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## **New Systems and Designs in the Construction of Professional and Amateur Astronomical Observatories (ProAm)**

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# New Systems and Designs in the Construction of Professional and Amateur Astronomical Observatories (ProAm)

Francisco A. Espartero<sup>1,2</sup>

<sup>1</sup> Area de Ciencia y Tecnología, International University of Valencia, Pintor Sorolla 21, 46002 Valencia, Spain.

<sup>2</sup> Observatorio Andaluz de Astronomía, 23680 Alcalá la Real, Jaén, Spain.

## ABSTRACT

A critical analysis of ten professional and amateur astronomical observatories, built between 2010 and 2015, has been carried out. In this analysis, different placement and engineering errors have been detected which have affected the operation of the facilities. As a result of this analysis, a set of practical solutions and applications to improve the performance of ProAm astronomical observatories has been presented. The study of climate conditions to ascertain the best placement for an observatory and new construction techniques have been taken into account for the construction of new astronomical observatories. Several of the solutions proposed have been applied and tested in six observatories built between 2013 and 2018, the results of which are presented in this work.

### Key Points:

New designs for amateur and professional astronomical observatories

Analysis of the study of environmental conditions for the location of observatories

Efficient and innovative solutions in the construction of astronomical observatories

## I. Introduction

Since Galileo Galilei used the telescope to observe celestial objects at the beginning of the 17th century, the protection and security of this optical instrument has been a constant worry for all astronomers (Hoskin, 2003). Over time, telescopes have evolved in size, precision and complexity, in such a way that the need to locate these instruments on suitable sites for optimum use is increasingly evident. The industrial revolution of the 18th century provided major advances which were applied to astronomy (Arcimis, 1878), but also, from this moment on, major elements which were harmful to astronomical observation began to appear in industrialised societies, such as environmental pollution and light pollution. (Comas, 1929).

From the 19th century, studies began on the ideal placement of observatories to minimize the elements which could harm the proper operation of telescopes as much as possible (Arcimis, 1879). Meteorological conditions and accessibility are also very important factors which are being increasingly considered (Galadí-Enriquez, 2001), which is why before deciding the placement of an observatory, it is essential to carry out a site-testing campaign (IAC, 2019). Technical advances and improvements in construction are of particular interest in the building of observatories, which start to stand out as very technically advanced engineering works. These are designed for each instrument and the location of observation.

Astronomical observatories have evolved together with human beings. Ancient civilisations mixed myths and religious beliefs with the observation of the stars (Sagan, 1980; Avilés & Hoskin, 2002), in such a way that astronomical observatories were also often religious temples. (Hoskin, 2003). From the Ziggurat of Ur (Babylon), until the present day, observatories have been developing along with the technical advances of each culture. We currently have astronomical observatories in space, giant observatories on land, and even autonomous robotic observatories (Castro-Tirado, 2010; Castro-Tirado et al. 2012) which can work independently or as a network as a whole. (Castro-Tirado et al. 2014).

Astronomical observatories are made up as a complex of facilities which provide support to astronomical research in different ranges of the electromagnetic spectrum (Moles et al. 2010), though currently, and with the help of new techniques and detectors, gravitational waves, cosmic rays, and even neutrinos can be studied. Until now, the buildings of astronomical observatories have been a set of facilities which allow a telescope and its accessories to be used efficiently (Espartero, 2013).

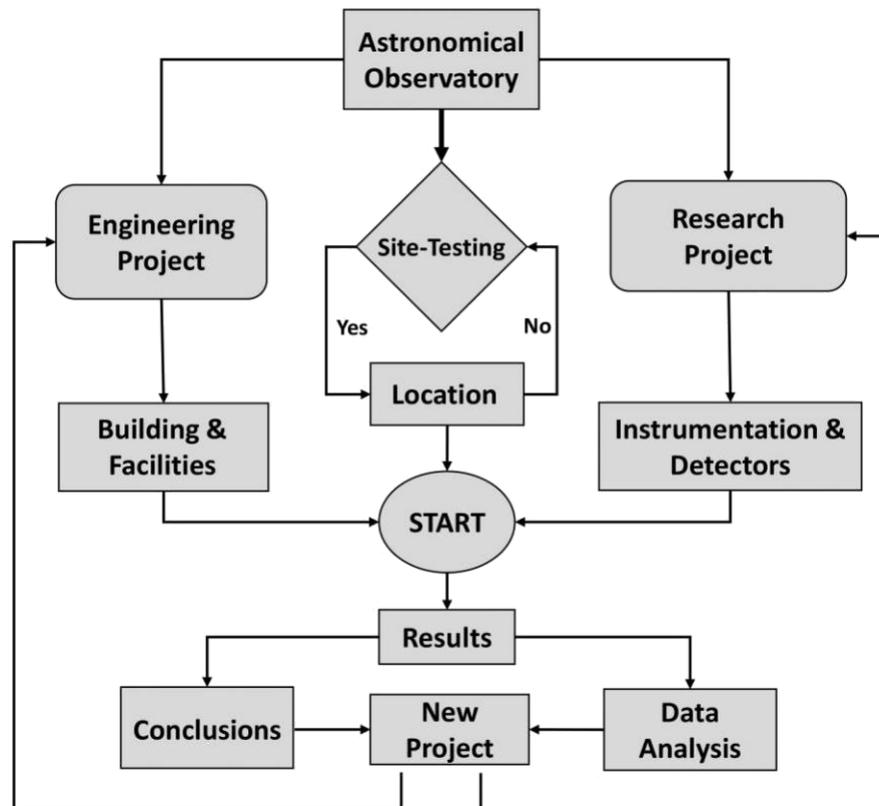
Whenever a team of astronomers has needed a new observatory, they have proceeded to seek the best location for its placement, taking into account the most beneficial elements and avoiding other circumstances that could cause observational problems. An observatory must be located in the best place so that the investment made, and its performance are optimal (Echevarría, 1998; Sánchez, 1985), taking into account the spectral range in which they plan to work. In this research and for the ProAm observatories, the visible spectrum region was mainly considered (3.800 Å a 7.800 Å) and the near infrared region was considered sporadically.

## II. Methods

After a thorough bibliographical review (introduction), followed by an exhaustive analysis of the projects carried out in ten astronomical observatories, building and facilities faults and errors have been detected. The analysis of these errors has allowed the creation of different proposals for improvements to repair the observatories studied and improve future projects.

The consultations carried out by the experts responsible for the facilities studied, has established the need to understand the objective in advance and the main use of the Observatory to be as an essential aspect (it is common to join education and dissemination together with scientific objectives). From this point, the preliminary procedures which guarantee the suitability of the location where an observatory and its later construction are stated.

In a preliminary phase, it is necessary to study the location (site-testing) which determines sky quality and the best placement of an observatory. Secondly, a technical project of the building and facilities must be combined with a scientific project, which will justify the existence and use of the observatory itself. Finally, once the observatory is fully operational, it will be possible to draw new conclusions on the results obtained (feedback), which must promote technical improvements and new research projects on astronomy and astrophysics (Figure 1).



**Figure 1** Framework to build an astronomical observatory: Engineering, research and location of the place.

### 2.1 Site-testing

According to the guidelines of the technical office of sky protection of the Instituto de Astrofísica de Canarias, the following must be considered as the main parameters to be considered for the selection of the location of a professional astronomical observatory: precipitable water vapour, photometric nights, infrared sky background, seeing, vertical turbulence, atmospheric extinction, meteorology, wind speed, inversion layer, night sky background, emission spectrum, sodium layer, seismicity, sky brightness, pollution light and environmental pollution. These elements must be evaluated during a campaign that could last several years and whose results will allow the sky quality of a specific location to be ascertained (McInnes and Walker, 1974; Murding P., 1985; Varela et al., 1999), from which, depending on the spectral range in which the instrumentation works, it will be possible to ascertain the suitability of the characteristics of the location (Moles et al. 2010; Castro-Tirado et al. 2012).. To these factors it is necessary to add the possibility of radio electrical pollution, the flight paths present at the location, and the unpredictable changing conditions caused by climate change, which seriously affect the previously mentioned meteorological and atmospheric parameters. (Giorgi & Francisco, 2000; Morice et al. 2012).

### 2.2 Location

The choice of a location for observation requires the placement of an observatory to be ascertained, its orientation, altitude and its position regarding the orography of the area, with respect to the ecliptic and the Pole Star, (essential reference point for the orientation of a telescope).

The correct placement must make the necessary logistics and accessibility available to carry out the works and facilities of an observatory. It will be essential that the optical instruments and detectors which are to be incorporated are not harmed by the setting (proximity to mountains, trees, power lines, and buildings, among

others), and its exterior conditions (artificial light, proximity to roads and highways, vehicle access, etc). Altitude will be a defining factor, in the case that infrared will be worked with, an altitude of over 1,500 mamsl is advisable ([http://webs.ucm.es/info/Astrof/users/jgm/IA/IA\\_01.pdf](http://webs.ucm.es/info/Astrof/users/jgm/IA/IA_01.pdf)) and a dry atmosphere (depending on the orography of the location) to minimise the presence of water vapour which hinders the ability to partially catch infrared radiation. The frequency of cloud banks or conditions of intense humidity will also be taken into account in areas whose orography has a propensity to retain or attract humidity, such as valleys, riverbanks and rivers and areas close to the coast. This information can be obtained by using geographical information systems (GIS) on different platforms such as <http://signa.ign.es/signa/Pege.aspx?>.

### 2.3 Construction

It is especially important that proper foundations, depending on the type of land of an observatory and the building of which it is a part. Correct design and formation of the pillars which support telescopes must be evaluated as well as proper insulation to avoid perturbations in the optics and detectors of the telescopes. The necessary and specific outer walls for the use of an observatory, the presence of aerators, (ventilation) which minimize thermal exchange between the interior and the exterior (which is very harmful for optics) are issues to be carefully taken into account. The problems which filtration and humidity can cause must also be carefully considered, as they increase the presence of water vapour, damaging the equipment, along with proper thermal isolation. The faults and errors in design, the motorization and control of the dome and automatic covers can frequently appear. The electrical and data installations must be of a good quality and must not produce unforeseen problems.

### III. Field Data

During the period from 2010 to 2015, ten astronomical observatories on the Iberian Peninsula were visited and examined. In this analytical work, different problems have been detected which affect the proper operation of the observatories and the causes have been very diverse. Interviews with the technicians responsible for these observatories have been carried out in order to obtain real information on the state of these facilities and the different problems they suffer from.

The astronomical observatories studied are prestigious facilities and continue in operation. In order to maintain their anonymity, they have been named with letters from the Greek alphabet. This work intends to extract conclusions and proposals for improvement from the lessons learned using the utmost scientific rigour.

From a site-testing point of view, some deficiencies have been detected which have been able to be improved thanks to the data provided by the meteorological stations, and the sky quality detectors of the observatories. A slight increase in the relative humidity index (annual average) has been seen in two cases, and also in precipitation, when compared with the initial values. An increase in light pollution (six cases) and a slight decrease in the quality of sky brightness (seven cases) have also been detected. Clear days have decreased in three cases.

Regarding the placement of the observatories, general good judgement has been used. Only three cases have been found in which ecliptic visibility and access difficulties have been disregarded.

The largest number of the problems detected come from construction and facilities. All the observatories analysed have problems related to construction defects or defects in their facilities.

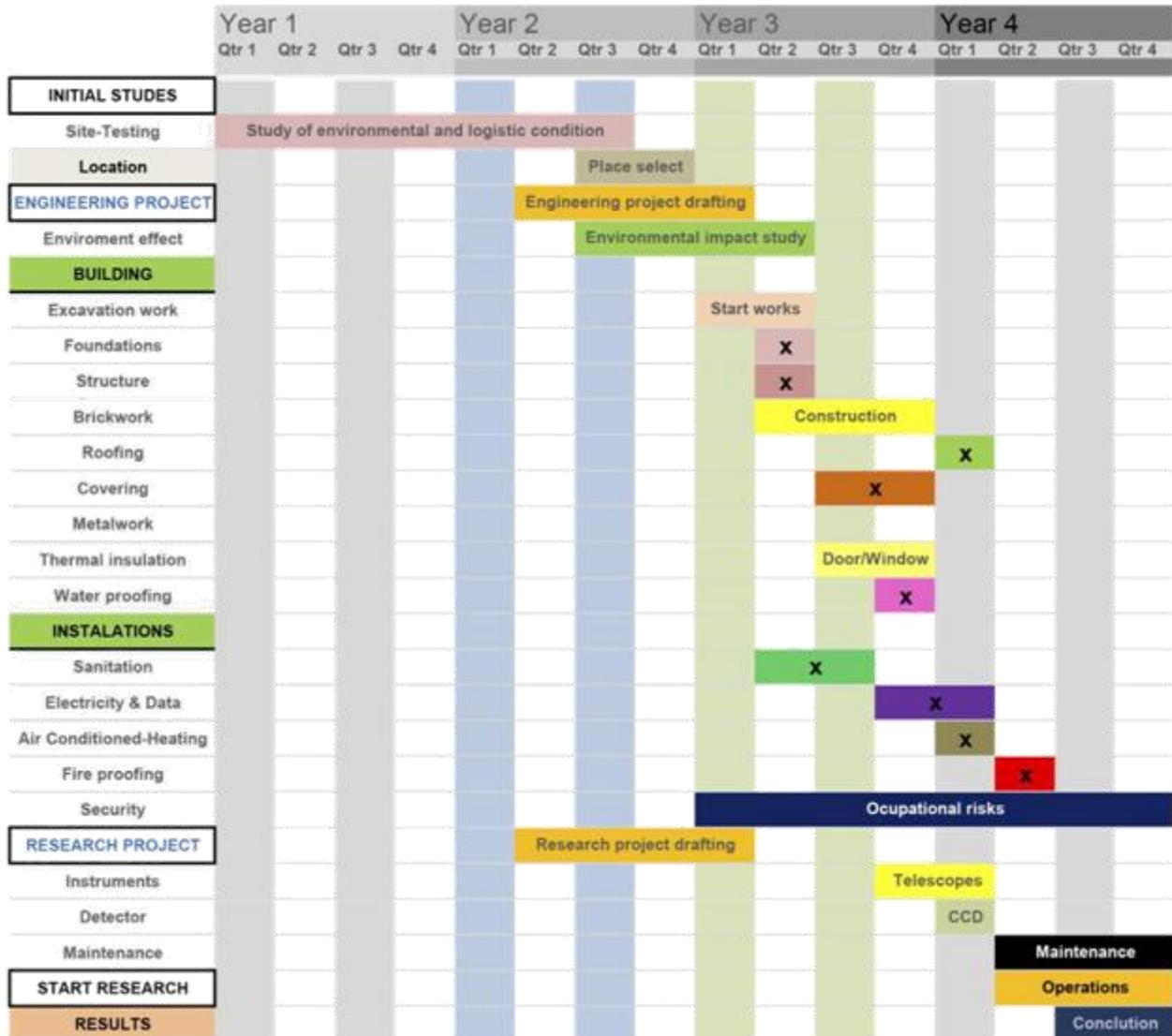
Some of these observatories were built without a project or optional technical management, others are the result of continuous extensions and some were the result of the renovation of disused old buildings. These circumstances make the appearance of anomalies predictable, as has been summarised in table1:

ISSUES	OBSERVATORIES ANALYSED									
	alfa	beta	gamma	delta	epsilon	dseta	eta	theta	iota	kappa
Relative humidity				x					x	
Annual precipitation				x					x	
Sky quality	x		x	x	x				x	
Light pollution	x	x	x	x		x			x	
Clear days				x	x				x	
Accessibility						x		x		
Location										x
Orientation										x
Foundations	x				x		x		x	
Outer walls	x		x		x	x		x		x
Ventilation	x	x		x			x	x	x	x
Leaks				x			x	x	x	
Insulation				x			x	x	x	
Dome / Vault		x					x			
Facilities	x	x		x	x		x		x	x

**Table 1** Main issues detected in the ten observatories analysed.

In four cases, there is no evidence of the type of foundations that were used, nor a geotechnical study of the land (the composition of the pillar of the telescope is unknown). The outer walls have been designed mainly from brick or concrete blocks and do not meet the needs of the observatory (in six cases they are oversized). Only three

observatories include aerators or ventilation systems. Leaks and a lack of insulation were detected in four cases. The domes have problems in two observatories, and all have had different types of faults at some point. Finally, in seven observatories, the facilities have evolved according to their needs. There was no prediction of future projects or extensions.



**Table 2** Temporary distribution of actions to build and make an astronomical observatory operational.

Plan of work which coordinates the technical actions of an engineering or construction project can be established with the scientific objective which is sought for an astronomical observatory. All of this starts from the establishment of an ideal place for its location. In Table 2, the initial works (site-testing) are developed for 2 years to correctly locate the placement of the observatory. Then, the development of the engineering project through the material execution of the works and its facilities. These actions must be coordinated with the installation of the telescopes and other detectors which allow the resources of the observatory to be efficiently used.

#### IV. Results

Below, the geographical location of the astronomical observatories that have been built or repaired between 2013 and 2018 are shown. In the six observatories mentioned in Table 3, the faults and errors detected in the

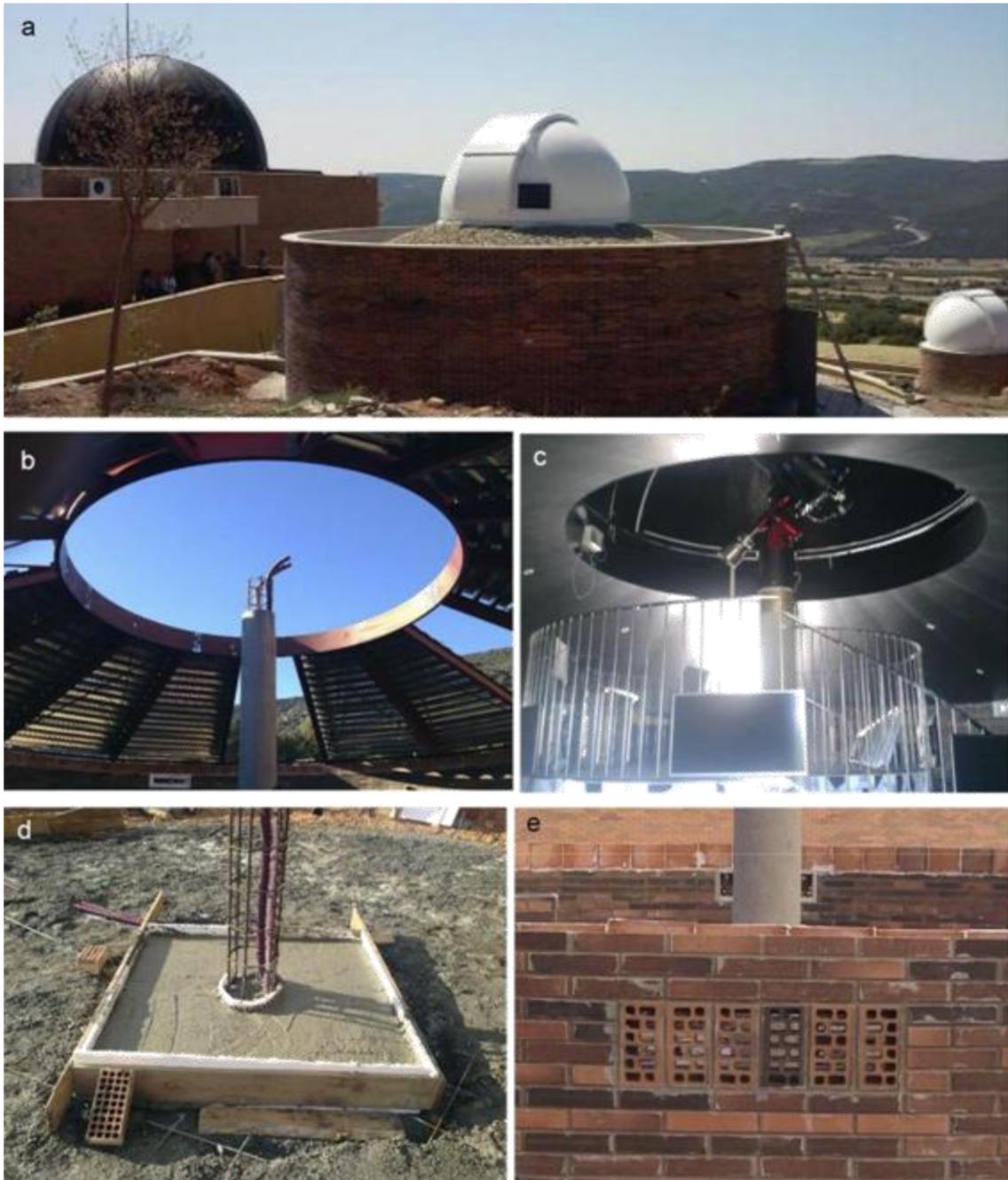
observatories analysed have been taken into account (table 1). The design and construction procedures of a ProAm Observatory have been carried out according to the criteria in Table 2.

Nº	Station Code	Station name	Longitude (W)	Latitude (N)	Height (mamsl)
1	COU	Centre d'Observació de l'Univers Áger (Lérida)Observatorio	359° 15' 48"	42° 01' 29"	815,0
2	OAA	Observatorio Andaluz de Astronomía. Alcalá la Real (Jaén)	03° 57' 12"	37° 24' 53"	1.030,0
3	OAM	Obs. Astronómico del Monfragüe Torrejón El Rubio (Cáceres)	06° 00' 33"	39° 46' 24"	318,0
4	OSN	Observatorio de Sierra Nevada Dílar (Granada)	03° 23' 05"	37° 03' 51"	2.896,0
5	OAZ	Obs. Astronómico de Zuheros Zuheros (Córdoba)	04° 18' 22"	37° 32' 23"	982,0
6	OMA	Kingsland Observatory Valdepeñas de Jaén (Jaén)	03° 46' 40"	37° 35' 09"	1.489,0

**Table 3** Geographical coordinates of the observation stations.

Subsequently, the technical details of greatest relevance which have been carried out in the construction of these six astronomical observatories are presented.

In the Centre d'Observació de l'Univers (COU), an initial project, which the architect Joseph Rule oversaw, was followed. At this observatory, a very intense collaboration took place from the initial phase of the project, which allowed the prevention and improvement of essential aspects for the optimum development of this observatory, which was the first Observatory Education Room in Europe. In the final phase of the execution of the works, some improvements to lighten the weight of the roofing was carried out. Below, images of some of the highlighted aspects of this project are shown (Figure 2).



**Figure 2.** Details of the improvements incorporated into the Observatory Education Room. a) Education Room COU finished, b) Lightweight metal roof that replaces concrete roof, c) Insulated interior with fireproof plasterboard and topped with black satin paint, d) detail of insulated pad for telescope pillar, e) integration of wall aerators.

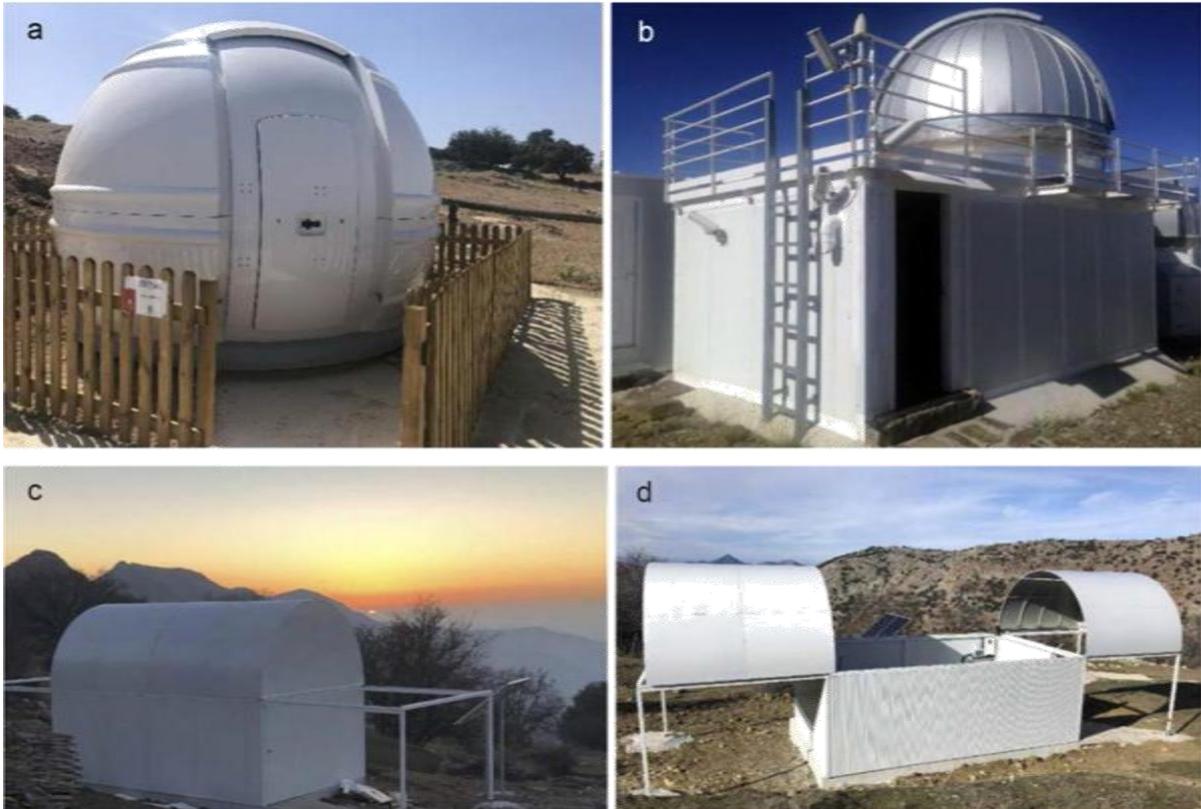
In the Observatorio Andaluz de Astronomía (OAA) and the Observatorio Astronómico del Monfragüe (OAM), the outer walls were constructed with clay blocks (load-bearing walls and insulation) achieving a diaphanous insulated interior. The floor was created using a slab of reinforced concrete and insulation with BBC. A water-repellent was incorporated into the mortar to avoid humidity, and hollow PLIEXPAN bricks in the base. The dome with a diameter of 4 metres was installed on the second floor of the buildings to minimise humidity, increase ventilation and improve visibility of the horizon. This can be seen in detail in Figure 3.



**Figure 3.** a) Observatorio Andaluz de Astronomía finished, b) Detail of the floor and pillar of the telescope, c) Observatorio Astronómico de Mongragüe finished.

The Observatorio Astronómico de Zuheros (OAZ) and the Observatorio Astronómico de Sierra Nevada (OSN), as with the Observatorio Astronómico de Monfragüe, required an environmental impact study and compliance with the legal legislation in vigour regarding Reserves and National parks. In the OSN, the actions were to improve the existing facilities, electricity, data and mechanics) and adapt it to health and safety regulations. In the OAZ, the project was a new one, and was carried out paying special attention to astronomical tourism. (Figure 4).

Kingsland Observatory is a complex of observatories which is being constructed and developed in the Ánimas mountain (OMA). This complex of observatories aims to be the second largest in continental Europe, after the Calar Alto Observatory (Almería). It will have five observatories with a total of six operative telescopes. Only one observatory has currently been built, whose design is totally new. It consists of a dome divided into two parts which can operate together or independently. The observatory has two robotic telescopes which can function manually or by remote control. The structure has been designed in steel and the outer walls with sandwich panels with polyurethane, which makes it very light and economic (Figure 4). All the systems work with renewable energy.



**Figure 4.** Detail of the OAZ, OSN and OMA. a) Observatorio Astronómico de Zuheros finished, b) Detail of the Observatory in Sierra Nevada, adapted for external work, c) Kingsland Observatory closed, d) Kingsland Observatory open (renewable energy).

## V. Conclusions

The construction of a ProAm observatory is a multidisciplinary project. It must be developed between the research team who promote the project and the engineers/architects responsible for its construction and facilities. The coordination of the project by a project manager with training in astrophysics and engineering is very important

A plan and work manual must be established, with the technical and scientific objectives of the observatory project.

For the outer walls and structures for observatories, light materials of a sandwich panel type or something similar are recommended because of their technical quality, price, and easy installation. This building system provides stability to the telescopes and minimises possible vibrations.

It is recommended that the pillars for telescopes are constructed using reinforced concrete and insulated pads for the rest of the foundations, which will also preferably be of reinforced concrete.

It is necessary to embed and bury the facilities of the observatory. This will increase cleanliness, comfort and the safety of personnel.

## VI. Acknowledgments

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## References

- [1.] Arcimis, Augusto T., (1878). El telescopio moderno. Montaner y Simón Editores. Barcelona.
- [2.] Avilés, J. A. B., & Hoskin, M. (2002). *Reflejo del cosmos: Atlas de arqueoastronomía en el Mediterráneo antiguo*. Equipo Sirius.
- [3.] Castro-Tirado, A. J. (2010). Robotic autonomous observatories: a historical perspective. *Advances in Astronomy, 2010*.
- [4.] Castro-Tirado, A. J., Jelínek, M., Gorosabel, J., Kubánek, P., Cunniffe, R., Guziy, S., ... & Tello, J. C. (2012). Building the BOOTES world-wide Network of Robotic telescopes. *Astronomical Society of India Conference Series*, Vol. 7, pp. 313-320.
- [5.] Castro-Tirado, A. J., Moreno, F. S., del Pulgar, C. P., Azócar, D., Beskin, G., Cabello, J., ... & González-Rodríguez, A. (2014). The GLOBal robotic telescopes intelligent array for e-science (GLORIA). *RevMexAA*, vol. 45, pp.104-109.
- [6.] Echevarría, J. et al. (1998). Site testing at Observatorio Astronómico Nacional in San Pedro Martir. *RevMexAA*, vol. 34, pp. 47.
- [7.] Espartero, F., El Observatorio Astronómico de “La Pedriza”. TFM Facultad de Ciencias. Universidad de Granada (2013).
- [8.] Espartero, F., Frías M., Martínez G., Pérez A. (2018c).The PRO-AM Observatory. *RevMexAA*, Conf.Ser., in press.
- [9.] Espartero, F., Martínez G., Frías M., (2018b). Observatorio Andaluz de Astronomía (2018b). *RevMexAA*, Conf.Ser., in prems.
- [10.] Espartero, F., Martínez G., Frías M., Montes F.S., Castro-Tirado A., (2018a). Autonomous spectrographic system to analyze the main elements of fireball and meteors. *Earth, Planets & Space*, 70:02.
- [11.] Fernández Pérez, Iván. 2009. Aproximación histórica al desarrollo de la astronomía en España.
- [12.] Tesis doctoral. Facultad de matemáticas. Universidade de Santiago de Compostela.
- [13.] Galadí-Enriquez, D. et. al., (2001) *Astronomía General, Teoría* Ediciones Omega. Barcelona.
- [14.] Giorgi, F., & Francisco, R. (2000). Evaluating uncertainties in the prediction of regional climate change. *Geophysical Research Letters*, vol 27, nº 9, p.1295-1298.
- [15.] Hoskin, M. (2003) *The history of astronomy: A very short introduction*. Oxford University Press Inc, .New York.
- [16.] IAC (24/042019). The Sky Team’s main objective is the continuous characterization and the preservation of astronomical conditions of the Canary Observatories. From <http://vivaldi.ll.iac.es/proyecto/site-testing>
- [17.] McInnes, B., & Walker, M. F. (1974). Astronomical site testing in the Canary Islands. *Publications of the Astronomical Society of the Pacific*, 86(512), 529.

- [18.] Moles, M. et al. (2010) Site testing of the Sierra de Javalambre: First Results. *Astron. Soc, Pacific*, Vol. 122, No. 889.
- [19.] Morice, C. P., Kennedy, J. J., Rayner, N. A., & Jones, P. D. (2012). Quantifying uncertainties in global and regional temperature change using an ensemble of observational estimates: The HadCRUT4 data set. *Journal of Geophysical Research: Atmospheres*, vol. 117, n° D8
- [20.] Murdin, P. (1985). Nighttime skies above the Canary Islands. *Vistas in Astronomy*, 28, 449-465.
- [21.] Sagan, C. (1980) *Cosmos*. Ed. Random House.
- [22.] Sánchez, F. (1985) *Astronomy in the Canary Islands*. vol.28, part.2, pag.417-430.
- [23.] Solá, J.C., (1929). *El Cielo*. Editorial Seguí. Barcelona.
- [24.] Varela, A. M., Muñoz-Tuñón, C., & Mahoney, T. (1998) *Astrophysics and Space Science*, 263(1/4), 373–376.

# Routing Techniques Study for D2D in Manet Based Environment: A Survey and Open Issues

**Marwah K. Farhan**

College of Information Engineering  
Al-Nahrain University  
Baghdad, Iraq  
marwa.farhan@coie-nahrain.edu.iq

**Muayad S. Croock**

Computer Engineering Department  
University of Technology  
Baghdad, Iraq

## ABSTRACT

Over the years, Mobile Ad-hoc Networks (MANETs) has gained attention in a wide range of applications such as disaster recovery, traffic control, military, and smart cities. In MANET, independent node mobility can cause frequent changes in network configuration. High Quality-of-Service demands with end-user experience are increasing day-by-day. However, due to the dynamic nature of nodes, MANET suffers from challenges to supply a QoS. The Wireless network can provide the best services for delay-sensitive communications by establishing direct communication between nodes. Two devices reuse the spectrum band to form D2D pairs. Such D2D communications provide access to services even when the cellular network is overloaded or dysfunctional due to disaster or emergency crises. D2D is a single-hop communication so it is decisive to find a method to transmit via arbitrarily assembled network even for longer distances.

Therefore, in this paper, we present a study for QoS based routing protocols for D2D communication in Mobile Ad-hoc Networks where various schemes have been used for path selection and provide quality delivery of packets. We also suggest an approach to perform a QoS routing in terms of some metrics and address an optimization technique that can rise up to the challenge of Quality of Service constraints.

**Keywords**—Routing algorithms, Optimization, D2D communications, MANET.

## I. INTRODUCTION

For wire or wireless networks, routing is an important function. Yet, designing routing algorithms in wireless networks is a major challenge as it has to deal with the mobility of nodes within the system as well as being designed to minimize communication overhead. Data communication in Mobile Ad-hoc Networks (MANETs) differs from that of wired networks in different aspects. The wireless communication medium does not have a foreseeable behavior as in a wired channel, On the contrary, the wireless communication medium has variable and unpredictable characteristics (1). Because of their special features, Mobile Ad-hoc Networks (MANETs) are involved in many applications for both

civilian and military usage. Such an infrastructure-less network is considered with less cost as a comparison to other traditional ones.

Mobile ad hoc network (MANETs) is a self-configured and infrastructure-free network based on ad-hoc communications. The routing in mobile ad hoc networks is very challenging due to the frequent updates for changes in topologies, and active routes may be disconnected as mobile nodes move from one place to another (2). Therefore, wireless nodes function as a host and as a router to keep the internal communications alive. Therefore, each node participates in the routing process in order to forward a packet to the destination node. As nodes are arbitrarily deployed and randomly organize themselves, Direct communications between nodes occur if they are within the range of radio transmission. Otherwise, multi-hop network communication is initiated via intermediate nodes to forward packets. Mobility and resource constraints are basic features in MANETs. It also has a lower bandwidth than that for a wired network. Since it operates on batteries; the implementation of routing protocol must be energy efficient to maximize the life span of the nodes and network by extension. The routing protocol delivering the data must be able to adapt to these changes by continually monitoring the link qualities and then route the data accordingly (3).

Ad Hoc mobile nodes can increase the capacity range, improve the system coverage, and reduce the transmission power at the same time. while the spectrum sharing mechanism allows D2D users to transmit data via alternative radio connection and keep the interference level within the required ranges can result in significant power saving. Based on mentioned facts, direct D2D communication is expected to be the main driver for future communication between devices.

the concept of D2D communications has been introduced to allow local peer-to-peer transmission among mobile devices (4) by direct communication without the need for infrastructure (access points or base stations). D2D communications will be the main feature supported by future wireless communications networks. Communication in the licensed spectrum bands is more controllable for communication operators than that in the unlicensed spectrum. By reusing cellular spectrum resources, D2D communications can improve the spectrum efficiency and thus contribute to a relatively high system capacity (3). D2D communications enhance energy efficiency and spectrum utilization that's why it's useful in dense networks. It presents a short-range direct mobile to mobile communication without the involvement of the network infrastructure.

From an architectural perspective, D2D communications are similar to mobile ad-hoc networks (MANETs). They offer similar features and characteristics, however, the main distinction is that D2D is driven by the cellular network and expected to be controlled by a central entity. The presence of central entity management in D2D communications relieve the existing challenges of MANET, such as available spectrum detection, synchronization, and collision avoidance. Moreover, D2D communication is operating mainly in single-hop communications, hence, it does not inherit the multi-hop routing problem that is distinct in ad-hoc networks. D2D has an advantage over MANETs in their effective capability to be more controllable and scalable in large networks. D2D users can operate autonomously only if the cellular infrastructure is unavailable.

The main goal of our research is to propose a D2D routing algorithm that can establish an efficient route between nodes in the network so data can be delivered according to the expected QoS requirements. The idea of a device to device (D2D) communications is to increase the capacity of cellular networks, where D2D pairs communicate directly without referencing the base station and it also uses the same frequency band.

A route discovery will be performed and the path selection process will be optimized according to specific metrics and design constraints. The performance of an ad hoc network routing protocol depends on the communication between entities in the neighborhood.

The rest of this paper is arranged as follows. In section II we reviewed the state of the art of related topics. The problem statement is described in section III. In section IV we state the proposed solution details. Finally, the expected conclusion provided by this method is discussed in section V.

## II. STATE OF THE ART

Over the research work so far, the authors conducted different issues in routing methods and protocols. New technologies and techniques have been addressed in the previous work.

In (5), the authors focused on MANET routing protocols by utilizing D2D communication when cellular network connection falls down. The selected MANET routing protocols were described and verified their suitability using NS-3. The authors addressed the question of direct communication between end devices in case of restricted connectivity to the cellular network due to disasters or emergency situations. Simulations were performed using two MANET routing protocols (AODV and DSDV) to route data traffic between end devices. Results confirmed that the propagation latency of both routing protocols was several tens of milliseconds at maximum. The overall delay in the combined scenario of D2D and LTE connection to a remote host on the Internet was up to 450 ms for DSDV and 83 ms AODV protocol both measured in 20 nodes. AODV protocol with less required hops was considered a suitable candidate for the D2D emergency system and using MANET routing protocols in case of malfunctioning cellular network/ infrastructure was a promising approach. The obtained results gave a rough idea of MANET routing protocols and their possible implementations as enablers for direct D2D communication.

In (6), the authors introduced a novel method of QoS routing in MANETs using Emergent Intelligence (EI). The EI is an intelligent group derived from a periodic interaction of a group of agents and nodes. MANET was logically divided into clusters by a static agent that's centrally located, and a mobile agent was deployed in each cluster. Mobile agent deal with nodes, neighboring mobile agents as well as a static agent that is responsible for collecting quality resource information (bandwidth, delay, packet loss rate, and cost) and selecting trusted reliable nodes to find an optimal QoS route. Analyzed simulation results showed that the proposed method quickly found the feasible QoS paths from the source node to the destination. Finally, results showed improvement in the service quality in MANET including an end to end delay, packet loss.

In (7), the researchers evaluated the performance of QoS in MANET and satisfied its constraint in the Ad-hoc On-Demand Distance Vector (AODV) protocol by enhancing the conventional Cuckoo Search algorithm (CS). The algorithm chose QoS path based on the best fitness value calculated Route Replay packet (RRPLY) instead of the shortest path. The fitness value was determined using three parameters (routing load, residual energy, and hop count). The algorithm was applied during the route discovery process protocol where multiple routes were available. The Cuckoo Search Optimization AODV (CSOAODV) protocol satisfied QoS routing parameters and constraints. The results were compared with Ant Colony Optimization, Particle Swarm Optimization, and basic AODV protocol and analyzed in terms of mobility, scalability, and congestion. Network simulation results were superior and effective as compared to other algorithms and could provide stringent QoS to numerous applications.

In (8), the authors suggested an energy-efficient multiple-path routing protocol for MANET and enhanced QoS and QoE metrics (EMRP-QQ) to minimize the data loss. An energy-efficient clustering was introduced using particle swarm optimization (PSO) and fuzzy optimization approach to calculate the next node with specifications (low mobility, packet loss ratio, routing cost, delay, energy consumption, and high throughput). The energy consumption of the introduced routing protocol was very low as compared to other energy-aware routing protocols. NS-2 simulation results showed that the proposed algorithm had better performance as compared to the FQ-MP-OLSR approach in terms of nodes' reduced energy consumption without affecting QoS and QoE.

In (9), the authors introduced a network graph preprocessing approach to managing the multicast routing issue in MANETs. They provided traffic engineering and energy efficiency enhancement by QoS provisioning. A prioritized admission control (PAC) scheme was implemented to formulate Device to Device communications into a cellular network to overcome MANET limitations. It enhanced the network performance by offloading cellular traffic onto the D2D scheme. Simulation performed for throughput, slot utilization, and energy efficiency and showed that the proposed system had enhanced

QoS multicast routing performance in MANETs, improved user's battery life, and overall energy efficiency of the network.

In (10), the researchers focused on D2D communications disaster response to extend the base stations coverage where disaster response is a modern cellular network main building blocks. They also used controller-assisted routing to increase the total end-to-end throughput to maximum using ant colony optimization. They evaluated route flows from the D2D users in a dead spot to active base stations serving as gateways. The proposed routing scheme outperforms shortest-path based routing schemes in terms of total throughput and fairness in flow rates allocation.

In (11), the authors formulated a quality of experience aware routing (QoE) over wireless multihop networks for SVC under time-constraints. They formulated mixed-integer linear programming and showed to be NP-hard in order to maximize the total MOS under time-constraints. They proposed a heuristic algorithm to speed up the procedure of finding solutions. where the multi-commodity network flows model described network flows. Results of simulation showed that the proposed method provided the optimal solution of the same video quality with less calculation time.

In (12), the writers enhanced the capacity of traffic offloading for cellular-assisted D2D relays. They introduced a unified model for D2D communication that supported three D2D communication modes (direct D2D mode, relay-assisted D2D mode, and local route mode). They designed a radio protocol architecture for the three D2D modes and suggested an algorithm for eNB scheduling. The scheduling algorithm was designed for an eNB to jointly perform communication mode selection, allocation of radio resource, and power coordination for all D2D-pairs in each sub-frame. The design was validated and results showed a significant improvement in traffic offloading capacity of D2D-capable UEs in LTE-A systems.

In (13), the authors utilized the OLSR routing algorithm to build a multi-hop D2D communications platform based on smartphones to expand the single-hop D2D scenarios. They performed experiments to measure performances of energy consumption, coverage, network latency, and link quality. Results highlighted the importance of multihop to D2D communications where a multi-hop showed better performances in terms of delay and delivery rate as compared to a single-hop for long-distance communications. Their experiment results provided a valuable reference to multi-hop D2D communications regarding mobile data offloading.

In (14), the researchers produced a secure adjacent position trust verification model and extended the standard ad hoc on-demand multipath distance vector protocol (AOMDV). They proposed a mesh-based multipath routing algorithm to discover all possible secured paths using the trust verification protocol. Dolphin Echolocation Algorithm was used to optimize the link path for efficient communication in MANET. Results analysis showed that the proposed routing protocol performs better in packet delivery rate, packet delay, and overhead reduction and provided security against attacks.

In (15), the authors proposed a hybrid model for D2D communications assisted by mobile operators for the LTE network. They used a D2D direct discovery stage and an optimized communication for proximity services. They introduced a D2D long term operator-assisted technique based on a trusted method for a Direct device to device discovery over E-UTRA. The operator authenticated and authorized D2D users and optimized signaling for D2D communication was proposed using a specified procedure to apply a per service QoS.

In (16), the writers introduced a cross-layer routing method to improve the main routing protocols. They have added decision measures to all the network layers using a fuzzy-based technique with QoS and QoE guarantees, mobility indicators and energy values. They have evaluated the proposed system in a network simulator to show its energy awareness, maximized the lifetime of the network and provided a better quality for the network. The fuzzy based technique improved the operation of mobile networks by using an intelligent decision engine.

In (17), the authors introduced a reliability-aware variant of AODV by conferring stability to routes. The selected routes are restricted with end-to-end delay and bandwidth variables to supply the QoS application layer. They also enhanced the reliability speed of intermediate nodes so that when the node moved slowly, route speed stability is not obstructed otherwise node had to adjust its

neighboring nodes to operate on its behalf as a part of the routing plan. Simulation has been executed on AODV, MAODV (Modified-AODV with end-to-end delay and bandwidth considered) and RA-AODV (Reliability AODV) and results were sorted and graphically presented for Packet Delivery Ratio, Throughput and End-to-End Delay regarding Mobility.

In (18), the authors suggested a QoS aware routing metric for reliable forwarding node using Link Stability cost Function (LSF). A multicast route mesh between a multicast source node and destination node has been established using nodes with a maximum LSF. The authors took median contention count as a basis for determination of link stability and the method depended on optimum contention count that was estimated based on the received signal strength. The suggested protocol performed the following steps: calculated the Link Stability Factor and determined the maximum LSF value then pruned the adjacent nodes to create a mesh consisting of more stable forwarding nodes and a mobile network where no node remains isolated and faced less contention. The suggested protocol was manifested on existing mesh-based Multicast routing protocols, ODMRP and simulated on Exata/Cyber simulator and results were compared with that of ODMRP. The analysis showed that the suggested protocol was more efficient regarding performance parameters (Packet Delivery Ratio (PDR), Average End-to-End Latency and Average Route Lifetime) as compared to ODMRP, LSMRP, and MMRNS. The obtained results were compared with minimum and maximum contention count cases and it can be concluded that contention count at a node influences the efficiency of a multicast routing method substantially. Large contention count increased competition for resources while small contention count reduced connectivity, a convenient contention count could balance connectivity and availability of resources in a network.

In (19), the researchers introduced a Multipath Battery and Mobility-Aware routing algorithm (MBMA-OLSR) based on MP-OLSRv2. They invested a Multi-Criteria Node Rank (MCNR) measurement that included the residual battery energy as well as the speed of nodes. It intended to rank the link stability using a link assessment formula and choose the best efficient and stable paths to the destination. The selection mechanism was introduced and performed by the MBMA-OLSR to set the readiness of nodes to assist as MPRs for flooding topological status. The authors executed the introduced scheme as an extension to the EXata network simulator. Simulation results proved the effectiveness of the algorithm during high mobility cases with heavy traffic load and outperformed the traditional MP-OLSRv2 routing protocol regarding QoS and energy-related measures.

In (20), the authors introduced a Cross-layer Threshold Multipath Routing Protocol (CTMRP), a MAC and Physical layers design through the network. It is designed to make a decision depending on the threshold of average paths signal for transmission of all multimedia. They modified an algorithm for DSR protocol that subjected to three adjustments; firstly, adjusted the mechanism of resending the intermediate nodes the RREQ broadcast message to neighboring nodes based on strength of the signal. Secondly, it adjusted the mechanism of route arrangement in memory according to the best signal strength of routes. Finally, permitted nodes to transmit data using multi-paths rather than a single path. The performance was evaluated using metrics such as route discovery delay, end-to-end delay, number of RREQ messages, number of RREP messages, throughput, packet delivery ratio. Results showed that the suggested algorithm had better performance and increased the stability of the transmission line.

In (21), the researchers introduced a hybrid optimized link-state routing protocol version2 that is multipath energy and QoS-aware (MEQSA-OLSRv2). It was presented to solve the limitation of energy resources, node mobility, and traffic congestion in WSN based MANET for IoT networks. They used a node rank of multi-criteria node rank metric MCNR that collected energy and QoS parameters. This significantly reduced the complexity of multiple constrained and avoided the control overhead MEQSA-OLSRv2 produced by broadcasting multiple parameters separately. Node's lifetime, remaining battery energy, node's speed, node's idle time and queuing length. A multiple-route computation was obtained by a new link quality assessment utilization as well as a multipoint relay mechanism for nodes was obtained using an energy and QoS-aware selection for flooding topology related information. The performance of the proposed routing protocol was evaluated using EXata-based simulations and validated using comparison with traditional routing protocols. The proposed

protocol outperformed existing ones by enhancing QoS as well as reducing energy consumption energy cost per packet.

In (22), the researcher proposed an enhanced fuzzy logic Ant Colony Optimization - based routing algorithm. The Security Aware routing protocol used a distributed fuzzy logic unit to identify and exclude misbehaved nodes from the routing procedure. The SAFEACO routing protocol was implemented using the NS-3 simulator and many experiments have been performed in both MANET and VANET environments. The performance of the proposed system was compared with other approaches. Simulation results showed that SAFEACO has better performance in all relevant metrics (packet delivery ratio and end-to-end delay). It also provides a high level of durability against attacks (Sybil, black hole and flooding) due to its ability to identify misbehaving nodes.

In (23), the researchers proposed a Virtual Ad hoc Routing Protocol (VARP). This algorithm produced increased security and scalability and decrement routing overheads as compared to traditional ad hoc routing protocols. They reduced traffic overhead in the LTE environment by multi-hop D2D communications running under SDN-controller. They also developed a source-routing protocol referred to as VARP-S. they analyzed routing overhead in the VARP-S, as compared to the overhead analysis of their previously proposed Hybrid SDN structure for wireless distributed networks (HSAW). results showed that VARP-S achieved better scalability and lower consumed power for mobile nodes as compared to HSAW.

In (24), the researchers proposed a trust-based and secure QoS routing method. The base approach of the proposed method depended on relieving nodes with various packet forwarding misbehavior as well as on-path discovery to guarantee reliable communication. The approach depended on best node selection according to packet forwarding as well as QoS variables (residual energy, link, and channel quality). The researchers also suggested a model for packet dropping attack. Simulation performed using Network Simulator-2 NS2 and showed that mixing social and QoS trust variables improved security and QoS routing in terms of packet delivery ratio, overhead, and consumed energy.

In (25), the authors introduced an improved energy and mobility ant colony optimization (IEMACO) routing method. The method speeded up the convergence of the routing algorithm and reduced the route discovery packets using an offset value of the transition probability. According to the rate of consumed energy, the residual lifetime of nodes (RLTn) was held, and the position and velocity status predicted the residual lifetime of the link (RLTI). Then the algorithm merged RLTn and RLTI to produce the pheromone formula that selected the path with the best quality based on the transition probability to ensure continuous transmission. The simulation showed that the proposed method reduced the route discovery attempts, lowered end-to-end delay, and packet loss rate, and extended the network lifetime as compared to AOMDV and AntHocMMP algorithms.

In (26), the researchers proposed a network coding-based routing protocol over a cycle network topology to reduce latency and traffic load for transmission of online gaming (real-time communication application). They considered the infrastructure of Device to Device network and proposed a medium access scheduling. The performance was evaluated in terms of latency using a network simulator. The latency was calculated in a lossless network and showed the benefit of the proposed protocol in terms of latency compared to the NC-based multicast protocol. They also considered problems of packet loss caused by network delay variation or jitter and presented the significance of choosing a time unit related to the cycle size and produced an acceptable latency for such real-time application.

In (27), the authors proposed a new on-demand routing protocol called PRP (Performance Routing Protocol). It allowed MANETs to select optimal routes with the highest throughput and the lowest time delay for data transmission. The route is selected by PRP as it satisfied two conditions: hop number and throughput. The throughput constraint means that the throughput of each link must achieve the minimum threshold and the throughput of the entire route must be the highest among candidate routes. The efficiency of PRP performance was compared with traditional routing protocols on NS2 by making changes in the velocity of network nodes and traffic. The results showed that performance factors (throughput, average end-to-end delay, and packet delivery ratio) of the network employing PRP was improved.

In (28), the authors presented a new concept of route availability (RA) as a measurement of route non-uniformity in a MANET as it represents the quality of service (QoS) of a network or the quality of experience (QoE) of video streaming. They checked RA as a useful indicator of network QoS and video streaming QoE by emulating MANET environment that's capable of sending streaming videos, and performed a method of measuring RA for two representative MANET routing methods: Ad hoc On-Demand Distance Vector (AODV) and Optimized Link State Routing (OLSR). They confirmed that RA had a linear correlation with the two QoS metrics (packet loss rate and throughput) and founded that RA is more sensitive to changes in video quality.

In (29), The researchers streamed a High Definition (HD) videos over MANETs. They designed a transmission system followed by a distortion system in order to evaluate network distortions such as packet-loss rate and end-to-end delay. The proposed design allowed a video framework to utilize the available bandwidth in MANETs efficiently, minimized distortions caused by the network and improved Quality of Service QoS. They also used an Error Concealment (EC) method to recover the lost/dropped video frames to improve the Quality of Experience QoE. Results showed that the suggested video streaming framework operates better than other MANET protocols such as Destination-Sequenced Distance Vector (DSDV) and Optimized Link State Routing (OLSR) protocols.

In (30), the authors proposed an optimized routing method to enhance the performance of the network and overcome network problems such as path destruction within a specific time. All possible paths between source and destination nodes are discovered and subjected to a three metric Quality of Service (QoS), where a maximum bit rate, minimum packet loss rate, and minimum delay are considered. The decision of path selection relies on three methods: Weighted Sum optimization method, Weighted Sum Based Genetic Algorithm optimization method and the Non-Dominated Sorting based Genetic Algorithm-II (NSGA-II) with two types of Crossover. The result of the three methods was compared with the Bellman-ford algorithm (based Ad Hoc on Demand Distance Vector (AODV) protocol) and with NSGA-II priority-based encoding. A Matlab (2017a) simulator was used to test the system by finding the best path based on QoS requirements in both static and dynamic environments. Under varying sensor nodes, the proposed method achieved an important decrease in packet loss rate as well as an increase in bitrate. In addition, it saves energy (the network lifetime by extension) due to no rerouting discovery process whenever a route failure occurs.

In (31), the researchers introduced a routing algorithm called Network Assisted Routing NAR for device-to-device communication in 5G architectures. The aim was to extend the coverage of base stations. NAR took into account that D2D communications are managed by base stations. NAR results were compared with the Load Balancing Based Selective Ad Hoc On-Demand Multipath Distance Vector algorithm. The proposed algorithm was implemented in SimuLTE, and the results showed an improvement of 35% in energy savings with a slight increase of 5% in the number of total packets sent.

Also in (32), the authors validated a trust-based protocol to mitigate security and performance issues in D2D networks. ‘neighborhood as a routing metrics’ was used to produce a secure and efficient trust-based protocol. The coefficients of neighborhood peers’ similarity have been taken into consideration to enhance the routing performance in mobile HetNets environments. The authors demonstrated that the connectivity of peers’ neighborhood in the network is a property that can affect peers’ routing performance. The analysis proved that only message with a higher probability of packet delivery is forwarded to the companions, thus it enhanced delivery rate, reduced latency and alleviated the problem of malicious peers by packet dropping method.

In (33), the researchers aimed to determine the multi-hop route between a device-to-device source-destination pair that meets with the required quality-of-service. They modeled a D2D-QoS routing problem as a Markov decision process and proposed a distributed multi-agent routing algorithm. The researchers assigned the QoS requirements in terms of bandwidth, delay, and packet loss rate, and the routing path was allocated according to link information over time (dynamic environments). They decomposed the Q-function into several local Q-functions where each agent computed its own optimal strategy using local observations, which in turn reduced learning costs and searching in large-scale systems. The simulation results showed that the proposed routing algorithm

reduced the average end-to-end delay, the average packet loss rate, and service rejection rate as compared with both the minimum hop algorithm and traditional routing algorithm (only considers static parameters).

In (34), the authors introduced a novel Joint Routing and Wireless allocation in D2D communications (JRW-D2D) that is based on the branch-and-cut method. They implemented the standard LTED2D protocol stack with the proposed scheme using the NS3 network simulator. The obtained results were satisfying in reliability, optimality, admitted D2D flows ratio and latency as compared to other basic one-sided optimal schemes.

In (35), the authors investigated the performance of various D2D communications routing protocols. Cellular networks are composed of D2D pair where relays arranged in clusters. D2D and cellular users are supposed to transmit over the same channel. The authors called interference generated from the relays to the base station and from the cellular user to the relays as mutual interference. They investigate D2D communication optimal and suboptimal routing in the existence of interference. Optimal routing was included to select the path with the largest end-to-end SINR. Also, a one-hop sub-optimal routing was suggested where the relay with the largest SINR was chosen. The result of optimal routing reduced outage probability than sub-optimal routing. Due to interference, it was shown that as the distance between D2D users and cellular users decreases, D2D outage probability increases.

In (36), the authors introduced a routing algorithm named Mobility, Residual energy and Link quality Aware Multipath (MRLAM) in MANETs. The proposed method took optimal routing decisions for energy-efficient nodes to sustain the reliability and lifetime of the network for a specified period of time. MRLAM method used a Q-Learning procedure for optimal intermediate node selection according to energy level, mobility, and link quality values, and then supplied positive and negative values. The suggested routing algorithm reduced energy cost, end to end delay, packet loss ratio and convergence time as compared to other routing schemes (Multipath Optimized Link State Routing protocol (MP-OLSR) and MP-OLSRv2). Results showed that the suggested MRLAM routing algorithm improves the overall performance of the network.

### III. PROBLEM STATEMENT

Due to MANET characteristics such as node mobility, topology changes, resource shortage, Non-centralized control, etc., the challenge of designing a Quality of Service routing algorithm is raised. Different issues were addressed in the research area so far [5] – [36], yet continues improvements and enhancement are a need in such a thriving network business. One of the important issues is keeping the QoS in the required and allowed ranges.

QoS routing is the process of transferring data packets from source node to destination node by taking into account resource constraints, such as delay, energy, bit rate, packet loss rate, cost, etc. The required solutions should tackle the enhancement in the QoS in the proposed routing protocol including the use of optimization methods.

### IV. PROPOSED APPROACH

A Quality of Service Routing is always a hard task due to the dynamic nature of MANET. Direct communication between devices D2D in such an environment can be realized in a single or multi-hop manner. The integration of wireless and multi-hop networks provides guaranteed Quality of Service (QoS), flexibility and adaptability. To achieve such a QoS routing, a multi-Objective QoS Routing between devices in MANET could be suggested. An intelligent algorithm should be used for path selection, a multiple criteria decision making optimization involving more than one objective function to be optimized simultaneously between the source and destination where optimal decisions need to be taken in the presence of trade-offs between two or more conflicting objectives.

The mathematical optimization strategy of Lagrange's multipliers rises up to this challenge. Due to its ability to find the local maximum and minimum of a function that subjected to equality constraints like the constraint in QoS Routing.

QoS constraints, such as maximize the bite rate, minimize the packet loss as well as minimize the delay, where the conditions of one or more equations have to be satisfied precisely by the selected values of the variables. The major advantage of this method is that it allows the optimization to be solved without explicit parameterization in terms of the constraints. As a result, the method of Lagrange multipliers is the best choice to solve challenging constrained optimization problems.

### CONCLUSION

An intense state of the art has been performed to explore the various smart methods and techniques for route selection such as Fuzzy Logic Ant colony, PSO, Genetic to enhance objectives like traffic offloading, energy consumption, throughput, packet loss ratio, routing cost, delay...etc.

Also a suggestion to use the Lagrange's multiplier to optimize a QoS routing function subject to a given constraint in terms of bit rate, packet loss, and delay. This technique finds the maxima or minima of a multivariable function bounded by a constraint function.

It is expected to enhance the QoS routing for D2D in the MANET environment by maximizing the bit rate, minimizing the delay and minimizing the packet loss rate. Some other constraint parameters might be added later on.

### REFERENCES

- [1] A. Boukerche, Algorithms and Protocols for Wireless and Mobile Ad Hoc Networks. John Wiley & Sons Inc., 2009.
- [2] R. R. Roy, HANDBOOK OF MOBILE AD HOC NETWORKS FOR MOBILITY MODELS. Springer, 2011.
- [3] L. Mcnamara, B. Pasztor, N. Trigoni, and S. Waharte, 'Mobile Ad Hoc Networking: Cutting Edge Directions', pp. 77–105, 2013.
- [4] I. Press, J. Anderson, G. W. Arnold, and K. Moore, 'MOBILE AD HOC NETWORKING Director of IEEE Book and information Services ( BiS )'.
- [5] Z. Bojkovic, B. Bakmaz, and M. Bakmaz, 'Recent Trends in Emerging Technologies toward 5G Networks University of Belgrade', pp. 137–143.
- [6] and J. H. Pavel Masek, Ammar Muthanna, 'Suitability of MANET Routing Protocols for the Next-Generation National Security and Public Safety Systems', Springer Int. Publ. Switz., pp. 242–253, 2015.
- [7] S. Chavhan and P. Venkataram, 'Emergent intelligence based QoS routing in MANET', Procedia Comput. Sci., vol. 52, no. 1, pp. 659–664, 2015.
- [8] V. V. Mandhare, V. R. Thool, and R. R. Manthalkar, 'QoS Routing enhancement using metaheuristic approach in mobile ad-hoc network', Comput. Networks, vol. 110, pp. 180–191, 2016.
- [9] V. S. Devi and N. P. Hegde, 'Energy efficient multipath routing protocol for enhancing QoS and QoE in multimedia applications for MANETs', Int. J. Commun. Networks Inf. Secur., vol. 8, no. 3, pp. 158–170, 2016.
- [10] S. B. Sridhara and B. Ramesh, 'Qos Provisioning for Energy Efficiency in Mobile Ad-Hoc Network', ... J. Comput. Sci. ..., vol. 15, no. 5, 2015.

- [11] M. Tanha, D. Sajjadi, F. Tong, and J. Pan, 'Disaster management and response for modern cellular networks using flow-based multi-hop device-to-device communications', IEEE Veh. Technol. Conf., pp. 0–6, 2017.
- [12] P. T. A. Quang, K. Piamrat, K. D. Singh, and C. Viho, 'Q-RoSA: QoE-aware routing for SVC video streaming over ad-hoc networks', 2016 13th IEEE Annu. Consum. Commun. Netw. Conf. CCNC 2016, pp. 687–692, 2016.
- [13] aNd Ch. Y. Ruofei Ma, NiaN Xia, Hsiao-Hwa CHeN, CHuN-YuaN CHiu, 'Mode Selection, Radio ReSouRce allocation, and Power cooRdination in d2d coMMunicationS', IEEE Wirel. Commun., 2016.
- [14] H. Qin, Z. Mi, C. Dong, F. Peng, and P. Sheng, 'An experimental study on multihop D2D communications based on smartphones', IEEE Veh. Technol. Conf., vol. 2016-July, 2016.
- [15] G. M. Borkar and A. R. Mahajan, 'A secure and trust based on-demand multipath routing scheme for self-organized mobile ad-hoc networks', Wirel. Networks, vol. 23, no. 8, pp. 2455–2472, 2017.
- [16] E. K. A. Bindaj, P. Y. P. Singh, S. Sharma, H. O. D. Ece, J. National, and P. G. I. T. M. Rewari, 'DEVICE-TO-DEVICE ( D2D ) COMMUNICATION UNDER LTE NETWORKS USING HYBRID MODEL', no. November, pp. 106–112, 2016.
- [17] T. Carvalho, J. Jailton, and R. Francês, 'A new cross-layer routing with energy awareness in hybrid mobile ad hoc networks: A fuzzy-based mechanism', Simul. Model. Pract. Theory, vol. 63, pp. 1–22, 2016.
- [18] S. Tyagi, S. Som, and Q. P. Rana, 'A Reliability based Variant of AODV in MANETs: Proposal, Analysis and Comparison', Procedia Comput. Sci., vol. 79, pp. 903–911, 2016.
- [19] G. Singal et al., 'Multi-constraints link stable multicast routing protocol in MANETs', Ad Hoc Networks, vol. 63, pp. 115–128, 2017.
- [20] W. A. Jabbar, M. Ismail, and R. Nordin, 'Energy and mobility conscious multipath routing scheme for route stability and load balancing in MANETs', Simul. Model. Pract. Theory, vol. 77, pp. 245–271, 2017.
- [21] A. A. Allahham, M. Mohammed, and N. S. Kadhim, 'Multipath Routing Protocol Based On Cross-Layer Approach for MANET', Int. J. Interact. Mob. Technol., vol. 11, no. 1, p. 71, 2017.
- [22] W. A. Jabbar, W. K. Saad, and M. Ismail, 'MEQSA-OLSRv2: A multicriteria-based hybrid multipath protocol for energy-efficient and QoS-aware data routing in MANET-WSN convergence scenarios of IoT', IEEE Access, vol. 6, no. c, pp. 76546–76572, 2018.
- [23] H. Zhang, 'A Security Aware Fuzzy Enhanced ACO Routing Protocol in MANETs', Ph.D thesis, doctoral program in Computer Science, Georg August University, Germany, 2018.
- [24] M. Abolhasan, M. Abdollahi, W. Ni, A. Jamalipour, N. Shariati, and J. Lipman, 'A Routing Framework for Offloading Traffic from Cellular Networks to SDN-Based Multi-Hop Device-to-Device Networks', IEEE Trans. Netw. Serv. Manag., vol. 15, no. 4, pp. 1516–1531, 2018.
- [25] M. S. Pathan, N. Zhu, J. He, Z. A. Zardari, M. Q. Memon, and M. I. Hussain, 'An efficient trust-based scheme for secure and quality of service routing in MANETs', Futur. Internet, vol. 10, no. 2, 2018.
- [26] D. Yang, H. Xia, E. Xu, D. Jing, and H. Zhang, 'Energy-Balanced Routing Algorithm Based on Ant Colony Optimization for Mobile Ad Hoc Networks', Sensors (Basel), vol. 18, no. 11, pp. 1–19, 2018.

- [27] M. Dammak, Y. Boujelben, and N. Sellami, ‘Cycle-Based Routing Protocol for Device-to-Device Group Communications’, IEEE 2018 14th Int. Wirel. Commun. Mob. Comput. Conf. IWCMC 2018, pp. 1053–1058, 2018.
- [28] V. K. Quy, N. D. Han, and N. T. Ban, ‘PRP : A High-Performance Routing Protocol for Mobile Ad-Hoc Networks’, 2018 IEEE Int. Conf. Adv. Technol. Commun., pp. 226–231, 2018.
- [29] T. Yashima and K. Takami, ‘Route availability as a communication quality metric of a mobile Ad hoc network’, Futur. Internet, vol. 10, no. 5, 2018.
- [30] M. Usman, M. A. Jan, X. He, and M. Alam, ‘Performance evaluation of High Definition video streaming over Mobile Ad Hoc Networks’, Elsevier B.V. Signal Process., vol. 148, pp. 303–313, 2018.
- [31] R. J. Kadhim and M. S. Croock, ‘QOS based path selection for modified smart optimization methods’, J. Theor. Appl. Inf. Technol., vol. 96, no. 23, pp. 8021–8033, 2018.
- [32] A. V. Bastos, C. M. Silva, and D. C. Da Silva, ‘Assisted routing algorithm for D2D communication in 5G wireless networks’, IEEE Wirel. Days (WD), Dubai, vol. 2018-April, no. April, pp. 28–30, 2018.
- [33] A. B. Usman, J. Gutierrez, and A. B. Bichi, ‘A Neighbourhood-Based Trust Protocol for Secure Collaborative Routing in WirelessGutierrez Mobile D2D HetNets’, Int. J. Comput. Sci. Inf. Secur., vol. 16, no. 4, pp. 1–9, 2018.
- [34] D. Liu, Z. Li, Z. Hu, and Y. Li, ‘Distributed Reinforcement Learning for Quality-of-Service Routing in Wireless Device-to-device Networks’, 2018 IEEE/CIC Int. Conf. Commun. China, ICCS Work. 2018, pp. 282–286, 2019.
- [35] S. Alwan, I. Fajjari, and N. Aitsaadi, ‘Joint Routing and Wireless Resource Allocation in Multihop LTE-D2D Communications’, Proc. - Conf. Local Comput. Networks, LCN, vol. 2018-October, no. 1, pp. 167–174, 2019.
- [36] N. Ben Halima and H. Boujemâa, ‘Optimal routing and one hop routing for D2D communications in the presence of mutual interference’, Springer Telecommun. Syst., vol. 71, no. 1, pp. 55–64, 2019.
- [37] V. Tilwari, K. Dimyati, M. Hindia, A. Fattouh, and I. Amiri, ‘Mobility, Residual Energy, and Link Quality Aware Multipath Routing in MANETs with Q-learning Algorithm’, Appl. Sci., vol. 9, no. 8, p. 1582, 2019.

# PORTAL ACADEMIC PORTAL INNOVATION BASED ON WEBSITE IN THE ERA OF DIGITAL 4.0 TECHNOLOGY NOW

**ARPAN<sup>1)</sup>**AUTHOR

*Lecturer Of Computer System Study Program  
Faculty Of Science And Technology  
Universitas Pembangunan Panca Budi  
Medan City, North Sumatera Provincy, Indonesia*

**Muhammad Muttaqin<sup>2)</sup>** CORRESPONDING AUTHOR

*Lecturer Of Computer System Study Program  
Faculty Of Science And Technology  
Universitas Pembangunan Panca Budi  
Medan City, North Sumatera Provincy, Indonesia*

## ABSTRACT

*Abstract -Technological developments that are intensively carried out from various innovations can be a benchmark for the start of more modern and inseparable technological advances for technology users in accessing various information.To facilitate the use of technology in terms of conducting academic activities through the university's website then clicking on the lecturer portal in accordance with the number of each lecturer's identity. The use of this portal is for easy data collection and supervision of lecturers for each activity through this portal. Some features have been adapted to the needs of lecturer activities after the Tri Dharma established by the University which must be carried out by all lecturers all made easier through the sophistication of technology in the current digital era with no limits on space and time. The research method used in this study is the Survey method, where this method takes data from a sample of a population using a questionnaire to collect data. From the value of this research carried out at the Universitas Pembangunan Panca Budi of Lecturers and Students of the Faculty of Computer Science with the reliability value using the SECI method in Socialization of 0.8045, Externalization of 0.813, Combination of 0.728, and Internalization of 0.751. From the value obtained it is known that the most influential factor is externalization is a factor that comes from outside. As a refinement of future research, it is necessary to develop a system to gain new knowledge in developing cases.*

**Keywords:** Academic Portal, Digital Technology, Knowledge Management Sharing, SECI Method

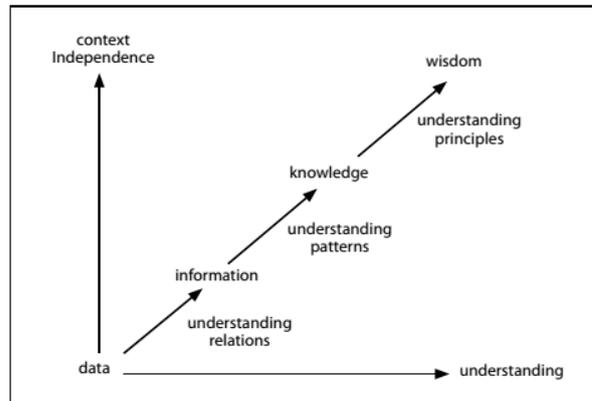
## I. Introduction

The current development trend in technology has become a necessity for every user who wants quick access to access, known as the era of digital technology 4.0. Likewise in the educational environment that is sheltered on campus the use of technology makes it easy for lecturers, students and the academic community to use the portal as a medium of information and communication that can be used throughout the academic community which can be accessed wherever they are. From input to the development of a recapitulation sharing system that can be obtained can be used as academic information to improve quality management at Panca Budi Development University by always

updating the application link through various methods and research not only limited to teaching but also for research, community service as a form of assessment a performance that has to be done every semester.

## II. LITERATURE REVIEW.

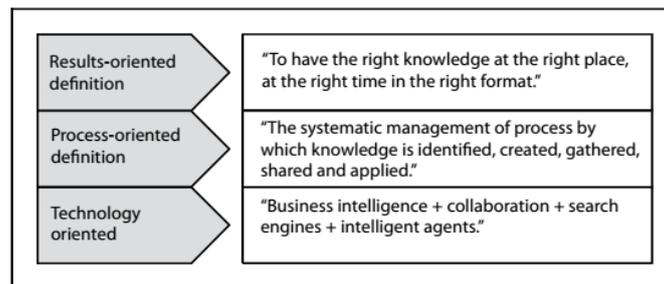
If we talk about knowledge, we will talk about data. Data is a number, word or letter without any context. A collection of data, not information. That is, if a collection of data has nothing to do with each other, then it is not information. In other words, what is important in making data or data collection context data, is the relationship between the pieces of data.



Gambar1. Conceptual Progression From Data to Knowledge Source : Adapted from Liebowitz, (2003)

In general, there are two kinds of knowledge, namely tacit knowledge and explicit knowledge. Tacit knowledge is everything stored in the human brain. Explicit knowledge is everything that is well documented, which is usually stored in facilities, products, processes, services, and systems. And both types of knowledge can be obtained from the interaction or innovation. "Knowledge management is basically about a systematic approach to managing intellectual assets and other information in a way determined by the company with competitive advantage" (Bergeron, 2009).

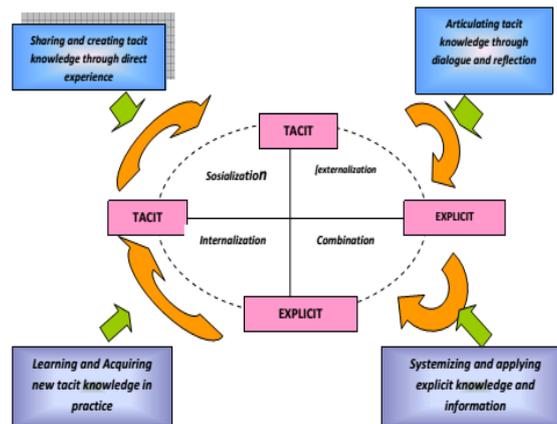
Simply put, knowledge management is the conversion of tacit knowledge into explicit knowledge and dividing it into.



Gambar 2. What is KM ?

Source: Benjamins, V.R., "Knowledge Management in Knowledge-Intensive Organizations", Intelligent Software Components (2001).

There are two main aspects of knowledge management, namely information management and human resource management. In practice, knowledge management involves, inter alia, identification and mapping of intellectual assets in an organization. Where, knowledge management can be considered as a process of auditing intellectual assets that focus on a unique organization, its resources and important functions. (Bergeron, 2009).



Gambar3 :PenciptaanKnowledge management  
Sumber :Nonakadan Takeuchi (2004:15)

### III. RESEARCH METHOD

The academic portal of the lecturer from the Universitas Pembangunan Panca Budi website consists of menus such as course schedules, subject matters, value management, academic guidance, and final assignment guidance. Academic Guidance and final assignment guidance are used by lecturers to conduct guidance processes such as counseling between lecturers and students so that if there are students who want to ask questions about academic issues, they can directly contact the lecturer through the academic guidance menu available on the academic portal. While the final assignment guidance menu is used by lecturers and students to conduct final assignment guidance or thesis so that students can conduct guidance in addition to meeting directly with the supervisor, this menu can also be used as an alternative to the guidance process. Therefore, the population in this study are academic supervisors and final project supervisors and students who are conducting academic guidance and final assignment guidance. The data collection method uses a survey process through questionnaires distributed to lecturers and academic guidance students who have a portal. In this study, the questionnaire used consisted of four parts, namely Socialization, Internalization, Externalization, Combination.

The research was conducted in several stages, namely the preliminary stage, reducing the data, presenting the data, presenting the model and drawing conclusions, the steps are as follow:

1. The preliminary stage is carried out by doing preliminary observations, finding the phenomenon of the problem and identifying the initial problem in the research and making a research proposal.
2. The second stage is collecting data using a survey process through a questionnaire which will be distributed to lecturers and academic guidance students who have a portal consisting of 4 parts namely Socialization, Internalization, Externalization, Combination.
3. The third stage is the stage of presenting data, presenting data can be done in brief descriptions, charts, relationships between categories, flowcharts, and others. Presentation of data conducted by the author is data from literature studies and previous research relating to the topic of discussion.
4. The fourth stage is the presentation of the model through the results and comparing the results with previous research.
5. The last stage of the conclusion is to conclude the results achieved and recommend to relevant parties.

#### IV. RESULT AND DISCUSSION

An analysis and research was carried out on the concept of the academic portal of the Universitas Pembangunan Panca Budi, followed by an analysis of the acceptance of the academic portal to the Lecturer and Student respondents at the Universitas Pembangunan Panca Budi, Medan. After that, an analysis of the SECI approach (Socialization, Externalization, Combination, Internalization) was carried out. which will be continued at the stage of the process of analysis of the academic portal using the SECI (Socialization, Externalization, Combination, Internalization) approach. The next stage of analysis that will be carried out is the stage of data collection and analysis in which measurement instruments will be made in the form of questionnaires, data collection, and data analysis. The distribution of questionnaire data is carried out at the Universitas Pembangunan Panca Budi, Medan. Respondents in the study consisted of lecturers and students from each faculty in the Universitas Pembangunan Panca Budi, Medan. The results of the questionnaire respondents were processed using SPSS 22 software. The number of questionnaires analyzed was 60, each of which was divided into two respondents namely students and lecturers at UniversitasPancabudi Medan. The number of questionnaires was considered to be sufficient and sufficient to be analyzed according to the Slovin method. Following the process of distributing the research sample in the form of questionnaire data distributed to respondents of academic portal users at Universitas Pembangunan Panca Budi Medan. The reliability value using the SECI method can be Socialization at 0.8045, Externalization at 0.813, Combination at 0.728, and Internalization at 0.751. From the values obtained, it is known that the most influencing factor is Externalization, which is a factor that comes from outside.s.

#### CONCLUSION

The conclusions obtained from the research results are:

1. The Knowledge Management System portal makes it easy to manage tacit knowledge to explicit because stored knowledge is digital and more structured.
2. The Faculty of Computer Science has a lot of knowledge about the use of the academic portal so that this facility can be used to process information given by lecturers to students or vice versa it becomes easier to develop guidance activities with an efficient time and want to do knowledge sharing needs to be supported by adequate technology and compensation as an appreciation for the efforts made by lecturers and students as a manifestation of the use of the Academic Portal as a medium for conducting Student Final Assistance Guidance.
3. The reliability value using the SECI method can be Socialization of 0.8045 so that it can be understood that the interaction of individuals involving language and must be observed first shows a consistent value because it is greater than the standard reliability value. Externalization of 0.8105 which means that respondents can capture information through the idea of knowing pictures through an easily understood format, students and lecturers capture relevant knowledge about the use of the Academic Portal through documents into an understanding that is implemented, and this point is another factor influencing the four factors found in this SECI method. The Combination Factor has a reliability value of 0.728, this value is smaller than the other 3 points, but it can still be stated that respondents can capture information about the use of the Academic Portal both from within and outside the UNPAB environment to be implemented on direct use to the Academic Portal owned to do Guidance. Internalization value of 0.751 which shows the results of measurements carried out shows a consistent and trustworthy value because it is greater than the established reliability standard limit of 0.66.

Suggestions for future improvements to the Web-based KMS are:

1. I can use other methods to test knowledge management sharing and can develop the system to get new knowledge in developing knowledge management sharing.
2. Each lecturer and student can make explicit all tacit knowledge possessed so that it can be disseminated through a media portal between lecturers and students. Attitudes that must be

cultivated and cultivated in the formation of this system include a strong urge to create, capture, capture, store, process, and disseminate the knowledge possessed using the Academic Portal that has been provided by the University.

3. The feature that should be improved is the help menu where it will be explained how a good and right mechanism is in conducting guidance using the Academic Portal, so that users, both lecturers and students can better understand their use to achieve the desired academic guidance process effectiveness. There is also a Conference menu to use when making guidance via remote video calls.

## BIBLIOGRAPHY

- [1.] Bergeron, B. (2009). Essentials of Knowledge Management. John Wiley & Son, Inc.
- [2.] Cahyadi, D; Using, W; 2015, Web-Based Knowledge Management System as a Human Resource Development System in Water Resources Management, Case Study of Public Companies (PERUM) JasaTirta II
- [3.] Cheng, E.C.K; 2015, Knowledge Management for School Development,, Knowledge Management for School Education, SpringerBriefs in Education, DOI 10.1007 / 978-981-287-233-3\_2, The Author (s) 2015
- [4.] Han Sulaiman; 2015, Web-Based Knowledge Management System Service Center, Exacta Factor, 8 (3): 220-230, 2015
- [5.] Hoga, S; Tony, D; Bobby, R; Didik, S; Knowledge Management Information System at Strmik University Widya Dharma Pontianak, Journal of Engineering and Computer Science Vol. 01 No. 03, Jul - Sep 2012
- [6.] Nurelasari, Ela; 2014, Analysis of the application of Higher Education Knowledge Management System Using the Most Admired Knowledge Enterprise, Journal of BianglalaInformatika, Vol. II No. 2, September 2014
- [7.] Rhoni, R; 2013, Application of Knowledge Management in the Library (Case Study in the Curated Stain Library), Khizanah Al-Hikmah, Vol 1 No.1, January - June 2013
- [8.] Rice, J; Rice, B., 2015, International Journal of Organizational Behavior, 671-682, Vol. 9, No. 8, August 3, 2015
- [9.] Setiawan, A; AbRazak C, H; Halina, M, D; 2013, Knowledge Management System as Enabler for Knowledge Management Practices in Virtual Communities, IJCSI International Journal of Computer Science Issues, ISSN (Print): 1694-0784 | ISSN (Online): 1694-0814, Vol. 10, Issue 1, No 1, January 2013
- [10.] Uriarte, J. F. (2008). Introduction to Knowledge Management. Asean Foundation
- [11.] Winda, K.S; Ken D.T; Implementation of Web-Based Knowledge Management System (KMS) Case Study of the Technician and Network Section of the Faculty of Computer Science, Sriwijaya University, Journal of Information Systems (JSI), VOL. 6, NO.2, October 2014
- [12.] <http://pancabudi.ac.id>. Accessed by Arpan, accessed on 1 July 2019 (Online).

# Analysis of Regional Expenditure in Education, Health and Infrastructure Sector on Human Development Index and Labor Productivity in Medan City

**Rahmat Sembiring<sup>1)</sup>** (Author)

*A lecturer in Development Economics Study Program  
Social Science Faculty  
Universitas Pembangunan Panca Budi  
Medan City, North Sumatera Provincy, Indonesia*

**Annisa Ilmi Faried<sup>2)</sup>** (Author)

*A lecturer in Development Economics Study Program  
Social Science Faculty  
Universitas Pembangunan Panca Budi  
Medan City, North Sumatera Provincy, Indonesia*

## ABSTRACT

The government plays an important role in development, one of which is human development and increasing productivity which can be achieved through education, health and infrastructure. The higher the level of quality to be achieved will increase productivity and human development index. Using path analysis tools and time series from 2010 to 2017 The results of the first analysis, that the direct effect of Regional Expenditure in the Education Sector (X1) is -0,135 less than the value of the indirect effect -0,384, which means that the Education Sector has a significant influence on Productivity Labor and Human Development Index in Medan City. For the direct effect of Regional Health Expenditures (X2) of 0.341, it is smaller than the value of the indirect effect of 0.606, meaning that the Health Sector has a significant effect on Labor Productivity and Human Development Index in Medan City. Finally, the direct influence of Regional Expenditure in the Infrastructure Sector (X3) of 0.125 is greater than the value of the indirect influence of -0.056, meaning that the Infrastructure Sector does not have a significant effect on Labor Productivity and Human Development Indexes such as in Medan City.

**Keywords:** *Regional Education Sector Expenditure, Health Sector, Infrastructure Sector, Labor Productivity and Human Development Index*

## I. Introduction

According to The Conference Board data in the total Economy Database, said productivity per Indonesian worker in 2017 has reached USD24.6 thousand. APO ranks Indonesia eleventh out of 20 countries with the best labor productivity. If seen from some ASEAN countries, Indonesia ranks fourth. High and low quality of labor will affect the quality of the economy of a country or region, especially the productivity of the output it produces. Productivity of an area can be seen from the state of the value of regional production which is reflected in the value of the GRDP with the number of workers who work in accordance with existing business fields in the area concerned. The main issue of manpower originates from the lack of competitiveness of the workforce towards the pace of labor growth. This issue does not actually stand alone but is an interrelated chain in the overall national development process. If you want to investigate it, first the population growth, following the problem of

education, then the problem of economic growth and finally the impact on the growth of employment and workforce opportunities. In terms of infrastructure, it is very important in an area. If the infrastructure is well built, the economy of a regional road runs smoothly. During the period of infrastructure in the city of Medan there was a very significant increase. Like the Medan-Tebing Tinggi toll road infrastructure, the Medan-Binjai toll road and other infrastructure, as well as the presence of this infrastructure can improve connectivity so that it can smoothen distribution and reduce logistics costs for goods and services.

## II. EASE OF USE

### A. Labor Productivity

According to Dharma (2004: 355) there are standards covering how to measure Productivity which covers three things, namely:

1. Quantity, i.e. the amount that must be completed must be achieved.
2. Quality, i.e. the quality that must be produced (good or bad).
3. Timeliness, i.e. according to whether or not it is planned.

Many factors can affect employee work productivity both related to the workforce itself and factors related to the company environment and overall government policy.

### B. Human Development Index

The value of the Human Development Index (HDI) in a country or region shows that the extent to which the country or region has reached the target to determine life expectancy, education, expenditure levels, and consumption that has reached a decent standard of living. HDI is a sensitive measurement tool to be able to provide the direction of change that actually occurs. The development paradigm places humans as the focus and target of the end of development, namely the occurrence of mastery over resources, improving education and improving health status (Suharto, 2010: 73). The formula for calculating HDI according to Suharto, (2010: 80) namely, as follows:

$HDI = 1/3 (\text{Index } X (1) + \text{Index } X (2) + \text{Index } X (3) \dots\dots\dots)$

Where :X (1): Life expectancy index

X (2): Education index =  $2/3$  (literacy index) +  $1/3$  (average length of school index)

X (3): Index of decent living standards

### C. Development Growth

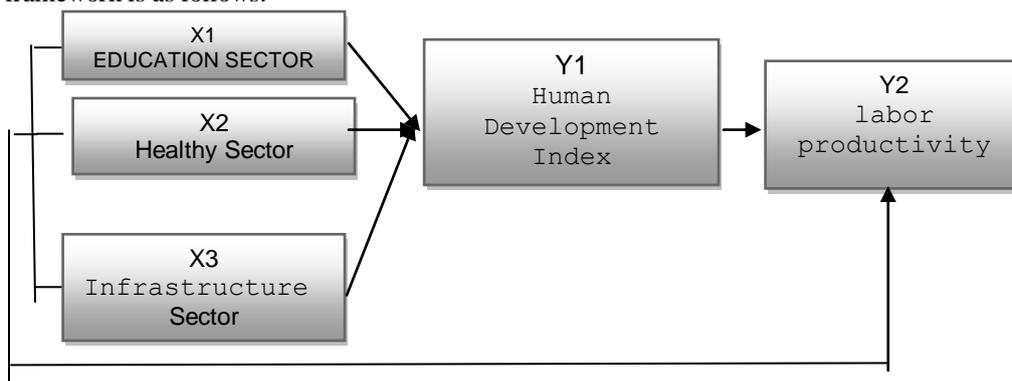
Economic growth can occur if there is an increase in per capita output which explains the increase in living standards is measured by real output per person. An economy is said to experience economic growth if the amount of production of goods and services always rises. To find out the economic conditions in an area / region or province within a certain period indicated by the Gross Regional Domestic Product (GRDP) data. The value of GRDP will provide a demonstration in the description of how regions / regions develop and utilize existing resources.

### D. Gross Regional Domestic Product (GRDP)

One indicator that is important to know the economic development in a region in a certain period, both viewed on the basis of current prices and on the basis of constant prices. GRDP is basically the amount of added value generated by all units in the business in a given area. The total value of final goods and services provided from production must be the same as the value of goods used on the GRDP and viewed from the basis of current prices shows the added value of goods and services calculated using prices in the current period, while GRDP at constant prices depicts the value added of goods and services is calculated using prices that apply to one year that is determined as the base year.

Devitasari (2010) also said that education has a very important role in increasing labor productivity, because of increasing labor productivity aimed at education. Basically, it aims to improve the ability of

human work and to improve the living standards of all members of society. Research conceptual framework is as follows:



Concept Framework Drawing

### III. PREPARE YOUR PAPER BEFORE STYLING

Table :Medan City Government Total Spending2010-2017 (In Rupiah)

Tahun	Total Belanja Daerah
2010	2.582.065.326.653,00
2011	3.395.728.853.449,00
2012	4.080.935.662.619,00
2013	4.237.560.638.891,00
2014	4.625.169.942.881,00
2015	5.467.952.757.114,00
2016	5.737.738.289.895,00
2017	5.554.084.308.979,40

Source: financial management and regional assets of Medan City

The existence of government expenditure determined by the Medan City government so that the expenditure of funds is used for development that really builds for the community so that people feel it in the existing development.

Table of Realization of Total Spending in Education Sector  
Medan City in 2010-2017 (In Rupiah)

Tahun	Sektor Pendidikan
2010	733.266.652.917,00
2011	983.774.581.356,00
2012	983.289.538.550,00
2013	1.109.133.107.469,00
2014	1.079.853.934.544,00
2015	1.162.361.929.743,00
2016	1.195.515.428.591,00
2017	883.069.743.930,00

Source: financial management and regional assets of Medan City

**Table Total Realization of Regional Health Sector Expenditures  
Medan City in 2010-2017 (In Rupiah)**

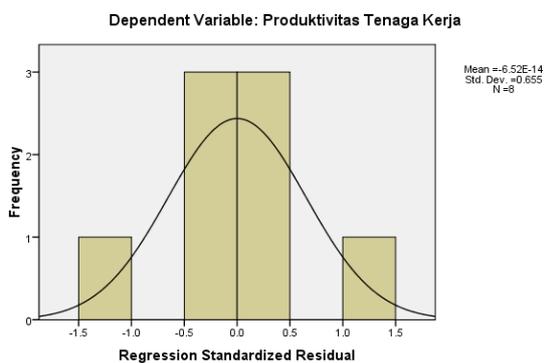
Tahun	Sektor Kesehatan
2010	294.671.898.434,58
2011	373.568.879.990,22
2012	423.878.270.895,25
2013	389.133.311.196,48
2014	495.610.513.080,28
2015	627.008.258.405,00
2016	691.863.259.661,01
2017	615.211.142.256,00

Source: financial management and regional assets of Medan City

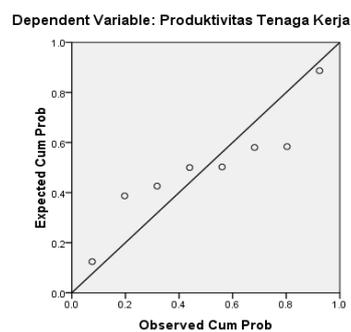
**Table of Realization of Total Spending on Infrastructure Sector  
Medan City in 2010-2017 (In Rupiah)**

Tahun	Sektor Infrastruktur
2010	894.447.095.338,91
2011	1.276.292.315.813,11
2012	1.210.637.409.110,42
2013	1.239.130.487.061,16
2014	1.162.369.583.640,77
2015	1.941.167.065.109,17
2016	1.973.444.225.304,52
2017	2.206.708.786.843,31

Histogram



Normal P-P Plot of Regression Standardized Residual



**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	3846.794	733.909		-5.242	.014					
SektorPendidikan	-.012	.009	-.095	-1.451	.243	-.385	-.642	.080	.701	1.427
SektorKesehatan	.123	.072	.277	1.707	.186	.950	.702	.094	.114	8.747
SektorInfrastruktur	.032	.013	.157	2.370	.099	-.443	.807	.130	.686	1.458
Indeks Pembangunan Manusia	50.242	9.786	.780	5.134	.014	.975	.948	.282	.130	7.682

a. Dependent Variable: Produktivitas Tenaga Kerja

**Model Summary<sup>b</sup>**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.995 <sup>a</sup>	.991	.979	9.19905	.991	82.362	4	3	.002	2.908

a. Predictors: (Constant), Indeks Pembangunan Manusia, SektorPendidikan, SektorInfrastruktur, SektorKesehatan

b. Dependent Variable: Produktivitas Tenaga Kerja

The autocorrelation test results above show that the Durbin Watson value is between 1 to 3 which is 2,908 then the data is declared to have passed the autocorrelation test. Thus the data is valid and can be further analyzed. The Human Development Index becomes the variable mediating / intervening between the Education Sector, the health sector to Labor Productivity, the Human Development Index functions as an intervening variable. For the Human Development Index not to be a variable mediating / intervening between the Infrastructure Sector to Labor Productivity, the Human Development Index does not function as an intervening variable.

## REFERENCES

- [1.] Andreas Ryan, 2012, *Analisis Pengaruh Tingkat Pendidikan, Tingkat Kesehatandan Investasi Terhadap Produktivitas Tenaga Kerja Di Kota Medan*.
- [2.] APO, 2015. *Asian Productivity Organization*.
- [3.] Arsyad, 1992. *Pembangunan Ekonomi*, Edisi 2. Yogyakarta: STIE YKPN.
- [4.] Dharma, 2004:355. *Teori Kinerja*, Jakarta.
- [5.] Kahang, Merangdkk, 2016, *Pengaruh Pengeluaran Pemerintah Sektor Pendidikan dan Kesehatan Terhadap Indeks Pembangunan Manusia Di Kabupaten Kutai Timur*
- [6.] Moekijat, 1998 : 38, *Tentang Produktivitas Karyawan*, Mandar Maju, Bandung.
- [7.] Muchdrasah Sinungan, 1985 : 12 dan 2000 : 23 *Produktivitas, Apa Dan Bagaimana*, Bumi Aksara, Jakarta, 2000.
- [8.] Melayu S.P Hasibuan, *Organisasi Dan Motivasi, Dasar Peningkatan Produktivitas*, Bumi Aksara Putra, Jakarta, 1996.
- [9.] Rivanto, 1986, *Produktivitas Karyawan*, Jakarta.
- [10.] Suharto, (2009). *Membangun masyarakat memberdayaan rakyat: Kajian strategis pembangunan kesejahteraan sosial dan pekerjaan sosial*. Bandung: Refika Aditama.
- [11.] Salinding, 2011 : 35, *Analisis Pengaruh Pelatihan Terhadap Produktivitas Kerja Karyawan Pada PT. Erajaya Swasem bada Cabang*.
- [12.] Thabrany, 2003. Dalam buku “*Social Health Insurance Indonesian*”.
- [13.] Undang-undang No 9 tahun 1960, Bab 1 Pasal 2. *Tentang Pokok Kesehatan*, Jakarta.
- [14.] United Nations Development Programme (1996), *Human Development Report 1996, Economic and Human Development*, Published for United Nations Development Programme. New York: Ox ford University Press.
- [15.] Umar, 2004, *Dimensi Produktivitas*, PT.Gramedia, Jakarta.
- [16.] William B. Wether, Keith Davis, 1992 : 124, Dalam Bukunya “*Human Resources and Personnel Management*”.
- [17.] <http://www.sumutprov.go.id>
- [18.] [https://www.apo-tokyo.org/news/wp-content/uploads/sites/4/2018/08/Indonesia\\_LewatMana.com\\_06March2018.pdf](https://www.apo-tokyo.org/news/wp-content/uploads/sites/4/2018/08/Indonesia_LewatMana.com_06March2018.pdf)
- [19.] <http://www.materibelajar.id/2016/04/teori-kinerja-pengertian-pengukuran.html>
- [20.] *Organisation For European Economic*, 1950.
- [21.] <https://www.conference-board.org/data/economydatabase/index.cfm?id=27762>
- [22.] [http://www.dpr.go.id/doksetjen/dokumen/apbn\\_Belanja\\_Fungsi\\_Kesehatan\\_dalam\\_APBN20130130135731.pdf](http://www.dpr.go.id/doksetjen/dokumen/apbn_Belanja_Fungsi_Kesehatan_dalam_APBN20130130135731.pdf)
- [23.] [https://www.google.com/search?safe=strict&rlz=1C1CHBD\\_enID797ID797&q=global+competitiveness+report+2015+2016+indonesia](https://www.google.com/search?safe=strict&rlz=1C1CHBD_enID797ID797&q=global+competitiveness+report+2015+2016+indonesia). Di akses 9 september 2015.