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KEEPING PHASE WITH DIGITAL DEVELOPMENT: DATA NETWORKING OF THE MUNICIPALITY OF HAGONOY, BULACAN

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Abstract: **The Municipality of Hagonoy is one of the rural towns of the province of Bulacan that envisions to be a progressive and happy town by providing high quality, fast and efficient government services to its people. At this present times, the services being rendered by the municipality involves traditional or conventional data processes and transactions. During the practicum period, the researcher observed some problems in the operations of the municipal offices such as recurrent forwarding of documents, insufficient means of file transfer, physical sharing of electronics peripherals and gradual preparation and formulation of tasks. As a result the researcher developed a design of a local area network that will address the difficulties in their current systems enabling high quality, fast and efficient public service that is vital to the rapid achievement of their vision. The researcher gathered information through observation, interviews and review of related theories and ideas from various literature and research studies. The researcher conducted an inventory of all electronic devices in the different offices in the municipality. The researcher also conducted a review of the existing floor plan of the municipality and planned the design of the network layout and conducted a study to identify the hardware, software and network requirements necessary in the completion of the project. The researcher considered the full implementation of the project which leads to a five-year development plan consisting of the phase by phase design of the network. In addition, the researcher developed the structured cabling design of the network. The next steps involves the assigning of the corresponding IP addresses on the network devices and thorough testing to check for possible adjustments to improve the design. Lastly, the researcher administered an evaluation to determine the acceptability and feasibility of the project. The researcher believed that the project has met its objectives and will be able to help the municipality in ensuring its vision to be a progressive and happy town by providing high quality, fast and efficient government services that will keep them in phase with digital development across municipalities in the country.**

Keywords: **Accessibility, Accuracy, Adaptability, Authorization, Availability, Bandwidth, Consistency, Credibility, Data Normalization, Extensibility.**

1. INTRODUCTION

In this new digital era, people from all walks of life establish communication by means of modern and conventional devices which include computer, telephones or mobile phones, telegraphs and others. Exchange of ideas, conveyance of information, correspondence and other methods of communication are done using the said devices. Thus, high standard transmission and reception of data becomes significantly essential to institutions including the government.

The Municipality of Hagonoy, Bulacan is a government institution established in 1671, which envisions to be a progressive and happy town. Aspiring to be the center of aqua-culture in the region with pro-God, environment-caring, physically and mentally healthy productive and law-abiding citizenry served by model and responsive government.

In the pursuit of its vision, the initiatives and efforts of the local government clearly defines the future of Hagonoy and its people in the achievement of its physical, environmental, social and economic development in the future.

The municipality of Hagonoy aims to provide high quality, fast and efficient government services to its people. The services rendered by the municipality involves traditional or conventional data processes that hinder to the rapid achievement of their vision.

At this time, the emergence of the digital era is very much helpful in delivering the services that involve data processing. The use of wire and wireless communication is indeed a great help for the various type of services provided by an office especially public service such as a municipality. Nowadays, public buildings in remote areas like the municipality of Hagonoy can be connected through wi-fi, however the stability and strength of the connection should be taken with great considerations.

To keep in phase with digital development that will enhance the services offered by the municipality with regards to transactions involving data communication, the researcher came up with the idea of developing a local area network which will be designed solely for municipal services and office use which will offer a number of advantages to the constituents and the economy. The municipal services includes works from fire officers, police officers, planners, engineers and librarians. While the municipal offices are the Treasurer's office, Assessor's office, Accounting office, Budget office, Planning and Development office, Human Resource Management office, Civil Registrar office, Health office, Nutrition office, Social Welfare and Development office and the likes.

Research Problem:

The general objective of the study is: How may a local area network be designed and developed to enable the delivery of high quality, fast and efficient public service of the Municipality of Hagonoy, Bulacan to its constituents?

In particular, the study sought answers for the following specific questions:

1. What are the current processes that are utilized by the different offices of the municipality in terms of paper and electronic processing of documents?

2. What are the innovations that must be considered to enhance the overall procedures being used by the municipality?

3. What are the hardware, software and development tool requirements necessary for the development of the network design?

4. What are the features of the developed network design that will enable high quality, fast and efficient public service of the Municipality of Hagonoy?

5. How acceptable is the network design in terms of the following qualitative characteristics:

5.1 availability;

5.2 usability;

5.3 reliability;

5.4 relevance and

5.5 presentation quality

Integrated Review of Related Literature and Studies:

In this present times, adaptation to the challenges of the fast growing technology advancements shall be taken into consideration for it enhances efficiency and effectiveness of services being rendered to the community. However, financial aspect shall also be regarded in a government institutions for they have limited budget allocation and narrowed prioritization inclined with advanced technological adaptation.

Worker productivity can also increase by giving city officials such as police officers and fire-fighters remote access to information. Municipal broadband helps public servants in the performance of their job as it also helps in bridging the gap brought by the digital divide through public access to information. This allows low-income families, travelers, and city officials to access important information without budgetary considerations in mind.

To address the difficulties of building reasonable systems, it includes the capacity to imagine elective and imaginative arrangements which joins the acts of the individuals who construct and utilize them and the mechanical affordances of remote systems that is connected to neighborhood concerns and practices. There is such a large number of nations who

have adjusted to the new time of mechanical headways, regardless of whether created or building up their private subjects are getting a charge out of the guarantees of nowadays equipment and gadgets, programming and applications, gear and systems.

Advanced correspondences particularly broadband interchanges have assumed an imperative part in the accomplishment of financial development and improvement of many created nations and was spurred to acquaint this innovation with the provincial district to open more prominent conceivable outcomes of progress in the present frameworks they have.

Nearby foundations have additionally considered that the genuine situation of this mechanical period requires associations to move from customary correspondence frameworks into electronic correspondence forms that will enhance conveyance of basic capacity of taxpayer supported organizations and give proficient and compelling ICT foundation and data frameworks to the general population.

For the most part, government workers can carry out their occupations all the more proficiently on the off chance that they approach city organize out in the field. The researcher became more challenged to continue the study since the House of Representatives have tackled that Information and Communications Technology have an important role in nation building. This will serve as backbone to establish good governance of the local government units for it will ensure availability, diversity and affordability of different product and services of the municipality.

By methods for significant advances, the volume of business related to administrations gave by neighborhood governments could be made more proficient, powerful, straightforward, responsible and fair. A structure for all computerization was affirmed and embraced here in the Philippines, the Government Information Systems Plan (GISP) which covers key administrations and operations. Four city governments: Caloocan, Muntinlupa, Antipolo and Tagaytay utilizes effectively ICT applications which decides the level of utilization of ICT and how their computerization endeavors encourage great urban administration. People must be urged, guided or pushed to adjust the data and information period. Adjustment includes subsidizing issues, framework upkeep, framework's ease of use, specialized preparing, and expanding work requests upon staff.

Notwithstanding, consider that the objective of this investigation is not simply to be keep in stage with innovative improvement additionally to utilize ICT an apparatus for accomplishing open part estimations of proficiency, adequacy, value, and responsiveness. Exponential development on the measure of worldwide information which prompts the rise of the huge information time which draws the enthusiasm of numerous businesses and in addition scholarly and government organizations. Advances of distributed computing, long range informal communication and the web of things has made the measure of information to increment consistently and gather at an extraordinary speed which brought forth the huge information. In this time, the information unit is not any more the Gigabytes (GB) and Terabytes (TB), however rather the Petabytes (1PB = 210TB), Exabytes (1EB = 210PB), and Zettabytes (1ZB = 210EB). The development of this new innovative period influenced specialists to progressively understand that this gigantic measure of data has benefits for understanding client needs, enhancing administration quality, and foreseeing and avoiding dangers.

The information quality standard is made out of five measurements of information quality - accessibility, ease of use, unwavering quality, pertinence, and introduction quality. In this study the researcher was able to acquire an overview of how fast the technology evolves in this current era that really affect the existence of men in various aspects. One of such is the adaptation of their workplace to technological advancements that had a great effect on government institutions for they oversee projects on different areas involving innovations. Moreover, it has been a great challenge for the researcher to persuade the administrators of the local government of Hagonoy of how essential is the study to public service.

2. METHODOLOGY

The study has applied mixed methodologies of action, descriptive and developmental research.

The researcher considered the concepts of an Action Research that describes a broad diversity of analytical and evaluative research methods which intend to identify the problem in an organization and develop practical solutions to address them as soon as possible.

The researcher has adopted the research method in examining the problems of the Municipality of Hagonoy regarding their current systems in utilizing traditional or conventional data processes that hinder to the rapid achievement of their vision. This study also used the descriptive method of research that focused on the present condition of the Municipality of Hagonoy as the cooperating industry. This method is used to obtain information concerning the current status of a

phenomena to describe "what exists". After the design of the proposed study was developed, various parameters have been tested and each result have been evaluated to ascertain the effectiveness of the developed design.

The study also used developmental research that involves organized study of plan, development and evaluation of systems and products based on the indicated criteria of internal consistency and effectiveness.

The researcher has adopted the research method in developing the network design for the Municipality of Hagonoy to provide high quality, fast and efficient public service to the people. The network design is guided by a set of criteria based on research framework by Cai and Zhu (2015), which is composed of five dimensions of data quality – availability, usability, reliability, relevance and presentation quality. The first four dimensions are regarded as indispensable inherent features of data quality that is expected from a network and the final dimension is an additional property that improve customer satisfaction.

The researcher used clustered sampling to determine the respondents of the study. The researcher divided the employees into separate clusters and the cluster samples were obtained using simple random sampling. The respondents of the study were composed of one (1) Municipal Engineer, one (1) Assistant Municipal Engineer, one (1) Engineer III, one (1) Architectural Designer, two (2) Building Inspectors, one (1) Clerk, three (3) Administrative Aides 1, six (6) employee-by-job-order (EBJO) and four (4) trainees with a total of twenty (20) respondents. The Likert scale was used to measure and interpret the evaluation results of the study.

Rating	*Descriptive Interpretation*	*Range of Weighted Mean*	*Description*
5	Highly Acceptable	4.51 – 5.00	The respondent really believes that the developed system is highly recommended for implementation.
4	Acceptable	3.51 – 4.50	The respondent is satisfied in the performance of the networkdesign conceming its criterion.
3	Neutral	2.51 – 3.50	The respondent is neutral in that criterion and believes that some adjustments were to be made, it is possible to be implemented.
2	Unacceptable	1.51 – 2.50	The respondent is skeptical in the performance of the network design in that particular criterion.
1	Highly Unacceptable	1.0 – 1.50	The respondent believes that the proposed network design failed in that criterion.

After network design was evaluated by the respondents, the gathered data were analyzed by the researcher thru the computation of the weighted means. The results of the analysis were interpreted by the researcher to determine the level of acceptability and feasibility of the study.

Significant Findings

The purpose of this study is to develop a Local Area Network for the Municipality of Hagonoy, Bulacan that will enable high quality, fast and efficient public service of the Municipality of Hagonoy.

The findings of the study are summarized in the following statements:

1. What are the current processes utilized by the different offices of the municipality in terms of paper and electronic processing of documents?

The current systems and technologies being used in each of the municipal offices involve the old-fashioned type of administration, coordination, supervision, as well as management and control. The administrators literally monitor the functions of each of their employees in all aspects of public service. At the level of the ordinary employees, it has been a normal part of their daily tasks the issues of manual forwarding and transfer of data of one office/employee going to the other. The physical sharing of electronic peripherals and the insufficient means of file transfer specifically for large volume of data needed by planners and engineers which gave them no other choice of using flash drives that causes low security and confidentiality of files and slows transaction procedures. Another concern is the manual encoding, storage and retrieval of pertinent documents in the archive and record section of the respective offices. Other transactions involve recurrent forwarding of documents from one office going to the other that have to be undergone until the completion of their requests or transaction that slows down the processes of public service.

2. What are the innovations that must be considered to enhance the overall procedures being used by the municipality?

The researcher considered the design and development of a data network that will enable the Municipality of Hagonoy to operate and process transactions through the use of technology advancement minimizing repetitive procedures undergone by both of its employees and constituents enabling high quality, fast and efficient public service.

The Local Area Network will help the Municipal Government to promote and ensure efficient delivery of public services to its constituents through innovative transaction of data in all of its offices.

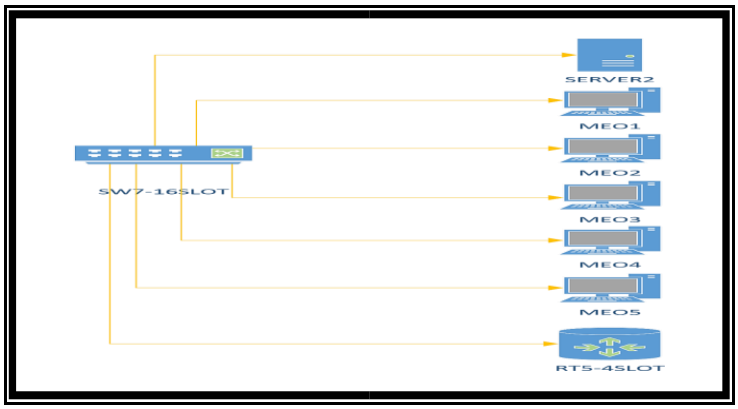

Figure 1. Phase I - Cabling Structure

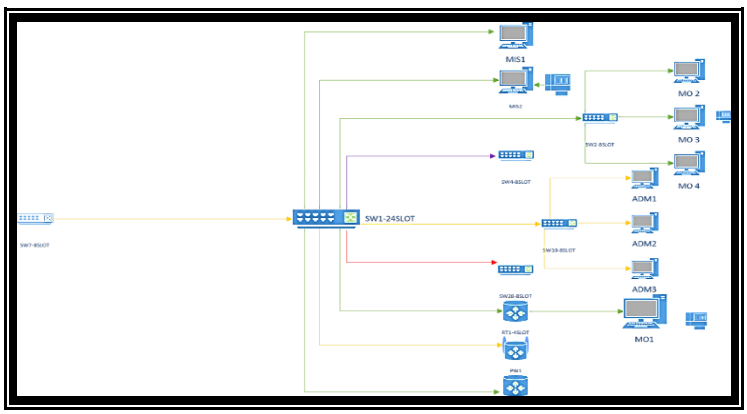

Figure 2. Phase II A - Cabling Structure

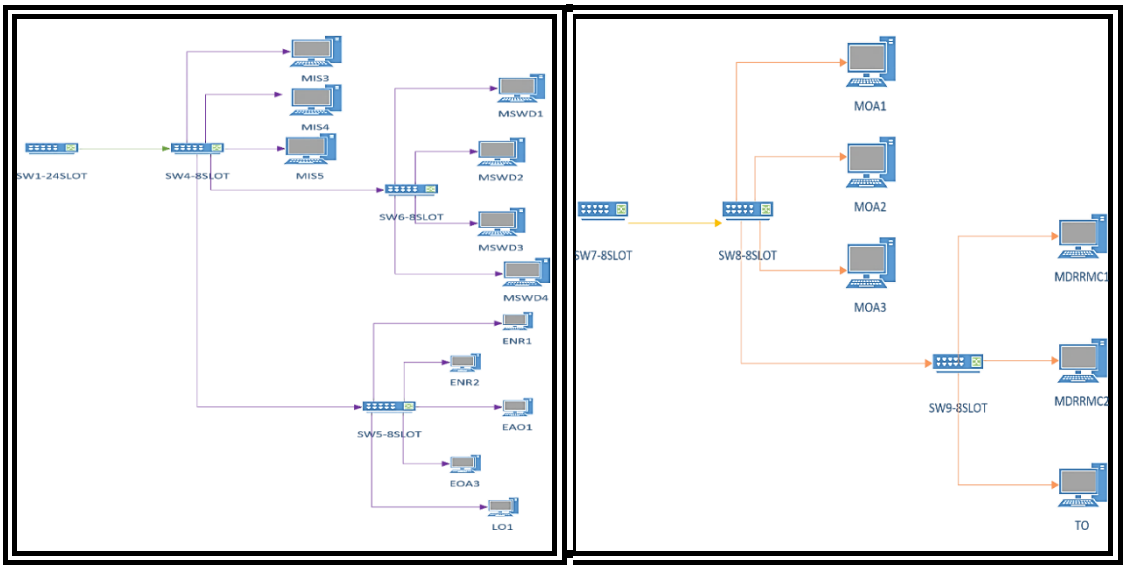

Figure 3. Phase II B - Cabling Structure

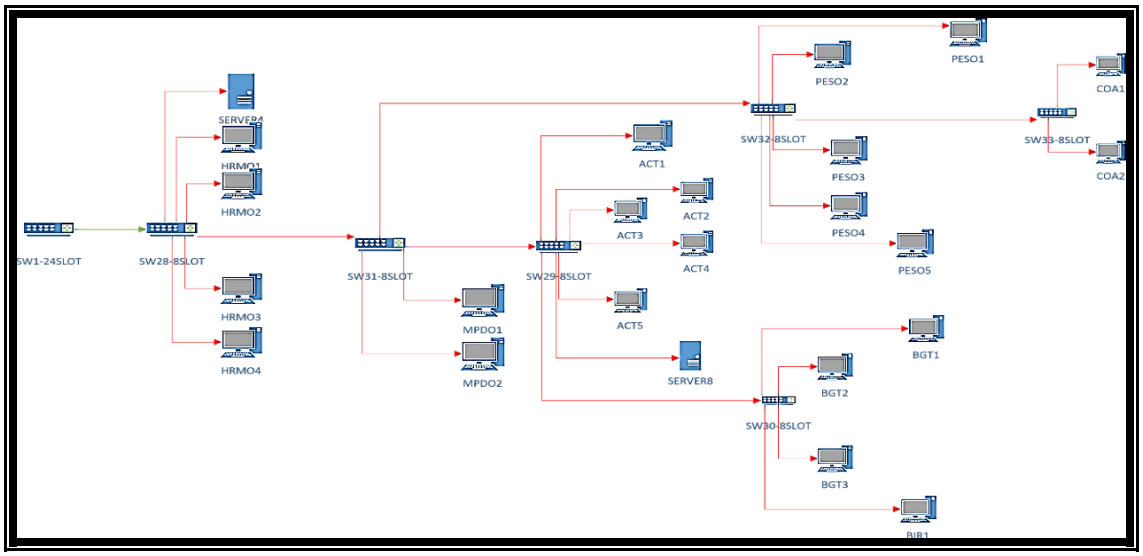

Figure 4. Phase III A - Cabling Structure

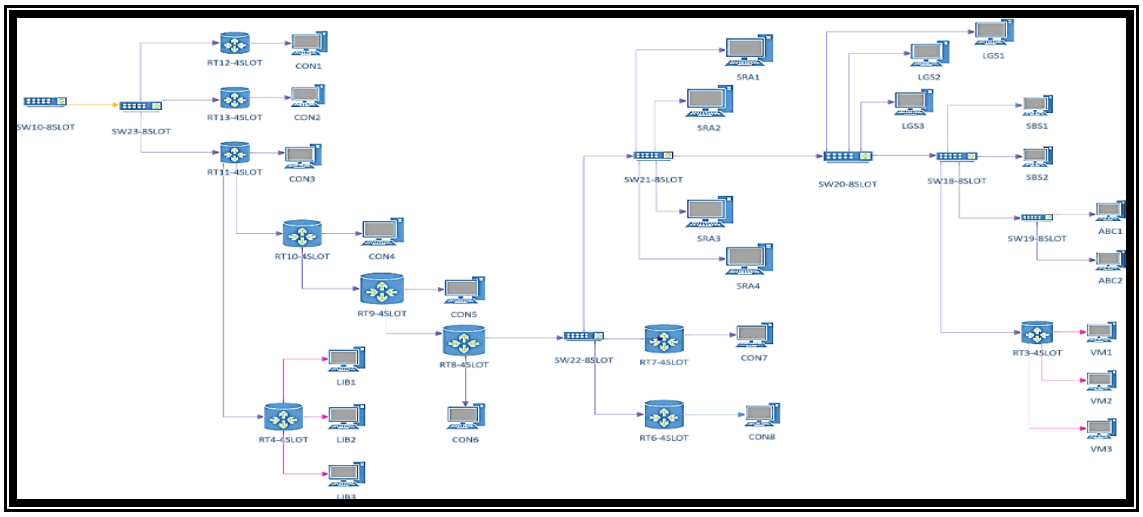

Figure 5. Phase III B - Cabling Structure

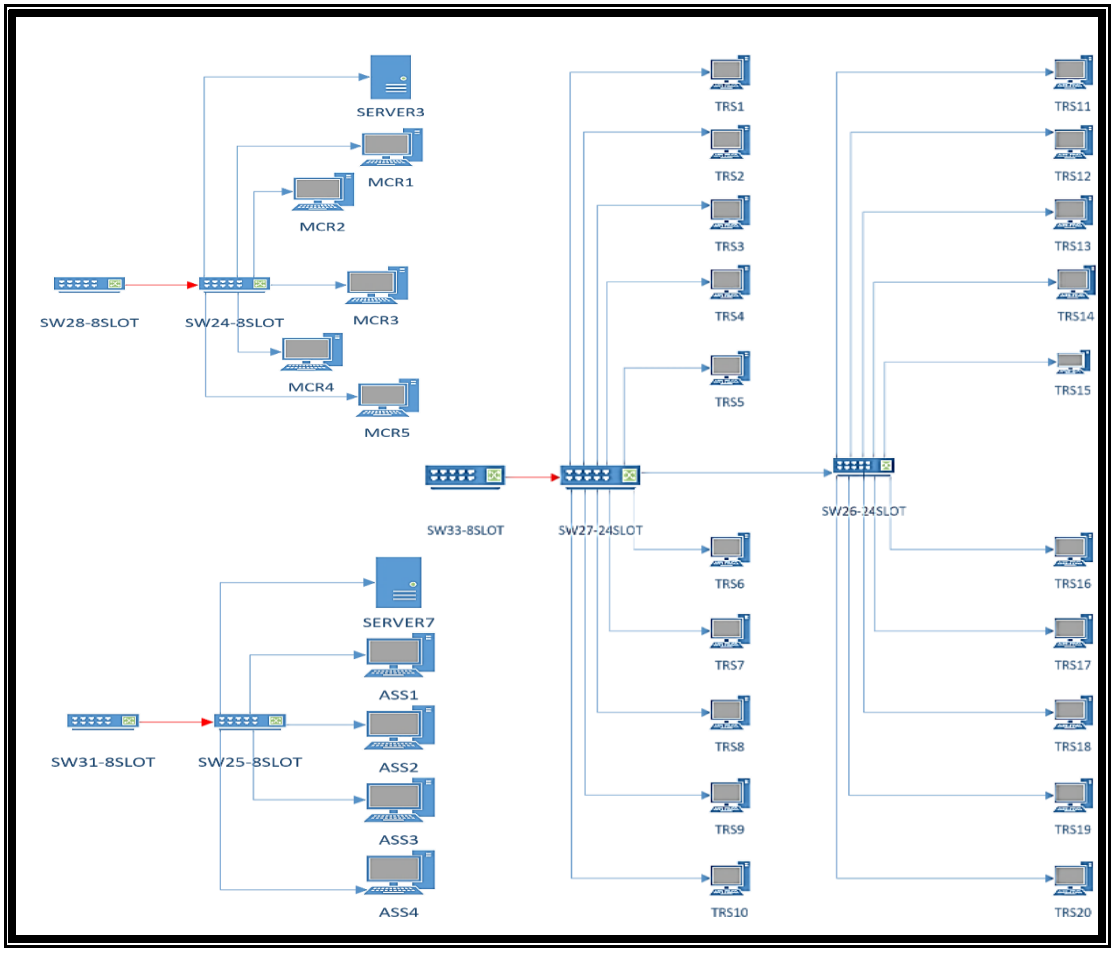

Figure 6. Phase IV A - Cabling Structure

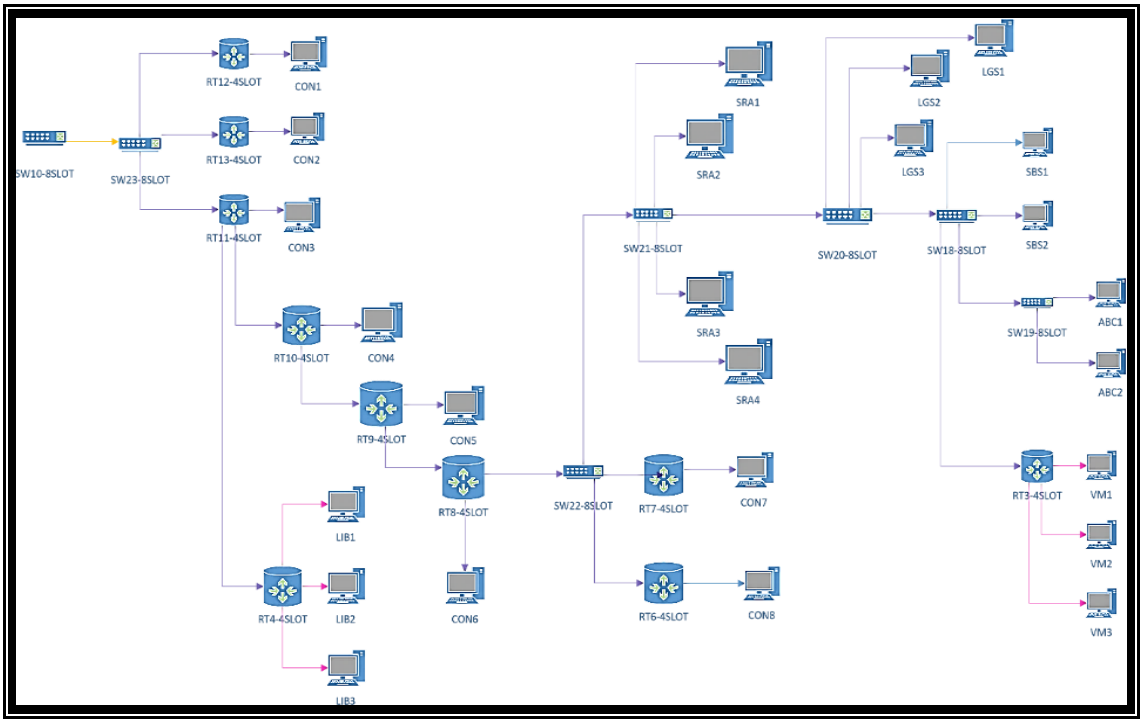

Figure 7. Phase IV B - Cabling Structure

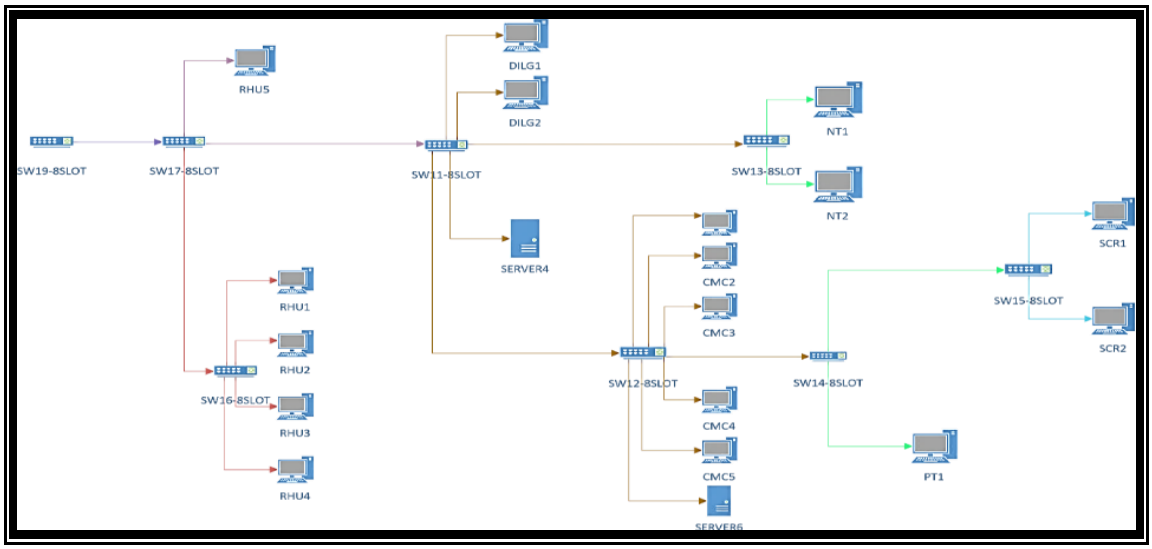

Figure 8. Phase V A - Cabling Structure

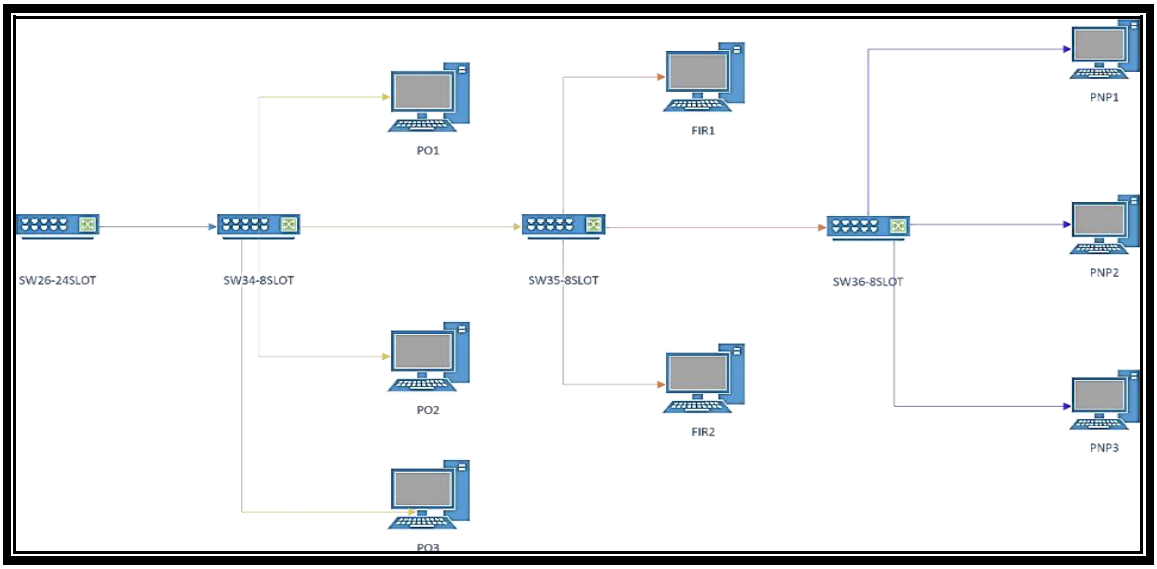

Figure 9. Phase V B - Cabling Structure

3. What are the hardware, software and development tool requirements necessary for the development of the network design?

For the hardware requirements, the researcher recommends the use of a switch instead of a hub because currently hub is becoming obsolete and replaced by more advanced communication devices. Switch is like a Hub but built in with advanced features and it uses physical device addresses in each incoming messages so that it can deliver the message to the right destination or port. A switch does not broadcast the received message to entire network, rather before sending it checks to which system or port should the message be sent. In other words switch connects the source and destination directly which increases the speed of the network.

The other device that used to connect a LAN with an internet connection is called router which is use to share a single internet connection to multiple computers and to other LANs. The researcher also recommends the use of the category 5 (CAT5) cable which supports computer network and telephone traffic. CAT5 can run at higher speeds and greater lengths. Cable is one way of transmission media which can transmit communication signals. Also, the researcher uses the standard type of physical connector for network cables which is known as the Registered Jack 45 (RJ45).

For the software requirements, the researcher recommends the use of Microsoft Windows 7 or any of its higher versions for the operating system of the computer due to its familiarity to most users.

For the network layout development the researcher make use of AutoCad Architecture which permits architectural designers to draw 3D objects, such as walls, doors and windows, with more intelligent data associated with them rather than simple objects, such as lines and circles. The data can be programmed to represent specific architectural products sold in the construction industry, or extracted into a data file for pricing, materials estimation, and other values related to the objects represented. The researcher also use Microsoft Visio 2013 to create the Structured Cabling design and installation of the cabling systems that will support multiple hardware uses systems and be suitable for today's needs and those of the future. With a correctly installed system your requirements of today and of tomorrow will be catered for and whatever hardware you choose to add will be supported. Microsoft Visio can be used to create simple or complicated diagrams. It offers a wide variety of built-in shapes, objects, and stencils to work with. The driving idea behind Visio is to make diagramming as easy as possible for the user.

Lastly, the researcher utilized Packet Tracer which is an innovative network configuration simulation tool that is used for practicing most of the networking configurations. It gives an experience that is close to real time devices.

4. What are the features of the developed network design that will enable high quality, fast and efficient public service of the Municipality of Hagonoy?

This study presents a five-year development plan composed of five phases needed to improve the current operating procedure in the Municipality. Phase 1 will focus on the design of a local area network on the MEO which was considered for implementation of this study. Phase 2A of the design includes all the offices on the second floor of the main building such as the MIS Office and Mayors Office, Phase 2B includes all the offices of both executive and extension building ground floor. Phase 3A of the design includes all the offices on the second floor of the Finance Building and Phase 3B includes all the offices on the second floor of the Sangguniang Bayan Building. Phase 4A of the design includes all the offices on the ground floor of the Finance Building and Phase 4B includes all the offices on the ground floor of the Sangguniang Bayan Building. Lastly, Phase 5A design includes all the offices at the left wing or left side of the municipality. This includes the Senior Citizen's Office, Nutrition and Physical Therapist Offices, COMELEC and DILG Offices and the Rural Health Unit 1 (RHU 1) and Phase 5B includes all the offices at the right wing or right side of the municipality which includes the Post Office, Fire and PNP Stations.

Administration, coordination, supervision, management and control of the various data transactions being processed in the different offices of the municipality may be applied as well as the consolidation and conversion of paper files into digital forms.

The workers' productivity will also be enhanced by giving them remote access to information. They can avoid the use of flash drives to forward or transfer electronic data from one computer unit going to the other as well as from one office going to another which causes low security of files and slow transaction procedures.

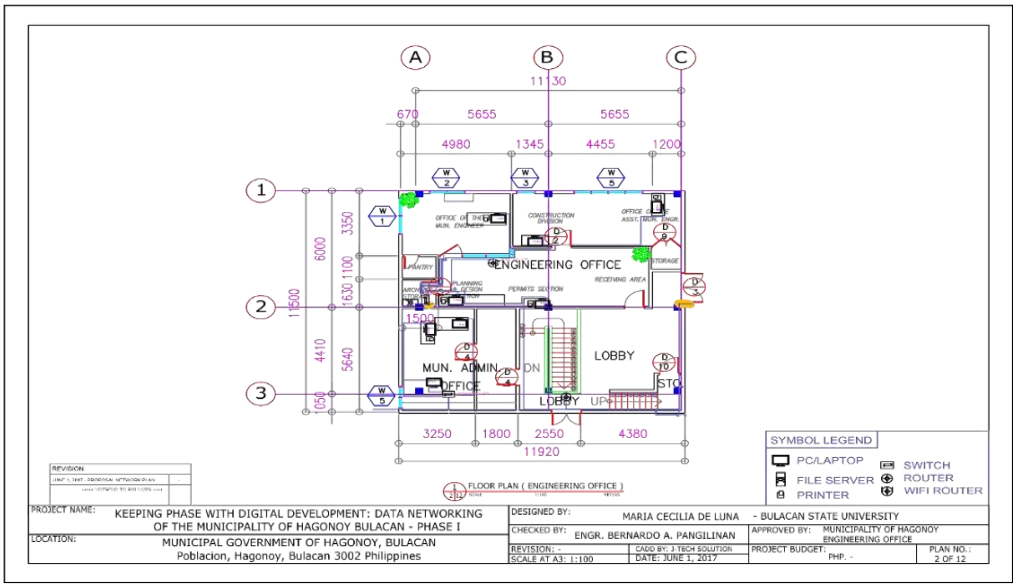

Figure 10. Phase I - Network Layout Design

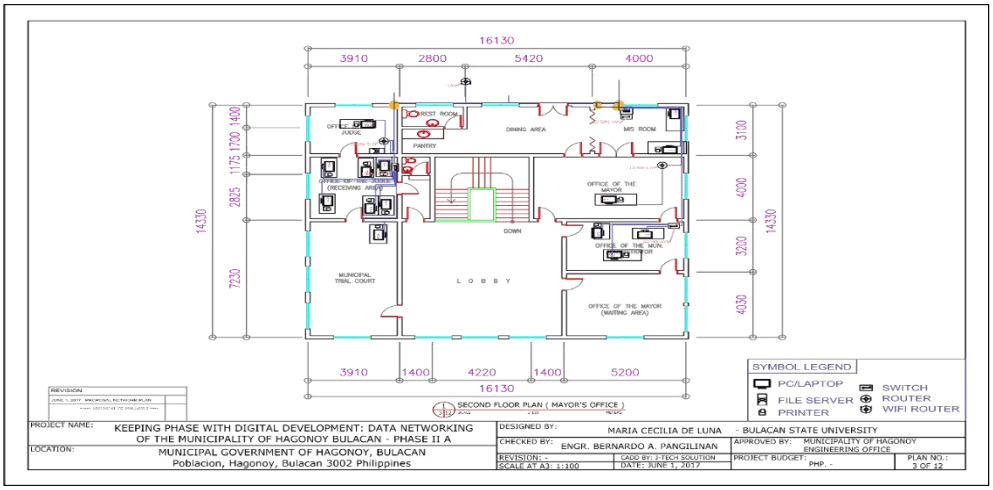

Figure 11. Phase II A- Network Layout Design

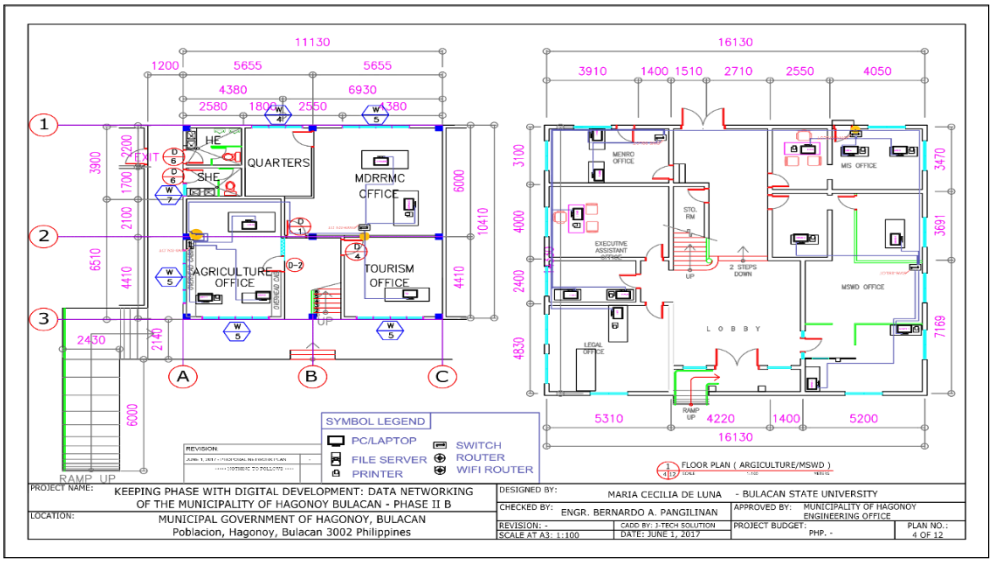

Figure 12. Phase II B- Network Layout Design

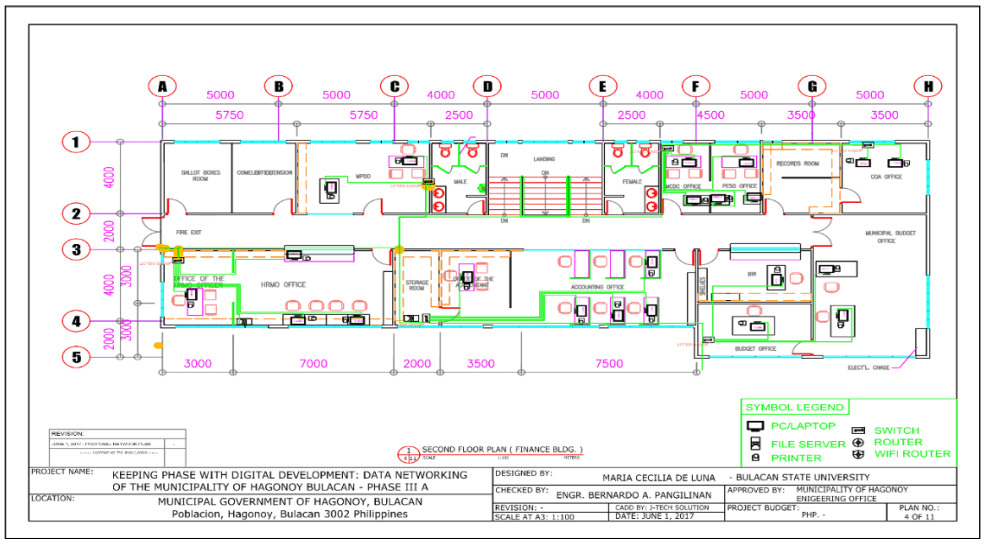

Figure 13. Phase III A- Network Layout Design

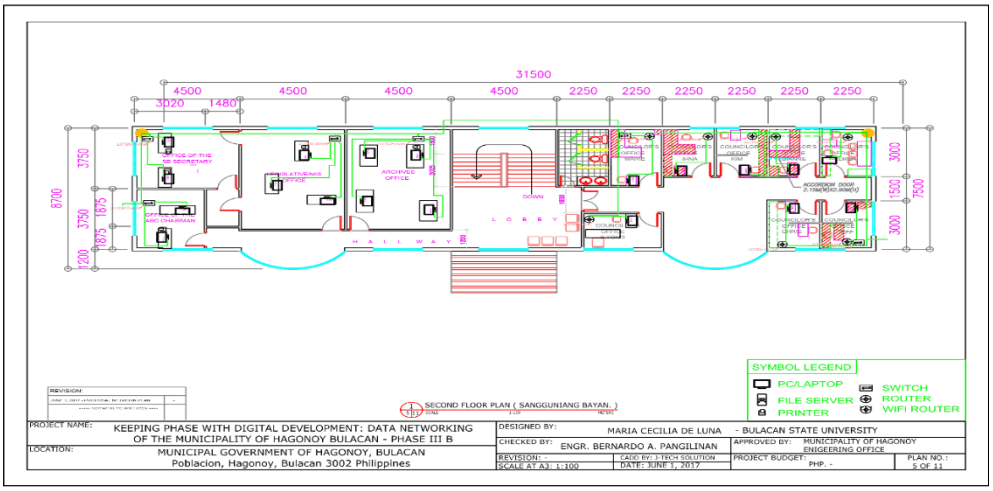

Figure 14. Phase III B- Network Layout Design

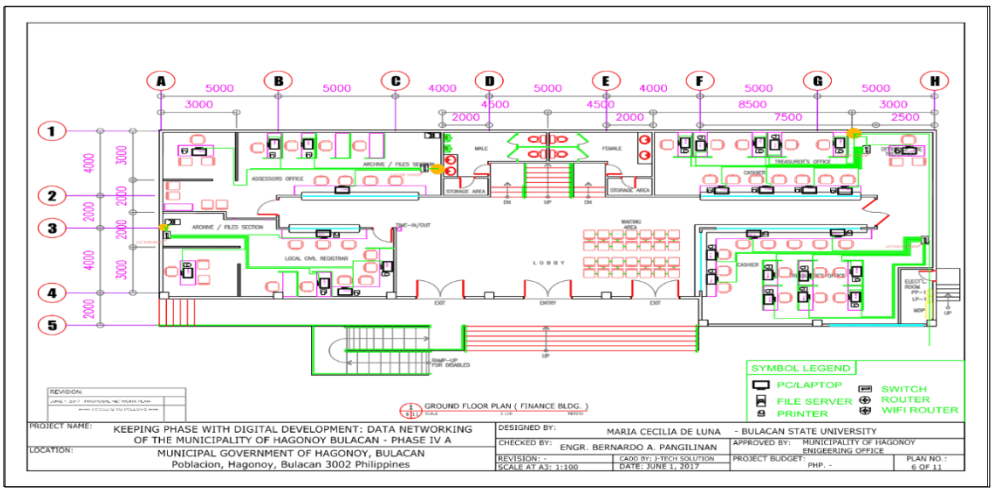

Figure 15. Phase IV A- Network Layout Design

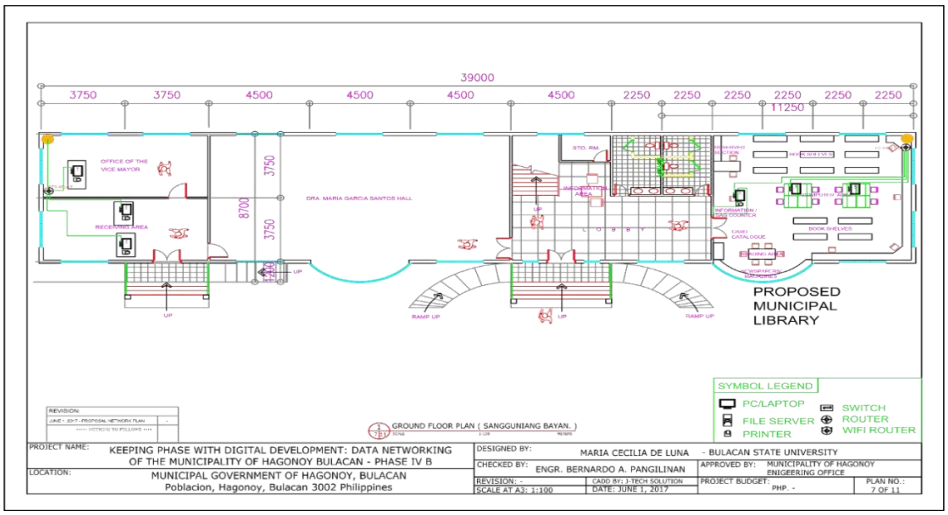

Figure 16. Phase IVB - Network Layout Desig

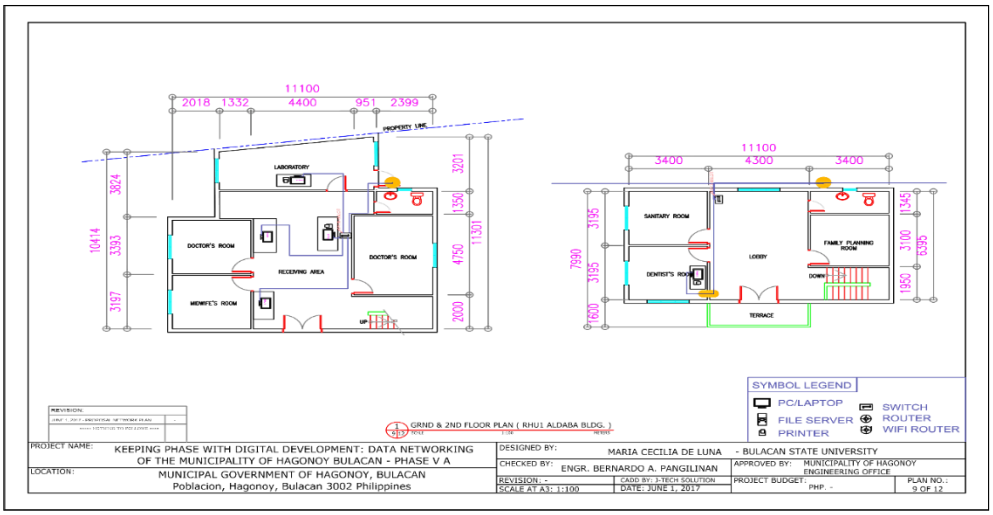

Figure 17. Phase V A - Network Layout Design

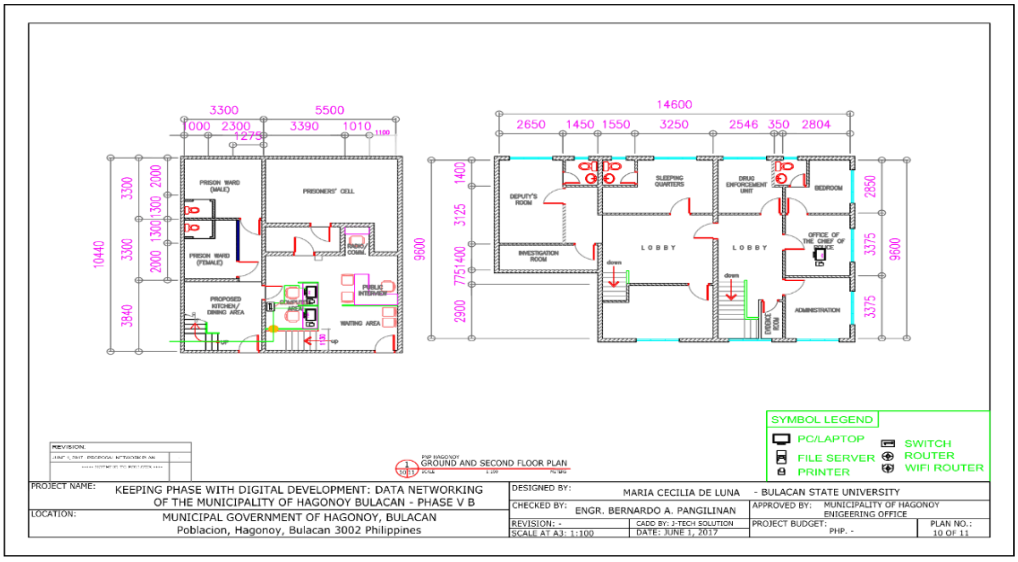

Figure 18. Phase V B - Network Layout Desig n

5. How acceptable is the network design in terms of the following qualitative characteristics; Availability, Usability, Reliability, Relevance, Presentation Quality?

The results of the project's evaluation were interpreted as "highly acceptable" in terms of relevance and "acceptable" in terms of availability, usability, reliability and presentation quality. Overall, the evaluation results were interpreted as "acceptable". The respondents of the survey believe that the project will significantly improve the current systems they have in both paper and electronic processing of documents. The respondents also agree that the level of efficiency among their co-employees will definitely improve after the implementation of the project.

Evaluation of the Project's Level of Acceptability

The researcher conducted an evaluation by means of a survey to determine the level of acceptability and feasibility of the project. The respondents rated the availability, usability, reliability, relevance and presentation quality of the network design using the provided evaluation forms structured in Likert format.

After the evaluation, the researcher analyzed the collected data by computing for the weighted means and interpret using Likert scale to determine whether the results are highly acceptable, acceptable, neutral, unacceptable or highly unacceptable.

Table 1 presents the frequency distribution and descriptive measures of the project's level of acceptability in terms of availability.

Table 1: Frequency Distribution and Descriptive Measures of the Project's Level of Acceptability in Terms of Availability

Evaluation Criteria	Frequency					Mean	Descriptive Interpretation
	5	4	3	2	1		
1. Accessibility (It refers to the difficulty level for users to access the network and obtain data.)	8	11	1	0	0	4.35	Acceptable
2. Authorization (It means whether an individual or organization has the right to have network access and use the data obtained.)	11	9	0	0	0	4.55	Highly Acceptable
3. Timeliness (It refers to the time delay from data generation and acquisition to utilization.)	1	16	3	0	0	3.90	Neutral
Total Mean						**4.26**	**Acceptable**

Table 2 presents the frequency distribution and descriptive measures of the project's level of acceptability in terms of usability.

Table 2: Frequency Distribution and Descriptive Measures of the Project's Level of Acceptability in Terms of Usability

Evaluation Criteria	Frequency					Mean	Descriptive Interpretation
	5	4	3	2	1		
1. Bandwidth (It refers to the degree of data usage.)	5	12	3	0	0	4.10	Acceptable
2. Data Normalization (It refers to the ability of the network to offer storage space and ensure the consistency of the data being stored.)	6	14	0	0	0	4.30	Acceptable
3. Credibility (It refers to the objective and subjective components of the believability of a source or message.)	10	9	1	0	0	4.45	Acceptable
Total Mean						**4.28**	**Acceptable**

Table 3 presents the frequency distribution and descriptive measures of the project's level of acceptability in terms of reliability.

Table 3: Frequency Distribution and Descriptive Measures of the Project's Level of Acceptability in Terms of Reliability

Evaluation Criteria	Frequency					Mean	Descriptive Interpretation
	5	4	3	2	1		
1. Accuracy (It states whether the data provided are accurate and will not cause ambiguity.)	9	10	1	0	0	4.40	Acceptable
2. Consistency (It states that after data have been processed, their concepts, value domains, and formats still match as before processing or during a certain time, data remain consistent and verifiable and the data from other data sources are consistent or verifiable.)	11	9	0	0	0	4.55	Highly Acceptable
3. Integrity (It states whether the data format is clear and meets the criteria.)	6	13	1	0	0	4.25	Acceptable
Total Mean						**4.40**	**Acceptable**

Table 4 presents the frequency distribution and descriptive measures of the project's level of acceptability in terms of relevance.

Table 4: Frequency Distribution and Descriptive Measures of the Project's Level of Acceptability in Terms of Relevance

Evaluation Criteria	Frequency					Mean	Descriptive Interpretation
	5	4	3	2	1		
1. Adaptability (It means that the network is capable for interoperability with other systems.)	14	6	0	0	0	4.70	Highly Acceptable
2. Usability (It means that the downloading of data is enough for intended use.)	16	4	0	0	0	4.80	Highly Acceptable
3. Flexibility (It means the degree in which the data provided matches user's needs.)	17	3	0	0	0	4.85	Highly Acceptable
Total Mean						**4.78**	**Highly Acceptable**

Table 5 presents the frequency distribution and descriptive measures of the project's level of acceptability in terms of presentation quality.

Table 5: Frequency Distribution and Descriptive Measures of the Project's Level of Acceptability in Terms of Presentation Quality

Evaluation Criteria	Frequency					Mean	Descriptive Interpretation
	5	4	3	2	1		
1. Extensibility (It is a measurement of a piece of technology's capacity to append additional elements and features to its existing structure.)	9	11	0	0	0	4.45	Acceptable
2. Security (It involves the authorization of access to data in the network.)	7	13	0	0	0	4.35	Acceptable
3. Sustainability (It means that the network design can be easily monitored and maintained by the users.)	8	12	0	0	0	4.40	Acceptable
Total Mean						**4.40**	**Acceptable**

Table 6 presents the overall mean and descriptive interpretation of the project's acceptability.

Table 6: Overall Mean and Descriptive Interpretations of the Project's Acceptability

Evaluation Criteria	Mean	Descriptive Interpretation
Availability	4.26	Acceptable
Usability	4.28	Acceptable
Reliability	4.40	Acceptable
Relevance	4.78	Highly Acceptable
Presentation Quality	4.40	Acceptable
Overall Mean	**4.42**	**Acceptable**

3. CONCLUSIONS

The researcher developed a data network that enabled the Municipality of Hagonoy to operate and process transactions which significantly improved the current systems they have in both paper and electronic processing of documents. The degree of convenience for users to access the network was established as well as data & related information within the network have been obtained; the usefulness of data was identified as it meets the needs of the users; the network can be trusted; there have been correlation between data content and the user's expectations or demands and the network had offered satisfaction to the consumers. The LGU would have the advantage of being able to take a long term view and write of investments in a "DATA-NETWORKED MUNICIPALITY" as they bring their services to their constituents' right to the forefront of the latest advances in the field and the fastest growing technologies in our culture today.

4. RECOMMENDATIONS

In light of the findings and conclusion of the study, the following recommendations were drawn:

1. The Municipality of Hagonoy, Bulacan may avail of a better internet service provider or consider a higher subscription rates that offer large data storage and bandwidth.

2. The Municipality may also consider to upgrade the computer units with higher allocation of CPU and Ram as well as its peripherals such that every offices can get along with technology advancements that will definitely boost the performance of the network.

3. The Municipality may also consider the five-year development plan presented phase by phase for the project implementation.

4. Industry and other researchers may update and upgrade the network depending on the possible future requirement project.

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