03-27 16:17:15	3	LFT
1810	AO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-11-30 17:28:23	2015-11-29 17:28:23	3	LFT
1812	DOW4ZC802479	Acer	K Series K222HOL 21.5" Full HD LED Monitor	Monitor	2015-12-08 14:19:33	2015-12-07 14:19:33	2	LFT
1813	AOW4ZC802479	Acer	K Series K222HOL 21.5" Full HD LED Monitor	Monitor	2015-12-21 06:28:00	2015-12-20 06:28:00	3	LFT
1315	T3894281G	Lenovo	Thinkpad T430	Laotoo	2016-01-20 13:32:14	2017-03-27 16:17:55	3	RM
1316	Y3894281G	Lenovo	Thinkpad T430	Laotoo	2016-03-22 14:26:22	2017-03-27 16:17:55	3	LFT
1814	EO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-01-04 12:19:00	2016-01-01 12:19:00	2	RM
1317	Z3894281G	Toshiba	Satellite Pro A10	Laotoo	2016-06-16 13:19:00	2017-03-27 16:17:55	3	LFT
1318	W3894281G	Asus	X751SA	Laotoo	2015-10-15 14:27:00	2015-10-14 14:27:00	2	RM
1815	CO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-03-10 13:27:00	2016-03-08 13:27:00	3	LFT
1816	CMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-01-12 14:25:00	2017-03-27 16:17:15	3	RM
1817	EMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-02-09 13:36:00	2017-03-27 16:17:15	3	LFT
1319	F61891H4S135748	EPSON	WorkForce WF-2750 All-in-One Inkiet Print...	Printer	2015-12-07 13:11:25	2015-12-06 13:11:25	1	LFT
1320	S3894281G	LENOVO	IdeaPad 510 15.6" Laotoo - Black	Laotoo	2016-07-20 13:10:00	2017-03-27 16:17:15	3	RM
1322	R3894281G	LENOVO	IdeaPad 510 15.6" Laotoo - Black	Laotoo	2016-04-12 18:15:00	2016-04-11 18:15:00	3	RM
1818	YO44942479	ACER	Aspire XC-780	Base Unit	2014-10-06 10:21:00	2014-10-05 10:21:00	1	RM
1819	ZO44942479	ACER	Aspire XC-780	Base Unit	2016-04-11 15:24:00	2016-04-10 15:24:00	3	LFT
1820	IMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	Monitor	2016-09-15 13:29:00	2016-09-14 13:29:00	2	RM
1821	JMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	Monitor	2015-09-15 12:23:00	2015-09-14 12:23:00	2	RM
1335	G61891H4S135748	SAMSUNG	Xpress M2070W Wireless All-in-One Monoc...	Printer	2015-10-13 11:20:00	2015-10-12 11:20:00	2	LFT
1336	P3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	Laotoo	2015-11-20 11:22:00	2015-11-19 11:22:00	2	LFT
1337	O3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	Laotoo	2015-06-21 14:29:00	2015-06-20 14:29:00	3	LFT
1835	MO44942479	APPLE	iMac 21.5" (2015)	Base Unit	2015-06-18 11:18:00	2015-06-15 11:18:00	1	LFT

Figure 86 Testing and validation of hardware and supplier details

2. The next step is to test and validate the maintenance history on individual items of a hardware. For this verification were introduced the details of job description, registration device, details of device, details of the device job type. This was made by came with the output of ***device_maintenance_history*** view:



job_description	registration_code	device_serial_number	device_manufacturer	device_model	device_type	issue_date
This device has a problem with the motherboard	1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2017-03-27 16:09:03
This device has a problem with the video card	1309	X3894281G	Toshiba	Satellite Pro A10	Laotoo	2017-01-20 11:50:00
This device has a problem with the video card	1309	X3894281G	Toshiba	Satellite Pro A10	Laotoo	2016-09-19 12:36:00
This device has a problem with the power cable	1809	DMW4ZC802479	RM	17"	Monitor	2016-03-27 15:57:38
This device has a problem with the video card	1313	A61891H4S135748	HP	DesionJet T120 24-in Printer	Printer	2017-02-14 08:42:00
This device has a problem with the power cable	1340	W61891H4S135748	HP	LaserJet Pro MFP M277dw All-in-One Wireless L...	Printer	2016-11-26 10:29:00
This device has a problem with the motherboard	1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2017-03-27 15:07:02
This device has a problem with the power cable	1309	X3894281G	Toshiba	Satellite Pro A10	Laotoo	2017-03-02 11:21:32
This device has a problem with the power cable	1818	YO44942479	ACER	Aspire XC-780	Base Unit	2017-04-02 18:47:57
This device has a problem with the power cable	1809	DMW4ZC802479	RM	17"	Monitor	2017-03-27 15:54:05
This device has a problem with the power cable	1311	u3894281G	Dell	Inspiron 15 3000	Laotoo	2015-12-20 13:19:22
This printer has a problem with the cartridge	1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-12-19 10:00:00
This printer has a problem with the cartridge	1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-11-11 10:00:00
This printer has a problem with the cartridge	1811	BO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2016-12-23 12:36:00
This device has a problem with the motherboard	1337	O3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	Laotoo	2017-03-27 16:07:35

Figure 87 Testing and validating the maintenance history of hardware

3. The next test is related to test and validate the records of hardware allocated to subject areas. To realise this test were introduced the details of device inventory, department location and details of each department. This was made by came with the output of ***hardware_by_departments*** view:

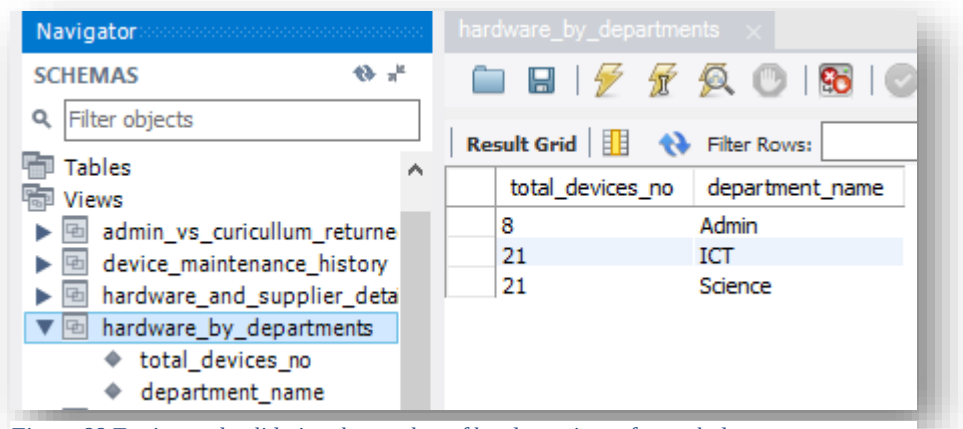


Figure 88 Testing and validating the number of hardware items for each department area

4. The following test is regarding the testing and validating the records related to the location for each device across the college. For this were necessary the details of device inventory, device registration, device details, device type, department location and details of campus college's buildings location. This was made showing the output of ***hardware_location*** view:

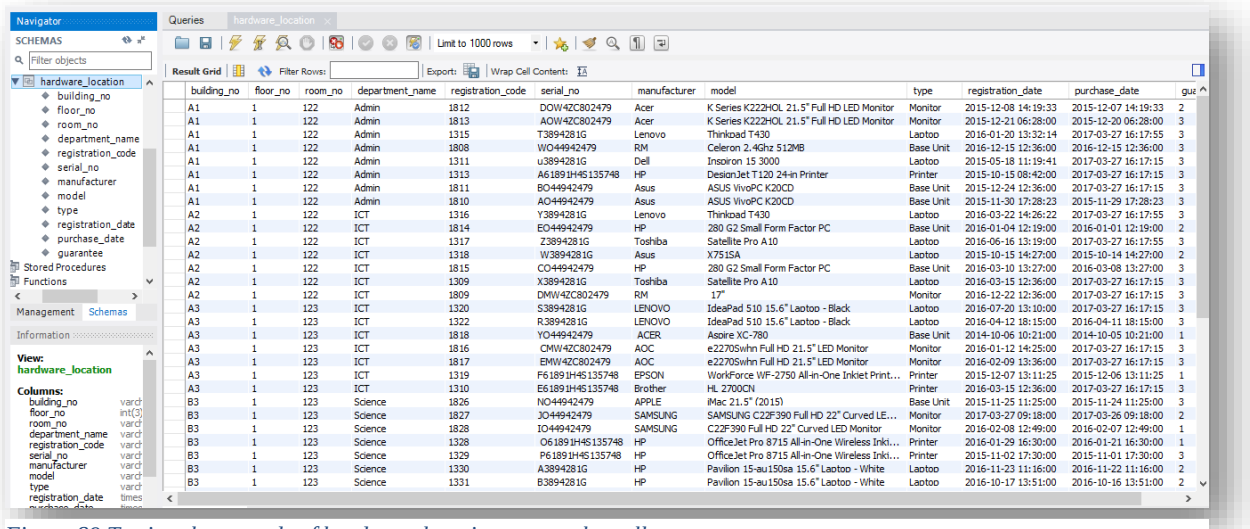


Figure 89 Testing the records of hardware location across the college

5. The next test will come with the test and validation of the government returns on the number of Base Units allocated to Admin vs Curriculum. For this were necessary the details of total number of PCs for Administration Department vs Curriculum departments (ICT department and Science Department). For this query were necessary the details of each department involved:
    - device job
    - device job type
    - device inventory
    - device registration
    - device
    - device type
    - department location
    - department

This was made by showing the output of ***admin_vs_curicullum_returned*** view:

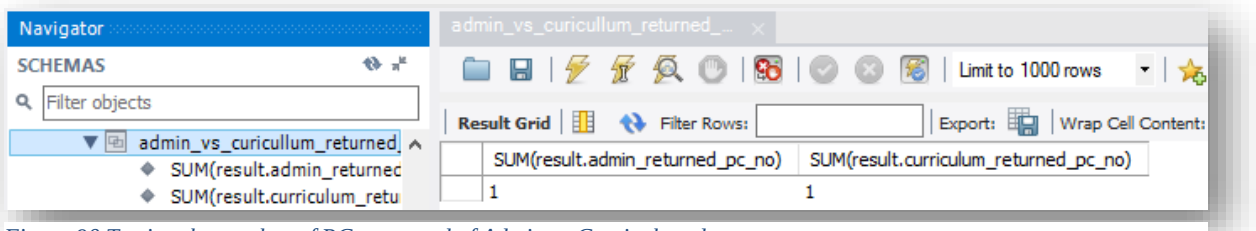


Figure 90 Testing the number of PCs returned of Admin vs Curriculum departments

3.1.6.1.2 Testing the functionality of setting up the roles and privileges of users for the new system

Were created user accounts for this new hardware inventory database and were tested the allocated privileges to each user related to their roles.

a) Testing the roles of the Administrator of the Database (DBA) which is the manager of ICT Department which has all the privileges over the database (Figure 87):

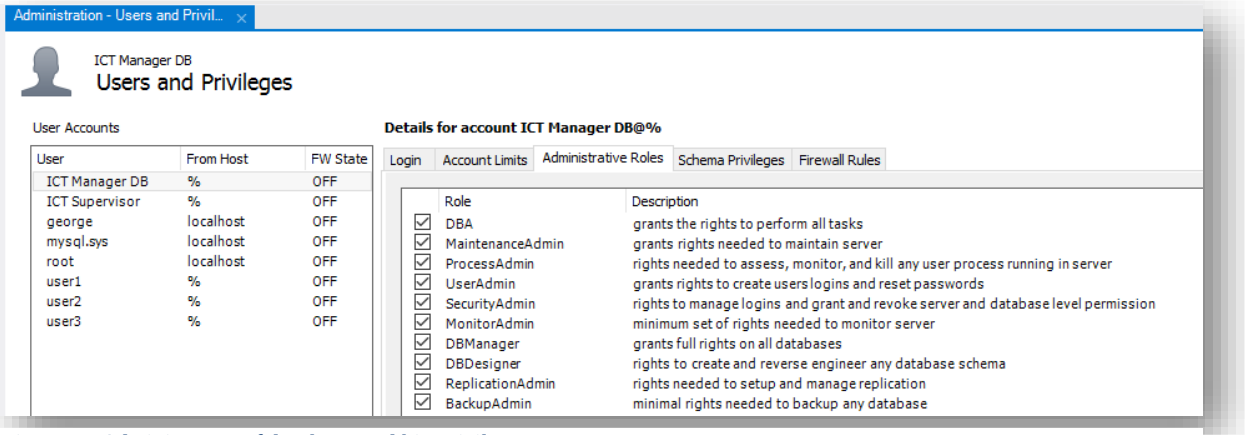


Figure 91 Administrator of database and his privileges

b) Testing the Supervisor account user which has some administrative and security privileges over the database including creating, deleting user accounts or giving privileges to them:

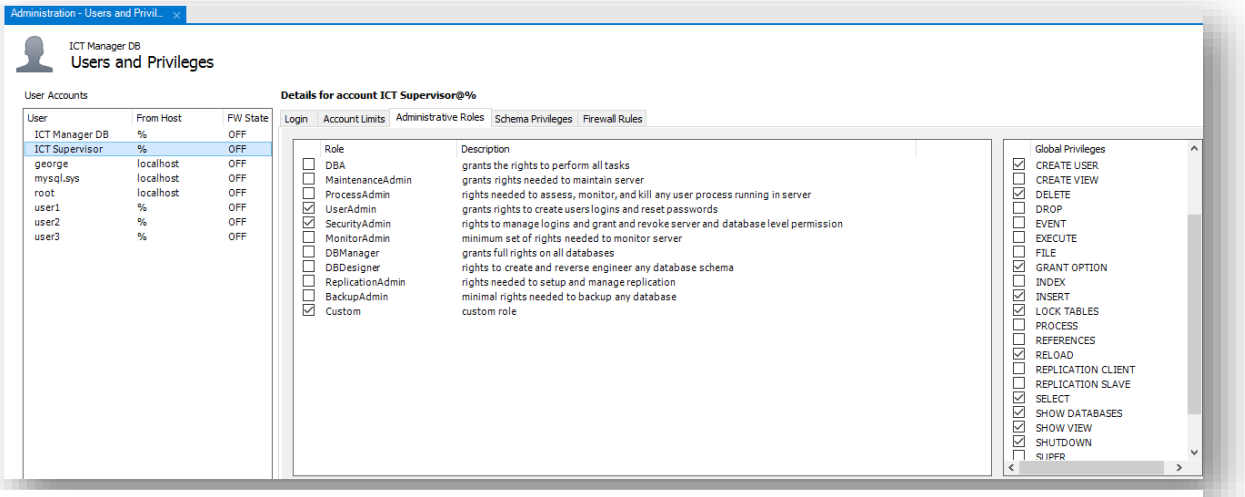


Figure 92 The Supervisor of database and his privileges

c) Testing the User account which has restricted privileges and benefits only by inserting, selecting, updating and showing data of schema (Figure 89):

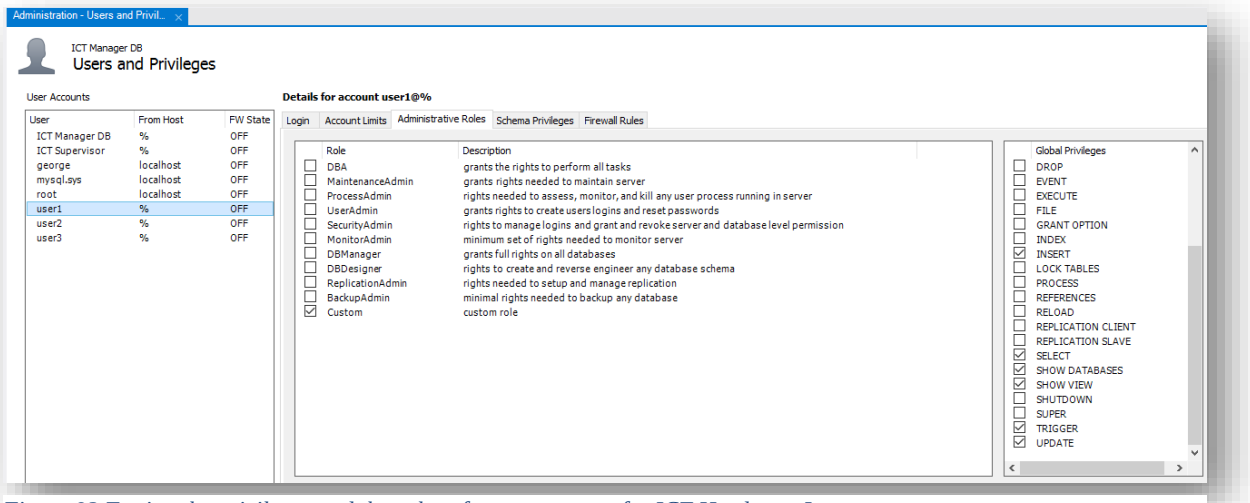


Figure 93 Testing the privileges and the roles of a user account for ICT Hardware Inventory

3.1.6.1.2 Testing the login into the database of a user for the new hardware inventory system

Each user of the new system has his created account which must be encrypted when log into database, using special characters, numbers and capital letters:

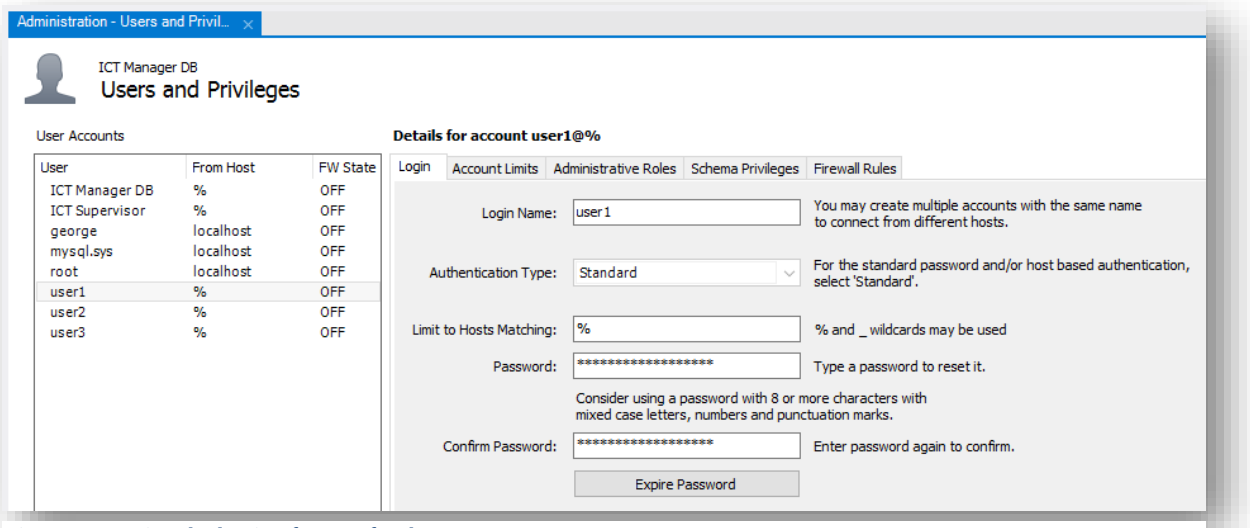


Figure 94 Testing the log in of a user for the new system

3.1.6.1.3 Testing the restore or backup files for the database

The testing of creating or restore involve checking if the database can be saved (full or incremental backups) or restored at a date required:

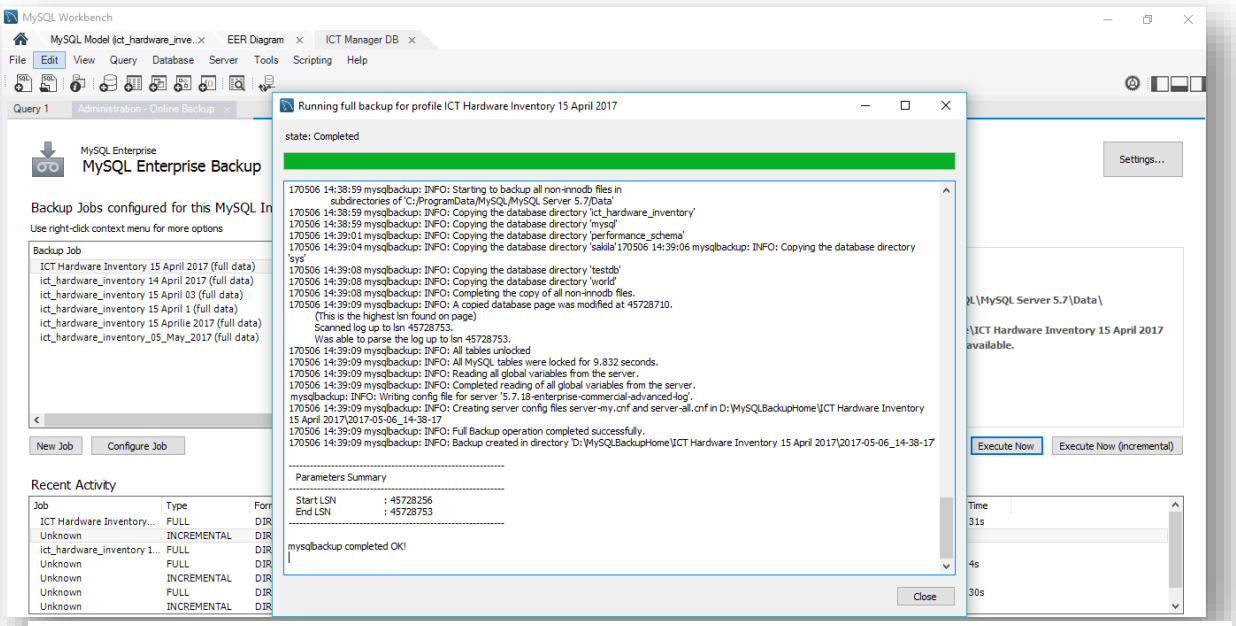


Figure 95Testing the creation of a full or incremental backup

3.1.6.1.4 Test of Update Data in ict_hardware_inventory Database

The data can be updated for a particular id. The next case will show if the data of a device can be updated by selecting the model data (Satellite Pro A10) of device id 1 from device table and inserting new data for the same id device with another value (Satellite Pro A11):

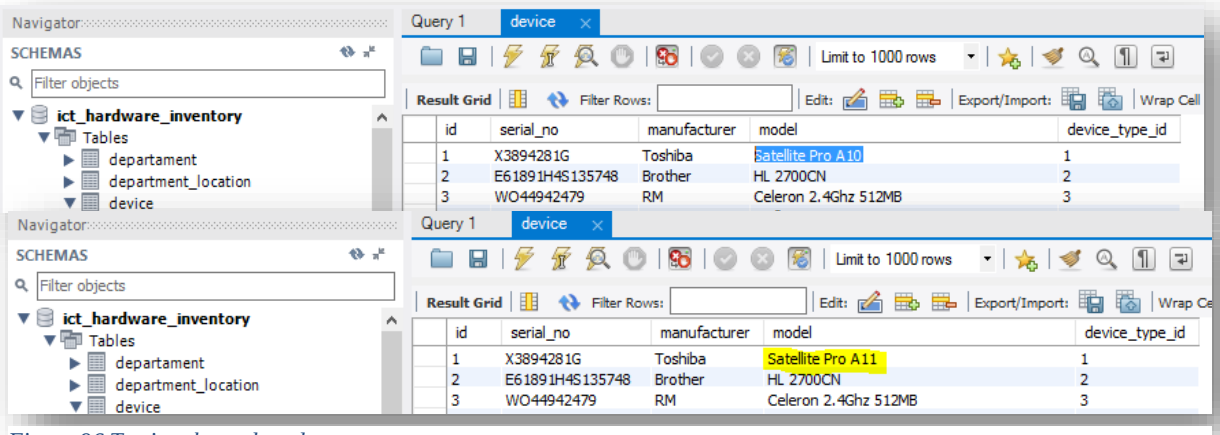


Figure 96 Testing the update data

3.1.6.1.5 Test of insert new data for the system inventory

The next test is related to insert new data for a new job of a device by selecting device_job table and add new data after the last job of a hardware and apply the changes:

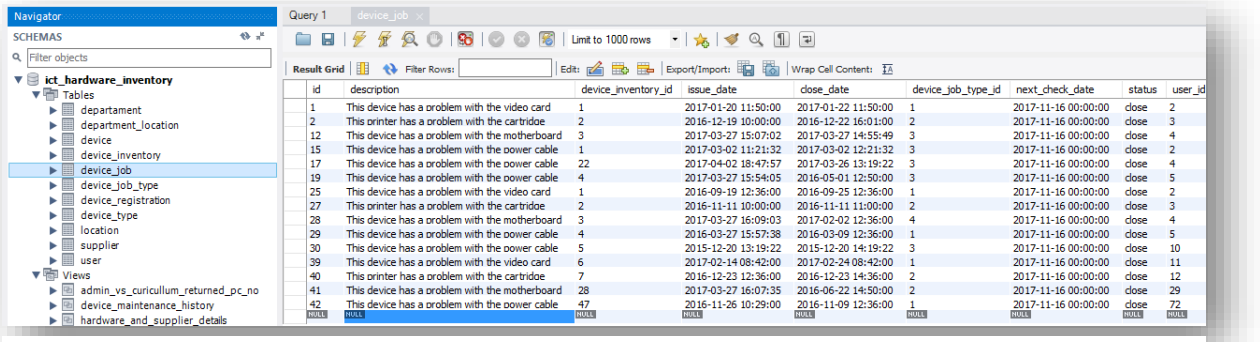


Figure 97 Testing of insert new data in the database

3.1.6.1.6 Performance Testing

This test is used to estimate the behaviour of a software product regarding response and stability under a certain task. It is also useful to investigate, measure, validate, or verify other system qualities such as scalability, reliability, and resource use (Figure 94):

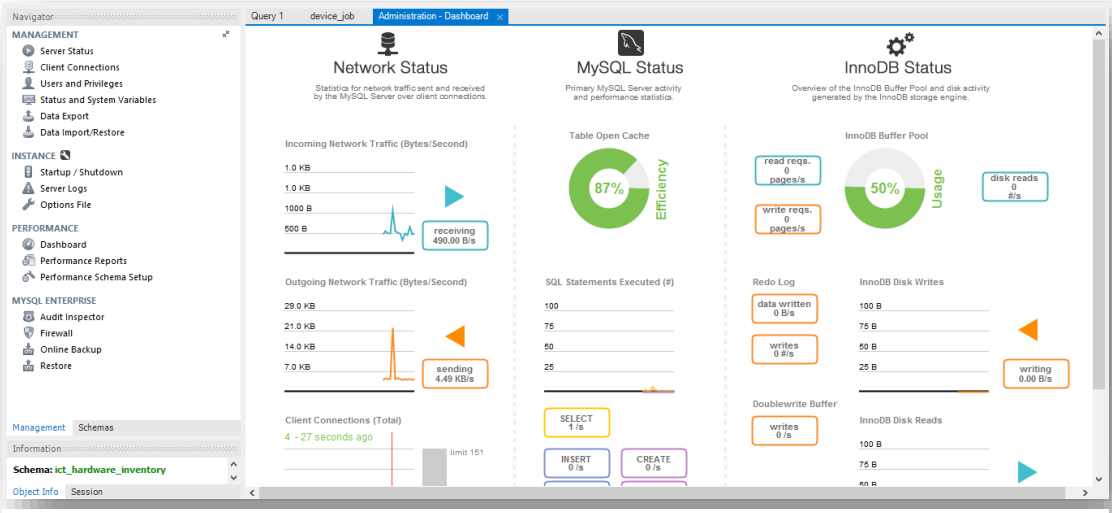


Figure 98 Testing the performance of the schema

3.1.6.2 White box tests

White Box Testing or Structural Testing is a testing technique that verifies the internal structure and data processing mode (is opposed to the black-box testing described above).

In the white box category is included:

- Flow control testing
- Testing the ways that the program can take
- Testing the data path
- Testing for the correct handling of errors

All of these tests were shown through images on the implementation of the new system.

a) Checks of the tables, columns, column types rules

Check if all the designed tables of schema have changed their name by the Data Developer's fault and the result of this test is that the schema has the same tables' name as the final design ones:

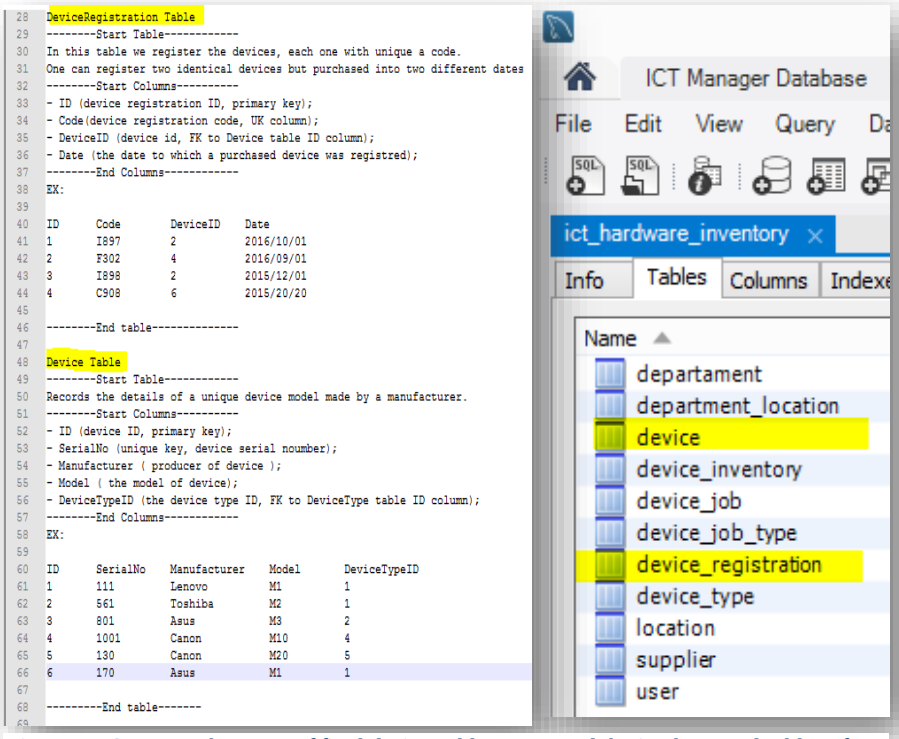
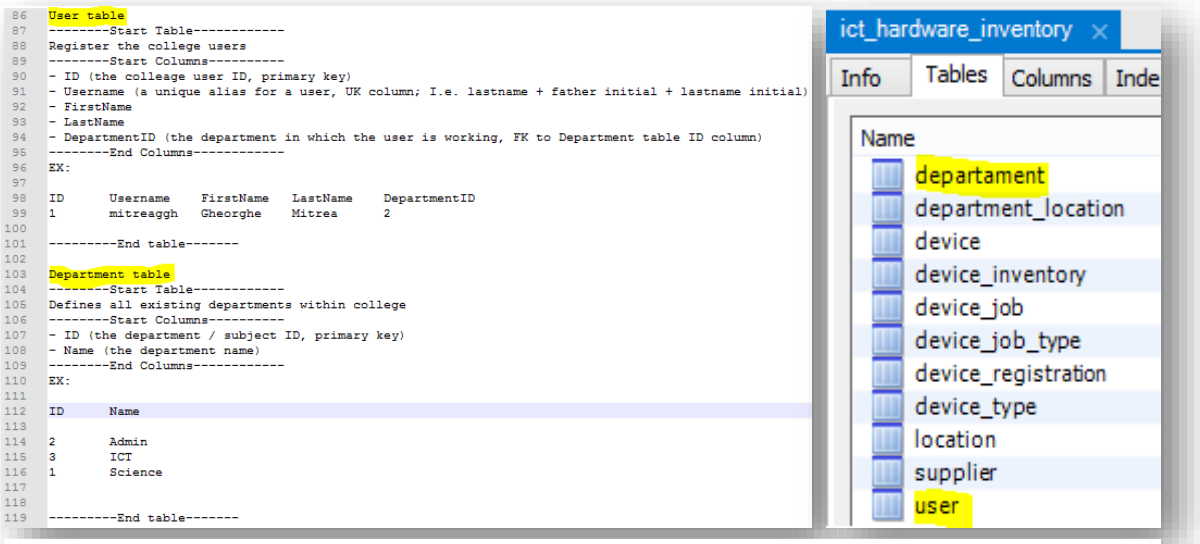


Figure 99 Compare the name of final design tables name and the implemented tables of

The next image is showing a writing spelling mistake of Department table with *departament* table



```
User table
--------Start Table------------
Register the college users
--------Start Columns----------
- ID (the colleage user ID, primary key)
- Username (a unique alias for a user, UK column; I.e. lastname + father initial + lastname initial)
- FirstName
- LastName
- DepartmentID (the department in which the user is working, FK to Department table ID column)
--------End Columns------------
EX:

ID      Username    FirstName   LastName    DepartmentID
1       mitreaggh   Gheorghe    Mitrea      2

---------End table-------

Department table
--------Start Table------------
Defines all existing departments within college
--------Start Columns----------
- ID (the department / subject ID, primary key)
- Name (the department name)
--------End Columns------------
EX:

ID      Name

2       Admin
3       ICT
1       Science


---------End table-------
```

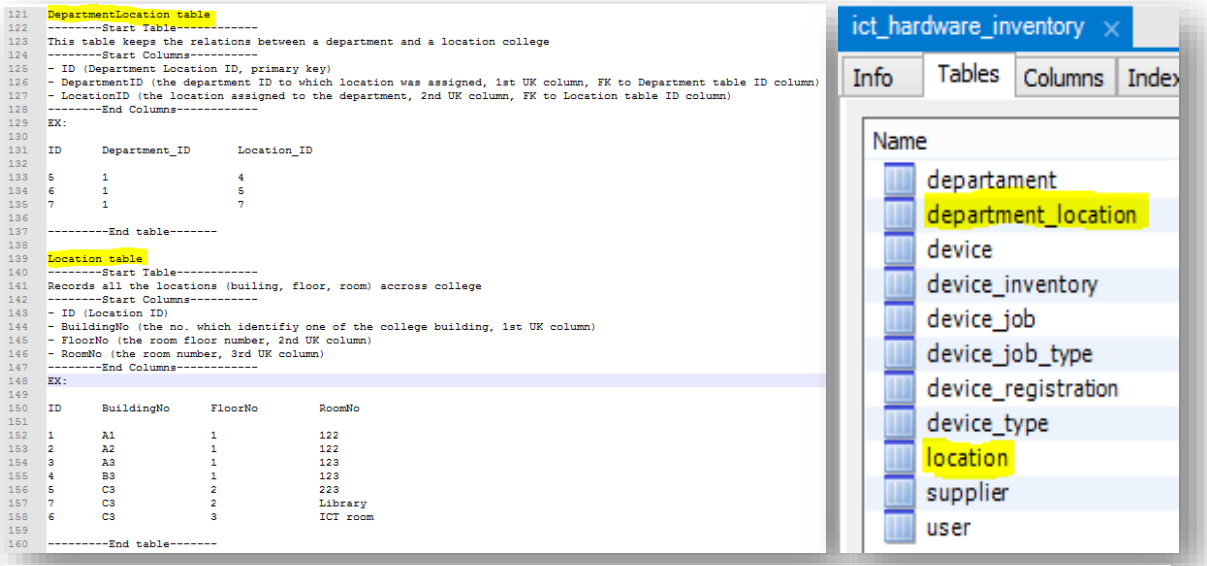
ict_hardware_inventory

Info | Tables | Columns | Inde

Name

- departament
- department_location
- device
- device_inventory
- device_job
- device_job_type
- device_registration
- device_type
- location
- supplier
- user

*Figure 100 Compare the name of final design tables and the implemented tables of **user** and **department** tables*



```
DepartmentLocation table
--------Start Table------------
This table keeps the relations between a department and a location college
--------Start Columns----------
- ID (Department Location ID, primary key)
- DepartmentID (the department ID to which location was assigned, 1st UK column, FK to Department table ID column)
- LocationID (the location assigned to the department, 2nd UK column, FK to Location table ID column)
--------End Columns------------
EX:

ID      Department_ID       Location_ID

5       1                   4
6       1                   5
7       1                   7

---------End table-------

Location table
--------Start Table------------
Records all the locations (builing, floor, room) accross college
--------Start Columns----------
- ID (Location ID)
- BuildingNo (the no. which identifiy one of the college building, 1st UK column)
- FloorNo (the room floor number, 2nd UK column)
- RoomNo (the room number, 3rd UK column)
--------End Columns------------
EX:

ID      BuildingNo      FloorNo         RoomNo

1       A1              1               122
2       A2              1               122
3       A3              1               123
4       B3              1               123
5       C3              2               223
7       C3              2               Library
6       C3              3               ICT room

---------End table-------
```

ict_hardware_inventory

Info | Tables | Columns | Index

Name

- departament
- department_location
- device
- device_inventory
- device_job
- device_job_type
- device_registration
- device_type
- location
- supplier
- user

*Figure 101 Compare the name of final design tables and the implemented tables of **department_location** and **location** tables*

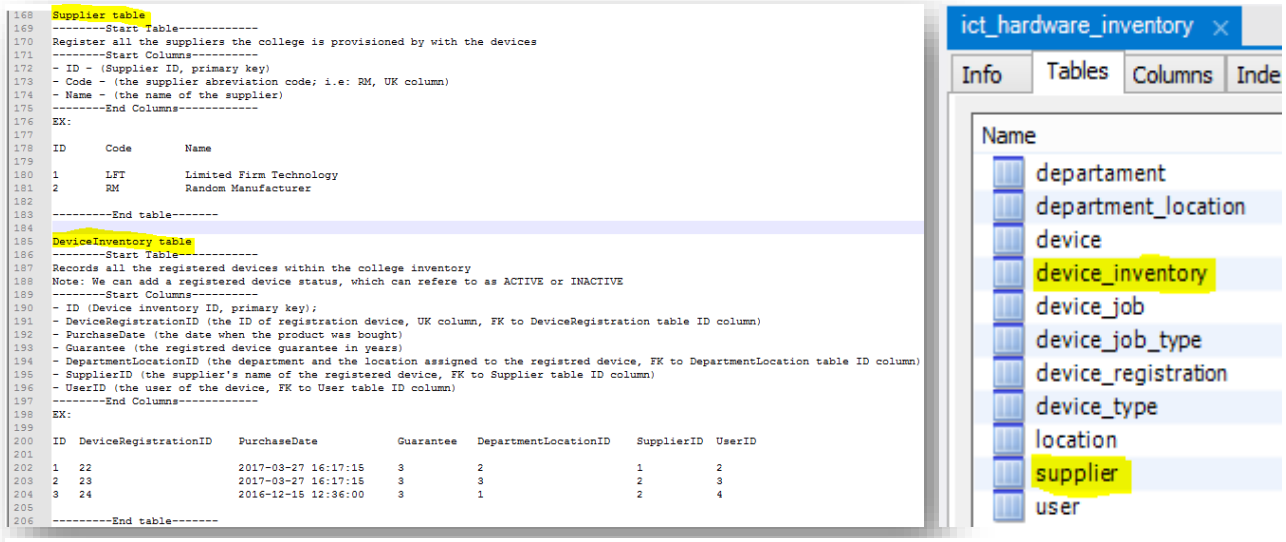


*Figure 102 Compare the name of final design tables and the implemented tables of **supplier** and **device_inventory** tables*

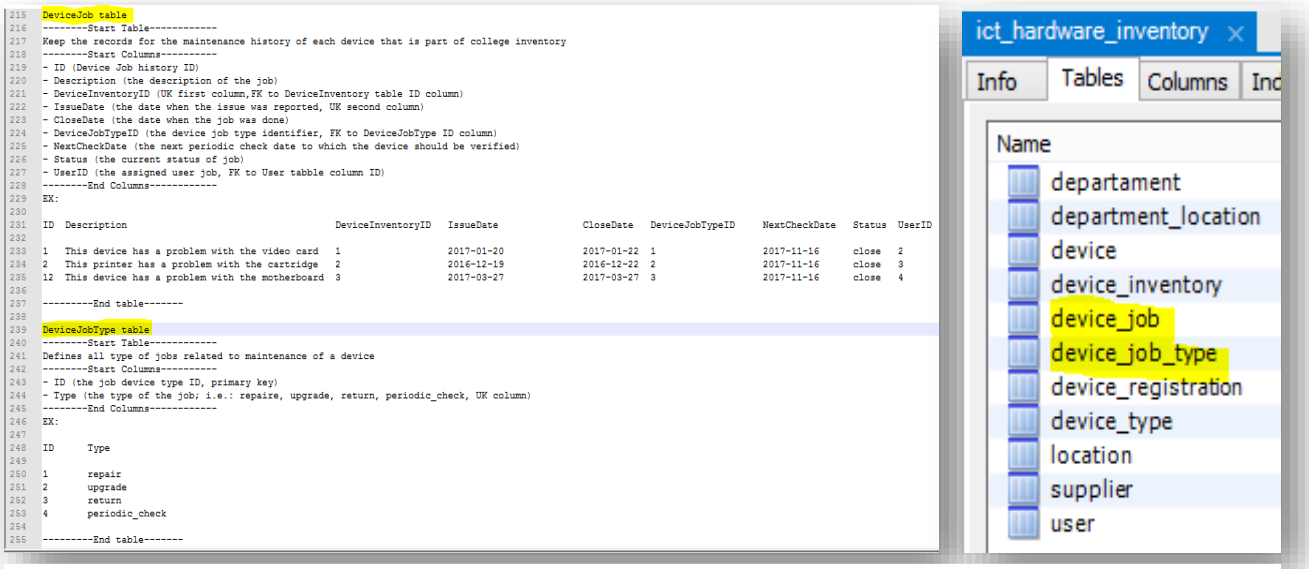


*Figure 103 Compare the name of final design tables and the implemented tables of **device_job** and **device_job_type** tables*

It will be given an example of testing the name of the column from Device table where the test result is that all the columns have the same name as the final design ones:

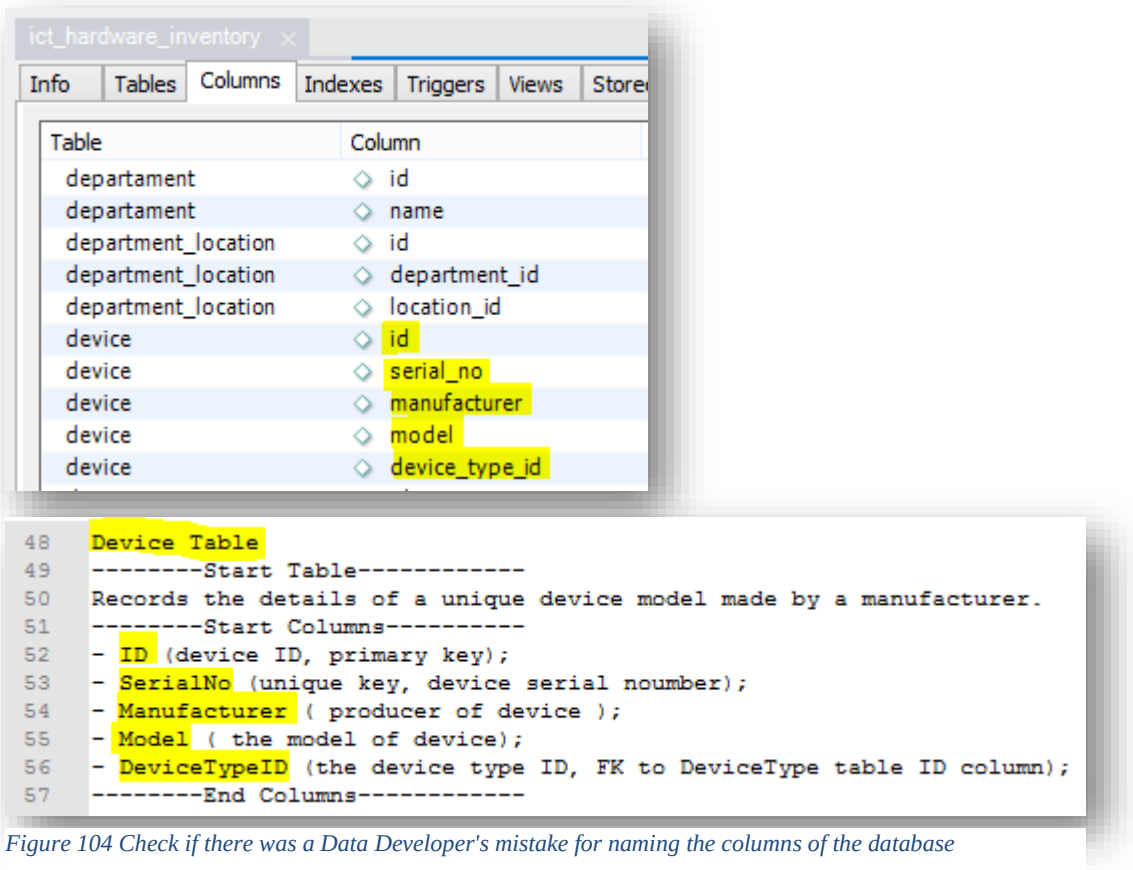


Figure 104 Check if there was a Data Developer's mistake for naming the columns of the database

3.1.7 Training phase

This phase will have related to training the users of the new system and include training related to how manipulate and manage the date of the new hardware inventory, how to ensure that the new system is secure and stable. Instructions must be provided to the users so that they will be access to the new integrated system. Also, this stage is regarding the recuperation of the data in case of a social engineering mistake, a natural disaster or hacking the new system.

3.1.8 Handover operation phase

In this phase, the project team and the client ICT of Melchester College will make the last modifications to the new system and after that the new product will be given to the client and close the project with the accordance of both parts.

4. Task 4 Use appropriate project evaluation techniques

Introduction:

The complete evaluation of the project, PERT techniques are used to improve the integrated system. This technique is generally used to plan and implement large-scale projects. It identifies the activities which are dependent on each other. It is generally used to coordinate the tasks given in the implementation plan to complete the project on time.

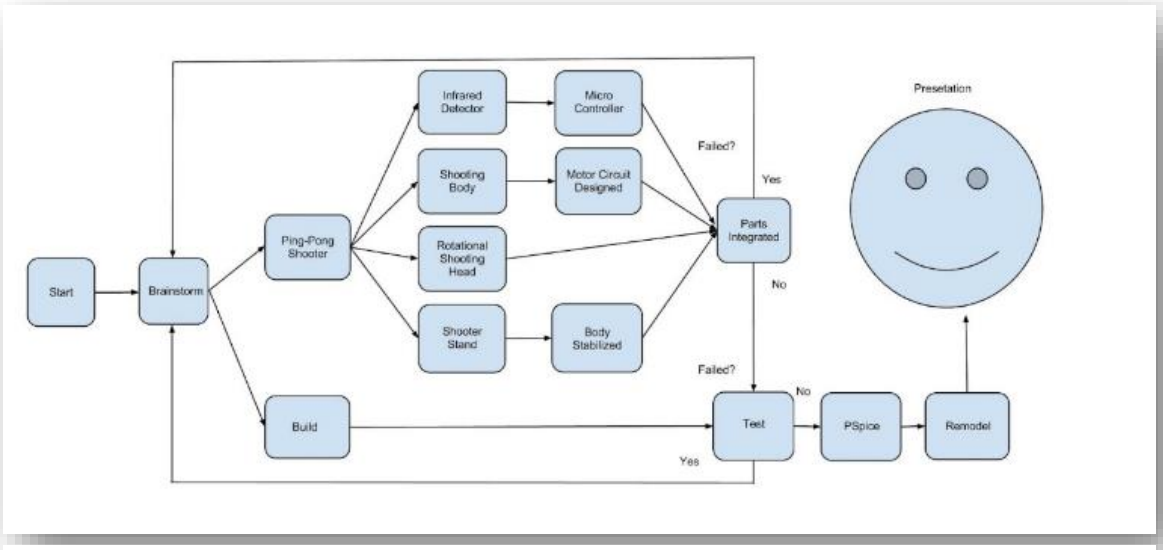


Figure 105 PERT chart

Source: Internet

PERT method is used to evaluate the project. The benefit of using the PERT techniques is that assists in identifying the relationships exist in the various stages involved. The PERT will involve the identification of the various tasks involved and thereby reduces the total time needed to complete the project. It depicts the graphical display of the project activities involved that assist the users to identify the opportunities available (Sinha, 2011). It is the best techniques to be used when there is only one activity to be installed i.e. installation of the new integrated system in the college involves the various hardware and software equipment. It helps in identify what if condition involvement in the activities of the project. It will calculate the overall time required to complete the given project which helps the managers and the installers to make the appropriate strategies accordingly.

The basic disadvantage of using the PERT technique is that if the project involves the two or more projects, it becomes difficult to handle the project efficiently. The very disadvantage of using the PERT techniques is that it requires a lot of information as the input which proves to be expensive.

4.1 Stages in the PERT planning process of the implementation of a new hardware inventory system:

1) Identifying specific activities and intermediate objectives:

In this stage was selected the scope of the project first which is defined by:

- offer quick access to hardware and supplier details
- provide maintenance history on individual items of hardware
- provide records of hardware allocated to subject areas
- offer inventory details of hardware in each room
- deal with government returns on the number of PCs allocated to Admin v Curriculum

Also, in this stage of PERT was identified the major baseline tasks and milestones of each tasks of the project which is showed in the next figure:

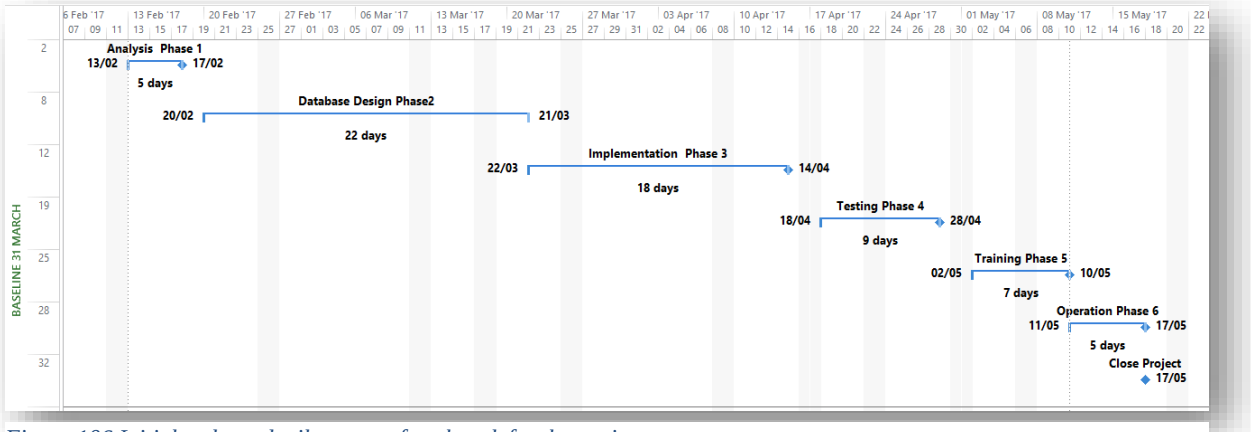


Figure 106 Initial tasks and milestones of each task for the project

A PERT diagram of the finished project implementation which contains the completed tasks duration (coloured bars) with milestone of each task and the baseline tasks duration (grey bars):

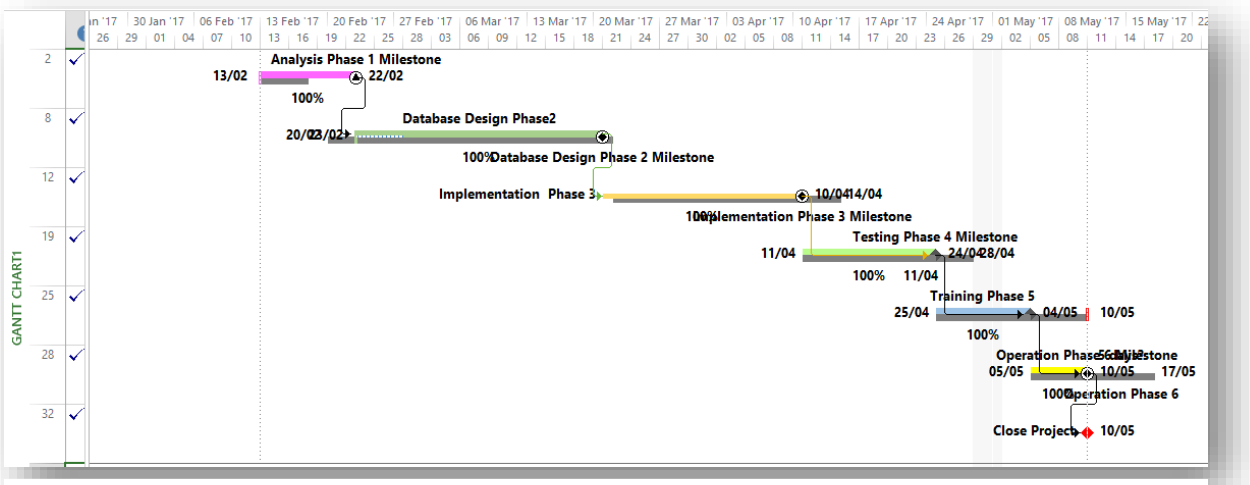


Figure 107 Complete project with milestone of each task and the baseline one in grey bars of each initial duration

2) Determining Staging of Activities

This stage involves an analysis of each task to determine its subtasks (the relation between subtasks) and the order in which the subtasks must be finished. In the below figure will be shown a diagram of staging activities for Analyse and System Definition phase and duration of each activity of this task:

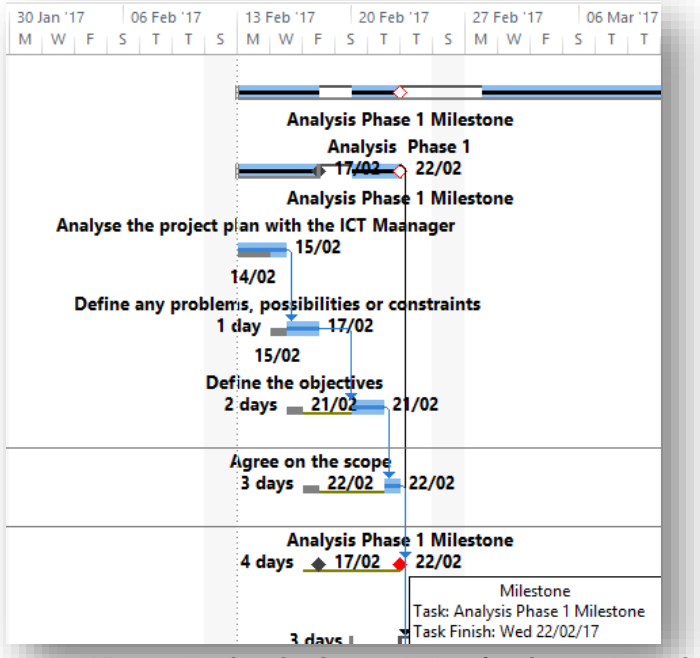


Figure 108 Determine the subtasks or activities of Implementation Task

3) *Building the network diagram*

Building the Network Diagram was done by using the Network Diagram function of the Microsoft Project software. Common symbols have been used, for example: activities will be represented on rectangle shapes (blue colour), while events are symbolized by sharp shapes (red colour);

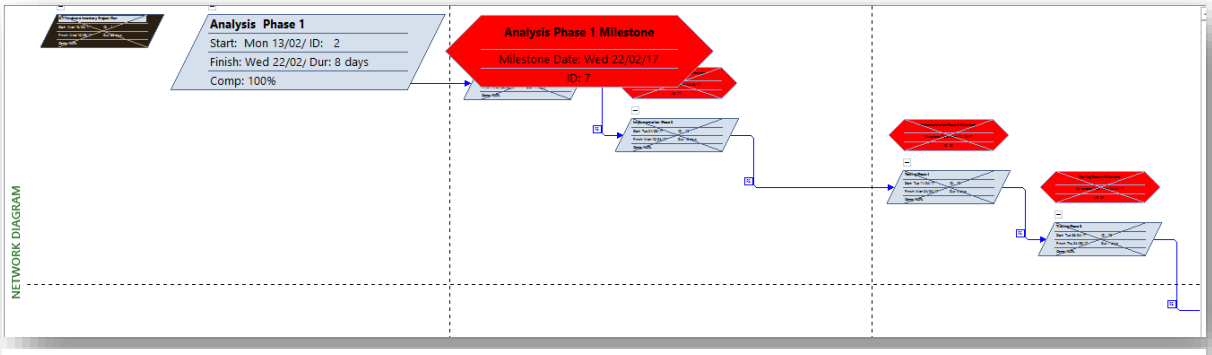


Figure 109 Network diagram of the project

Conclusion:

From the above, it can be concluded that for the better management of the project, PERT techniques are used to evaluate the project outcomes. The installation of the new hardware inventory system in the college involves a single project. That is the reason, PERT technique is beneficial to implement in accordance with the management of the project so that risk must be identified at the early stages and steps must be taken to redress them.

5. Task 5 Interpret and Analyse the Results in Terms of the Original Project Specifications

The original project specifications were defined by the fact that ICT manager is expecting that the new computerised system will serve the following specifications:

- offer quick access to hardware and supplier details
- provide maintenance history on individual items of hardware
- provide records of hardware allocated to subject areas
- offer inventory details of hardware in each room
- deal with government returns on the number of PCs allocated to Admin v Curriculum

Compare the current implemented hardware inventory results to the expected project specifications which were described above, the new implemented hardware inventory system includes quick and easy access to the details of the hardware or supplier, provide history of maintenance on every individual item, is giving maintenance history for each device, is providing records of different hardware allocated to the subject areas, is giving details of the inventory of hardware and is showing the PCs for Admin and Curriculum departments returned to the government agency.

Results of the implemented project compared to the original project specifications:

Test Case	Expected Result	Current Result	Functional	Date of the test	Analyse the specification	Action required
Offer quick access to details	Offer quick access to hardware and supplier details	The new system is offering a quick access	✓	25/04/2017	The result is showing the output of ***hardware_and_supplier__details*** view where it can be see the details of the device, type of the device, registration of the devices and details of the suppliers of the devices	Test Passed

		to the hardware and the supplier details				
Provide maintenance history	Provide maintenance history on individual items of hardware	The new system provides maintenance history on individual items of hardware	✓	25/04/2017	The maintenance history was tested and validated on individual items of a hardware. For this verification were introduced the details of job description, registration device, details of device, details of the device job type. This was made by came with the output of ***device_maintenance_history*** view	Test Passed
Provide records	Provide records of hardware allocated to subject areas	The new system provides records of hardware allocated to subject areas	✓	25/04/2017	Were tested and validated the records of hardware allocated to subject areas. To realise this test were introduced the details of device inventory, department location and details of each department. This was made by came with the output of ***device_maintenance_history*** view	Test Passed
Offer hardware details for each location	Offer inventory details of hardware in each room	The new system offers inventory details of hardware in each room	✓	25/04/2017	testing and validating the records related to the location for each device across the college. For this were necessary the details of device inventory, device registration, device details, device type, department location and details of campus college's buildings location. This was made showing the output of ***device_maintenance_history*** view	Test Passed
PCs returned	Deal with government returns on the number of PCs allocated to Admin v Curriculum	The new system provides deal with government returns on the number of PCs allocated to Admin v Curriculum	✓	25/04/2017	Were tested and validated the government returns on the number of Base Units allocated to Admin vs Curriculum.	Test Passed

The new computerised system is helping now in enhancing the performance of the college hardware inventory and also provide support to the process of dealing and managing the data or the records in a better manner.

In this task, project log has been prepared in order to specify the people engaged in the project installation. The role and responsibility of each individual have been described and will allocate them sometime in order to complete the desired task. The status of each individual has been supervision in order to perform the necessary task.

Project log

Project name	Implementation of the new hardware inventory system
Team members	Gheorghe Mitrea, ICT Manager, Samuel Horopciuc, Andrei Pacurar, Andrei Cirimpei

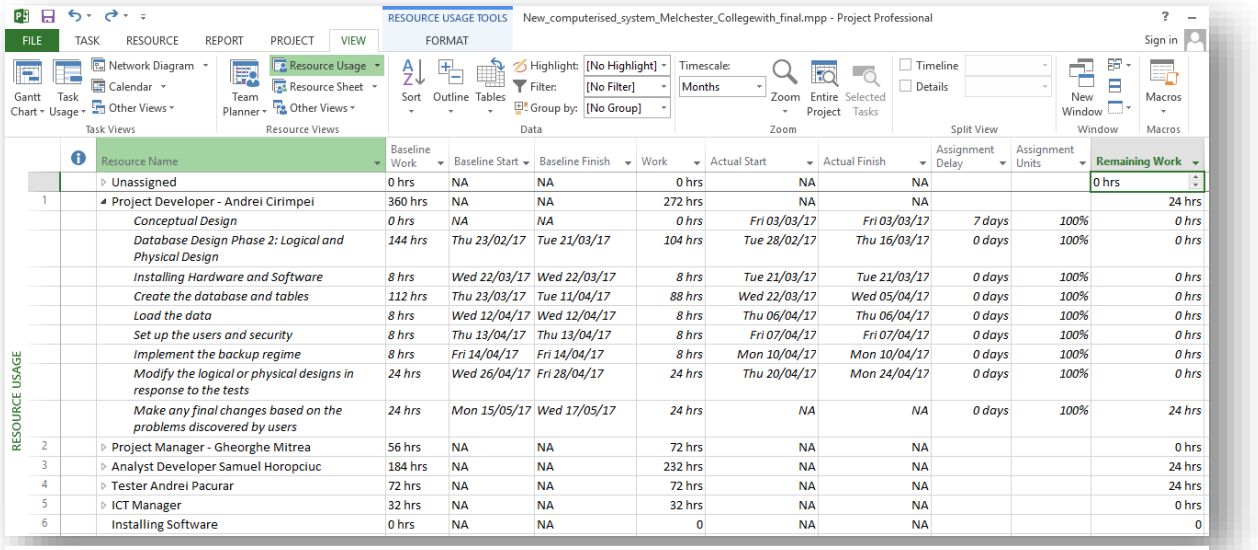


Figure 110 Project log

The project log is used to define the various tasks involved and how they will be done.

- It assists the time period required to do the relevant tasks and period involve in completing the task. It may also include the start and the end time by which it can easily identify the time required for completion of the project (Figure 103):

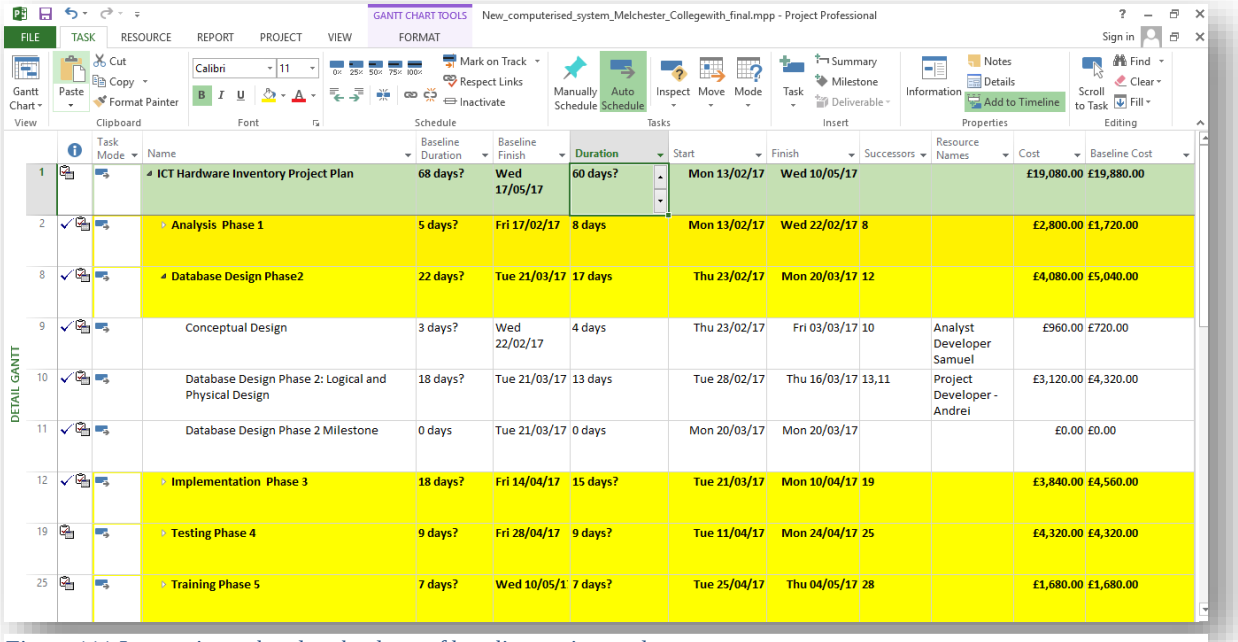


Figure 111 Log project related to the dates of baseline project and current one

- It helps in finishing the tasks in the given period of time and it will be able to assign a new task so that the team project can move on to the further task.
- It can calculate all the days that were spent on each task and add all the time so that it will help in analysing the complete time required in maintain all the tasks related to the project (Le Métayer, 2010).

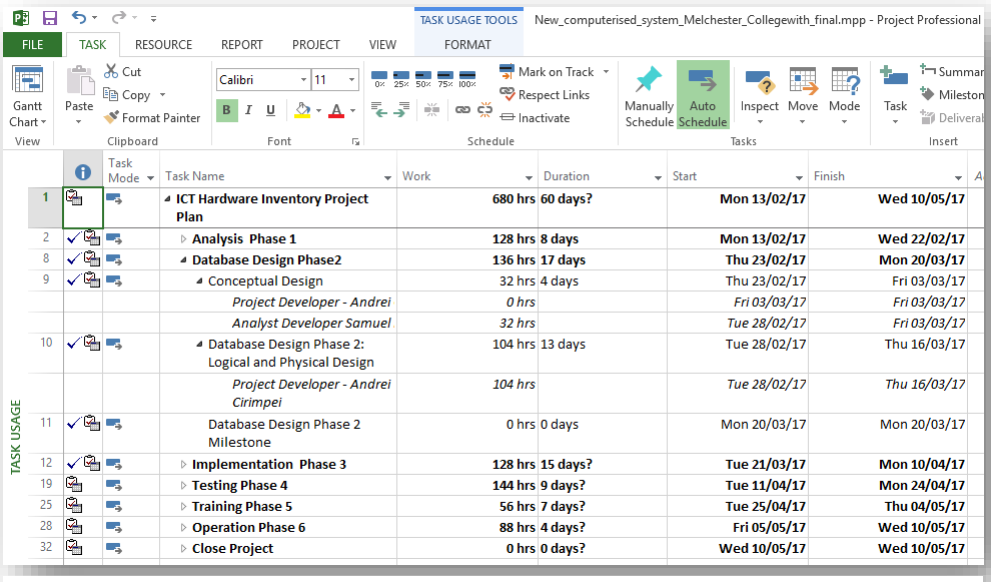


Figure 112 Tasks logs of the project

Conclusion:

By the above, it can be concluded that the new computerised system is helping now in enhancing the performance of the college hardware inventory and also provide support to the process of dealing and managing the data or the records in a better manner.

6. Task 6 Make recommendations and justify areas for further consideration

6.1 Introduction

The area that will be considered further by the college is the installation of new hardware inventory in ICT department of the college. The college has to develop the software according to the market trends as it provides efficiency in the inventory of the devices across the college. ICT department needs the new system that is automated through which reduces the risks of errors. The recommendation and justification of areas for further consideration are with regards to the:

6.2 The importance of the project:

According to Fuggetta, & Di Nitto (2014), the project is about the installation of the new system in the college. With the installation of the system in ICT department increase the value and efficacy of the college. Every organization needs to maintain its inventory correctly and cautiously. The installation of the new database in the department helps in reducing the risk of error in the record and it provides confidence in the staff to being productive.

The college requirement needs to perform the best practices, detailed delivery of the training and development so that focus is on all aspects. The college management needs to consult with its staffs and employee before modification in the system software. Services of the system can be developed by creating, testing and supporting the new system software. The system installation benefitted the staff of ICT department and other of the college and reduces the chances of error and penalties.

6.3 Application of the project result

The project brings the awareness of technology in the college with providing efficiency and effectiveness in the work of the employee. It manages the hardware inventory error, risk, and detects the location of each device across the college. The staff of ICT department feel easy as it consumes less time in comparison with manual work. The project suggests adopting the technology and investigating new technology so that college can provide high-quality inventorying system to the college (Fuggetta, 2014).

6.4 Limitation of the project

According to Bigelow (2017), the project has the limitation that with the development of the software and hardware, the development of employee or staff is also needed. It means it is necessary to provide the training and development to the employee so that they can adopt the new modification in the college. The limitation is applied with the ethical use of technology; neither the staff nor the students can misuse the technology. The technology and software implementation is done for the ease of the staffs. The college management needs to focus on the optimum utilization of resources.

The limitation of the software is that it occupies many megabytes and demand high storage memory in the computer system. The college needs to focus on the impact of the software system such as database management software system has a higher impact of failure. It focuses on the domination of resources and it increases the vulnerability of the system. The failure in any components can cause the termination of the system.

The installation of the system software involves the great cost and complexity. Database management involves the limitation to the operator. It is necessary to understand the system because failure in the understanding leads to the ruthless decision and have the serious impact on the college.

Recommendation for further consideration

The project needs to develop the software and hardware system in the other department. The development in hardware inventory automation involves high efficiency in the work of staffs. According to Gelogo, & Lee, 2012, therefore installation of DBMS software system of hardware inventory system in ICT department leads to the high efficiency in the management of the college. The recommendation involves the development of the software are done by investigating the requirement of the college and trends in the market. The further consideration involves software installation in the system that provides confidence to the staff and manages the risk, errors in the hardware inventory. The project benefited many people in the college and also helps in the detection of errors in hardware inventory. The error detection helps the college from the paying penalties towards government.

The project of installation of new hardware inventory system involves the further consideration of the development of the revised software that fulfils the requirement of the college. The

requirement the college is installing the database for keeping records of devices across the college. DBMS is the software system that provides a sense of security and imposes the restriction on the end users. It is well-designed software system and defines the authority to each user (Gelogo, 2012).

6.5 Conclusion

It is the evaluation of the report that how the installation of the system software benefits and what further development is needed. The further recommendation for the software installation is to develop the software system in the other departments according to the college requirements and trends in the market. The college uses the DBMS software system to prohibit the unauthorized users.

7. Task 7 Produce a record of all project procedures used

Introduction:

The project was divided into various phases in order to find the appropriate solution related to the new hardware inventory system in Melchester College, which is offering now the appropriate solution in the required specification. The entire project was divided into various segments in order to monitor it easily. In order to have a good new implemented system, it was tested, validated, monitored and controlled within the specified time period. For its better implementation, the whole system was divided into different phases without skipping any of its phases. The plan included various aspects that relate to the implementation of the new computerized system.

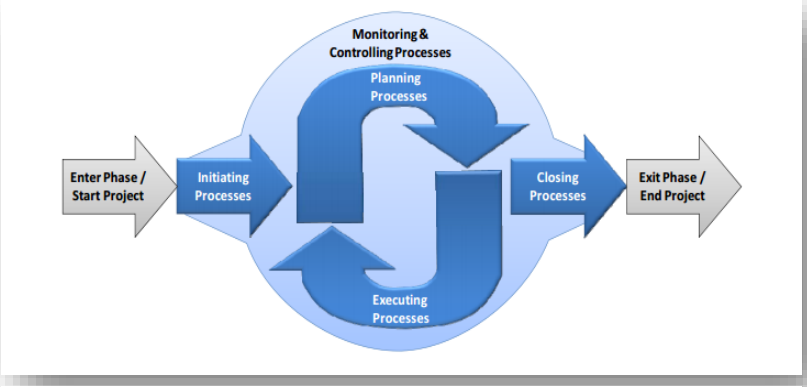


Figure 113 Project Management Process Group

Initial and Analysis phase: During this phase, the project feasibility was tested. The decision was taken out in regard to who is responsible for the project and which persons were involved in the implementation of the project. The project examined the technical feasibility required in order to install the system in the college. Various issues have been discussed in respect of the project implementation. The questions related to the specifications or scope of the new system were involved. The members of the project were not clear on the subject matter due to which conflicts appeared. The project was divided in tasks and subtasks (Kerzner, 2013).

Also, in this stage, various expectations engaged with the project were tested in accordance with the outcomes. The information regarding how long time is needed to be achieved each task and subtask were discussed. It was necessary to identify the requirements of the project as early as possible because these involved preconditions, functional requirements, operational requirements and design limitations (Sinha, 2011). It was necessary that all the parties involved in the project needed to collaborate each other in the implementation of the project. The project

was most benefitted when it comes to comply with the future requirements. In order to avoid any disparities, the various meetings were conducted from time to time with all the parties involved during this phase (Sinha, 2011).

Design phase: The Analysis Phase needed to be later supported by the Design Phase specifying the requirements that were made in according with the choices. The design phase included the conceptual, logical and physical designs needed for implementing the new hardware inventory. The Project Manager selected the design plan which was appropriate to the project. Once the design has been selected it can't be changed on the later. (Sinha, 2011).

Implementation phase: In this phase, the project was showed to the client. It was necessary to maintain the various encoding and decoding involved in the implementation of the integrated system. The results were carried out according to the specification set out in the definition phase. It was ascertained that the system used in the installation system must be the same as it was stated in the designed phase (Stark, 2015).

The implementation system included the following processing components and input/output components that help to pass the instructions and generate relevant output in considered of the given input. The systems perform the various tasks related to multiprocessing, multitasking, and multithreading. Multitasking allows the new hardware inventory system to run the application concurrently in the given time (Wysocki, 2011).

Follow-up phases (testing, training and handover phases): All the necessary things that have been required for the successful completion of the project will be bought. It may include the activities that relate to giving testing and training to the users or staff regarding the use of it or how it will be used (Stark, 2015).

Software testing phase is conducted in order to obtain information about the quality of software developed in earlier stages. Testing is running the program in order to discover software errors. The Project Manager discussed with ICT Manager of Melchester College the validation and the errors of the new system. The errors of the new implemented system were corrected in accordance with the specifications pf the project. It was necessary to document all the desired changes in order to lessen the misunderstandings.

Instructions and training were provided to the users of the new hardware inventory system so they must know how to use and access the new integrated system. The Project was monitored by both parties involved (Melchester College represented by ICT Manager and the Team

Project), to ensure that no problem occurred in regard to its implementation. Various techniques like PERT were used to evaluate the project (Stark, 2015).

Conclusion:

From the above, it can be concluded that various phases took place for successful implementation of the project. The use of the new system increased the vulnerability of the new database. The installation of the new integrated system required a lot of information that was developed in a professional manner, so for this reason it must be monitored properly in order to avoid any huge loss. The team worked on different tasks according to their skills in order to make sure the effective management of the system involved. The project was monitored on daily basis in order to evaluate its effectiveness and efficiency in the overall operations.

8. Task 8 Produce a record of all project procedures used

8.1 The Specifications of the Project

The main goal is to implement a new computerised system of hardware inventory. This system is used by ICT department of Melchester College, exploiting facilities provided by the "ict_hardware_inventory" database. The specifications of this project are:

- offer quick access to hardware and supplier details
- provide maintenance history on individual items of hardware
- provide records of hardware allocated to subject areas
- offer inventory details of hardware in each room
- deal with government returns on the number of PCs allocated to Admin v Curriculum

8.2 Meeting Note

The meeting in which to discuss the terms and specifications of the project.

Meeting Note

To: Project Manager – Gheorghe Mitrea

From: ICT Manager Department, Melchester College

Date: March 02, 2017

Subject: Installation of new hardware inventory system

Due to extensive ICT staff feedback, we Melchester College would like to demonstrate our commitment in making the installation of a new the hardware inventory system in the ICT department. It provides an advanced system to our system inventory and college for maintaining the record of digital equipment.

The enthusiasm, product knowledge, and implementation strategy were impressive and a specific deal is signed with the company for maintenance and training of staff.

The letter is only to develop an obeisance that makes you aware that credit exists and you need to verify the specific records that are in agreement.

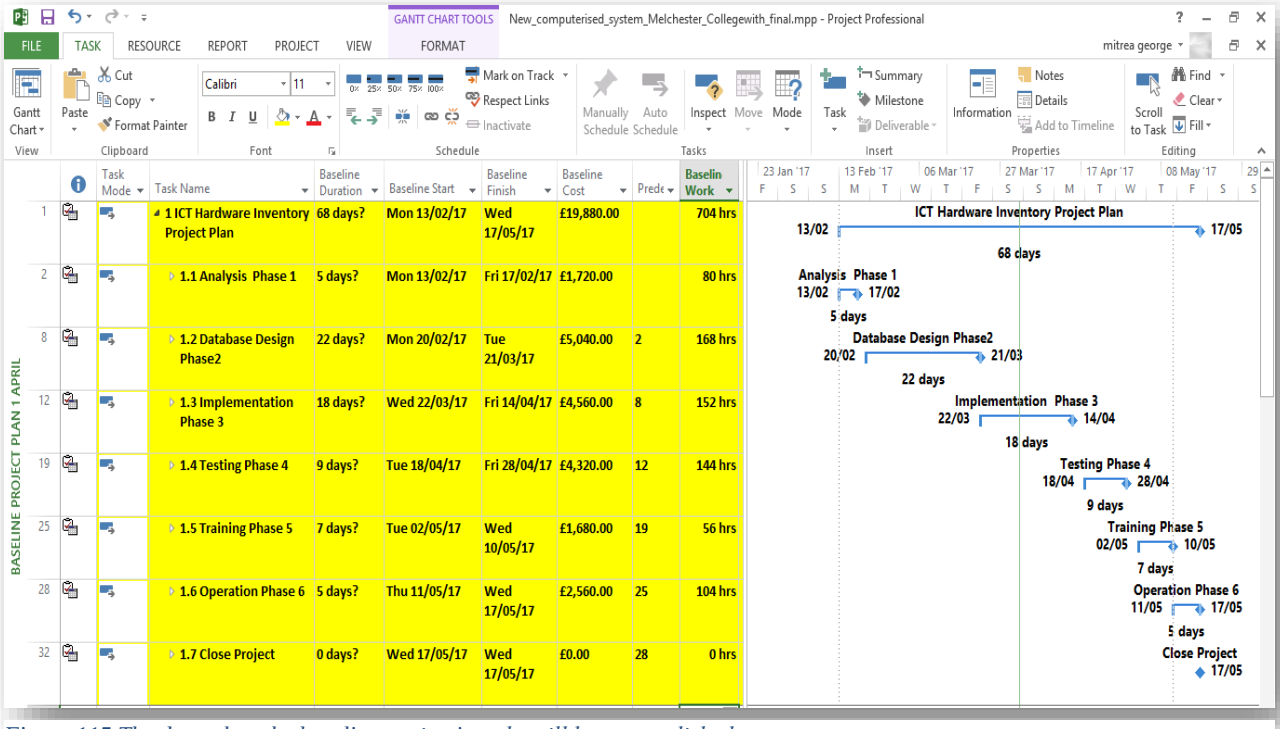
Thank you for the outstanding work and commitment.

Thank you and regard, ICT Department!

Figure 114 Meeting note

8.3 Project Plan with its tasks

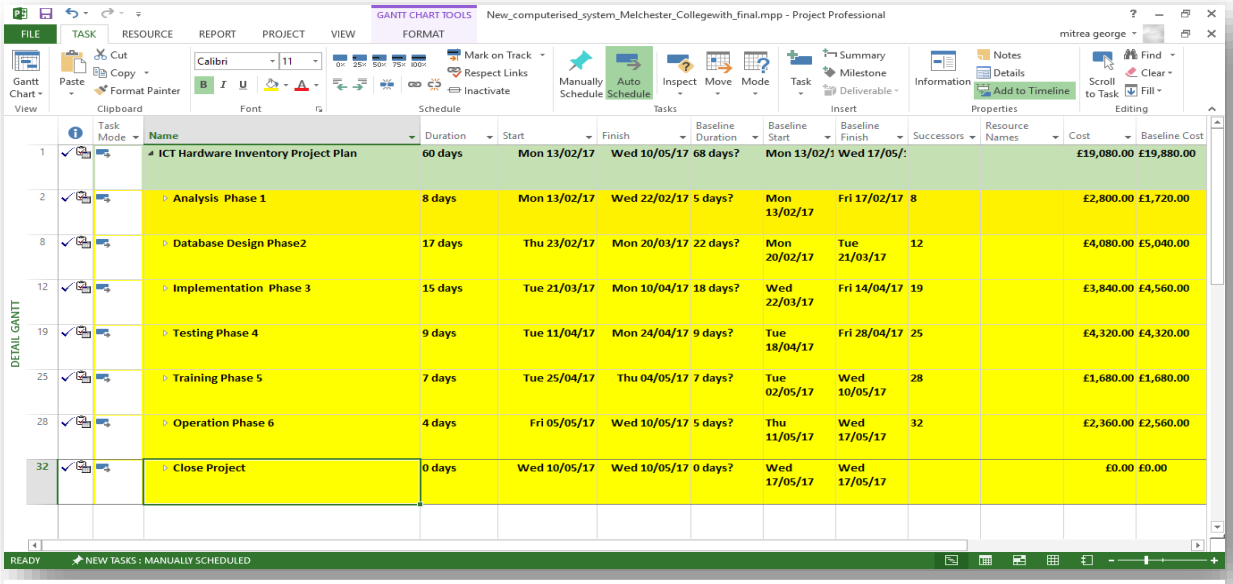
The baseline project with its tasks is shown in the bellow figure:



	Task Mode	Task Name	Baseline Duration	Baseline Start	Baseline Finish	Baseline Cost	Prede	Baselin Work
1		1 ICT Hardware Inventory Project Plan	68 days?	Mon 13/02/17	Wed 17/05/17	£19,880.00		704 hrs
2		1.1 Analysis Phase 1	5 days?	Mon 13/02/17	Fri 17/02/17	£1,720.00		80 hrs
8		1.2 Database Design Phase2	22 days?	Mon 20/02/17	Tue 21/03/17	£5,040.00	2	168 hrs
12		1.3 Implementation Phase 3	18 days?	Wed 22/03/17	Fri 14/04/17	£4,560.00	8	152 hrs
19		1.4 Testing Phase 4	9 days?	Tue 18/04/17	Fri 28/04/17	£4,320.00	12	144 hrs
25		1.5 Training Phase 5	7 days?	Tue 02/05/17	Wed 10/05/17	£1,680.00	19	56 hrs
28		1.6 Operation Phase 6	5 days?	Thu 11/05/17	Wed 17/05/17	£2,560.00	25	104 hrs
32		1.7 Close Project	0 days?	Wed 17/05/17	Wed 17/05/17	£0.00	28	0 hrs

Figure 115 The date when the baseline project's tasks will be accomplished

The completed project plan:

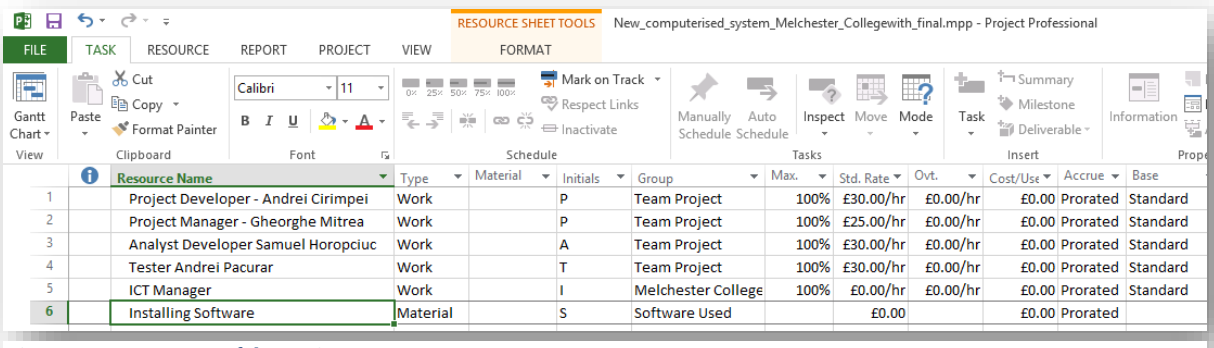


	Task Mode	Name	Duration	Start	Finish	Baseline Duration	Baseline Start	Baseline Finish	Successors	Resource Names	Cost	Baseline Cost
1		ICT Hardware Inventory Project Plan	60 days	Mon 13/02/17	Wed 10/05/17	68 days?	Mon 13/02/1	Wed 17/05/1			£19,080.00	£19,880.00
2		Analysis Phase 1	8 days	Mon 13/02/17	Wed 22/02/17	5 days?	Mon 13/02/17	Fri 17/02/17	8		£2,800.00	£1,720.00
8		Database Design Phase2	17 days	Thu 23/02/17	Mon 20/03/17	22 days?	Mon 20/02/17	Tue 21/03/17	12		£4,080.00	£5,040.00
12		Implementation Phase 3	15 days	Tue 21/03/17	Mon 10/04/17	18 days?	Wed 22/03/17	Fri 14/04/17	19		£3,840.00	£4,560.00
19		Testing Phase 4	9 days	Tue 11/04/17	Mon 24/04/17	9 days?	Tue 18/04/17	Fri 28/04/17	25		£4,320.00	£4,320.00
25		Training Phase 5	7 days	Tue 25/04/17	Thu 04/05/17	7 days?	Tue 02/05/17	Wed 10/05/17	28		£1,680.00	£1,680.00
28		Operation Phase 6	4 days	Fri 05/05/17	Wed 10/05/17	5 days?	Thu 11/05/17	Wed 17/05/17	32		£2,360.00	£2,560.00
32		Close Project	0 days	Wed 10/05/17	Wed 10/05/17	0 days?	Wed 17/05/17	Wed 17/05/17			£0.00	£0.00

Figure 116 Completed project plan and the baseline one

8.4 The Project Resources

The college defined the resources as the team's project and the materials (software and hardware) needed for the project's implementation. The image below shows the entire resources for this project:

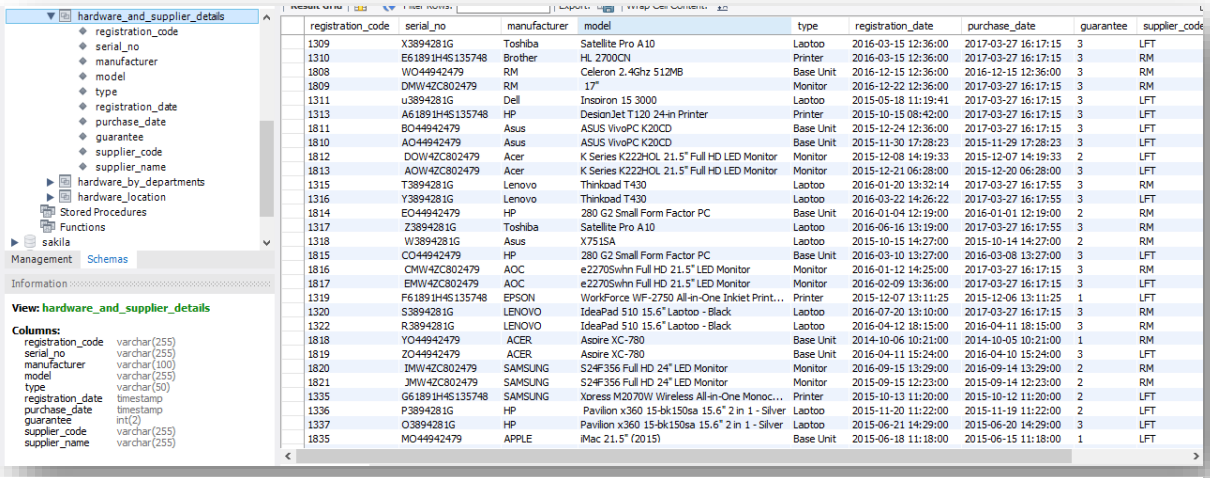


	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base
1	Project Developer - Andrei Cirimpei	Work		P	Team Project	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
2	Project Manager - Gheorghe Mitrea	Work		P	Team Project	100%	£25.00/hr	£0.00/hr	£0.00	Prorated	Standard
3	Analyst Developer Samuel Horopciuc	Work		A	Team Project	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
4	Tester Andrei Pacurar	Work		T	Team Project	100%	£30.00/hr	£0.00/hr	£0.00	Prorated	Standard
5	ICT Manager	Work		I	Melchester College	100%	£0.00/hr	£0.00/hr	£0.00	Prorated	Standard
6	Installing Software	Material		S	Software Used		£0.00		£0.00	Prorated	

Figure 117 Resources of the project

8.5 The Outcomes of The Product Project related to the requirements of the project

hardware_and_supplier__details - details of the devices, type of the devices, registration of the devices and details of the suppliers of the devices:



registration_code	serial_no	manufacturer	model	type	registration_date	purchase_date	guarantee	supplier_code
1309	X3894281G	Toshiba	Satellite Pro A10	Laotoo	2016-03-15 12:36:00	2017-03-27 16:17:15	3	LFT
1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-03-15 12:36:00	2017-03-27 16:17:15	3	RM
1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2016-12-15 12:36:00	2016-12-15 12:36:00	3	RM
1809	DMW4ZC802479	RM	17"	Monitor	2016-12-22 12:36:00	2017-03-27 16:17:15	3	RM
1311	u3894281G	Dell	Insoiron 15 3000	Laotoo	2015-05-18 11:19:41	2017-03-27 16:17:15	3	LFT
1313	A61891H4S135748	HP	DesignJet T120 24-in Printer	Printer	2015-10-15 08:42:00	2017-03-27 16:17:15	3	LFT
1811	BO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-12-24 12:36:00	2017-03-27 16:17:15	3	LFT
1810	AO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-11-30 17:28:23	2015-11-29 17:28:23	3	LFT
1812	DOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	Monitor	2015-12-08 14:19:33	2015-12-07 14:19:33	2	LFT
1813	AOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	Monitor	2015-12-21 06:28:00	2015-12-20 06:28:00	3	LFT
1315	T3894281G	Lenovo	Thinkpad T430	Laotoo	2016-01-20 13:32:14	2017-03-27 16:17:55	3	RM
1316	Y3894281G	Lenovo	Thinkpad T430	Laotoo	2016-03-22 14:26:22	2017-03-27 16:17:55	3	LFT
1814	EO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-01-04 12:19:00	2016-01-01 12:19:00	2	RM
1317	Z3894281G	Toshiba	Satellite Pro A10	Laotoo	2016-06-16 13:19:00	2017-03-27 16:17:55	3	RM
1318	W3894281G	Asus	X751SA	Laotoo	2015-10-15 14:27:00	2015-10-14 14:27:00	2	RM
1815	CO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-03-10 13:27:00	2016-03-08 13:27:00	3	LFT
1816	CMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-01-12 14:25:00	2017-03-27 16:17:15	3	RM
1817	EMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-02-09 13:36:00	2017-03-27 16:17:15	3	LFT
1319	F61891H4S135748	EPSON	WorkForce WF-2750 All-in-One Inkjet Print...	Printer	2015-12-07 13:11:25	2015-12-06 13:11:25	1	LFT
1320	S3894281G	LENOVO	IdeaPad 510 15.6" Laotoo - Black	Laotoo	2016-07-20 13:10:00	2017-03-27 16:17:15	3	RM
1322	R3894281G	LENOVO	IdeaPad 510 15.6" Laotoo - Black	Laotoo	2016-04-12 18:15:00	2016-04-11 18:15:00	3	RM
1818	YO44942479	ACER	Aspire XC-780	Base Unit	2014-10-06 10:21:00	2014-10-05 10:21:00	1	RM
1819	ZO44942479	ACER	Aspire XC-780	Base Unit	2016-04-11 15:24:00	2016-04-10 15:24:00	3	LFT
1820	IMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	Monitor	2016-09-15 13:29:00	2016-09-14 13:29:00	2	RM
1821	JMW4ZC802479	SAMSUNG	S24F356 Full HD 24" LED Monitor	Monitor	2015-09-15 12:23:00	2015-09-14 12:23:00	2	RM
1335	G61891H4S135748	SAMSUNG	Xpress M2070W Wireless All-in-One Monoc...	Printer	2015-10-13 11:20:00	2015-10-12 11:20:00	2	LFT
1336	P3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	Laotoo	2015-11-20 11:22:00	2015-11-19 11:22:00	2	LFT
1337	O3894281G	HP	Pavilion x360 15-bk150sa 15.6" 2 in 1 - Silver	Laotoo	2015-06-21 14:29:00	2015-06-20 14:29:00	3	LFT
1835	MO44942479	APPLE	iMac 21.5" (2015)	Base Unit	2015-06-18 11:18:00	2015-06-15 11:18:00	1	LFT

Figure 118 Testing and validation of hardware and supplier details

device_maintenance_history - maintenance history on individual items of a hardware. For this verification were introduced the details of job description, registration device, details of device, details of the device job type

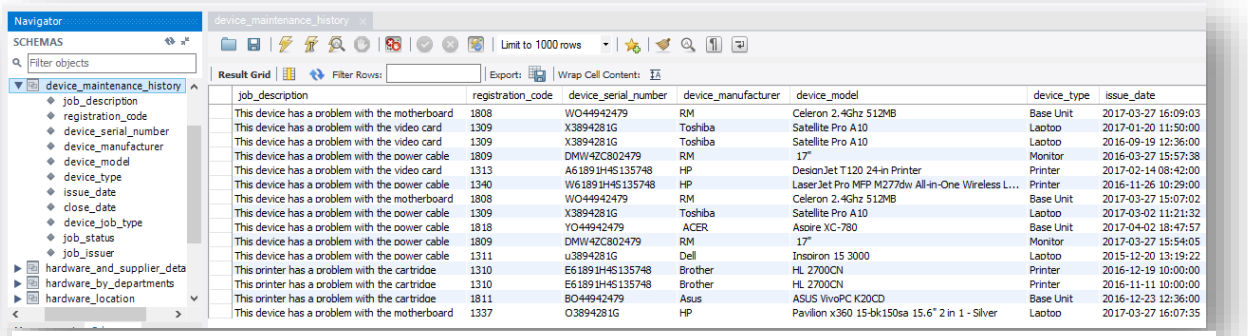


Figure 119 Testing and validating the maintenance history of hardware

hardware_by_departments - records of hardware allocated to subject areas. To realise this test were introduced the details of device inventory, department location and details of each department

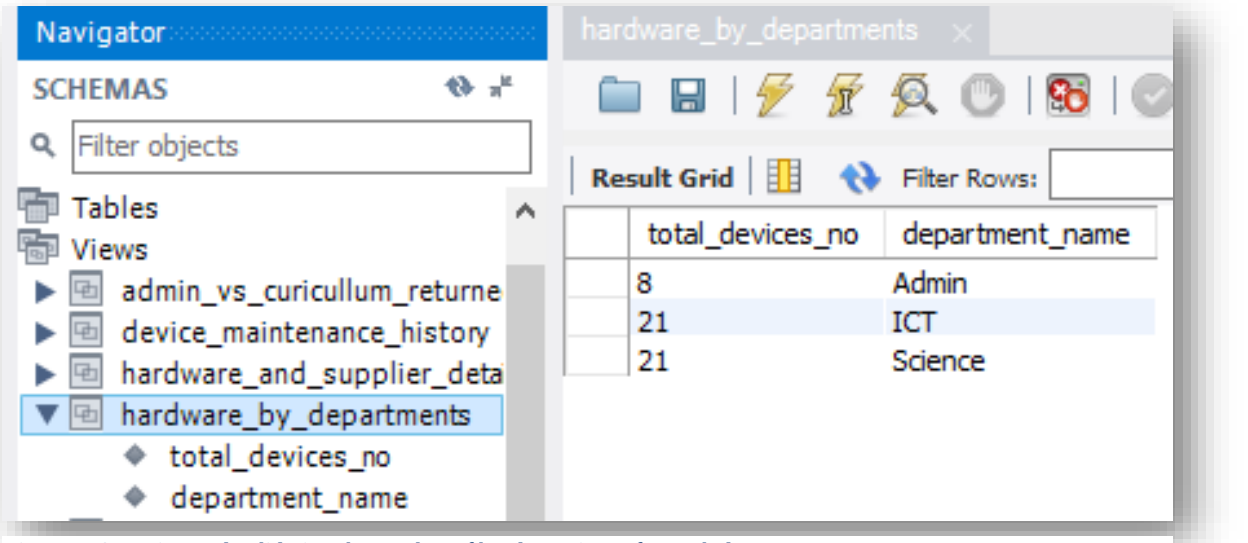
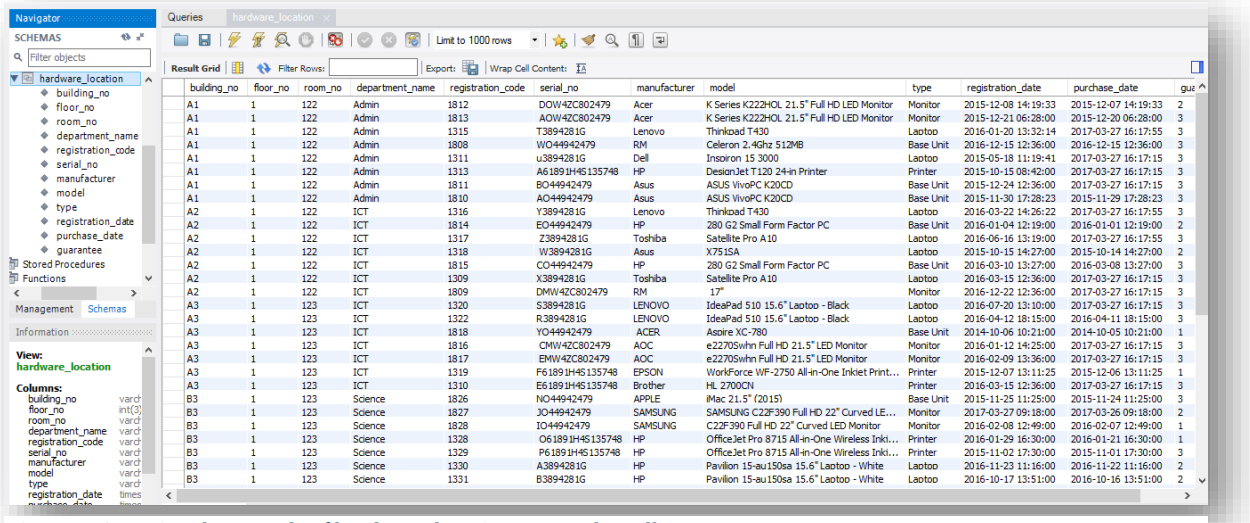


Figure 120 Testing and validating the number of hardware items for each department area

hardware_location - records related to the location for each device across the college. For this were necessary the details of device inventory, device registration, device details, device type, department location and details of campus college's buildings location



building_no	floor_no	room_no	department_name	registration_code	serial_no	manufacturer	model	type	registration_date	purchase_date	gua
A1	1	122	Admin	1812	DOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	Monitor	2015-12-08 14:19:33	2015-12-07 14:19:33	2
A1	1	122	Admin	1813	AOW4ZC802479	Acer	K Series K222HQL 21.5" Full HD LED Monitor	Monitor	2015-12-21 06:28:00	2015-12-20 06:28:00	3
A1	1	122	Admin	1315	T3894281G	Lenovo	Thinkpad T430	Laptop	2016-01-20 13:32:14	2017-03-27 16:17:55	3
A1	1	122	Admin	1808	WO44942479	RM	Celeron 2.4Ghz 512MB	Base Unit	2016-12-15 12:36:00	2016-12-15 12:36:00	3
A1	1	122	Admin	1311	u3894281G	Dell	Insoiron 15 3000	Laptop	2015-05-18 11:19:41	2017-03-27 16:17:15	3
A1	1	122	Admin	1313	A61891H4S135748	HP	DesignJet T120 24-in Printer	Printer	2015-10-15 08:42:00	2017-03-27 16:17:15	3
A1	1	122	Admin	1811	BO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-12-24 12:36:00	2017-03-27 16:17:15	3
A1	1	122	Admin	1810	AO44942479	Asus	ASUS VivoPC K20CD	Base Unit	2015-11-30 17:28:23	2015-11-29 17:28:23	3
A2	1	122	ICT	1316	Y3894281G	Lenovo	Thinkpad T430	Laptop	2016-03-22 14:26:22	2017-03-27 16:17:55	3
A2	1	122	ICT	1814	EO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-01-04 12:19:00	2016-01-01 12:19:00	2
A2	1	122	ICT	1317	Z3894281G	Toshiba	Satellite Pro A10	Laptop	2016-06-16 13:19:00	2017-03-27 16:17:55	3
A2	1	122	ICT	1318	W3894281G	Asus	X751SA	Laptop	2015-10-15 14:27:00	2015-10-14 14:27:00	2
A2	1	122	ICT	1815	CO44942479	HP	280 G2 Small Form Factor PC	Base Unit	2016-03-10 13:27:00	2016-03-08 13:27:00	3
A2	1	122	ICT	1309	X3894281G	Toshiba	Satellite Pro A10	Laptop	2016-03-15 12:36:00	2017-03-27 16:17:15	3
A2	1	122	ICT	1809	DMW4ZC802479	RM	17"	Monitor	2016-12-22 12:36:00	2017-03-27 16:17:15	3
A3	1	123	ICT	1320	S3894281G	LENOVO	IdeaPad 510 15.6" Laptop - Black	Laptop	2016-07-20 13:10:00	2017-03-27 16:17:15	3
A3	1	123	ICT	1322	R3894281G	LENOVO	IdeaPad 510 15.6" Laptop - Black	Laptop	2016-04-12 18:15:00	2016-04-11 18:15:00	3
A3	1	123	ICT	1818	YO44942479	ACER	Aspire XC-780	Base Unit	2014-10-06 10:21:00	2014-10-05 10:21:00	1
A3	1	123	ICT	1816	CMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-01-12 14:25:00	2017-03-27 16:17:15	3
A3	1	123	ICT	1817	EMW4ZC802479	AOC	e2270Swhn Full HD 21.5" LED Monitor	Monitor	2016-02-09 13:36:00	2017-03-27 16:17:15	3
A3	1	123	ICT	1319	F61891H4S135748	EPSON	WorkForce WF-2750 All-in-One Inklet Print...	Printer	2015-12-07 13:11:25	2015-12-06 13:11:25	1
A3	1	123	ICT	1310	E61891H4S135748	Brother	HL 2700CN	Printer	2016-03-15 12:36:00	2017-03-27 16:17:15	3
B3	1	123	Science	1826	NO44942479	APPLE	iMac 21.5" (2015)	Base Unit	2015-11-25 11:25:00	2015-11-24 11:25:00	3
B3	1	123	Science	1827	JO44942479	SAMSUNG	SAMSUNG C22F390 Full HD 22" Curved LE...	Monitor	2017-03-27 09:18:00	2017-03-26 09:18:00	2
B3	1	123	Science	1828	IO44942479	SAMSUNG	C22F390 Full HD 22" Curved LED Monitor	Monitor	2016-02-08 12:49:00	2016-02-07 12:49:00	1
B3	1	123	Science	1328	O61891H4S135748	HP	OfficeJet Pro 8715 All-in-One Wireless Inki...	Printer	2016-01-29 16:30:00	2016-01-21 16:30:00	1
B3	1	123	Science	1329	P61891H4S135748	HP	OfficeJet Pro 8715 All-in-One Wireless Inki...	Printer	2015-11-02 17:30:00	2015-11-01 17:30:00	3
B3	1	123	Science	1330	A3894281G	HP	Pavilion 15-au150sa 15.6" Laptop - White	Laptop	2016-11-23 11:16:00	2016-11-22 11:16:00	2
B3	1	123	Science	1331	B3894281G	HP	Pavilion 15-au150sa 15.6" Laptop - White	Laptop	2016-10-17 13:51:00	2016-10-16 13:51:00	2

Figure 120 Testing the records of hardware location across the college

admin_vs_curicullum_returned - government returns on the number of Base Units allocated to Admin vs Curriculum. For this were necessary the details of total number of PCs for Administration Department vs Curriculum departments (ICT department and Science Department). For this query were necessary the details of each department involved:

- device job
- device job type
- device inventory
- device registration
- device
- device type
- department location
- department

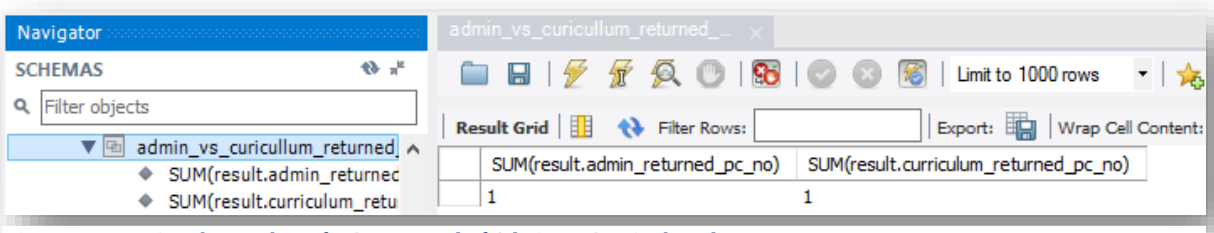


Figure 121 Testing the number of PCs returned of Admin vs Curriculum departments

Bibliography

Al-Daihani, S., 2011. *ICT education in library and information science programs: An analysis of the perceptions of undergraduate students,* s.l.: Library review.

Babravicius, K. a. V. E., 2012. *Knowledge of ICT of Secondary School Graduates,* s.l.: Informatics in Education-An International Journal.

Best, A., 1999. *Secondary data bases and their use in outcomes research: a review of the area resource file and the Healthcare Cost and Utilization Project,* s.l.: Journal of medical systems.

Castellano, J. A.-P. D. a. B. P., 2014. *Evaluation of research using computerised tracking systems (Amisco® and Prozone®) to analyse physical performance in elite soccer,* s.l.: A systematic review. Sports medicine, 44(5), pp.701-712..

Dhanavandan, S. E. M. a. N. M., 2011. *Information Communication Technology (ICT) Infrastructure Facilities in Self-Financing Engineering College Libraries in Tamil Nadu,* s.l.: Library Philosophy and Practice, (1), p.69..

Fakkirappa Kattimani, S. a. R. N. R., 2013. *Evaluation of librarianship and ICT skills of library and information professionals working in the engineering college libraries in Karnataka, India: a survey,* s.l.: Program, 47(4), pp.345-369..

Fuggetta, A. a. D. N. E., 2014. *Software process,* s.l.: In Proceedings of the on Future of Software Engineering (pp. 1-12). ACM..

Gelogo, Y. a. L. S., 2012. *Database management system as a cloud service,* s.l.: International Journal of Future Generation Communication and Networking, 5(2), pp.71-76..

Handayati, P. a. R. A., 2014. *THE DEVELOPMENT OF ICT-BASED ASSESSMENT DATABASE WITH REINFORCEMENT ON ACCOUNTING SUBJECT AT SENIOR HIGH SCHOOL,* s.l.: European Scientific Journal.

Helo, P. G. A. a. R. A., 2016. *Designing and Managing Industrial Product-Service Systems,* s.l.: Springer.

Hu, Z. a. M. I., 2012. *Integrating ICT into College English: An implementation study of a national reform,* s.l.: Education and Information Technologies, 17(2), pp.147-165..

Kerzner, H., 2013. *Project management: a systems approach to planning, scheduling, and controlling,* s.l.: John Wiley & Sons..

Le Métayer, D. M. M. T. V. M. E. P. M. C. N. F. S. a. H. R., 2010. *Liability in software engineering: overview of the LISE approach and illustration on a case study,* s.l.: In Proceedings of the 32nd ACM/IEEE International Conference on Software Engineering-Volume 1 (pp. 135-144). ACM.

Mtebe, J. D. H. a. R. C., 2011. *Integrating ICT into teaching and learning at the University of Dar es Salaam,* s.l.: Distance education.

Sinha, K. a. L. S., 2011. *Transportation decision making: Principles of project evaluation and programming,* s.l.: John Wiley & Sons.

Stark, J., 2015. *Product lifecycle management. In Product Lifecycle Management (pp. 1-29),* s.l.: Springer International Publishing.

Wysocki, R., 2011. *Effective project management: traditional, agile, extreme,* s.l.: John Wiley & Sons..