

Performance Optimization of Higher Education System by using Secure & Reliable ERP System

Ahmad Jamal, Om Kumar Harsh, Aamir Khan

Abstract: Paper An ERP System is the dorsum of every individual organization. In the new advance world, ERP is not limited to any particular organization boundaries. It is now used by the education sectors for the smooth functioning of academics performances. ERP plays a very crucial role in the education sector, as earlier universities used to monitor stand-alone software for each department/sector separately, which has faced the problem of centralization of information. Also, there was a problem of record modification/change in the stand-alone software, In order to update any information in any department/sector. We also need to do the same on every department/sector individually, which is a very tedious, time-consuming, and complex job. To overcome such problems and boosting the functionality of the particular education sector we have managed to introduce the system for the better solution of this problem by making a centralized ERP system i.e. Enterprise Resource Planning, with a general approach for the education environment. No doubt many ERP tools are available in the market but generally, they do not fulfill all the aspects of the education environment, because of the lack of proper requirements gathering. The reason behind this is that all the ERP solutions are made by the industry by assuming the requirements. So this paper provides the implementation of an ERP system for the higher education systems which fulfill all the requirements of higher education institutions after taking the requirements from the education sector for the smooth functioning of their particular institution.

Finally in this research we have observed the efficiency of work done before and after the introduction of E-HE system and the promising results were observed for quarter 3rd and 4th for all seven cases. In quarter 1st and 2nd we observe less tasks performed by standalone software whereas for quarter 3rd and 4th after the introduced of E-HE system we have observed enormous increase in performance for the completion of jobs done.

Keywords: E-Higher Education (E-HE), Cross-platform, Web Enabled, Business Process, ERP implementation, MVC architecture.

I. INTRODUCTION

ERP is an Enterprise Resource Planning system which is used by most of the organization for their smooth functionality of services and practices. ERP is an information system that integrates all departments and functions across to an organization into a single unit. ERP is not only limited to the organization, but a higher education environment is also using the ERP system. Every academic organization faces

various problems related to their resource management and it is that time that every organization tries adopted to look for some quick-fix solution hence they fall to purchase some software related to individual departments/sections. After surveying of the departments of the organization at different institutions, we come to develop a solution to all these problems, which is related to the ERP system for higher education, the name set to be E-HE (E-Higher Education). The development and implementation of an ERP system require a careful analyze in gathering information or the requirement. E-HE is developed with the idea of smooth functionality. As it is a centralized system that will be very helpful in better decision making, E-HE is designed to automate the Academics and Administrative activities or tasks. E-HE streamlines the complete student university/college life cycle from generating inquiry to gradation, administrative processing such as hostel, library, finance, IT, HR, Examinations. E-HE is built on the open-source technologies with the web-enabled facility. The core objective of E-HE implementation is to provide better tools and help in the smooth functioning of the university situated in India, not only this but also to enhance the performance of research teaching methodology at a reasonable price at resource person. It has been climbed as many as 60% to 80% in all ERP existing systems that are failed to meet expected outcomes in these university areas [6].contents of the paper are fine and satisfactory. Author (s) can make rectification in the final paper but after the final submission to the journal, rectification is not possible. In the formatted paper, volume no/ issue no will be in the right top corner of the paper. In the case of failure, the papers will be declined from the database of journal and publishing house. It is noted that: 1. Each author profile along with photo (min 100 word) has been included in the final paper. 2. Final paper is prepared as per journal the template. 3. Contents of the paper are fine and satisfactory. Author (s) can make rectification in the final paper but after the final submission to the journal, rectification is not possible.

When we examined the same implemented system in higher education boundaries, we can evaluate that system is extremely static in performance, due to this particular situation we work on that for making E-HE as a dynamic performer for our universities, schools, and various departments.

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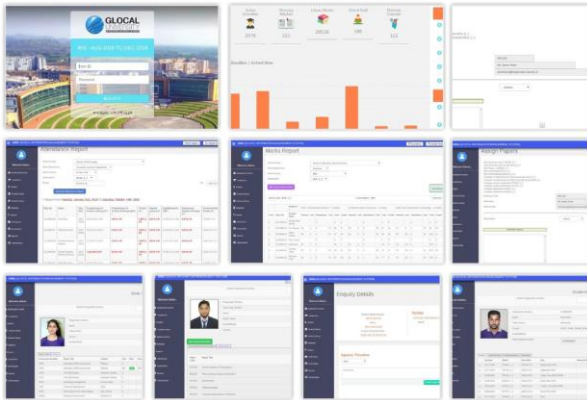


Fig. 1.E-HE view

A. The obligation of Software System: The virtuous software used in process of universities to give a better performance and knowledge educated system improvement and increase the work rate, status, and reliability and reduced the cost for the better output. It also keeps down the implementation time as compared to manual work or stand-alone software. In the recent implementation when we invested some required cost and asset to start the software implementation in the current scenario, some Abstruse difficulties and bugs came into our knowledge after that we were able to resolve those difficulties and error for the same with our E-HE system. When the E-HE system is entirely released in a business organization or in an educational area, we can mostly focus on yield marks able benefits such as improving the finance system, academic attendance system, faculty performance evaluation system, examination appraisal, and assessment system.

E-HE is also working as a knowledge base system as it is completely used for university evaluation for NAAC and UGC approval. This system is implemented in our university for the last 3 years. An automated code is working in backend data to evaluate our performance and authentication process in every period that is fixed by the system developer. The identification is the main logic for adaptation in the streamline of the system, greater usability, and integration with all modules. It also provides switching flexibility in the role of the user. Mostly the system is based on business logic and re-engineering that support of current advanced technologies and libraries. These technologies and libraries are open sources.

II. ANALYSIS OF THE ALGORITHMS

A. System Core:

We develop a Core system Architecture / Framework to develop E-HE. It has a core component as the backbone of the whole system and the core component is responsible for the skeleton of the E-HE.

- 3.1: Architecture/Framework Design (MVC based)
- 3.2: Authentication
- 3.3: Roles and Permission
- 3.4: Module Management
- 3.5: E-HE Configuration
- 3.6: User Activity Log

B. Architecture/Framework Design (MVC based): E-HE is an interrelated framework or plan of function for the implementation of the system. It provides the facility for the base architecture that will develop our desirable logic and business code. In E-HE our first phase that we build a blueprint of the proposed system. It will follow the MVC tessellated procedure to design our system. In the starting development stage, we mark design components for architecture so first, we make a desktop design page using various techniques such as HTML, CSS, JavaScript, JQuery, XML, JSON. The architectonic comprises of dispute modules that are specified in figure 2.

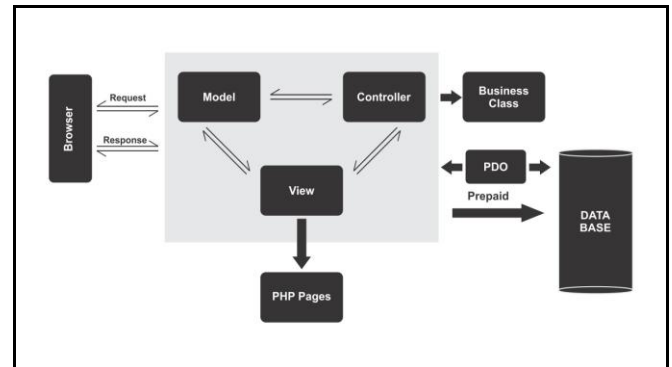


Fig. 2.E-HE framework(MVC) work flow

In this given diagram, various major classification of work is divided into different sections which are administrative, Staff, Finance, Examination, IT, Library. The Administration is set to be a backbone, playing a major role in our system and is set to perform critical tasks. In higher education system E-HE is one step ahead to analyzing the actual benefit of the education system for the predetermined requisites [2]. We also define role activity according to the survey done. The administrator can give specific access and control over the particular module for e.g. faculty member has permission to mark attendance, Upload assignments /Upload Lectures / Lecture Plans / Study Materials and any other documents. The Administrator also monitors the login history of every single user. That will be knowledgeable for senior management and also for the purpose of mentoring the unauthorized user. It also generates a system performance evaluation chart. Figure 3 shows the complete architecture and file representation of E-HE.

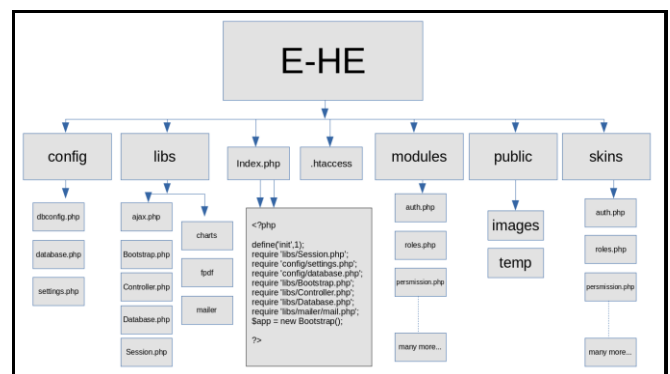


Figure 3: E-HE System Architecture

C. System Authentication:

The E-HE is a web-based system that works for higher education development. In our system the second stage is authentication. It is a phase where E-HE checks the loopholes for unauthorized users and admin. It also allows universities to use an integrated system without any difficulty. An authentication face is a well-connected and reusable module, where every user will be verified before the login in the system. In our system, a user is asked to use a unique user Id and password that is only provided by the administrative; the password is protected by the encryption algorithm SHA-1. SHA-1 is a secret cryptography function that converts the input string into the 160-bit hash value. The output from the SHA-1 can't be decrypted into his original form as it is the only the one-way method to transform the string into the encrypted string. Every user needs to go through the login process to login to the E-HE by using the given Id and Password.

In our programming, The PDO library is working as a connecting switch between the application server and database server that prepares a statement for the authentication of data or variable value that will be binding with predefined existing record or table data. After the successful login step to the system, it will be redirected to the login page. IN the backend business logic will be automatically interpreted for deciding the user role and access permission. User basic information will be displayed in the predefined section on a user dashboard. All the login history of every user is storing the database for further use. Figure 4 shows the authentication code of the system. Figure 5 shows how the authentication system is authenticating the user using the PDO library.

```
<?php
class Auth extends Controller{
function __construct() { parent::__construct(); }
public function index(){ header('Location: '. URL.'auth/login' ); }
public function login(){
    Session::init();
    $logged = Session::get('login');
    if ($logged == TRUE) { header('Location: '. URL.' exit; )
    if(isset($_POST['sub'])){
        $user=trim($_POST['username']);
        $pass=trim($_POST['password']);
        $fields=id,password,role_id,username,name;
        $table="TABLE NAME"; // USER INFORMATION TABLE NAME
        $qry="WHERE username=? AND password=?";
        $values=array($user,$pass);
        $u=$this->pdoFetch($fields,$table,$qry,$values);
        if(isset($u['username'])){
            Session::init();
            Session::resetId();
            $f=array('username','user_id','ip','session_id','date','in time');
            $u=array($u['username'],$u['id'],$SERVER['REMOTE_ADDR'],Session::id(),$this->getdate(),$this->gettime());
            $this->db->insert('tbl_session',$f,$u);
            Session::set('login',true);
            Session::set('user',$u['username']);
            Session::set('name',$u['name']);
            Session::set('role_id',$u['role_id']);
            Session::set('user_id',$u['id']);
            header('Location: '.URL);
        }
        else{ Controller::sview['message']="Login Failed!"; }
        $this->view['stafflogin'];
    }
}
```

Figure 4: E-HE authentication code

D.

```
<?php
class Database {
private $connection;
private $pdoConnection;
function __construct() {
    $this->pdoConnection = new PDO("mysql:host=".DB_HOST."; dbname=".DB_NAME, DB_USER, DB_PASS);
}
public function pdoFetch($fields, $table, $qry = FALSE, $values = FALSE) {
    $this->pdoConnection->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);
    $sql="select $fields from $table $qry";
    $stmt=$this->pdoConnection->prepare($sql);
    $stmt->execute($values);
    $u=$stmt->fetch();
    return $u;
}
}
```

Figure 5: E-HE PDO Fetch

Authentication is a process of authenticating every user in the E-HE. It is using prepared statement techniques to provide a greater level of security. It makes a connection with the database using the PDO Connection Object [5]. After making a successful connection with the database it prepares the statement, the reason behind preparing the statement before triggering the query in the database is to provide the security from the SQL Injection. After a successful run of a prepared statement, the data-bind process starts; it is the process of adding the requested user data into a query string to find the result from the database where after the query will trigger the database layer and provide the result. If the result is true then E-HE sets the session data for the particular user. It is after then checking the roles and permissions, the user is redirected to the dashboard of the system. Here, Figure 6 shows the flow chart of the authentication system of E-HE.

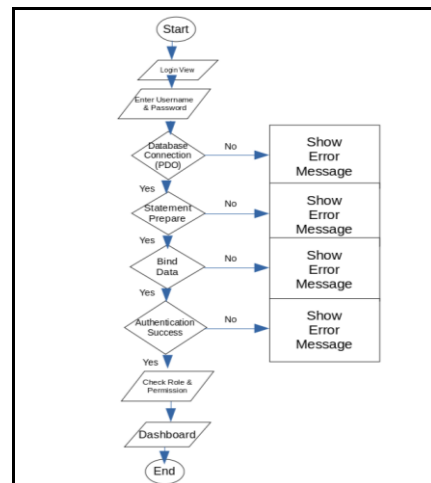


Figure 6: E-HE authentication flow chart

SQL Injection is the database threat, In which the attacker adds SQL statement/query to an application form input box e.g. Username field, to gain access to the resources or make changes into the database [7]. Any positive SQL Injection rush can result in the unannounced data being rubbed out, strayed or robbed; application being trashed; impermissible doorway to system or user-account, before long, haggles of distinct machine/tool. SQL Injection is nose out in 1998; it is after 21 years of exploration, SQL Injection hold up the primary database defense anxiety.

E. Roles and Permission:

It is a very critical component of the E-HE system as it is the function/method which provides every user limitation and maintains security. For this E-HE has a component that is named as a getpermissions, and it defined under the Controller class.

getpermissions() fetch the user's data from the session and then gives the role Id of the user and the function will check for the permission on to the particular role in the database. According to the permission, the values of session variables will be set. If no permission is allowed to a particular user then a header redirection function will call. In the same segment which is again checking that particular user is login or not.



Figure 11 shows the programming code of database.php.

```
<?php
require 'dbconfig.php';
define('DB_HOST', '<HOST NAME>');
define('DB_NAME', $database_name);
define('DB_USER', '<DB USER>');
define('DB_PASS', '<DB PASS>');
?>
```

Figure 11: E-HE database.php code

c. Settings.php: This file contains the DIR path, ROOT path, URL path, Skin name, Page Limit (for the pagination), Master admin phone number and email. Figure 10 shows the programming code of Settings.php.

```
<?php
define('DIR', '/<DIRECTORY NAME>');
define('URL', 'http://'.$_SERVER['HTTP_HOST'].DIR);
define('ROOT', $_SERVER['DOCUMENT_ROOT'].DIR);
define ('SKIN', '<SKIN NAME>');

define ('PAGELIMIT',50); //Limit of records to show per page
define('PHONE', "7253810400");
define('EMAIL', "ahmadjamalcs@gmail.com");
?>
```

Figure 12: E-HE settings.php code

H. User Activity Log:

E-HE is a user interaction system where every individual user access every role based module and also access the resource that logged activity in monitor and visible in log files of each system which depended on central activity log file, These files can store and capture machine IP, time, login session, login history and so on and of the system. Every activity is also known as a transaction that will monitor and store data by the automated mechanism which is trigger when any activity performs. This information can only see by the administrator [9]. The activity transaction information fed into tables against a specific user id which set to be a uniquely identifiable amount all of the user activity files. Further, we can upgrade the activity log file with a machine learning mechanism that will become a better system for future enhancement in the education environment. In the E-HE system, you will find a good, reachable and interactive system with proper workflow benchmark. The user activity log is a mechanism to trace every user's actions in the E-HE. E-HE traces every activity between the login and logout of the user. Whenever any activity is performed is the E-HE then E-HE itself calls an add Activity function. This function captures some additional details except the activity details like date, IP, time, user-id, username and a brief description of the activity. Here is the database skeleton of the user activity log.

I. User activity table:

id	userid	table_key	table_name	username	activity	des	date	time	ip
----	--------	-----------	------------	----------	----------	-----	------	------	----

Add Activity function is written in the Database.php file which exists in the libs directory. This Database.php consists of all the functions which are using to operate on the database layer. It is a private function because we are tracking everything from the core. AddActivity() function can't be call from the outside classes. It can only be a call from the same class in which it is defined because of the private function. The diagram shows the connection between the user and the database and how the system is monitoring the things. Figure 13 shows how the user activity tracking mechanism takes place.

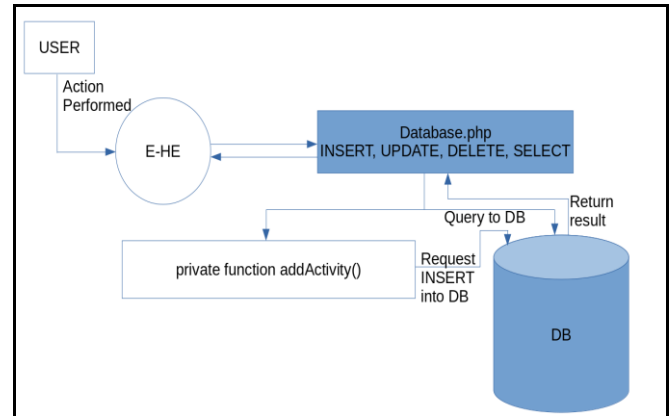


Figure 13: Activity tracking mechanism

J. Open Source Environment:

Open Source defined as the program/function whose development code and some other legal rights are made available for use/modification by others, under a software license that meets the Open Source Definition of the Open Source Initiative (OSI) or that is in the unattainable[1]. In today's trends, Open source is gaining popularity very quickly, because of the use of this globally. The concept behind the open source is that everything should be available for everyone for the benefit of others. E-HE is completely is an open-source solution for the education environment. E-HE is available on the GitHub public repository.

K. Crose Platform Web Enabled:

The adoption of Internet technology allows access to ERP systems from anywhere at any time. E-HE is the concept and technique for the collaborative management of the educational institution, from the angle of effectual use of education institution/university management. E-HE is a full-dress cross-platform web-enabled solution for the education environment. The main ambition of E-HE is to perform mechanisms for automated processing and administration of the total institution/college/University. E-HE is developed after finding the prospects and challenges of the ERP system in higher education and then it is made.

L. E-HE future Discussion:

E-HE requires some more technical advancement that can be introduced later and will improve the performance in the near future and will try best to make it more powerful and upgraded than the existing one.

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Database, being the backbone of E-HE, we were providing the facility of manual backup not only this in the near future we can shift our database to a new database software package named as Apache Cassandra, which is fully capable of storing huge data and provide full supportable automatic backup in a particular period. These updated factors in our system will be helpful in the satisfactory and desirable performance of E-HE products. As a result of the change, the working of a particular module will contribute to the more accomplishment in the future [8]. To understand further the E-HE implementation factor on the education system, this paper attempts to calculate the actual impression of the E-HE system on its user performance, with the help of well schedule business logic and we also focus on how currently implemented technologies can be better for the education system[3].

In our system, a user is indeed the main motivational factor to check and evaluate system quality and performance. In the last two decades, most of the education sector has not used any ERP systems or have the manual concentration to the user, to the best of our surveyor knowledge mainly few well established higher education institutes are working on these types of the automatic system. In the next few days we want to implement this type of system in each field related to higher education.

M. Technology:

The role of technology in ERP is immense. E-HE is a cloud platform web-enabled system, and the technology used here is said to be very efficient. Nowadays PHP is using globally for the web applications whereas PHP has the best combination of the database is MySQL. That's why E-HE is completely set to develop in the PHP as a server-side language and MySQLi as the database engine. E-HE is using the improved version of MySQL that is MySQLi because of advanced security mechanisms. E-HE is developed on a Linux platform using the apache web server and using the latest version of all the used technologies i.e. PHP7, apache 2 and MySQLi

Table- I: E-HE Features:

Platform (can be used in)	Cloud, Windows, Linux
Desktop/Web based:	Web based
SaaS Platform	Rack Server
Web Application	PHP 5, Ajax, XML, HTML, DHTML, JQuery, Java Script, CSS
Database	MySQLi
Application/Web Server	Apache 2
Integration/Web Services	FPDF
Database Server	MySQLi
User interface/ Look and feel	Yes
Charts/Graphical reports	Yes
Text/CSV/PDF reports	CSV/PDF
On demand custom reports	Yes
Development architecture (one/multi tier)	Multi tier
Role based user/user group/permission management	Role Based
Database migration	Yes
Database backup (manual/ daily/ scheduling)	Daily Schedule
Database replication (Synchronous/ Asynchronous)	Synchronous

Encrypted Password	Yes
Tracking user login details with date/time	Yes (date, time and IP address)
User activity tracking for each and every transaction	Yes (Add/Edit/Delete)
IP/MAC address tracking/ browser/ operating system tracking	IP
Runs on (protocol)	http

N. Component Reusability: The software/program administration and reuse allow adopting, customize, standardize and integrate reusable components based on the satisfactory properties[4]. E-HE is designed with the concept of component reusability. Here are the components which are reusing again and again in the system.

- 1: CheckAuth
- 2: getPermissions
- 3: addActivity
- 4: Sort
- 5: GetPage
- 6: SearchRecords
- 7: exportCSV
- 8: GetRecords
- 9: countRecords
- 10: Insert
- 11: Delete
- 12: Fetch
- 13: FetchList
- 14: Update
- 15: get_time_difference_php
- 16: realScape
- 17: printMessage
- 18: Activate
- 19: deActivate
- 20: status
- 21: getActions
- 22: Reset
- 23: get_Password
- 24: navigation
- 25: sendEmail
- 26: LoginInfo

III. METROLOGY

In this research we have observed the efficiency of work done before and after the introduction of E-HE system and the promising results were observed for quarter 3rd and 4th for all seven cases. In quarter 1st and 2nd we observe less tasks performed by standalone software whereas for quarter 3rd and 4th after the introduced of E-HE system we have observed enormous increase in performance for the completion of jobs done. In our observation tasks done by the finance department in first and second quarter is 132 and 134 respectively whereas tasks done in quarter 3 and 4 were 290 and 310 respectively. Tasks done by HR department for quarter 1, 2, 3, 4 were 102, 121, 210, and 274 respectively. Tasks done by Registrar office for quarter 1, 2, 3 and 4 were 92, 87, 230 and 240 respectively. First two quarter the tasks that are completed by the VC Office are 72 and 78 respectively whereas rest two quarter the tasks completed are 201 and 205 respectively.



For examination department the tasks that are completed in first and second quarter are 102 and 110 respectively while for next two quarters tasks done are 265 and 295 respectively. Tasks done by store for 1st and 2nd quarters are 184 and 196 respectively whereas for 3rd and 4th quarters 360 and 406 respectively. Finally for library tasks done in quarter 1st and 2nd are 135 and 129 respectively whereas for quarter 3rd and 4th are 260 and 272 respectively. Finally we observe an enormous increase of tasks completion after using E-HE system for all the seven departments. The table 2 shows increasing number of tasks completion for last two quarter where we introduced E-HE system.

Table. 2 E-HE System

E-HE Tasks				
Department	Quarter 1 (Jan - March)	Quarter 2 (April - June)	Quarter 3 (July - Sept.)	Quarter 4 (Oct. - Dec.)
Finance	132	144	290	310
HR	102	121	210	274
Registrar office	92	87	230	240
VC Office	72	78	201	205
Examination	102	110	265	295
Store	184	196	360	406
Library	135	129	260	272
Total Tasks (Quarter-Wise)	819	865	1816	2002

IV. RESULTS ANALYSIS

Higher Education Institutions has the many sections, but we have chosen seven departments which include Finance, HR, Registrar office, VC Office, Examination, Store, and Library. Before the E-HE each department was using the standalone software. Standalone software works offline with their independent database. Data updating in standalone software is very time consuming and un-serialized process. For example if we want to change the last name of a student then we need to do this specific task for all the sections standalone software, and many more complexity will arise. E-HE is design for the purpose of solving the all the problem which was the faced in case of standalone software. E-HE has the centralized database, every information is maintained in a time sensitive manner. Report management is very strong in the E-HE, when we want a single report compiled from the different sections. The number of tasks completion before and after the introduction of E-HE system for all the seven departments as shown in figure 14.

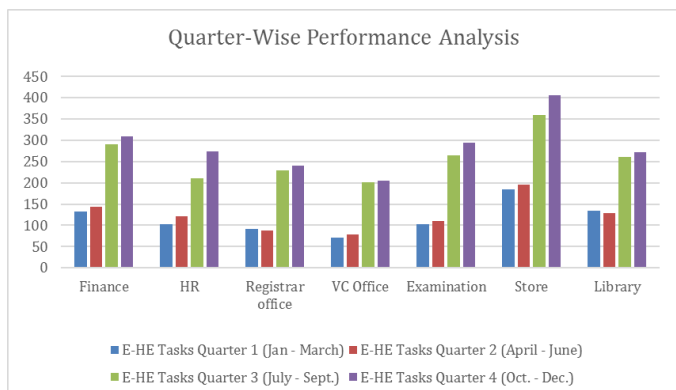


Figure. 14: Quarter-Wise Performance Analysis for Higher Education ERP

This is the flow infrastructure of activities and if done in this manner can help to achieve a reliable, smart and secure ERP. E-HE is also following this paradigm.

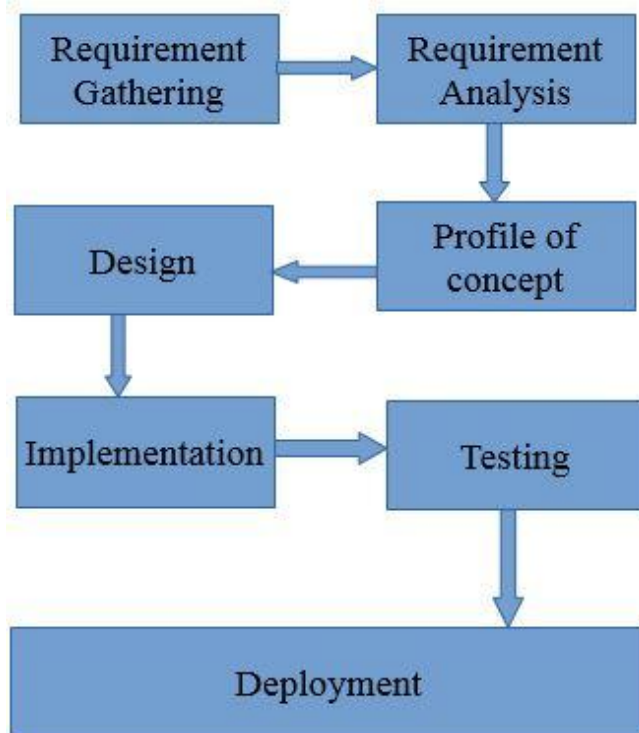


Figure 15: Flow Infrastructure of Activities

V. CONCLUSION

This research paper suggests that the E-HE system internally related to an educational functionality which is necessary for the higher education system. Our system is designed for organizational structure involved in an educational strategy, policy, workflow, and interrelated departments (Examination, Finance, Library, Academics, Helpdesk, Admission) within their business process. This paper well built for every academic justification that can achieve a fully automated and control system for an effective management process. E-HE is already implemented in the Glocal University that has been operating every desirable functionality for higher education. Moreover, in the next phase, we will make this more stable and extremely powerful, just like we want to shift our database to a new efficient database that will give a better and economical improvement in the system.

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